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Foreword

Climate change, population growth and competing demands for land and resources are putting great pressure on the world's food systems. The current approach for feeding the world is based on large-scale and high-input monoculture production system. The environmental and social problems caused by such an agricultural production model are well known. The current agro-food system failed to feed the world population and to eradicate rural poverty. The most dramatic environmental damage is caused by habitat conversion and corresponding climate change, loss of biodiversity and ecosystem functions, soil erosion and degradation, and pollution from fertilizers and pesticides. Nevertheless, agricultural development have greatly alleviated hunger and poverty.

The world's population is set to reach nine billion by 2050. To feed them it is needed to produce 70% more food, and do so without destroying our environment. The futureagriculture will be based on traditional knowledge, science, innovation, and ecological principles. Sustainable agriculture concept, apart from agro-ecosystem services protection, include various economic,environmental, social and institutional aspects. The successful management of agricultural resources for meeting the changing human needs, while maintaining or enhancing the quality of the environment and conserving natural resources, is imperative for a stable food production.

Appropriate agricultural and rural development strategies in the Balkan area and beyond should ensure food and nutrition security – through the sustainable intensification of crop and animal production - while protecting the environment and natural resource base. They should also contribute to the eradication of rural poverty and improvement of livelihoods of rural populations through the diversification of their income-generating activities.

During three days; November 15-17[Th], 2012; the 3rd International Symposium "Agrosym 2012" made an important contribution to the improvement of knowledge in agriculture, environment and rural development fields. A total of 120 papers were presented representing more than 20 countries (*e.g.* Albania, Algeria, Cameroon, Croatia, England, Georgia, Greece, Ghana, Iran, Italy, India, Israel, Macedonia, Montenegro, Poland, Serbia, Spain, Sudan, Turkey and Vietnam).

This publication comprises a selection of edited papers from those that were submitted. We are convinced that the results reported here will be significant in the dissemination of knowledge to the wider audience about important issues regarding agriculture, food, environment and rural development.

The success of the symposium was made possible thanks to the unconditional commitment and invaluable contributions of a wide range of partners and cosponsors. Much appreciation is due to the authors of all papers submitted and presented at the symposium as well as to all the symposium participants for ideas, insights and contributions.

Academician Dusan Kovacevic
President of the Scientific Committee

Prof. Vesna Milic
President of the Organizing Committee

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I

KEYNOTE PAPERS

CLIMATE CHANGES: ECOLOGICAL AND AGRONOMIC OPTIONS FOR MITIGATING THE CONSEQUENCES OF DROUGHT IN SERBIA

Dusan KOVACEVIC[1,3*], Snezana OLJACA[1], Zeljko DOLIJANOVIC[1], Vesna MILIC[2]

[1]University of Belgrade, Faculty of Agriculture, Zemun, Serbia,
[2]University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia and Herzegovina
[3]Academy of Engineering of Serbia, Belgrade, Serbia
(Corresponding author: dulekov@agrif.bg.ac.rs)

Abstract

Drought represents a certain period of time, which is manifested by a lack of rainfall for a normal growth and development of crops with simultaneously high temperatures and low humidity. Damages caused by drought depend on the time of its duration and its intensity. If this time is longer, therefore damages are greater, and they can sometimes be catastrophic.

Drought occurs over a wide area in the first place as a result of reduced rainfall and due to increased temperatures at the global level. It is believed that 1/2 of the Earth's continental area has the deficit of rainfall. The tendencies of reduction in rainfall were recorded in Serbia as well. In the last three decades, rainfall has decreased in the region of Vojvodina, Šumadija, most of Pomoravlje (the Morava river valley) and southern Serbia. The highest rainfall deficit (20%) was recorded in the last decade. The causes of drought are different. One of the main causes is the lack of a total amount of rainfalls during the year and their distribution during the vegetative period of plants and evaporation intensity of precipitation. Furthermore, these are the properties and soil condition in which there are also water needs of the plants. Within our climate, drought is an occasional occurrence which sometimes manifests itself in a mild and sometimes in a very harsh form.

In the fight against drought, regular and specific cultural practices are used along with an adequate assortment of plants more resistant to drought. Regular practices comprise soil tillage, fertilising, sowing, care treatments, crop rotations, and as regards the particular practices, they include snow retention, mulching, antievaporants. In addition to these practices, it is important to mention irrigation as the most direct practice by which water can be added in desired quantities completely independently of precipitation. However, irrigation essentially changes all of the conditions substantially in a cropping system, so that it represents, for itself, a special practice with far-reaching effects, which should be considered.

The aim of this study was to analyse the data of the two-decade period between 1990-2012 of rainfall and temperature, and to observe the change in Serbia and in the Belgrade area. Based on the evaluation criteria for climate according to Lang for our conditions, we analysed the effects of certain practices on mitigation of drought in which the role of crop rotation was particularly emphasised. On the basis of the data analysis, cultivation practices which can be used for an indirect influence on drought and yields of the two most important crops in Serbia, maize and winter wheat.

Keywords:*Climate change, ecological aspect of drought, adaptations, cultivation practices, winter wheat, maize, Serbia*

Introduction

The studies on anthropogenic climate change performed in the last decade over Europe show consistent projections of increases in temperature and different patterns of precipitation

with widespread increases in northern Europe and decreases over parts of southern and eastern Europe (Olesen and Bindi, (2002).

In many countries and in recent years there is a tendency towards cereal grain yield stagnation and increased yield variability. Some of these trends may have been influenced by the recent climatic changes over Europe. The expected impacts, both positive and negative, are just as large in northern Europe as in the Mediterranean countries, and this is largely linked with the possibilities for effective adaptation to maintain current yields. The most negative effects were found for the continental climate in the Pannonian zone, which includes Hungary, Serbia, Bulgaria and Romania. This region will suffer from increased incidents of heat waves and droughts without possibilities for effectively shifting crop cultivation to other parts of the years. A wide range of adaptation options exists in most European regions to mitigate many of the negative impacts of climate change on crop production in Europe. However, considering all effects of climate change and possibilties for adaptation, impacts are still mostly negative in wide regions across Europe Olesen, et. al. (2011).

Many definitions exist for each of the main types of drought, including meteorological, agricultural, hydrological and socio-economic Meteorological drought applies to a long-term lack of precipitation that is frequently intensified by anomalously high temperatures that increase evapotranspiration. This often leads to other types of droughts including agricultural - periods during which soil moisture is insufficient to support crops; hydrological - prolonged periods of unusually low surface run-off and shallow groundwater levels and socio-economic droughts an unusual shortage of water that produces an adverse effect on society and the economy (Maybank et al.1995).

Drought is one of the major hazards affecting Serbia and drought is a normal part of the climate. Most global climate models project increased summer continental interior drying and, as a result, a greater risk of droughts is projected for the twenty-first century. The increased drought risk is described as likely and is a result of a combination of increased temperature and evaporation not being balanced by precipitation. Increasing the efficiency of water use within agricultural systems is an essential priority in many regions and State of the World including the R. Serbia. The primary source of water for agricultural production for most of the world is rainfall. Amount of rainfall, frequency and intensity are three values of which vary from place to place, day to day, month to month and also year to year. For crop growth is important information of the amount, intensity and distribution of days, decades monthly or annual rainfall for the most important places in the world. Crops with high water consumption create greater deficits of moisture in the soil; therefore effective rainfall is directly proportional to the rate of water uptake by the plant. Crop characteristics influencing the rate of water uptake are the degree of ground cover, rooting depth and stage of growth. The crop is an important factor in interpreting the basic data. Hence the seasonal needs of major crops in a given area should be taken into account when the extent of effective rainfall is assessed.

Some recent studies have pointed out more frequent and severe drought in the territory of Serbia and in other parts of the Balkan peninsula (Bosnjak,1997; Dragovic,1997; Spasova Danica et al.,1997; Spasova Danica etal.,1999; Spasov and Spasova Danica, 2001; Spasov, 2003; Marinkovic et.al., 2009; Malesevic et al, 2011).

This review examines the research priorities, the prospects for crop and soil management and plant breeding and biotechnology that are needed to achieve high stable yield under drought. Research must combine the latest latest knowledge including agroecology, crop and soil management practices, genetics and ecophysiological understanding of the interactions between crop plant genotypes and the growing environment to better inform crop improvement.

Ecological aspects of drought

When speaking about drought in ecology, it most often refers to the lack of active moisture in the environment in which plant organisms are, that is, in lithosphere, pedosphere and atmosphere. Drought occurs, either due to a real lack of water in the environment, or because of difficulty in supplying plants with water in otherwise sufficiently wet environment. Drought occurs over a wide area in the first place as a result of reduced rainfall and due to increased temperatures at the global level. It is believed that 1/2 of the Earth's continental area has the deficit of rainfall. The tendencies of reduction in rainfall were recorded in Serbia as well. In the last three decades, rainfall has decreased in the region of Vojvodina, Šumadija, most of Pomoravlje (the Morava river valley) and southern Serbia. Knowing the problem of drought is of great importance particularly for the planning and rational use of natural potentials in the area of plant production, as well as for taking measures to mitigate and eliminate a harmful effect of drought (Cvetkovic et al., 1996; Cvetkovic and Oljaca, 1999; Oljaca Snezana et al., 2002).

Nature discovered in the course of evolution many different ways for the plants to adapt to drought. It is a big challenge that many of them find their application in grown plants, which are usually not resistant to drying out. Plants can avoid drought in two ways: to avoid it completely by not growing in the dry season, or to actively adapt to those conditions. Plants usually avoid drought by means of accelerated growth and the completion of the life cycle before the onset of a drought period. Tolerance to drought is acquired through various developmental, morphological and physiological adaptations that allow the plant either the balance between water uptake and transpiration, or water-deficit tolerance. Avoiding dehydration is the ability of plants to maintain relatively high leaf water potential, when soil or air droughts occur.

The causes of drought mainly come from the atmosphere. A man can hardly influence the quantity and distribution of rainfall, therefore his actions to combat drought are mainly of indirect character.

Drought represents a certain period of time, which is manifested by a lack of rainfall for a normal growth and development of crops with simultaneously high temperatures and low humidity. Damages caused by drought depend on the time of its duration and its intensity. If this time is longer, therefore damages are greater, and they can sometimes be catastrophic.

Adverse physiological effect of drought reflects in stopping the increase if of lesser intensity, and it can intensify until a complete halt to all vital functions of the plant. Due to drought, transpiration and photosynthesis are reduced, but respiration is carried out continuously and spare organic matters are used. The plant loses its weight, the leaves wither, and their tops dry. When a prolonged dry period occurs, the whole plants dry out. If a dry period in the summer continues in the autumn then it hinders the timely sowing of winter crops.

The causes of drought are different. One of the main causes is the lack of a total amount of rainfalls during the year and their distribution during the vegetative period of plants and evaporation intensity of precipitation. Furthermore, these are the properties and soil condition in which there are also water needs of the plants. Within our climate, drought is an occasional occurrence which sometimes manifests itself in a mild and sometimes in a very harsh form. The evaporation intensity depends on the temperature, winds activities and geographical location of a certain area and it increases in our country going from the west to the east or from the north to the south of the country. In particular, these values are high in the southeast. Temperatures unquestionably have a great impact on this phenomenon. The evaporation is a product of the high temperature and it is in the closest relation to the direction of decreasing of the rainfall. This fact should show the reasons why our eastern and southeastern regions often suffer from more or less serious consequences of drought. Soil

having favourable properties can absorb and retain moisture, which is available throughout the year. Soils of favourable structure, loose, with plenty of humus better receive and hold moisture than light sandy and heavy clay soil or shallow soils. In addition, if soils are well cultivated, fertilised and generally speaking in a better conditional state, they less suffer from the drought consequences.

Properties of plants and their water needs (xerophytes, hydrophytes) are also different. The size of the transpiration coefficient indicates water needs of the plant. If it is larger, the water needs of the plant concerned are generally greater as well. In these terms, when growing crops it is important to know how great their general water need is and when critical periods for moisture occur.

As a consequence of global climate change, changes in the intensity and frequency of climate extremes - tropical cyclones, droughts, floods, landslides, soil erosion, storm disasters, snow storm and frosts, heavy rains of short duration, waves of extremely high temperatures of air, fires, conditions for the spread of epidemics and pests (Easterling, 1996).

The greatest economic damages in Serbia have been caused by droughts, floods, storms accompanied with hail, landslides, erosion caused by the torrents, and in recent years there has been an increasing number of heat waves and the conditions for the occurrence and spread of forest fires.

Taking a long-term view, the problems arise due to the fact that since the seventies of the twentieth century to the present days average annual temperatures in the country and the region have been constantly rising. However, climate change in this area so far have been reflected in the increased frequency and intensity of extremes, such as this one with the drought in the past two years and with increasingly frequent occurrences of heat waves, etc. If this trend of climate change continues as shown by the various climate change scenarios for this region, it could lead to big problems in weather and climate as well as the water supply.

Characteristics of the main climate parameters in Serbia

Climate in Serbia can be described as moderate-continental, with more or less distinct local variations. As the main plant production is carried out under conditions of moderate continental climate in the lowland and undulating regions it is important to specify its main features. The average annual temperature is around 11 ℃, the warmest month is July with about 23 ℃, and the coldest month is January with about -1 ℃ of mean monthly temperature. Temperature in spring rises quite rapidly, whereas a temperature drop in the autumn is sharp as well. The length of the period with the mean temperatures above 10 ℃, and these are the temperatures for the vegetation of spring crops (maize, sunflower, sugar beet, potatoes, etc.), is equal to about 200 days. Mean temperatures above 20 ℃ last for three summer months, around 80 days. The frostless period lasts approximately from 1 April to 15 November, totalling around 230 days. The annual amount of rainfall amounts to 600-750 mm. The rainfall ratio of warm to cold part of the year (warm part of the year lasts from 1 April to 30 September) is 55-60% to 40-45%. In other words, although there are more rainfalls during the vegetative period for spring crops there is often a problem of their lack during July and August. The maximum rainfall is received in June, whereas the minimum is measured in January and February. The annual rainfall rate in different parts of central Serbia is mainly satisfactory, although there are years with the extreme lack of rainfalls (drought periods) that affect a significant decrease in crop yields.

Influence of meteorological conditions in the area of Belgrade in the period (1990-2012) on maize and winter wheat

Based on many-decade analysis of the data obtained from the Republic Hydrometeorolgical Service of Serbia in the Belgrade area (Tables 1 and 2 at the end of this paper as a supplement), it can be noticed that droughts have been increasingly frequent in these regions for the last twenty years. Even six years of the last twelve years were dry. It is very important for agriculture when drought occurs. If the drought occurs during the critical periods for moisture in a given crop, or when the fruit is being formed and grain filled, then the damages are the greatest. For example, in the analysed period of 22 years: 1992, 2000, 2007, 2003, 2001 and the current year of 2012 were very dry. In these years, drought was observed in the spring, and it was especially noticeable in the summer period so that the adverse consequences for most of the spring crops were great. In Serbia, 2007 even higher temperatures than those in the current year of 2012 were recorded. The subject under discussion is the highest temperature ever recorded in the area and up to 45 ^{0}C, when some previous maximums were exceeded. Damages that are registered via reducing yields were severe. Obtained maize yields were lower in comparison with the previous year by 32 per cent, and yields of sunflower as the most resistant to drought were decreased by 23 per cent. The spring drought also occurred in 2009, but it was overcome and it does not belong to severe droughts. During the vegetative period of maize an increasingly frequent heat waves are observed. In the beginning, these were the waves in the month of September, which contributed to more rapid maturation of maize. However, in recent years, tropical heat waves in which the nighttime temperatures do not drop below 20 occur earlier in August, and this year they occurred in the second half of July. These waves contributed to the accelerated maturation and disturbed the grain filling. This is becoming a real problem these days.

A special problem arises when the drought is transferred to the optimal time for sowing of winter crops (regarding our conditions, October to mid-November), which significantly complicates and prolongs their seedling emergence until the winter. As the example the situation from 2011 is given when the drought was pressing during the whole vegetative period, particularly in August and September, when it was the worst. After that, it continued in October and November resulting in the soil without any moisture for a long time, which had an effect on wheat yield the next year.

This 2012 was characterised by the fact that the rainfalls in June, July and August were significantly lower than the average rainfall. In June, the rainfall measured was only 32 per cent of the average, and in July only because of the raining at the end of the month the rainfall received was 86 per cent of the average. In August, only 5 per cent of the average were recorded-there almost was no rainfall at all. Thus, in these three months most of the territory of Serbia received 25-50 per cent of the average rainfall which is actually a severe drought that has an impact not only on agricultural crops, but also on the water levels of rivers and reduction of the amount of groundwater as well.

In contrast to the dry years in the analysed period there were those ones with more abundant rainfalls such as 1999, 2001, 2004, 2005, 2009 and especially 2010. In 2010, the rainfall received was 80 per cent higher than the average, there were even floods. Similar results were obtained for 2005.It is for this reason that humid years with long periods of abundant rains that replaced drought in Serbia have contributed to more favourable situation with the level of groundwaters that are sometimes significant as a source of water for the cultivation, particularly of spring agricultural crops which are more distributed than winter crops in sowing structure in Serbia. Abundant rainfall during the winter period has caused in some years, as was the extreme 2010, severe damages such as floods and lying waters throughout the territory, especially in Vojvodina.

Table 3. Mean temperature and precipitation in different period of maize growing season in Belgrade (1991-2010)

Period	June	July	August	Average summer	IV-IX	I-XII
Temperature (^{0}C)						
Average1970/2000	20.4	22.1	22.0	21.5	18.6	12.1
2001/2012	22.1	24.3	23.9	23.4	20.3	*13.4
difference	1.7	2.2	1.9	1.9	1,7	1.3
Precipitation in mm						
Prosek1970/2000	95.4	68.9	57.1	73.8	404.0	688.1
2001/2012	98.1	62.6	63.0	74.6	386.3	*719.2
difference	2.7	-6.3	5.9	0.8	-18.0	31.1

*Average 2001/2011: 2012 yet not finished

Using the analysis of the data in the study period for the past eleven years, the average annual temperature has risen by 1.3 ^{0}C in relation to the reference period 1971-2000 (Table 3). However, the temperature increase is far more significant in the vegetative period of maize as well as of other spring crops by 1.7 ^{0}C compared to the same reference 30-year period at end of the last century. The strongest influence on the crops in some extremely dry years as were in 1992, 2000, 2007 and 2012, was exercised by temperature increase in June by 1.7 ^{0}C, in July by 2.2 ^{0}C and in August by 1.9 ^{0}C, that is, averagely for the three months by 1.9^{0}C. This is particularly dangerous because the increases are accompanied by several heat waves that increase nighttime temperatures in July and August at the tropical level where the temperatures during the night do not fall to a level below 20 ^{0}C.

Table 4. Mean temperature and precipitation in different period of winter wheat growing season in Belgrade (1991-2010)

Period	autumn	winter	spring	veget.period
	X-XII	I-III	IV-VI	X-VI
Temperature (^{0}C)				
1971/2000	7.2	4.0	16.7	9.3
2001/2010	8.6	4.6	18.2	10.5
difference	1.4	0.6	1.5	1.2
Precipitation in mm				
1971/2000	166.3	127.8	223.0	517.1
2001/2010	177.0	154.1	190.3	521.4
difference	10.7	26.3	-32.7	4.3

As for rainfalls if their rate at the annual level is considered, and even at the level of vegetative period of maize in the first decade of the new century, there was more rainfall. Even in the two months, June, otherwise in this region with the highest rainfall, and in August, the rainfall was averagely higher at a monthly level (Table 4).

Only in July, a small deficit of 6.3 mm was reported. It is certain that the rainfall became more extreme and more shifted in other periods, which is favoured by wheat. Namely, more rainfalls are distributed in the first half of June and the second half of August, which additionally can create drought conditions because that is the critical period for moisture in maize from silking to different stage of maturity.

Agricultural impacts and adaptations to drought

The causes of drought mainly come from the atmosphere. A man can hardly influence the quantity and distribution of rainfall, therefore his actions to combat drought are mainly of indirect character. In the fight against drought, regular and specific cultural practices are used

along with an adequate assortment of plants more resistant to drought. Regular practices comprise soil tillage, fertilising, sowing, cultivation practices, crop rotations, and as regards the particular practices, they include snow retention (to keep snow with residue precrops), mulching etc. All those cultural practices are applied so as to retain moisture and prevent moisture loss while encouraging its more efficient and economical use (Kovacevic et al, 2000; Molnar et al., 2001, Smith and Skinner, 2002; Kovacevic et al., 2005a; Falloon and Betts, 2010). In addition to these practices, it is important to mention irrigation as the most direct practice by which water can be added in desired quantities completely independently of precipitation. However, irrigation essentially changes substantially all of the conditions in a plant production system, so that for itself, it represents a special practice with far-reaching effects and special adjusting of all other cultivation practices that accompany it. The creation of a new assortment of cultivated plants resistant to stressful conditions caused by the drought comprises plant breeding. The proper selection of cultivars (hybrids), that is, genotypes of crops more tolerant to drought is in accordance with the prevailing local conditions.

Fighting against drought is mainly focused on the implementation of certain measures through soil and through the plants.

Basic tillage with seedbed preparation. The creation of favourable conditions in the soil through tillage and fertilisation (agromeliorative tillage, creation of tilth, autumn deep tillage) makes a layer of soil that is able to receive and carry or accumulate sufficient reserves of moisture from the period when it is abundant as well as to put them at the disposal of the plants in their critical periods for moisture.Hence the autumn deep tillage is of enormous significance for all, especially for the spring crops. All practices of presowing tillage methods as well as care treatment aimed at capillarity cutting and moisture conservation are also welcome for this purpose (drilling, interrow cultivation and hoe and ridge cultivation). For the purpose of eliminating various unfavourable abiotic influences which are directly manifested in the soil and creating favourable conditions for crops, different care treatments are used, first of all, those of mechanical nature: drilling, rolling and interrow cultivation with hoe and ridge cultivation (Kovacevic et al., 2000; Kovacevic et al., 2009a).

Sowing. When speaking about sowing, one should bear in mind the selection of cultivars (hybrids) adaptable to drought for the known area, pre-defined technology (high or low-input), expected meteorological conditions in the given year as far as possible to predict on the basis of certain indicators, plant density and depth of sowing spacing, that is, the quantity of high quality processed seed (high quality cleaning, calibration with full seed treatment which means disinfection, disinfestation and protection).

One of the most common mistakes, but fatal in dry years, is a high crop density, much higher than the predicted optimum that is recommended for a particular hybrid or cultivar. As regards arid conditions or when on the basis of numerous indicators the dry year is expected, the density of the crops sown should be lower than the one predicted for moderate years. In irrigation conditions and humid regions, the density certainly does not have to be a problem provided that there are sufficient quantities of water for all plants.

According Turner (2004) conventional plant breeding so far only increased the yield of crops grown under drought at about half the rate achieved for crops grown in temperate regions Crop response to stress is dependant on numerous traits many of which are constitutive and expressed irrespective of water availability, but such constitutive traits may also be modified by stress. Directed breeding strategies must focus on the key traits important to performance under drought stress [e.g. phenology, rapid establishment, early vigour, root density and depths, low and high temperature tolerance, ^{13}C discrimination (a measure of the extent to which photosynthesis is maintained while stomatal conductance decreases), root conductance, osmoregulation, low stomatal conductance, leaf posture, habit, reflectance and duration, sugar accumulation in stems to support later growth of yield components]. The aim is to allow wheat to continueto grow and yield grain under water-limited conditions.

Breeding for drought tolerance is further complicated bythe fact that several types of abiotic stress can challengecrop plants simultaneously. High temperatures, high irradiance,scarcity of water, and nutrient deficiencies arecommonly encountered under normal growing conditionsbut may not be amenable to management through traditionalfarm practices. Certain soil properties such ascomposition and structure can also affect the balance ofthese different stresses. However, breeding combined with agronomy in an optimised system may increase efficiency and productivity. Even if breeding for drought tolerance lowers the yield potential of the crop, it may increase yield stability over seasons, which could still benefit many farmers in drought-prone areas (Araus et al., 2003). However, in many cases, newer improved varieties are accepted slowly by farmers.

The improvement is noticed in the field of genetic methods and breeders have been working on the creation of new program to drought tolerance. We will need to develop water use efficency in crop species, tolerance to periodic drought stress both in dryland and irrigated crops, and adaptation of species that are more efficient in use of limited water. In the meantime, until new culitvars more resistant to drought and other stressful conditions are obtained, one should carefully select cultivars, that is, hybrids that have been best adapted so far on the basis of previous experience. The proper selection of cultivars-hybrids, that is, genotypes of crops resistant to drought is in accordance with the prevailing local conditions. (Calderini and Slafer,1998; Brissona Nadine et al., 2010;Fleury et al., 2010; Kovacevic et al., 2011; Kovacevic and Lazic Branka 2012).

Minimising the damage caused by the drought in most areas sown with maize can be achieved by certain cultivation practices, selection of hybrids and sowing at the recommended densities per unit area. The number of plants per unit area has the greatest impact on maize yield in years with favourable weather. However, in years with lower rainfall, or their unfavourable distribution, it is very risky to grow hybrids at large densities because it results in the occurrence of sterile plants (plants without ear). Maize hybrids created in our country are better adapted to drought conditions in these areas. In addition, our hybrids have the ability to produce high yields due to smaller number of plants per unit area in favourable weather conditions, whereas in the dry years they are more tolerant of drought. Similarly, these hybrids at lower density are more tolerant of the drought compared with the hybrids at high density. For the purpose of better using of moisture supplies in the soil and of better preventing of evaporation, there are plans for creating hybrids suitable for very early sowing, even in early April in our climate. The work is being carried out apropos developing hybrids with accelerated growth at the beginning of vegetative period so as to close vegetative area, shade the soil and reduce evaporation, that is, free run-off of water, and besides that, to pass earlier a critical period for moisture, which in our conditions from mid-June to mid-July.

Interrow cultivation and hoeing. The soil sown with wide-row crops is unprotected for a long period of time. Applying interrow cultivation, with cultivators intended only for such purposes, the soil is cut and the loosed between the rows. In this way, the following objectives are achieved: the existing crust is destroyed and the emergence of a new one is prevented, capillarity cutting creates a loose layer on the soil surface, which also prevents unnecessary loss of the existing moisture in the soil, as well as the ability of soil to absorb new moisture from rainfall; bulk density is reduced while the porosity and air capacity are increased, which increases aeration and improves the soil thermal regime, weeds from the interrow space, which can be strong competitors to cultivated crops for moisture, are destroyed .

Mulch Tecniques reduce evaporation in such a way that the lower surface is exposed to sun and wind. The sun's rays reflect back more from lighter surfaces (mulch is lighter than soil) causing a decrease in temperature. Chopped materials or tinier substances used for mulch better absorb moisture and prevent its run-off or evaporation. The area under the mulch is more porous without soil crust and can absorb more moisture. For these reasons, soil is supplied with moisture.

Thinning crops. The need for thinning crops occurs in those cases when due to various reasons we have not succeeded in sowing crop at the desired density. All these redundant plants have to be removed when hoeing for the first time. In this way, the best vegetative area is left to the remaining plants by removing their competitors for water and nutrients.

Manuring and Fertilizing. Manuring of the soil under different crops cannot resolve all issues in the field of plant mineral nutrition. Plants have very different needs for some fertilizers (mineral-inorganic fertilizers with macro and microelements in various, only for them typical growth periods, during vegetative period. Fertilizer top dressing significantly improves poor condition in winter worn and damaged winter crops (Malesevic et al, 2011). As regards spring crops with a long vegetative period, it is usually intervened about two times with interrow cultivation and side dressing fertilizers in the way that they significantly help to occupy the space faster and become more competitive regarding adverse conditions including drought.

Irrigation. The lack of rainfall and their unfavourable distribution are eliminated in the most effective and most direct way by irrigation. Irrigation is mentioned here as one of the possible care treatments for eliminating the effects of drought. However, irrigation essentially changes all the conditions substantially in a plant production system, so that it represents, for itself, a special practice with far-reaching effects. In irrigation cropping system, there are numerous specific cultivation practices, and the existing ones require some adjustments to the conditions which are significantly different from those in the natural wetting regimes. Irrigation is particularly important in arid areas where crops cannot be successfully grown without it. In other areas, it allows normal water supply and removing the discontinuity in an unfavourable rainfall distribution.

Our experience with crop rotation in years with different rainfall regime

Crop Rotation. Agriculture is increasingly based on market laws of supply and demand, that is, conjuncture and this is where economic interests dominate, which are often not in accordance with the agrobiological reasons, at least when it comes to crop rotation.

Apart from continuous maize cropping that is still evident and is still only possible due to the absolute domination of maize on arable land in sowing structure of Serbia, there is still two-field crop rotation (winter wheat - maize) and an increasing number of three-field crop rotation, which includes soya bean, which is very positive (Dolijanovic et al., 2006; Dolijanovi et al., 2007; Dolijanovi et al., 2009; Dolijanovi et al., 2010).

Crop rotation is the most general and most comprehensive cultural practice, which more or less links all others in a mutually dependent system, designed for the successful achievement of certain objectives. Using modern cropping systems that include multiple cropping, cover crops to create the most favourable conditions reliably ensuring that each of cultivation practices best makes great success (Oljaca et al., 1999; Oljaca et al., 2000; Govaerts et al., 2007; Kovacevic et al., 2005b).

In the crop rotation the crops before in cropping pattern should be taken into account. No sensitive plants should be sown after the crops before in cropping pattern, which had already spent a lot of moisture the previous year. Sunflower, sugar beet, alfalfa are exactly such crops. As for the plants themselves, it should be mentioned that apart from the selection of species, the cultivars (hybrids) of one species should be also taken into account. Some are more resistant to drought and adaptable to such circumstances, and some are still very intense, with very high demands for all factors starting from nutrients to water (Kovacevic et al., Kovacevic et al., 2005b; Kovacevic et al., 2007b, Kovacevic et al., 2008a; Kovacevic et al., 2010).

Water use can be further improved by changing cropping patterns. The choice of crop to be grown is critical and should reflect both the availability of water and socio-economic

requirements. Water requirements can be greatly reduced by replacing a crop requiring substantial amounts of water, sugar beet, with crops requiring less water. Similarly, utilisation of the best-adapted cultivars is important in maximising yield under water stress. Even simple adjustments such as cultivars that can be planted earlier to more closely match crop growth to rainfall distribution can increase productivity (Turner, 2004). There may be a compromise between yield and water use as more rapidly maturing varieties may have smaller yield potential.

At "Radmilovac" experimental estate of Faculty of Agriculture in Zemun on chernozem luvic soil type, different cropping systems have been established: continuous cropping (winter wheat, maize and soya bean) and different crop rotations two-field crop rotation (winter wheat - maize); three-field crop rotation (winter wheat - maize - soya bean) and six-field crop rotation (winter wheat, maize - soya bean - spring barley - red clover - sunflower). They are still there.

In order to compare the effects of crop rotation to the abiotic stress in dry years on the yield of our two most important crops of winter wheat and maize, we had to choose, tentatively speaking, dry, moderate and wet years from a series of meteorological data from the last two decades (1991/92-2011/12), which are characterised by very pronounced oscillations in temperature and precipitation.In agrometeorology and agronomy, when we want to gather more information about the type of climate, it is necessary to know the specific climatic indices (Standardized Precipitation Index) - SPI based on the amount of rainfall 30, 60 and 90 days with the step in the calculation of one day; SPI for 1,2,3,4,5,6,9,12 and 24 months - a step in the calculation is the calendar month; Palmer Z-index (Palmer Drought Severity Index - PDSI), which is a measure of the monthly moisture anomaly or detailed climatograms. Considering the dependence of the rate of plant growth on the moisture content in the soil and evaporation it has been shown to be advisable to establish such indices which would indicate that climate characteristic of the region in terms of the intensity of evaporation and soil moisture reserves (Spasov and Danica Spasov 2001; Mihajlovic, 2002; Spasov, 2003, Radicevic Zorica etal., 2011).
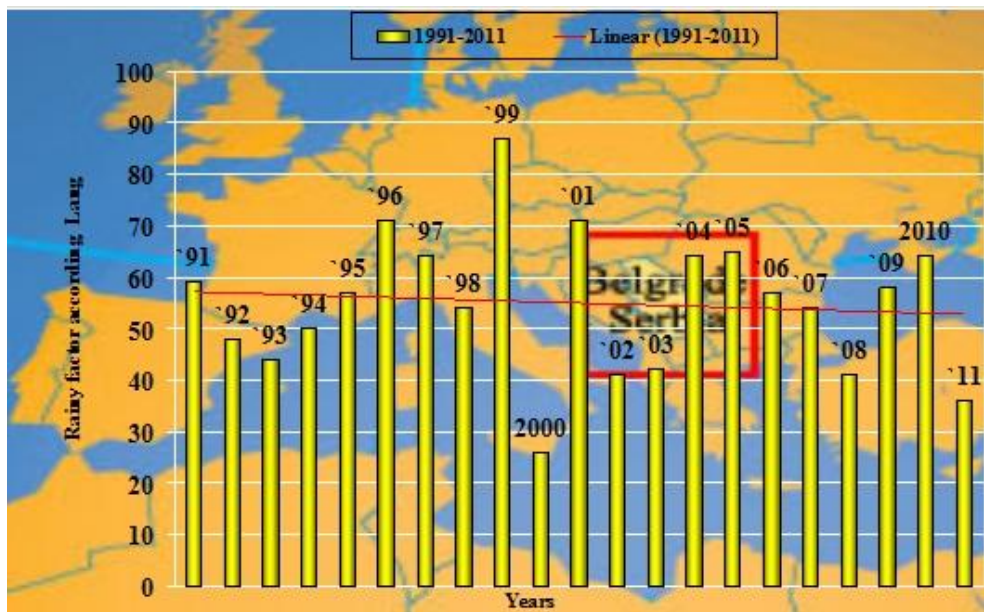
Figure 1. Rainy factor according Lang per year in Belgrade, period 1991-2012
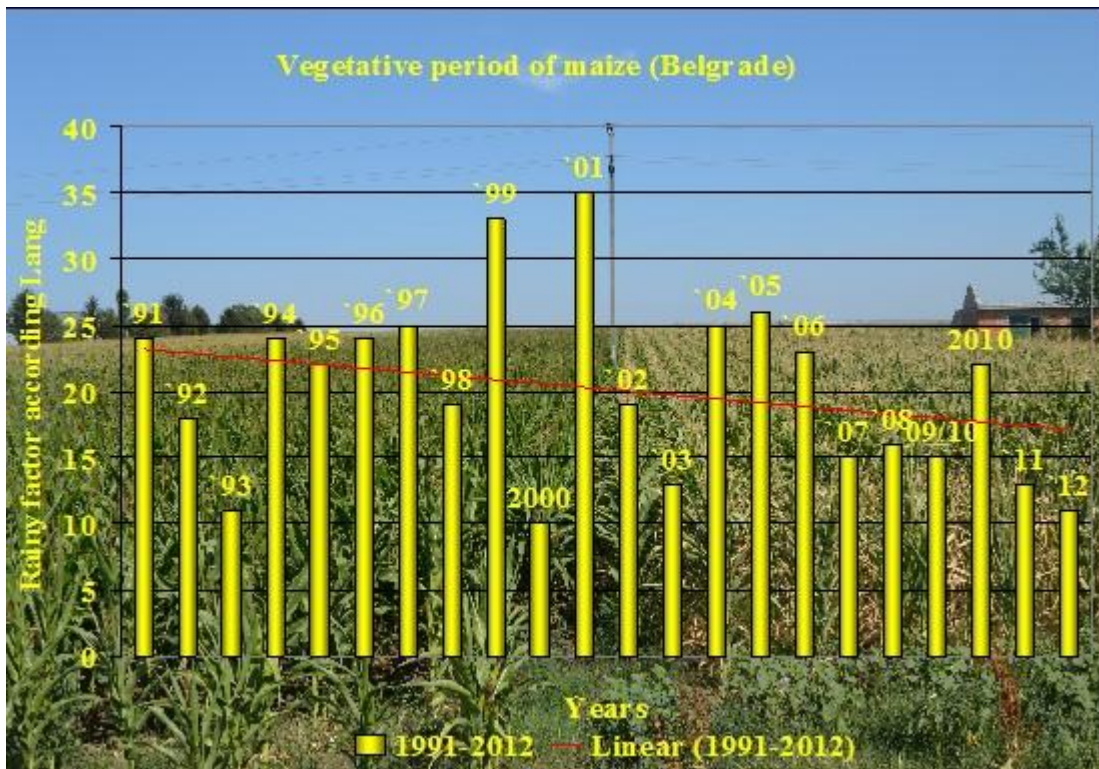
Figure 2. Rainy factor according Lang in vegetative period of maize (Belgrade 1991-2012)
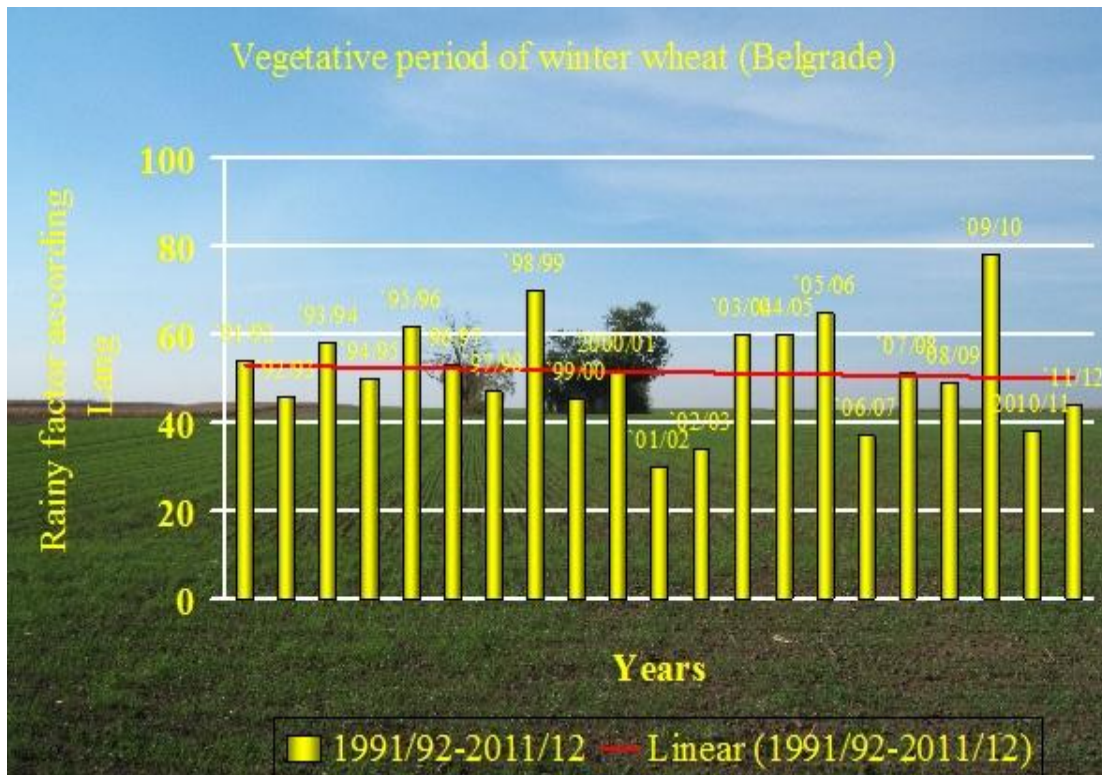
Figure 3. Rainy factor according Lang in vegetative period of winter wheat(Belgrade 1991-2012)

Table 5. Effects of cropping system in different weather conditions on grain yield of maize (t ha^{-1})

Weather conditions	RF acc. Lang	Cont. cropp	Crop rotation			Average crop rotat.	Decrease in cont. cropp.
			2-crop rot.	3-crop rot.	6-crop rotat.		
2000	25.9	5.75	6.50	6.50	5.55	6.18	
2003	42.4	6.05	5.45	5.69	5.36	5.50	
2011	36.1	6.40	6.80	7.10	7.40	7.10	
Dry	Average	6.07	6.25	6.43	6.10	6.26	0.19
1994	50.2	8.52	8.87	8.91	9.34	9.04	
2004	64,3	7.00	9.55	10.02	9.12	9.56	
2006	56.9	8.25	8.40	8.60	8.60	8.53	
Moderate	Average	7.92	8.94	9.18	9.02	9.05	1.13
1999	87.3	8.45	9.67	9.75	10.74	10.1	
2001	70.1	8.00	8.50	8.75	8.54	8.60	
2005	64.8	7.20	9.15	10.60	8.80	9.52	
Wet	Average	7.88	9.11	9.70	9.36	9.39	1.51
Decrease grain yield		1.85	2.86	3.27	3.26	2.80	
	%	23.4	31.4	33,7	34.8	31.1	

For this purpose, the most commonly used are Lang's rain factor, De Marton`s drought index, Conrad's index of continentality and Ivanov moisture coefficient (Spasov and Spasov Danica 2001; Lalic Branislava et al., 2002; Spasov, 2003; Radicevic Zorica et al., 2011).

We opted for Lang`s rain factor calculated as the ratio of annual rainfall and mean annual air temperature of an area. (Figure 1, Figure 2 and Figure 3). According to Lang, the characterisation of climate is as follows: 0 - 20 Desert - Arid, 20 - 40 Semi-desert, 40-60 Steppe and Savanna ; 60-100 Weak forests - Humid, 100-160 High forests and over > 160 Steppes and tundras-Perhumid. The graph shows the noticeable trend of decreasing moisture indices according to Lang for the first twelve years of the new millennium compared to the last decade of the old one. This trend is particularly evident in the vegetative period of maize.

On the basis of the rainfall regime and the average annual air temperatures for the whole year in the Belgrade area, we have chosen three extremely dry, three moderate and three very wet years.

In those years, according to data from Table 5, appropriately established crop rotations with greater diversification of crops such as three-field and six-field crop rotations provide better tolerance of extreme humidity conditions as shown in our study compared to the continuous cropping of winter wheat and maize.

Continuous cropping in this sense has proved to be worse solution even for maize that is known to show better tolerance. High maize yields in dry years were obtained in smaller areas with complete cultivation practices and full compliance with all deadlines of implementation of management practices, so it should not be surprising that in widespread practice it is not the case.

Table 6. Effects of cropping system in different weather conditions on grain yield of winter wheat (t ha^{-1})

Weather conditions	RF acc. Lang	Cont. cropp	Crop rotation			Average crop rot.	Decrease in cont. cropp.
			2-crop rotat.	3-crop rotat.	6-crop rotat.		
2001/02	29.9	3.20	4.86	4.86	5.10	4.94	
2002/03	34.2	2.90	3.10	3.10	3.30	3.17	
2010/11	38.3	3.01	4.02	4.16	3.89	4.02	
Dry	Average	3.04	3.99	4.04	4.10	4.04	1.00
1997/98	46.6	3.16	3.41	3.51	4.56	3.83	

2000/01	52.5	3.30	4.60	4.60	4.70	4.63	
2008/09	48.7	3.60	3.90	4.10	3.98	3.99	
Moderate	Average	3.35	3.97	4.07	4.41	4.15	0.80
1998/99	69.6	3.46	3.79	3.79	4.89	4.16	
2005/06	64.5	3.10	3.35	3.35	3.90	3.53	
2009/10	78.1	2.96	4.10	4.24	3.90	4.08	
Wet	Average	3.17	3.75	3.79	4.23	3.92	0.75
Decrease grain yield		0.31	-0.24	-0.28	0.31	0.23	
	%	9.25	6.01	6.88	7.02	5.54	

All crop rotations produced higher yields, which averagely for three investigated amounts to 0.19 t ha^{-1}, and we can say that it is not a big difference. This fact demonstrates that when maize is lacking moisture with much higher temperatures and the above-mentioned heat waves accompanied by the tropical nighttime temperatures, nothing can replace it.

In years with moderate humidity and better distributed rainfall we have significantly increased yield in crop rotation compared to continuous cropping and the highest one in over wet years as for total rainfall (1.13 t ha^{-1}; 1.51 t ha^{-1}). This shows what a stimulating effect the moisture has on better availability of other vegetation factors, that is, on the synergistic effect of all other applied cultivation practices for maize through well designed crop rotation scheme. As regards winter wheat, it is known that it is not tolerant of continuous cropping, therefore the yields in this system are always expectedly lower (Table 6). Unlike maize, at this point crop rotation effect in dry years compared to continuous cropping was higher 1:00 t ha^{-1}. While the moisture content increased, the influence of crop rotation decreased, and in moderately humid that difference was 0.80 t ha^{-1}, and in the extremely wet ones it amounted to 0.75 t ha^{-1}.

This advantage of crop rotation compared to continuous cropping is quite expected. However, if crop rotations are compared with each other in different wetting conditions, then it is noticed that in excessively wet years lower yield was produced than in the dry years in crop rotations with smaller number of crops in rotation, in two-field crop rotation by 0.24 t ha^{-1} (winter wheat-maize) and three-field crop rotation (winter wheat-maize-soya bean) 0.28 t ha^{-1} compared to six-field crop rotation.

Conclusion

Based on a detailed analysis of climatic factors in the multi-year period for the Belgrade region, which may be representative of the wider area of central Serbia, it can be emphasised that some changes in terms of temperature and precipitation occurred. The causes of drought mainly come from the atmosphere and affect our country and show clearly that the climate is changing in our area. Based on these facts, we must have the right answers in order to mitigate if not to completely eliminate these effects. Agronomic aspect of looking into the problem requires a good knowledge of our crop needs for primary vegetative factors as well as temperature and moisture.

Annual air temperatures in the investigated period increased not only at the annual level, but also in the vegetative period of winter wheat and particularly maize. The temperature increase is particularly dangerous in the vegetative period of maize during the three months of June, July and August by almost 2 ^{0}C. Precipitations at a monthly level of the vegetative period or a total per year do not provide such a picture. Besides the lack in July, normally the warmest month, by and large, precipitations are somewhat higher than the reference 30-year period 1971-2000. This fact tells us that precipitations are more frequent in other parts of the year, which is more favourable for winter wheat, at least when regarding

warmer years (especially in the wet years as it is known in the case of extremely wet 2010 when it was vice versa).

A man can hardly influence the quantity and distribution of rainfall, therefore his actions to combat drought are mainly of indirect character. This comprises a good knowledge of the problems and prediction. For this, we need a lot of knowledge of agronomy, genetics, ecology, physiology, and relevant technical and economic possibilities. If we start from the assumption that the main goal is to provide sufficient and safe quantities of food for our population, then we need to focus on what we have in our hands and begin with it.

In the fight against drought, regular and specific cultivation practices are used along with an adequate assortment of plants with more tolerance to drought. Out of regular practices, soil tillage, particularly conservation tillage, proper fertilization, elimination of all possible mistakes in sowing should be taken into account as for optimal time and plant density. Care treatments are a useful tool which can eliminate the adverse effects and create favourable conditions for the growth and development of cultivated crops, ranging from the usual ones to some special ones that retain moisture and prevent moisture loss by encouraging its more efficient and economical use.

Appropriately established crop rotations with greater diversification of crops provide better tolerance of extreme moisture, which is particularly the case of wheat. Our research shows inferiority of continuous cropping of both crops compared with crop rotations. However, when comparing crop rotations with each other then it can be noticed that the proper setting, even under extreme conditions, provides better results. As for maize it is evident that all increases of moisture are suitable for it as it is related to the warmer part of the year, either as direct rainfall during the summer or indirectly if the reserve is provided from a period when there are more precipitations during the autumn, winter and spring. Moisture improves the efficiency of all other cultivation practices. In the case of its extended absence followed by high temperatures it is quite the opposite.

Acknowledgements

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Table 1. Mean monthly temperature (^{0}C) in Belgrade, period 1991-2012

Year	Months												X-VI	Mean IV-IX	Year
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Octob.	Nov.	Dec.			
1991	-0.4	4.5	9.2	13.8	16.0	17.8	21.7	16.0	11.7	11.4	7.7	-1.1		16.1	10.7
1992	1.7	4.2	5.2	13.0	17.9	20.6	22.8	26.8	15.5	13.1	5.2	1.2	9.0	19.4	12.3
1993	1.5	-0.6	5.0	12.6	20.0	21.7	22.5	23.4	18.1	14.5	3.0	4.7	8.9	19.7	12.2
1994	4.3	3.5	10.4	12.8	18.5	21.0	24.3	24.1	21.7	11.2	7.5	3.4	10.3	20.4	13.6
1995	0.6	7.9	7.1	12.6	16.8	20.5	24.8	21.6	16.6	13.4	4.2	2.2	9.7	18.8	12.4
1996	-0.2	-0.6	2.6	12.6	14.3	21.9	22.0	22.1	14.0	12.6	10	1.7	7.8	17.8	11.1
1997	0.5	5.1	5.2	8.2	16.8	21.8	21.3	21.5	17.6	10.4	8.3	4.6	9.1	17.9	11.8
1998	3.7	6.2	4.8	13.6	16.0	21.7	22.0	21.8	15.9	12.8	4.4	-2.4	9.9	18.5	11.7
1999	1.4	1.9	8.2	13.2	17.3	20.0	21.1	21.1	18.4	12.2	4.8	2.2	8.5	18.5	11.8
2000	-1.0	5.2	8.1	16.2	19.6	23.0	23.5	25.7	17.9	14.6	11.9	5.3	10.0	21.0	14.2
2001	4.2	5.4	11.8	12.0	18.3	19.0	23.0	24.0	16.1	14.8	4.7	-1.9	11.4	18.7	12.6
2002	1.4	9.1	10.7	12.7	20.2	22.4	24.6	22.8	17.9	14.0	11.5	1.6	10.5	20.1	14.1
2003	0.8	-2.0	7.4	12.2	21.6	25.0	23.4	25.8	18.4	11.5	9.9	3.5	10.2	21.1	13.1
2004	-0.1	3.7	8.1	13.5	16.2	20.7	23.0	22.3	17.7	15.9	8.5	4.0	9.7	18.9	12.8
2005	2.1	-1.0	6.0	13.1	17.7	20.2	22.9	21.4	18.9	13.8	7.1	3.6	9.6	19.0	12.2
2006	-0.2	2.2	7.1	14.0	17.6	20.3	24.7	21.5	19.7	16.1	9.6	4.7	9.5	19.6	13.1
2007	7.9	7.8	10.8	14.7	19.8	24.4	26.9	25.2	15.8	12.1	5.6	1.5	12.9	21.1	14.4
2008	3.4	6.6	9.8	14.2	19.3	23.0	23.6	24.2	17.5	15.9	9.9	4.9	10.6	20.3	14.4
2009	0.1	3.4	8.6	16.2	19.8	21.1	24.0	24.5	21.0	14.0	10.4	4.9	11.1	21.1	14.0
2010	1.0	3.9	8.7	13.9	18.3	21.4	24.4	24.3	18.4	10.5	12.2	2.5	10.7	20.1	13.3
2011	2.0	1.4	8.2	14.6	17.3	22.4	24.1	24.7	23.2	12.9	5.0	5.8	10.1	21.1	13.5
2012	2.7	-2.5	10.1	14.4	17.9	24.6	27.1	26.2	22.0				10.1	16.1	

***Republic Hydrometeorological Service of Serbia

Table 2. Precipitation (mm) in Belgrade, period 1991-2012

Year	Months												Total		
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Octob.	Nov.	Dec.	X-VI	IV-IX	I-XII
1991	20.2	11.2	83.7	51.3	94.7	86.3	43.9	32.8	25.8	84.2	62.7	31.7		334.8	628.5
1992	7.6	33.5	6.9	58.8	19.4	180.0	43.5	24.3	25.2	90.5	61.7	34.8	528.5	351.2	586.2
1993	21.9	31.8	77.1	28.7	12.8	50.4	56.9	24.5	51.5	18.8	77.8	88.9	484.8	224.8	541.1
1994	40.4	23.0	27.7	64.6	41.4	212.2	46.1	90.5	29.5	37.9	35.9	34.4	409.7	484.3	683.6
1995	82.2	45.9	43.9	61.0	83.6	64.7	33.7	69.2	92.6	0.3	57.0	67.1	594.8	404.8	701.2
1996	42.6	62.2	41.2	52.3	108.0	57.1	35.5	66.6	107.7	37.1	77.7	100.8	489.5	427.2	788.8
1997	33.0	50.4	10.2	87.0	51.0	31.0	131.0	113.0	31.0	106.0	30.0	81.0	487.8	444.0	754.6
1998	70.4	4.0	28.4	31.0	68.9	42.7	34.4	82.2	89.7	91.6	55.3	28.5	478.2	348.9	627.1
1999	60.8	68.9	15.6	68.9	68.8	135.5	275.9	7.0	55.4	54.9	69.4	149.3	462.4	611.5	1030.4
2000	27.3	28.3	30.3	41.9	34.5	19.1	29.3	7.8	70.7	16.6	20.7	41.2	593.9	203.3	367.7
2001	35.3	27.2	65.6	157.9	47.0	186.0	19.7	56.7	183.7	16.7	63.4	33.9	455.0	651.0	893.1
2002	14.0	14.0	15.0	55.0	21.0	80.0	62.0	107.0	50.0	80.0	34.0	53.0	597.5	375.0	585.0
2003	51.0	26.0	11.0	22.0	40.0	33.0	116.0	5.0	57.0	124.0	29.0	42.0	313.0	273.0	556.0
2004	99.1	28.2	18.4	69.0	62.8	107.1	93.7	88.1	45.8	30.6	128.8	51.3	350.0	466.5	822.9
2005	53.0	87.0	32.0	53.0	48.0	94.0	90.0	145.0	56.0	27.0	23.0	83.0	579.6	486.0	791.0
2006	43.0	58.0	105.0	97.0	40.0	137.0	22.0	123.0	26.0	21.0	25.0	48.0	577.7	445.0	745.0
2007	36.0	53.0	100.0	4.0	79.0	108.0	18.0	72.0	35.0	104.0	131.0	34.0	613.0	316.0	774.0
2008	42.0	10.0	79.0	35.0	61.0	45.0	64.0	46.0	68.0	18.0	52.0	77.0	474.0	319.0	597.0
2009	54.0	84.0	63.0	6.0	34.0	153.0	79.0	45.0	4.0	101.0	62.0	122.0	541.0	321.0	807.0
2010	89.0	111.0	46.0	41.0	85.0	180.0	41.0	54.0	51.0	49.0	45.0	61.0	541.0	452.0	853.0
2011	40.0	53.0	26.0	11.0	63.0	40.0	107.0	9.0	49.0	35.0	6.0	49.0	837.0	279.0	488.0
2012	82.0	62.0	3.0	67.0	128.0	14.0	39.0	4.0	31.0				388.0	334.8	

***Source:Republic Hydrometeorological Service of Serbia

ADOPTING CROP MODELS FOR GREENHOUSE PRODUCTION OF PEPPERS TOWARD INTEGRATED PEST MANAGEMENT

Nebojsa MOMIROVIC

University of Belgrade, Faculty of Agriculture, Serbia
(Corresponding author: emomirov@agrif.bg.ac.rs)

Abstract

Advanced vegetable production under protected conditions have accomplished by multifunctional integration of several methods and techniques in order to get produce for fresh consumption with an added biological value. This paper deals with recent achievements in the field of integrated, biological and organic vegetable production and possibilities for biological control of common pests and diseases in different crop models. The usage of modern greenhouse covering films and mulch films has afforded several benefits in more precise control of microclimate fluctuations. Photo-selective plastic films could change the character and spectral composition of solar radiation, which leads to less pests and disease infection and better crop performances, such us earliness, fruit size and uniformity and cumulative and total yield.

Induced systemic resistance is one of the modes of action that allows soil born diseases suppression with regular application of organic composted amendments as well application of beneficial microorganisms: *Trichoderma harzianum*, *Bacillus subtilis*, *Bacillus amyloliquefaciens* etc. Besides its mycoparasitism, permanent exudations of enzymes and bioactive ingredients after roots colonization have influenced the decrease of inoculums presence and disease susceptibility of the resistant varieties of peppers. Practical results of application of lactate peroxidase, phosphytes, other simple salts and biopreparation, and bioactive ingredients have showed great possibilities for wide implementation of IPM, especially with advanced application techniques. By pheromone traps and usage of predators *Amblyseius swirskii*, *Orius laevigatus*, *Aphidius colemani*, as well application of oxymatrine extracted from *Sophora lutescens* we could manage good balance in biological protection under especially adopted and designed greenhouse conditions.

Keywords: *peppers, crop models, greenhouse microclimate, beneficial, predators,*

Introduction - Consumers perceptions and preferences to vegetable's origin, quality and cultural practice

Understanding how the environment and production and cultivation practices influencing the composition and quality of food crops being fundamental to the production of high-quality nutritious foods. Consumers demand healthy, bio, or organic products because they believe they are more flavorful and respectful to the environment and human health. High quality and health safety, high nutritive and biological value, high aesthetic values: color intensity, shininess, uniformity in shape and size, preferable aroma and taste, and finally high marketability; storability, transportability, the shelf life, these are the most important issues of vegetables marketing. Many research have been dedicated last decade to investigate the effects of conventional, integrated, and organic farming growing practice on quality of vegetables.

Vegetable nutritional quality is related to concentrations of antioxidants and other minerals. The results of Aghili et al., (2012) indicated that bell pepper is an excellent source of ascorbic acid and potassium for humans. Improved nutritional management in greenhouses could enhance micronutrient concentrations in this vegetable.Field-grown vegetables had lower contents of Cu, Mn, Fe, Zn, and ascorbic acid compared to greenhouse-grown vegetables,In general, the nutritional quality (contents of micronutrients and ascorbic acid) of greenhouse-grown vegetables was better than that of field-grown vegetables, although fruit micronutrient concentrations of field- and greenhouse-grown vegetables were lower than expected levels.

Reporting the effects of conventional, integrated, and organic farming, grown in a controlled greenhouse, on color, minerals, and carotenoids of sweet pepper fruits, Perez-Lopez et al., (2007) have proved that organic farming provided peppers with the highest intensities of red and yellow colors, contents of minerals, and total carotenoids. Integrated fruits presented intermediate values of the quality parameters under study, and conventional fruits were those with the lowest values of minerals, carotenoids, and color intensity. As an example, the concentrations of total carotenoids were 3231, 2493, and 1829 mg kg $^{-1}$ for organic, integrated, and conventional sweet peppers, respectively. Finally, organic red peppers could be considered as those having the highest antioxidant activity.

In 3-year study Chassy et al., (2006), were measured total phenolics, percent soluble solids, ascorbic acid, and the flavonoid aglycones quercetin, kaempferol, and luteolin in two varieties of tomatoes and two varieties of bell peppers grown by certified organic and conventional practices. Significantly higher levels of soluble solids (17%), quercetin (30%), kaempferol (17%), and ascorbic acid (26%) were found in Burbank tomatoes. Bell peppers were influenced less by environment and did not display cropping system differences. Cultivars and growing conditions seems to play an important role in affecting the metabolism of antioxidant components and antioxidant capacity. Deepa et al. (2006) have reported results of ten cultivars of red sweet peppers grown over two consecutive years with regard to ascorbic acid, total reducing content, -carotene, total antioxidant activity and free radical scavenging activity.All cultivars fulfilled common requirement for vitamin C, but only some of them excelled in terms of -carotene.

It is obvious that greenhouse production of vegetables should go to a certain level of ecologization, trying to imitate natural ecosystems in their balance and sustainability, where biological plant protection have a crucial importance for successful implementation of modern growing practices.

Modeling greenhouse performance for passive energy efficiency and optimal microclimate control

The development of energy conservative greenhouse systems is the overall result of improvement of greenhouse construction, cladding materials and insulating techniques, innovative climate control equipment and implementation of physical and physiological knowledge in the operational climate control systems (Bakker et al., 1995; Bakker, 2006). The development of these systems represents an optimization problem and the use of both physical as well as physiological information and models have shown to be a most powerful tool in dealing with these issues. A control philosophy is described for maximizing the financial margin between the value of a greenhouse crop and the cost of controlling the greenhouse climate. This uses physical models, which describe how the conditions inside the greenhouse are influenced by external conditions, to determine the inputs necessary to create the internal climate. Biological models are used to predict the influence of the climate on crop production. Economic models provide input costs and crop market value. These models are used in an

optimization algorithm to determine the values of specific climate variables which maximize the financial margin. The algorithm will operate in real time in the greenhouse climate controller to reduce the cost of greenhouse heating by optimizing the closing and opening thermal screens, and by controlling heating on the basis of integrated air temperature.

Sweet pepper production is characterized by large fluctuations in fruit yield per week. Buwalda et al., (2006) had described a dynamic, calibrated model which was able to simulate the measured data fairly well, in particular the yield fluctuations, in order to improve chain's supply efficiency that requires farmers to supply production forecasts several weeks in advance. Yield prediction was helpful for efficient labor planning, while the results obtained in research of Van Henten et al., (2006) indicate that fluctuations in sweet pepper production can be reduced using optimized temperature strategies, either by controlling production in one part/block or by controlling production in opposite phase in two different parts.

For the continental climate of Serbia (Momirovic et al., 2010) passive methods (double inflation plastic, IC screens and covers, transparent water tubes, mulching, shading) for optimization energy efficiency of advanced tunnel's production have enormous influence on its sustainability

Baille et al., (2006) have analyzed the night energy balance of an air-heated greenhouse in mild-winter climatic conditions of Almería, south-eastern Spain. In their conclusion the measures to improve the energy efficiency would be: (i) to improve the air tightness of the greenhouse, (ii) to reduce radiation losses by means of thermal screens or IR-opaque plastic covering materials, and (iii) to increase the soil efficiency in storing solar energy and releasing it during the night.

Precise, highly efficient irrigation could also have enormous impact on energy efficiency of peppers production grown as protected crops, both because of cost and yield influence, as well heat transfer to the soil layers. Greenhouse grown white blocky and white conical peppers were used to develop recently introduced Time-Space deficit irrigation (TSDI), irrigation technique based on regulated deficit irrigation (RDI) and partial root zone drying (PRD) trough 3 drip laterals per each two-row beds covered by plastic mulch film.

By measuring plant growth, yield and irrigation water use efficiency Shao Guang-Cheng et al., (2010) was concluded that it is difficult generally to apply TSDI for increasing vegetative biomass but with it is possible to prevent crop yield reduction or to improve crop quality. The ultimate profitability of a given watering regime for plant growth in the greenhouse requires fine-tuning of the pattern and level of water supply to the plant response during different stages.

Management of solar radiation toward better environmental conditions and less pressure of pests and diseases

Because of the inability to cure plant virus diseases and the need to protect the environment from toxic pesticides, alternative indirect strategies of disease control are required. In recent decades, virologists have developed non-pesticide, cultural control practices aimed at reducing the damage caused by these virus diseases by interrupting their epidemiological cycle. Accumulated data on the insects search for the host plants and environment associated with visual communication by insect vectors have facilitated the development of cultural practices that interfere with their search, landing and orientation to the crop (Antignus et al., 1996a).

Modern PE films has afforded several benefits in greenhouse climate control, significant savings of resources, machines and labor cost, as well as efficient control of plant diseases and pests (Momirovic et al., 2011). Photo-selective films could have significant application in Integral Pest Management Systems for vegetables, fruits, flowers and herbs.

Many authors have reported benefits of these materials decreasing incidence of pests and diseases (Antignus et al., 1996b, Antignus, 2000, Elad et al., 1997).

Antivirus (UV blocking) films have decreased application of pesticides for the suppression of aphids, white fly, thripses, leaf miners and other pests and affording efficient pollination and biological protection. Effects of particular films application and methods of its combination in order to achieve better energy efficiency of the protected cultivation of horticultural crops (Momirovic et al., 2010) In addition to conventional polymers used in agriculture for greenhouses and mulches such as PE, PVC, EVA, photo-selective and luminescent polymers have been used, in order to improve the quality of crops. For the same reason plastic nets are used mainly in countries with tropical and Mediterranean climates. For an environmentally friendly agricultural activity, an alternative strategy can be represented by bio-based agricultural raw materials. For low environmental impact applications, biodegradable materials for agricultural films are nowadays produced (Scarascia-Mugnozza, ey al., 2011).

The individual and joint effects of covering the soil with polyethylene mulch before planting and fungicides commonly being used by organic growers on tomato late blight (caused by *Phytophthora infestans*), while in peppers *Botrytis cinerea* is the main problematic disease.According to Shtienberg et al., (2010) application of fungicides resulted in inconsistent and insufficient late blight suppression (control efficacy +/- standard error of 34.5 +/- 14.3%) but the polyethylene mulch resulted in consistent, effective, and highly significant suppression (control efficacy of 83.6 +/- 5.5%) of the disease. It was found also that the type of polyethylene mulch used (Al-Or, clear, or black) did not affect the efficacy of late blight suppression. The disease-suppressing effect of mulch appeared to come from a reduction in leaf wetness duration, because mulching led to reductions in both the frequency of nights when dew formed and the number of dew hours per night when it formed. Mulching also reduced relative humidity in the canopy, which may have reduced sporulation.

Reflected diffused light could have great impact on yield and performance of several vegetable crops, due to a spectral interception (Kasperbauer and Hunt, 1998;. Kasperbauer et al., 2007), as well different soil temperature regime (Momirovic and Savic, 2007).

Soil microbial activity and Induced Systemic Resistance-(ISR)

Enriching soils permanently with composted organic manure characterized by high concentrated microbial activity, except fertility and aggregate stability could participate also with lower soil born disease potential. History of organic amendment use to suppress plant diseases is abundant (Hoitink and Boehm, 1999).In most cases, there is no single mechanism controlling plant diseases in any given plant growing system; rather several mechanisms operate concurrently to suppress plant diseases. A recent literature review on biologically and organic matter mediated disease suppression highlights several predominant mechanisms (Stone et al., 2004): competition for energy and nutrient sources and for organic matter substrate colonization. antagonism, competition for root colonization and induced systemic resistance (ISR) or systemic acquired resistance (SAR).

Warman (2005) by his study have demonstrated that the long-term use of compost can produce similar yields and elemental analysis for most crops in compost- amended and conventionally-fertilized soils. On the other hand, combined application of boat composted manure and beneficial microbial: *Bacillus subtilis, Bacilus amyloliquefaciens, Trichoderma harzianum* etc. especially after few years of permanent application could lead to a certain decrease or total avoidance of chemical pesticides.

The best explanation of several modes of action on roots infected by bacterial have been revived by Compant et al., (2005). *Trichodermaspp*. are free-living fungi that are

common in soil and root ecosystems. Recent discoveries show that they are opportunistic, avirulent plant symbionts, as well as being parasites of other fungi. Root colonization by *Trichoderma* spp. also frequently enhances root growth and development, crop productivity, resistance to abiotic stresses and the uptake and use of nutrients (Harman et al., 2004). Ahmed et al., (2000) were studied the effect of pepper seed and root treatments with *Trichoderma harzianum* spores on necrosis caused in stems by *Phytophthora capsici* inoculation and on the course of capsidiol accumulation in the inoculated sites. The results indicate that seed treatments significantly reduced stem necrosis, which fell by nearly a half compared with the values observed in plants grown from non-treated seeds. Necrosis was also reduced in plants whose roots were drenched with various doses of *T. harzianum* spores, although the extent of necrosis was not correlated with the dose used.

Elicitation of induced systemic resistance (ISR) by plant-associated bacteria was initially demonstrated using *Pseudomonas* spp. and other gram-negative bacteria (Kloepper et al., 2004).

Published results are summarized showing that specific strains of the species *B. amyloliquefaciens, B. subtilis, B. pasteurii, B. cereus, B. pumilus, B. mycoides*, and *B. sphaericus* elicit significant reductions in the incidence or severity of various diseases on a diversity of hosts. Protection resulting from ISR elicited by *Bacillus* spp. has been reported against leaf-spotting fungal and bacterial pathogens, systemic viruses, a crown-rotting fungal pathogen, root-knot nematodes, and a stem-blight fungal pathogen as well as damping-off, blue mold, and late blight diseases. ISR elicited by several strains of *Bacillus* spp. is independent of salicylic acid but dependent on jasmonic acid, ethylene, and the regulatory gene. Ramirez and Kloepper, (2010) have studied the effect of soil P-related properties and inoculum concentration on plant growth promotion by the phytase-producing strain *Bacillus amyloliquefaciens* FZB45. Significant interaction between P regime and bacterial inoculation was found. FZB45.

Trichoderma harzianum could be used (Elad et al., 1993) for spaying vegetable crops with concentrations 1g l^{-1} plus surfactant, to achieve up to 90% of control fruit and stem grey mould. Populations of *T. harzianum* were on a level of 3×10^5-8×10^5 c.f.u. per leaf and ten times lower on one fruit. They remained high after the second and third sprays. Conditions favoring the ability of *T. harzianum* to control grey mould were temperatures above 20°C and relative humidity between 80 and 97%. Another treatments with amino-acids, see-weeds extracts, phosphytes, as well lactate-peroxydase, potassium iodide, potassium-thiocyanate, or *Aureobasidum pullulans* yeast strains, could afford very successful protection against diseases.

Predator's activity and their role to achieve certain threshold level of biological protection

Among several pests attacking greenhouse crop of peppers, by far, thripses could affect severely, both the yield and quality of fruits, as well could transmit several viral diseases. Knowledge of thrips population dynamics in relation to temperature can be used to its successful control. In order to have monitoring, both blue and yellow sticky plates and films being used frequently with pheromone attractant as it is Lurem.

The use of *Amblyseius swirski* (*Neoseiulus swirski*) and *Orius laevigatus* has proved to be successful in the control of thrips and tomato spotted wilt virus (TSWV) incidence. In the Southeast of Spain, about 10 000 ha of sweet pepper are grown in plastic houses, in the provinces of Almeria, Murcia and Alicante as have reported Sanchez et al. (2000). Out of 1300 ha in Israel amost 1000 ha is under IPM control with biological protection against thripses. After introduction of *Amblyseiuss cucumeris* which was successful in reducing the

increase of thrips populations in the first few months with lower temperature, we are now in position to use *Amblyseiuss swirski* which is much more sustainable in hot and dry climate conditions. Most of the other pests are controlled by natural enemies too.

Frankliniella occidentalis (Pergande) and *Thrips tabaci* Lindeman (*Thysanoptera: Thr*ipidae) are major pests of sweet pepper for direct damage and tospovirus transmission. To control their infestations, *Orius laevigatus* (Fieber) (*Heteroptera: Anthocoridae*) is produced by many commercial insectaries and widely used on IPM vegetable crops of Europe. This predator is naturally widespread along the Mediterranean and Atlantic coasts, and not in more continental areas, where other *Orius* spp. are more common. Bosco et al., (2008) were conducted research in a continental area of Northwest Italy to access the natural presence of anthocorids on pepper, and to compare their colonization and predatory ability with those of the species artificially introduced. *O. laevigatus* was rarely found and only in the greenhouses in which it had been released. However, its introduction resulted in thrips control before natural colonization by the native species occurred.

Population dynamics of *Frankliniella occidentalis*, *Thrips tabaci*, and *Orius spp.* were studied by Tavela et al., 2008 in sweet pepper crops, northwestern Italy, and best control was achieved by *Orius laevigatus*, which was abundant in greenhouses that practiced integrated pest management (IPM). *O. laevigatus* could overwintered in Mediteranian area on flowering plants (e.g., *Eriobotrya japonica, Rosmarinus officinalis*, and *Vicia faba*), and in the spring, the adults spread to wild and cultivated plants both outside and inside greenhouses. *O. laevigatus* adults appeared naturally inside sweet pepper greenhouses in June and effectively controlled thrips, but it suppose to be late. The minimum night temperature allowing *Orius* introduction is 16-17°C, Thrips populations decreased rapidly and disappeared after 20–30 days. Predator populations increased and reached their maximum in August. *O. laevigatus* remained in the sweet peppers even at very low levels of thrips and fed on pollen. When high thrips infestations occurred, *O. laevigatus* was introduced as a control agent (1-2 adult/m^2). Good results were obtained at 25°C when the sweet pepper plants were in flower and covered with foliage.

As a cultural control strategy for reducing the spread of non-persistently transmitted aphid-borne viruses, barrier crops have been used since the early 1950's in Spain (Fererras , 2000), and since then, this strategy has been investigated by several authors, resulting in a wide range of divergent conclusions on its effectiveness. The barriers acted as natural 'sinks' for non-persistent viruses and did not reduce the number of aphids landing in the protected crop, as suggested by some authors. It is concluded that use of barrier crops can be an effective crop management strategy to protect against virus infection, but only under specific circumstances. Barley crop barrier oftenly being used in sweet pepper crops (Pineda and Marcos-Garcia, 2008).

Aphidius colemani Viereck*, Aphidius matricariae* Haliday (*Hymenoptera: Aphidiidae*) are the main parasitic wasps used for biological control of aphids (Dik et al., 2002). Since some aphid species has a very high rate of development and it is able to increase up to 12 times per week, we need to develop population of parasitic wasps very fast by increasing air temperature up to 25°C for *A. colemani* and up to a 30 °C, for *A. matricariae*. Several experiments have shown that the aphid parasitoid *A. matricariae* performs better and faster as compared to *A. colemani* on *Myzus* species. The tobacco aphid *Myzus nicotianae*, a major problem in sweet peppers, is easily controlled.. The ratio of female wasp:aphid at the start should be approximatelly 1:20.

Against moths and caterpillars, especially *Ostrinia nubilalis*, very promising results we had achieved with oxymatrine, the natural extracts from *Sophora lutescens*, but we also could use *Bacillus thuringiensis var. kurstaki*. There is also very good effect against mites, so we are not forced to use chemicals as it is Nissorun and Torque.

Possibilities and constraints among crop models intensity toward integrated pest management and full ecologization of greenhouse peppers production

Long term studies and practical achievements with particular pilot projects among main growing regions in Serbia have resulted by significant export increase and price high enough to cover certain improvements in greenhouse practice. Opposite to a standard crop model with soil production of peppers in walking plastic tunnels, advanced systems were good enough to accept integrated pest management or full biological protection, predominantly because of optimized microclimate control.

Table 1. Long-term performance of different crop models of greenhouse peppers in Serbia

Production / Crop model	Total yield (kg/m^2)	Healthy status	Quality range	I class shares (%)	Average bottom price (EUR/kg)
A) Soil production / Simple tunnels	7	+/-	*	50	0,30
B) Soil production / Advanced tunnels / Spanish system	14	+	**	65	0,45
C) Soil production / Double inflated plastic / Trellising / Additional heating	20	++	****	75	0,65
D) Hydroponic on coco-peat / Modern greenhouses / Full heating	25	+++	*****	85	0,85

Testing different crop models on the way to its full sustainability

Following average yield, quality and price dynamics data, then after with appropriate cost calculations and trough few economics issues, we could confirm high profitability, as well low risk of advanced crop models, comparing to a standard crop model of pepper production. It is clear that based on domestic market, crop model B had the lowest risk regarding price and yield break even points, while for export purpose both soil and coco-peat grown peppers with heating are the crop models generating higher profit. Comparing results with sensitivity analysis by Jovicich et al. (2005) for colored blocky peppers hydroponically grown in pots, we could see similar results. Variation of the yield data had shown range between 7 and 15 kg m^{-1}. Based on the yield of 13 kg m^{-1}, breakeven point was 7,8 kg^{-1}, even expected price were bit higher.

Table 2. Break even points for yield and price of peppers among examined crop models

Crop models	Yield of peppers t ha^{-1}	Price EUR t^{-1}	Annual income EUR ha^{-1}	Peppers turnover EUR ha^{-1}	Yield breakeven point t ha^{-1}	Price breakeven point EUR t^{-1}
Model A	70	350,0	37.000,0	24.500,00	69,09	345
Model B	140	650,0	123.000,0	91.000,0	84,54	393
Model C	200	800,0	160.000,0	160.000,0	152,31	609
Model D	250	1.000,0	250.000,0	250.000,0	171,46	686

Conclusions

This article reweaving the modern trends in precise conventional, integrated, and organic greenhouse production of peppers toward full ecologization of cultural practices and growing techniques. The practical achievements in this field have shown great possibilities of vegetables growers in Serbia and in the region to achieve certain level of quality and to respond on high expectations in fresh consumption of vegetables regarding human health implications and benefits. Sustainable crop models of greenhouse production of peppers that

could accept integrated pest management methods are based on advanced growing techniques with higher energy efficiency, enabling growers to have longer production cycle and higher yields, as well precise microclimate control to avoid infection and to keep well balanced biological protection against common pests and diseases.

Aknowlegements

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CONVENTIONAL AND MOLECULAR PLANT BREEDING: BENEFIT AND RISKS IN SEED AND PLANT QUALITY IMPROVEMENT

Kosana KONSTANTINOV[*], Milosav BABIC, Snezana MLADENOVIC DRINIC

Maize Research Institute "Zemun Polje", Belgrade, Serbia
(Corresponding author: kosanak@open.telekom.rs)

Abstract

Conventional breeding technologies are including selection, mutagenic breeding and somaclonal variation. Molecular breeding includeMAS,"omics technology and genetic modification genetically modified organisms (GMO) with specific changes in genome by genetic engineering. The main goal of breeding is to increase stable yield, which depends on the genetic potentional and tolerance/resistance to biotic and abiotic stresses, but recently it is intensive working to improve the properties and quality of grain.Genetically modified *RoundupReady* soybean has 2.3% yields increase but 2 – 5 times higher amount of herbicide applied. By conventional breeding maize average is increased from 2t/ha 1947 to more than 6t/ha during 2010. At Maize Research Institute "Zemun Polje" among 665 created and officially recognized hybrids by state officials, 83 has improved quality.Similar results were obtained in other institution as well as in other plant species (wheat, soybean, sunflower, tomato *etc*). By genetic engineering it is possible to introduce genes not only from plant species but from evolutionary different organisms (bacteria, viruses, fungi, *antisense genes*) and create GMO. Food produced from soybean and maize, has been on the market 1996.GM crops are grown in the world at over 160mil/ha,mainly soybeans, maize cotton and canola, In addition to tolerance to herbicides, drought and deseases has been much work on improving the quality of grain (rice with increased content of beta carotene, oil crops with modified fatty acid content,, altered protein, starch). Inaddition to food obtained directly from genetically modified plants containing GM ingradients or GM derived ingradients the standard process of food production, can be improved by adding different genetically modified microorganisms as sources of enzymes. A lot of controversy is connected with GMO – food, including biological safety, ecological effect and particularly economic aspect due to low for GMO plants patenting in order to protect intellectual property.

Key words: *plant breeding, molecular, conventional, GMO, food*

Introduction

Food is essential for the survival of human beings. Long - term improvements in well being can only be accomplished by providing people with access to food, skills, education and opportunities. Health involves ensuring adequate nutrition and safeguards against unsafe food. Technical progress in Agriculture and food production traditionally occurred through a process of selection in the field and adaptation of traditional landraces of crops. This was supplemented by purposive breeding of new varieties of crops, mainly through crossing varieties with desirable characteristics. Conventional breeding is cumulative science and seeds accumulate innovations, but can be very time consuming and is often not very accurate. Genetic engineering can create plants with the exact desired trait as plant geneticists can isolate a gene responsible for drought tolerance, pest resistance, herbicide tolerance, disease resistance, cold tolerance, salinity tolerance, nutrition, pharmaceuticals, phitoremediation*etc.* and insert that gene into a

different plant. Genetic modification offers both faster crop adaptation and a biological, rather than chemical, approach to yield increases. GM foods or GMO is most commonly used term to refer to crop plants created for production of safe food for human or animal consumption using this technology.

In recent years the development of food and agriculture sector is being conceptualized globally. For example, food – borne disease originating in one farm field my generate health problem in several continents. In every large city on earth it is possible eat at "fast food" restaurant and drink the same bottles soft drinks. Also important and actual question is whether GM can solve world hunger (Diouf and Sheeren, 2010).

Overview of current result in GM and GMO – food research and commercialization

- Comparison of conventional and molecular plant breeding effect on yield

The main goal in agriculture, independent on plant species, whether conventional or new technologies are applied, is increasing of yield and quality improvement. Modern science requires from breeders to develop new highly yielding variety and hybrids tolerant to various stress factors in as shorter as possible period. These requirements resulted in needs for the development and the application of contemporary and efficient techniques and methods in plant breeding. With increasing knowledge and improved technology, breeders have developed ways to enhance the speed, accuracy and scope of the breeding process. Achievement in various fields of science have resulted in the development of new approaches and techniques in plant breeding such as molecular marker technology, MAS, "omica" technologies, transgenesis and cisgenesis. Marker assisted breeding allows breeders to determine whether desired traits are present in a new variety at an early stage in the breeding programme. Genomics research is generating new tools, such as functional molecular markers and informatics, as well as new knowledge about statistics and inheritance phenomena that could increase the efficiency and precision of crop improvement. The development of new techniques in plant breeding did not lead to the replacement of the older methods. The use of all available technologies is essential for plant breeding. Conventional breeding techniques, transgenesis and new plant breeding techniques are essential components of what we could call the plant breeders' toolbox.

The study concluded that in the United States, other agricultural methods have made a much greater contribution to national crop yield increases in recent years than genetic engineering. According to results from different studies including (Drini *et al.* 2007) the genetic yield potential of ZP maize hybrids over last 40 years amounted to 1000 kg per ha $^{-1}$ per year. More than 665 high yielding hybrids have been officially recognized by State regulations since 1964. including hybrids for special purposes and industrial use as high - oil maize, high - lysine maize, waxy maize, white maize, pop corn and sweet corn, inbred lines and hybrids resistant to economically important diseases and hybrids suitable for industrial use (Saratli *et al*. 2007., Babi *et al*, 2011). Hybrids for special purposes are obtained by introducing genes controlling desired trait through conventional crossing procedure. The same or similar results in maize breeding were obtained in different countries as well as with breeding of other plant species (wheat, soybean, tomato, sunflower, sugar beet *etc*).

Data published by United States Department of Agriculture showed that the yield contribution of engineered genes is a modest fraction—about 14 percent—of the maize yield increase since the mid 1990s. Benbrook (1999)found that genetically engineered Roundup Ready soybeans had a yield drag of 5.3% across all varieties tested. This "yield drag" is similar to what is observed when other traits are introduced into soybeans by conventional

breeding (Caviness, C.E., and H.J. Walters. 1971) and may not be due to the *Roundup Ready*trait or the genetically modified nature of the crop. There have been no reports of "yield drag" with the other *Roundup Ready* crops maize, sorghum or canola. Researchpublished by Qaim *et al.* (*2003*)has shown that the use of genetically modified *Bt* cotton in India increased yields by 60% over the period 1998–2001, while the number of applications of insecticides against bollworm were three times less on average. In paper published by Carpenter (2010) has beenreported that the results of 49 peer - reviewed studies on GM crops worldwide average, farmers in developed countries experienced increase in yield of 6% and in underdeveloped countries of 29 %. Monsanto claimed average yield was reduced by 25% in those fields explained the corn varieties were affected by a mistake made in the seed breeding process but Marian Mayet, an environmental activist and director of the Africa Centre for Biosecurity in Johannesburg, called ([http://www.digitaljournal.com/article/270101, retrieved 24 October 2010](http://www.digitaljournal.com/article/270101).) for a government investigation and asserted that the biotechnology was at fault, "*You cannot make a 'mistake' with three different varieties of corn*". According to Brasher, (2010) in 2009 South African farmers planted 1,900,000 hectares (4,700,000 acres) of GM maize (73% of the total crop).

- Genetically modified crops

Among huge number of domesticated plant species and varieties in last two decades scientists did develop genetically modified crops, source of food and feed, such as:

Soybean (resistant to glyphosate or glufosinate herbicides), high oleic, **Maize** resistant to glyphosate or glufosinate herbicides; insect resistant via producing *Bt* proteins, some previously used as pesticides in organic crop production: vitamin-enriched corn derived from South African white corn variety M37W has bright orange kernels, with 169x increase in beta carotene, 6x the vitamin C and 2x folate (Shaista Naqvi, et al. (2009), **Cotton** - cottonseed oil, pest-resistant cotton; **Alfalfa,**   resistant to glyphosate or glufosinate herbicides, **Hawaiian papaya** variety is resistant to the papaya ringspot virus (Manshardt, 1998); **Tomatoes,** variety in which the production of the enzyme polygalacturonase (PG) is suppressed, retarding fruit softening after harvesting (U.S. Food and Drug Administration 1994), **Canola/ Rapeseed**, resistance to herbicides (glyphosate or glufosinate), high laurate canola (U.S. Food and Drug Administration, 1994) http://en.wikipedia.org/wiki/Genetically_modified_food_-cite_note-22, **Sugarcane**,resistance to certain pesticides, high sucrose content; **Sugar beet,** resistance to glyphosate, glufosinate herbicides; **Rice,** Golden Rice: genetically modified to contain beta-carotene (a source of vitamin A), **Squash,** (Zucchini/ Courgette, resistance to watermelon, cucumber and zucchini/courgette yellow mosaic viruses (Pocket K , 2010); **Sweet peppers,** resistance to virus (Paroda 2008). Varius enzymes from genetically engineered micro-organisms are in use for the food production. These include *alpha-amylase* from bacteria, which converts starch to simple sugars, *chymosin* from bacteria or fungi that clots milk protein for cheese making, and pectin esterase from fungi which improves fruit juice clarity (Panesar et al. (2010).

Comparing transgenic wheat with conventionally bred wheat, Baker *et al,* (2006) concluded that "...transgenic plants could be considered substantially equivalent to untransformed parental lines." Ridley *et al.* (2002)reported that genetically engineered maize was equivalent to conventional maize for proximates, fiber, amino acids, fatty acids, vitamin E, nine minerals, phytic acid, trypsin inhibitor, and secondary metabolites. Cheng *et al.* (2008) showed that genetic engineering of soybeans cause's smaller unintended changes than are seen with traditional breeding. Comparing genetically engineered tomato *Lycopersicon esculentum* and *Nicotiana benthamiana.* a close relative of tobacco (U.S. Food and Drug Administration, 1994) with their untransformed counterparts and concluded that genetic engineering did not significantly affect the plants' proteomic profile.

- Genetically modified foods - GM foods or biotech foods

World Health Organization (WHO report, January 2003) put on the table twenty questions on genetically modified foods : What are genetically modified (GM) organisms and GM foods? Why are GM foods produced? Are GM foods assessed differently from traditional food? How are the potential risks to human health determined? What are the main issues of concern for human health? How is a risk assessment for the environment performed? What are the issues of concern for the environment? Are GM foods safe? How are GM foods regulated nationally? What kind of GM foods are on the market internationally? What happens when GM foods are traded internationally? What happens when GM foods are traded internationally? Have GM products on the international market passed a risk assessment? Why has there been concern about GM foods among some politicians, public interest groups and consumers, especially in Europe? How has this concern affected the marketing of GM foods in the European Union? What is the state of public debate on GM foods in other regions of the world? Are people's reactions related to the different attitudes to food in various regions of the world? Are there implications for the rights of farmers to own their crops? Why are certain groups concerned about the growing influence of the chemical industry on agriculture? What further developments can be expected in the area of GMOs? What is WHO doing to improve the evaluation of GM foods? Conventional techniques by which humans modify food organisms include selective breeding, plant breeding, animal breeding and somaclonal variation. Genetically modified foods (GM foods, or biotech foods) are foods derived from genetically modified organisms which possess specific changes introduced into their DNA by genetic engineering techniques. Flavr Savr, a genetically modified tomato was the first commercially grown genetically engeneered food to be granted a license for human consumption. It was produced by Californian company Calgene and submitted to the U.S Food and Drag Administration (FDA) in 1992.

Animal products have also been developed, although as of July 2010 none are currently on the market (Holmes 2010). http://en.wikipedia.org/wiki/Genetically_modified_food - cite_note-1. In 2006 (Fiester 2006., Kang JX *et al*. 2007) a pig was engineered to produce omega-3 fatty acids through the expression of around worm gene (Lai et al. (2006). Researchers have also developed a genetically modified breed of pigs that are able to absorb plant phosphorus more efficiently, and as a consequence the phosphorus content of their manure is reduced by as much as 60% (Guelph Transgenic Pig Research Program (2005). Although enveloped, animal products are not currently on the market (Holmes, 2010).

- Genetically modified foods - GM foods or biotech foods safety

Among the key areas of controversy related to genetically engineered (GE) food is food safety. Consumers generally consider that traditional foods (that have often been eaten for thousands of years) are safe. When new foods are developed by natural methods, some of the existing characteristics of foods can be altered, either in a positive or a negative way (Diouf and Sheeran 2010)**.** GMOs' proponents (Ricroch, et al, 2011) note that transgenesis has less impact on the expression of genomes or on protein and metabolite levels than conventional breeding or plant (non-directed) mutagenesis (Ricroch *et al*. 2011)An example of an allergenic plant created using traditional breeding is the kiwi.

Kuiper *et al.* (2002) suggestedthat "The concept of substantial equivalence is an adequate tool in order to identify safety issues related to genetically modified products that have a traditional counterpart". They also noted difficulties in applying this standard in practice, including the fact that traditional foods contain many chemicals that have toxic or carcinogenic effects and that our existing diets therefore have not been proven to be

safe.Millstone *et al*. (1999) argued that all GM foods should have extensive biological, toxicological and immunological tests and that the concept of substantial equivalence based solely on chemical analyzes of the components of a food should be abandoned (Keeler and Lappé 2001), comparing Roundup ready soybean to its unmodified counterpart, noted significantly lower levels of protein than unmodified soybean". Levels of trypsin inhibitor were 27% higher and after toasting lectin was double that found in conventional soybean and both are known allergens. GM soybean also has 29% less holine, a B – complex vitamin **(**Milestone et al, 1999)

Up to date, no adverse health effects caused by GM products approved for sale have been documented, although two products failed initial safety testing and were discontinued, due to allergic reaction (WHO, 2003). Most feeding trials have observed no toxic effects and saw that GM foods were equivalent to unmodified foods. Although there is now broad scientific consensus that GE crops on the market are safe to eat (NRC, 2004) some scientists (Seralini *et al*. 2007) and advocacy groups such as Greenpeace and World Wildlife Fund call for additional and more rigorous testing of existing GM food and for approval of any new introductions of GM food (Le Curieux - Belfond *et al*., 2009).

BT toxin (a protein having insecticidal effects on certain insects, produced by a gene from a soil bacterium *Bacillus thuringiensis*) produced in genetically modified maize, has been subject of the experiment. to evaluate the correlation between maternal and fetal exposure and to determine exposure levels of the pesticides and their metabolites**.** Authors (NCBI ,2011) reported the presence of pesticides associated with GM foods in both non-pregnant women and pregnant women and their fetuses (Poulter, 2012)**.** The paper did not discuss safety implications or find any health problems. Several authors and organizations found paper to be unconvincing (de Weck, 2011, FSANZ, 2011).

There are suggestionsthat GM food might trigger food allergies but in a study by Lehrer and Bannon (2005) results from allergen testing of current GM foods stated that "no biotech proteins in foods have been documented to cause allergic reactions". GM soybean with enriched protein content, intended for animal feed did not reach the market due to it producing an allergic reaction. Investigation of the allergenicity were conducted by company because it was supposed that allergen was transferred unintentionally from the Brazil nut into genetically engineered soybeans, in a bid to improve soybean nutritional quality for animal feed use. Testing included, radio allergosorbent testing, immune blotting, and skin-prick testing. The tests revealed that they produced immune reactions in people with Brazil nut allergies, since the methionine rich protein happened to be a major source of Brazil nut allergy (Nordiee *et al*. 1996).Company discontinued further development of the GM soybean, due to the difficulty in ensuring that none of these soybeans entered the human food chain (Streit *et al*. 2001)

Pest-resistant field pea developed by the Australian CSIRO for use as a pasture crop was shown to cause an allergic reaction in mice.The protein added to the pea did not cause the reaction in humans or mice in isolation, but when it was expressed in the pea, it exhibited a subtly different structure which may have caused the allergic reaction. The immunologist who tested the pea noted that crops need to be evaluated case-by-case (Prescott, 2005). GM - products that failed safety testing can either be viewed as evidence that genetic modification can produce unexpected and dangerous changes in foods, or alternatively that the current tests are effective at identifying any safety problems before foods come on the market, (Key *et al*. 2008)**.**

According to Herman (2003) genetic modification can be used to remove allergens from foods, which may, for example, allow the production of soy products that would pose a smaller risk of food allergies than standard soybeans.This approach has been tried in ryegrass, which produces pollen that is a major cause of hay fever: fertile GM grass was produced that

lacked the main pollen allergen, demonstrating that the production of hypoallergenic grass is also possible (Bhalla et al. 1999)**.**

Flachowsky *et al* (2005) concluded that first-generation genetically modified foods had been found to be similar in nutrition and safety to non-GM foods, but noted that second-generation foods with "significant changes in constituents" would be more difficult to test, and would require further testing. Long term effect of the use of GM food in the human diet is not known and requests multiannual tests to have reliable determination of its safety.

- Testing and regulations of GMO and GM Food

Availability of GM seed for testing is considered by some to be problematic because, due to restrictive end – user agreements, independent researchers cannot obtain GM plants to study. As a result of restrictive access to GMO seed, no truly independent research can be legally conducted on many critical questions regarding the technology" (Stutz, 2010). While recognizing that seed companies' intellectual property rights need to be protected, *Scientific American* called for the restrictions on research in the end-user agreements to be lifted immediately and for the EPA to require, as a condition of approval, that independent researchers have unrestricted access to GM products for testing (The Editors, 2009). GM Free Cymru group argues that governments should use independent studies rather than industry studies to assess crop safety and stated that independently funded researcher, Professor Bela Darvas of Debrecen University was refused Mon 863 Bt corn to use in his studies after previously publishing that a different variety of Monsanto corn was lethal to two Hungarian protected insect species and an insect classified as a rare (Hungary Bans, 2005).

In the regulation of GMOs the most marked differences occurring between the USA and Europe depending on the intended use of the products of the genetic engineering. Determination the safety of a particular GM food in USA regulates several laws (Guide to US Regulation, 2012). Crop not intended for food use is generally not reviewed by authorities responsible for food safety. The main conclusion from the efforts of more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular GMOs, are not per se more risky than e.g. conventional plant breeding technologies." (Acreage NASS, 2010)

When Monsanto was interested for approval in Europe to introduce a rootworm resistant (MON863) maize, Seralini, as member of the committee that reviewed MON863 for the French government, continues to be a critic of toxicity study design (Seralini et al. 2011). Authors noted that "It must be said that very few tests on humans have been carried out up to now". European Food Safety Authority (EFSA) describing the data that Monsanto provided concluded that the observed small numerical decrease in rat kidney weights were not biologically meaningful, and the weights were well within the normal range of kidney weights for control animals. It had no reservations about recommending the authorization of MON863 (Seralini *et al*, 2011). In June 2005 http://en.wikipedia.org/wiki/Genetically_modified_food_controversies_-_cite_note-44 German court released the original study by Monsanto (Statement of Court, 2005).

Conclusion

Results obtained by comparison contribution of conventional and molecular breeding increase demonstrated that still conventional technologies have prestige. Higher molecular breeding contribution has been recorded in undeveloped countries because GM genotypes have higher yield before transformation and usually for the first time have been planted in this part of world. Many scientific groups are investigated GMO – originated foods and almost all agree that there is not drastic difference between food safety between foods produced from

non - GM plant and varieties developed through conventional technology. Several cases when GM – plants have been found as dangerous for environment authors (particularly Monsanto and Pioneer) stopped to sell those materials. Results on negative effect on experimental animals and even several human cases USA- FDA did not find as convincing one. Even there are differences between GM and GMO - food regulations in Europe and USA many countries in Europe started to grow genetically modified plants. Highly processed foods, such as vegetable oils or breakfast cereals, most likely contain some tiny percentage of genetically-modified ingredients because the raw ingredients have been pooled into one processing stream from many different sources. Also, the ubiquity of soybean consumer derivatives as food additives in the modern American diet virtually ensures that all U.S. consumers have been exposed to GM food products. (http://vm.cfsan.fda.gov/%7Elrd/biocon)

Acknowledgement

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WELFARE OF DAIRY CATTLE – TODAY AND TOMORROW

Slavca HRISTOV[1*], Branislav STANKOVIC[1], Nevena MAKSIMOVIC[2]

[1] University of Belgrade, Faculty of Agriculture, Belgrade-Zemun, Serbia,
[2]Institute for Animal Husbandry, Belgrade-Zemun, Serbia
(Corresponfing author: hristovs@agrif.bg.ac.rs)

Abstract

The goal of this review is to discuss the most important issues in the dairy cattle welfare challenges that facing the dairy industry today and tomorrow, namely dairy cattle welfare indicators and standards and the most significant welfare problems, and to illustrate the role of science in addressing these challenges.

It should be noted that producers have always been concerned about the condition of dairy cattle and have tried to ensure that they are healthy and well nourished. In this tradition of the dairy cattle care, good welfare is seen largely as the absence of illness or injury and malnutrition. More recent concerns about dairy cattle welfare have focused on the pain and distress that the cattle might experience as a result of widely accepted management practices, and the possibility that the animals suffer as a result of being kept under apparently inadequate conditions.

The evidence suggests that, whilst improvements to the welfare of dairy cows in the developed and developing countries have been made, we believe that more can and should be done to ensure that a dairy cow has a life worth living. The critical dairy cattle welfare issues relate to the supply of trained, skilled dairy farmers and stockmen, the incidence, prevalence and causes of lameness, mastitis, metabolic diseases, injuries and the infertility rate, though this is not itself a direct measure of welfare, the lack of centralized recording schemes yielding data at the national level, breeding policies for dairy cattle and public surveillance of welfare.

Keywords: *dairy cattle, welfare, indicators, standards*

Introduction

An improved understanding of motivation, cognition and the complexity of animals' behaviour has led in the last 30 years to the rapid development of animal welfare (Broom, 1986; Hristov *et al.,* 2006; Blokhuis, 2008; Fraser, 2008; Broom, 2011, OIE, 2011). That also contributed to an increasing interest among scientists in the field of welfare of dairy cattle (Albright, 1987; Rushen and de Passille, 1998; EFSA, 2009; FAWC, 2009; EFSA, 2012; von Keyserlingk *et al.,* 2009).

It should be noted that producers have always been concerned about the condition of dairy cattle and have tried to ensure that they are healthy and well nourished. In this tradition of the cattle care, good welfare is seen largely as the absence of illness or injury and malnutrition (von Keyserlingk *et al.,* 2009). More recent concerns about dairy cattle welfare have focused on the pain and distress that the animals might experience as a result of widely accepted management practices and the possibility that animals suffer (Fraser, 2008). Over the past decade scientific research expanded on the welfare of cattle to address these issues (Phillips, 2002; Webster, 2005; Broom and Fraser, 2007; Rushen *et al.,* 2008; Grandin, 2010).

The goal of this review is to discuss the most important issues in the dairy cattle welfare challenges facing the dairy industry today and tomorrow, namely dairy cattle welfare indicators, standards and the most significant welfare problems, and to illustrate the role of science in addressing these challenges.

Dairy cattle welfare indicators and standards

Nowadays in the literature several definition of animal welfare and also a range of different type of welfare indicators are described (e.g., Dawkins, 1990; Hristov and Bešlin, 1991; Broom, 1996; Bracke *et al.,* 2001; Webster, 2005; Vu ini , 2006; Broom and Fraser, 2007; Hristov *et al.,* 2007b; Grandin, 2010). The definition of animal welfare is important in assessment of this very important issue mainly from production, public, moral and ethic reasons. Two approaches to definition of animal welfare have been dominating the scientific animal welfare debates: the feeling and coping definition (Hristov and Bešlin, 1991; Duncan, 1996; Vu ini , 2006; Grandin, 2010).

In the previous decade, great importance is given to the various indicators used to assess the welfare of dairy cattle (e.g., Bartussek *et al.,* 2000; Rousing *et al.,* 2000; Capdeville and Veissier, 2001; Fregonesi and Leaver, 2001, Johnsen, 2001; Keeling and Veissier, 2005; Maksimovi and Hristov, 2007; Reli *et al.,* 2008; Hristov *et al.,* 2009; Keeling, 2009; Hristov *et al.* 2010b; Hristov *et al.,* 2011b, Ostoji -Andri *et al.,* 2011). The welfare indicators are divided principally as direct and indirect, whether they take into account the wellbeing of dairy cows and the environment in which they are kept (Huxley and Whay, 2006; Vu ini , 2006; Anon., 2009; EFSA, 2009; Grandin, 2010; EFSA, 2012).

In the papers by Broom (1996, 2011) was emphasized that early attempts to define welfare referred to individuals being in harmony with nature, but the first usable definition incorporated feelings and health as part of attempts to cope with the environment. Most reviews of the welfare now start with listing the needs of the animal, including needs to show certain behaviours (Webster, 2005; Broom and Fraser, 2007; Grandin, 2010). This approach has used sophisticated studies of what is important to animals and has replaced the earlier general guidelines described as the freedoms. Many measures of the welfare are now used and indicate how good or how poor the welfare is (Broom, 2011).

For some time public and consumer pressure for assurance that farm animals are raised humanely has led to a range of private and public animal welfare standards, and for methods to assess compliance with these standards (Hristov *et al.* 2007a; Hristov *et al.,* 2010a; Rushen *et al.,* 2011). The standards need to be validated regarding the definitions of welfare that has broad support and which is amenable to scientific investigation (Hristov *et al.,* 2010a). According to Rushen (2003) concepts of animal welfare have not dealt adequately with the multidimensional nature of animal welfare. Ensuring that such standards acknowledge scientific uncertainty is also challenging, and balanced input from all scientific disciplines dealing with animal welfare is needed. On-farm assessment of animal welfare requires a combination of animal-based measures to assess the actual state of welfare and resource-based measures to identify risk factors (Rushen *et al.,* 2011; EFSA, 2012).

Back in 1987, Albright observed that needed research includes studying learned helplessness of cattle. Alert caretakers are encouraged to read behavior signals of cattle. Increased standing of cattle is often taken now as a sign of discomfort or discontent in studies of cow and calf confinement. Criteria that should be considered in assessing welfare or well-being are behavior, health, musculoskeletal soundness, productivity, physiological and biochemical characteristics, and reproduction.

The paper by von Keyserlingk *et al.* (2009) provides that concerns about the welfare of animals typically include 3 questions: is the animal functioning well (e.g., good health,

productivity, etc.), is the animal feeling well (e.g., absence of pain, etc.), and is the animal able to live according to its nature (e.g., perform natural behaviours)?

In the paper written by Johnsen *et al.* (2001) were described and compared nine methods of assessing the welfare of farm animals at herd level. A distinction is made between two types of welfare parameter: the environmental and the animal-based. The relative weight of these parameters, together with variation in their measurability, explains many of the differences between the methods with which the paper is concerned.

The paper of Hristov *et al.* (2012, *in press*) scrutinized the most important group of welfare indicators that are based on an assessment of the current state of the welfare of dairy cows on farms with detailed consideration of their behavior, health, physiology, performance and disease resistance. In addition, the paper describes the indicators for the evaluation of welfare of dairy cows to observe a way of managing the farm and specific interactions between animals and housing systems. Several systems of welfare quality evaluation of dairy cattle are in use during last decade as Animal Need Index (Bartussek *et al.,* 2000), the related TGI200 in Germany (Sundrum *et al.,* 1994), the ethical account in Denmark (Sorensen *et al.,* 2001), Freedom Food schemes in the United Kingdom (FAWC (1993)), specific tools for dairy cows in France (Capdeville and Veissier, 2001) and Italy (Tosi *et al.,* 2001), assessment protocol for cattle which is developed within Welfare quality® project (2009) and finally the system of welfare indicatorswhichwas developed in Serbia within the national project TR 20110: Development and implementation of welfare and biosecurity standards to improve the technology of cattle and pigs production (Anon., 2011).

In the paper of Rushen (2003) were discussed some of the major conceptual and methodological problems that have arisen in attempts to assess the relative levels of farm animal welfare in different housing systems. In some cases these problems arise because applied research has not kept pace with more fundamental research.

The most significant welfare problems in dairy cattle

Given a natural healthy life, cows can live for twenty years or more. However, high yielding dairy cows are usually culled after three lactations, because they are chronically lame or infertile (EFSA, 2009; von Keyserlingk *et al.,* 2009; EFSA, 2012). Mastitis is also very important cause. It is well known that there are a large number of bacteria, both contagious and environmental, that are capable of causing mastitis. In some countries, records of the incidence of clinical and subclinical mastitis for individual cows are collected regularly as part of disease surveillance. Examples of other endemic diseases that may lead to premature culling of dairy cattle are tuberculosis, bovine viral diarrhoea, infectious bovine rhinotracheitis, leptospirosis and Johne's disease, although some of these can be controlled by vaccination. Metabolic diseases of dairy cows are important in terms of lost production and poor welfare and include ketosis, milk fever, left displaced abomasum and acidosis. Many other causes as overproduction of milk, restrictive housing systems, poor nutrition, and physical disorders impair the animals' welfare in industrial dairy operations. In their fragile end-of-production state, handling, transport, and slaughter raise additional welfare concerns (FAWC, 2009; EFSA, 2009; 2012).

It is well known fact that cows kept indoors have less opportunity to act naturally and exercise. Very often poor ventilation and high humidity increase the risk and spread of infection. Hard concrete flooring can cause foot damage and is more painful for lame cows to stand and walk on. Also, zero-grazing systems have been linked to increased lameness. Some herds are kept on concrete floors with inadequate bedding. These are uncomfortable for the cows to walk, stand or lie down on. Management and nutritional factors can have a large effect, often obscuring the influence of housing. The behavior of the cow, particularly time

spent lying or standing, can influence the likelihood of lameness. The diet of high yielding cows often has relatively little fibrous content and is inappropriate for their type of digestive system. This can lead to acidosis and painful lameness from laminitis (von Keyserlingk *et al.,* 2009; Hristov *et al.,* 2011; de Vries *et al.,* 2011; Shearer and van Amstel, 2011).

In commercial dairy farming, nearly all calves are taken away from their mother shortly after birth. This causes severe distress to both the cow and the calf and has long-term effects on the calf's physical and social development. The most significant welfare problems in dairy calves in intensive rearing conditions have been investigated in the paper by Hristov *et al.* (2011). These problems mainly result from inadequate intake of colostrum (separation from the mother), inadequate ventilation (resulting in inappropriate airflow, low or high temperatures, high humidity and poor air quality), poor floor conditions (wet floor, without bedding), inadequate monitoring of health, exposure to pathogens causing respiratory and gastrointestinal disorders and occurrence of iron deficiency. In addition, on cattle farms in our country welfare problems in calves originate from continuous restocking (no "all in - all out") and mixing calves from different sources, as well as insufficiently balanced solid food, insufficient access to water and generally poor response of farmer to health problems, especially necessary dietary changes. A special welfare problem is insufficient floor space allowance which results in calf's discomfort.

In the EFSA reports (2009; 2012) and opinion of FAWC (2009) was suggested that nearly all diseases affect the welfare of dairy cows to some degree. In recent decades, a marked increase has occurred in the incidence of various production diseases in dairy cattle of which lameness is the most prevalent. Lameness continues to be a common problem across many types of housing. Lameness of dairy cattle is a very visible well-being issue as well as a production and economic issue. In the paper of Hristov et al. (2011) analysed the most significant predisposing factors and causes of lameness of dairy cows. It is considered that lameness is related to the genetics of the animal, housing and nutrition. High levels of production do not necessarily lead to increased lameness, although genetic correlations between levels of production and the incidence of lameness suggest that continued high selection for milk production will likely exacerbate the problem.

Unsuitable designs of cubicles are commonly implicated in hock, back and hook bone lesions; feed barrier design and access to feed are implicated in neck and shoulder calluses. Risk factors for the more severe injuries associated with slipping and falling include the floor surface, loafing space/overcrowding, shed design (cow flow), poor stockmanship, social group size, care of high risk, recently-calved animals in the herd and bulling cows. The common injuries to dairy cows are hock abrasions and swollen hocks, neck calluses, calluses on the back, injuries of the hook bone and skeletal injuries after slipping, e.g. fractured or dislocated hips (Regula et al., 2004, EFSA, 2009; FAWC, 2009; EFSA,2012).

Recent research has shown that body condition affects both health and fertility. The cow with high genetic merit for milk production produces more milk partly because of a greater propensity for losing body condition to support milk production. This leads to a greater negative energy balance in early lactation, with more rapid loss and a slower recovery of body condition that, in turn, affects her ability to conceive. The immune resistance of high yielding cows in negative energy balance during early lactation is weak, raising susceptibility to some diseases. Cows of high genetic merit for milk production need a high level of management to ensure good nutrition, avoid extremes of body tissue loss and hence be fertile (EFSA, 2009; FAWC, 2009; Roche *et al.,* 2009; EFSA, 2012).

Infertility among high yielding dairy cows is linked to stress, poor body condition and the demands of high milk production on the cow's general health. Infertility is also influenced by concurrent disease, such as lameness and mastitis. Inappropriate phenotype for the system, poor management, inadequate feeding, breeding immature heifers and using inappropriate

bulls that exacerbate dystocia, all contribute to infertility. Management of the dry cow is also critical to fertility, particularly to ensure that cow is neither too thin nor too fat at calving. Appropriate nutrition is clearly important to avoid metabolic diseases. In addition, observing cows for heat and timing of insemination is crucial to good management (EFSA, 2009; FAWC, 2009; EFSA, 2012).

Good stockmanship is the key to good welfare and the quality of stockmanship is critical to the management of high yielding dairy cows. Sound education and up-to-date training of dairy farmers and stockmen are essential to promote and maintain good welfare in dairy herds (Hristov et al., 2010a).

When dairy cows come to the end of their productive life, they may be transported long distances to be slaughtered. The effects of land transport on animal welfare are described by Broom (2005). Animal welfare during and as a result of transport can be assessed by using a range of behavioural, physiological, pathological and carcass-quality indicators that are described in this paper. Measures of the extent of any disease, injury or mortality resulting from, or exacerbated by, transport are important because health is an important part of welfare. Factors affecting the welfare of animals before, during and after transport mainly related to: definition of the staff responsibilities and competence, attitudes to animals and need for training of staff, planning of journeys and methods of payment of staff, laws and retailers' codes, genetics, especially selection for high productivity, rearing conditions and experience, the mixing of animals from different social groups, handling and loading procedures, driving methods, space allowance and increased disease susceptibility and spread of disease.

Animal health, the most important aspect of their welfare, has vastly improved, as has the care of sick or injured animals. At the same time, the latest amenities used in livestock rearing, transport and slaughter are helping to eliminate situations involving extreme stress and suffering (Seng and Laporte, 2005).

Conclusion

On the bases of literature data about welfare of dairy cattle – today and tomorrow and experience of authors could be concluded:

- Dairy cattle health, the most important aspect of their welfare, has vastly improved, as has the care of sick or injured animals. At the same time, the latest amenities used in livestock rearing, transport and slaughter are helping to eliminate situations involving extreme stress and suffering;
- The evidence suggests that, whilst improvements to the welfare of dairy cows in the developed and developing countries have been made more can and should be done to ensure that a dairy cow has a life worth living;
- The critical dairy cattle welfare issues mainly relate to the incidence, prevalence and causes of lameness, mastitis, metabolic diseases, injuries, infertility overproduction of milk, restrictive housing systems, poor nutrition, and physical disorders impair the welfare of the animals in industrial dairy operations.

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A SYSTEMS APPROACH TO RURAL DEVELOPMENT IN SERBIA: RESULTS OF A BASELINE SURVEY ON THE COMMUNITY

Steve QUARRIE[1*], Aca MILOSEVIC[2], Richard SIMMONS[3]

[1]School of Biology, Newcastle University, United Kingdom (UK)
[2]Elementary School "Velizar Stankovi Korcagin", Veliki Šiljegovac, Serbia
[3]School of Applied Social Science, University of Stirling, UK
(Corresponding author: steve.quarrie@gmail.com)

Abstract

Sustainable rural development requires increased economic productivity and the social development of communities. Economic productivity can be increased in a number of ways: 1) improving quality of existing production, 2) improving quantity of existing production, 3) improving reliability of supply to the market, 4) developing added-value products, 5) diversifying into new types of production, and/or 6) diversifying into new economic sectors. Traditional approaches to rural development have tended to focus on one or the other. We propose a holistic perspective where economic and social development work together to strengthen rural communities. To support this, a systems approach is taken, where targeting individual sectors within a community is integrated into a strategy to build on existing social capital and develop improved interaction and co-operation to support both social and economic growth.

For this combined strategy to work, we need a clear initial picture of a community's existing strengths, weaknesses, opportunities and threats. This establishes a baseline of information, not only on conventional economic indicators, but also of social capital indicators such as levels of trust, existing willingness to cooperate, social problem areas, traditional community culture, etc.We recently completed a baseline survey of the community of Boljevac, in Kruševac municipality, located on the slopes of Jastrebac mountain in southern Serbia. The community is fortunate in still having a village school where the local schoolteacher, Aca Miloševi , has been playing the role of community development officer, in addition to his teaching duties. In consequence, the survey showed high levels of trust within the community, and considerable willingness to cooperate and share resources, skills, labour. The survey also identified in several households a willingness to innovate and develop new economic activities.

Thus the scene is set for discussing with the community specific opportunities to improve its economic productivity, while at the same time cultivating improved trust and cooperation amongst community members. This holistic perspective is essential if increased economic productivity is to lead to the increased economic cooperation required to generate better buying power, exploit new markets, etc.

Keywords: *rural development, systems approach, economy, social capital, cooperation*

Introduction

Drift of population from rural to urban areas is a centuries-old global phenomenon. Serbia has not escaped this phenomenon, having experienced a shift from over 79% rural population (settlements <10,000 inhabitants) in 1948 to only 45.9% rural population at the 2011 population census (Anon 2004, 2011). During this period the capital city Belgrade, for example, grew from only 630,000 (11% total population) to over 1,630,000 (23% total

population) (Anon 2004, 2011). The causes of rural depopulation are many, including expectations of gaining a better job; a better standard of living; to attend school; a desire for technology; or a desire to experience the better amenities that an urban environment can offer.

This drift from rural communities to the urban centres results not only in the breakdown of rural social networks and an impact on rural economic productivity if land is abandoned, but pressure on the infrastructure and social services of urban areas to which the population migrates. The financial implications of this population drift for local authority budgets are considerable. Thus, the experience of Kruševac municipality in southern Serbia is typical: "The biggest problems facing Kruševac are: unemployment, environment and lack of spaces in the pre-school institution 'Nata Veljkovi ', stated during the interview, and the priorities currently engaging the management of the City are: water supply, modernization of schools, streets and roads, and ...' (Anon 2010). Kruševac spends 20% of its budget (*ca.* €6 million) on buildings, maintenance, supplying heating and water (Anon 2012).

Sustainable rural development, through increasing the productivity and social development of rural communities, serves the dual purpose of raising the economic contribution of rural areas to the wealth of the region and reducing the pressures of migration on urban centres by improving the quality of life of rural communities. Economic productivity can be increased in a number of ways: 1) improving the quality of existing production, 2) improving the quantity of existing production, 3) improving the reliability of supply to the market, 4) developing added-value products, 5) diversifying into new types of production, and/or 6) diversifying into new economic sectors.

Social development builds community assets, social capital, co-operation and democratic involvement. Traditional approaches to rural development have tended to focus on individual sectors, such as agriculture or tourism (e.g. Mihajlov and Petrovi 2011, Hristov and Siv ev 2007, UNDP 2009). Strategic plans for rural areas also tend to take a piece-meal approach. Thus, Bogdanov and UNDP-funded coworkers (Bogdanov 2007) established that problems of the young in rural areas were generally inadequately treatedin municipality strategic plans. Municipalities whose programmes included alleviating problems of the young in rural areas usually addressed them through educational programmes related only to agriculture. Further, the position of women in local communities was not frequently considered in municipal strategic plans (only 35% of municipalities).

To overcome the limitations of targeting specific sectors of the rural economy, we propose a holistic perspective where economic and social development work together to strengthen rural communities. To support this, a systems approach is taken. Intensive development at the level of a small village is linked to the wider economic system – other surrounding villages, nearby major city markets, strategic commercial actors and so on. This intensive development takes a 'matrix pattern'. One aspect targetsimproved productivity through technical help in carefully specified economicactivities. This is integrated into a strategy to build on existing social capital and develop improved interaction and cooperation to support both social and economic growth.

An essential first step in implementing this strategy for a rural community is to establish a baseline upon which to build; namely a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This will identify the community's existing social capital upon which ideas to develop further the community's economy and social capital can be built, facilitated by expert support and guidance, akin to the neo-endogenous approach to rural development proposed by Ward et al. (2005), and references cited therein.

Thus, here we present a preliminary report on results of a baseline survey of aspects of social capital of a rural community, focusing on establishing the community's existing levels of trust and cooperation; essential factors determining the community's capacity to make progress.

Material and methods

The rural community at the centre of our research is Boljevac, one of seven settlements making up the parish of Ribare in Kruševac municipality. The village is located on the south-eastern flank of Jastrebac mountain at an altitude of 660-700 m, at the end of a badly-worn Macadam road 3 km from the main asphalt road to Kruševac. According to preliminary results from the 2011 population census (Anon, 2011), the village has 125 inhabitants distributed amongst 43 households. The community is typical of much of rural Serbia, with most families carrying out largely subsistence farming, and a few with employment outside the village.

Although the village has no public transport, shop or local amenity, it still has a village school providing education for the first four years. The village schoolteacher, Aca Miloševi , in addition to his formal role as schoolteacher, has also acted as an unofficial community development worker during the five years since he started teaching at the school (Petrovi , 2011). In consequence, many in the community are already motivated to improve themselves and their lives in the village.

A questionnaire was put together on the basis of questions provided by a group of experts and motivated individuals who were interested in helping Boljevac to develop. They had expertise in:

- agricultural production,
- food processing,
- tourism,
- agricultural pollution control,
- small-scale energy production,
- market economics,
- product branding,
- entrepreneurship and book-keeping,
- rural economics,
- ethnology and
- community cooperation.

In this way, we would get a broad picture of the village's social capital and its strengths, weaknesses, opportunities and threats in many sectors potentially of interest, apart from aspects of agriculture. The questionnaire had over 370 questions, divided into the section headings shown in Table 1.

Table 1. Section headings of the questionnaire. Headings in bold indicate questions for which results are presented here.

Section heading	Questions
You and your family	**4-10**
You and your community	**11-38**
Membership of associations, clubs, etc	**39-52**
How far and often do you travel?	**53-60**
Who do you trust?	**61-76**
Your household assets, services, support	**77-101**
Your use of land	102-117
Your crop production	118-195
Your food production	196-202
Your animal production	203-231
Your selling and marketing challenges	232-240
Your other sources of income	241-248
Your farm production and household costs	249-274
Your agricultural support services	275-279
Your level of cooperation	**280-337**
Borrowing and saving money	338-344
Your views on tourism	345-366
Your thoughts on the future	367-372

To speed up the process of interviewing villagers, show cards were prepared for groups of questions, so that respondents could just point at the most appropriate answer on the show card, which would then be recorded by the interviewer on the questionnaire. The questionnaire was prepared and formatted in English and then translated into Serbian.

Two post-graduate (diploma) students were given instructions on how to conduct the interviews, which took place during one week in late October/early November 2011, and every household in Boljevac was visited. The interviewers stayed in a house in Boljevac that had previously provided accommodation for visitors. The village schoolteacher had informed some of the villagers of the questionnaire shortly before the interviewers arrived, though many households were not previously aware that interviewers would call.

Completed questionnaires were transcribed into both SPSS (for detailed quantitative and qualitative analyses, to be reported elsewhere), and Excel (Microsoft, Version 2004 for Mac) for the analyses presented here.

Results and discussion

The survey process

Of the 43 households in the village, 34 agreed and six declined to take part in the questionnaire (85% return), and three households were absent during the time of the survey. The respondent was usually head of the household (25/34 households), with the remainder being either wife or son of the head of the household. The process was completed quicker than expected because many respondents had no idea of the answers for many questions, in particular about agriculture - no idea how big their fields were, no idea what their crop yields were, no idea what prices they got, and so on - they seemed in many cases to live a very hand-to-mouth existence. They knew which fields were theirs and they could see how big they were, but it wasn't important to know how many ha/ares they were! No-one kept any farm records of anything; not surprising as most of the adults were known to be functionally illiterate!

One student interviewer found it easier to communicate with respondents than the other, as people in Boljevac had met her on a previous visit and had more trust in her. A few people were reluctant to give answers because they feared they were officials from the council or some other mistrusted organisation. One person didn't want to answer the questionnaire because he works for a local influential politician. Although most of the time the male head of the household gave the answers, often the women knew more about their agricultural production than the men!

Although show cards had been prepared for each batch of questions, these were rarely used, partly because it saved time to go through the choices of answer verbally, and partly because all the information on show cards had been typed in Latin Serbian, whereas the villagers, especially those who left school early in their education, were more used to reading Cyrillic Serbian! On other occasions the wording of some of the questions was difficult for them to understand.

Many respondents were very happy to spend the time going through all the questions, but a sizeable proportion thought it was rather long and were clearly impatient to get to the end. Many were also reluctant to give answers because of lack of trust. One person initially said 'No' the first day (lack of trust and not lack of time), but then a day later said 'OK' and agreed to answer the questions.

During the interviewing process the two interviewers got the impression that the village was divided amongst those who got on well with each other and a (probably smaller) proportion who didn't get on well with each other, and were mistrusting. These impressions were reflected in answers to many of the questions on trust and cooperation (see below).

On a technical note, the questionnaire demonstrated a widespread lack of information amongst the people of Boljevac on aspects of agriculture, no doubt in part associated with functional illiteracy amongst most adults. Therefore, future activities in Boljevac should include opportunities for the villagers to improve their reading and writing skills. The challenge of reading and understanding information using the Latin as opposed to the Cyrillic Serbian alphabet needs to be taken into account not only for our future activities within the Boljevac development project but because it has much wider implications for projects on rural development in general. For international aid projects in particular, the Latin alphabet is more generally used for documentation (leaflets and brochures) for project stakeholders, which would include subsistence farmers (V Jovanovi , personal communication).

Selected findings from the questionnaire

Population structure is shown in Figure 1. Of the 109 people recorded, half were over 48 years old, and the number of children of school age, at 18.3% (20/109), was exactly average for a village of its size in rural Serbia (Anon, 2003). The continued supply of children reaching school age each year explains why the village still has a functioning school, teaching years 1 to 4 of basic schooling. Although the number of children at school is currently only six, the school roll has shown no significant trend during the last 18 years, fluctuating between six and nine (A Miloševi , personal communication).

Nine households had a family member with a job outside the village. No respondents were planning to move from Boljevac and only three respondents had children who were planning to move from the village. So, the population of the village is likely to be stable for the next few years, which is an encouraging sign. Membership of associations and clubs was not high, being essentially limited to political parties (9 respondents), trade unions (syndicates) (4), and sports clubs (3). Although nearly everyone visited the centre of the parish (Ribare) at least once a month, one third of households had never visited Belgrade and only one person had ever been out of Serbia.

Household assets painted a general picture of poverty in the community. Nearly two thirds of households (21/34) either owned or had access to a car, though tractor is the most frequent form of transport. Twelve households had no bathroom or toilet; only five households had a computer of some sort; only 21 households had a vacuum cleaner and no-one in the village had air conditioning, even though summer temperatures reach 40˚C. The only service that was regarded as good in the village was access to water (30/34 scored this very good), which comes from a local spring and is piped by gravity around the village. Housing, health care, dental care, education and bus services were generally considered to be either OK (housing and education), poor (health and dental care), or very poor (bus transport) - not surprising considering that the nearest bus stop is 3 km from most of the village, along unlit cart tracks. Despite the generally worse-than-average picture in these quality of life data, 71% of respondents assessed their personal life as being better than the life of their parents, 21% assessed this as the same and only 9% as worse.

Achieving sustainability in rural development for the community will be determined largely by the extent to which individuals are able to develop effective and long-term cooperation of various types, both amongst the inhabitants of Boljevac itself and with people from neighbouring communities, particularly those in the six other settlements making up the parish of Ribare. However, effective cooperation needs trust. Therefore, several questions in the questionnaire probed aspects of trust (Figures 2a,b) as well as aspects of cooperation (Table 2, Figure 3).

It was clear that most people in Boljevac put high trust in their family members and relatives, with 76% of respondents saying they could trust all family members and relatives (Figure 2a), though 21% said they could trust only some of their family and relatives. As would be expected, levels of trust decreased the further away respondents got from family relationships. Only 25% trusted all of their friends; only 21% trusted all their neighbours, and levels of trust in people they did not know well from outside Boljevac were much lower (only 6-12% respondents choosing 'All'). Consequently, the choice 'None' gained the highest score for people they did not know well from other nationalities (79%), and the frequency of 'None' gradually reduced the nearer they got to family relationships. Even so, two respondents said they couldn't trust any of their friends, and five said they had no trust in any of their neighbours.

Regarding the level of trust of representatives of different categories of official and profession (Figure 2b), members of political parties commanded the least trust (32/33 respondents choosing either 'Some' or 'None'). Note that four respondents who were members of political parties said they had no trust in members of any political party! Lack of trust in political parties was closely followed by members of state government (30/33 choosing 'Some' or 'None'), then private companies (28/32) and local government (27/33). In contrast, responses were the other way round for members of professions, with schoolteachers having very high levels of trust (27/33 respondents choosing 'All' or 'Most'), then doctors and priests with reasonably high levels of trust (22/33 for both). Only two respondents did not trust any schoolteacher, five didn't trust any doctors, though, interestingly, seven (21%) did not trust any priests!

Questions on cooperation were divided into existing cooperation within Boljevac and with neighbouring villages, and future intentions on cooperation within Boljevac and with neighbouring villages. Results from these questions are summarised in Table 2. Currently around two thirds of people in Boljevac (68%) already cooperate with others in the village, and 21% are cooperating in some way with people in other local villages. Most popular forms of cooperation with others in Boljevac were supply of mechanical/machinery services (20 respondents), supply of animal feed (18), supply of agricultural labour (15) and supply of artificial fertilisers (12). In addition to these four types of cooperation (either 3 or 4

respondents), cooperation with people outside Boljevac included supply of seeds (3), sales of crops (3) and sales of livestock (3).

Interestingly, four respondents who were currently cooperating with others in Boljevac were not planning to continue this cooperation, though others not cooperating in the village at the moment planned to do so in the future, resulting in very little change overall in the proportion of people planning to cooperate within Boljevac in the future (65%). However, many more people from Boljevac were planning to cooperate with others in local villages in the future (53%). These planned increases in outside cooperation targeted supply of mechanical/ machinery services (8), supply of agricultural labour (6), sales of milk (5), fruit and vegetables (5), as well as food products (4). Food products were evidently seen by several respondents as a potential growth area, requiring cooperation both within and beyond the village.

Table 2. Questions relating to cooperation of villagers with others in Boljevac and in neighbouring villages.

Question	Yes	No
Do you co-operate with other households in Boljevac on agricultural issues?	23	11
Do you co-operate with people in other local villages on agricultural issues?	7	26
Do you intend to co-operate more with other households in Boljevac in the future?	22	12
Do you intend to co-operate more with people in other local villages in the future?	17	15

When asked for their general views on cooperation (given free choice to say what they wanted), replies could be categorized into four types of response: they thought cooperation was a bad thing or unnecessary, they fondly remembered the former cooperative (that collapsed around 10 years ago) and wanted something like that back again, they thought cooperation was generally a good thing or useful, they thought cooperation was essential or very good. Frequencies for these four categories of response are shown in Figure 3. Only three respondents thought that cooperation was either not necessary or bad. Thus, overall, 91% (31/34) considered that some sort of cooperation would be useful, either as a cooperative like the former Ribare cooperative, or some other form of association with others in Boljevac and/or neighbouring villages. This result gives considerable encouragement for providing the village with a better future.

Respondents were also given a free choice to suggest any type of training that they would like to receive in the future, both to improve existing skills and to introduce new skills. Two thirds of households (23/34) suggested at least one type of training, including six households already in their 60s or above. Of those households not interested in training, seven were in their 60s or above and only one household specifically stated that no training courses were needed. The most popular types of courses were on aspects of agricultural production (crops, soft fruit and animal and milk production, irrigation and soil conservation), with five households specifically requesting training in aspects of food processing, and one household requesting advice on tourism. This indicates a very high level of interest amongst the younger households (over 80%) in improving themselves and their future economic prospects.

Conclusions

The data collected from our Boljevac questionnaire have provided a detailed picture of a small village community, which would be typical of many in rural Serbia. While their quality of life in terms of assets and incomes is inevitably below average for the country as a whole, the fact that the large majority of families is content to stay in Boljevac indicates that quality of life means more to them than just tangible assets and money. Several respondents who have jobs outside the village said they enjoy life in the village because there they can

relax, enjoy the clean environment and peace and quiet. Nevertheless, there was universal complaint about the absence of an asphalt road to the village.

Improving the quality of life standards will inevitably need improvements in the economic productivity of the community. As explained earlier, this may be achieved through one or more of the following mechanisms: 1) improving the quality of existing production (to get higher prices per unit sold), 2) improving the quantity of existing production (to sell more at the same price), 3) improving reliability of supply to the market (to encourage buyers to pay a premium), 4) developing added value products (to get much higher prices than selling unprocessed goods), 5) diversifying into new types of production (to sell new crops for which there is high market demand), and/or 6) diversifying into new economic sectors (to get additional income from tourism, or small-scale energy generation, for example).

Training of one sort or another, working alongside the villagers on a regular basis, will provide opportunities for them to make progress in one or other of these six areas of economic development. However, although outside expert support for Boljevac is needed to ensure that the community builds on its existing strengths and interests, future development work should be undertaken with caution, as intensive development of the village could lead it to lose the very character and appeal that its inhabitants cherish at present. The ambitions of the villagers seem modest, and this needs to be recognised by those who seek to help the village to develop sympathetically and sustainably.

To achieve any of these developments will require cooperation of some sort to a greater or lesser extent, maybe initially to pool resources in some form of informal association, which might lead eventually, if the market conditions are appropriate, to a new cooperative focusing on one or other products the village has to offer, creating a 'Boljevac' brand. It is clear that the existing level of cooperation of households is high. Evidently the groundwork in community development laid during the previous five years by Aca Miloševi , as the village schoolteacher in Boljevac, has had an impact on people's willingness to do something (as evidenced by the high level of interest in training courses), and to cooperate to improve the village's economic future.

Thus, for our systems approach to rural development to be implemented successfully in other rural communities around Serbia, an essential starting point will be the existence within the community of a willingness to doing something for itself and an existing high level of cooperation with others; i.e. initial groundwork in community development needs to be carried out by someone in the community who commands a widespread high level of trust and respect, like the village schoolteacher, as an essential prerequisite for any project on rural development to have sustainability beyond the end of the project.

As a footnote to this research, following publicity for Boljevac on local and national media during the past two years, an investor has recently bought land on the edge of the village with the intention of setting up a fish farm, and providing accommodation for tourists. The new government of Kruševac municipality has also agreed to provide funds to make a start on building a road to Boljevac in 2013. Thus, the efforts of the village schoolteacher to motivate the community and to publicise Boljevac are beginning to bring tangible rewards.

Acknowledgements

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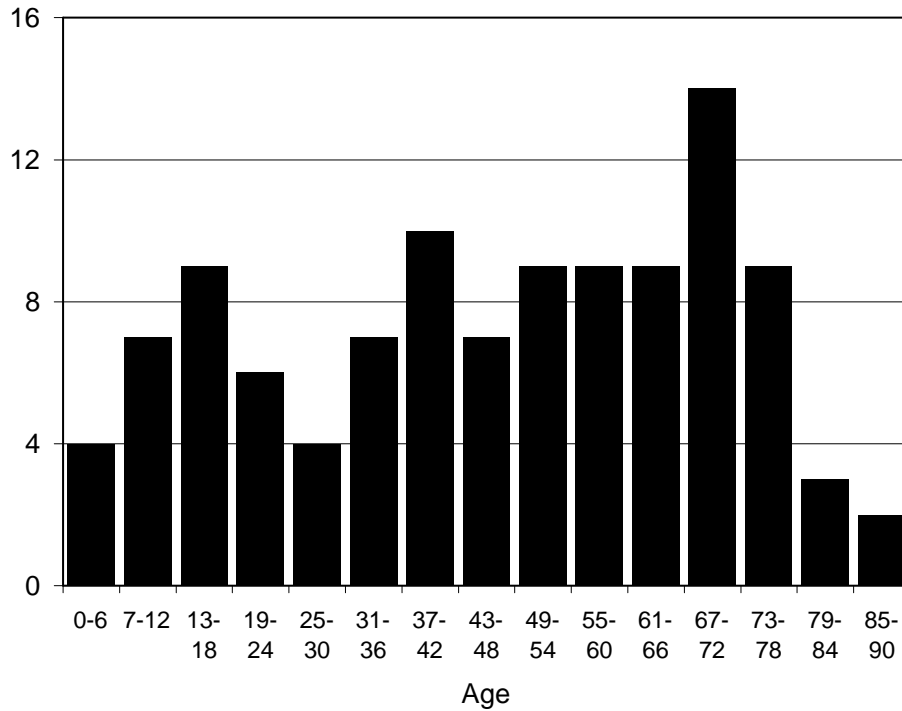
Figure 1. Frequency distribution of population in Boljevac.
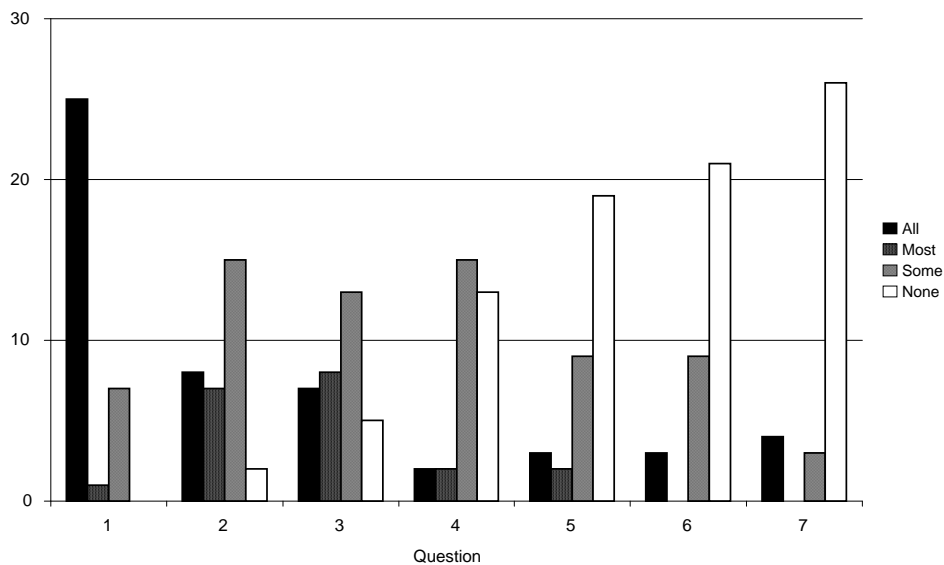
Figure 2a. Frequency distribution of level of trust in different categories of people. Answers to the following question - Everybody has different opinions about different groups of people. Please tell me if you think you can trust: All, Most, Some, or None of the people in the following groups:

Question number:
1 - Family and relatives
2 - Friends
3 - Neighbours
4 - People you do not know well from other local villages
5 - People you do not know well from nearby cities such as Kruševac
6 - People you do not know well from Belgrade
7 - People you do not know well from other nationalities
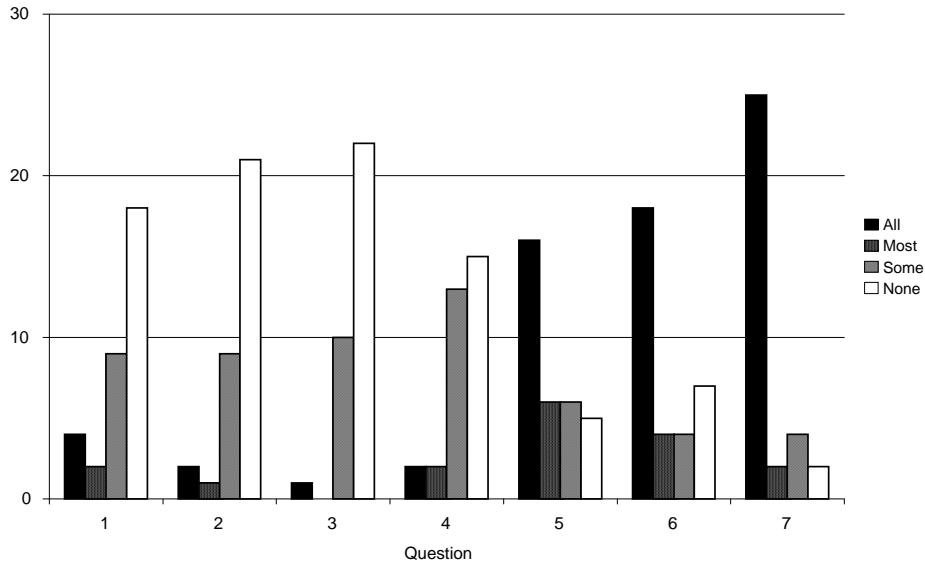
Figure 2b. Frequency distribution of level of trust in different categories of people. Answers to the following question - And do you think you can trust: All, Most, Some, or None of the people in the following groups:

Question number:
1 - Local government officials
2 - State government officials
3 - Political parties
4 - Private companies
5 - Doctors
6 - Priests
7 –Schoolteachers
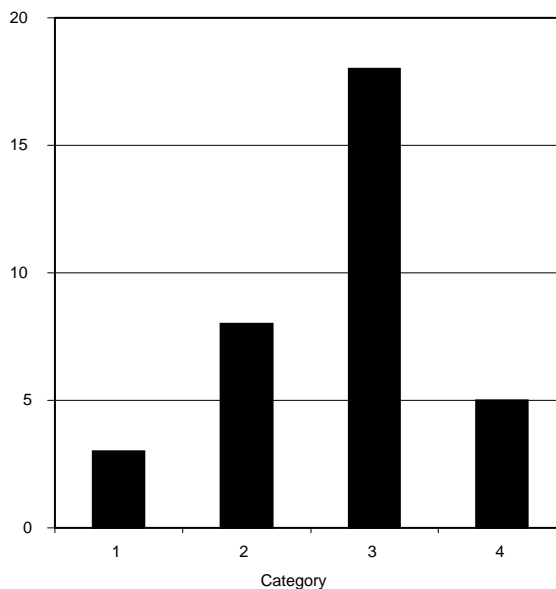
Figure 3. Frequency distribution of respondents' opinion about cooperation in general.

Category number:
1 - Negative views on cooperation
2 - They want the former cooperative to come back
3 - Positive views on cooperation
4 - Very positive views on cooperation

FOOD ENVIRONMENTAL SUSTAINABILITY IN BOSNIA, ITALY AND SERBIA: WATER, ECOLOGICAL AND CARBON FOOTPRINTS

Roberto CAPONE[1], Hamid EL BILALI[1*], Philipp DEBS[1], Fabio LORUSSO[2], Sinisa BERJAN[3]

[1]Department of Sustainable Agriculture, Food and Rural Development; Mediterranean Agronomic Institute of Bari; International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM); Bari, Italy
[2]Faculty of Agriculture, University of Bari; Bari, Italy.
[3]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska,, Bosnia and Herzegovina
(Corresponding author: elbilali@iamb.it)

Abstract

Fundamental changes in food consumption and production patterns are indispensable for achieving sustainable development. The paper aims at analysing food production and consumption environmental sustainability in Bosnia, Italy and Serbia by comparing the water, ecological and carbon footprints.The paper is mainly based on secondary data from different sources: FAOSTAT; Water Footprint Network; Global Footprint Network; etc. FAO food balance sheets data were used to characterise the food consumption patterns in Bosnia, Italy and Serbia. The water footprint of food consumption in each country was calculated using water footprints per commodity. All the three countries have an ecological deficit. Carbon footprint is higher in Italy than in Serbia and Bosnia (1.17 gha/capita/yr). Water saving in Italy is higher than in Bosnia (1,890 Mm^3/year) and Serbia. Total food supply in Italy is much higher than in Bosnia (3082 kcal/capita/day) and Serbia. The share of plant-based energy in the diet is higher in Bosnia (84.7%) with respect to Italy and Serbia. Water footprints of food supply are similar in Bosnia (1849.70 Mm^3/capita/year) and Italy but lower than in Serbia. Water footprint of a Bosnian citizen is 0.08% higher than an Italian one and 22.86% lower than that of a Serbian. The highest water footprint is the green one. Meat and dairy products represent more than a half of the water footprint. Adoption of more sustainable food consumption and production patterns can bring about not only significant human health benefits but also reduce the food consumption environmental footprints on natural resources especially water.

Key words: *Food; footprint; Bosnia; Italy; Serbia.*

Introduction

The participants to the United Nations Conference on Sustainable Development (Rio+20) recognized that fundamental changes in the way societies consume and produce are indispensable for achieving global sustainable development. Therefore, they recalled the commitments made in the Rio Declaration on Environment and Development, Agenda 21 and the Johannesburg Plan of Implementation and adopted the 10-year framework of programmes on sustainable consumption and production (United Nations, 2012).

There is growing evidence on the impact of diet on health, including increased risk of obesity, cardiovascular diseases and cancers, and also of its role as a social indicator (Reddy *et al*., 2009). However, sustainability of food systems and consumption patterns is about more than health concerns as it regards also environmental impacts. Agriculture is the largest single source of greenhouse gas emissions in the food chain (Carlsson-Kanyama, 1998). Diets are a

significant factor in a number of critical sustainability issues such as climate change; public health; social inequality; biodiversity; energy, land and water use; etc. (Reddy *et al*., 2009).

Many studies provided a strong evidence for a beneficial effect of higher conformity with the Mediterranean dietary pattern on risk of death from all causes, including cardiovascular diseases and cancers (Giugliano and Esposito, 2008). In the Mediterranean region, there have been unprecedented changes in lifestyles and food consumption patterns during the past few decades. Diet change is the result of the dual phenomenon of the spread of the English-speaking countries dietary model and of globalization (Padilla, 2008). The adhesion to the Mediterranean Diet (MD) by getting the food proportions and composition defined in the new Mediterranean Diet pyramid can not only influence human health but also the environment (Sáez Almendros *et al*., 2012).

The paper aims at analysing food environmental sustainability in Bosnia, Italy and Serbia by comparing the water, ecological and carbon footprints.

Material and methods

The paper is mainly based on secondary data from different sources: FAOSTAT Food Balance Sheets; Water Footprint Network; Global Footprint Network; etc. The current Bosnian, Italian and Serbian food consumption patterns were characterised using data from the FAO food balance sheets 2006 (FAOSTAT, 2010). In this paper, three environmental footprints have been taken into consideration *i.e.* Ecological Footprint (EF), Carbon Footprint (CF) and Water Footprint (WF).

The EF on a national scale was fully explained by Ewing *et al.* (2010, 2010b). The EF measures appropriated biocapacity, expressed in global average bioproductive hectares, across six major land use types (*i.e.* cropland, grazing land, fishing grounds, forest land, carbon footprint, and built-up land). The EF methodology uses a consumer-based approach; for each land use type. The EF of consumption (EFC) is thus calculated as: *EFC=EFP+EFI-EFE; where: EFP is the EF of production; EFI and EFE are the ecological footprints embodied in imported and exported commodity flows, respectively.*Biocapacity refers to the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans (GFN, 2011).

The CF is a measure of the exclusive total amount of CO_2 emission that's directly and indirectly caused by an activity or is accumulated over the life stages of a product (Wiedmann and Minx, 2008). The carbon Footprint is calculated as the amount of forest land required to absorb given carbon emissions (Ewing *et al*., 2010).

The WF is the demand of freshwater resources required to produce goods and services and it represents a measure of human's appropriation of freshwater resources measured in terms of water volumes consumed (evaporated or incorporated into a product) or polluted per unit of time (Mekonnen and Hoekstra, 2011). The water footprint concept is closely linked to the virtual water concept (Hoekstra and Chapagain, 2007). The water footprint includes the use of blue water (ground and surface water), green water (rain water or moisture stored in soil strata), and grey water (pollution) (Hoekstra *et al*., 2011). Water footprint of food consumption in each country was calculated using average water footprint per ton of commodity per country, weighted based on origin (Mekonnen and Hoekstra, 2011).

Results and discussion

Ecological and carbon footprints and biocapacity in Bosnia, Italy and Serbia
Italy has a higher EF of consumption compared to Bosnia and Serbia. Concerning the EF of production, Italy has the highest value compared to Bosnia and Serbia. Bosnia presents

the highest biocapacity per capita (1.6 gh/capita) among the three countries (Ewing *et al.*, 2010).

Net importing countries import more biocapacity than they export and have an ecological footprint of consumption greater than their ecological footprint of production (*e.g.*Italy). The opposite is true for net exporting countries (*e.g.*Serbia). All the three countries have an ecological deficit – as the ecological footprint of consumption is higher than the total national biocapacity: Italy (3.8 gh/capita), Bosnia (1.1 gh/capita) and Serbia (1.2 gh/capita). The highest carbon footprint was recorded in Italy (2.66 gha/capita/yr), followed by Serbia (1.27 gha/capita/yr) then Bosnia (1.17 gha/capita/yr). In Serbia and Italy, the carbon footprint is alone higher than the total national biocapacity (Tab. 1).

Tab. 1. Ecological footprint and biocapacity, 2007 (Source: Ewing *et al.*, 2010).

		World	Bosnia	Italy	Serbia	Europe
Ecological Footprint (global hectares per capita)	Ecological Footprint of Consumption	2.70	2.7	4.99	2.4	4.68
	Carbon Footprint	1.44	1.17	2.66	1.27	2.54
	Ecological Footprint of Production	2.70	2.47	3.08	2.44	4.31
	Total Biocapacity	1.78	1.6	1.14	1.2	2.89
	Ecological Deficit	0.9	1.1	3.8	1.2	1.8

Water footprint of national production and consumption in Bosnia, Italy and Serbia

According to Mekonnen & Hoekstra (2011), the global water footprint was 9087 Gm^3/yr (74% green, 11% blue and 15% grey) in the period 1996-2005 and agricultural production contributes 92% to this total footprint. Moreover, the water footprint of the global average consumer was 1385 m^3/yr in the period 1996-2005. Serbia is the country with the largest water footprint of consumption (2390 m^3/yr) compared to Bosnia (1256 m^3/yr) and Italy (2303 m^3/yr). The differences can be partially explained by differences in consumption pattern and by water consumption and pollution per unit of product per country. The share of water footprint of agricultural products consumption in the total water footprint of national consumption is 94.9% Bosnia, 89.4% in Italy and 61.85 inSerbia.Regarding production side, Italy is the country with the largest total water footprint of production (70392.1 Mm^3/yr) followed by Serbia (28898.8 Mm^3/yr) then Bosnia (3057.9 Mm^3/yr). In all countries, the water footprint related to agricultural production (crop production, grazing, and animal water supply) takes the largest share in the total water footprint within the country: 99% in Bosnia, 85.4% in Italy, and 58.6% in Serbia.

The total volume of international virtual water flows related to trade in agricultural and industrial products was 2320 Gm^3 yr^{-1} (68% green, 13% blue, 19% grey) of which 76% is related to crop products trade (animal products trade contributes 12%). Italy presents a water saving of 62,157 Mm^3/year which is higher than Bosnia (1,890 Mm^3/year), while Serbia presents a negative virtual water balance (-1,779 Mm^3/year), which means that it has a net virtual water export.

Economic efficiency of land and water use

Natural resources use economic efficiency changes from a country to another as well as depending on the footprint that is used in calculation so the considered resource (i.e. Land, water). Economic efficiency of land use - EF/GDP - is the highest in Italy followed by Serbia then Bosnia. That means that a higher surface of land is needed in Bosnia in order to generate one million of national income than in Serbia and Italy. The situation is different regarding water. In fact, in this case the highest water use economic efficiency - WF/GDP - is recorded

again in Italy, but followed by Bosnia then Serbia. It can be noticed that in both cases Italy does the best.

Characterisation of food consumption patterns in Bosnia, Italy and Serbia

FAOSTAT (2010) data show that dairy products are the most consumed food group in Italy and Serbia while vegetables are at the top of the list in Bosnia. Cereals represent the second most consumed food group in Italy; vegetables are ranked second in Serbia and dairy products in Bosnia. Meat consumption is much higher in Serbia (74.02 kg/capita/year) than in Bosnia (20.10 kg/capita/year). Total food supply in Italy (3649 2748 kcal/cap./day) is much higher than in Bosnia (3082 2748 kcal/cap./day) and Serbia (2748 kcal/cap./day). Moreover, the share of plant-based energy in the diet is higher in Bosnia (84.7%) with respect to Italy (74.2%) and Serbia (67.8%).

Water footprint of food supply in Bosnia, Italy and Serbia

Water footprint of food supply in Bosnia (1849.70 m^3/cap./yr) is slightly higher than that recorded in Italy (1848.29 m^3/cap./yr) but much lower than the total water footprint in Serbia (2397.78 m^3/cap./yr). The analysis of the total water footprint of food supply in Bosnia, Italy and Serbia shows that the average water footprint of a Bosnian citizen is 0.08% higher than an Italian one and is 22.86% lower than that of a Serbian one (Fig. 1).
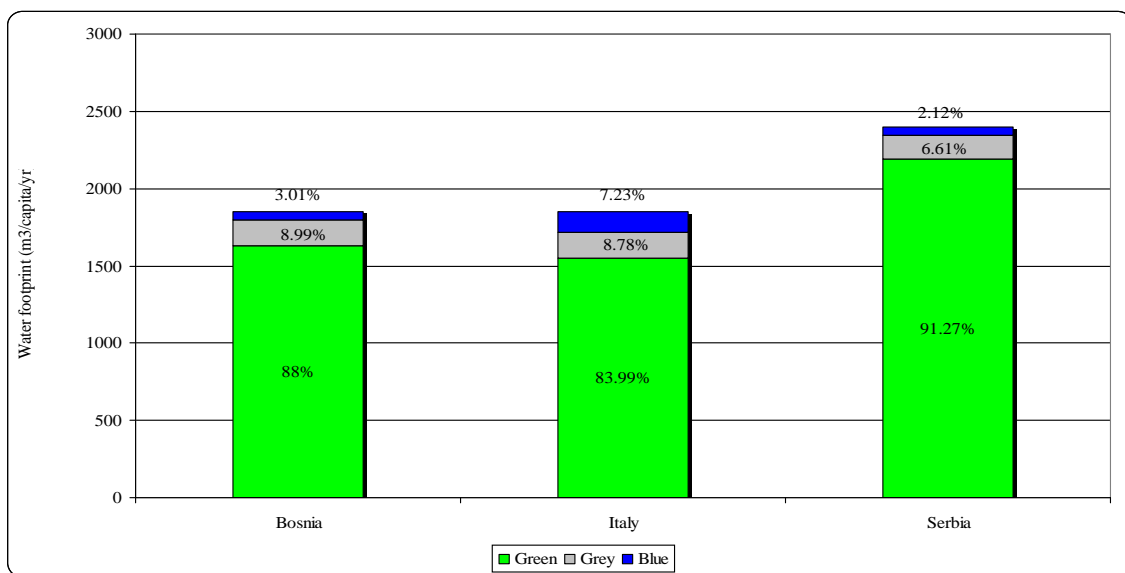
Fig. 1. Green, grey and blue water footprints of food supply in Bosnia, Italy and Serbia; 2006.

In all the three countries, the highest water footprint is the green one, followed by the grey then the blue one. That is also an indicator of the relevance of agricultural products since there is no green water footprint in the cases of industrial products and domestic water use. However, the shares of the three components of the water footprint change from a country to another. The grey component is the second highest in all the three countries. The highest share of the blue water component in the water footprint is recorded in Italy; where water is used to irrigate Mediterranean crops (Fig. 1).

Meat contribution to the water footprint is the highest in all the three countries. In fact, in Italy, Bosnia as well as Serbia about a third of the water footprint is due to meat consumption. The contribution of vegetable oils to the water footprint is relevant in Italy but not in the case of Bosnia and Serbia. Dairy products are also another important contributor to water use. When considering both meat and dairy products, they represent in all the three countries more than a half of the total water footprint of food supply. The contribution of

stimulants (*i.e.* coffee, cacao, tea) is particularly relevant in the case of Bosnia. The same thing is true for sugar and sweeteners in Serbia (Fig. 2).
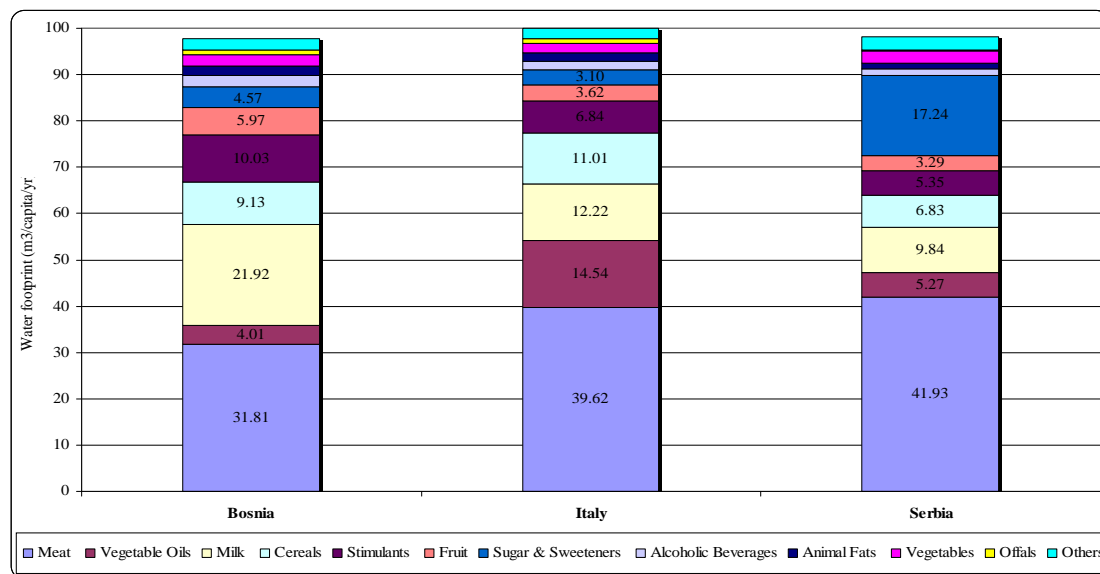
Fig. 2. Food product groups contribution to the total water footprint of food supply in Bosnia, Italy and Serbia; 2006.

The top ten contributor products to the total water footprint of food supply change from a country to another. In Bosnia, they are - in descending order: milk, wheat, bovine meat, maize, coffee, cocoa beans, poultry meat, potatoes, sunflowerseed oil, and offals.

Conclusions

Total food supply in Italy is higher than in Bosnia and Serbia. The share of plant-based energy in the diet is higher in Bosnia with respect to Italy and Serbia. Dairy products are the most consumed food group in Italy and Serbia while vegetables are mostly consumed in Bosnia. None of the three countries has an ecological reserve. In fact, there is an ecological deficit in all the analysed countries as the ecological footprint of consumption is higher than the biocapacity. The highest carbon footprint was recorded in Italy. Serbia is the country with the largest water footprint of consumption compared to Bosnia and Italy. In all countries, the water footprint related to agricultural production takes the largest share in the national total water footprint. Italy is the country with the largest total water footprint of production. Italy presents a water saving higher than Bosnia, while Serbia presents a negative virtual water balance. The average water footprint of a Bosnian citizen is 0.08% higher than that of an Italian one and 22.86% lower than that of a Serbian one. The green component is the most relevant one followed by the grey then the blue ones. Meat and dairy products represent in all the three countries more than a half of the total water footprint of food supply. The top contributors to the total water footprint of food supply in Bosnia are milk, wheat, bovine meat, maize, coffee, cocoa beans, poultry meat, potatoes, sunflower seed oil, and offals. Adoption of more sustainable agro-food production systems and food consumption patterns in Bosnia, Italy, and especially, Serbia can reduce the food environmental footprints on the scarce natural resources especially water.

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II

PLANT PRODUCTION AND PROTECTION

PRECIPITATION AND TEMPERATURE REGIMES AND YIELD OF MAIZE IN CROATIA

Vlado KOVACEVIC[1*], Mirta RASTIJA[1], Marko JOSIPOVIC[2]

[1]University J. J. Strossmayer, Faculty of Agriculture, Croatia
[2]Agricultural Institute Osijek, Croatia.
(Corresponding author: vkovacevic@pfos.hr)

Abstract

Maize is main field crop on arable lands in Croatia. According data of State Bureau of Statistics, maize in the 2010 growing season was grown on 296195 ha or 22% of utilized arable land of the country. In the period 2001-2010 mean yield of maize in Croatia was 6.33 t ha^{-1} (mean harvested area 303946 ha) with variation among the years from 4.2 t ha^{-1} (2003) to 8.0 t ha^{-1} (2008). Weather characteristics, especially precipitation and temperature regimes, are mainly the most responsible factors for these yield differences. In general, the higher and good distributed precipitations as well as lower air-temperatures during three summer months (June-August) are mainly in connection with high yields of maize. The growing season 2003 was the most unfavorable for maize growing among ten tested years because precipitation in June-August period was for 30% lower (Osijek) and for 48% lower compared to 30-year average. At the same period, air-temperature was for 3 ^{o}C (Osijek) and even 4.7 ^{o}C (Zagreb) higher. This phenomenon is main reason for considerable yield reduction (mean yield 4.2 t ha^{-1}) in Croatia. In accordance with global climatic changes, frequency occurrence of „dry years" (below 150 mm in June-August) has increasing trend.

Key words: *grain yield, maize, precipitation, air-temperature, Croatia*

Introduction

Weather characteristics, especially precipitation and temperature regimes, have considerable effects on yields of field crops. The influences of weather characteristics on maize plants start seven before sowing. The lower the soil-moisture reserve is in connection with the higher precipitation requirements in this crop-season. It is desirable that by preseason precipitation soil is supplied by water in level or above field water capacity, but without too much excess. In the early vegetative growth needs of maize for water are mainly moderate and cold weather decreasing growth rate. However, in the late vegetative stage, tasseling, silking and pollination, the relationships between weather and yield of maize are more marked (Shaw, 1988). The experiences from USA Corn Belt (Thompson, 1963) indicated low correlations between maize yield and both June temperature and June precipitation. However, optimum July precipitation is much above normal for the Corn Belt states. Also, August temperatures are higher than those associated with optimum maize yields in the Corn Belt. During the ear-filling stage, significant reduction in yield can occur from water shortage and the higher air-temperatures (Thompson, 1986). The higher and good distributed precipitations as well as lower air-temperatures during three summer months (June-August) and especially in July and August are in connection with high yields of maize in Croatia (Josipovic et al., 2005; Kovacevic and Josipovic, 2005; 2010b; Markulj et al., 2010). Also, similar effects of weather conditions on maize yields were found in Serbia (Jelic et al., 2009; Kovacevic et al., 2009a; Maklenovic et al., 2009) and Hungary (Kovacevic et al., 2009a, 209b). Aim of this

study was testing of precipitation and temperature regime status in three months period (June-August: Osijek Weather Bureau) and maize yields in Croatia for the 2000-2010 period.

Material and methods

For this study, the data from State Hydrometeorological Institute (precipitation and air-temperature: Osijek and Zagreb-Maksimir Weather Bureaues) and State Institute for Statistics (statistical yearbooks: maize yields) were used. Rain factor (RFm) was calculated monthly as quotient of precipitation (mm) and mean air-temperatures (°C) according Gracanin (1950).

Results and discussion

Maize is main field crop on arable lands in Croatia. According data of State Bureau of Statistics (SYB, 2011) utilized arable land area in Croatia (status 2010) was 1334825 ha with harvested areas of main field crops as follows: maize 296195 ha, wheat 168507 ha, soybean 56524 ha, barley 52524 ha, silage maize 30 145 ha, alfalfa-hay 27207 ha, sunflower 26412 ha and rape seed 16339 ha. Maize growing in Croatia is characterized with high yield variations among years. In the period 2001-2010 mean yield of maize in Croatia was 6.33 t ha^{-1} (303946 ha) with variation among the years from 4.2 t ha^{-1} (2003) to 8.0 t ha^{-1} (2008). Weather characteristics are mainly the most responsible factors for these yield differences.

Table 1. The harvested area, grain yield of maize in Croatia and meteorological data

Maize	Year (The Weather Bureaues: OS = Osijek; ZG =Zagreb-Maksimir)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Harveted area (ha) and grain yield (t ha^{-1}) of maize in Croatia for 2001-2010 period									
ha	304035	305625	304762	319855	297692	290816	313125	313125	295000	295428
t ha^{-1}	5.7	6.4	4.2	6.3	6.9	6.5	4.9	8.0	7.4	7.0
	Precipitation (mm) in 3-month (June-August) period*									
OS	324	172	146	216	521	240	105	201	138	377
ZG	190	338	145	228	381	250	248	244	243	298
	Mean air-temperature (°C) in 3-month (June-August) period*									
OS	20.8	21.4	23.3	20.6	20.1	21.0	22.8	21.7	21.8	22.2
ZG	20.9	21.3	24.0	20.4	20.1	21.1	22.1	21.4	21.6	21.5

* 30-year (1961-1990) averages: 211 (OS) and 278 (ZG) mm, 20.3 (OS) and 19.3 (ZG) °C

Precipitation and air-temperature regimes in three summer months (June-August) are considerable factors of maize yields in Croatia. With that regard, the growing season 2003 was the most unfavorable for maize growing among ten tested years because precipitation in June-August period was for 30% lower (Osijek) and for 48% (Zagreb) lower in comparison with 30-year average. At the same period, air-temperature was for 3.0 °C (Osijek) and even 4.7 °C (Zagreb) higher. This phenomenon is main reason for considerable yield reduction (mean yield 4.2 t ha^{-1}). The growing season 2007 was also unfavorable for maize growing, especially in the eastern part of the country. For example, precipitation in June-August in Osijek was 50% lower and air-temperature for 2.5 °C higher from 30-year mean (Table 1).

Monthly distribution of precipitation and air-temperatures in Osijek and Zagreb (Table 2) were specific with high variations for the same month among different years. Excess of precipitation accompanied with cold weather in June and very low precipitation with the higher air-temperatures in August characterized 2001 growing season. Two growing seasons (2003 and 2007) were unfavorable for maize. For example, mean June temperature in Osijek

was 24.3 ^{o}C or 4.8 ^{o}C and in August 23.6 ^{o}C or for 3.3 ^{o}C higher than LTM. August air-temperature in Zagreb was 25.0 ^{o}C or even for 5.7 ^{o}C higher than LTM and this stress was accompanied with only 17 mm precipitation. The 2007 growing season was especially unfavorable for maize in the eastern part of Croatia. Adequate June and August precipitation and water deficit in July characterized the 2010 growing season. Monthly precipitation and temperature regimes in remaining tested years were less or more close to LTM.

Table 2. Precipitation and mean air-temperature in June-August period

Year	Osijek Weather Bureau						Zagreb-Maksimir Weather Bureau					
	June		July		August		June		July		August	
Precipitation (mm) and mean air-temperature (^{o}C): LTM = average 1961-1990												
	mm	^{o}C	mm	^{o}C	mm	^{o}C	mm	^{o}C	mm	^{o}C	mm	^{o}C
2001	240	18.1	77	21.6	7	22.7	121	18.4	55	21.8	14	22.5
2002	36	21.1	59	22.3	77	20.9	71	21.1	124	21.9	143	20.8
2003	44	24.3	61	22.1	41	23.6	66	23.9	62	23.0	17	25.0
2004	77	19.2	43	21.5	96	21.0	102	19.1	70	21.1	56	21.0
2005	112	19.5	171	21.5	238	19.3	69	19.9	137	21.5	175	18.9
2006	91	20.1	15	23.5	134	19.3	40	20.5	32	23.8	178	18.9
2007	33	22.3	27	23.9	45	22.2	97	22.2	49	22.9	102	21.3
2008	76	21.5	79	21.8	46	21.8	103	20.9	86	21.9	55	21.4
2009	63	19.2	14	23.2	61	22.9	68	19.8	96	22.3	79	22.6
2010	234	20.4	32	23.2	111	21.7	104	20.4	53	23.2	141	20.8
Mean	101	20.6	58	22.5	86	21.5	84	20.6	77	22.3	96	21.3
LTM	88	19.5	65	21.1	58	20.3	100	18.5	83	20.1	95	19.3
Rain factor (RFm): precipitation / mean air-temperature (Gracanin, 1950)												
	June		July		August		June		July		August	
2001	13.2 h		3.6 sa		0.3 a		6.6 h		2.5 a		0.6 a	
2002	1.7 a		2.6 a		3.7 sa		3.4 sa		5.7 sh		6.9 h	
2003	1.8 a		2.8 a		1.7 a		2.8 a		2.7 a		0.7 a	
2004	4.0 sa		2.0 a		4.6 sa		5.3 sh		3.3 sa		2.7 a	
2005	5.7 sh		8.0 h		12.3 h		3.5 sa		6.4 sh		9.2 h	
2006	4.5 sa		0.6 a		6.9 h		2.0 a		1.3 a		9.4 h	
2007	1.5 a		1.1 a		2.0 a		4.4 sa		2.1 a		4.8 sa	
2008	3.5 sa		3.6 sa		2.1 a		4.9 sa		3.9 sa		2.6 a	
2009	3.3 sa		0.6 a		2.7 a		3.4 sa		4.3 sa		3.5 sa	
2010	11.3 h		1.4 a		5.1 sh		5.1 sh		2.4 a		6.8 h	
Mean	4.9 sa		2.6 a		4.0 sa		4.1 sa		3.5 sa		4.5 sa	
LTM	4.5 sa		3.1 a		2.9 a		5.4 sh		4.1 sa		4.9 sa	

Legend: a = arid (<3.3), sa = semiarid (3.3-5), sh = semihumid (5-6.6),
h = humid (6.6-13.3), ph = perhumid (>13.3)

Table 3. Response of maize to fertilization (Stojic et al., 2012)

Response of maize (2004-2011) to ameliorative fertilization (April 2004)								
Fertilization (2004)			Year (residual effects 2006-2011)					
	P_2O_5	K_2O	2004	2006	2008	2009	2011	Mean
	kg ha^{-1}		Grain yield of maize (t ha^{-1})					
a) STD*	0	0	12.28	10.37	10.93	9.00	7.58	10.03
b) a + P	1000	0	12.62	10.84	11.30	9.74	8.42	10.58
c) a + K	0	1000	12.73	10.58	11.36	9.78	8.42	10.57
d) a + PK	1000	1000	13.75	11.17	11.70	10.27	8.83	11.14
	LSD $_{0.05}$		0.52	0.64	0.50	0.49	1.02	
* P2K2 effects (STD = 100)			112	108	107	114	116	
* STD = basic (standard) fertilization in kg ha^{-1}: 160 N + 60 P_2O_5 + 80 K_2O								
Daruvar Weather Bureau (June-August period: 1961-90 = 30-year averages)								1961-90
Precipitation (mm)			225	274	314	169	205	276
Mean air-temperature (^{o}C)			19.8	20.1	20.7	20.8	21.2	19.7

RFm average values for 30-year period in Osijek characterizing semiarid climate in June and arid climate in July and August, while in Zagreb these values were in level of semihumid (June) and semiarid climate (July and August) and for this reason something more favorable for maize growing. However, for 2001-2010 decade period these values have tendency for increasing aridity degree. Especially unfavorable for maize growing was the growing season 2003 because rain factor in June-August period both in Osijek and Zagreb characterized arid climate (Table 3).

Kovacevic et al. (1994) reported survey of maize yields and precipitation regime in Slavonija and Barannya region for the 1960-1989 period. Average yield of maize in the region was 4.82 t ha^{-1} with yield variation among years from 2.74 to 7.08 t ha^{-1} (Croatia: 3.81 t ha^{-1} and from 2.45 to 5.33 t ha^{-1}). Precipitation quantities in June-August (Osijek) was 201 mm and variation among years from 138 to 460 mm and in eight year they were below 150 mm. The 2001-2010 period characterized by the higher precipitation (mean 244 mm), their higher variation among years from 105 to 521 mm and below 150 mm precipitation in three years (Table 1). However, by addition of the last two years 2011 and 2012 in consideration (precipitation in Osijek for June-August period: 129 and 120 mm, respectively), frequency of occurrence „dry years" at beginning of 21 century have increasing trend.

Additional factor of relative low yields of maize and yield variation among years could be growing under soil conditions characterizing different soil fertility. By adequate soil and crop management practice is possible to alleviate detrimental effects of unfavorable weather conditions on field crops yields (Butorac 1999; Kovacevic, 2010a). Stojic et al. (2012) reported that by ameliorative fertilization with phosphorus and potassium were increased maize yields under drought stress of 2009 and 2011 for 14% and 16%, respectively (Table 3). Kovacevic et al. (2011) found effects of KCl fertilization and genotype on nutritional status and yield of maize, soybean and wheat.

Conclusion

Maize is main field crop on arable lands in Croatia. Weather characteristics, especially precipitation and temperature regimes, have considerable effects on yields of maize. In general, the higher and good distributed precipitations as well as lower air-temperatures during three summer months are in connection with the higher yields of maize. In accordance with global climatic changes, frequency occurrence of „dry years" (below 150 mm in June-August) has increasing trend.

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RESIDUAL EFFECT OF LIMING ON SOIL PROPERTIES AND MAIZE GRAIN YIELD

Domagoj RASTIJA[*], Zoran SEMIALJAC, Mirta RASTIJA, Ana GULISIJA

University of J. J. Strossmayer in Osijek, Faculty of Agriculture, Osijek, Croatia
(Corresponding author: drastija@pfos.hr)

Abstract

The residual effect of liming on soil pH and plant available phosphorus and on maize grain yield was studied in the 2011 growing season. Field trial was conducted in 2006 in the east Croatia on the very acid luvisol with low phosphorus availability. Liming material containing 73 % CaO and 2-3% MgO was applied at following rates: 0, 5, 10, 20 and 40 t ha^{-1}. Liming gradually raised soil pH from initial very acid to even alkaline reaction on the highest rate. Also, available phosphorus content was considerably improved by liming. Significant liming impact on maize grain yield was ascertained, and it was higher on all liming treatments except on the 40 t ha^{-1}, due to overliming. The highest yield (11.9 t ha^{-1}) was achieved on the treatment with 10 t ha^{-1}, but between application of 5, 10 and 20 t ha^{-1} of lime there were no significant differences. So, liming with moderate lime rate proved to be effective five years after application.

Key words: *liming, soil pH, plant available phosphorus, maize grain yield*

Introduction

Acid soils occupy about 30% of the world's ice-free land area (von Uexkull and Mutert 1995). In Croatia the problem of natural and anthropogenic acidification of the soils has a great importance. There is about 1.6 million hectares of acid soils in Croatia (Bogunovic *et al.* 1997) and they are especially widespread in the eastern Croatia. Major causes of acidity are leaching and plant uptake of basic cations, production of organic acids from organic matter decomposition. Also, fertilisation, especially with some nitrogenous fertilisers containing strong acid forming anions, may increase acidity of soils with weak buffering capacity (Bierman and Carl, 2005). Under temperate climates long term losses of base cations from lower soil layer change the soil chemical properties and decrease nutrient avaliability. High levels of soil acidity (low soil pH) can cause reduction of root growth, nutrient availability, reduction of crop yields and deterioration of soil physical properties (Adams 1984). In general it affects the biological, chemical and physical properties of soil, which in turn affect the sustainability of crop production. In order to produce a better maize yield on acid soils, farmers are recommended to apply liming materials rich in calcium and magnesium to increase the soil pH and thus eliminate Al toxicity and increase nutrient avaliability, especialy phosphorus. Liming is common recommendations for improvement of acid soils in Croatia (Kisic et al. 2002, Kovacevic et al. 2006, Loncaric et al. 2006, Rastija et al. 2007, 2008, 2009, Kovacevic and Rastija 2010, Andric et al. 2012). The aim of this study was to provide data for sustainable cropping by evaluating the residual effect of liming on soil chemical properties and maize grain yield.

Material and methods

The field trial was conducted in Zel in (eastern Croatia) at dystric luvisol with low pH and low nutrients availability (pH $_{KCl}$ =4.31, SOM=1.71 %, P_2O_5= 7.8 mg/100g and K_2O= 22.8 mg/100g). The experiment was setup in a randomized complete block design in four repetitions. The plot size was 44.8 m^2 (5.6m x 8m). In the March of 2006 soil were limed with different amount of hydrated calcite (73% CaO + 2-3% MgO) what resulted in five treatments: 0, 5, 10, 20 and 40 t ha^{-1}. The experimental plots were fertilized for maize in 2011 with 175 kg N ha^{-1}, 150 kg P_2O_5 ha^{-1} and 225 kg K_2O ha^{-1}. Maize hybrid OsSK 552 was sown at the last decade of April and harvested manually at the end of September.

Maize growing seasons of 2011 were characterized by lower precipitation for 135 mm and higher air temperatures for 1.9 ^{o}C as compared to the 30-year mean. However, in terms of precipitation distribution, the lowest amount were in August (only 4 mm) while in May and July were above long term mean. Air temperatures were higher in all months during maize growing season (Figure 1).
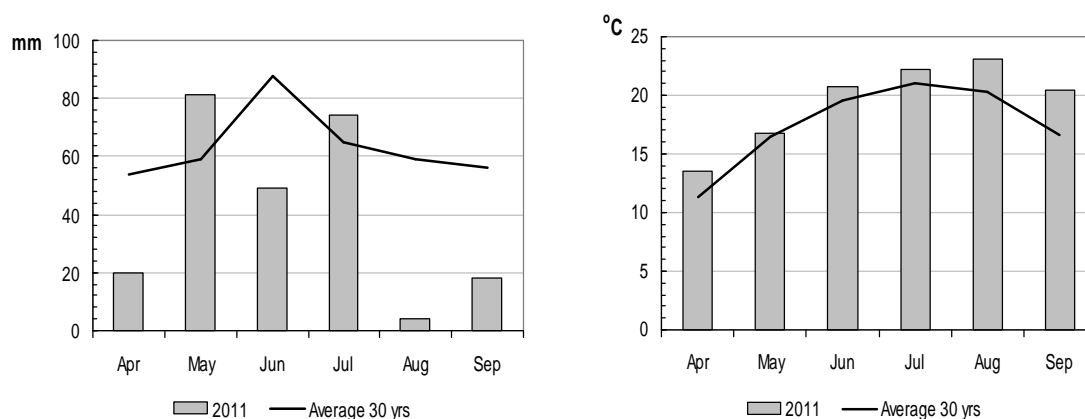
Figure 1. Monthly amount of rainfall (mm) and average air temperatures (°C) for maize growing seasons 2011 and 30-year mean values for the experimental site

The soil samples (0-30cm) were collected before fertilization (October 2010) and after harvest (October 2011). The soil pH (H_2O and M KCl, 1:5 v/v) were determined according to ISO (1994), plant available phosphorus and potassium by ammonium-lactate extraction (Egner et al., 1960) and soil organic matter content (SOM) by sulfocromic oxidation (ISO, 1998).

Yields were calculated on a 14% grain moisture basis. From each treatment, 10 cobs were used for determination of grain moisture and grain share in cob. Grain moisture was determined by electronic grain moisture instrument.

Data were statistically analyzed by single-factor ANOVA using SAS software (SAS Institute, Cary, NC, USA; PROC ANOVA), and the effects of liming on tested parameters were evaluated by t-test and least significant difference (LSD) at 0.05 probability levels.

Result and discussions

The results of the residual effect of liming on the soil chemical properties before and after growing season are shown in Table 1. The soil pH gradually raised from 5.29 by 5 t ha^{-1} calcite to 7.66 t ha^{-1} on overliming plots with 40 t ha^{-1} in the 2011. The same trend was observed one year before. This is in agreement with results from Andri et al. 2012, where is

indicated that liming with 5 and 20 t ha^{-1} lime raised pH for 0.5 and 2 pH units, respectively. Similar effect of liming was recorded by Kovacevic et al. 2006 and Rastija et al. 2008.

Table 1. Soil chemical properties

Liming t ha^{-1}	pH(H$_2$O)	pH(KCl)	P$_2$O5	K$_2$O	SOM
			mg/100g soil		%
Before growing season (October 2010)					
0	5.27	4.02	7.9	26.0	1.94
5	6.12	4.97	8.4	24.0	1.74
10	6.99	6.05	9.2	23.2	1.82
20	7.86	7.04	10.2	21.8	1.67
40	8.40	7.91	9.5	19.8	1.71
After growing season (October 2011)					
0	5.08	4.04	8.6	26.2	1.86
5	6.27	5.29	10.0	22.0	1.77
10	6.58	5.58	10.6	20.6	1.84
20	7.35	6.54	13.1	22.5	1.72
40	8.26	7.66	11.0	23.7	1.64

Liming also considerably affected phosphorus availability. The highest value of plant available phosphorus was achieved by the application of 20 t ha^{-1}, while the lower effect was determined with the highest calcite dose, probably due to slightly alkaline soil reaction (Table 1). Zhang et al. 2004 and Rahman et al. 2002 reported about impact of liming on phosphorus availability in acid soils, pointed that a moderate pH increase leads to greater phosphorus availability, while too high doses can cause its decreasing. Available potassium content in 2011 ranged from 20.6 to 26.2 mg/100g soil.

Table 2. Maize yield and grain moisture

Liming t ha^{-1}	Grain yield t ha^{-1}	Grain moisture %
0	9.24 b	22.8 a
5	10.97 a	21.3 b
10	11.88 a	21.5 b
20	10.74 a	21.5 b
40	9.10 b	22.2 a
Mean	10.38	21.8
F test	**	**
LSD$_{0.05}$	1.28	0.63

a - values followed by the same letter are not significantly different at P 0.05 level
**significant at P 0.01 level

The average grain moisture at harvest was relatively low (21.8%). On the control treatment, as well as on the treatment with the highest rate, significantly higher moisture content was found.

Considering less favourable weather conditions during maize growing season, satisfying mean grain yield of 10.38 t ha^{-1} was achieved (Table 2.). Liming significantly increased grain yield on all treatments, except on the highest calcite amount, where it stayed on the level of the control. This is probably consequence of overliming and slightly alkaline reaction what could lead to soil nutrients imbalance and microelements unavailability.

The highest yield was attained with 10 t ha^{-1} of lime(11.88 t ha^{-1}), and it was higher for 2.64 t ha^{-1} compared to control. However, between 5, 10 and 20 t ha^{-1} there were no significant differences, indicating that five years after liming its positive effects are still expressed as the yields on all treatments, except the last, were statistically significantly higher.

Conclusion

Significant liming impact on soil chemical properties and maize grain yield was ascertained. Application of different rates of hydrated lime gradually raised soil pH from acid to slightly alkaline reaction. Available phosphorus content was improved by higher liming rates, but the soil is still remained at the low level of phosphorus supply, indicating that liming of acid soil should be implemented along with rich phosphorus fertilization. Maize grain yield was significantly higher on the all liming treatments except on the 40 t ha^{-1}, due to overliming. As between 5, 10 and 20 t ha^{-1} of lime there were no statistical differences, it can be concluded that liming with moderate amount could be effective five years after application.

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MICROELEMENTS CONCENTRATIONS IN MAIZE INBRED LINES GROWN ON ACID SOIL

Mirta RASTIJA[1*], Vlado KOVACEVIC[1], Domagoj SIMIC[2], Tomislav BRKANIC[1]

[1]University of J. J. Strossmayer in Osijek, Faculty of Agriculture, Osijek, Croatia
[2]Agricultural Institute Osijek, Osijek, Croatia
(Corresponding author: mrastija@pfos.hr)

Abstract

Maize genotypes show great variability in nutrients content, depending on growing conditions. The objective of present study was to determine effects of genotype and environment on grain yield and Fe, Mn, Zn and Cu concentrations in leaf and grain of maize inbred lines grown on acid soil. Five inbred lines were grown in a field trial during 2003 and 2004 in the east Croatia on the very acid soil with pH (KCl) 3.9. Growing season of 2003 was very dry and warm, while in 2004 above average rainfall was recorded. Highly significant effect of genotype and year was observed for the grain yield. Average yield across the years was 3.08 t ha^{-1}, and it was significantly lower in 2003, due to severe drought. Higher influence of genotype was found for microelements in leaf, while for microelements concentrations in grain effect of year was also significant. Average microelements concentrations (in mg kg^{-1}) were 143 Fe, 185 Mn, 47.7 Zn and 15.0 Cu for the leaf, and 30.7 Fe, 5.4 Mn, 24.5 Zn and 7.02 Cu for the grain.

Key words: *maize inbred lines, microelements, acid soil, leaf, grain*

Introduction

Adequate microelements concentrations in agricultural plants, grain or seed, is very important for both, crops productivity and nutritive value of agricultural products. Maize genotypes show great variability in nutrients content, depending on environmental and growing conditions. Nutrients availability is associated with soil pH. The most microelements essential for plants are more available in acid soils, but this could lead to some other nutrient imbalances in plants. Important role of genotype on nutritional status of maize genotypes grown on acid soil has been reported (Kovacevic et al., 1997; Kovacevic et al., 2004; Antunovi et al. 2003, Rastija et al., 2010). Heckman et al. (2003) reported that nutrient concentration in the same maize hybrid can vary considerably depending on the environment and microelements in grain shows much higher variability than macroelements. The microelements content in grain is a complex trait affected by a number of factors, including genotype, soil properties, environmental conditions and nutrient interactions (House, 1999).

Significant genetic variation in grain mineral concentration has been reported among maize inbred lines in Croatia (Brki et al., 2003; Brki et al., 2004; Šimi et al., 2004). The objective of present study was to determine effects of genotype and environment on grain yield and Fe, Mn, Zn and Cu concentrations in leaf and grain of maize inbred lines grown on acid soil.

Materials and methods

Five genetically divergent maize inbred lines, parental components of hybrids, were grown at the location in the east Croatia during 2003 and 2004. The lines Os 84-44 (L1), Os 438-95 (L2) and Os 30-8 (L3) which are used as female parents of hybrids belong to BSSS pool, while Os 1-44 (L4) and Os 6-2 (L5), used as male parents, are of Lancaster origin. The field trial was conducted on a very acid distric luvisol with very low phosphorus and low potassium, but high manganese and iron availability, whilst zinc and copper were in a moderate range (Table 1).

Table 1 Soil chemical properties

Year	pH		Organic matter	mg(100 g)$^{-1}$		mg kg^{-1}			
	H$_2$O	KCl	%	P$_2$O$_5$	K$_2$O	Fe	Mn	Zn	Cu
2003	5.23	3.87	1.55	7.50	18.46	40.12	65.72	1.60	2.30
2004	4.83	3.90	2.00	9.57	17.85	98.70	56.81	2.51	3.69

The trial was set up in a randomized complete block design in three replications. The size of experimental plot was 8.4 m^2 in two rows. Usual crop management practice for maize growing was used. Maize was sown and harvested in the optimal agrotechnical terms.

Soil samples for chemical analysis were taken before each harvest. Soil pH was determined according to ISO (1994), organic matter by sulfocromic oxidation (ISO, 1998), plant available phosphorus and potassium by ammonium-lactate extraction (Egner et al., 1960), and concentrations of microelements (Fe, Mn, Zn and Cu) by absorption technique after extraction with EDTA. The samples of ear-leaves were taken at the siliking stage. Grain samples were made of the five randomly picked ears per plot. The concentrations of Fe, Mn, Zn and Cu in leaf and grain were measured by inductively coupled plasma (ICP) technique after microwave digestion with HNO$_3$+H$_2$O$_2$.

The obtained data were statistically analysed using ANOVA firstly separately for each year. Afterwards, combined analysis of variance was performed, considering genotype (inbred line) and year as main factors.
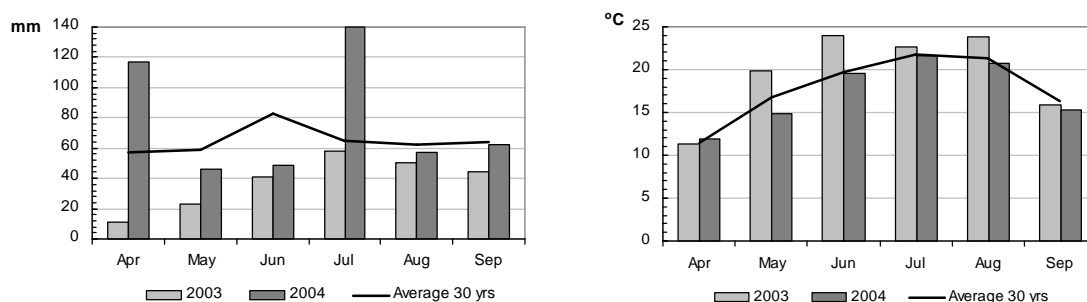
Figure 1. Monthly amount of rainfall (mm) and average air temperatures (°C) for maize growing season 2003 and 2004 and 30-year mean values for field trial location

Weather conditions during maize growing season considerably differed in two experimental years (Picture 1). The 2003 was exceptionally dry and warm and total rainfall in the growing period achieved only 50% of the long term mean value. The main feature of 2004 was rainy April and July, but generally it was more favourable year for maize growing.

Results and discussion

The analysis of variance showed very significant (P 0.01) effect of genotype (inbred line) on all traits, except for grain Fe concentration (P 0.05). The effect of year was also

statistically proven for grain yield, concentration of Zn in leaf as well as for concentrations of all microelements in the grain. On the other hand, interaction line x year was no significant in most cases, except for Fe, Zn and Cu concentrations in grain.

Table 2. Grain yields (t ha^{-1}) of inbred lines over the years and significance levels for line (L) and year (Y) effects with LSD at the 0.05 probability level

Inbred line (L)	Year (Y)		Mean (L)
	2003	2004	
L1	2.93	4.79	3.86 a[#]
L2	2.39	3.68	3.03 b
L3	2.65	5.06	3.86 a
L4	2.02	3.05	2.54 b
L5	1.81	2.49	2.15 b
Mean (Y)	2.36 b	3.81 a	3.08
F-test	**	**	**
LSD$_{0.05}$ (L)	0.48	1.25	0.66
LSD$_{0.05}$ (Y)			0.42

[#] Mean values followed by the same letter within each column are not significantly different at P 0.05
** - significant at P 0.01 level

The grain yield averaged over years was 3.08 t ha^{-1} and great differences among years were found (Table 2). Much lower yield in 2003 is a consequence of severe drought and high air temperatures during maize growing season. It is well known that inbred lines are more susceptible to stress and that lower maize grain yield is in connection with dry and hot summer (Kova evi et al., 2009). Expectedly, female parental lines achieved higher yield. The lowest yield in the both years had L5, which is used as a male component and characteristic of high yield is not primarily important.

Table 3. Concentrations of Fe, Mn, Zn and Cu (mg kg^{-1}) in leaf and grain of five maize inbred lines averaged over two years and significance levels with LSD at the 0.05 probability level

Inbred line	Leaf (mg kg^{-1})				Grain (mg kg^{-1})			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
L1	143 b[#]	157 c	46.2 b	16.7 b	29.5 a	5.36 b	22.2 c	10.7 a
L2	138 b	161 c	46.0 b	13.9 c	33.8 a	4.22 c	25.1 b	7.12 b
L3	123 b	122 c	41.5 b	9.2 d	23.8 b	5.10 b	21.6 c	3.70 c
L4	131 b	269 a	65.2 a	16.4 bc	32.1 a	5.45 b	25.0 b	7.36 b
L5	180 a	218 b	39.4 b	20.0 a	34.4 a	6.86 a	28.7 a	6.25 b
Mean	143	185	47.7	15.2	30.7	5.40	24.5	7.02
F-test	**	**	**	**	*	**	**	**
LSD$_{0.05}$	22	47	7.57	2.67	6.3	0.77	2.76	2.03

[#] Mean values followed by the same letter within each column are not significantly different at P 0.05
*,** - significant at P 0.05 and P 0.01 level

Regarding microelements concentrations in ear-leaf, great variability among inbred lines was found, but even greater for concentrations in grain (Table 3). The highest Fe and Cu concentration in leaf had L5, while the highest values for Zn and Mn in leaf was observed for the L4. Generally, in the both years quite high Mn leaf status was determined, what is a consequence of low pH and high Mn availability in soil (Table 1). According to Godo and Reisenauer (1980) manganese content in the leaves abruptly increases when soil pH drops below 5.5. Mengel and Kirkby (2001) reported that the value of 200 mg Mn kg^{-1} may reduce dry matter yield, while values of 35 to 100 mg Mn kg^{-1} in maize ear leaves consider as

optimal (Bergmann, 1992). The both male parental lines had leaf Mn above 200 mg kg^{-1}. However, although two years differed regarding growing conditions, year effect wasn't significant for microelements in leaves, except for the Zn. In the more favourable 2004 growing season, higher Zn concentration was found (Table 4) and it was in the optimal range. The greatest variability among lines was determined for the Cu concentration, as it was in the wide range from 9.2 to 20.0 mg kg^{-1}.

Table 4. Mean values for concentrations of Fe, Mn, Zn and Cu in leaf and grain of five maize inbred lines across the years and significance levels with LSD at the 0.05 probability level

Year	Leaf (mg kg^{-1})				Grain (mg kg^{-1})			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
2003	146	194	44,0 b[#]	15,2	37,2 a	5,80 a	25,5 a	10,3 a
2004	140	176	51,3 a	15,2	24,2 b	5,00 b	23,6 b	3,7 b
Mean	143	185	47,7	15,2	30,7	5,40	24,5	7,0
F-test	ns	ns	**	ns	**	**	*	**
LSD$_{0.05}$			4,79		3,4	0,49	1,74	1,29

[#] Mean values followed by the same letter within each column are not significantly different at p<0.05
*,** - significant at 0.05 and 0.01 level respectively, ns - not significant

Unlike the leaves concentrations, growing year considerable affected micronutrient grain status, especially copper, whose concentrations was almost three times higher in the first year (Table 4). Overall, higher values for all tested microelements was recorded in 2003, what can be attributed to concentration effect i.e. reverse dilution effect due to lower grain yield and lower carbohydrates accumulation in dry growing season. Microelements concentrations in grain are often in the negative correlation with grain yield (Bänziger and Long, 2000) and depend on the content in a vegetative tissue and on the efficiency of translocation, both of which may be under genetic control (Bouis et al., 1999).

Inbred lines were clearly differentiated by concentrations of micronutrients in the grain. The highest grain Mn and Zn content again were determined in L5, male component of hybrid. Brki et al. (2003) also found the highest Zn concentration in grain of genotypes that included this line as a parent, indicated importance of inheritance for grain nutrient contents. Commonly, maize grain contains small amount of manganese and the average value of 5.40 mg Mn kg^{-1} is in the normal range, although quite high concentration in leaves were observed. On the contrary, between Zn concentration in leaf and grain is much smaller difference than in Mn (Table 3), due to more efficient translocation of Zn into the grain (Pearson and Rengel, 1994). Unlike other microelements, whose concentration in the grain was highest in L5, the highest Cu value in the grain was determined in L1, female parent, suggesting the specificity of this genotype for Cu accumulation.

Conclusion

The study showed that the both, year and genotype significantly affected maize grain yield and grain Fe, Mn, Zn and Cu concentrations, while on leaf microelements concentration higher influence had genotype. In hot and dry growing season the microelements grain content was higher due to lower yield. Considerable variability for micronutrient status in leaf and grain of maize inbred lines was determined, although only five genotypes were included. It seems that independently on higher Mn availability in acid soil and its greater accumulation in leaf, Mn content in the grain remains relatively low. Generally, male inbred lines had higher microelements concentrations in leaf and grain. However, the highest Cu concentration in grain had one female parental line, suggesting on some genetic specificity for higher Cu accumulation.

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ROLE OF GENETIC RESOURCES IN DIVERSITY INCREASMENT OF COMMERCIAL MAIZE HYBRIDS

Vojka BABIC[*], Violeta ANDJELKOVIC, Milosav BABIC, Milovan PAVLOV, Zeljko KAITOVIC, Milomir FILIPOVIC

Maize Research Institute "Zemun Polje" Serbia,
(Corresponding author: vbabic@mrizp.rs)

Abstract

Although breeders have almost unlimited access to diversity of maize germplasm, economic aspects and competition among seed companies impose a broad use of one or a small number of the first-ranked hybrids. Monitoring the genetic diversity available to farmers is important, because plant breeding practices, the registration procedures, and the marketing of new varieties can cause potential genetic erosion and consequently a potential increased genetic vulnerability of cultivated varieties. It is estimated that approximately 3000 inbreds in the hybrid combinations are annually tested at the Maize Research Institute (MRI), Zemun Polje. Nevertheless, each year, only one to two hybrids enter the commercial production.

The assessment of the genetic diversity that exists in the available germplasm is fundamental in the improvement of agricultural plants. Within the MRI gene bank collection a special attention is paid to former Yugoslav landraces (2217), which could be a source of early maturity, bigger ear length, a greater number of kernel rows, larger kernel length and greater kernel weight. Moreover, they can be a source of natural resistance to diseases, pests and abiotic stress or a source of different specific traits. Recently, studies carried out at the Maize Research Institute, Zemun Polje, have been done on the following properties of collected germplasm: tolerance to drought, tolerance to herbicides, new sources of cytoplasmic male sterility (CMS) and new sources for increasing the content of available phosphorus in maize kernels.

Keywords: *genetic erosion, landraces,maize hybrids, new variability*

Introduction

Maize, as a cultivated crop, unlike wheat or rice has no obvious wild relative. Therefore, the development of maize, as a cultivated species, has been a mystery for such a long time. Today, one annual Mexican teosinte is considered the direct ancestor of today's maize. In the process of domestication, the artificial selection through the rapid phenotypic transformation of wild grass teosinte (*Zea mays* ssp. *parviglumis*) has led to the development of the modern maize plant (*Zea mays* ssp. *mays*). Although, modern maize breeders have achieved enormous yield increase in the process of the development of hybrid species, the maize development by Indians remains the greatest breeding accomplishment (Beadle 1980). In the period of several millennia prior to the arrival of Colombo, natives used to cultivate all more important forms of maize. These forms exist even today.The process of domestication itself has resulted in a certain loss of maize diversity.Based on nucleotide polymorphism this loss has been estimated to approximately 30% (Goloubinoff et al., 1993; Hilton and Gaut, 1998). Regardless of a certain loss of diversity, maize is a species that is characterised with tremendous morphological and biological diversities. Maize is distributed from 58° north latitude through moderate, subtropical and tropical regions down to 40° south latitude. In the

region of the Andes it grows up to 1016 m above sea (Grant et al. 1963). From the aspect of the conservation of maize diversity, maize is one of the best conserved field crops. It is estimated that the plant gene banks worldwide encompass more than 60,000 accessions.

With the discovery of the New World, maize has quickly become a crop of the essential importance for people who previously were not familiar with such a species. The European maize growing regions, including the territory of the former Yugoslavia, had especially favourable conditions for the growth and development of maize. The development and the improvement of this crop in our regions have, to a large extent, kept up with the maize improvement in developed countries, particularly in the USA. Hybrids have eventually taken priority over other maize types in the commercial production. On the other hand, attention has been paid to conservation and preservation of old landraces with the aim to conserve the diversity of the species (Babic et al., 2012b). The rapid replacement of local varieties by hybrids makes it imperative for the European material to be collected and preserved before this irreplaceable germplasm source is lost (Edwards and Leng, 1965). Therefore, the Maize gene bank has been established within the Maize Research Institute, Zemun Polje.

Although breeders have almost unlimited access to diversity of maize germplasm, the system that delivers the products of plant breeding reduces the diversity of cultivated hybrids leading to an increased genetic vulnerability. The principal problem arises from the use of homozyogous inbreds as parental components of hybrids. If a certain single-cross hybrid is more superior (more yielding) than another single-cross hybrid, economic aspects and competition among seed companies impose a broad use of one or a small number of the first-ranked hybrids.

In the second phase of hybrid breeding, new inbreds were primarily developed by a second cycle of breeding from crosses among elite inbreds within heterotic groups. Moreover, outstanding elite lines were shared as parents of different commercial hybrids. In combination with intensive selection this is expected to result in a reduced genetic diversity in the breeding pools but even more seriously in the hybrid varieties grown by farmers. The risk of genetic erosion does not only depend on plant breeding practices but also on the system that delivers the final products of plant breeding to the market. This includes the regulations to register new varieties and the marketing of registered varieties. Statutory testing of new varieties is required to register them on the national lists (VCU, DUS-UPOV). Afterwards, their acceptance by farmers depends on the amount and quality of the marketing effort of breeding companies but also on further series of voluntarily recommended lists based on regional trials. Consequently, only a few of the registered varieties are grown on a large scale.

There is another sector, which at first glance, has nothing to do with the decrease of genetic variability of maize, while in fact is very important. Namely, the situation within maize breeding has drastically changed during the last 50-60 years in relation to the participation of the private and public sectors in maize breeding. Public sector breeders developed many inbreds through the 1980s. Today, maize breeding is dominated by the private sector. Why is it important, from the perspective of cultivated maize varieties, that there is public breeding? Genetic diversity is the "raw material" of selection and is critically important to maintaining long-term selection progress. The continuing development of an expended germplasm base is a natural role for the public sector.Education of future plant breeders is the most frequently cited role of public maize breeding programs. Secure long-term financial support for genetic resource conservation is fundamentally important. It would be a catastrophic error of monumental proportions if genetic resources that could be more effectively identified and accessible in the future as complex genetics are increasingly well understood have in the meanwhile been left to disappear or to die.

Trends in genetic diversity among maize cultivars

Detailed information about a reduction in genetic diversity could help to emphasize the importance of identifying germplasm sources for broadening the elite breeding pools. Therefore, this issue is a goal of significant genetic studies not only in the USA but also in Europe.Upon maize introduction to the countries of the Old Continent, two events in the recent history of maize breeding had a major impact on the genetic diversity among and within cultivated varieties in Central Europe (Reif et al., 2005). First, the transition from Open Pollinated Varieties (OPVs) to hybrids occurred in the 1950s. Second, during the 1980s there was a shift in cultivation of top- or double-cross hybrids to three-way or single-cross hybrids. With advent of first maize hybrids, in 1933 in the US and around 1950 in Europe, maize cultivation has undergone a complete change. Numerous open-pollinated landraces adapted to specific regions were substituted by a limited number of hybrids bred from a large genetic basis. Today, the main hybrids cultivated in the world involve a restricted number of key inbred lines. Therefore, genetic diversity of those cultivars is almost certainly limited in comparison to the large genetic diversity available in gene banks (Le Clerc et al., 2005).

American breeders were already concerned by the genetic diversity among their maize hybrids after the Southern corn leaf blight of 1970 (Williams and Hallauer, 2000). Unfortunately, contemporary agriculture caused the cultivation of a very limited number of the most yielding hybrid varieties on very large areas. The series of studies carried out during the 1970s (Sprague, 1971; Zuber, 1975) pointed out to a broad use of a small number of public inbreds in the seed production of certified seeds. Maize breeders want to be assured that the genetic base of their hybrid varieties has not become too narrow to face unexpected environmental stresses. Therefore, in the process of maize breeding, great efforts have been made to broaden the genetic base of the material that has been offered to the market. Hallauer et al. (2010) have estimated that approximately 18.000 inbreds were tested in the USA during each year, i.e. 720,000 from 1939 to 1979. The number of self-pollinated, improved and selected inbreds to be tested probably amounts to a million. However, the majority of these inbreds are genetically related. These studies indicate that probably one of the 10.000 S_2 and S_3 tested inbreds finally ends up in the commercial production. So, although breeders are trying to develop and test a large number of inbreds (either in public or private sector), the frequency of the development of new, unique inbreds in the commercial sense is very low. A quite separate issue relates to recycling elite inbreds through pedigree selection.

It is estimated that approximately 3.000 inbreds in the hybrid combinations are annually tested at the Maize Research Institute, Zemun Polje. Thirty to forty out of the total number of hybrid combinations (i.e. 50-60 inbreds) are tested by the Variety Release Committee. Based on VCU tests, 10-20 hybrids, on average, are annually released (included those entered into the national list). Each year, only 1-2 out of this number of hybrids enter the commercial production after tests carried out in post-official production trials.

In the Europe, in the initial stage of the hybrids development, as a promising heterotic pattern, high yielding US dent lines were crossed with adapted European flint lines. The steady influx of dent germplasm from North America to Europe has continued over past 50 years. In contrast, the parental flint inbreds were developed by selfing from a few European open-pollinaded varieties such as Lacaune, Lizagaraute, Gelber Badischer Landmais and Rhentaler (Messmer et al., 1992). A total of 55 SSR markers was used by German researchers (Reif et al., 2005) when they observed five distinct Central European UPV varieties, 85 hybrids and their parental components. Genetic variation within and among varieties decreased significantly during the five decades. The five OPVs contain numerous unique

alleles that were absent in the elite flint pool. Consequently, OPVs could present useful sources for broadening the genetic base of elite maize breeding germplasm. Therefore, it can be conjectured that 1) a bottleneck occurred in the flint pool during the transition from OPVs to hybrids and 2) OPVs, which did not serve as a germplasm source for the original flint inbreds, contained untapped allelic variation useful for future breeding progress.

The group of French scholars (Le Clerc et al., 2005) have quantified genetic diversity among modern and historical maize varieties (133 hybrids during the last five decades) with 51 SSR markers. The analysis of molecular variance showed that the variation among periods represented only 10% of the total molecular variation. However, the differentiation among periods, although low, was significant, except for the last two periods. Their results showed that the genetic diversity has been reduced by about 10% in the maize varieties bred before 1976 compared to those bred after 1985. The very low differentiation observed among varieties of the last two decades should alert French maize breeders to enlarge genetic basis in their variety breeding programmes.

A modern maize breeding programme based on the inbreeding-hybridization concept was established at the Maize Research Institute, Zemun Polje in 1953. Since then, the main objective in the breeding programme has been the development of maize hybrids with a superior potential for high yields and high quality of grain. Many generations of breeders, genetics, phytopathologists, entomologists, and physiologists have greatly contributed to achieved accomplishments (Drinic, et al., 2007). The development of the first ZP maize inbred lines from three local open-pollinated varieties (Vukovarski Dent, Rumski Golden Dent and Sidski Dent) started at the Maize Research Institute in 1953. Stojkovic, (1955) citing the original scientific paper written by Flajšman, has stated that all Ruma material, from which all varieties mentioned were derived, had originated from a parental ear (ear number 122 from the year 1909). What this fact may mean in terms of genetic diversity is a big question.Furthermore, the significant amounts of the following inbreds were imported in the former Yugoslavia in the 1953-1956 period: WF9, 38-11, Hy, Oh7, L317, W32, W22, W117, M14, N6, A374, A375, W153R, W37A, K148, K150, C103. Some of these inbreds considerably affected the future breeding programmes. The inbred C105, imported at the end of the 1950s, had a particular importance. It was used as a tester and a male component of the majority of single cross hybrids of the first cycle of selection (ZPSC 1, ZPSC 3, ZPSC 4, ZPSC 6 and NSSC 70). It has to be emphasised that due to this import, germplasm was significantly introduced from the US Corn Belt to the regions of the former Yugoslavia (Babic et al., 2012). Ivanovic et al. (2002) have singled out four inbreds originating from landraces that significantly affected breeding programmes in our institutes: NS796 - from Vukovarski Yellow Dent, R70Z from the Rumski Golden Dent variety; NS568 - developed by pedigree selection from the cross of one inbred of the BSSS origin to the adapted material from the Pannonian Plain and ZPPE25-10-1 - derived by pedigree selection from the cross of one inbred of the Lancaster origin and the inbred ZPPE25-10 developed from the Pecki Yellow Dent population. These inbreds were components of the leading commercial hybrids: NSSC 70, ZPSC 46a, NSSC 640 and ZPSC 677, while some of them are still present in the market because consumers want them even now. It is estimated that these hybrids together with another five hybrids (until 2002 when these data were published) were grown on approximately seven million hectares, which was the overall five-year maize production on the areas of the former Yugoslavia (Ivanovic et al., 2002).

Rumski Dent has been very popular in neighbouring Hungary. Hadi (2005a) states that this variety was grown on almost half the maize-growing area in Hungary for 30 years (1925-1955). The varieties derived from the parental plant Ruma 122 were known in Hungary under names"F" Early Yellow Dent and "F" Mcz hegyes Yellow Dent and latter was also popular in Yugoslavia under the name Novosadski Flajšman. Furthermore, these varieties had a

significant role in the latter period of the development of self-pollinated inbreds and hybrid varieties in Hungary. The Caribbean Flints (introduced from Spain by the Turks in the 16th century) dominated maize production for nearly four hundred years. In the early 19th century these genetic stocks of the Caribbean origin were supplemented by Andean popping maize (Chutucuno Chico, Chutucuno Grande), introduced from Italy and to a lesser extent by Northern Flints (Pennsylvania 8-row). Under the influence of the American maize exhibition in the 19th century, Southern Dents (especially Gourdseed, but also Shoepeg, Hickory King and Tuxpan) and Corn Belt Dents (Queen of the Prairie, Iowa Goldmine, Leaming, Funk Yellow Dent) gained ground in Eastern Central Europe. These varieties were crossed to already grown flint varieties, and new varieties were developed, which then dominated maize production in the first half of the 20th century. As a result of hybrid maize breeding in Eastern Central Europe, two distinct gene pools were developed: Ruma and Mindszentpuszta (MYD) heterosis sources (Hadi, 2005b). Locally developed maize varieties, which have a background quite different from those developed in the North American Corn Belt, could, after suitable breeding, enrich the available sources of heterosis (Hadi, 2006). In their studies, Radovi et al. (2000) and Van etovi et al. (2010) have pointed out to the existence of a new heterosis source in this material, which certainly has opened up the possibility for the improvement in contemporary breeding under conditions of temperate climate.

In Maize Research Institute, Zemun Polje, studies have been carried out to determine how much temporal cycles of selections differed in terms of genetics and what was happening with variability of materials originating from different cycles of selections. For the purposes of this research, 30 maize hybrids have been selected (six from each cycle) developed at the Maize Research Institute, Zemun Polje, which were typical representatives of the five periods of selection and widely grown. Genetic characterisation has been done by the use of RAPD markers. Although the tested hybrids were grouped into five clearly separated sub-clusters on the basis of the cluster analysis, the results of the discriminant analysis, indicate that the discrimination between groups is not strong, especially of the third and fourth clusters. The conclusion based on the results of three statistically analyses is that in genetic terms there are three different selection cycles. The distinction between the first and the second temporal cycles of selection is the move from four to two-line hybrids, while in the case of the third and the fourth temporal cycle of selection there is a change of parental pairs and no introduction of new genetic material. The fifth cycle is clearly separated, and this is in agreement with pedigree information, which indicates that at that time exotic germplasm and lines from new heterotic groups were introduced (Babic et al., 2009).Within the same studies, genetic variances of selection cycles were estimated on the basis of the RAPD analysis by parameterization of binary data. The comparison of genetic variances of different selection cycles shows that there were no differences in variability of hybrids over cycles, i.e. that the decrease/increase of variability did not occur over cycles of selection (Eric, 2004).

Conclusions

Monitoring the genetic diversity available to farmers is important, because the system that delivers the products of plant breeding and agricultural practices reduces the diversity of cultivated varieties leading to an increased genetic vulnerability. The assessment of the genetic diversity that exists in the available germplasm is fundamental in the improvement of agricultural plants. Recently, studies carried out at the Maize Research Institute, Zemun Polje, have been done on the following properties of collected germplasm: tolerance to drought, tolerance to herbicides, new sources of cytoplasmic male sterility (CMS) and new sources for increasing the content of available phosphorus in maize kernels (Babic et al., 2012; Vancetovic et al., 2009). A special attention is paid to former Yugoslav landraces, which could be a source

of early maturity, ear length, a greater number of kernel rows, kernel length and kernel weight. Moreover, they can be a source of resistance to diseases, pests and abiotic stress or a source of different specific traits. The formation of a core collection tolerant to drought is in progress.

Although some efforts have been made, attention paid to the improvement of landraces has not been adequate, hence, they, in terms of modern breeding, eventually lost in importance. In what way and how much available variabilitywill be used largely depends on work and funds to be invested in long-term breeding programmes.

Acknowledgement

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COVER CROPS EFFECTS ON THE YIELD OF SWEET CORN

Zeljko DOLIJANOVIC[1*], Nebojsa MOMIROVIC[1], Vojislav MIHAJLOVIC[2], Milena SIMIC[3], Snezana OLJACA[1], Dusan KOVACEVIC[1], Zeljko KAITOVIC[3]

[1]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
[2]Institute of Field and Vegetable Crops, Novi Sad, Serbia
[3]Maize Research Institute, Zemun Polje, Belgrade, Serbia
(Corresponding author: dolijan@agrif.bg.ac.rs)

Abstract

Sweet corn (*Zea mayssaccharata* Sturt.; the hybrid ZP 424su of FAO 400 maturity group) was grown for two growing seasons (2011 and 2012) on slightly calcareous chernozem (locality Zemun Polje) after winter wheat as a previous crop. The cover crops were as follows: a = *Vicia sativa* L., b= *Vicia vilosa* Roth., c = *Pisum sativumssp. arvense* L., d = organic malch, e = conventional system. The experiment was in factorial setting with two factors (A = growing season, B = cropping system) the factor in RCBD with four replicates (the basic plot 16.8 m^2). Because of extremely unfavorable weather conditions of the 2012 growing season (drought and hot stress: precipitation in July-August 43 mm accompanied with 26.7 ^{o}C mean air-temperature), maize yield was realized only in the first year of testing. Depending on the treatment, yields of sweet corn in 2011 were from 8.09 t ha^{-1} (conventional system) to 10.00 t ha^{-1} (organic malch).

Keywords:*cover crop; organic farming; yield of grain; sweet corn*

Introduction

Cover crops are crops grown for managing soil fertility, soil quality, water, weeds, pests, diseases and for increasing biodiversity in agroecosystem (Lu *et al*., 2000), which is the key role of sustainable and organic farming system.

Cover crops improve the sustainability and quality and sustainability of both natural systems and agroecosystems. Farmers choose the kinds of cover crops on the basis of their needs and goals, influenced by biological, social, cultural and economic factors (Snapp *et al.* 2005). Legume cover crops are typically rich in nitrogen and are often able to provide the exact amount of nitrogen required for crop production. In conventional farming system, this nitrogen is usually introduced into the soil in the form of chemical fertilisers. This property of cover crops is called a fertiliser replacement value (Thiessen-Martens *et al.,* 2005). Some scholars (Bohlool *et al.* 1992; Peoples and Craswell 1992; Giller and Cadisch 1995) consider that the extended biological nitrogen fixation achieved by growing cover plants is the only alternative to industrial nitrogen fixation in terms of maintaining and increasing food production in the future. Industrial nitrogen fixation has been criticised as an unsustainable source of nitrogen for the production of food due to its reliance on fossil fuel energy and environmental impacts associated with the use of chemical fertilisers in agriculture (Jensen and Hauggard-Nielsen 2003).

At the same time with the introduction of nitrogen in agroecosystems through biological nitrogen fixation, there are some sorts of cover crops, known as "catch crops" that can retain and recycle nitrogen, which is already present in the soil. These crops use excess of nitrogen that is left over after the fertilisation of the previous crops, preventing its loss

through leaching, denitrification or evaporation (Thorup-Kristensen *et al*., 2003). Catch crops are usually fast-growing annual types of wheat adapted to efficiently collect available soil nitrogen (Ditsch and Alley, 1991).

Cover crops can also improve soil quality by increasing soil organic matter levels through the input of cover crop biomass over time. Increased soil organic matter enhances soil structure, as well as the water and nutrient holding and buffering capacity of soil (Patrick *et al.,* 1957).It can also lead to increased soil carbon sequestration, which has been promoted as a strategy to help offset the rise in atmospheric carbon dioxide levels (Sainju *et al.,* 2002, Lal, 2003).

Although cover crops can perform multiple functions in an agroecosystem simultaneously, they are often grown for the sole purpose of preventing soil erosion. Dense cover crop stands physically slow down the velocity of rainfall before it contacts the soil surface, preventing soil splashing and erosive surface runoff (Romkens *et al.,* 1990). Additionally, vast cover crop root networks help anchor the soil in place and increase soil porosity, creating suitable habitat networks for soil macrofauna (Tomlin *et al.* 1995). Erosion control, cover crops, improving the speed and volume of water that passes through the topsoil layer, which can decrease the salinity of the soil and how soil pollution and water courses.

Just before cover crops are killed (by such practices including mowing, tilling, discing, rolling, or herbicide application) they contain a large amount of moisture. When the cover crop is incorporated into the soil, or left on the soil surface, it often increases soil moisture. In agroecosystems where water for crop production is in short supply, cover crops can be used as a mulch to conserve water by shading and cooling the soil surface. While cover crops can help to conserve water, especially in years of deficient rainfall, may also affect the drying if too much moisture from heavy rain during the winter.

Thick cover crop stands often compete well with weeds during the cover crop growth period, and can prevent most germinated weed seeds from completing their life cycle and reproducing. If the cover crop is left on the soil surface rather than incorporated into the soil as a green manure after its growth is terminated, it can form a nearly impenetrable mat. This drastically reduces light transmittance to weed seeds, which in many cases reduces weed seed germination rates (Teasdale, 1993). Some cover crops suppress weeds both during growth and after death (Blackshaw *et al.,* 2001), and in addition to competition-based or physical weed suppression, certain cover crops are known to suppress weeds through allelopathy (Creamer *et al.,* 1996, Singh *et al.,* 2003). This occurs when certain biochemical cover crop compounds are degraded that happen to be toxic to, or inhibit seed germination of, other plant species. Some well known examples of allelopathic cover crops are *Secale cereale*L. (rye), *Vicia villosa*Roth. (hairy vetch), *Trifolium pratense*L. (red clover), and species in the *Brassicaceae* family, particularly mustards (Haramoto and Gallandt, 2004). In one study, rye cover crop residues were found to have provided between 80% and 95% control of early season broadleaf weeds when used as a mulch during the production of different cash crops such as soybean, tobacco, corn, and sunflower (Nagabhushana *et al.,* 2001).In the same way that allelopathic properties of cover crops can suppress weeds, they can also break disease cycles and reduce populations of bacterial and fungal diseases (Everts 2002), and parasitic nematodes (Vargas-Ayala *et al.,* 2000). Species in the *Brassicaceae* family, such as mustards, have been widely shown to suppress fungal disease populations through the release of naturally occurring toxic chemicals during the degradation of glucosinolade compounds in their plant cell tissues (Lazzeri and Manici, 2001).Some cover crops are used as so-called "trap crops", to attract pests away from the main crop of value and toward what the pest sees as a more favorable habitat (Shelton and Badenes-Perez, 2006).

The consequence of all these positive aspects of growing cover crops is the indirect effect on increasing the yield of crops that are grown after them on arable land. The

combinations of main crop and cover crop were based on a combination of legume and non-legume.This was specially achieved with the oats–vetch mixture as maize preceding cover crop and with grasses as soybean preceding crops (Restovich*et al.,* 2012). Uchino *et al.,*2009 found that the largest increase in soybean yield determined if the cover crops were rye and corn following hairy vetch. However, the cover crop sowing time is very important for achieving high yields of major crops, especially corn. So in treatments where cover crops actions for spreading the 20 or so days after sowing maize main crop recorded the highest grain yield. Hiltbrunner*et al.*, 2007 found that the growing of cover crop from August to planting winter wheat in October had a very positive impact on the quality of planting, weed and later on grain yield per unit area.

The aim of this study was to evaluate the impact of different types of growing winter cover crops on yield of sweet maize from traditional cultivation of this crop with conventional practice.

Materials and methods

The experiment included three kinds of winter cover crops in the family *Fabaceae*, a variant in which the land was covered with dead organic mulch and traditional, classical variant-plowing in the fall and land bare, uncovered during the winter. Investigated types of winter legumes (common vetch and hairy vetch, and field pea) varieties belonging to Novi Sad (Neoplanta,NS Vilosa and Pionir). Crops are grown in rainfed conditions.

Field experiments were conducted in 2010/11 and 2011/12 at Maize Research Institute, Zemun Polje, in the vicinity of Belgrade (44°52'N 20°20'E). The soil was slightly calcareous chernozem with 47% clay and silt and 53% sand. The soil properties at 0-30-cm layer were 3.22% organic matter, 0.19% total N, 1.9% organic C, 16.2 and 22.4 mg per 100 g soil of available P and extractable K, respectively, 1.38% total $CaCO_3$ and pH 7.3. The experiments were located in different fields in each year and winter wheat was the previous crop. Plant nutrition and nitrogen fixation in legumes, we came up to the required amount of macronutrients for sweet corn (120 kg ha^{-1} N, 90 kg ha^{-1} P_2O_5 and 60 kg ha^{-1} K_2O). In the fall, before planting of cover crops have entered the entire amount of P and K in the form monopotassium phosphate and 50 kg ha^{-1} N in the form of ammonium nitrate, and the two control variants, also all ofP_2O_5 i K_2O and 40 kg ha^{-1} N in the form AN.In the spring (April 07 2011 and April 09 2012) is a leguminous cover crops added another 30 kg ha^{-1} N in the form of AN (for the remaining 40 kg ha^{-1} is considered to be provided nitrogen fixation), and control plots another 80 kg ha^{-1} N, also in the form of AN. The experimental area was ploughed in autumn, followed by one pass of a disk harrow and a field cultivator prior to sowing.

Table 1. Average monthly air temperatures and monthly precipitation sums from April to September at Zemun Polje

Months	Temperature (°C)		Precipitation (mm)	
	2011	2012	2011	2012
April	14.6	14.4	11	67
May	17.3	17.9	63	128
June	22.4	24.6	40	14
July	24.1	27.1	107	39
August	24.7	26.2	9	4
September	23.2	22.0	49	31
Average/Sum	21.1	22.0	279	283

Sowing cover crops is carried out manually, October 10 2010 and October 14 2011, and measuring and cutting the above-ground biomass of cover crops was performed 7-10 days before planting sweet maize. Planting of the main crop, after the production of seedlings, was the May 26 2011, and May 212012 year. Crops were harvested 22-24 days after pollination, in 2011 harvest was performed on August 18. and because of the extreme conditions of drought and high temperatures in the growing season 2012th there was a crop failure. The climatic conditions during the maize growing season were presented in the Table 1.

Experimental design

The experiment was in factorial setting with two factors in RCBD with four replications. Sweet corn was sown in densities: 65.000 plants ha^{-1} The inter-row distance was 70 cm for all plant densities, while the within-row plant distance was 22 cm. The two new Zemun Polje (ZP) sweet corn hybrids in FAO 400 maturity group ZP 424su. The main plot size was 16.8 m^2 (2.8 m by 6.0 m).

Measurements and statistical analysis

All ears in two inner rows of each subplot were harvested and weighed directly from the field, 25 days after silking. Furthermore, a shelling percentage, as a kernel weight to cob weight ratio, was determined in a sample of 10 randomly selected ears.

The yield data were underwent to ANOVA for the factorial trials set up according to the plan for two years, five variants, and differences between means were tested by the least significant difference (LSD) test (Gomez and Gomez, 1984).

Results and discussion

Results of yield of grain and shelling of sweet corn in the investigated sample are presented in Table 2. Meteorological conditions in the investigated years were extremely unfavorable (Table 1), both leguminous cover crops, and for maincrop – sweet corn. Yields above-ground biomass of cover crops were higher in 2011. year, and of the crop species significantly highest yields are obtained by growing pea in both years (Table 2). At least above ground biomass yields are achieved by growing winter common vetch (34.6 and 33.9 t ha^{-1}).

Analyzing the yield of sweet corn was determined that he was not positively correlated with the yield of above ground biomass of cover crops. The highest yield was obtained in the variant with dead organic mulch (10.00 t ha^{-1}), primarily due to the fact that for its decomposition was significantly more time alone and the planting of corn was thus greatly facilitated. The lowest yield was obtained following the traditional cultivation (8.09 t ha-1). In addition, at least achieved yields probably the balance of nitrogen in the soil after harvest, at least, will be a subject of a subsequent paper. Yield of sweet corn in the study year were below average yields in similar experiments (Simic *et al*., 2012), and the reason is mainly in the way of growing this crop. Specifically, in order to meet the goal of preserving the land and cover crops to enable it to adhere to the land, we decided to planting sweet corn from previously produced seedlings. However, the weather conditions in which they were the 2012th years, this method of cultivation have failed despite the fact that at the time of planting moisture conditions were highly favorable (Table 1).It is a known fact that agronomic plants from seeds are generally quite resilient, how to extreme drought conditions, and the conditions of high air temperatures during the growing season.The estimates of the shelling percentage were at level for observed hybrid. The hybrid has been the best seller for years

among ZP sweet maize hybrids, and a recent result of breeding of maize hybrids with specific properties of increased sugar.

Table 2. The growing season and cropping system effects on yield and shelling

Cropping system	The growing season (2011 and 2012) and cropping system effects					
	Yield (t ha^{-1})**				Percent	
	ABCC		Sweet corn (SC)		SC Shelling	
	2011[*]	2012[*]	2011[*]	2012	2011[*]	2012
Vicia sativa L.	34,6[a]	33,9[a]	8,84[a]	-	62,58[a]	-
Vicia villosa Roth.	36,8[ab]	35,9[ab]	9,98[b]	-	74,69[b]	-
Pisum sativum ssp. *arvense* L.	40,1[b]	39,7[b]	9,55[a]	-	67,82[ab]	-
Organic mulch	-	-	10,00[b]	-	68,09[ab]	-
Conventional system	-	-	8,09[ab]	-	60,79[abc]	-
Average	37,2	36,5	9,29	-	66,79	-

*P=0.05; Values of means followed by the same letter are not significant;
** ABCC = above ground biomass of cover crops

Conclusion

Meteorological conditions during the trial had an important impact on all the cropping systems. Perceived benefits of the alternative technology over conventional in terms of grain yield of the main crop. This breeding system is extremely important for the appropriate management of weeds for long-term weed control in organic agriculture. Sinceexamination of weeds was not included in this study, particulare research should be continued and focused it the direction of precise examination of the floristic composition of weed sinuzya depending on the cropping system of sweet corn.

Acknowlegdement

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ASSESSING SOIL ORGANIC MATTER DYNAMIC IN LONG-TERM EXPERIMENT USING ROTH C 26.3 MODEL

Srdjan SEREMESIC[*], Dragisa MILOSEV

[1]Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
(Corresponding author: srdjan@polj.uns.ac.rs)

Abstract

Soil organic matter (SOM) has many environmental functions and it can be a considered as important indicator of soil quality. The changes in soil organic carbon (SOC) stock can occur following land use or land management change or with climatic change. RothC model is one of the most used model for the prediction of changes in SOC stock on agricultural soils. The efficiency of RothC model was tested to predict the dynamic of SOC stock during 20-year period (1991-2010) on a long term experiment. The obtained results showed 10% in SOC stock loss both on the fertilizer and unfertilized plots, and 30%-45% loss compared with 1940-50, respectively. The RothC model was found sufficiently sensitive to the parameters of long-term experiment and can be successfully used in similar agroecological conditions.

Keywords: *Soil organic matter, Roth C model, crop residues, RMSE*

Introduction

Soil organic matter (SOM) is the most often reported characteristic of a long–term experiments and can be identified as an valuable indicator of agroecosystem development within the specific agroecological conditions and agricultural practice (Körschens, 2004). Therefore, evaluation of SOM may provide crucial information for sustaining soil quality and agroecosystem health (Birkás, 2008). The maintenance of site–specific SOM content is a prerequisite for a protection of soil function and can be identified as a most important attribute of agroecosystem agronomic sustainability (Reeves, 1997). Likewise it is important to indentify vulnerable areas exposed to serious SOM loss due to intensive agriculture or natural causes. Numerous studies showed decline in organic matter content with tillage, insufficient fertilization and crop residue removal and burning (Dalal and Mayer, 1986; Manojlovi et al., 2008). The changes of SOM in Serbia were observed both on the national level (Li ina et al., 2011) and also in Vojvodina Province (Sekuli et al., 2010). Preservation of SOM is a long-term process and includes both monitoring and predicting changes of SOM trends. The assessment of SOM change in the future was recognized as important tasks in the process of SOM protection. There are several types of models for the estimation of SOC stock (SOMM, ITE, Verberne, RothC, CANDY, DNDC, CENTURY, DAISY, NCSOIL). RothC and CENTURY are two of the most widely used and tested SOM models. RothC 26.3 (Colleman and Jenkinson, 2005) was originally developed and parameterised to model the turnover of organic C in arable topsoils from the Rothamsted Experiments. RothC-26.3 was tested in long term experiments on a range of soils and climatic conditions in Western and Central Europe, with detailed descriptions of the sites conditions and treatments (Coleman et al. 1997; Falloon and Smith 2002) The aim of this paper was to evaluate SOM content in the top soil after winter wheat at the long–term experiment on Chernozem, and examine RothC 26.3 model in prediction of SOM change in continuous cropping under conventional tillage practice.

Material and methods

The present study was performed on a long–term experiment (LTE) "Plodoredi" carried out at the Rimski Šan evi Experimental Field of the Institute of Field and Vegetable Crops in Novi Sad. The trial was located at the southern border of Chrenozem zone of the Panonian basin. For the purpose of this study SOM was accessed in the winter wheat based cropping systems. The study treatments were as follows: fertilized 3–year crop rotation (wheat–maize–soybean) D3; fertilized 2–year crop rotation (wheat–maize) D2; fertilized wheat monoculture MO; unfertilized 3–year rotation (wheat–maize–soybean), N3 and unfertilized 2–year rotation (wheat–maize) N2. The unfertilized treatments were established 1946/47, and fertilized in 1969/70. Conventional tillage practice including moldboard plough, harrow disc, and cultivator was performed every year. Harvest residues were incorporated by ploughing after 1988. Winter wheat sowing was done in October (20–30. X) with seeding rate of 250–270 kg ha^{-1}. During the observed period leading wheat and soyabean varieties and maize hybrids were grown and dital description of the trail can be found in Milošev (2000). The amount of crop residue was calculated according to obtained yield (Bolinder et al., 2007).

RothC 26.3 (Colleman and Jenkinson, 2005) was originally develop from Rothamsted Long Term Field experiments data. The RothC 26.3 model was previously tested in the agroecological area of long-term experiment. The study period was from 1991 to 2010, subsequent to experiment was subjected to changes in cropping technology. The model requires three types of data: (a) Climatic data – monthly rainfall (mm), evapotranspiration (mm) and average monthly mean air temperature (°C); (b) Soil data – clay content (%), inert organic carbon (IOM), initial SOC stock (t C ha^{-1}), depth of the soil layer considered (cm) c) Land use and land management data – soil cover, monthly input of plant residues (t C ha^{-1}), monthly input of farmyard manure (FYM) (t C ha^{-1}), residue quality factor (DPM/RPM ratio) and d) climatic data. Model performance was evaluated using the following indices: Root mean square error (RMSE), Coefficient of correlation (r), Mean difference (M) and Relative error (E). After Loague and Green (1991), the total difference between the simulated (predicted) and the measured values were calculated as the RMSE. The statistical significance of RMSE was assessed by comparing to the value obtained assuming a deviation corresponding to the 95% confidence interval of the measurements: where: $t_{(n-2)95\%}$ is Student's t distribution with n-2 degrees of freedom and a two-tailed P-value of 0.05. To assess whether simulated values follow the same pattern as measured values, the sample r was calculated. Mean difference or difference between means of predicted and measured values expresses the total simulation bias;t of M (student's t-test of M): if the t of M is lower than the critical two-tailed 2.5% t-value means that the model bias is not significant.

Results and discussion

The analysis of the achieved yield of wheat points to a significant difference between fertilized and unfertilized variants. The highest grain yields was achieved on the D3, followed in most of the years by D2. When comparing the fertilized rotations, MO had the lowest yield. However, despite the unfavourable crop rotation, it was shown that MO in most years can achieve the yield between 3000 and 4000 kg ha^{-1}. The lowest yield was obtained on average at the N2 (1000 kg ha^{-1}) and N3 (1500 kg ha^{-1}), respectively. By analyzing the long-term yields it was found that there is certain stability in yields at some level and relatively small annual variations (Milošev, 2000; Šeremeši , 2007; Milošev et al., 2010). The crop yield analysis is important for the estimation of residue that could be transformed into SOM. Additionally, it is

necessary for parameterization of belowground and aboveground net primary production used in RothC model calculation. In accordance with this higher potential for SOM preservation was found at D3 plot (Beauchamps and Voroney, 1994; Seremesic et al., 2011).

Modeling SOM dynamic with Roth C model

According to studies conducted at the same experimental field an estimated carbon stock observed during 1940-50. period would be 95 t C ha^{-1} (Bogdanovic, 1955). To initiate the RothC model it is necessary to calculate the SOM equilibrium as an initial value for modeling C in soil (Coleman and Jankinson, 2005). For wheat MO, D2 and D3 equilibrium is done for the 1970 with C stock of 78 t C ha^{-1}. RothC calculation from that period takes into account input from the aboveground and belowground crop residue. Inputs are determined each year based on the yield quantity. For unfertilized rotation N2 and N3, the equilibrium C was established for 1947 (91.4 t C ha^{-1}). Until 1988 only averaged belowground residues of wheat, corn and soybeans were considered for the calculation, and afterwards all plant remains were included, based on crop yields.

Figure 1 (b, c, d, e and f) shows the values of C stock obtained using the Roth C model (line) and the measured values of SOC (dot) during the period 1991-2010. The results indicate pronounced downward trend in soil C content especially in the initial years which later slows. The amount of SOC reserves with RothC model at MO decresed from 72.7 to 64.19 t C ha^{-1} (-12% lower). Though, SOC stock reserves compared to other fertilized rotations, indicated that wheat growing in MO could preserve SOM. This can be explain with better weed control during the growing season, reduced yields and nutrients removal. The SOC stock at D2 decresed from 66.2 to 59.7 t C ha^{-1} (-10%), and at D3 from 70.0 to 64.1 t C ha^{-1} (-9%). Compared with equilibrium created at 1970 the fertilized rotation lost 18% of C stock in topsoil (D3 and MO) and 25% at MO. However, the SOC loss is even bigger compared with stock C from 1940-1950 (30 % loss). Based on the model the current C reserves content in the unfertilized soil is about 50 t C ha^{-1} which is 10% lower than 1991 and 45% lower compared with equlibirum initiated 1940-50. Further on, a negative trend projected by the model will continue into the future resuting with the C reserve of about 44 t C ha^{-1} for the unfertilized plots and 50 t C ha^{-1} for fertilized plot by the 2030.

Continous SOC loss indicate that even with fertilization it would be difficult to preserve initial content in soil. RothC model data suggest that returning and properly manage all crops residue is crucial in the preservation of SOM (Baraníková et al., 2010). With lower yields, narrow rotation (without legumes) and projected climatic changes it would be a great chalange to maintain SOM level observed at 2010.
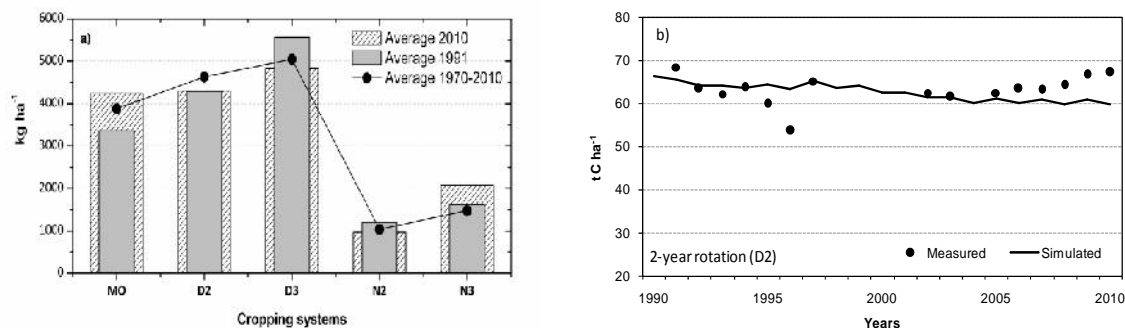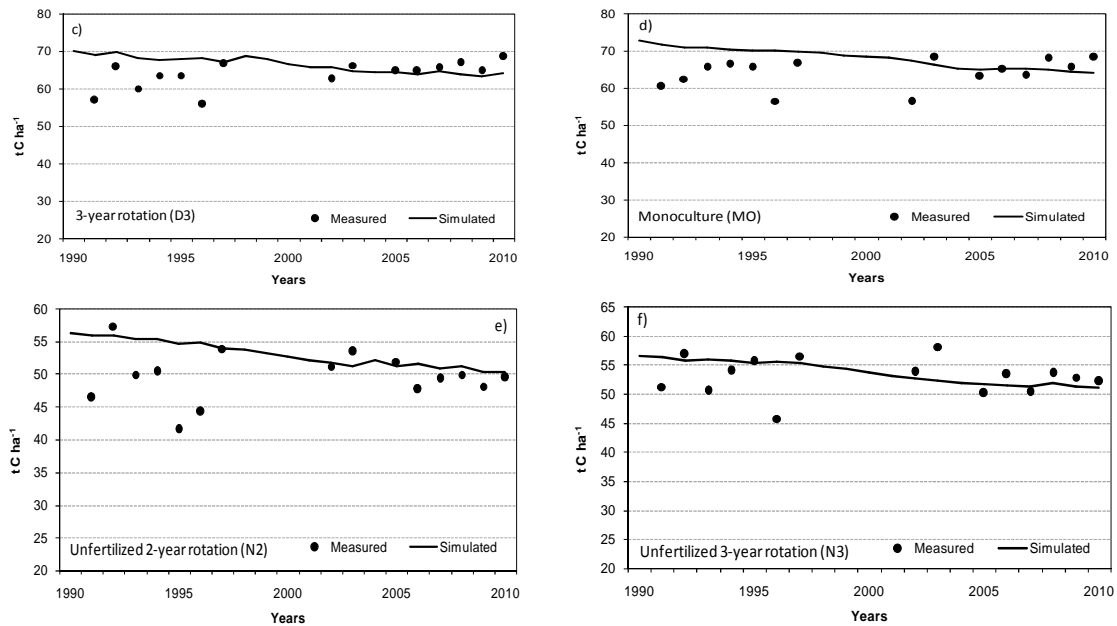
Figure 1. a) winter wheat grain yield, Roth C model and measured C (t ha^{-1}) for b) 2-year rotation, c) 3-year rotation, d) wheat monoculture, e) unfertilized 2-year rotation and f) unfertilized 2-year rotation

Higher correlation of measured and modelled data was observed with D3, whearas other cropping systems showed no correlation (Table 1). The significant RMSE for investigated plots indicating that the simulations fell within the 95% confidence interval of the measured data (Coleman and Jankinson, 1996). The simulation biases expressed as M were all significant because all the values of t of M were less than the 2.5% critical two-tailed t-value. Values of M and E rank model bias similarly. A significant bias in a given simulation indicated by E for the no fertilization plots was -5.76 and -1.13, respectively for N2 and N3. For the fertilization plots E values was 1.27 for D2, -3.76 for D3 and -5.73 for MO. The close match between the simulation lines and the measured data was again reflected in low values for E which were all well below the respective E95% values, suggesting that there was no significant bias towards either over- or under-prediction by model.

Table 1. Statistics describing aspects of the performance of the RothC models when simulating data from long-term experiment at Rimski Šancevi

Statistics		D2	D3	MO	N2	N3
r = Correlation Coeff.		-0.09	-0.58	-0.34	0.01	0.01
Assuming no model parameters adj. k=1.						
	F = ((n-2) r^2) / (1-r^2)	0.12	6.48**	1.65	0.00	0.00
	F-value at (P=0.05)	4.67	4.67	4.67	4.67	4.67
RMSE	Model	6.48**	8.73**	10.03**	9.45**	7.04**
	95% Confidence limit	12.01	11.90	11.84	15.16	14.33
E	Model	1.27**	-3.76**	-5.73**	-5.76**	-1.13**
	E 95% Confidence Limit	10.33	10.23	10.18	13.03	12.32
M	Model	0.81**	-2.39**	-3.67**	-2.88**	-0.60**
	t = Student's t of M	0.75	-1.78	-2.59	-2.86	-0.61
	t-value (Crit. at 2.5% - 2-tailed)	2.16	2.16	2.16	2.16	2.16

r = Correlation Coeff; RMSE = Root mean square error of model; RMSE (95% Confidence Limit;E = Relative Error M = Mean Difference (t-value critical at 2.5% - 2-tailed =2.10)

Conclusion

The modelling SOM in soil approach represents one of the most promising methods for the estimation of the stock and changes of SOC. On the basis of our results, it can be concluded that RothC model is suitable for the estimation of SOC stock changes in agricultural soils and can be used for the modeling of SOC stock changes on the chernozem soils with similar agroecological conditions. Generally, the fertilized rotation in topsoil were lower in C stock by 10 % in comparison with 1991 by 18% (D3 and MO) or 25% (MO) compared with 1970 and by 30 % compared with 1940-50. The unfertilized plots were lower 10% lower than 1991 and 45% lower compared with 1940-50.

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IMPORTANCE OF GENETICALY MODIFIED ORGANISMS

Desimir KNEZEVIC[1*], Danijela KONDIC[2], Sretenka MARKOVIC[2]

[1]Faculty of Agriculture, University of Pristina, Lesak,Kosovo andMetohia, Serbia,
[2]Faculty of Agriculture,University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: deskoa@ptt.rs)

Abstract

In the past, men, at different levels of practice and science, dealt with the plants and animals in specific environmental conditions according with their needs and abilities. Selected plants, fruits and seeds as well as animals of which man had the greatest benefit were cultivated. By learning from nature and adopting scientific knowledge man developed methods of creating an economic and cost-effective varieties and hybrids. At the same time he was developing methods of breeding, feeding and protection from environmental stress factors. In the breeding practice man used heterosis in plants, induced mutations, and nowadays new techniques in biotechnology. Numerous varieties and hybrids were created using conventional breeding methods, which are characterized by a high genetic yield potential. Breeding effects are evident in the change of architecture of plants, ripening time, increased productivity as well as biodiversity. Studies have shown that breeding programs of important plant species contributed to the average annual yield increase in about 1%. However, the application of new bioengineering technologies has contributed significantly to increased productivity of plant species. Realization of several times higher yields is crucial in ensuring safe raw materials for food production and helping to solve world hunger.

Keywords: genetically modified organisms, genes, food safety

Introduction

Since the genesis of living beings it was expressed diversity at all system levels of the organization as well as within taxa. Mechanisms of maintenance of organisms variability were expressed in the reproduction process and coexistence with the other living beings and environmental conditions. Although the man since his creation had selection approach in the use of plants and animals for their own needs, he did not know the causes of the recognized advantages of the organisms and was not able to explaine them scientifically. With the explanation of sexual reproduction of plants in the 17th century, it was open new perspective for the possible impact of changes in plant organism. With the first cross breedings between organisms man has created the first engineering, although the open pollination and fertilization of these processes already existed in the nature. In the second half of the 18th century from cross breedings are created new varieties and hybrids of different plant species. The knowledge of the inheritance of traits is provided planned cross breeding and directed selection of genotypes. Hard work in organisms breeding is proved to be justified and successful where as a result has been achieved increment in the total biomass production, yield, quality and content of organic compounds, resistance to the pests and diseases as well as increased adaptibility to environmental conditions (Knezevic et al., 2006).

Changes in characteristics of the organisms in the cross breeding process have been carried out on the basis of reproductive compatibility (Kondic et al., 2012) and had a contribution to maintatance and increment of genetic variability and economic impact in terms of increasing the quantity and quality of food.

Progress in the cross breeding of organisms and their transformation was accompanied by the development of the scientific methods. Special contribution has been given by the study that gives knowledge of the role of the individual genes and their function regarding on the interaction with the other genes. In addition, it is important to know the function of gene compensation for the damaged gene, which might be caused by physiological nature on the level of the metabolism adaptation or the level of activation of multiple allels. To create varieties and hybrids with higher yields and quality and increasing adaptive ability were used sources of genes from natural population, wild relatives of certain species. The major challenge for research in the laboratory and in the field experiments is the ability to identify and evaluate the variability of genes allels that have the function of the controlling the phenotypic changes.

Modern technology including recombinant DNA technology provides an opportunity for studying gene function and genetic regulation of gene interactions. With this technology is possible to determine the gene sequences that could be used for genetic mapping and to determine the chromosomal locations of genes that control the required properties. Beside that it is possible to detect and to take advantage of the changes in DNA sequence that occure due to changes of basis, deletion or addition of purine or pyrimidine base or varying the number of repetition of short sequences. In order to determine the diferences it is used restricted enzymes or plymerase chain reaction (PCR) which requires separation of DNA on the gel (Karp et al., 1997).

Also, biotechnology allows the transfer of favorable allels at loci through conventional cross breeding using marker technology and the introduction of new loci at the transformation. This feature is essential for the transfer of desirable genes from wild relatives of one species. One of the most important goal of transformation is to improve crops in relation to their protection using herbicides and insecticides (Miflin, 2000). There are numerous examples of the transformation of the genome and introduction of genes that are responsible for resistance to herbicides.

Creation of genetically modified organisms

Creation of genetically modified organisms is based on the results achieved in 1973 with using restriction enzymes, bacterial nuclease, which accurately recognize and cut the DNA chain, whereupon such fragments can be reconnected i.e. recombined. During the following two years at Stanford University it was found that the gene recombination can be done not only in bacteria but also in vertebrates (Berg *et al*., 1974, 1975). This possibility has caused concerns that led to fear for the future and strengthening security, which initiated introduction of rules in performing experiments with recombinant organisms. The first rules were defined in 1975 in USA which also included ethical code. Despite many obstacles and suspiciousness, biotechnology is developing rapidly especially in the pharmaceutical and food industry (Konstatinov & Drini -Mladenovi , 2006). The first examples of products derived by recombinant DNA technology are: cheese obtained with synthesized enzyme chymotrypsin, increased lactation of cows by injecting recombinant bovine somatotropin, *FlavrSavr* tomato with extended freshness, insect-resistant Bt corn, golden rice which contains more carotene and iron, etc.

This technology has contributed to the production of specific protein in bacteria instead of expensive and slow industrial processes. To create genetically modified organisms altered through recombinant DNA technology at least two genes should be inserted, of which one should allow the synthesis of a protein that is required for commercial use and the second gene that serves as a marker. This technology has made it possible to carry out the transfer of

genes from evolutionarily distant, unrelated, species of organism into another, without provoking transformation of one organism to another, but only the expression of desirable trait in organism that the gene was inserted into.

Plant breeding to increase yields, resistance to disease and other stress factors, is focused on the introduction of genes controlling resistance to insects, causal agents of disease, herbicide resistance.Up today, was realized transfer of genes which are controlling these traits in numerous diffeent agricultural plant species: corn soybeans, cotton, sugar beets, potatoes, pumpkin, banana (Knezevic et al. 1998; Drini Mladenovic et al., 2006).

So, the transfer of genes from yeast was achieved in tomato lycopene content three times higher than that of ordinary tomatoes, and expression of three enzymes, the levels of flavonoids and antioxidants in potatoes were increased in potatoes.From wheat to corn is transferred gene that controls the synthesis of enzyme dehydoascorbate reductaze and modified corn has increased contents of vitamin C, more than 100 times (Chenetal., 2003), and transformed genes controlling vitamin E, which have been isolated from barley, wheat and rice, wheat and rice and by its transferring into the corn had the effect to increasing 6 times of contents of vitamin E (Cahoonetal., 2003).

GMO Safety use

The creation of genetically modified organisms, has allowed greater production of raw materials for the food industry, thanks to productivity gains multiple GMOs in relation to the breeding organisms obtained by classical methods. GM plants have a higher content of protein, oil, starch with a specific structure. Specific biochemical composition can have different effects on human health. There are examples of some of GM organisms used as a human food caused adverse effects. So, GM soya, in which is transferred gene from Brazilian nut, used as food caused allergic reactions in people, or transgenic tomato with a gene from the fish, used in human food, was causing allergies in people who are normally allergic to fish.

On the base of this, is possible say that it's not just the gene and its expression, no matter what organism is. This leads us to not exclude pleiotropic effect of foreign genes, which increases the unpredictability of the possible effects of GM foods. If we look without prejudice the effect of transgenic organisms, we can say that up to nowdays registered negative effects of GMO are not only frightening, but is normal and expected, considering that among the natural plants and animals are the ones that cause certain adverse reactions that are known as an allergy to milk, flour (lactose, gluten).

In addition to higher yields, which is the most important economics feature, the advantage of GM crops was increased resistance to diseases and pests and viruses, which helps to reduce costs due to reduced use of pesticides during cultivation. This can be illustrated by the sweet potato in Africa in which the transferred gene for resistance to *FeatheryMottleVirus*, which had a 60% higher yield than ordinary potatoes. In transformed organisms can be achieved increasing of adaptability to different environmental factors, such plants with high content of linoleic acid are more resistant to low temperatures and frost. Or, plants with entered resistance to herbicides allow more effective control of occurence of weeds in crops. From this, it can be derived that the creation of plants with desirable functional properties, contributes to reduced allergenicity, toxicity, extending maturing plant species, increasing the content of starch, improved the proteins and fats, etc.. which is of great nutritional importance.

Advantages of GMO crops and food in developing countries is reflected in the quality of nutrition and health, improving: the quantity and quality of meat, milk and livestock

production, the ability to clean and safe method for the production of edible vaccines and medicines, reduced use of fertilizers and herbicides, and the preservation of agricultural resources and so on.

Disadvantages of using GMOs are reflected in the appearance of loss of genetic diversity of crops, and thereby economic losses, the threat of use of generic drugs, change the nutritional quality of food, many religious and ethical pressures, potential monopoly ownership of major food products.

It is important to promote the existence of selection, approval, precautions and preventive measures in the field of biological safety, food safety, consumer choice, public research and commerce are contained in the developing countries (Gómez-Galera et al., 2010). Public debate and concern in industrialized societies about environmental protection, uncertainties and risks for health with the use of GMO technology, should not discourage developing countries to use GM crops to harvest and that use of GMOs can solve their most pressing problems of hunger and malnutrition.

The use and trade of genetically modified organisms is framed by appropriate and legislation in the European Union. Food which is derived from genetically modified organisms should not be present more than 1% of the specific product and must be labeled (Ramessar et al., 2010).

Conclusion

Food production is very important on a global and local level, so that the variation in the quantity and quality of food causes certain changes on the market in terms of supplying and demanding. This is an important factor for connecting all institutions and companies in the chain of production and distribution of food to provide for mankind healthy and safe food, that meets the nutritional requirements for quality and technology. Modern agriculture is characterized by large production of genetically modified organisms (GMOs), GM crops and products of them in the world. Economy and biothechnology in the most overpopulated states in the world, is based on GMO agriculture that is the field of interest of all spheres not only politics and science. Also, a number of fermented foods that may contain all or a parts of natural organisms, are prepared and stored in a safe hygienic conditions and are in wide use. Achievement in biotechnology contribute to the improvement of life in the agricultural and economically poor countries. Investigations in molecular biology are increasingly associated with information technology and nano-technology, which leads to new achievements in the field bionanomatics. However, we are aware of the fact that the developed world already met his heeds in the food using intensive agriculture in disturbed ecosystems in which is placed a "dirty industriy". Today developed world stimulate ecological awareness and organized movement for organic food production. Regardless of the legitimity of different views on the importance of biotechnology and GMOs, it is fair to say that responsible biotechnology is better than the phenomenon of hunger and vulnerability of human health.

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Acknowledgements

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VIGOUR, YIELD COMPONENTS AND FRUIT WEIGHT OF SOME PLUM (*Prunus domestica L.*) CULTIVARS DURING EARLY YEARS AFTER PLANTING

Ivan GLISIC[1*], Tomo MILOSEVIC[1], Evica MRATINIC[2], Gorica PAUNOVIC[1], Ivana GLISIC[3]

[1]Faculty of Agronomy, University of Kragujevac, Cacak, Serbia
[2]Faculty of Agriculture, University of Belgrade, Serbia
[3]Fruit Research Institute, Cacak, Serbia
(Corresponding author: glishoo@yahoo.com)

Abstract

This study presents three-year results on the effect of pomological practices [shoot bending, pinching off the shoot tip (decapitation), shoot notching, heading back to 3-5 buds at the poorly developed basal leaf zone] undertaken during the growing season in 5 plum cultivars. The research was conducted from planting date until the fifth growing season, involving cvs. a anska Rana, a anska Lepotica, a anska Najbolja, a anska Rodna and Stanley, grafted onto Myrobalan seedling rootstock.

The results showed that tree vigour as measured by trunk cross-sectional area was highest in cv. a anska Najbolja (55.14 cm^2) and lowest in a anska Lepotica (27.06 cm^2). a anska Rodna and a anska Najbolja produced their first yields already in the second year after planting. All cultivars obtained their first substantial yields already in the third year after planting (a anska Rana 2.48 t ha^{-1}, Stanley 4.17 t ha^{-1}, a anska Rodna 7.31 t ha^{-1}, a anska Najbolja 7.68 t ha^{-1}, a anska Lepotica 8.35 t ha^{-1}). Cumulative yield was highest in a anska Rodna (47.18 t ha^{-1}), and lowest in a anska Rana (11.09 t ha^{-1}). Yield efficiency showed variations across cultivars and years of the study, whereas the fruit weight values were not significantly different from the literature data reported for the cultivars tested, and ranged from 52.75 g in a anska Rana to 24.83 g in a anska Rodna.

The use of the above pomological practices during the growing season induced early fruiting, satisfactory to excellent yields in the early years after planting, and reduced tree vigour in the plum cultivars analysed.

Keywords*: plum, pomological practices, summer pruning, yield.*

Introduction

In terms of the volume of production, plums are the most important fruits in Serbia. In 2010, Serbia ranked second in Europe and third worldwide after China and Romania, with an annual plum production of 426.846 t and an acreage over 130.000 ha of land (FAOSTAT, 2012). The most widely grown cultivars include a anska Lepotica, a anska Rodna, Stanley, a anska Najbolja and a anska Rana (Miloševi and Miloševi , 2011). According to Paunovic et al. (2011), the most dominant and maybe the only rootstock used for plum grafting is Myrobalan seedling (*Prunus cerasifera,* Ehrh.). Primarily due to its vigour, the Myrobalan rootstock causes certain problems in plum cultivation such as late fruit-bearing and high tree vigour (Mika et al., 2001; Milosevic et al., 2008). This fact, along with some other deficiencies of this rootstock, is the reason why some authors do not consider Myrobalan for use in highly intensive plum production (Elfving, 1988; Gaash et al., 1989; Weber et al., 1994). In order to overcome and solve these problems associated with Myrobalan rootstock, adequate pomological practices should be employed to a large extent

during the growing season instead of winter pruning, in the early years after planting (Gliši and Miloševi , 2006). Shoot bending, pinching off the shoot tip (decapitation), shoot notching, and summer pruning of shoots can contribute to a reduction in and subsequent control of tree vigour, as well as to early fruiting in plum trees (Mika and Piatkowski, 1989; Dimkova and Vitanova, 2001; Mi i et al., 2005; Gonda, 2006).

The objective of this study was to evaluate the effect of pomological treatments employed during the growing season in the early years after planting on tree vigour and yield components of different plum cultivars grafted onto Myrobalan seedling rootstock.

Material and methods

The research was conducted in a plum orchard at Gornja Gorevnica, 9 km northwest of a ak (20°57'48" N; 20°19'31" E; 396 m a.s.l). The plum cultivars used in the experiment included a anska Rana, a anska Lepotica, a anska Najbolja, a anska Rodna and Stanley. Myrobalan (*Prunus cerasifera* Ehrh.) seedling was used as the rootstock. The orchard was planted at a spacing of 4 m x 2 m (1.250 trees ha^{-1}). Spindle bush training system was used. During the first 4 years (each year), the following pomological treatments were applied during the growing season instead of winter pruning:

1. shoot bending, using toothpicks when shoots reached 30-40 cm in length;
2. pinching off shoot tips (decapitation), applied to 40-50 cm long shoots adequately positioned within the crown. Inadequately positioned or extremely vigorous shoots in the crown were completely pruned off during the growing season;
3. shoot notching, conducted at the stage of bud scale separation (stage 03 of the BBCH scale of vegetative bud development in stone fruit trees (Meier, 2001); with the light green bud sections clearly visible;
4. heading back to 3-5 buds at the poorly developed basal leaf zone, performed 60 days after the end of flowering (mostly the second half of June).

From the second to the fifth growing season, measurements included trunk diameter at 10 cm above the graft union, yield per tree, yield per unit area, and fruit weight, whereas trunk cross-sectional area and yield efficiency were calculated. The experiment was conducted in 3 replications, each with 10 plum cultivars i.e. 20 fruits.

The data were subjected to analysis of variance, and differences between arithmetic means were assessed by the LSD test at $P< 0.05$ and $P< 0.01$ using the statistical software SPSS 5.0 (SPSS Inc., Chicago, IL, USA).

Results and discussion

The results on the effect of pomological practices used during the growing season on the trunk cross-sectional area (TCSA) of plum cultivars are presented in Graph 1.
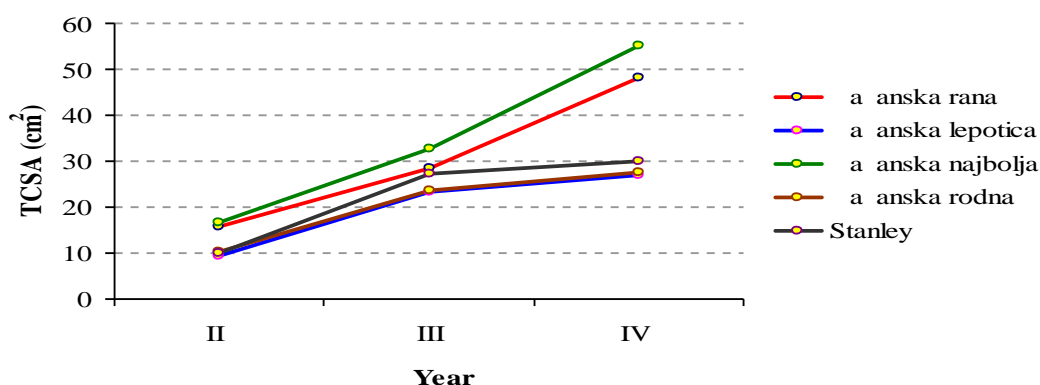
Fig. 1. Trunk-cross sectional area (TCSA) of plum cultivars

The results show that, during all years, TCSA was lowest in cv. a anska Lepotica, followed by cvs. a anska Rodna and Stanley, and highest in a anska Rana and a anska Najbolja. At the end of the fourth growing season, TCSA was 27.06 ± 1.12 cm^2 in a anska Lepotica, 27.43 ± 1.02 cm^2 in a anska Rodna and 29.99 ± 2.05 cm^2 in Stanley, whereas the highest values were found in a anska Rana - 48.32 ± 3.90 cm^2 and a anska Najbolja - 55.14 ± 4.10 cm^2. The difference between a anska Najbolja and a anska Rana was statistically significant, whereas the vigour of both cultivars highly significantly differed from that of Stanley, a anska Rodna and a anska Lepotica, which showed no significant differences at the end of the fourth growing season.

TCSA values were almost identical to those obtained by Dinkova et al. (2007) who produced plum cultivars on Myrobalan seedling, but with no substantial use of pomological practices during the growing season. This suggests that it is difficult to affect TCSA values by pomological treatments during the first and second years after planting. However, in the third and fourth growing seasons, in the present study, tree vigour was lower than that of the same cultivars grown at a higher spacing with the use of winter pruning only (Miloševi et al., 2001; Vitanova et al., 2007).

The results on the effect of pomological treatments applied during the growing season on yield components in plum cultivars are given in Tab. 1.

Tab. 1. Yield components of plum cultivars

Cultivar	Yield per tree (kg)			Yield per ha (t)			Cumulative yield (t ha^{-1})
	2nd year	3rd year	4th year	2nd year	3rd year	4th year	
a anska Rana	/	1.99 ± 0.09d	6.88 ± 0.05d	/	2.48 ± 0.12d	8.61 ± 0.08d	11.09 ± 0.09d
a anska Lepotica	/	6.68 ± 0.07a	11.45 ± 0.09c	/	8.35 ± 0.09a	14.31 ± 1.30c	22.66 ± 2.08c
a anska Najbolja	1.47 ± 0.10a	6.14 ± 0.07ab	4.10 ± 0.05d	1.85 ± 1.40a	7.68 ± 0.08ab	5.12 ± 0.07d	14.65 ± 1.12d
a anska Rodna	1.08 ± 0.08b	5.85 ± 0.04b	30.82 ± 2.88a	1.35 ± 0.10b	7.31 ± 0.07b	38.52 ± 3.50a	47.18 ± 3.90a
Stanley	/	3.34 ± 0.03c	22.70 ± 1.85b	/	4.17 ± 0.04c	28.38 ± 2.15b	32.55 ± 3.00b

 a anska Rodna and a anska Najbolja produced their first yields already in the second year after planting (1.35 ± 0.10 t ha^{-1} and 1.85 ± 1.40 t ha^{-1}, respectively). The first substantial yield in all cultivars was obtained in the third year after planting, ranging from 2.48 ± 0.12 t ha^{-1} in a anska Rana to 8.35 ± 0.09 t ha^{-1} in a anska Lepotica. In the fourth year after planting, cvs. a anska Rodna and Stanley attained almost maximum yield potential – 38.52 ± 3.50 t ha^{-1} and 28.38 ± 2.15 t ha^{-1}, respectively. a anska Lepotica gave a moderate yield – 14.31 ± 1.30 t ha^{-1}. Likewise, the yield of fresh market cultivars a anska Rana and a anska Najbolja in the fourth year after planting was not negligible – 8.61 ± 0.08 t ha^{-1} and 5.12 ± 0.07 t ha^{-1}, respectively. The cumulative yield obtained in the first four years after planting was lowest in a anska Rana (11.09 ± 0.09 t ha^{-1}) and somewhat higher in a anska Najbolja (14.65 ± 1.12 t ha^{-1}), but the difference between the two cultivars was not significant. Cumulative yield was 22.66 ± 2.08 t ha^{-1} in a anska Lepotica, 32.55 ± 3.00 t ha^{-1} in Stanley, and 47.18 ± 3.90 t ha^{-1} in a anska Rodna. The differences among the cultivars were highly significant, as well as those compared to a anska Rana and a anska Najbolja.

The results on yield typically provide the best indication and estimate of the care and management practices and cultivation systems used. In this study, the first yield was attained as early as in the second year, which is highly important in terms of the return on investment, but also due to the fact that vigour is best controlled by yield (Mika, 1992; Blažek et al.,

2004). Mi i et al. (2005) evaluated plum cultivars trained to slender spindle and grown on Myrobalan rootstock, and reported an initial yield of 48-112 fruits per tree or 1.2-2.8 kg per tree in a anska Rodna in the second year. Similar results were obtained in the present study. The yield produced in the third and fourth years after planting was almost double the yield reported by Mitrovi et al. (2005) in a cultivation system without the use of shoot bending and other pomological treatments during the growing season. For the sake of illustration, the yield produced in the third year in the present study was similar to that obtained by Jankovi et al. (1997) from the fifth to the eighth year at a spacing of 6 m x 4 m, with winter pruning applied. The use of pomological treatments during the growing season instead of winter pruning significantly contributed to early cropping and early production of substantial yields. The vegetative development during the initial years after planting was characterised by an intense growth of shoots, due to the use of Myrobalan seedling as a rootstock. Shoot bending during the growing season and other practices reduce the mobility of nitrogen and cause carbohydrate accumulation in the shoots by the end of the growing season (Gaudillére et al., 1992; Moing et al., 1993). This resulted in a high degree of flower bud differentiation in all cultivars and fruit-bearing in some cultivars in the second year, and led to significant yields of all cultivars already in the third year.

The results on the effect of pomological practices used during the growing season on yield efficiency and fruit weight in plum cultivars are presented in Tab. 2.

Tab. 2. Yield efficiency and fruit weight of plum cultivars

Cultivar	Yield efficiency (kg cm^{-2})				Fruit weight (g)			
	2nd year	3rd year	4th year	Average	2nd year	3rd year	4th year	Average
a anska Rana	/	0.07±0.01c	0.14±0.01 d	0.10±0.01 c	/	52.75±4.11 a	50.26±4.02 a	51.50±4.06 a
a anska Lepotica	/	0.29±0.02a	0.42±0.03 c	0.36±0.03 b	/	36.69±1.15 b	32.65±1.02 b	34.67±1.08 b
a anska Najbolja	0.09±0.01	0.28±0.01a	0.07±0.01 d	0.14±0.01 c	51.27±4.88 a	48.80±3.20 a	51.74±4.00 a	50.60±4.01 a
a anska Rodna	0.10±0.01	0.25±0.01a	1.12±0.09 a	0.49±0.04 a	25.26±1.12 b	28.75±2.00 c	20.48±0.16 c	24.83±1.09 c
Stanley	/	0.12±0.01b	0.75±0.03 b	0.43±0.02 ab	/	36.61±2.03 b	33.49±3.05 b	35.05±2.54 b

The average yield efficiency was lowest in a anska Rana (0.10±0.01 kg cm^{-2}), and somewhat higher in a anska Najbolja (0.14±0.01 kg cm^{-2}). However, the difference between the two cultivars was not statistically significant. Significantly higher yield efficiency values were obtained in a anska Lepotica (0.36±0.03 kg cm^{-2}), Stanley (0.43±0.02 kg cm^{-2}) and a anska Rodna (0.49±0.04 kg cm^{-2}). Although a anska Rodna and Stanley gave the highest values for yield efficiency, they exhibited very large variations across years, whereas a anska Lepotica had stable yield efficiency throughout the study. These results completely comply with those of Nenadovi -Mratini et al. (2007), who reported highly stable yields of a anska Lepotica during a three-year study, as compared to a anska Rodna and Stanley. In general, the average values of yield efficiency are satisfactory and in agreement with the results obtained by other authors in highly intensive plum orchards (Blažek et al., 2004; Meland, 2005). The average values obtained for fruit weight were consistent with cultivar-specific traits. The average fruit weight was lowest in a anska Rodna (24.83±1.09 g), significantly higher in a anska Lepotica (34.67±1.08 g) and Stanley (35.05±2.54 g), and highest in a anska Najbolja and a anska Rana (50.60±4.01 g and 51.50±4.06 g, respectively). Fruit weight showed differences across years, and was found to correlate inversely with yield. Sosna (2010) reported an average fruit weight of a anska Lepotica of 31-32 g, but a total annual yield of over 32 t ha^{-1}. The average values of fruit weight in the present study are mostly in agreement with the findings obtained under different cultivation

systems by many authors (Mitrovi et al., 2005; Magyar and Hrotkó, 2006; Vitanova et al., 2007; Sosna 2010). The pomological practices used during the growing season did not significantly contribute to obtaining a stable increase in fruit weight in plum cultivars during the initial cropping years.

Conclusion

The pomological practices used during the growing season in plum cultivars in the early years after planting induced a reduction in tree vigour as measured by trunk cross-sectional area (TCSA). Reduced vigour was highest in a anska Lepotica, a anska Rodna and Stanley, and somewhat lower in a anska Rana and a anska Najbolja.

 a anska Rodna and a anska Najbolja produced their first yields already in the second year after planting. All cultivars obtained their first substantial yields already in the third year after planting. Cumulative yield by the end of the fourth year was highest in a anska Rodna, followed by Stanley and a anska Lepotica. Likewise, the yield of fresh market cultivars a anska Rana and a anska Najbolja was not negligible.

Yield efficiency was highest in a anska Rodna and Stanley, and most stable throughout the years in a anska Lepotica.

The results on fruit weight were in agreement with cultivar-specific traits, with a anska Rana and a anska Rodna obtaining the highest and lowest values, respectively.

In the early years after plum planting, the pomological treatments used during the growing season induced reduced tree vigour, early fruiting, and satisfactory to very high yields in the third and fourth growing seasons, but did not lead to increased fruit weight in the plum cultivars analysed.

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EVALUATIONOF ONTOGENIC CHANGES ON YOUNG PLANTLET IN MICRO PROPAGATION OF GRAPEVINE (V. vinifera ssp. Sylvestris)

Edlira KUKALI[1*], Anarita LEVA[2], Efigjeni KONGJIKA[3]

[1]Horticulture Department, Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania
[2]Institute for the use of Wood and Tree species National Research Council (CNR) Florence, Italy
[3]Albanian Academy of Science, Albania
(Corresponding author: edlirakukali@yahoo.com)

Abstract

Studiedin this researchwaschlorophyll variability inyoungshoots ofthe grapevine(Paulsen &Kobbercultivars) in propagation "In Vitro". Two rootstocks of grapevine, inoculated for proliferation and rooting, in mediaMS, "In Vitro", withtwodifferent synthetic hormones in it, ANA andBAP. Searchindicator received chlorophyll, incorrelationwith the percentage ofsugarandhormonesatthreesubcultures. TheInitiationof callus from bud yeaststarted inculturecontaining1mgl^{-1}and2mgl^{-1}BAPand1mgl^{-1}and2 mgl^{-1}ANA. Sucrose used intwodoses30and60g/l. Based on observationsofemissionfoliar(leafy) growthin length, significantlyinfluencedthe formation of callus was (1:32 LSD, q=0.05) fromthe concentration ofBAPandsucrose.

Best resultsobservedwithhighdosesofBAPandsucrose(78%). Concentration of60g /lsucroseimproves theinduction, differentiationandpromotesregeneration of callus, better.Youngshootsin threesuccessivesubculturehavebeenfoliarandrootphenotypewithoutchanges(LSD 1.11, q=0.05). Variance of variability like effect of vitrification was small; cv=1.9 (coefficient of variation)

Keywords: In vitro, *Paulsen, Cobber*, saharoza, vitrification

Introduction

This work carried out about micro propagation of grapevine securedregeneration tworootstocks 1103Paulsenand Kober, through the application ofmineralconstituentandresearchingdifferentformulationsdepending on thegenotype. Study of tworootstocks ,whichconstitute85% ofthematerial of propagate, with impactofdifferentconcentrationsofcitocininandimpactonthe rate ofmultiplicationintendedtoexamineandfindeffectofculturesandshowthesuperiorityofBAPconce ntrationincultureMSin relationotherformulationstested.

Material and methods

Explants of two grapevine roots, 1103 P and Kober, inoculated nutrient soils MS with relevant additions to study the physiological changes, to explants in plantlets. Citocinin BAP applied in concentrations; (T1-1 mg l -1 and T2 2 mg l -1). Subculture carried out every 45 days of armpit buds, obtained. Explants and all cultures placed in a vegetative room (temperature 23 ° C ± 2 ° C, the intensity of the lighting 2000 luxury and photoperiod 16 hours), with white light with 30-35. Indicators of research : .i. Definition of regenerative potential, ii. Explants number, iii. Number of buds, iv. Length of new shoot for explants.

Results and discussions

Results of three years resulting from treatment expletive placed in culture MS1 with two concentrations of BAP, have proven positive impact on increasing the capacity proliferate seedlings, and buds all expletive of cultivars 1103P and Kobber. (Tab1 and 2)

(1)   (2)   (3)   (4)   (5)   (6)
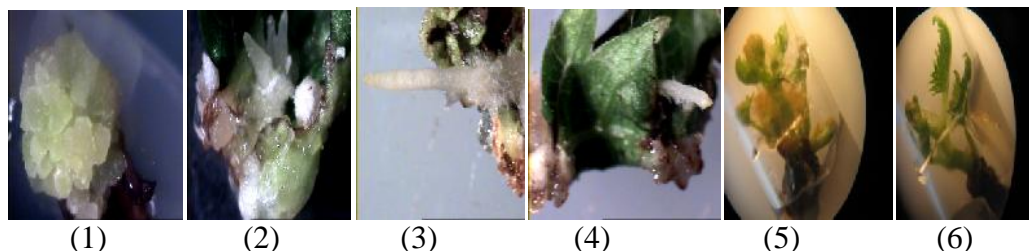
Photo (1,2,3,4) Differentiation Callus tissue.(5-6) proliferation in plantlets.

Results indicate that BAP at any concentration applied, has been important in cell division and increasing the length of the sprouts. Benzilaminopurina (BAP) significantly influenced the rapid proliferation of the cells and the highest dose, influenced better in increase in spur length. Evaluations performed about 20 days after inoculation represent increased by 5mm to 17mm but different in both cultivars. Sizes greater than bisques growths achieved when it is applied BAP concentrations 2 mg / l $^{-1}$. Using these nodal segments cut, to identical manner, improved multiply and after planting material and their development made possible interfering use for the realization of the recurrent cycle's initial propagation. In this way, is ensuring large number explants, in a relatively short period of 30-40 days. BA concentrations, influence on morphological characteristics of vegetable material. In table one and two, are three-year averages explants blown and differentiated leafs. Stage included the induction of meristematic centers of which are developed adventives organs. Shoot produced, used as the basis, for further breeding cycles, in which, they passed back to the culture (Subculture) to add to their number, and to prove their propagation coefficient.

Table 1. Means for oneway of Anova above average explants light and the number of leaves differentiated. (Each treatment = 16 explants)

Treatment	Number Repetition	Mean Nr Leaf	Mean. Nr explants vivid
KO 1mlg/l	4	31.2500 ±2.88	7.25 ±1.89
KO 2mlg/l	4	50.0000 ±2.43	10.00 ±0.81
PA 1mlg/l	4	44.2500 ±1.83	10.00 ±0.81
PA 2mlg/l	4	56.0000 ±1.12	10.50 ±0.57

Evaluation of morphological development has shown variability in starting capacity and growth in two cultivars of grapevine under the effect of different concentrations cytokinins. In general, the effect of BAP was powerful, because it has fostered a better rate and morphologic homogeneity propagation of seedlings, always interdependent concentration used in correlation with the features of genetic material.

Table 2. Means for one way ANOVA of the number of explants blown by subcultures
Std Error Uses a pooled estimate of error variance

Treatment	Number of Repetition	Mean of expl vivid	Number leaf vitrifikuar
Subcult-1	4	10.7 ±0.50	0
Subcult-2	4	9.5 ±1.73	3
Subcult-3	4	8.7 ±1.89	6

Using cytokinins gave large effects on the percentage of the opening and the formation of numerous seedlings from micro cleavage committed in aid buds, made in plants, cv. rootstocks 1103 Paulsen, Kobber. We analyzed two concentrations benzyl adenine (BA 1.0, 2.0 mg/l^{-1}), concentration 2 mg/l^{-1}, has given the best answer morphological. Good results have been above all concentrations, but particularly 2, mg / l^{-1} have disposed flourishes with the highest percentage, and seedling multiplication. In which treatment is used BA 2mg / l^{-1} of stitch inoculated are differentiated average from 10 -10.5 explants and the 50-56 leaves, for each explants planted. Results of all years for treatment averages, prove that 2 mg / l^{-1} had the best indicators to the two types of proven and significant changes for HSD lsd.1.67, that it proves the effectiveness of use BAP dosage has therefore a maximum coefficient multiplication of buds and percentage of hatching.

Studies and the results for the capacity organogenic fragments stitch present interesting data for the development of explanted in the way of direct organogenesis. It is observe that immediately after the beginning of cultivation breeding ground, according Pierik; epidermal cells, show clear, differentiation cell characteristics, such as large diameter cores, nucleoli pyrophilic and cytoplasm currents visible.

Phase, defined as activation or meristematic. In 4-daylong explants, observed periclinal divisions in all epidermal cells, while 6-8 daylong explants, except appropriations periclinal, which increase in number, begins to appear anticline divisions in epidermal cells. This phase was similar for all the genetic material in the experiment. However, after 10 days, in explants appear primordial leafs strands, and it is differentiated in time and intensity influenced by genetic material. Remarkable for the opening speed 1103 Paulsen.

Percentage of explants, cv 1103 P fluctuated in accordance with the concentration of cytokinins. At a level, 66.1% obtained for auxiliary buds, with 2 mg / l^{-1} BA, in cv.1103 P. For these cultivar acceptable results, 62 % obtained also in 1 mg / l^{-1} BA

In the analysis of the ability proliferates the two cultivars, with weak results had cv. Kober, in terms of percentage explanative blown; bud and shoot multiplications coefficient (B.M.C) (S.M.C)
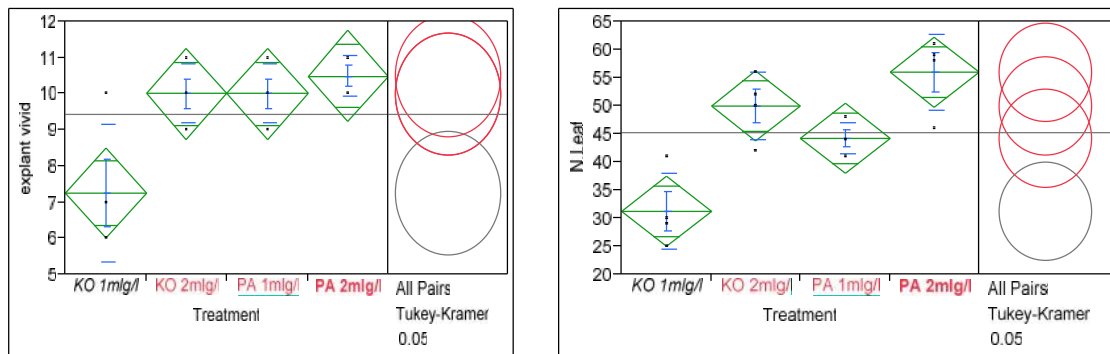
Graphic 1 and 2. Onaway Analysis of explant vivid By Treatment and Number of leaf by Tretment.

Cv.Kobber, has anatomical features with changes, in rootstock 1103P. Significant changes related to the size of large bone and reduced levels of wood tissue and flumes. Particularly cortexes tissue, which is the development, processes of reproduction and differentiation of seedlings and radical explants.

Variables replays average, each treatment, were within the limits of the standard deviation, without statistical differences, while the effect of applied concentrations of BAP has different effects on the development and growth of meristem. There are no major changes, intwomoments ofisolation, but in terms ofdosage,2mg/l^{-1}is provide, into others, thenumber, seedlingandlargersize.

This result was identical in all subculture, analyzed in ANOVA testing for LSD 1.39, demonstrating that in vitro application, for micro propagation cv. Koober and Paulsen dose, 2 mg / l^{-1}is economic, compared to the application of other concentrations in this cultivar.

From the analysis of the influence of cytokinins rootstocks, 1103P Kobber, in 2 concentrations, results that improved gradually morphological indicators in parallel with the increase of BA concentration, but validated changes between them. Morphologic response, effect cytokinins concentrations, has been catalytic to 2 dose mg / l^{-1}to two cultivars tested. In general, the twocultivarsusingBA, have reached59.3% plantlet.

From the analysis of averages, TUKEY-Kramer HSD lsd - 1.39, demonstrates the significant changes the percentage opening of 1103 Paulsen, compared with Kober and for the effect of using cytokinins in this concentration in all subcultures.

The effect of statistical changes flowed from the application of concentration confirms dosage, 2 mg / l^{-1}for economic effectively that brings together the maximum buds coefficient multiplying (B.M.C) and the coefficient multiplication of the shoots (S.M.C). Cultures stimulated the paces of opening have grown plantlets production from lateral buds, for each explants.

Modulate analysis of regression (graphic 3), expressed and confirmed that opening explants averages, at all times of isolation and regeneration; there are not changes and progress (in ascending). Graphical, demonstrates a linear slope line in climbing (R2 = 0.87) (y = mx + b), which means that the treatments have had constant effect and affect the effective action.
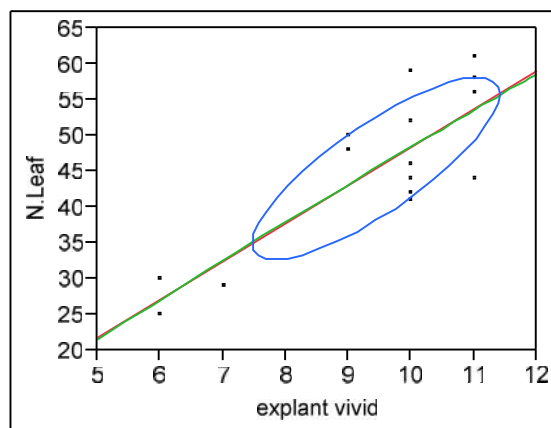
Graphic 3. Bivariate Fit of N.Leaf By explant vivid

Hypothesis test in two concentrations of BAP analyzed for statistically et assessed value for a = 0.05 has shown that hypothesis (Ho) that express the Treatment 2 mg / l^{-1} confirmed, by correlative analysis showed that up to second sub culture multiplication cycle are not observed phenomena and material degeneration. In this way the effect morphologic of two concentrations cytokinins, 6-benzyl adenine purine (BA) has prompted the scale to better, breeding and morphologic homogeneity of the seedlings. Influence of concentrations of BA, induction growth and development of buds at the same time; number and leaf buds per explants went to increase in parallel with increasing concentrations up to 2 mg / l^{-1}.

Shoots proliferating have had different size, and caused by the impact of phytohormon whether in size and in the number of cells reproduced. The larger size of the seedlings are realized in the concentrations 2 mg / l^{-1}(13.15 cm) compared with those obtained with BA in concentrations 1mg / l $^{-1}$(1.75cm). Maximum axial buds developed per explants was 11 to two cultivars, and has fluctuated from 8.3 in cv Kober, 11 in 1103P cv.

Results followed by the effects of hormonal promoters' action proved that the assumptions have been acceptable. On analysis of the averages of each treatment through

Testy TUKEY, and the resulting homogeneous groups after analysis confirmed the effects stemming from the use of cytokinins concentrations either in quantitative and qualitative morphological values. The all BAP concentrations cultivars have been influences in the same way and without changes. Concentrations of BAP, have had results with statistical significant changes to the above morphological indicators, treatments I to II. Value of t (Ho> H1), a = 0.05 resulted in all cultivars, is a very good test, because it has provided and the value of F. The effect of the performance indicators morphological of explants verified with regression analysis for hypothesis testing (graphic 3).

New leafs have had the same phenotype, assessed in normal light index, and the shape and symmetry. We thus proved that the two cultivars suffered no deviations below applying sub - cultures. Large number of measurements has reduced the error, which observed in the absence of variability with no changes in any year from the average of four replays. P = 0055, that is significant because they have influenced the composition of explants to open and other morphological indicators.

Conclusions

- Cytokinins action, in organogenesis and the formation of new organs, induced by, chemical manipulation nourishing terrain.
- During organogenesis, explants followed a morphological process in conformity with general road, namely forming meristem, buds, shoots and adventives roots.
- Response of two varieties on the opening and the number of inter- nodes, the effect of the increase in length for each explants has shown that treatment containing 2mg/l $^{-1}$BA has been the best compared with other treatments.
- On the same premises of the two varieties of rootstocks, expressed differences on the effects that gives citocinin in proliferation explants.
- Cv.Kober expressed many changes through the two treatments applied, but cv. Paulsen has shown for the best effect all treatments cytokinins.
- Application of two cultivars in continuous regeneration in two sub - culture, no effects manifested in two grapevine cultivars genetic features.
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STUDY OF CORRELATIONS AMONG VEGETATIVE GROWTH, FRUIT AND OIL SYNTHESIS IN THE OLIVE

Hairi ISMAILI[1*], Zaim VESHAJ[2], Adriatik CAKALLI[1], Lumturi XHELILI[2]

[1]Agricultural University of Tirana, (Gene Bank), Tirana- Albania
[2]Agricultural Tingransfering Technology Center Vlora, Albania
(Corresponding author: hairiismaili@yahoo.fr)

Abstract

This study treats interdependence of vegetative growth of olive, oil synthesis and growth of the fruit to three olea europaea variety. Analysis was based on statistical modeling for Bivariate analysis for Statistics Estimates, according Diagnostics and multivariate correlation matrix analysis, for the flowering period of olive maturity. Percentage of olive oil was characteristic varietal and expressed great variability inter varietal. (*lsd 1.233 q=0.05*). The dynamic of oil formation have been the same sense with the growth of fruit. (*$R^2=0.933$*). The polp of fruit has increased in correlation with weight. (*$r^2=0.881$*). Fruit weight has fluctuated from 1.1 to 3.6g. The fruit growth was 11- 22 mlg/day, oil 3.7-6 mlg/day and vegetative growth 0.9-2.4 mm/day. Frutis after bonding have increased with velocity and vegetative growth is medium. In the phase of sclerification of endocarp; fruit growth, vegetative growyh and olive oil synthesis are inhibited. After this time, increase the volume of cells of pericarp, is done intensive synthesis of oil; decrease in maximum vegetative growth. Percentage of olive oil at the time where the fruit has the maximum weight constitute the biological value of the variety. After this moment is reduced fruit weight (*$r^2=312$*), while the percentage of oil increases as a consequence of dehydration of the fruit. Vegetative growth is interrupted.

Keyword: *olea europaea; vegetative growth; pericarp; percentage;olive oil; dehydration.*

Introduction

The climate influences vegetative growth, efflorescence, the growth of fruit and the chemical components of the olive fruit (*Villiam H. K. 1994*). The temperature is of great importance because the varieties differentiate the organs based on thermal valences. The variety is important for fruit characteristics, dimensions, the ratio pulp - endocarp, etc. The formation and growth of olive fruit requires a long time and fluctuates according to the varieties from 130-210 days. During the dynamics of growth the fruit competes with vegetative growth for water and food elements. The olive differentiates a considerable amount of flowers, but their fruiting and the progress of grains up to the period of ripeness are very few or zero. This disorder has been the object of a range of different researches, which have found several aspects of compatibility and sterility, (*Cimato A. et all. 1986*) while others for flower biology, the quality of the pollen, nutritional state etc. (*Martin G. et all. 1994*). From this point of view we have studied the physiological correlations that occur within the sprig, as an organ that holds and grows flowers, fruit and vegetation to define the relations and reciprocal influences.

Materials and Methods.

Efflorescence, flowering, fruit growth and vegetative growth have been monitored in one-year-sprigs which have differentiated crowns. The study was carried out in three years and its object was the interconnection of these phenomena within the sprig in three autochthonous variety (Kaninjot, Himara and Pulazeqin). 200 flowering sprigs scattered in the 4 areas of the horizon were chosen in 5 trees of each variety. Vegetative growth was measured monthly (mm), the number of crowns (Nc), the number of flowers (Nf). Physiological dropping was evaluated in June, followed by the monthly evaluation of the dynamic of fruit weight growth, fruit dropping and vegetative growth. The monitoring of biological processes was accompanied with statistical modelling for testing variability (alpha=0.05). Bivariate analysis for statistic estimates has analyzed the correlation limits among the main indices and the amount of reciprocal influence. The degree of influence on the variability of independent factors and the importance of the relations according to eigenvalue and eigenvectors was determined with PCA correlation.
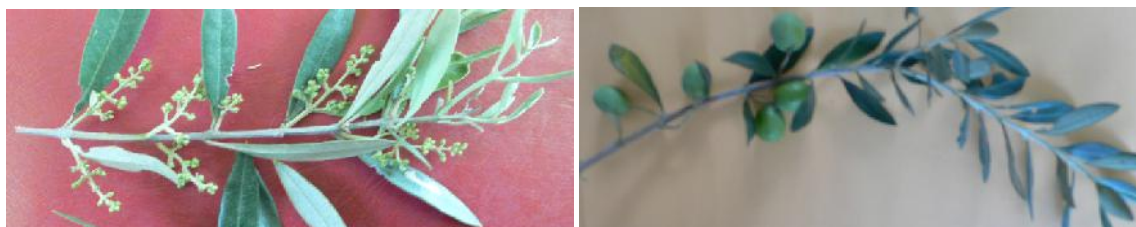
Photo-1 and 2. This olive sprig differentiates crowns and flowers, develops the vegetative growth, linking and increases fruit, simultaneously forms the fruit oil.

Results and Discussion

The varieties were characterized for their thermal constants (Kt= t-t°). Their biological processes are developed on their basis. Kaninjot cv for the differentiation, growth and ripeness for needs 2600ºC, (t-t°), Himara cv. 2600ºC and Pulazeqin 2270 ºC (*Koppen W. 1923*). The sprigs have shown considerable polymorphism within one variety as well as among the varieties, which was caused by the activity of the buds, flowering and oil synthesis. The sprigs are one year old and are the biological basis for the flowering induction and the formation of carbon hydrates ($C_6H_{12}O_6$) (*Tombesi A. et all.1986*) (*Boulouha B. 1994*). (*Photo-1 and 2*)

In March the buds of each sprig have differentiated crowns in the armpit of the leaves, whereas the bud of the top has a vegetative sprig. Small fruits appear immediately after flowering and fertilization, a part of whose has dropped for physiological causes, incomplete fertilization by the high temperatures and lack of nutrition, (*El Khavaga AS 2007*). The quantity of the dropped flowers has been different and depended on the variety (*HSD. lsd.1.1311, q=0.05*) Kaninjot cv. 37.8%, Himara cv. 45.1% and Pulazeqin cv. 45.3%. After physiological dropping fruit development has undergone three important stages: (i) in June-July, the fruit undergoes intensive growth and endocarp is formed due to rapid cell division. (ii) In August growth has been stopped because the embryo is developed and endocarp is sclerified. (iii) In September the fruit re-starts to grow, forms the pulp by increasing in volume the endocarp cells. (*Photo-1 and 2*)

Fruit growth, vegetative growth and the formation of oil were created during a different active period of time. (t-t°), while the biological processes were in unity and

contradiction. Pulazeqin cv has a shorter biological period (2270°C), whereas Kaninjot and Himara cv display no differences (2600ºC)

Vegetative growth, flowering and fructification. Vegetative growth and fructification were developed following the active period, *tukey-kramer lsd 1.78. q=0.05*, *(Tab-1)*. As it can be seen, vegetative growth was developed from March to December and displayed obvious oscillations. After the differentiation of the top of the bud (vegetative) the sprigs grew rapidly and they decreased the rhythm of the fruiting period of time. Vegetative growth was dominant at two different moments: In the period March - May, and after endocarp sclerification in September. In general, vegetative growth and fruit growth are in contradiction during their development cycle (*Villemur P et. All. 1978*). This is expressed with a negative correlation coefficient (r^2= -0.706), and the coefficient of variation for three varieties cv=7.5%. Whereas vegetative growth with flourishing, have a strong connection and without negative impacts, value of correlation coefficient positive r^2=0.864 and varietal variation coefficient, cv=5.9%.

Table-1, Data on analysis of variance of cv. Kaninjot, Himara and Pulazeqin for fruit growth, vegetative growth, % oil by Month.

Month	Kan. Fruit growth (g)	Him. Fruit growth (g)	PZeq. Fruit growth (g)	Kan. Veg. Growth (mm)	Him. Veg. Growth (mm)	PZeq Veg. Growth. (mm)	Kan. Oil. (%)	Him.Oil. (%)	PZeq Oil (%)	Kan. LF. (%)	Him .LF. (%)	PZ. LF. (%)
3	0	0	0	34	26	13	0	0	0	0	0	0
4	0	0	0	49	39	33	0	0	0	100	100	100
5	0	0	0	118	77	66	0	0	0	100	100	100
6	0	0	0	82	16	39	0	0	0	37,8	45	45
7	0,84 **f**	0,55 **e**	0,6 **b**	6	4	5	2,1 **c**	1,2 c	1,3 g	1,57	8,1	8,1
8	1,66 **e**	0,81 de	0,94 e	2	3	4	3,8 **c**	2,7 c	2,9 f	1,48	6,3	6,3
9	2,13 **cd**	1,19 cd	1,24 d	33	23	18	9,6 bc	7,1 bc	7,3 e	1,47	6,1	6,1
10	2,71 **b**	1,33abc	1,88 c	6	4	2	16,4 abc	12,5 abc	14,6 d	1,44	5,4	5,4
11	3,21 a	1,51 ab	2,12 b	1	2	2	23,8 ab	16,6 ab	17,1 c	1,43	4,9	4,9
12	3,82 **b**	1,69 a	1,88 a	1	1	1	26,1 a	17,5 ab	18,3 b	1,34	4,1	4,1
1	3,34 **c**	1,24 ab	1,37 f	0	0	0	29,4 a	19,4abc	21,6 a	1,04	2,8	2,8
2	2,78 **d**	1,1 bc	1,14 c	5	4	2	35,3 ab	21,3 a	22,3 a	0,67	0,8	0,8

Levels not connected by same letter significantly different

I.e, vegetative growth, flowering and fruit growth in the three varieties has been in unity from bud differentiation up to flowering, (r^2=0.888), (*Figure-3*). Later they follow contradictorily, detrimental to vegetative growth (r^2= 0.234), the first stage of fruit growth up to endocarp sclerification, followed by pulp formation (increase of the volume of the pericarp cells), fruiting begins to strengthen again (r^2=0.445) and this unity resists up to the beginning of October, where oil formation becomes active, and fruiting becomes weak, detrimental to vegetative growth up to fruit ripeness, (*r^2=0.123*). In table-1, vegetative growth during the period April – May is dominant and it had growth of 2.78 mm/day, later it was slowed down following the period June – August 0.59mm/day. It regained dominant position in September (1.1mm/day) and it was later characterized for minimal growth up to December (0.04mm/day). It is obvious that following the active period the growth values were different, verified by the value of the coefficient of variation. (cv=39%).

In this analysis, the relation between growth and fructification started during the period of bud differentiation (*first stage of fructification*), and continues up to the stage of fruit ripeness. In several phenophases these processes have been in disproportion and have created unfavourable situations because of nutritional rivalry.

Fruit growth and oil synthesis. The analysis proved strong interdependence among the number of fruiting, vegetation and oil percentage. When the coefficient of correlation fluctuated between the values (r^2=0.812-0.913), the quantity of the oil increased parallel with the increase of fruit weight. This progress went up to a certain limit, after which fruit weight begins to decrease whereas oil percentage increases. (*Figura-3*). Fruit in the trees after the optimal date of the moment of joining of weight with the corresponding percentage of the oil, have decreased in weight and some oxidation phenomena have increased their acidity and the unreal oil percentage. Oil percentage at the moment of meeting point constitutes the varietal biological value. After this moment fruit weight is reduced, whereas oil percentage is increased as a consequence of fruit dehydration. The correlation coefficient between the percentage of oil and the average fruit weight after their moment of joining is negative (r^2= -0.233), while cv=3.2%.

Finally the bio-physiological sprig processes and the correlations between fruit growth, the quantity of the oil and vegetative growth are shown via the ratio V=Nf/S. i.e. oil quantity (O) serves the number of fruit (Nf) and leaf surface (Sl).

The quantity of oil being a product of metabolism i.e. a genetic feature, has shown great inter- varietal variability (*lsd 1.233 q=0.05*), because the Kaninjot cv had 26.1% oil, Himara 17.5% oil, and Pulazeqin 17.1% oil. The process of oil formation within the fruit has been in strong correlation with fruit growth (r^2= 0.860), but it has been in contradiction with the vegetative growth of the sprig (r^2= -0.612), (**SAS User guide. 2008**).

Three periods have resulted interesting for each variety: (i) from fruiting up to endocarp sclerfication; the fruit undergoes intensive growth but a low oil synthesis, (ii) growth of fruit pulp up to ripeness, accompanied by maximal oil synthesis and increase of fruit weight. In *Figure-3*, The fruit pulp has increased in correlation with its weight (r^2=0.881). (iii) When the fruit gains maximal weight each variety has a characteristic quantity of oil. After this moment fruit weight is reduced whereas oil percentage is increased as a result of fruit dehydration was expressed by the correlation coefficient value (r^2= -0.233) and cv=3.2%, (*Soltani A. 2007*)..

As it can be seen in Tab-1 and *Figure-2,* in the 1st stage, the fruit have grown 8-12mlg/day, oil 1-3 mlg/day and vegetative growth 1-1,1 mm/day. Whereas in the 2nd stage, fruit growth 8- 12mlg/day, oil 1-3 mlg/day and vegetative growth 1-1,1 mm/day. In the third stage oil is increased to 12 mlg/day, whereas the fruit loses weight progressively -12 mlg/day.

In the three varieties the fruit have grown intensively detrimental to vegetative growth. Later with endocarp sclerification, fruit growth and vegetative growth were inhibited. Whereas with pulp growth even fruit grow a lot until they gain maximal weight being accompanied by minimal vegetative growth 0.2mm/day and maximal oil synthesis 8mlg/day. Whereas in the third stagevegetative growth becomes zero and the fruit dehydrates water, thus losing weight, while oil percentage has increased as a result of dry matter increase.

Statistical importance of the correlation of processes. Finally, the biological processes occurring in the sprigs as well as the correlation within the fruit for growth, oil formation and vegetative growth are shown via the ratio V=Nf/S. The largest the leaf surface of the sprig the biggest is the assimilation activity and the power of growth. The relation between vegetative growth and fructification in each variety have evidenced several biological ratios: vegetative growth – crown differentiation. Vegetative growth - efflorescence/fruiting, vegetative growth –endocarp sclerification, vegetative growth – pulp/fruit ripeness. The number of fruit at ripe for each variety in percentage has been different and this was an individual varietal characteristic.

The number of fruit at ripe displayed differences among the varieties because the Pulazeqin cv and Himara had a higher fruit percentage at the period of ripeness 4.9% and

4.1%, whereas Kaninjot cv 1.34%. Thus although each variety has differentiated a large quantity of flowers, their fruiting and the number of grains at ripe are considerably low.

The PCA analysis has distinguished the importance that the factors had in correlations for each variety, and it has found positive links among them. Eight independent factors possess, as it can be seen in eigenvalue (*figure-2)*, 99% of the whole variability. But four factors are more important because they possess 86%. In the eigenvectors analysis of PC1 there are 76% of the possessing capacity referring to 3 vectors of the value PC above 0.3. The varieties with the independent variables are found in the axis of x, 77% whereas the difference between the axis y and z, i.e. the importance of the analysed factors is strongly interdependent with the varieties and between each other.

Prin. Components / Factor Analysis			
Principal Components			
EigenValue:	9.2998	1.7753	0.3950
Percent:	77.4982	14.7940	3.2914
CumPercent:	77.4982	92.2922	95.5835
Eigenvectors:			
Kan-Fruit (g)	0.30424	0.24809	0.13766
Him-Fruit (g)	0.30097	0.19047	0.29200
PZ-Fruit (g)	0.29230	0.18893	0.39855
Kan-RV (mm)	-0.29277	0.19054	-0.39592
Him-RV (mm)	-0.28201	0.25274	-0.19877
Pz-RV (mm)	-0.29945	0.23578	-0.21353
Kan-O (%)	0.27621	0.35136	-0.33082
Him-O (%)	0.28291	0.35182	-0.24962
PZ-O (%)	0.28317	0.34918	-0.24113
Kan-LF (%)	-0.27910	0.35524	0.26979
Him-LF (%)	-0.28243	0.33897	0.30720
PZ-LF (%)	-0.28692	0.31695	0.31310

Figura 2. Data for Principal Components Factor Analysis for three varieties: Kaninjot (Kan), Himara (Him), dhe Pulazeqin (PZ)
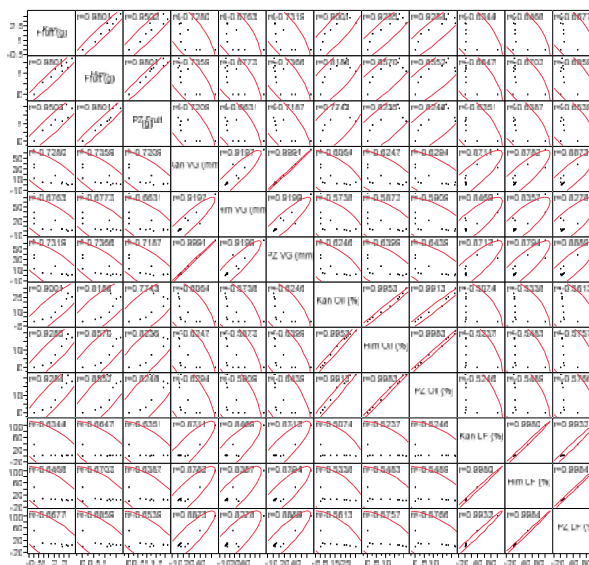
Figura 3. The correlations are estimated by Pairwise method in Multivariate Correlations Scatterplot Matrix the main indicators for cv. Kaninjot, Himara and Pulazeqin

The bivariate analysis - correlation parwoise, has analyzed the level of double relations and has defined the importance and the sense of the relation between the factors and the cultivars.

The mentioned considerations were proved through analysis of the variance which resulted in a lower value at F in the minimal limit of importance (5%). Vegetative growth, oil formation and fruit growth are important factors, they rank in PC1 and have a coefficient of correlation 0.8-0.92. In this case they grow the sprigs as a biological basis for the year in succession, fruit and fruit growth, and form oil in quantity and quality. Each sprig has maintained 4-13 fruit, and fruit weight in the sprigs has fluctuated from 12-36 grams.

In diagram 4 and 5, indicates with Statistics Model Comparisonsaccording to Diagnostics -2Loglikelihood*, and parametric estimate; weibull and Weibull (figura-5)* have proved the correlation and the impact for each variety with oil synthesis process, vegetative growth and fruit growth, the link of flowers and fruits, and their performance until matyrity. After biological matyrity reduced fruit weght associated with not real increase te percentage of oil.*Average oil = -14.69933 + 18.692539*Average Fruit + 3.0176342* (Average Fruit 1.13917)^2 - 7.3626403*(Average Fruit-1.13917)^3.*
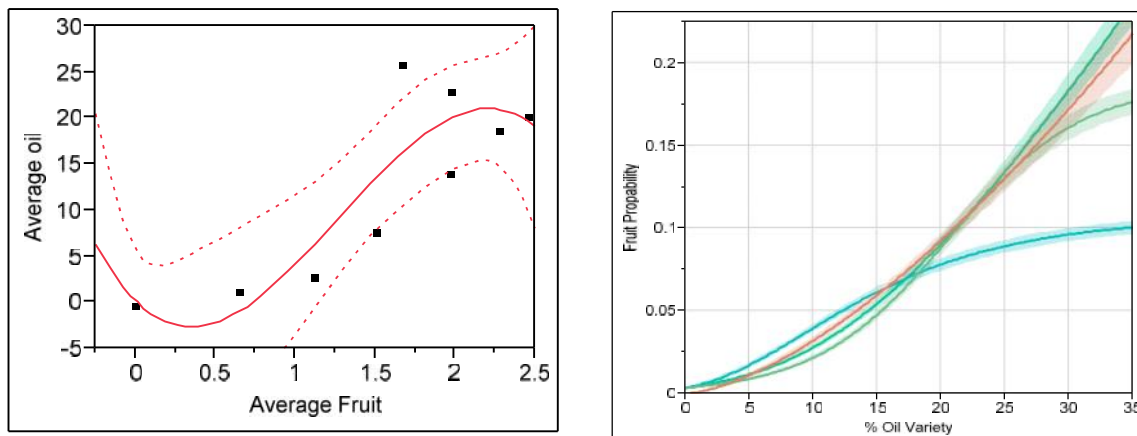
Figura -4 and 5. Bivariate normal ellipse Fit of Average Fruit By Average oil, P=0.05, for three olive variety, Kaninjot, Himara and Pulazeqin.

While elaborating the analysis, when we say that Fruit Growt,h has strong connectin with Oil Synthesis in fruit, are accepted for the level of a = 0.05, we must understand that this acceptance is statistically important for a=0.05 and tf <*tk*. (t>2). r²= 0.821-0.900.

In the flowering phenophase and until the fruit matures, the *value* tf>tk, 2.2092>2. This proves the hypothesis that vegetative Growth influences on the flower fertility, oil synthesis and fruit growth.   the result is statistically unimportant for a level of the value tf<tk.

Conclusions

Three olive varieties have different individuality, have specific relations with the environment, have different thermal constant, consequently, different behaviour for biological processes, above all for fertility and oil synthesis in fruits.

The biological processes occurring in the sprigs as well as the correlation within the fruit for growth, oil formation and vegetative growth are shown with typical values of interdependence.

During the vegetative cycle, each variety ha demonstrated different values of the relations with positive or negative inpacts.

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EFFECT OF PREVIOUSCROPS (LEGUMES, FALLOW, WHEAT) ON YIELD COMPONENTS OF DURUM WHEAT (*Triticum durum. Desf*)VARIETY WAHA UNDER DIRECT SEEDING IN SEMI ARID REGION OF SETIF

Khalissa CHENITI[*], Monamed DEKHILI

Faculty of Nature and Life Sciencies, University Ferhat Abbas Agronomy department of Setif, ALGERIA,
(Corresponding author: khalissaabed@yahoo.fr)

Abstract

The objective of this study was part of the experimental station of the ITGC of Setif (Algeria) during the campaign (2008/2009), is to determine the best previous crop among legumes, fallow, wheat for a culture durum (WAHA) driving under direct seeding in semi arid to obtain appreciable yields in quantity and quality.

The results of statistical analyzes of variance at the 5%, showed significant differences between these precedents on wheat yield components such as: "Number of ears / m, grain yield, 1000 kernel weight, fertility cob and stalk height at maturity. " This allowed the establishment of a comparison of the means of Newman-Keuls this threshold where the previous "lens" has recorded the best yield of grain was 27.4 quintals / ha the previous wheat gave a maximum value for the parameters: "1000 kernel weight, fertility, and corn stalk height at maturity." The previous fallow him, gave the maximum for the variable "Number of ears / m". These results allow us to conclude and confirm the effectiveness of previous "legumes and fallow" to 62.5% from the previous wheat despite the good results that he gave during the campaign, it remains to check on them several other campaigns in order to rule.

In conclusion we can argue that crop rotation is always a best management practice and in the absence of tillage, it may take even more important, increasing yield, the rate of organic matter in soil and the availability of nitrogen if it includes nitrogen fixing legumes. In addition, the rotation in no-till systems presents some challenges to overcome-especially-weeds.

Keywords:*previous crop, direct seeding, rotation and semi arid.*

Introduction

Cereals and their derivatives occupy the largest share in the Algerian food system (AMARA, 2006). However, BENFERHA and MEDERBAL (2009) note that the device Algeria cereal production is very low productivity. Over long periods, we find that average yields are very low (17 million quintals compared to estimated needs at 63.5 million cwt for 2008). Indeed, the annual production volumes are subject to strong variations due to weather, but also according BELLIDO- LOPEZ (1992), there has been a continuing degradation of natural resources mainly due to misuse and inappropriate farming techniques.

Thus, intensive tillage leads to a deterioration of soil quality that threatens the long-term agricultural production in the Mediterranean basin (BELLIDO - LOPEZ, 1992). Zaghouan et al (2006) also believe that conventional tillage adopted and implemented in several passages, induces an increase of erosion by wind and water, the destruction of organic matter and soil structure ; Add to that the high cost of production (ESCRIBANO, 2006).

Works such as those of RAGUIN (2008) in Morocco, show incontrovertibly that improving and stabilizing crop yields in semi-arid areas can only be achieved through long-term and

replacement work conventional soil tillage or non-tillage (BOUZZA 1990; Kacemi 1992; MRABET 1997; MRABET, 2000).

Simplified cultivation techniques and direct seeding vegetation appear as alternatives to even correct the negative impact of production systems adopted by farmers. They arrive at better controlling erosion, organic matter stoker, improve water efficiency and restructure the soil under the effect of improved biological activity (KRIBAA et al, 2001).

However, the practice of direct seeding leads to problems of invasion by weeds whose solution is to use an appropriate rotation grass / broadleaf (DERKSEN et al, 2002). .

Indeed BELLANGER et al. (2007) advocate cropping systems based on crop rotation, which are recognized as beneficial to maintain soil productivity and quality of production. Also Oueld SAID et al (2002) report that the rotations cereals / legumes are probably the most interesting in the agronomic driving conditions in the dry semi-arid regions; legumes enrich the soil fertility nitrogen , but this type of rotation contributes to the reduction of fallow is currently a topic of discussion.

Therefore we tried by the present work, to show the importance of rotation in production systems, under direct seeding to maintain significant levels of performance and to avoid the disadvantages of monoculture (weed , diseases .... etc..) compared to conventional tillage and cultivation techniques simplified, and eventually, to determine the best precedent for a durum wheat crop from: legumes, wheat and fallow in order to have good performance in terms of quantity and quality.

Materials and Methods

The experiment was conducted during the crop year 2008/2009 and carried out on the lands of the Middle Agricultural Technical Institute (ITMA) of Setif working in collaboration with the Technical Institute of Crop (ITGC) of Setif. This station is located partly in the small valley of the river of Oued Bousselam which is situated in the center of Setif and it belongs to the semi-arid zone (KRIBAA et al, 2001)

According to the Table 1, we find that the the growing season 2008/2009 is devided into two major periods: wet and dry periods. The wet season lasts approximately seven (07) months (from September 2008 to April 2009), but the dry period lasts only three months, which are: August 2008, May and June 2009). It can be seen that June is the driest month (4.7mm) and the hottest of the campain 2008/2009 (22.13 °C). While the coldest period of the campain, which coincides with the life slowed vegetation, corresponds to the months of December, January and February (5.27 °C, 5.54 °C and 5.41 °C). This indicates that there is an inter-monthly variation during the experimentation reflecting great irregularity at both levels, temperatures and rainfall which annual quantity (386.1mm) shows that the crop was just rainy.

During this campaign, we recorded 62 days of frost spanning from November 2008 to May 2009, including 19 days (March, April and May) corresponding to the high sensitivity of the plants.

Plant material

The durum wheat variety that was used in the test is Waha. this is obtained from CIMMYT (1979) and introduced in Algeria at the ITGC Setif in 1986 through the center of ICARDA in Syria. Table 2 below, shows the agronomic characteristics of this variety.

Table 1: Rainfall, temperature and other climatic factors characterizing (the season 2008-2009)

Parameters	Rainfall in mm	Temperatures in ° C			Others		
	2008/2009	Min	Max	Avg.	Gelée (days)	Snow (days)	Siroco (days)
September	44.90	14.14	26.54	20.34	---	---	---
October	55.40	10.11	20.63	15.37	---	---	---
November	22.80	3.53	12.94	8.24	05	---	---
December	38.10	1.22	9.52	5.27	14	04	---
January	66.30	1.60	9.50	5.54	10	05	---
February	38.20	1.0	9.83	5.41	14	03	---
March	31.50	2.44	14.38	8.41	12	03	---
April	79.10	3.36	14.76	9.09	06	02	---
May	5.10	9.34	24.88	17.09	01	---	---
June	4.70	13.06	31.20	22.13	---	---	---
Total	386.1	59.80	174.18	116.99	62	17	---

Table 2 : Characteristics of the variety Waha

Agronomic parameters	Characteristics
-ear	-Half-loose to compact, clear amber to red
-Plant height at maturity	-80- 90 cm
-Vegetative cycle	-Early
-Tillering	-Medium to high
-Resistance to cold: -Lodging: -The drought:	-Tolérante -Résistante -Sensible
-Conduct against diseases.	-Resistant to: powdery mildew, eyespot -Moderately resistant: fusarium, septoria. -Tolerant to: yellow, brown and black. Rusts -Sensitive: take-all.
-Weight of 1000 grains	-Medium.
-Technological characteristics	-Semolina Quality: good enough. -Resistant to: mitadinage, fly and ginning.
-Characteristics cultivation	-Sowing time: November-December. -Dose seed: 100-120 kg / ha

Source BOUFNAR-ZAGHOUANE *et al* (2006).

Previous cropping and Crop management:
The Factor studied focuses on five different cropping history of the culture of the current season (2008-2009) of durum wheat variety Waha (Tables 3)and Table 4 summarizes all the cultivation techniques practiced during the campaign.

Table 3. The previous cropping and their abbreviation

Block	1	2	3	4	5
Precedent	Lens/Wheat	Chickpea/Wheat	Wheat/Wheat	Medic/Wheat	Fallow/Wheat
Abreviation	Len/blé	Pc/blé	blé/blé	Med/blé	J/blé

Table 4. Crop management

Cultivation techniques	Dates and Particularities
Sowing	November 23rd 2008 using a specialized drill brand Semeato 4 meters, with a density of 300 seeds/m2.
Fertilization	-Fertilizers background as TSP (Tri-super phosphate) 100Kg incorporated with the seed. (Localized fertilization) -Fertilizers coverage Sulfazote 120Kg/ha at early tillering.
Weeding	-Weeding post-sowing with a total herbicide: Glyphosate total (or 480g /l Glyphosate isopropylamine salt) at a rate of 2.5 l / ha further of an acidifying Lawer7 acid in an amount of 90 ml in 300 l of water /ha -Post-emergence weed control with Granstar due to 15g/ha
Harvest	The grain harvest was carried out on 27/06/2009 using a combine harvester type HEGE80 with 1.19 m in width a surface area of 71.4/m² per plot.

Experimental Protocol:
The experimental device is adopted en bloc complete random distribution. The main plot is divided into five blocks, each measuring 6 m wide by 60 m long, each block is divided itself into four elementary plots (replicates) of 1.5 m wide each, the blocks are spaced apart by 2 m (Graph 1)
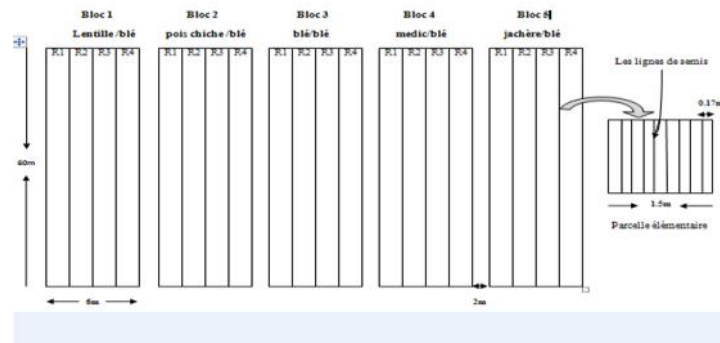
Graph 1: Experimental protocol

The measured parameters:
For reasons of convenience, these abbreviations will be used in the following paragraphs to present each parameter (Table 5)

Table 5 : Measured traits and their abbreviation

Parameters	Abbreviation
Number of emerged plants per square meter	Pt /m²
Number of herbaceous tillersper square meter	Th /m²
Number of ears per square meter	Epi /m ²
Cob (Epi) fertility	Fert
Stem height at maturity	Haut
Le poids de mille grains	Pmg
Le rendement paille	Rdtp
Le rendement en grains	Rdtg

These traits have been measured and The STATITCF software version 5.0.was used for the statistical treatment of data.

Two approaches were used for this purpose:

- The analysis of variance the effect of the five previous under direct seeding on yield components, followed by a comparison of means of Newman-Keuls to highlight the best results compared to the effect of various precedents used.
- The connection between the studied variables was evaluated by correlation matrix at the threshold of 5%.

Results and Discussion

The analysis of variance showed highly significant effects for the variables **Epi /m²**, and **Pmg Rdtg** (p<0.00) and a significant effect for **Fert.** and **Haut.** (p<0.01). This is explained by the fact that these traits constitute the most important components of performance, they can give to each species its own potential. While variables **Pt/m², Th/m²** and **Rdtp** are not significant (Table 6).

This result means that the various precedents show no significant difference with regard to their effect on the lifting of the wheat crop, and that no significant difference can be attributed to the use of the same variety (Waha) with the same seeding and tracking the same route technique (date of sowing, weeding ... etc..).

In addition, according ABDELLAOUI et al. (2006), the settlement to the lifting ensure largely successful culture and has an important role in determining the population ears, which is an important component of performance.

Table 6.Results of the analysis of variance

S: significant NS: not significant

Significant (*); very significant (**) highly significant (***)

The effects of previous cropping by comparing averages of Newman and Keuls on the measured parameters gave these results:

1-Number of ears per m²:

The results of the Graph 2, give a ranking into three groups according to the test of comparison of means with J/blé at the head (group A) of all previous cropping.

The heading stage is an important step in the life cycle of the plant. At this stage, the plant architecture becomes apparent and reaches its maximum. Most often, it gives an indication of the capacity of producing differential varieties. (KIRBIY et al, 1999).

Source of variation	DDL	Pt /m²	Th/m²	Epi/m²	Pmg	Fert	Haut	Rdtp	Rdtg
Var. totales	19	584.17	3316.37	2553.41	11.62	18.90	18.92	83.06	25.29
Var. précédents	4	150.38	3973.30	10186.17	45.27	69.72	32.91	127.72	104.39
Var. résiduelles	12	174.14	1232.10	510.65	2.25	4.99	8.70	65.74	3.89
Ecart type (E.T)	---	13.20	35.10	22.6	1.5	2.23	2.95	8.11	1.97
Coefde variation(%	---	5.1	8.8	9	5.4	7.6	4.6	27.9	9.6
Test FISHER	---	0.86	3.22	19.95***	20.15***	13.96**	3.78*	1.94	26.85***
Signification statist.	---	NS	NS	S	S	S	S	NS	S

On the stand ears per m², a highly significant difference of this component was revealed by the analysis of variance at 5% (Table 5). This can be attributed to the coincidence of this phase with the drought (May: 5.10 mm, June: 4.70 mm according to Graph 1), causing the plants to draw their water from the ground, and according to the potential of each of these cultures:

- Fallow has a larger pool compared to other precedents;
- Chickpea consuming plenty of water (taproot system exhausting water in the soil);
- The lens develops a lot of dry matter (then higher water requirements);
- Same goes for the medic except that it is infested with weeds;
- Not to mention the effect of monoculture wheat / wheat.

All these features water, will essentially explain these results
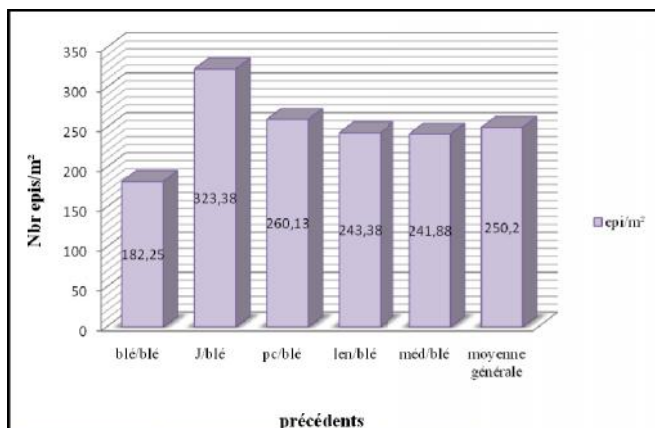
Graph 2: Number of ears/m²

2-The weight of a thousand grains:

According to the Graph 3, the highly significant effect of this variable has a ranking of three homogeneous groups. It appears that the thousand grain weight of blé/blé precedent, is ranked first (group A) because of the low density recorded in the population épis per square meter during the heading stage .GATE (1995) notes that the thousand grain weight decreases significantly under the effect of high temperature or water deficit which coincides with grain filling;fertilization and weed density can also reduce the size of the grain, as well the filling stage in our case, coincides with a period of low rainfall in May (5.10 mm on Table 1)
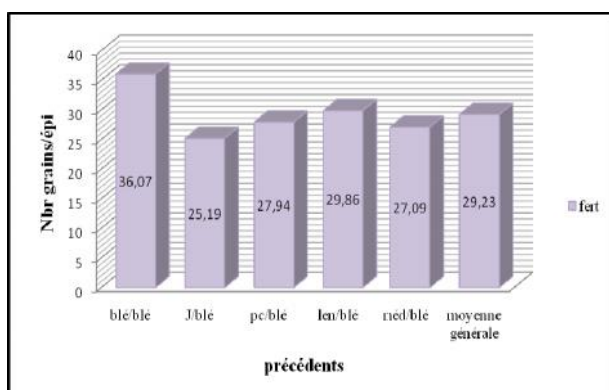
Graph 4: Cob fertility   Graph 3: Thousand grains weight.
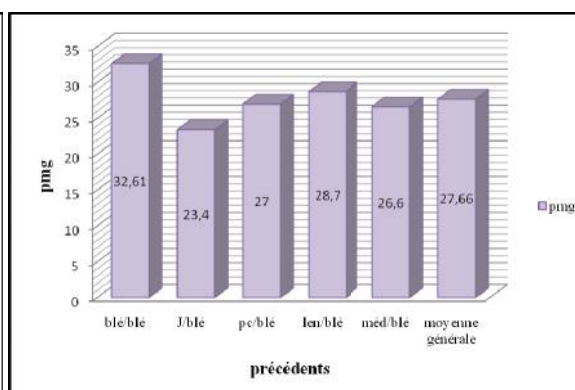
3-Cob fertility (the number of grains per ear):

SOLTNER (2005), noted that the number of grains per ear varies between 21 and 40 grains/ear,which corroborates with our results as the overall average is 29.23 (Graph 4)

The significant difference between the previous crop for this variable was used to classify them into two groups, the second set includes all legumes which reflects the absence of statistically significant difference between them compared to monoculture. This result can be attributed to the fact that the number of grains is influenced by the quality of the soil water reserves, as well as nutrition nutrients such as nitrogen and phosphorus (SOLTNER 1978;

Kolev, 1979).The trade-off between yield components may also occur. The filling phase which takes place under high water and thermal stresses, gives very low yields, even if the state of the plant at the heading stage promises a good yield, following growth conditions of the post -heading (ABBASSENNE et al, 1998). This component is critical and is considered as an essential component of the final yield and it decreases gradually as the number of ears per m² population increases (in case of water deficit in grain filling stage),

4-The stem height at maturity:

Stem height at maturity is varying between 60 and 70 cm (Graph 5), which approximates the results of BENNASSEUR (2004) indicating a broader range (60 - 110 cm).

For that, precedents are distributed in three homogeneous groups ranked by comparing the average (Table 9), where previous: wheat and lens constitute the first group with nearby averages. The rest of the groups are formed by: J/blé, Pc/blé and Med /blé that not much different from the first group
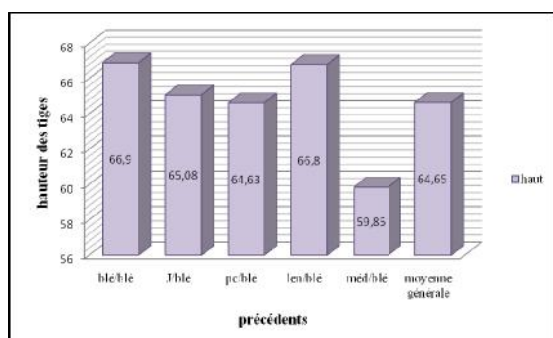
Graph 5: The stem height at maturity
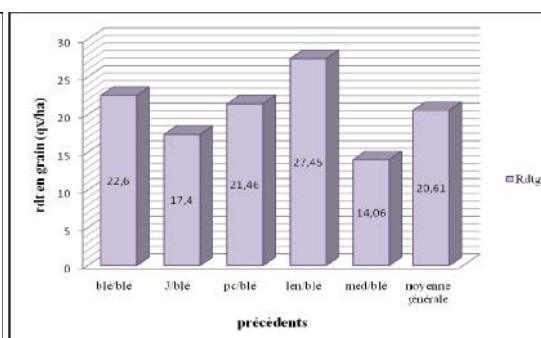
Graph 6: Grain yield

5-Grain yield:

For this trait (Rdtg), the results in Graph 6, provide a ranking into four groups according to the test of comparison of means (Graph 6) and show that compared to an overall average of 20.61 quintals/ha, the precedent lens/wheat with 27.45 quintals/ha (group A) is the best one among all the precedents.

BELAID (1996) notes that a wheat following to lens crop whose performance is higher than 4 quintals / ha, requires less nitrogen than wheat after hay vetch-oats.

The values of the linear correlation coefficients are used to study the links between the variables. Existing correlations are of two types (Table 7)

Table 7: Correlation matrix

	Pt /m²	Th/m²	Epis /m²	Pmg	Fert	Haut	Rdtp	Rdtg
Pt/m²	1.000							
Th/m²	**-0.449* (p<0.05)**	1.000						
Epis/m²	0.072	0.075	1.000					
Pmg	0.067	-0.175	**-0.817** (p<0.001)**	1.000				
Fert	0.164	0.064	**-0.708** (P<0.001)**	**0.642** (p<0.001)**	1.000			
Haut	0.431	-0.325	-0.042	0.314	0.245	1.000		
Rdtp	0.095	0.321	0.280	-0.056	-0.009	0.136	1.000	
Rdt g	0.057	-0.222	-0.321	**0.470* (P<0.05)**	**0.453* (p<0.05)**	**0.484* (P<0.05)**	-0.203	1.000

At the threshold of 5%, ddl = 18, correlation coefficient r = 0.4338

Significant negative correlations such as those between **Pt / m²** and **Th /m²** (r=-0,449), this indicates that in proportion as the number of plants raised per m² increases, the number of

tillers per m² decreases ; there is also a highly significant correlation between variables **Fert** and **Epi /m²** and between **Pmg** and **Epi /m²** respectively r = -0,708 and r = -0,817, this means that a large number of ears per m² causes a decrease in fertility and therefore inthe thousand grain weight. Significant positive correlations: **Rdtg** is moderately correlated with **Fert** (r = 0.453), **Pmg** (r = 0,470) and the **Haut** (r = 0,484) where it can be deduced a highly significant correlation between the **Fert.** ears and **Pmg** (r = 0,642).

Finally we can conclude that these yield components, in this case, have fulfilled their role.

Conclusion

At the end of this work which was initially intended to draw the importance of rotation in production systems and identify the best among previous: legume, fallow and wheat under direct seeding in semi-arid area, we can conclude that:

Various previous induced some variability in agronomic traits measured. Indeed, the analysis of variance at 5% showed that previous cropping really induces significant differences characters: ears per m², thousand grain weight, fertility ears, stem height at maturity and grain yield which gives a rate of distinction between these previous results about 63% confirmed by the study of correlations where the previous lens achieved very good results, especially for the trait grain yield.

This study enters in the ITGC station program within the introduction andextensionof the system of direct seeding in the high plains area in particular, and Algeria in general, compared to Morocco (20 years of research on direct seeding) and Tunisia (5-6 years of research) where system has been tested and has reserved areas where it does not cease to grow. So whatever the cropping, crop rotation is always a best management practice. In the absence of tillage, it may take even more important; especially to interrupt the life cycle of insects, diseases and weeds that crop rotation can also increase performance, the rate of organic matter in the soil and the availability of nitrogen if it includes nitrogen-fixing legumes. However, crop rotation tillage systems present some challenges.

This system can be an effective way to ensure that conservation agriculture and ensure the sustainability and preservation of the environment. But this can be done by:

1-A more intensive program of research carried out on the direct seeding.

2-Dissemination of research findings in the producer middle and farmer participation in development program and engagement should ensure widespread adoption of the system in farms. In addition, financial support for farmers is recommended to purchase specific equipment.The beneficial effect of direct seeding on the components of the environment is not found as soon as the early years of his practice, but probably in the long term and with the rotation, the evolution of soil structure and its chemical composition positively influence productivity and soil quality. The results of this study are preliminary to better capitalize on this research topic we strongly recommend its recovery with a possible extension in time and space in this case deal with new issues such as rotation and evolution of weeds, insects and diseases conducted under direct seeding.

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USE OF INDIGENOUS BACTERIA SELECTED AT THE RHIZOSPHERE OF POTATO IN BIOLOGICAL CONTROL

Mezaache-Aichour SAMIA[*]. N., SAYAH., M., ZERROUG., N., HAICHOUR, A., GUECHI

Laboratoire de Microbiologie Appliquée, Faculté des Sciences de la Nature et la Vie Université Ferhat Abbas Sétif, ALGERIA
(Corresponding author: mezaic2002@yahoo.fr)

Abstract

The soil-borne pathogens of plants that cause root rot, crown, ring rot and seedling blight are the major factors limiting crop yields and fiber plants. Resistant varieties of plants are not available for many pathogens and chemical control is often not sufficiently effective in the soil. Moreover, a reduction of pesticide use is considered to reduce the potential for environmental pollution. Improved properties suppressive soil will limit the development of diseases, is of great importance to ensure agricultural sustainability and the development of organic farming systems. The aim of our work fits into the context of sustainable development and ecosystem preservation, by the introduction of biological control agents in order to limit the use of chemical inputs in agriculture. This work is done by selection and isolation of indigenous bacteria from the soil of potato crops, can hinder the development of pathogenic fungi by their adversarial nature. The preliminary screening allowed us to select a group of microorganisms capable of reducing in vitro growth of phytopathogens such as soil fungi. This work allowed us to isolate bacteria belonging to the genera *Bacillus* and *Pseudomonas*. These bacterial populations have inhibited fungal growth by a percentage ranging from 0% to 92%.

Keywords: *biological control, antagonism, soil borne pathogens.*

Introduction

The soil-borne pathogens that cause plant rot roots, crowns, wilting and damping off are the main factors that limit crop yields, fiber, and ornamental plants. Most telluric pathogens are difficult to control with conventional strategies such as use, host resistant cultivars and synthetic fungicides. The absence of reliable chemical controls, the development of resistance to fungicides and the degradation of host resistance by the pathogen populations are major factors that highlight efforts to develop alternative control measures (Haas and Défago, 2005).

The search for alternative strategies was also stimulated by concerns public on the harmful effects of fumigants ground such as methyl bromide on the environment and human health (Léon *et al*., 2009).

Suppressive soils are probably the best natural examples in which the indigenous microflora effectively protects plants against pathogen. Initially removing soil became apparent because the incidence or severity of the disease is lower in comparison with infested soil. Suppressive soils have been described for many soil-borne pathogens, such as: *Gaeumannomycesgraminis* var. *tritici*, *Fusarium oxysporum*, *Aphanomyces euteiches*, *Heterodera avenae*, *H. schachtii*, *Meloidogyne* spp. *Criconemella xenoplax*, *Thielaviopsis basicola*, *Phytophthora cinnamomi*, *Phytophthora infestans*, *Pythium splendens*, *P. ultimum*, *Rhizoctonia solani*, *Streptomyces scabies*, *Plasmodiophorabrassicae* and *Ralstoniasolanacearum* (Haas and Défago, 2005).

Material and methods

Fungal strains:

Four fungal strains were use dis this study, *Fusarium solani* (LMA), *Phytophthora infestans* (Pr. Larous), *Fusarium oxysporum* f. sp. *albedinis* (INRA, Alger) and *Fusarium solani* var. *coeruleum* (Institut Pasteur Paris, France).

Soil samples

The soil samples were obtained from potato fields in three regions of Sétif, at which samples are taken randomly.

The first and third samplings were conducted in a soil that received culture of potatoes harvested for almost a month, at a depth of 10 to 15 cm. The second was made in April of the same year, but in a potatoes culture. Sampling were performed in separate strata of soil: rhizosphere soil, spermosphere (soil) and soil adhering strongly to potatoes tubers

Thesamples were storedinsterileplastic bags, then reported the laboratory.After dryingin an oven at28°Cfor 24 hours, the soil is subject to sieving tohavequite finesoil grains(sieve mesh of1.5 mm).Finally a dilution series were made.

Microorganisms trapping

Trapping ofmicroorganismdescribed byTivoli*et al.*(1983), inspired by Lansadework(1950), is tospread aportionof the earthto be testedon the wafer half-tubers andfreshlysevered,afterincubation, the level of soil contaminationand the nature ofmicroorganisms were determined.

Analysis of bacterialmicroflora

Isolation

The primary screening of bacteria with antifungal activity is carried out according Léon *et al.* (2009).

Analyses of the bacterial microflora are made by the method of suspensions dilutions (Tamietti and Pramotton, 1990). 30g of each soil sample was suspended in 75ml sterile saline water (Tivoli *et al.*, 1990). After stirring (for 30 minutes) and a settling period (for 15 min), a series of suspension $1/10^{th}$ dilutions is made from these supernatants (Tamietti and Pramotton, 1990).

From thepreviousdilutions, 0.1 mlwas plated onPDAin dual culture with fungaldisc(reference strains studied). Plates were incubatedat a temperature of28C°for 15 days (Aliye *et al.*, 2008).Bacteria whichinhibitedfungal growthwereselected tobe purified.

Purification

Bacterial strains with fungal inhibition were purified by a series of successive transfer of the isolated colony on Nutrient Agar in two to 5 times (Jalal *et al.*, 2006).

Test of antagonism:

The sametest was used as thatcarried outfor the isolationexcept, weused purebacterial strains were incubated until thefull growthof the control withoutbacteria (Léon*et al.*, 2009).

Results and discussion

The screening strategy used was to isolate natural antagonistic cultivable bacteria. The primary screening allowed us to select a group of microorganisms which can survive in the presence of other phytopathogenic microorganisms. The Exploration of the biodiversity in microorganisms from potatoes field soils has highlighted two categories of bacteria with antagonistic capacity. We focused our study on populations of the most common bacterial

genera, such as Gram-positive spore-forming belonging to the genus *Bacillus* and Gram negative belonging to the genus *Pseudomonas*.

The antagonistic test performed by dual culture between thebacterial isolatesand the fungal strainsstudied (Fsc, Foa andPi),showed an inhibitory actionbetween these microorganisms.The inhibitionvariedbetween 0 and 92.30%, depending on the isolateandpathogen considered(TableI). 14 antagonistic strains that have been selected *in vitro* have revealed an antagonistic effect proved. In fact, three isolates showed an interesting activity against the three phytopathogenic isolates studied. Léon et al. (2009) reported that among 80 isolates with antifungal activity greater than 40%, and 150 microorganisms selected from isolated, six showed antagonistic activity against the phytopathogenic fungi studied (Ascomycetes, Deuteromycetes and Oomycetes).

Some isolates are antagonistic against the three fungi studied, the high activity was obtained with isolate 20b, the lowest one was obtained with isolates 17b and 24b. Whereas, some are antagonistic against two fungi and finally four isolates are antagonists to one fungus (Table I). These strains belong toGram-positive and Gram-negative. Among the studied Grampositivestrains, 4.16% inhibitthe growth of *Fusarium solani*var.*coeruleum*6.25%inhibit the growth of*Fusariumoxysporum* f.sp. *albedinis*while4.16%inhibit*Phytophthorainfestans*.Whereasinbacteria Gram-negative, 16.66%inhibitthe growth of *Fusariumsolani*var.*coeruleum*, 14.58%inhibit the growth of*Fusariumoxysporum* f.sp.*albedinis*and10.41% inhibit*Phytophthorainfestans*.Of the 7strains ofinhibitoryGram-negative bacteria, which colonize the rhizosphere,a single straininhibitsthreephytopathogenic fungi.Our result are similar to those of NionandToyota(2008),whoisolated270strainsfrom thefive isolates ofBurkholderiawith provedantagonistic effect againstRalstonia solanacearum and those ofKamilova*et al.*(2005),whoselected16 isolatesoffluorescent*Pseudomonas*colonisingthe rhizosphere oftomato,among whicha single isolateeffectivelyinhibitfourof the fivetestedfungi.

Table 1. Percentage of fungal inhibition.

Zones	Souches	Rate of inhibition		
		Mitosporic fungi		Oomycetes
		Fsc	Foa	Pi
1	2[a]	37.5	53.48	Nd
	5[a]	34.72	76.74	Nd
	9[a]	6.94	6.97	Nd
	8[b]	0	53.84	Nd
2	1[b]	6.25	37.5	0
	16[b]	41.25	42.5	0
	17[b]	85	1.25	30
	18[b]	46.25	Nd	34.21
	20[b]	82.5	92.30	63.15
	22[b]	52.5	43.75	0
	24[b]	32.5	32.5	2.5
	2[c]	Nd	Nd	35.75
	6[c]	Nd	Nd	86.25
	7[c]	Nd	Nd	7.5

Zone 1: spermosphere ; Zone 2: rhizosphere ; a, b et c : 1st 2nd and 3rd sample ; Fsc: *Fusarium solani* var. *coeruleum* ; Foa : *Fusarium oxysporum* f. sp. *albedinis* ; PI : *Phytophthora infestans* ; Nd: not determined.

Conclusion

Our results are consistentwiththe hypothesis,that thegroup microorganismsisolated,would be responsible forthe general suppressionin the soil.

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TESTING OF CHEMICAL COMPOSITION OF WILD BERRIES

Zeljka MARJANOVIC-BALABAN[1*], Slavica GRUJIC[1], Mithat JASIC[2], Dragan VUJADINOVIC[3]

[1]University of Banja Luka Bosnia and Herzegovina
[2]University of Tuzla, Bosnia and Herzegovina
[3]University of East Sarajevo, Bosnia and Herzegovina
(Corresponding author: zeljka.marjanovic@sfbl.org)

Abstract

Berry fruit consumed fresh or processed into various products (juices, jams, fruit yogurt, ice cream, beverages, etc.) provides a valuable addition to any diet of people around the world. Surveys carried out in the last ten years show that berries, because of the content of antioxidant substances, vitamins, minerals, fiber and other physiologically active components, significantly affect the preservation of human health.

Chemical composition of berries has a great influence on their appearance, color, smell and taste.These types of fruit has a sweet taste, fruity smell, soft and juicy flesh consistency. Fruit color, depends on the berry type, can vary between the bright red and dark blue shades. Chemical fruit composition of each variety is greatly influenced by environmental factors, maturity stage and storage conditions.

In this paper the authors are presented results obtained during the examination of basic chemical composition, vitamin and mineral content, and the content of antioxidant substances in several species of wild berries, which produced in the eastern part of the Republika Srpska. Content of water determined in different berry is following: strawberries (80.51- 85.19%), raspberries (80.86-83.76%), blueberries (79.37-85.12%), black currants (75.06-80.46%), blackberries (82.16-86.11%) and gooseberries (81.16-84.24%).Depending on the type of fruit, protein content ranged from 0.50-0.92% (strawberry) to 1.42-1.65% (black currant), the average carbohydrate content from 8.00% (blackberry) to 13.06% (black currant), the average fat content from 0.23% (black currant) to 0.77% (raspberry), and ash content ranged from 0.15-0.28% (blueberry) to 0.68-1.10% (black currant). Energy value of berries is low (below 50 kcal/100 g).The analysis shows the following contents of calcium (5-50 mg/100 g), iron (0.30-1.30 mg/100 g), zinc (0.10-0.60 mg/100 g).Among the vitamins, ascorbic acid (1.9-60.51 mg/100 g) and riboflavin (0.02-0.05 mg/100 g) were determined.

The content of total phenolics and anthocyanins was determined in raspberry, strawberry and blackberry fruit.

Keywords:*wild berries, chemical composition*

Introduction

According to FAO data (FAO, 2012) berries have great economic importance in world production and processing of fruit.The countries of the Western Balkans, by participation in the production of some types of soft fruit and berries are the leading European and world producers.For example, Republic of Serbia has a leading position in raspberry production achieving the third place in the world. An average raspberry production in Serbia during the period of 2002-2010 is 82,360 Mt. In this period the average production of strawberries in Serbia is over 35,000 Mt.Production of strawberries and raspberries in Bosnia and

Herzegovina is small, but there is evident increase in seeded area with regard to the quantities produced in the last ten years.The production of raspberries in Bosnia and Herzegovina in 2010 increased 10 times compared with production level recorded in 2002 (FAO, 2012).Conventional production of this group of fruits is an example of good organization in agricultural production.

Besides large world production of berry fruit in conventional conditions (strawberries, raspberries, blackberries, black currants, red currants, gooseberries, grapes and other) harvest of wild fruits (strawberries, raspberries, blackberries, blueberries, cranberries, etc.) contributes to total world production of berries (Céspedes et al., 2010; Kubola et al., 2011; Garzón et al., 2010).

Berries on the market can come in one of three ways (Zhao, 2007): (a)direct sale - the customer pick fruit or collector is sold fruit, (b)selling through local stores or through online trade, in the case of imports, and (c)placement ofprocessed fruits (frozen, dried fruits, fruit processed into jams, jellies, juices, wine, ice cream, fruit yogurt, dried fruit mixtures, etc).

The chemical composition of berries depends on many factors: variety, environmental factors, stage of maturity, time and method of harvest, conditions and duration of storage.The influence of these and other factors on the quality and acceptability of berries by consumers has already reported (Castrejon, 2008; Giovanelli G., Bobinait et al., 2012).It is very difficult to identify the specific factors which determine the quality of berry fruits. Large number of chemical substances (carbohydrates, proteins, minerals, organic acids, vitamins, pigments, phenolic compounds, etc) can be contained in different concentrations in mature fruit, and they can react each other in different ways (Starast et al., 2007).

Berries have a prominent sweet taste and fruity smell. The fruits have a soft consistency. Color of ripe fruit can vary from yellow through red and continue to blue or black shades, depending on the type of pigments that are found in fruits and on their relationship (Zhao, 2007.). Berries are an important source of minerals, vitamins and other biologically active substances. Berry fruits providing significant effects on human health.

The quality of berries is defined by the following parameters: size and weight, uniformity of fruit shape, color, texture and firmness, soluble solids percentage (°Brix), pH, titration acidity, anthocyanin content, etc.

Visual perception of fresh and / or processed fruit is the first factor that indicates the quality, color, taste and smell of the product.Volatile and nonvolatile compounds greatly influence the sensory properties of berries (taste, flavor, and color) (Koni -Risti , 2011).Soluble sugars (sucrose, glucose, and fructose) and their relationship with organic acids and volatile aromatic substances present in fruits are most contributors of their sweet flavor (Zhao, 2007; Kubola et al., 2011). Organic acids, especially ascorbic acid, acting an important role in extension of the sustainability and preservation of fresh fruit colorsbased on anthocyanins stabilization. Increase consumption of berries in the world is associated with the action of some active ingredients (vitamins, minerals, dietary fiber) and their influence on the reduction of people number suffering from certain chronic diseases, including heart disease and cancer (Acosta-Montoya et al., 2010; Lee et al., 2012; Kubola et al., 2011).

Although berry fruits have been the subject of different studies reported before, there is a lack of information on chemical composition and sensory characteristics of wild berry grown in the eastern part of Republika Srpska and Bosnia and Herzegovina.The aim of this study was to examine nutritional value of some types of wild berries that grow in Podrinje region.

Materials and methods

Fruit samples tested in this paper were collected during full maturity in the period of 2011 - 2012 from wider area of Srebrenica and Bratunac municipalities.Approximately 1 kg of fresh

fruits per species were collected at peak ripeness and quickly transported to the laboratory. Samples of the same fruit species were collected at 5 locations. The samples were packed in plastic bags and transferred to the laboratory where it was analyzed in refrigerated conditions. The fruits were mashed in a homogenizer and prepared for further analyses. Four replicates were used per analysis. Basic analyses of chemical fruit composition were performed using standard methods of analysis (AOAC, 1990). pH was measured in the aqueous extract using a pH meter.The titration acidity was determined by neutralizing with 0.1 M NaOH solutionand results were expressed as citric acid equivalent (g/100). The content of anthocyanins and phenolics was determined using Escribano-Bailon et al. (2006) method.

The experiment was a completely randomized design with four replications. Data were subjected to analysis of variance (ANOVA) and means were separated by Duncan's multiple range test at $p<0.05$ significance level.

Results and discussion

Content of chemical compounds contained in different berries are shown in Tables 1-4. As can be seen from Table 1, the water content ranged from 75.06 % (black currant) to 86.11% (blackberries). When we compare the results for 2011 and 2012, notes that a significantly lower ($p<0.05$) water content of the fruit from 2012.One of reasons for this may be the lack of rainfall during the summer of 2012.The dry matter content is proportional to the total carbohydrates, total sugars, proteins and minerals (Table 1).The results obtained by measuring these properties are presented as a mean values.Various factors, especially, climate and rainfall have a major impact on each of these properties.

Mineral content in the berry fruit is higher than content in other plant foods, especially related to animal products (Plessi, 2007).Blackberries (0.60-3.78 mg/100 g), black currant (1.54-2.79 mg/100 g) and blueberries (0.25-1.38 mg/100 g) are exceptionally rich in iron, black currant (49.36-60.56 mg/100 g)and raspberry (28.45-30.45 mg/100 g) are rich in phosphorus, black currant is also rich in calcium (54.24-58.72 mg/100 g), while blackberries (0.51-0.62 mg/100 g) and raspberries (0.39-0.48 mg/100 g) extremely rich in zinc. As cited by (Plessi, 2007) this group of fruit is rich in content and selenium, manganese, etc.

Berry is a rich source of vitamins. Zhao (2007) stated strawberry, black currant and raspberry are well-known as a source of vitamin C, strawberries as a source of riboflavin, and black currant as a source of pantothenic acid.Strawberry also contains a high level of ascorbic acid (60.12-70.45 mg/100 g) whereas currants are recognized as a source of riboflavin (0.05 mg/100 g) (Table 2).

Several authors (Castañeda-Ovando, 2009; Céspedes, 2010; Kubola et al., 2011) reported that the fruit quality is not only result of the content of mentioned ingredients. A number of different pigments and other physiologically active compounds are contributing to the protection of human health.Total phenol content in raspberries was in the range of 240-400 mg/100 g, followed by the values recorded in blackberries ranging from 110-180 mg/100 g (Table 3). The content of total anthocyanins in the fruits ranged from 20 – 65 mg/100 g (raspberry) and 35 - 125 mg/100 g (blackberry).

Berries are a rich source of polyphenols, especially flavonoids (anthocyanins, flavonols, and flavan-3-oils).Hidoxybenzoic acid derivatives are also present in berry fruits (Zhao, 2007; Plessi, 2007; Acosta-Montoya et al., 2010; Bobinait et al., 2010; Buri ova et al., 2011).Many factors influence the composition and quantity of phenolic compounds in fruits.The main anthocyanins, which can be found in berry fruits, differ according to the number and position of hydroxyl and metoksil groups located on the B ring.Anthocyanins found in strawberries are solely nonacylated form (over 99%) (Wu et al., 2006). Similar situation is observed with cyanidin derivatesof blackberries and red and black raspberries.Blueberries are a unique berry

fruit which contains contain the mono glycosides (glucosides, galactosides, and arabinosides) of delphinidin, cyanidin, petunidin, peonidin, and malvidin (Wu et al., 2005).

Total phenol content, ranged from 428 to 1079 mg/100 g in black colored fruit, 192 to 512 mg/100 g in red fruit, 428 to 451 mg/100 g in pink/red fruit, and 241 to 359 mg/100 g in yellow fruit. Obtained results are in accordance with previously published data of Wada and Ou (2002) and Zhao (2007). Anthocyanins are the major phenolic present in black raspberries, with levels ranging from 464 to 627 mg/100 g (Wada and Ou, 2002). Red raspberries contain much lower levels of anthocyanins than black raspberries, with values ranging from 19 to 89 mg/100 g. The levels of total phenolics over all studies range from 43 to 273 mg/100 g. The levels of total phenolics in blackberry over all studies range from 114 to 1056 mg/100 g. Anthocyanins are the major phenolic in the berry fruits with concentrations ranging from 31 to 256 mg/100 g (Gu et al., 2002).

Present anthocyanins and other pigments give color of berryruits (red, purple, blue or black).In practice, there is great interest to use of anthocyanins as natural pigments instead artificial colors which represent the risk to human health.Consumers in the market are showing great interest in fresh strawberries, which have a pronounced red color. They believe that such kind of fruit has a nice taste.The composition of anthocyanin derivatives can vary significantly among types of fruit, although uniform composition can be observed within the same type.Therefore, the profile can be considered as anthocyanin fingerprint of certain products.

Storage conditions for fresh berries influence the loss of anthocyanins. For example, storage of cranberries at 0°C does not affect the loss of anthocyanins, but anthocyanins losses are over 60% when it stored at 20°C. Freezing does not affect the loss of anthocyanins.Color, smell and taste are also subject to change due to changes in pH and acidity of fruits (Table 4). Anthocyanins degrade during thermal processing of berries. Experts in the field of food technology and nutrition work intend to preserve the color of juice during the storage and processing of berries (Miszczak et al., 1995; Koni -Risti et al., 2011).

Besides fresh berries in human nutrition these fruit can be used in the form of juice (Sánchez-Segarra et al., 2000), yogurt, and jam (Plessi et al., 2007).

Table 1. The averagechemical composition of wild berries

Mean values	Strawberry		Raspberry		Blueberry		Black Currant		Blackberry		Gooseberry	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Water, %	85.19a	80.51b	83.76a	80.86b	85.12a	79.37b	80.46a	75.06b	86.11a	82.16b	84.24a	81.16b
Ash, %	0.35a	1.00b	0.44a	0.67b	0.15a	0.28b	0.68a	1.10b	0.24a	0.46b	0.40a	0.61b
Fat, %	0.35a	0.84b	0.61a	0.94b	0.27a	0.98b	0.23a	1.09b	0.44a	0.64b	0.46a	0.62b
Proteins, %	0.50a	0.92b	1.10a	1.59b	0.72a	0.95a	1.42a	1.65a	1.27a	1.49b	0.81a	0.97a
Simple sugars, total,%	5.21a	7.06b	4.11a	4.77a	5.00a	7.17b	6.40a	8.08b	4.25a	4.98a	5.78a	6.34a
Carbohydrates, total, %	8.93a	10.11a	10.12a	11.16a	9.16a	11.48b	11.10a	13.06b	8.00a	10.15b	8.96a	9.58a
Iron, mg/100g	0.40a	3.41b	0.55a	0.79a	0.25a	1.38b	1.54a	2.79b	0.60a	3.78b	0.28a	0.78b
Phosphorus, mg/100g	20.23a	38.78b	28.45a	30.33a	11.45a	16.78b	49.36a	60.56b	21.14a	24.45b	26.12a	28.56a
Calcium, mg/100g	16.00a	28.70b	22.45a	28.48b	6.26a	14.08b	54.24a	58.72b	28.74a	30.12a	24.78a	26.46a
Zinc, mg/100g	0.10a	0.19a	0.39a	0.48a	0.11a	0.18a	0.25a	0.30a	0.51a	0.62a	0.09a	0.12a

Values in the same rows for the same type of fruit with different lower case letters are significantly different at p<0.05

Table 4. Average pH and titration acidity of the fruits of wild berries

Mean values	Strawberry		Raspberry		Blueberry		Black Currant		Blackberry	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
pH	3.33a	3.58a	2.76a	2.98a	3.30a	3.54a	2.55a	2.78a	3.08a	3.25a
Titration acidity (%)	0.45a	0.65b	1.74a	2.20b	0.40a	0.70b	2.50a	3.10b	0.20a	0.30b

Values in the same rows for the same type of fruit with different lower case letters are significantly different at p<0.05

Conclusion

The results obtained during this study suggest two things:

- that the wild berries in this region are highly nutritional rich with protective materials and

- contains some of the protective substances in quantities greater than data obtained in other parts of the world.

The reason for this is the favorable climatic conditions and altitude for growing of berry fruits.

Table 2. The average content of some vitamins in fruits of wild berries

Mean values	Strawberry		Raspberry		Blueberry		Black Currant		Blackberry	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Ascorbic acid (mg/100g)	60.12a	70.45b	20.10a	35.46b	8.14a	9.50a	17.12a	19.45a	17.45a	21.16b
Riboflavin (mg/100g)	0.02		0.03		0.04		0.05		0.04	

Values in the same rows for the same type of fruit with different lower case letters are significantly different at p<0.05

Table 3. The average content of total phenolics and anthocyanins in fruits of wild berries

Mean values	Raspberry		Blackberry	
	2011	2012	2011	2012
Total phenols (mg/100 g)	240a	400b	110a	180b
Total anthocyanins (mg /100g)	20a	65b	35a	125b
Color	Red		Black	

Values in the same rows for the same type of fruit with different lower case letters are significantly different at p<0.05

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EVALUATION OF THE QUALITY OF AUTOCHTHONOUS PLUM CULTIVARS IN THE AREA OF BOSANSKI PETROVAC

Dragana VUKOJEVIC[1*], Jasmina SIMIC[2], Nikolina DRAGISIC[2], Dragana SEVO[3], Milutin MISIMOVIC[1], Nada ZAVISIC[1], Elmir BOLIC[4], Bojana RADANOVIC[1]

[1]Agricultural Institute of the Republic of Srpska, Bosnia and Herzegovina
[2]Cooperative Union of the Republic of Srpska, Bosnia and Herzegovina
[3]Drinic/Petrovac Municipality, Republic of Srpska, Bosnia and Herzegovina
[4]Bosanski Petrovac Municipality, Bosnia and Herzegovina
(Corresponding author: vukojevicd@yahoo.com)

Abstract

History of our autochthonous fruit cultivars is very long. Balkan Peninsula is one of the most important and richest centers of genetic diversity of fruit species in Europe. In the process of domestication many fruit species came into contact with their wild relatives, intersecting different genetic material and adjusting to the given environmental conditions. In this way, there was enrichment of biodiversity with many landraces that now constitute our unique biological heritage. Autochthonous fruit varieties were suppressed by industrial and commercial varieties.

The objective of this study was to investigate main pomological characteristics as well as fruit quality of the selected autochthonous plum cultivars from the region of Bosanski Petrovac. The fruits of selected cultivars could be processed, particularly into plum brandy, or they could be used fresh or dried. Also, can be used both in breeding programmes and as rootstocks as well as in further disease related systematic studies under field and laboratory conditions. In our region conservation of indigenous varieties is a prerequisite for the preservation of biodiversity, and the recognizable quality of our national products that have preserved specificity of our natural and cultural heritage. Also the potential for branding our traditional food products could represent good strategy for future rural development.

Key words: *autochthonous plum cultivars, preservation, agrobiodiversity, organic production.*

Introduction

Bosnia and Herzegovina has a long plum growing and processing tradition as well as evident biological diversity in local plum (*Prunus domestica*) germplasm. Autochthonous or local (primitive, folk) plum cultivars (accessions) grown in Bosnia and Herzegovina belong to *Prunus domestica* L. and *Prunus insititia* L. (Milosevic &Milosevic, 2012). Considering the current tendency of consumers to select typical regional products, there is a need to define Bosnian autochthonous varieties and to characterize the specificity of related products. Data available are limited to an earlier work by Paunovic and Paunovic (1994) suggesting the existence of 92 autochthonous cultivars and noting a high variability in the main morphological, pomological and technological traits.

The fruit quality is a complex of features and specific characteristics, which besides other criteria is mostly in accordance to the market demand. It is recent trend to study possibilities of autochthonous fruit cultivars in order to enrich the food industry with highly valuable raw materials while preserving biodiversity and straightening rural development.

Conservation and utilization of plant genetic resources in agricultural is one of the main trends in development of sustainable food production. Old varieties and populations are mainly characterized with lower demands and higher adaptability to environmental factors. For this reason they are suitable for low input agriculture and organic production. The interest of individual farmers in maintaining autochthonous breeds and varieties is declining since there is no economic gain in preserving and exploiting agricultural diversity. This means that the heritage of species and varieties is at risk of genetic erosion and hence requires measures that will encourage conservation and provide incentives towards sustainable use of autochthonous genetic resources (Bertacchini, 2009). Although traditional varieties (synonym to landraces, e.g. Harlan 1975) are generally thought to have lower yield potential than modern ones, they offer many commercial advantages. They also have inherent potential for increased productivity, they are often better adapted to local climatic conditions, cultural practices, and pest and disease; provide resilience and stability under variable and difficult cropping conditions (Bellon 1995, Brush 1995). During the 1970s and 1980s the general opinion was that these varieties would rapidly disappear, but they have proved remarkably resilient (Thompson *et al.*, 2007). In former Yugoslavia, the plum tree was the most spread species, because of the good climate conditions, the fruit value (energetic, nourishing, dietetic etc.) and was further considered a traditional species (Mratinic, 2000).In remote rural areas in Bosnia there are still households that breed autochthonous fruit varieties. Bosnian plum production is characterized by extensive growing technology, low unstable yields, low quality fruits and problems with plum pox virus. Autochthonous plum cultivars are a limiting factor in improving plum production. Nevertheless, they can be used as an outstanding source of germplasm and as a genetic basis underlying breeding activities, principally the development of new cultivars, clonal selection (Ogasanovic *et al*., 1994; Milosevic, 2000), the development of new plum, apricot and peach rootstocks (Paunovic, 1988; Djuric *et al*., 1998), resistance to economically important diseases (Paunovic & Paunovic, 1994; Rodrigues *et al.,* 2009) or intensive cultivation (Mratinic, 2000).

Many factors are known to affect the nutrient content of foods including variation due to differences in nutrient composition of foods below the level of species, i.e. subspecies, variety, cultivar or breed (Toledo & Burlingame, 2006).Until now over-exploitation of certain cultivars and varieties was driven by market demands. Nevertheless, recent studies have shown that human nutrition and dietary diversity within the traditional food system has to be enhanced not only with different fruit and vegetable species but also with varietal diversity in terms of fresh consumption and processing as well. It is generally thought that macronutrients vary only insignificantly within the same species (Greenfield & Southgate, 2003; Kuhnlein, 2003; Rodriguez-Amaya *et al*., 2008). However, Burlingame *et al.* (2009) show data that this is not always the case and that the compositional differences among varieties or cultivars can be very significant for macronutrients, micronutrients and bioactive non-nutrient. That is not a simple approach but a complex one, taking into account the diversity and quality of cultivars permanently improved and also having in view the nutrients which confer the fruit quality (Burzo *et al.,* 2005). Therefore, fruit chemical analysis recently received special attention, since it can provide information on fruit quality based on previously known adequate and critical nutrient levels and, therefore, prevents deficiencies and physiological disturbances in fruits (Marcelle, 1984; Suzuki & Argenta, 1994; Nachtigall & Freire, 1998; Ernani *et al*., 2002).

Action for Nutrition adopted at the 1992 International Conference on Nutrition (ICN, 1992). The declaration recommended the promotion of dietary diversity, and the use of locally available nutrient-rich indigenous and traditional foods as a vital strategy against food insecurity, malnutrition and disease.

Materials and methods

Investigations included *in situ* identification, marking and observation of autochthonous plum cultivars (accessions) in the area of Bosanski Petrovac. During 2012 recording of the phenological traits – first flowering, full flowering, end of flowering and harvest date was conducted on sample of five trees per each cultivar, as following: the beginning of flowering was recorded when at least 5% of the flowers bloomed; full flowering was accepted when at least 80% of the flowers bloomed, the end of flowering was determined when 90% of the flowers bloomed and corollas began to fall off, and harvest date was established when the fruits were sufficiently colored and soft to be eaten (Funt, 1998).

On 30 fruits, per sample, collected during full maturity, fruit weight, size, shape, color, firmness, stone weight, and stone general shape were measured.Randman, that represents percentage of fruit flesh in total fruit weight, was established calculating. All measurements were performed using hand caliper. Observation and recording of their phenological and pomological traits were performed using UPOV methodologies.

Analysis of the K, Ca and Mg content was conducted by wet burning of dried fruits with acid mixture (HNO3 + HClO4 + H2SO4) and concentration was determined in the AAS system (UNICAM, Model SP9).

Results and discussion

The phenological characteristics of autochthonous plum cultivars are given in Tab. 1. The data show that the onset of flowering was recorded in the second and third decade of April.Fruits of all examined plum cultivars averagely ripen in interval from 09th September up to 22nd September (Tab. 1).

Full flowering date of evaluated cultivars showed a high range (13 days), while the differences for harvest date were 13 days as well. These traits depend on environmental conditions (temperature, altitude etc.)and may change every year (Liverani *et al*. 2010). Cosmulescu *et al.* (2010) stated that "*flowering time duration*" is a feature which is influenced by climatic factor and genetic factor.In general, the earlier the flowering is developing, the shorter its time duration. The period between the beginning of flowering and the end of it vary from 14 to 17 days, and differences occur between cultivars. Similar data on the period and duration of flowering of autochthonous plum cultivars were reported by other authors (Jovancevic, 1977; Milosevic, 2010). Pozegaca ripens during the end of August and the beginning of September, but in higher altitudes even in October (Jacimovic *et al.* 2011).

Tab. 1. Phenological characteristics of autochthonous plum cultivars in Bosanski Petrovac

Cultivar (local name)	Flowering			Duration (days)	Harvest date
	Onset	Full	End		
Pozegaca	23.04.	03.05.	10.05.	17	22.09.
Durgulja	20.04.	27.04.	04.05.	14	12.09.
Bjelica sitna	11.04.	20.04.	28.04.	17	10.09.
Prskulja	10.04.	20.04.	27.04.	17	09.09.

All monitored autochthonous plum cultivars have extremely small fruit according to FAO plum descriptor. The average fruit weight of autochthonous plum cultivars ranged from 4,7 (Prskulja) g to 26,4 (Bjelica sitna), with significant differences comparing to average fruit weight of commercial plum cultivar Stanley (40,6 g). Comparing to measurements from previous years, average fruit weight of autochthonous plum cultivars in 2012 was significantly smaller due to the strong drought conditions during July and August. Also freeze

damage in the beginning of the vegetation strongly reduced fruit set affecting the yield in 2012. Fruit weight is in direct correlation with fruit size and other authors recorded statistically high differences in both, between different autochthonous plum cultivars (Jacimovic *et al.* 2011).

Tab. 2. Pomological and sensorial characteristics of autochthonous plum cultivars in the area of Bosanski Petrovac

Cultivar (local name)	Fruit weight (g)		Fruit Size[1]	Fruit Shape[2]	Flesh Color[3]	Flesh Firmness[4]	Stone weight (g)	Stone shape[5]	Share of flesh (%)
	2010	2012							
Pozegaca	20,7	15,5	1	2	3	7	0,5	1	96,78
Durgulja	17,3	11,1	3	5	3	3	0,9	3	91,90
Bjelica sitna	11.5	26,4	1	6	4	5	0,5	2	98,11
Prskulja	8,9	4,7	1	2	3	3	0,5	2	89,36
Stanley	39,8	40,6	5	2	3	7	1,9	1	99,53

[1] Fruit size: 1 = extremely small, 2 = very small; [2] Fruit shape: 2 = rounded, 3 = elliptical, 4 = ovate, 6 = oblong; [3] Flesh color: 2 = light green, 3 = yellow green; [4] Flesh firmness: 3 = soft, 5 = medium, 7 = firm; [5] Stone general shape in lateral view: 1 = narrow elliptic, 2 = elliptic, 3 = circular.

Stone weight of autochthonous cultivars was significantly smaller in relation to Stanley, and it ranged ranged from 0,5 g (Pozegaca, Bjelica sitna, Prskulja) to 0,9 g (Durgulja), which was in agreement with the results obtained by Milosevic *et al.* (2010), Paunovic (1988), Paunovic and Paunovic (1994) and Mratinic (2000).

All monitored autochthonous cultivars have high share of flesh ranging from 89,36 % (Prskulja) to 98,11 % (Bjelica sitna), but lower comparing to Stenley that is well known for high share of flesh in fruit's total weight.

Tab. 3. The mineral composition of selected essential macro minerals (K, Ca, Mg) in investigated plum cultivars from Bosanski Petrovac

Cultivar	K %	Ca %	Mg %
Stanley	1,16	0,02	0,04
Prskulja	1,40	0,06	0,05
Pozegaca	0,99	0,06	0,04
Bjelica	1,25	0,07	0,06
Durgulja	1,15	0,06	0,05

It has been proposed by several authors that different varieties as well as different cultivars should be examined for their nutritional value (Campeanu *et al.*, 2009; Imran *et al.*, 2007; Imran *et al.*, 2010; Jacimovic *et al.* 2011). The various mineral elements enter the maturing fruit at different rates (Valvi & Rathod, 2011). Among the macro-minerals (K, Ca, and Mg), the content of K varied from 0,99% (Pozegaca) to 1,40% (Prskulja). Cultivars Prkulja and Bjelica had higher K content comparing to Stenley. Chemical analysis showed that Stenley had lowest Ca content comparing to autochthonous cultivars. Ca contetnt ranged from 0,02% (Stenley) to 0,07% (Bjelica). The lowest Mg content was determined in Stanley and Pozegaca (0,04%) and the highest in Bjelica (0,06%).

Conclusion

Investigated autochthonous cultivars are fully adapted to the environmental conditions in the area of Bosanski Petrovac. The aim of these studies should be to provide information about the nutritional value of old varieties, in order to preserve autochthonous varieties and cultivars from genetic erosion.

In this study the autochthonous plums were classified as being extremely small in terms of fruit size. The obtained values, particularly those for fruit weight and fruit size, were lower than standard commercial cultivar.

Due to the various ways of propagation (both by cuttings and seedlings), plum populations are highly heterogeneous and show environmentally dependent traits. This implies that detailed evaluation and description of autochthonous cultivars should be preformed and that reliable estimation will be possible only through a multi-disciplinary approach by examining selected cultivars grown in a collection orchard as well as under field and laboratory conditions over the next five to ten years.

All the autochthonous fruits could be processed, and some could be dried or used fresh. The autochthonous (primitive, local) plum cultivars could serve as an outstanding genetic basis and a source of germplasm for plum breeding aimed at developing new cultivars and rootstocks. More effort and resources are needed to analyze and disseminate data on the nutrient composition of wild, underutilized, autochthonous varieties, and under-appreciated food biodiversity.

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DUTCH EARLY POTATO VARIETIES IN BOSNIA AND HERZEGOVINA

Josip COTA[1], Milana SILJ[2]

[1]Federal Department of Agriculture, Sarajevo, Bosnia and Herzegovina
[2]Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
(Corresponding author: j.cota@fzzp.com.ba)

Abstract

The five varieties (Adora, Arizona, Saviola, Attrice and Antea) were examined in experiments during 2011. The study was carried out at Butmir (at approximately 500 m above sea level) and Glamoc, (about 900 m a.s.l.).

The productive characteristics of potato varieties (yield, weight and the number of tubers per plant were studied. The experiments were carried out at randomized block system, in four repetitions. The feedback results were processed with the analysis of variance. The experiment was performed on acid soil lacking humus and phosphorus and containing enough potassium for a normal growth of the crops.The climatic conditions were favorable for the potato growth. Higher yield in comparison to Andora was evident at the following varieties: Arizona (49%), Saviola (31%), Arttice (21%) and Antea (36%). Dry matter content ranged from 21.40% in the case of Arizona variety, up to 22.90% in the case of Attrice.The testing of potato varieties should be continued in the future, in order to find the best conditions for farming in Bosnia and Herzegovina.

Key words*: potato, variety, yield, quality*.

Introduction

Variety is an important component in crop production and seed is the basic reproductive material. Well-chosen variety gives higher yields and better quality itself in the same conditions and without any particular investment. Since 1995 until now over 60 varieties of potatoes has been introduced in Bosnia and Herzegovina. Selection of varieties depends on the purpose and requirements of consumers. Varieties with shorter vegetation period with early tuberisation and quickly forming of tubers are selected for the production of early potato. Besides knowing the production characteristics of each variety it is necessary to know their specific production characteristics and requirements in terms of: seed dormancy, size of vegetation area, depht of planting, fertilization irrigation, resistance to stress, as well as protection, storage and consumption quality. Varieties that form 10-12 tubers per plant provide stable and high yields while very high yields are achieved with varieties that form about 15 tubers per plant, with mandatory irrigation. The aim of the study was to show the most important characteristics of newly introduced Dutch potato varieties, their productivity characteristics and agrotechnical specificity as well by the means of network of micro-experiments in different agroecological conditions. The introduction of appropriate varieties into production, based on preliminary examination in our conditions, will provide an increase in the potato yield.

Material and methods

The study was carried out at Butmir (at approximately 500 m above sea level) and Glamoc, (about 900 m a.s.l.) in 2011. The five varieties were examined in experiments: Adora, Arizona, Saviola, Attrice and Antea. A class of seeding material was used. The experiments, were carried out at randomized block system in four repetitions. Planting of potatoes was done manually with 75 cm between row distance and 33 cm within row plant distance respectively, achieving the density of 40.000 plants per hectare. Standard agricultural practice for the potato crop was applied. Mineral fertilizers in quantities 80-100 kg/ha N, 100-120 kg/ha P_2O_5 and 180-200 kg/ha K_2O of pure nutrients were applied (total quantity of P and K in early spring as well as 60% of N, while 40% of N was used for top dressing). Crop protection was against the blight pathogen (*Phytophthora infestans Mont de Bary*) and pest Colorado potato beetle (*Leptinotarsa decemlineata*) as needed. Phenological observations of a number of parameters were carried out during vegetation. Harvest of potato tubers was carried out manually after drying of aboveground mass. After harvest, total weight and the weight of tuber fractions in a sample of 10 plants per variety was analyzed. Samples of potato tuber were taken during the harvest in order to determine the qualitative characteristics of varieties. Content of dry matter and starch in potato tubers was determined with standard method for potatoes (Rajman scale). The results were statistically analyzed using analysis of variance.

Soil and weather conditions

The experiment was set up on brown valley soil in Butmir and on brown, medium-deep soil on the limestones and dolomites in Glamoc. Soil reaction in Butmir is acidic and alkaline in Glamoc. In content of nutrients, soil in Butmir and Glamoc are poorly supplied with phosphorus. Soil on both localities has been moderately supplied with potassium.

Table 1. Chemical characteristics of soil at experimental fields

Locality	pH		Content (%)		mg/100g soil	
	H_2O	KCl	Total nitrogen	Humus	P_2O_5	K_2O
Butmir	6,28	5,45	0,230	1,75	11,50	8,50
Glamoc	8,10	7,40	0,09	1,80	6,90	12,00

Climatic conditions vary from one locality to another. Mountain climate prevails in Glamoc where summers are cool, and the winters are cold while in Butmir we have quite harsh winters and moderately warm summers.

The following tables provide a multi-year averages of temperature and precipitation for these sites. Data for 2011 were are provided for Sarajevo and Livno since a weather station in Glamoc is not in use.

Table 2. Monthly air temperature (°C) for 2011

Locality	I	II	III	IV	V	VI	VII	VIII	IX
Sarajevo	0,2	0,6	5,2	11,0	14,0	18,9	20,5	21,7	19,1
Livno	0,8	1,9	4,5	10,5	14,1	18,5	19,7	20,8	17,7
Averge Sarajevo(1996-2005)	0,07	1,02	5,27	9,58	15,16	18,7	20	19,81	14,4
Averge Livno (1996-2005)	0,17	0,47	4,45	8,69	14,57	18,3	19,98	19,56	14

Table 3 Monthly precipitation (l/m^2) for 2011

Location	I	II	III	IV	V	VI	VII	VIII	IX
Sarajevo	37,9	35,9	40,7	32,7	103,6	76,3	134,4	4,8	38,9
Livno	40,8	21,0	87,7	48,3	85,5	82,4	115,4	21,1	27,6
Averge Sarajevo(1996-2005)	70	71,4	50,8	85,1	70,6	71,8	74,5	65,3	124
AvergeLivno(1996-2005)	93,5	76,8	71	110,4	71,5	60,7	48,2	60,9	121

In comparison to multi-year average, the temperatures were favourable during potatoes experiment. Average monthlytemperatures were favourable in fourth, sixth, seventh and ninhtmonth in Sarajevo while infourth, eight and ninht month in Livno compared to multi-year average**.** Precipitation during the growing season of potato were relatively well distributed. Rainfall excess was in the fifth, sixth and seventh month in both places compared to multi-year average.

Results and discussion

Emerging uniformity, vigor, crop uniformity and lenght of the growing season is highly influenced by external factors *Suvajdži , Gliši (1975/76).*

Table 4. Emerging uniformity, the number of additives, vigor, crop uniformity, length of growing season of potatoes at Butmir

Variety	Emerging uniformity (1-5)	Number of additives	Vigor	Crop uniformity (1-5)	Length of growing season
Arizona	5	-	4	4	121
Saviola	3	-	3	3	110
Actrice	4	-	4	5	106
Antea	5	-	4	5	113
Adora (St.)	5	-	4	4	95

Experiments were established in well-prepared soil. Emerging was relatively good while emerging uniformity ranged from 3 to 5. The most uniform emerging had varieties Arizona, Anthea, Adora, while poorer uniformity of emerging was registered with other varieties studied. There was no additives within varieties. Varieties were relatively uniform by vigor. There was no differences within varieties.

Length of the growing season has fluctuated from variety to variety, what is essentially varietal characteristic, ranging from 95 to 121 day in Butmir. The length of the growing season had been influenced by climate. The shortest vegetation of 95 days had a variety Adora, and longest vegetation had variety Arizona - 121 days. In relation to Adora vegetation was longer by 26 days in the variety Arizona.

Table 5. Number of potato tubers per plant (10 boxes) at Butmir

Variety	Ill tubers	> 55 mm	28-55 mm	< 28 mm	Average tuber mass g-
Arizona	0	18	77	25	12
Saviola	1	7	58	30	9
Actrice	0	13	55	18	8
Antea	1,5	17	58	27	10
Adora (St.)	0	6	71	16	9

Number of tubers per plant ~~bed~~ is a characteristic of the variety that can vary depending on the climate and growing conditions. Among the varieties studied highest number of tubers had variety Arizona (12 tubers/plant) and the lowest variety Actrice (8 tubers/plant).

Table 6. The average mass of potato tubers (10 beds) in g and % at Butmir

Variety	Ill tubers		> 55 mm		28-55 mm		< 28 mm		Average tuber mass g-
	G	%	G	%	g	%	g	%	
Arizona	0	0	4125	40,74	5600	55,30	400	3,95	101,2
Saviola	0	0	1200	22,42	3750	70,09	400	7,47	53,5
Actrice	0	0	2800	40,00	3950	56,42	250	3,57	70,0
Antea	0	0	3750	43,85	4500	52,63	300	3,50	85,5
Adora (St.)	0	0	1250	18,51	10500	77,77	250	3,70	67,5

The average tubers weight and number of potato tubers were done by sampling 10 beds of each variety at Butmir. It may be noted that sorts had varying weight of tubers, from 53.5 g in the case of Saviola to 101.2 g in the case of Arizona variety. There was higher precentage of medium sized tubers (28-55 mm) compared to large and small.. The highest percentage of tubers of this fraction had a standard variety Adora (77.77%). Minimum small tubers, less than 28 mm, had a variety Anthea - 3.50% and a maximum variety Saviola - 7.47%.The number of small tubers is the characteristic of the variety and the result of climatic conditions for the growth of potatoes in the summer months, as well as toxic effects of herbicides (Sencor) in the variety Saviola.

Table 7. The yield of potato per variety (t / ha)

Variety	Locality				Average	
	Butmir	%	Glamo	%	Cultivar	%
Adora (St.)	22,43	100	27,6	100	25,0	100
Arizona	35,52[**]	158	39,12[**]	141	37,3[*]	149
Saviola	24,27[**]	108	41,15[**]	149	32,7	131
Actrice	25,34[**]	113	35,32[**]	128	30,3	121
Antea	27,66[**]	123	40,45[**]	146	34,01	136
Lsd $_{p=5\%}$	0,52		0,65		10,81	
Lsd $_{p=1\%}$	0,74		0,91		17,94	

Compared to the standard variety Adora, the varieties tested had significantly higher tuber yield at both sites. The highest yield at the locality of Butmir had variety Arizona, 58% higher than the standard and the variety Saviola 49% higher yield than Adora at the locality of Glamoc. Significantly higher average yield in comparison to Andora was evident at the following varieties: Arizona (49%), Saviola (31%), Arttice (21%) and Antea (36%).

Table 8. The yield of potato per localities (t/ha)

Locality	Yield (t/ha)	%
Butmir	27,04	100
Glamoc	36,70*	136
Lsd$_{P=5\%}$	6,89	
Lsd$_{P=1\%}$	11,40	

Differences in the yield of potatoes are being observed depending on the year (ota J., Hadži A., Spahovi E., 2005.). Higher yield of potato was in Glamoc, 36% higher than in Butmir.

Table 9 The chemical composition of potato tubers at Butmir

Variety	Starch content %	Dry matter content %
Adora	16,50	21,70
Arizona	16,20	21,40
Saviola	16,70	21,90
Actrice	17,60	22,80
Antea	17,00	22,20

Based on the content of starch and dry matter it can be concluded that the highest percentage of starch had a variety Actrice 17.60% and 22.80% of dry matter, while the lowest had a variety Arizona 16.20% with 21.40% of starch.

Reasearch of other authors have shown that the content of dry matter and starch fluctuates in a very wide range. Starch content depends on the variety (*Quasem, 1978*), day length (*Jakovljevi , 1965*), nutrition with micro and macro elements (*Stojiljkovi , 1986*), length of growing season and other factors. *ota, et al. (2004)* find that the qualitative properties of potato react to the slightest changes in agro-ecological factors. In dry and sunny years starch content is higher, while being lower in colder and wetter years, with more cloudy days and precipitation. The content of dry matter and starch increases with later maturing of tubers (*ota, 2002*). Varieties with higher content of dry matter and starch have higher nutritional value.

Conclusions

The four varieties (Arizona, Saviola, Attrice, and Antea) were examined in experiments during 2011, along with standard variety Adora. Air temperatures were favorable for the development of potatoes in relation to a multi-year average. Precipitation during the growing season of potato were relatively well distributed. The shortest vegetation of 95 days had a variety Adora, and the longest vegetation of 121 days had a variety Arizona.

Among the early varieties tested the highest number of tubers had a variety Arizona (12 tubers/plant).

It may be noted that the varieties had varying weight of tubers, from 53.5 g in the case of Saviola variety to 101.2 g in the case of Arizona. The highest percentage of large tubers had a variety Antea 43.85%.

In comparison to standard Adora variety, varieties tested had significantly higher tuber yield at both localities. The highest yield at the locality of Butmir had variety Arizona, 58% higher than the standard and the variety Saviola 49% higher yield than Adora at the locality of Glamoc. Significiantly higher yield of potato in comparison to Andora was evident at the following sorts: Arizona (49%), Saviola (31%), Arttice (21%) and Antea (36%).

Significantly higher yield of potato was in Glamoc, 36% higher than in Butmir.

Variety Actrice had the highest percentage of starch 17.60% and 22.80% of dry matter.

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LONG-TERM EXAMINATION OF POTATO VARIETIES IN SARAJEVO-ROMANIJA REGION

Vesna MILIC[1*], Milana SILJ[1], Branka CODO[1], Igor DJURDJIC[1], Zoran JOVOVIC[2]

[1]Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina,
[2] Biotechnical faculty, University of Montenegro, Podgorica, Montenegro
(Corresponding author: vesnamlc@yahoo.co.uk)

Abstract

Inthis paper the results of examination the productivity of 10 potato varieties are given. The experiment was carried out on the experimental field of Faculty of Agriculture in East Sarajevo, "KULA", on the brown valley soil in the period of five years (2007 – 2011). The aim of our studies was to determine the genetic potential of the examined varieties. In certain years of examination, the variation in yield and weight of tubers were determined. The yield was alsoaffected by the weather conditions so that higher or lower yieldvariation in some varieties were recorded. The varieties with the highest yield were: Agria, Anais, Kennebec and Arnova. There is a need to expand these examinations in future, and to expand the number of examination sites with the aim of their detection and implementation into the production of stable and productive variety, and aloso the increasing of the average potato yield.

Key words: *potato, yield, variety*

Introduction

In Republic of Srpska, potato is cultivated on 14 500 hectares with an average yield of about 11 t/ha (Statistical Yearbook of Republika Srpska, 2007-2011), although some farmers achieve yield of over 30 t/ha. Larger areas sown with potato are located in lowland areas, although the potato sown with spring wheat is of great significance for hilly-mountainous regions. Several varieties are presented in a wider production.

This issue was treatedby or evi , 2000, ota et al 2000, Bugar i et al 2000, Mili and Bogdanovi 2009, Mili and Kova evi , 2009.

The aim of the research was to discover the genetic potential of potato varieties in the agro-ecological conditions of Sarajevo-Romanija region.

Materials and methods

In the five-year period (2007 – 2011), the varietal trials were set on the experimental field of the Faculty of Agriculture in East Sarajevo in five replications in completely randomized block system. Examinations included 10 varieties (Agria, Aladin, Anais, Arnova, Desiree, Kennebec, Liseta, Ostara, Riviera and the Terra Gold). The biggest problem in these examinations was the purchase of seed material of certain potato varieties.

The crop planted before potato was barely. Primary tillage was conducted in autumn by 30 cm deep plowing and with mineral fertilizing ($N_{10}P_{20}K_{30}$ in the amount of 800 kg/ha). Elementary plot (25 m^2) consisted of four rows of 10 m length and the planned plant population per hectare was 40 000 plants. The seed of original category was used for planting. The soil of the experimental field is brown, valley.The number of tubers and their weight were determined

after harvest. Tuber yield per hectare was calculated. Statistical data processing was done using variance analysis method, and as for individual comparison tests, the LSD test was used.

Meteorogical conditions during the performance of the experiments

In the potato production, the climatic conditions are important, especially the amount and distribution of rainfalls. Meteorological data given in Table 1 show that there is often a lack of rainfalls during the summer or the amounts of rainfall are not equally distributed. Temperature conditions were appropriate for potato cultivation.

Table 1.Meteorogical data – Sarajevo

Months	2007		2008		2009		2010		2011		Average 1961-1990	
	$°C$	l/m^2	$°C$	l/m^2	$°C$	l/m^2	$°C$	l/m^2	$°C$	l/m^2	$°C$	l/m^2
I	-2.4	28.6	0.2	28.6	-1.3	82.2	0.3	118.3	0.2	12.9	-0.8	74
II	0.1	14.5	2.0	14.5	1.2	29.8	0.8	63	0.6	22.6	1.7	69
III	4.1	144.2	5.4	144.2	4.9	62.4	5.0	55.6	5.2	27.8	5.5	73
IV	11.9	83	11.0	62.3	12	35.6	10.3	45.4	11.0	31.4	10.0	76
V	15.9	48	16.2	59.2	16.2	72	14.5	63.2	14.0	70.4	14.8	85
VI	20.1	79	19.9	86	17.8	116.6	18.1	147.8	18.9	23.4	17.7	94
VII	22.0	67	20.3	85.5	20.7	40.4	20.6	26.0	20.5	93.4	19.7	83
VIII	21.6	109	20.7	7.8	20.2	42.6	20.9	31.8	21.7	4.4	19.4	73
IX	15.2	148	14.1	60	16.3	12.8	14.6	95.4	19.1	45	15.9	73
X	13.3	19	11.2	47.4	9	125.4	8.3	48	9.2	47.8	10.9	79
XI	8.2	25	6.6	92.4	6.6	43.8	8.7	113	3.7	22	5.6	98
XII	1.3	58	1.2	86.7	2.0	87.2	0.6	100.1	2.3	80.6	0.4	88
Average/Total	10.9	823.3	10.7	774.6	10.5	750.8	10.2	907.6	10.5	481.7	10.1	965

In 2007, the average annual temperature in Sarajevo was 10.9°C and the total amount of rainfall 823.3 l/m^2 . The average monthly temperatures during the conduction of the trial were higher than average. During the spring, there were enough rainfalls, while in summer there was their.

In 2008, the average monthly temperature during the conduction of the trials were higher than average. During the spring, there were enough rainfalls, while there was a deficit of the rainfalls in summer.

In 2009, the average annual temperature in Sarajevo was 10.5°C, and the total amount of rainfall 750.8 l/m^2 . The average monthly temperatures during the vegetation period of potato were extremely higher than the average. Throughout the year, there were enough
in rainfalls.

In 2010, the average annual temperature Sarajevo was 10.2°C. It was extremely hot in 2010, but the amount of rainfall of 907,6 l/m^2 was also extreme.

In 2011, the average annual temperature was 10,5°C. It was very hot in 2011, but also very dry, 481.7 l/m^2.

Results and discussion

Number of tubers.

The number of stolons and the number of formed tubers (Knowles, 2003) depends on the genetic capacity of the plant, as well as on the conditions of growth and development of the inner physiological factors that enables this ability to materialize. Tuber formation takes place in 4 – 5 weeks after germination, and in normal years, there are tubers formed on each stolon. Lack of moisture in this period leads to weaker stolon formation and thus fewer number oftubers (Pisarev and Moros, 1991; Postic et al., 2011)

Table2. Tuber Number

Variety	2007	2008	2009	2010	2011
Agria	9.8	8.7	9.4	10.3	9.6
Aladin	8.2	9.4	8.7	8.8	7.8
Anais	13.4	-	12.5	12.5	12.8
Arnova	10.6	-	11.3	10.5	-
Desiree	7.5	9.5	9.2	9.3	8.5
Kennebec	-	-	10.5	11.8	11.4
Liseta	9.5	-	9.6	8.9	-
Ostara	-	6.5	5.3	5.9	5.3
Riviera	10.1	8.2	11.2	8.9	8.5
Terra Gold	-	9.5	9.2	9.5	-
LSD $_{0,05}$	1.859	1.245	0.794	0.957	0.853
$_{0,01}$	2.454	1.804	1.268	1.435	1.375

At Ostara variety, we have found the smallest number of tubers in all years of examination, while Anais, Kennebec, and Arnova varieties formed more than ten tubers per plant (Table 2). The Riviera had the highest variations in number of the formed tubers, and Terra Gold had the lowest. The size of the tubers is a varietal characteristic but it also depends on the number of agro-technical measures, the soil type and its structure, as well as on meteorological conditions during the vegetation period of potatoes (Ilin et al., 2000).

Table 3. Tuber Weight (g)

Variety	2007	2008	2009	2010	2011
Agria	77.20	79.51	72.42	75.32	77.56
Aladin	75.35	70.54	72.95	74.23	71.32
Anais	53.54	-	54.43	50.85	52.45
Arnova	65.22	-	68.00	63.20	-
Desiree	68.84	58.50	59.63	56.97	57.34
Kennebec	-	-	60.14	62.24	60.55
Liseta	62.30	-	65.51	66.93	-
Ostara	-	72.11	77.11	73.51	74.21
Riviera	65.21	69.10	68.24	66.37	65.45
Terra Gold	-	65.21	65.12	62.22	-
LSD $_{0,05}$	9.005	7.540	6.549	8.351	5.436
$_{0,01}$	12.085	9.813	8.841	12.022	8.638

Tuber weight.
Anais and Desiree varieties had the smallest, while Agria variety had the biggest tubers (Table 3). The differences found were statistically significant. Achieving high potato yield depends on a series of factors. Along with the favorable climatic factors during the growing season of potatoes, the determining factors are variety, the use of adequate amount of fertilizers, as well as appliance of appropriate tillage systems and crop care.
Tuber yield.
In 2007, variety Desiree had the lowest tuber yield (20.65 t/ha), and Agria variety had the highest tuber yield (30.24 t/ha). The differences found were significant. Varieties Anais, Riviera and Arnova had high yields, while varieties Aladin and Liseta lower than 25 t/ha.

Tabele 4. Tuber yield in t/ha

Variety	2007	2008	2009	2010	2011
Agria	30.24	27.65	29.14	31.03	29.78
Aladin	24.70	26.42	25.56	26.12	22.25
Anais	27.65	-	26.75	25.42	26.85
Arnova	27.64	-	27.25	26.54	-
Desiree	20.65	22.19	21.77	21.19	19.49
Kennebec	-	-	28.32	29.37	27.61
Liseta	23.65	-	23.09	23.82	-
Ostara	-	18.65	17.93	17.34	15.73
Riviera	26.32	22.65	24.64	23.62	22.25
Tera Gold	-	24.75	24.75	23.64	-
LSD $_{0,05}$	2.547	2.856	1.857	3.457	2.251
$_{0,01}$	3.587	3.896	2.894	5.032	3.362

In 2008, variety Ostarahadthe lowest tuber yield (18.65 t/ha), and variety Agria the highest one (27.65 t/ha). In the crop of Aladin variety was also measured high yield (26.42 t/ha).

In 2009, variety Agria gave the highest ŧ yield (29.14 t/ha), and variety Ostara had the lowest one (17.93 t/ha). The differences found were significant. Varieties Kennebec and Arnova had the high yields, too.

In 2010, in the crop of Ostara variety was measuredthe lowest tuber yield (17.34 t/ha), while variety Agria had the highest one (31.03 t/ha). The differences found were significant. Varieties Kennebec, Aladin and Arnova gave also high yield.

In 2011, variety Ostara gave the lowest (15.73 t/ha), and variety Agria the highest tuberyield (29.78 t/ha). The differences found were significant.

In all years of examination, varieties Liseta, Arnova and Terra Gold had the lowest and, Aladin and Riviera the highest variation.

Conclusion

On the basis of the five-year (2007 – 2011) varietal examinations set on the experimental field of Faculty of Agriculture in East Sarajevo, we can conclude the following:

Varieties Agria, Anais, Kennebec and Arnova had the highest yield. The lowest variations in yield, during the years of examination, were recorded at varieties Agria and Desiree, and the highest ones at varieties Ciklon and Jaerla.

Variety Ostara had the lowest, and Anais, Kennebec and Arnova the highest number of tubers per plant. Variety Agria had the biggest, and Desiree and Anais the smallest tubers.

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POMOLOGICAL CHARACTERISTICS OF SOME RASPBERRY VARIETIES GROWN IN THE CONDITIONS OF BRATUNAC REGION

Mirko KULINA[1*], Ranko POPOVIC[2], Mirjana STOJANOVIC[1], Goran POPOVIC[2], Radisav KOJOVIC[3]

[1]Facultu of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia & Herzegovina
[2]Biotechnical faculty, University of Podgorica, Montenegro.
[3]Agricultural faculty University of Kragujevac, Cacak, Serbia
(Corresponding author: kulinamirko@yahoo.com)

Abstract

The aim of this research was to study physical and chemical fruit characteristics of some raspberry types in row planting system in agro-ecological conditions of Bratunac and to determine validity of existing planting and introduction of raspberry types. Among the studied types Meeker expressed better physical and chemical fruit characteristics than other two examined types Willamette and Heritage.

Keywords: *raspberry, cultivar, fruit quality*

Introduction

Raspberry (*Rubus sp.*) is, after strawberry, the most important berry fruit type. According to the data of International Organization for Agriculture and Food (FAO), for 2009, raspberry world production was organised on 91 257 ha with total production of 486 889 tons of this fruit, and average yield of 5.3 t/ha. The biggest producers of raspberry in the world are Russia (120 000 t), Serbia (86 961 t), Poland (81 778 t) and USA (60 056 t). The biggest exporter of raspberry is Serbia with 63 000 tons exported with achieved income of 200 million dollars. In accordance to the data of the Bureau of Statistics of the Republic of Srpska for 2009/2010, raspberry production in Bosnia and Herzegovina was organized on 1 031 ha with the total production of 8 487 tons and average yield of 8.2 t/ha. There are 754 ha under raspberries in the Republic of Srpska with the total production of 5 129 tons and average yield of 6.8 t/ha.

There are more than 1 200 types of red, black and purple raspberries in the world, but the number of economically important ones is small (Miši and Nikoli , 2003). Also, it has been intensively worked on plant production and creating new types of raspberry in the world, which, in its genetically base, will consolidate basic requests of producers, processors and consumers. One of the aims of plant production is also extension of the season of fresh raspberry fruit consumption.

Materials and methods

Research was done in plantation of raspberry types Willamette, Meeker and Heritage, located in village Bjelovac, near Bratunac. The plantation was established in the form of vertical system for Willamette and Heritage types, and T-row for type Meeker. The distance between rows for all three plots was 2.3 m and in one running meter of row 6 raspberry plants were planted. Planting was done with certified nursery plants in spring 2007.

During the research, all pomo-technical measures within winter and green pruning were done, respecting the principles of type specificity. It should be mentioned that the system of winter

pruning was done with the type Heritage, where the complete upper part of plant is removed, with goal to obtain fruits only on primocanes of fruits. In that way significantly longer period of ripening (60 – 80 days) can be provided, what would later reflect on specificity of this system on methods applied during the research.

As a material in this work we used raspberry types Willamette, Meeker and Heritage. Willamette is the most present in raspberry production in Bosnia and Herzegovina. Type Meeker is marked as perspective and highly productive one, with a trend of increasing surfaces, and the type Heritage is newly introduced primocane fruiting type which development and expansion are still negligible. Researches were done in 2011, and sampling of fruit was done in accordance to the principle of "random selection" in a production nursery. From pomological characteristics of examined types, the following ones were analysed: fruit weight (g); fruit length (mm); fruit width (mm); thickness of fruit (mm), number and mass of seeds; chemical fruit composition: total content of soluble solids (%); total sugar content (%); sucrose content (%); total acid content (%); pH value. Among biological features, fruitiness and dynamics of type ripening were also analysed.

Fruit weight was determined on the sample of 30 fruits of each above mentioned types, by measuring on analytical scales brand Chyo type "Petit balance", with the exactness of 1/100 g. Fruit length, width and thickness were measured by movable measure, brand "GOST 166-80" with the exactness of 0.1 mm and measurable extent 0-125 mm. Number and mass of seeds were determined on the sample of 10 fruits of each type, by measuring on analytic scale, brand Chyo type "Petit balance", with the exactness of 1/100 g.

Chemical fruit composition: Content of soluble solids was determined refract-metrically. Content of total acid was measured by titration with 0.1 N NaOH solution, sugar content (total and inverted) was done volumetrically according to Luff-Schoorl method, and sucrose content by calculating. The pH value was determined by pH-meter.

Yield potential of examined types was registered by determination of kg/ha and kg/shoot for each type.

The results for fruit weight are processed by the statistical method of the analyses of variance for monofactorial experiment. The significance of differences between mean values is determined by Duncan's multiple range test at P=0,05.

Results and discussion

Table 1. Physical fruit characteristics of examined raspberry varieties

Variety	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fruit thickness (mm)	Number of seeds	Mass of seeds/
Willamette	3.51 b	21.33±0.29	20.85±0.33	6.88±0.14	78.6	0.21
Meeker	4.00 a	22.38±0.26	21.29±0.17	6.93±0.093	88.8	0.26
Heritage	3.49 b	21.54±0.31	20.88±0.27	6.85±0.093	98.2	0.24

Means followed by the same letter do not differ significantly according to Duncan's multiple range test at P=0,05

Good fruit quality is the basic aim in raspberry production. There are different fruit colours (red, black, purple and yellow) depending on type. The fruit weight also varies depending on raspberry type as well as environmental conditions. Thus, the weight of wild raspberry varies from 1.1 – 1.6 g (*Petrovic and Milosevic,* 2002), while the fruit weight of cultivated raspberries range from 3 g to 6 g (*Misic and Nikolic,* 2003). The results of fruit weight and dimensions are given in table 1. Minor differences can be observed in fruit dimensions among

examined types, and compared with previously published data. Larger fruit dimensions were recorder in this study.

Veli kovi et al. (2004) state that the fruit weight of raspberry type Willamette is about 3.3 g, height 20 mm and width 18 mm. Higher values of fruit weight (4.72 g), height (24.01 mm) and width (21.60 mm) were previously reported by Stanisavljevic et al. (2004).

In our research the highest average fruit weight was found in the type Meeker (4.00 g.), and the lowest one in the type Heritage (3.49 g.). Also, concerning fruit height and width, and thickness of fruit, we can observe differences among studied types and these values are a bit higher than those reported by mentioned authors.

The biggest average length and width were found in the type Meeker (22.38 cm and 21.29 cm), and the lowest ones in the type Willamette (21,33 cm and 20,85 cm). Meeker type also expressed the highest average thickness of fruit (6,93 cm), and the lowest was observed in the type Heritage (6.85 cm).

A very high average number of seeds was recorded at the type Heritage (98.2), and the lowest at Willamette. Researches also showed that the biggest total weight of seeds was recorded at the type Meeker (0.26 g), and the lowest at Willamette (0.21 g).

Table 2. Chemical fruit characteristics

Variety	Soluble solids content/ (%)	Total sugars (%)	Inverted sugars (%)	Sucrose (%)	Total acids (%)	pH value (0-14)
Willamette	10,00	3,42	2,55	0,83	1,35	3,00
Meeker	13,00	6,54	5,28	1,20	1,19	3,27
Heritage	12,00	6,09	5,13	0,91	2,33	2,90

Nutritional value of raspberry fruit is reflected in relation to sugars and acids content, taste and aroma.

Fresh raspberry fruit consist up to 18% of dry matter, 7% of total sugars and 3% of organic acids. Content of basic chemical compounds varies depending on raspberry type, ecological conditions and level of applied practical measures (*Milosevi , 1997*).

Gavrilovic-Damnjanovic et al. (2004) reported higher content of soluble solids and acids obtained in fruit of Skeena, Meeker, Chilcotin and Willamette types and content of soluble dry matters and acids, and among them, the best were Skeena, Meeker, Chilcotin and Willamette as the standard.

Our results on content of soluble solids are in line with the results of mentioned authors. The highest soluble solids had in Meeker type (13.00 %), and the lowest type in Willamette (10.00 %). Meeker type had slightly higher content of soluble solids compared with Willamette and Meeker, what also may be addressed to better adaptation of the type to agro-ecological conditions of Bratunac.

The results of total sugar content showed that the highest content had type Meeker (6.09 %), which is significantly higher compared to results reporter by Velickovic et al. (2004).

In accordance to the mentioned authors, the content of total sugar ranged from 5.4% (Meeker) to 6.8% (Tulameen), while the content of inverted sugars was from 4.2% (Meeker) to 5.8% (Willamette). The results obtained in our study indicate that Meeker type was ranked the highest in terms of inverted sugars content, followed by Heritage type (5.28% and 5.13%, respectively). The lowest content was observed in Willamette type (2.55%) which is significantly lower than that obtained by Velickovic et al. (2004)

Total acids content ranged from 1.19% (Meeker) to 2.33% (Heritage). Obtained results are in accordance with those reported by Gavrilovic–Damnjanovic et al. (2004) The results of our researches are in accordance with the results mentioned by Gavrilovi -Damnjanovi and collaborators (2004). Similar trend can be noted for pH values that varied between 2.90 (Heritage) and 3.27 (Meeker).

Table 3. Total yield of examined raspberry

Variety	Total yield	
	kg/ha	kg/shoot
Willamette	20 100	0.913
Meeker	22 400	1.02
Heritage	19 800	0.90

The results of yield components of examined raspberry types showed that the highest yield per hectare had type Meeker (22400 kg), and the lowest Heritage (19800 kg), while type Willamette had an average yield of 20100 kg/ha.

Table 4. Ripening time of examined raspberry varieties

Variety	Dynamics of ripening (days)		
	Beginning	End	Duration
Willamette	17.06.2011.	21.07.2011.	34
Meeker	14.06.1011.	17.07.2011.	33
Heritage	28.07.2011.	30.09.2011.	64

Ripening time depends on genetically hereditary characteristics of type and climate conditions before and during ripening process. Raspberry fruits cannot significantly continue ripening after being picked up, and so they should be picked in full maturity or just a bit before it. The highest quality of raspberry fruit is achieved when the picking performs in commercial ripeness. Such fruit have the most delicious taste, they are the most aromatic and with the best organoleptic characteristics.

 The results regarding beginning of fruit ripening showed that the earliest one was Meeker type, whereas the latest was Heritage as primocane fruiting type. Duration of ripening period was different and depends of the type. Heritage expressed a very long ripening time (64 days) with regard to the fact that their fruits are produced on several series of primocanes, and the lowest was expressed by Miker (33 days), while type Willamette had ripening period of 34 days.

Marinkovi et al. (2004) reported that blooming and ripening time of Chilcotin, Nootka, Skeena and Willamette raspberries grown in   a ak start in the middle of May or in June (Stanisavljevi et al., 1988). These phenological phases began 7 – 14 days later for same types grown in Pancevacki rit.

Conclusion

On the basis of investigations of important pomological properties of raspberry types, we have made the following conclusions:

Agro-ecological conditions of Bratunac region are considered as appropriate for intensive raspberry production. Among the studied types, Meeker expressed better physical and chemical fruit characteristics than other two examined types (Willamette and Heritage), while the lowest qualities were expressed by the variety Willamette, but without exception of specific characteristics for certain type.

In accordance to the achieved resultsconcerning economic-biological characteristics of examined raspberry types, it can be concluded that the intensive production of standard and perspective floricane fruiting raspberries in the region of Bratunac is justified. Besides that, introduction of primocane fruiting varieties can provide off-season raspberry production in this region.

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POMOLOGICAL PROPERTIES OF SWEET CHERRY CULTIVARS ON GISELA 5 ROOTSTOCK IN THE REGION OF SARAJEVO

Mirjana STOJANOVIC[1*], Dragan MILATOVIC[2], Mirko KULINA[1], Zlatka ALIC – DZANOVIC[3]

[1]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina,
[2] Faculty of Agriculture, University of Belgrade, Serbia
[3] Federal Department of Agriculture, Sarajevo
(Corresponding author: rmirjana26@yahoo.com)

Abstract

Pomological properties of five sweet cherry cultivars, grafted on Gisela 5 rootstock, were studied in the region of Sarajevo, during a two – year period (2010 – 2011). Studies have included time of flowering and maturing, and the most important physical and chemical properties of fruits. Cultivar 'Karina' had the greatest abundance of flowering, and, at the same time, the lowest weight of fruit. The highest weight of fruit was found in cultivar 'Schneider's Spate Knorpelkirsche', which also had the lowest abundance of flowering. In general, among the studied cultivars, 'Kordia' and 'Regina' were shown the best properties, and they can be recommended for commercial production in the region of Sarajevo.

Keywords: *sweetcherry, cultivar, flowering, maturing, fruit quality*.

Introduction

Sweet cherries are grown worldwide, on all continents, in all parts of temperate climate. They are very interesting for consumers and has always been described as ''respected'' fruits of high quality. Fruits of sweet cherry are refreshing, diuretic, energetic, anti–infective and it has the laxative and detoxifying effect. That is the reason why the greatest part of harvest (around 85%) is used fresh for consumption, although it is also used for various kind of processing (compote, jam, candied fruit, juice, brandy, etc.). Concerning the fact that the demand for sweet cherry fruits increases from year to year, in perspective, there are real conditions to expand the production, and at the same time to enlarge its economic significance. An increase in production of sweet cherries, as well as profitability of its growing, depends on biological and economic properties of the cultivar and the rootstock.

Bosnia and Herzegovina has a long tradition of fruit production, as well as all conditions for the development of fruit production. According to the data of Federal Bureau of Statistics, there has been an increase in the number of planted and productive trees recently, affecting an enlargement of production. In the region of Bosnia and Herzegovina, sweet cherry is mostly grown on the location of Mostar and in the valley of the Neretva River, in the first place due to favorable agro-ecological conditions. The mostly grown are early – season cultivars, that ripen at the beginning of May. They are, mostly, autochthonous cultivars such as: Mostarska, Arslama, Bosanlija, Hrust, Bjelica. Unavailability of sweet cherry on the market is permanent, and the export of fruits is almost negligible. According to the data of Agency for Statistics of Bosnia and Herzegovina during 2007 and 2008, there was no export of sweet cherries and the whole production was put on the domestic market. Apart from that, a certain amount of fruits was also imported during this period.

The aim of this work was the study of pomological properties of sweet cherry cultivars, with different time of ripening. According to this results, recommendation of the best cultivars for commercial growing in the conditions of Sarajevo could be made.

Materials and methods

The research was carried out during 2010 and 2011, on the location of Sarajevo, in the cherry orchard for cultivar testing of Federal Bureau of Agriculture of Bosnia and Herzegovina located in Butmir – Ilidza. Test plantation was bulit in the spring of 2007, at the altitude of 600 meters above sea level. Five cultivars of sweet cherries were studied: 'Burlat', 'Kordia', 'Schneider's Spate Knorpelkirsche', 'Karina', 'Regina'. Rootstock for all varieties was 'Gisela 5'. Training system is modified slender spindle with spacing of planting 4×2 m (1250 trees/ha).

Flowering was followed by recommendations of the International working group for pollination (*Wertheim*, 1996). The date of beginning of flowering was taken when 10% of flowers were open, full – when 80% of flowers were open, end – when 90% of petals were fallen. Duration of flowering was determined by the number of days from the beginning to the end of flowering. Abundance was assessed according to a scale from 1 (no flowers) to 9 (abundant bloom). The date of harvest is taken as the time of maturing. Characteristics of fruit are determined on a sample of 30 fruits for each cultivar. Standard morphometric methods were used to determine the weight of fruit, dimensions of the fruit, the length of the stalk and the weight of the stone. Index of the fruit shape is calculated by formula: length of the fruit^2/width of the fruit × thickness of the fruit. Proportion of the stone is calculated by formula: the weight of the stone × 100 / total weight of the fruit. Soluble solids are determined by refractometer, total acidity is determined by titration with 0,1N NaOH, and sugars by method of Luff-Schoorl.

The results are processed by the statistical method of the analyses of variance for two factorial experiment. The significance of differences between mean values is determined by Duncan's multiple range test at P=0,05.

Results and discussion

Flowering is one of the most important sweet cherry phenophases, because yield depends on the start, duration and abundance of flowering. The flowering time is greatly influenced by weather, particularly by temperature and relative humidity before the beginning of flowering and during flowering. Considering that many high – quality cultivars of sweet cherries are self – incompatible, knowing the flowering phenophase is very important for choice of cultivars before orchard planting. For a successful pollination it is necessary to combine those varieties that belong to the same group by the time of flowering.

Table 1. Phenological properties of sweet cherry cultivars in conditions of Sarajevo (average, 2010-2011)

| Cultivar | Flowering | | | | | Time of maturation |
	Beginning	Full	End	Duration /days	Abundance (1-9 Scale)	
Burlat	13.04.	17.04.	25.04.	12	2,3	03.06.
Kordia	17.04.	20.04.	30.04.	13	4,1	21.06.
Schneider's	18.04.	24.04.	02.05.	14	2,0	22.06.
Karina	17.04.	22.04.	01.05.	14	7,1	27.06.
Regina	19.04.	23.04.	04.05.	15	6,2	29.06.

The differences in flowering between the years of studies were noticed. Namely, in 2011, an earlier flowering period was noticed, 2 – 8 days in comparison with 2010. The average duration of flowering was 13.6 days (with variation of 12 – 15 days). The abundance of flowering has large influence on fruit set and yield. The largest flowering intensity was found in cultivar 'Karina' (grade 7.1), while the smallest intensity was found in cultivar 'Schneider's Spate Knorpelkirsche' (grade 2.0). In 2010, there was a smaller abundance of flowering because the studied cultivars were in the first year of production. The time of maturation of the studied cultivars was from 03. 06. ('Burlat') to 29.06. ('Regina'). Comparing the years of studies, it can be concluded that the differences in the time of maturation for the same cultivar were not big (4 – 6 days).

The weight of fruit is one of the most important pomological characteristics because the fruits are mainly used for fresh consumption. *Kappel et al.* (1996), giving the model of 'ideal' of sweet cherry cultivar, state that it should have the weight of fruit 11 – 12 g. *Crisosto et al.* (2003) state that the size of the fruit determines the crop, quality and acceptance of the cultivar by the consumers.

In our study, the weight of fruit ranged from 6.20 g in cultivar 'Karina' to 8.03 g in cultivar 'Schneider's Spate Knorpelkirsche'. 'Karina' and 'Regina' had statistically significant lower fruit weight than other cultivars . According to the obtained coefficients of variation, it can be concluded that the most uniform fruits were in cultivar 'Kordia' (5.76%) while the greatest variation was in cultivar 'Burlat' (11.41%).

Table 2. Fruitproperties of sweet cherry cultivars in conditions of Sarajevo (average, 2010-2011)

Cultivar	Fruit weight		Fruit dimensions (mm)			Shape factor	Stalk lenght (cm)	Stone properties	
	g	CV (%)	Lenght	Width	Thickness			Weight (g)	Share (%)
Burlat	7,94 ab	11,41	23,1	25,2	20,3	1,04	3,2	0,44	5,5
Kordia	7,81 b	5,76	23,0	24,7	20,6	1,03	4,9	0,42	5,3
Schneider's	8,03 a	6,27	23,3	25,3	21,1	1,01	5,0	0,48	5,9
Karina	6,20 d	7,71	20,9	22,7	20,0	0,96	4,4	0,45	7,2
Regina	7,50 c	6,92	22,5	23,8	21,0	1,01	5,1	0,57	7,6

Means followed by the same letter do not differ significantly according to Duncan's multiple range test at P=0,05

Average values of fruit dimensions were in correlation with the weight of fruit. In all studied cultivars, the larger width than length was found. On the basis of fruit dimensions, fruit shape factor was calculated. That value was lowest in cultivar 'Karina' (0.96), and highest in cultivar 'Burlat' (1.04). The length of stalk is an important parameter in cultivar determination. Longer stalk is better than shorter one because of easier picking and lesser tendency to decay and cracking of the fruit. According to *Schick* and *Toivonen* (2000) short and green stalk reminds buyers on freshness and juiciness of the fruit. Average weight of the stone in studied cultivars ranged from 0.42 g in cultivar 'Kordia' to 0.57 g in cultivar 'Regina'. The lowest share of the stone in total weight of the fruit was in cultivar 'Kordia' (5.3), and highest in cultivar 'Regina' (7.6). Sweet cherries with lower weight of the stone have better value, as well as those having lower share of the stone in total weight of the fruit.

Fruit quality of sweet cherry cultivars was defined on the basis of chemical properties of the fruit, and the results are presented in Table 3.

Table 3. Chemical composition of sweet cherry cultivars in conditions of Sarajevo (average, 2010-2011)

Cultivar	Soluble solids	Total sugars	Inverted sugars	Total acids
Burlat	13,40	8,28	7,25	0,44
Kordia	16,50	10,48	9,10	0,49
Schneider's	15,00	7,35	6,38	0,46
Karina	16,10	9,53	8,33	0,62
Regina	14,50	7,38	6,08	0,52

Main factor of fruit quality, is the content of soluble solids (*Crisosto et al*., 2003). It depends on many factors, and mostly on the cultivar (*Goncalves et al*., 2006), rootstock (*Usenik et al., 2010*) and stages of fruit ripeness (*Drake and Elfving*, 2002). The content of soluble solids in studied cultivars was 15.10% on average. The lowest content was found in cultivar 'Burlat' (13.20%), and the highest in cultivar 'Kordia' (16.50%). Lower content of soluble solids in cultivars 'Regina' and 'Kordia' was found in our study in comparison to the results of *Milatovic et al.* (2011). Comparing our results to the results of *Vo a et al.* (2010) we can see that content of soluble solids in cultivar 'Karina' is slightly higher, while it is lower in cultivar 'Regina'. Content of total sugars ranged from 7.35-10.48%. The highest sugar content level was found in cultivar 'Kordia', while the lowest content of sugar was found in cultivar 'Schneider's Spate Knorpelkirsche'. Lower content of sugar in studied cultivars in comparison to the results of *Milatovi et al*. (2011) is the result of earlier picking in relation to optimal fruit ripeness. Analysing the content of sugar types in the fruit, we made a conclusion that inverted sugars are dominant, and sucrose is present in smaller amounts, which is in accordance with the results of other authors (*Girrard and Kopp*, 1998; *Voca et al*., 2008). The content of acids ranged from 0.44% ('Burlat') to 0.62% ('Karina'). *Vangdal* (1985) states that the acid content does not significantly determine the quality of sweet cherry, considering that most of sweet cherries cultivars have almost the same low level of acids. According to *Kappel et al*. (1996) the 'ideal' of sweet cherry cultivars would be the one having the content of soluble solids between 17% and 19%. The differences between our results and results of other authors can be explained by the influence of different rootstock, soil and climate conditions, cultural practeces, and stage of maturity (*Drake and Elfving*, 2002; *Crisosto et al.*, 2003).

Conclusion

On the basis of two-year investigations of important pomological properties of sweet cherry cultivars, grafted on Gisela 5 rootstock in the region of Sarajevo, we have made the following conclusions:

Flowering of studied cultivars started in the second half of April, and it lasted 12 – 15 days (13.6 days on average). The earliest flowering was in cultivar 'Burlat', and the latest in cultivar 'Regina'.

Average time of maturation was from 3rd June ('Burlat') to 29th June ('Regina').

The weight of fruit ranged from 6.20 g ('Karina') to 8.03 g ('Schneider's Späte Knorpelkirsche'). 'Karina' and 'Regina' had statistically significant lower fruit weight than other cultivars. The most uniform fruits were in cultivar 'Kordia' while the greatest variation was in cultivar 'Burlat'.

Fruit shape factor ranged from 0.96 ('Karina') to 1.04 ('Burlat').

The length of stalk varied from 3.2 cm ('Burlat') to 5.1 cm ('Regina'). The studied cultivars can be divided into cultivars with short stalk ('Burlat'), cultivars with medium length of stalk

('Karina') and cultivars with long stalk ('Schneider's Späte Knorpelkirsche', 'Regina', and 'Kordia').

The lowest weight of stone was in cultivar 'Kordia' (0.42 g), and the highest was in cultivar 'Regina' (0.57 g). The lowest share of stone in the weight of fruit was in cultivar 'Kordia' (5.3%), and the highest was in cultivar 'Regina' (7.6%).

The content of soluble solids ranged from 13.40% ('Burlat') to 16.50% ('Kordia'). The content of total sugars was 7.35 - 10.48%, and of inverted sugars 6.38 - 9.10%. Total acidity of studied cultivars ranged from 0.44 - 0.62%.

Taking all into account, the best features among studied cultivars were found in cultivars 'Regina' and 'Kordia'. However, in order to make a final conclusion about these cultivars, the study has to be continued.

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MOUNTAIN MAPLE (*ACER HELDREICHII ORPH. EX BOISS.*) IN THE FLORA AND VEGETATION OF MOUNTAIN JAHORINA

Sladjana PETRONIC[1], Dragana PAVLOVIC[2], Natasa BRATIC[3*], Sara TODOROVIC[1]

[1]Institute for Protection of Cultural, Historical and Natural Heritage of Republic of Srpska, Bosnia
[2]The University of Kragujevac, Faculty of Natural Sciences and Mathematics, Serbia
[3]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: natasa.bratic@yahoo.com)

Abstract

Jahorina Mountain is located in the central part of Bosnia and Herzegovina. It is a part of the continental Dinaric Mountain massif,where the largest peak is known as Ogorjelica (1916 meters above sea level).

Jahorina Mountain is very rich in maple (*Acer pseudoplatanus, Acerpseudoplatanus* f. *argutum*, *Acer pseudoplatanus* f. *serratum*,*Acer heldreichii* subsp. *visianii*, *Acer intermedium* , *Acer platanoides*, *Acer campestre*). Its presence is significant, and that is why the former name of this mountain was "Javorina" ("javor" is the local word for maple).

Jahorina is the northern border of the mountain maple in the Balkan Peninsula. In this area, maple occurs in mixed deciduous forests. For example, *Acer heldreichii* subsp. *visianii* is common within ass. *Abieto-Fagetum illyricum* and *Piceo – Abieto - Fagetum*, whereas *Aceri visianii – Fagetum* B. Jov. 1957 isfrequent inforests.

 Significant presence of mountain maple caused the separation in two Nature reserves with stricter regime for protection, to the Gold Valley in subalpine and Small Maple in the mountain belt of Jahorina.

Keywords:*Jahorina, Javorina, mountain maple, flora, vegetation, protection.*

Introduction

Jahorina Mountain represents a fascination for nature admirers (mountain climbers, athletes, hunters, tourists,). The oldest existing information about flora researching of Jahorina Mountain dated back to Fial from 1893, 1895; Beck-Mannagetta 1886-1898, 1903-1923; Maly 1938, 1939; Bjel i 1964-1965. Herbarium collection that was created as a result of these studies is well-preserved and located in Sarajevo at the National Museum of Bosnia and Herzegovina. After the flora researching process, there comes a period where scientists conduct a detailed study of vegetation from different areas of Bosnia and Herzegovina, including Jahorina Mountain as well. One of the first vegetation researchers of Jahorina was Slavni (1954). Fukarek and Stefanovi explored forest vegetation in 1958, and Bjel i did the same with meadows and pastures situated in front of mountains. Floristic and vegetation data can be seen in the ecosystem study of Ravna planina moorland, Lakuši et al 1981.

Vegetation of this mountain was analyzed in order to know more about mountain maple distribution on Mt. Jahorina (in the territory of Republic of Srpska) which could be an important prerequisite for possible proclamation of the mountain as protected nature area. The main purpose was to establish the presence and state of the population of Balkan endemic species, the mountain maple *Acer heldreichii,* and its groups that are indigenous for Jahorina Mountain. By protecting this area, there will be additional measures for conservation of the mountain maple as well,.

Methods and materials

All available literature sources concerning mountain maple in Bosnia has been examined. After that, detailed field studies had been conducted during 2004, 2005 and 2006. The studies were performed using the method of transect and recording of number of phytocoenological relevés in different habitats (Braun-Blanquet, 1965).

Identification of species was based on floristic literature (Beck, 1903, 1927; Josifovic et al., 1970-1977; Javorka and Csapody, 1979). Nomenclature is adjusted to (I-V)FloraEurop ea. Floral elements and life forms of plants are given by Oberdofer (2001). Ecological indices were analyzed by Kojic and associators (1997).

Maple forests of Jahorina Mountain have been examined at sites such as: Javor, Dvoriste and "Zlatna dolina near Stansko vrelo.

These phytocoenological records are presented within synthetic phytocoenological chart and compared with results obtained for this and other areas of Republic of Srpska, Bosnia and Herzegovina and wider.

Results and discussion

Forests with maple on Mount Jahorina can be seen within the altitude of 1300 – 1 600 m, while some individual specimens can grow at even higher altitudes. Mixed broadleaved-deciduous and conifer forests are well present in this zone, and consisted of mainly beech, fir and spruce trees in various quantitative relations. This zone is much wider, compact and with better preserved forests, in contrast to the subalpine beech forests which are degraded, discontinuous and usually turned into subalpine lawn. Degradation of forest vegetation of Jahorina`s highest parts started in a distant past, starting from 1 600 meters up to the peaks, where such poor vegetation got its geographical name "Gola" ("Naked") Jahorina.

Forest population and mountain maple communities on Jahorina have been considerably reduced, and the most beautiful representatives of the previously mentioned maple trees have been cut down. Because of these reasons, mountain maple is very rarely seen in form of a tall tree, comparing to more common shrub form. One of the main causes why this happens is the constant cutting for the purpose of formation of the ski pists, lifts, ropeways and transmission lines. These destroyed surfaces are still being naturally or artificially maintained in that disastrous state. Other argument is the obvious effect of the previous war (fires) that happened in this region.

Maple forests have been studied in places such as Javor, Dvorište and in the highest forest belt of vegetation called Zlatna Dolina up to Stansko vrelo (Tab. 1). At high altitudes in the range from 1350 to 1600 meters, in northern and northeast exposures and mild slopes up to 15 degrees, geologic surface is mostly consisted of limestone, quartz sandstone and colluvial deposits. The land is basically in different developmental stages of calcareous soils. Forests are scarce and the general coverage spans from 60% to 80%. Vegetation height is not the same everywhere – in reassembled forests it goes up to 30 meters high, and in degraded is about 8 meters, with individual trees of over than 30 m of height. Age of the vegetation is different, probably from 70 to 150 years.

Table 1. Mixed forests with mountain maple (*Acer heldreichii)* on Jahorina

J A H O R I N A A

	1	2	3	4	5	6	7	8	9
Locality	"Bistica" Hotel, 3 kilometers in the direction of Podgraba		"Bistica" Hotel, to Ravla planina	"Zlatna dolina" – Stansko vrelo	"Zlatna dolina"	Dvorišta	Mali Javor	Javor	Javor	Javor
Altitude (m)	1400	1400		1380	1600	1350	1450	1580	1500	1400
Exposure	N	N-NO		NO	N	N	NO	NO	N	N
Slope	2-5	5-10		5	15	10	10-15	15-20	15	15-20
Geological surface	Quartz sandstones	limestone		sandstone and claystone	Poured lime	Sandstone and claystone	limestone	limestone	limestone	limestone
Soil Type	Acid brown	Brown limestone		Acid brown	humus	Acid brown	Brown limestone	Humus x ilimer	Humus x ilimer	Humus x ilimer.
Surface of the recordings (m^2)	1000									
General coverage (%)	60	80		80	60	70	80	70	60	70
Height of vegetation (m) max	34 7	25		35	30	25 20	25	30	25	25
Pectoral diameter (cm)	50 15	50 10		80 15	70 10	70	50	50	40 20	40
Age of vegetation (years)	70	80		150	100	80	70	80	70	70
Date	12.08. 2004	12.08. 2004		10.10. 2004	19.06. 2005	20.06. 2005	20.06. 2005	15.09. 2005	15.09. 2005	15.09. 2005
Number of localities	1	2		3	4	5	6	7	8	9

FLORISTIC COMPOSITION
I Level of high trees

	1	2	3	4	5	6	7	8	9
Abies alba	2.2	4.4	1.1	1.1	2.2	2.2	1.1	2.2	1.1
Picea abies	3.3	2.2	1.1	.	2.2	1.2	3.3	1.1	2.2
Fagus sylvatica	1.1	1.1	1.1	3.3	+.1	2.2	.	1.1	2.2
Acer heldreichii	+.1	+.1	1.1	+.1	.	.	1.1	.	.
Acer pseudoplatanus	.	.	1.1	.	+.1	.	+.1	.	.
Sorbus aucuparia	.	.	.	.	.	.	+.1	+.1	.
Fraxinus excelsior	.	+.1	.	.	.	.	.	.	.

II Level of low trees

	1	2	3	4	5	6	7	8	9
Abies alba	1.1	1.1	1.1	+.1	2.2	1.1	1.1	+.1	+.1
Picea abies	1.1	+.1	1.1	+.1	1.1	1.1	1.1	+.1	+.1
Fagus sylvatica	+.1	1.1	3.3	.	+.1	1.1	+.1	+.1	+.1
Acer heldreichii	.	.	1.1	+.1	.	.	+.1	.	.
Acer pseudoplatanus	.	.	.	+.1	+.1	.	+.1	.	.
Sorbus aucuparia	.	.	.	.	+.1	.	+.1	.	.

III Level of shrubs

	1	2	3	4	5	6	7	8	9
Abies alba	+.1	+.1	2.2	+.1	1.1	+.1	1.1	1.1	1.1
Picea abies	+.1	+.1	2.2	+.1	1.1	+.1	+.1	1.1	1.1
Fagus sylvatica	+.1	+.1	1.1	3.3	2.2	+.1	2.2	+.1	1.2
Acer heldreichii	+.1	+.1	.	+.1	+.1	.	1.1	+.1	+.1
Sorbus aucuparia	+.1	+.1	.	.	+.1	.	+.1	+.1	+.1
Rubus idaeus	+.1	.	+.1	.	.	.	2.2	+.1	+.2
Acer pseudoplatanus	+.1	.	.	.	+.1	.	+.1	.	+.1

Vaccinium myrtillus	.	.	.	.	2.3	.	+.1	1.2	+.3
Rosa pendulina	+.1	.	.	.	.	.	+.1	.	.
Lonicera xylosteum	+.1	.	.	.	.	.	.	.	+.1
Rubus hirtus	+.1	.	.	.	.	.	.	.	+.1
Ulmus glabra	.	+.1	1.1	.	.	.	.	.	.
Daphne mezereum	.	.	.	.	+.1	.	+.1	.	.
Rosa pendulina	.	.	+.1	.	.	.	.	.	.
Sambucus racemosa	.	.	.	+.1	.	.	.	.	.
Lonicera nigra	.	.	.	.	.	.	+.1	.	.
Lonicera alpigena	.	.	.	.	.	.	+.1	.	.
IV Level of herbaceous plants									
Oxalis acetosella	1.2	+.1	1.2	+.2	+.2	.	1.2	1.2	1.2
Fragaria vesca	+.1	+.1	+.1	.	+.1	+.1	1.1	+.1	1.1
Galium odoratum	.	2.2	1.1	1.1	+.1	1.1	1.1	1.1	+.1
Athyrium filix-femina	1.1	+.1	1.1	+.1	+.1	+.1	.	+.1	.
Viola reichenbachiana	1.1	1.1	+.1	+.1	+.1	+.1	.	.	+.1
Aremonia agrimonoides	1.1	+.1	+.1	.	+.1	+.1	+.1	+.1	.
Gentiana asclepiadea	1.1	.	+.1	.	+.1	+.1	+.1	1.1	1.1
Asarum europaeum	.	+.2	.	+.1	+.1	+.1	+.2	1.1	+.2
Symphytum tuberosum	+.1	+.1	.	+.1	1.1	+.1	.	+.1	.
Ajuga reptans	+.1	1.1	.	.	+.1	+.1	1.1	.	+.1
Prenanthes purpurea	+.1	.	+.1	+.1	.	+.1	+.1	+.1	.
Euphorbia amygdaloides	.	+.1	+.1	.	1.1	.	+.1	+.1	1.1
Lamiastrum galeobdolon	.	.	.	1.2	1.1	+.2	1.2	1.2	1.2
Acer pseudoplatanus	+.1	+.1	.	+.1	+.1	+.1	.	.	.
Abies alba	+.1	+.1	.	.	+.1	+.1	+.1	.	.
Dryopteris filix - mas	.	.	1.1	1.1	1.1	+.1	1.1	.	.
Adenostyles alliariae	.	.	1.1	+.1	.	+.1	+.1	.	+.1
Hypnum cupressiformae	2.3	1.3	1.3	.	.	1.3	.	.	.
Mycelis muralis	+.1	+.1	.	+.1	.	+.1	.	.	.
Carex sylvatica	1.1	+.1	.	.	.	+.2	.	.	+.2
Doronicum austriacum	+.1	.	+.1	.	.	+.1	+.1	.	.
Polygonatum verticillatum	1.1	.	.	+.1	+.1	.	+.1	.	.
Dactylorhiza maculata	+.1	.	.	.	+.1	+.1	+.1	.	.
Saxifraga rotundifolia	.	.	.	+.1	.	+.1	+.1	+.2	.
Hieracium murorum	1.1	.	+.1	.	+.1	.	.	.	.
Euphorbia carniolica	+.1	.	.	+.1	+.1	.	.	.	.
Anemone nemorosa	+.1	.	.	.	1.1	1.1	.	.	.
Luzula sylvatica	1.2	.	.	.	.	.	1.2	2.2	.
Picea abies	.	+.1	.	.	+.1	.	+.1	.	.
Acer heldreichii	.	+.1	.	+.1	.	+.1	.	.	.
Sorbus aucuparia	.	+.1	.	.	.	+.1	+.1	.	.
Hordelymus europaeus	.	+1	.	.	.	.	.	+.1	3.3
Veronica urticifolia	.	.	1.1	+.1	.	.	.	1.1	.
Sanicula europaea	.	.	2.2	.	+.1	.	.	.	+.1
Thalictrum aquilegifolium	.	.	.	+.1	.	+.1	.	+.1	.
Rosa pendulina	.	.	.	+.1	.	.	+.1	+.1	.
Pulmonaria officinalis	.	.	.	+.1	.	.	1.2	.	+.1
Aegopodium podagraria	.	.	.	.	+.1	.	+.1	.	+.1
Aposeris foetida	2.2	.	+.1	.	.	.	.	.	.
Myosotis sylvatica	+.1	.	.	.	1.1	.	.	.	.
Melampirum hoermannianum	1.2	.	.	.	1.1	.	.	.	.
Hypericum tetrapterum	+.1	.	.	.	+.1	.	.	.	.
Hylocomium loreum	1.3	.	.	.	1.3	.	.	.	.
Epilobium montanum	+.1	.	.	.	.	+.1	.	.	.
Fagus sylvatica	+.1	.	.	.	.	+.1	.	.	.
Actaea spicata	.	+.1	.	2.1	+	+	+	+	+
Luzula pilosa	.	1.2	.	.	+.1	.	.	.	.
Cardamine waldsteinii	.	.	+.1	.	1.1	.	.	.	.

Species	1	2	3	4	5	6	7	8	9
Cardamine enneaphyllos	.	.	.	+.1	.	1.1	.	.	.
Polystichum aculeatum	.	.	.	1.1	.	+.1	.	.	.
Milium effusum	.	.	.	+.1	.	.	+.1	.	.
Geranium robertianum	.	.	.	1.1	.	.	.	.	+.1
Veratrum album	.	.	.	.	+.1	+.1	.	.	.
Phegopteris robertianum	.	.	.	.	+.1	.	.	+.1	.
Lilium martagon	.	.	.	.	.	+.1	.	+.1	.
Caltha palustris	3.3	.	.	.	.	.	.	.	.
Carex brizoides	1.3	.	.	.	.	.	.	.	.
Dicranum scoparium	1.3	.	.	.	.	.	.	.	.
Thuidium tamariscinum	1.3	.	.	.	.	.	.	.	.
Equisetum sylvaticum	1.1	.	.	.	.	.	.	.	.
Melica nutans	+.2	.	.	.	.	.	.	.	.
Allium ursinum	+.2	.	.	.	.	.	.	.	.
Deschampsia cespitosa	+.2	.	.	.	.	.	.	.	.
Melica uniflora	.	1.2	.	.	.	.	.	.	.
Mercurialis perennis	.	.	.	1.1	.	.	.	.	.
Chrysosplenium alternifolium	.	.	.	.	+.2	.	.	.	.
Polytrichum communae	.	.	.	.	+.2	.	.	.	.
Festuca drymeja	.	.	.	.	.	.	.	3.3	.
Laserpitium marginatum	.	.	.	.	.	.	.	1.1	.
Rubus hirtus	.	.	.	.	.	.	.	.	+.2

In the first of 1-8, with a value of +.1, represented the following species:

1: *Prunella vulgaris, Tussilago farfara, Filipendula ulmaria, Ranunculus platanifolius, Geranium sylvaticum, Veronica officinalis, Senecio subalpinus, Astrantia major*

2: *Lathyrus venetus, Galeopsis speciosa, Moehringia trinervia i Epipactis helleborine*

3. *Salvia glutinosa, Potentilla micrantha i Cardamine bulbifera*

4: *Lunaria rediviva, Urtica dioica, Scrophularia nodosa, Rubus idaeus*

5: *Viola biflora, Usnea barbata, Cladonia rangiferina*

6: *Cicerbita pancicii, Paris quadrifolia*:

7: *Aconitum* sp.

8: *Phyteuma spicatum, Senecio nemorensis* subsp. *fuchsii*

The floristic composition of these forests consists of 107 species. Levels of high and low trees are made of seven species, but only beech, fir and spruce are in all levels, with considerable number and coverage. The level of shrubs creates 17 species, including the ones from the group of low trees. In the group of herbaceous plants, there has been a recording of 89 species, where nine are seedling of woody plants. Not even one species is seen in these stands. The most often species are: *Oxalis acetosella, Fragaria vesca, Galium odoratum, Ar monia agrimonoid s, Viola reichenbachiana, Athyrium filix-femina, Asarum europaeum, Gentiana asclepiadea, Ajuga reptans, Symphytum tuberosum, Lamiastrum galeobdolon.* Some of them are significantly placed in individual stands: *Caltha palustris, Aposeris foetida, Sanicula europaea, Festuca drymeja* and *Hordelymus europaeus* and they induce environmental conditions in them. Great diversity of different stands can be seen; which is also an indicator that a number of species (41) is only in one recording each. Mountain maple is relatively little represented in these forests (from +1 to 1.1). There are 5 stands concluded out of 9 analyzed; but only in level of shrubs in four stands and in level of herbaceous plants in one stand.

Analysis of the biological spectrum of the association completes the picture of the environmental conditions and the character of the habitat. Biological spectrum builds 5 groups of life forms. According to biological spectrum the highest percentage is with hemikryptophytes with 60% of all species but with small covering values. On the second place by percentage of the forms are phanerophytes with 16.85% of the species. but that make

the greatest cover values. In building of biological spectrum there is a slight percentage of geophytes (15.78%), chamaephyta (5.26) and therophyte (2.11%).

Based on the analysis of areal spectra the presence of 10 groups of floral elements is revealed. The most significant percentage of the types have pre-Alps (22.34%), boreal (21.27)and sub-Atlantic (18.08%) and Eurasian (15.96%) group of floral elements. The presence of these species from the group of floral elements is in accordance with the environmental conditions in which this type of vegetation develops. Low percentage of participation in the construction of areal spectra is reached by moderate continental, sub-Mediterranean, endemic, European and adventitious group of floral elements.

More complete picture of the ecological habitat specificities is obtained by the analysis of environmental indices for basic environmental factors (soil moisture, soil acidity, mineral content in the soil, light and temperature conditions. According to soil moisture community is mesophilic , because the typical mesophytes accounted for 78.82% of total number of species. In accordance with the requirements for soil acidity community is neutrophilic because these species are 62.35% of all the species, and the transitional group between the neutrophil and basophil makes 28.23% of the species. In relation to the amount of nitrogen in the soil it is dominated by mesotrophic plant species with 58.82% of all the species. Most types of community building belong to the transitional group between sciophytes and semi-sciophytes with 45.88% and semi-sciophytes with 38.83% of total number of species, semi-sciophytes and heliophytes (S_4). Mesothermic types participate in community building with 67.05%, while the transitional group between frigorophilic and mesothermic plants is ranged with 25.88% of species.

Flora of Jahorina Mountain consists of 1.159 taxa including es endemic species of Balkan Peninsula-the mountain maple (*Acer heldreichii* Orph. ex Boiss.). It belongs to the central-Balkan floral element. This species was for the first time recorded for Balkans by Fiala in Klek village in 1895. Karlo Maly later established that this mountain maple is more frequent on Mount Jahorina. He described a subgroup *A. h.* subsp. *visiani,* which is distributed in Bosnia and Herzegovina and Serbia.

Beech-maple forest *Acer heldreichii* subsp. *visianii* forms more families in illyrian-moesian area, which is populated with limestone, smaller silicates, and in subalpine belt it creates colluvial drift with even deeper luvic land. They are situated in cooler humic habitats mostly around 1 300 – 1 600 meters above sea level, places where snow stays longer.

Many beech and forest maple plant associations have been described as: *Aceri heldreichii - Fagetum* B. Jov. 1957 (Serbia); *Aceri visiani – Fagetum* Fuk. t Stef. 1958 (Bosnia and Herzegovina); *Fago - Aceretum visianii* Ble . et Lkš . 1970 (Montenegro); *Aceri heldreichii – Fagetum* subalpinum Jank. et Stev. 1983. (Kosovo); *Fagetum subalpinum inferiorum* (=*Fagetum altimontanum*); Miši and Popovi 1954 (Kopaonik), and also on Mount Golija, around the river area we have *Aceri heldr ichii – Fagetum montanum* Jov., and *Aceri heldreichii – Picetum abietis*. They are all rounded up into a widely understood family by the name of *Aceri heldreichii – Fagetum* B. Jov. 1957 (Jovanovi , 1986). Koviljka Stankovi Tomi marked beech-fir forests in Mokra Gora (which grow around 1 200 – 1 500 meters above sea level) as *Abieto - Fagetum aceretosum visianii* in the year of1974.

In the area of Mountain Jahorina there is a presence of sub-alpine forests of beech and maple(Aceri-Fagetum subalpinum). This community on Jahorina occupies less area because sub-alpine belt is significantly degraded. In sub-alpine forests of spruce (*Piceetum subalpinum*) mountain maple (*Acer heldreichii* subsp. *visianii*) is present individually. Below this belt there are mixed forests of beech, fir, spruce (*Piceo-Abieti-Fagetum*) where Greek maple trees are encountered with small degree of presence and small covering value. In the mixed forests of the study area Greek or mountain maple has optimum.

In Serbia, this type builds woods, almost always with sub-alpine beech (*Aceri heldreichii - Fagetum*). On Mountain Rudnik in Serbia, Greece maple occupies the extreme northern point of distribution in the world. Perovic and Cvjeticanin (2009) describe the community of mountain maple with beech and hornbeam (*Acer heldreichii-Fagetum* subass. *carpinetosum betuli*) which represents a new sub-association within the community *Aceri heldreichii-Fagetum*.

Conclusion

In the flora of Jahorina there is an endemic Balkan species called forest maple (*Acer heldreichii* Orph. ex Boiss. subsp *visianii* K. Maly), located on northwestern border of this area.
The forest maple occurs within broadleaved-deciduous and coniferous forests (ass. *Piceo - Abieto - Fagetum*). Comparing to the dominant species, beech, fir and spruce, it is less abundant and distributed at many sites of studied area. Subalpine forests of beech and forest maple are not that widespread on Mount Jahorina because the subalpine belt is degraded and turned into mountain lawns.
Community where there is a mountain maple has phanerophytic- hemikryptohpytic character. In relation to humidity community it is very mesophilic , in relation to soil acidity it is neutrophilic, in relation to nitrogen it is mesotrophic, in relation to light it is sciophytic to semi-sciophytic , and in relation to the temperature it is frigorific to mesothermic. Areal spectra is dominated by sub-mountain, boreal and sub-Atlantic group of floral elements.
Forests of Mount Jahorina are considerably depleted, and the most beautiful populations of mountain maple are being cut down. Mountain maple is rarely seen as a tree, and more common form was the shrub.
Preservation of Jahorina Mountain area will allow continuous survival of forest vegetation and with it also survival and regeneration of forest maple.

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WHAT ARE THE BEES COLLECTING? CASE STUDY OF STINGLESS BEES IN THE CENTRAL REGION OF GHANA

Afia Serwaa KARIKARI[1*],B.A. MENSAH[2], P.K. KWAPONG[2], K. AIDOO[2], R. COMBEY[2]

[1]Council for Scientific and Industrial Research (CSIR), Savannah Agricultural Research Institute (SARI). Ghana
[2]Department of Entomology and Wildlife, School of Biological Sciences, University of Cape Coast, Cape Coast Ghana
(Corresponding author: kserwaafia@yahoo.com)

Abstract

Bees provide pollination service which is very important for the reproduction of most seed producing plants as well as food crops. The Pollination services are also crucial for biodiversity conservation. *Apis mellifera* bee species have been known and kept all over the world for pollination services. In recent times it has become critical to explore and enhance the prospects of other bee species as alternatives to *A. mellifera* due to diseases and pests such as the varroa mites. Some tropical countries such as Australia have benefited immensely from stingless beekeeping but this practice is non-existent in Ghana due to lack of knowledge about the bees even though some species are found. By means of Direct Visual Observation Method in a randomized complete block design, the foraging resources of stingless bees in a forest and coastal savannah ecologies were investigated, using coconut as test crop to form a baseline for stingless beekeeping in Ghana. The stingless bees in the two ecosystems visited only the floral parts of the coconut, collecting pollen and nectar. The bees collected more pollen than nectar from the coconut and the probability of the two sample t-test showed a highly significant difference (P< 0.001). Also the two species of *Meliponula* stingless bees, identified were found in either of the two ecosystems.

Keywords: *Pollination, biodiversity conservation, stingless bees, food crops, ecosystems*

Introduction

The Meliponines or stingless bees are the only social bees other than the true honeybees, *A. mellifera* (Michener, 2000). These bees have so many characteristics that enhance their potential as pollinators of crops. They are polylectic or generalist flower visitors, visiting a broad range of plant species. Heard (1999) reviewed the crop pollination of stingless bees and reports that *Hypotrigona ponthieri* visited 54 species in 28 families, *Melipona marginata* visited 173 species in 38 families and *Melipona favosa* visited 38 species in 26 families. In the tropics and subtropics stingless bees have been found to visit most flowering plants (O'toole and Raw, 1991) and are therefore considered to be important pollinators of crops in these parts of the world (Free, 1993).

Pollination service of bees is very important for the reproduction of most food crops and seed producing plants as well as biodiversity conservation. In GhanaApis mellifera bee species (common honeybees) are the only bee species that have been kept, especially for hive products. However with the diseases and varroa mites havoc that is threatening honey beekeeping all over the word in recent times, it has become critical to explore and enhance the prospects of other bee species in Ghana as alternatives to *A. mellifera.*

Knowledge about the forage resources of insects is key to effective and successful rearing of insects or beekeeping. Stingless bees are found to collect a lot of food resources on coconut

from various parts of the world. For instance in Surinam and Costa Rica, stingless bees are reported to be the dominating visitors of coconut (Engel Dingemans-Bakels, 1980; Hedström, 1986). In Trinidad, four species of stingless bees occasionally collected coconut pollen (Someijer *et al*., 1983). Both the male and female flowers of coconut are visited by the bees (Hedström, 1986) but previous studies give different accounts about which forage resource is collected more by the bees. For example, Heard (1999) reports that about 83% of individual stingless bees visiting pistillate flowers in search of nectar, carried loads of coconut pollen from previously visited staminate flowers. Kleinert-Giovannini and Imperatriz- Fonseca (1987) also reports that coconut species are mostly visited for nectar rather than pollen.

The study sought to investigate the foraging resources of stingless bees in a forest and coastal savannah ecologies using coconut as test crop to form a baseline for stingless beekeeping in Ghana.

The following hypotheses were tested during the study:

Ho 1: Generally, stingless bees do not collect more pollen than nectar on coconut

Ho 2: Stingless bees in forest ecosystems do not collect more pollen than nectar on coconut plants.

Ho 3: Stingless bees in coastal savannah ecosystems do not collect more pollen than nectar on coconut plants.

Materials and methods

The studies were carried out in two ecological areas also in the Central region of Ghana. These ecological areas are Agyirikrom (elevation 172ft 05° 06.207$^'$ N and 001° 27.627$^'$ W) in the Lower – Denkyira district of the Central region representing the forest zone and Ayensudo (elevation 204ft, 05° 13.893' N and 001° 12.079' W) in the Komenda Edna- Eguafo Abirem (KEEA) district of the Central region representing the coastal savannah zone.

Both the forest and coastal savannah zones are generally hot and there is a comparatively dry period from November to February when the North-East Trade Winds sets in, bringing in harmattan conditions. In the KEEA district the original vegetation was dense scrub, which was supported by rainfall. This has given way to grassland and scrubs of about 1.5m high grass and a few scattered trees in the coastal areas. In the Lower –Denkyira district, the predominant vegetation is secondary forest.

The studies were conducted through direct visual observation also known as sampling at flowers (Silveira, 2004) in a randomized complete block design. Within each coconut farm five trees of the crop were randomly selected. Each selected tree within a coconut farm was observed for 10 minutes and the various stingless bee species visiting the plants were identified. However, unidentified bees were collected using insect net, for further studies and identification in the laboratory by a bee Taxonomist. The foraging materials collected by the bees were also noted. Data was collected twice per month from the period October 2006 – March 2007. The diversity of the bees within the two ecosystems was computed using the Simpson's Diversity Index D (http://www.countrysideinfo.co.uk/simpsons.htm).

Results and discussion

Stingless Bee Species Found on the Coconut Plants

A total of four stingless bee species were recorded on coconut flowers from the forest and coastal savanna zones within the six, months' research period. The four species are *Dactylurina staudingeri* (Gribodo), *Meliponula bocandei* (Spinola) *Meliponula ferruginea* (Lepeletier) and *Liotrigonaparvula* Darchen. *M. ferruginea* occurred only in the coastal savannah zone, whereas *M. bocandei* occurred only in the forest zone.

Diversity of Stingless Bees on Coconut Plants
The diversity of stingless bees was taken as a measure of species richness (the number of different kinds of stingless bee species present in a particular ecosystem) and evenness (the relative abundance of the different species making up the richness of an ecosystem). According to the Simpson's diversity index, an area is more diverse when its D- value is more towards zero (0) and less diverse when it approaches one (1). The D-values indicate that the forest is more diverse than the coastal savannah ecosystem in terms of stingless bees as it is more towards zero (0). Even though the two ecosystems had the same stingless bee richness, the relative abundance of the various species was different in both ecosystems (Table 1). *D. staudingeri* dominated all the other stingless bee species in terms of abundance.

Table 1. Diversity of the stingless bees on coconut plants within the two ecosystems

Species	Forest n (relative abundance)	Coastal savannah n (relative abundance)
D. staudingeri	104	53
M. bocandei	30	0
M. ferruginea	0	5
Liotrigona parvula	14	3
D (diversity index)	**0.54**	**0.76**

Foraging resources collected by the stingless bees on the coconut plants
The stingless bees were found visiting only the floral parts of the coconut plants within the two ecosystems (Plates 1 & 2). They collected resources from both the male and female inflorescences of the plants confirming Heard's earlier observation (Heard, 1999). The probability (under null hypothesis of equal variances) of the two sample t-test showed a highly significant difference ($P < 0.001$), thus Ho1 is rejected in support of Ha1. Thus the bees generally collected more pollen than nectar from the coconut. Nonetheless, at the 95% Confidence Interval (C.I.), the T-test value of 0.23 with a P-value 0.826 within 10 degrees of freedom, shows that the difference between the frequency of pollen and nectar collection by the three stingless bee species in the forest ecosystem is not significant thus failure to reject Ho2. This implies that within the forest ecosystem, the stingless bees did not frequently collect more pollen than nectar. In the coastal savannah ecosystem on the other hand, at the 95% C.I., the T-test value of 2.79 with a P-value of 0.019 within 10 degrees of freedom shows that the difference between the frequency of pollen and nectar collection by the three stingless bee species is significant. Therefore we reject Ho3 in favour of the alternate hypothesis. In other words, within the coastal savannah ecosystem, the stingless bees frequently collected more pollen than nectar.

Figure 1. *D. staundingeri* collecting nectar on female inflorescence

Figure 2. *M. bocandei* collecting pollen on the male inflorescence

Conclusion

The study showed that generally stingless bees frequently visit coconut to collect pollen than nectar. This confirms the observation that stingless bees prefer pollen to nectar as food and therefore collect mainly pollen during visits (Amano, 2002) probably for brood provisioning. The bees were found to be more diverse in the forest than in the coastal savannah and *M. bocandei* and *M. ferruginea* occurred separately in the forest ecosystem and coastal savannah respectively. Further work needs to be undertaken to comprehend the separate occurrence of the two meliponula species.

Acknowledgement

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PRODUCTIVITY TESTING OF EARLY AND MEDIUM EARLY POTATO VARIETIES IN AGRO-ECOLOGICAL CONDITIONS IN NORTHERN MONTENEGRO

Zoran JOVOVIC[1*], Vesna MILIC[2], Dobrivoj POSTIC[3], Ana VELIMIROVIC[1], Milana SILJ[2], Katarina STRUNJAS[1]

[1] Biotechnical faculty, University of Montenegro, Podgorica, Montengro [*]
[2]Faculty of Agriculture, University of East Sarajevo, Bosnia and Heezegovina
[3]Institute for Plant Protection and Environment, Belgrade, Serbia
(Corresponding author:jovovic@t-com.me)

Abstract

In this paper result of two years study of genetic potential on productivity of seven early and medium early Dutch potato varieties are shown: Riviera, Monaco, Arrow, Artemis and Tresor (early) and Almera and Arnova (medium early). Research was done on three localities in agro ecological conditions of northern Montenegro: Niksic (800 m a.s.l.), Kolasin (900 m a.s.l) and Zabljak (1450 m a.s.l). Field trials were set up using standard methodology; random block design in 4 repetitions.

Variance analysis showed variability of potato yield depending on variety, locality and year of testing. Highest two years average yield had variety Arnova (32.1 tha^{-1}), and the lowest variety Arrow (22.9 tha^{-1}). Zabljak, located in the highest altitude, had the best conditions for growing of early and medium early potato varieties (30.8 tha^{-1}), while the lowest productivity was measured in Niksic (23.6 tha^{-1}). In 2011, average yield was higher (31.1 tha^{-1}) as a consequence of better rainfall distribution during potato growing season.

Key words: *potato, early and medium early varieties, yield*

Introduction

According to the planted area, potato represents the leading agricultural crop in Montenegro. In the production structure of the arable land, potato accounts for more than 20%. Zoning of the potato production is closely related to the nature, primarily climatic conditions. The production of early potatoes, intended for fresh consumption, is mainly located in the Zeta-Bjelopavli i plain and the coastal zone with a share in the total production of 16.8%. Production of potatoes intended for the storage is a dominant type of production (83.2%) and is related to hilly-mountainous area (Monstat, Statistical Yearbook for 2011.).

Potato yields are still relatively low in Montenegro. Such condition is caused by various factors, among which, the most important are: the low level of applied technology, growing potatoes in long-term monoculture, fragmentation of production plots, limited application of mechanization, production under dry farming conditions, insufficient use of certified planting material (used on only 10-12% of the surface), adverse effects of agro-ecological factors (high summer temperatures and growing deficit of rainfall during the growing season of potato), periodical epiphytotic attacks of fire blight, etc. *(Jovovic et.al., 2011, Miloševic et. al. 2004).*

Potato yields in Montenegro are very unstable and very susceptible to the influence of meteorological conditions *(Jovovic et al., 2002).* By proper selection of varieties it is possible to overcome the adverse impacts of vegetation factors, especially the water-air regime of soil, high air temperatures and short growing season in the mountain area.

Potatoes for human consumption must have the organoleptic quality, i.e. it must be adapted to the requirements of the market. Tubers should be nicely shaped, with shallow buds, healthy, strong and pretty equal in size. Tuber skin and flesh colour are not essential for the quality, but significantly determine customers' interest. Color stability of meat after cooking is also very important feature of tubers' that significantly affect its marketability. Only by good knowledge of biological, morphological and productive traits of potato varieties and their compliance with existing pedoclimatic conditions it is possible to achieve high and stable yields *(Momirovic et al., 2000)*.

The systematic study of the different varieties of potatoes on a number of sites is extremely important because it spreads a wider selection of varieties adapted to the given specific conditions *(Yang, 2002)*. Some potato genotypes have the ability that in very different environmental conditions provide stable yields, either on a higher or lower level *(Annicchiarico, 2002)*. Variety productivity is a function of its adaptability to provide stable yields in very different agro-ecological conditions, so it is very important to create varieties that will, in a wide range of environmental factors, be able to consistently provide high yields *(Haldavankar et al., 2009)*.

The aim of this study was to investigate the genetic potential of the tested potato varieties and examine their reactions to the specific conditions of mountain regions, in order to find the genotypes that will, in the certain production conditions, give satisfactory and stable yields.

Materials and methods

The study of the productivity of seven early (Riviera, Monaco, Arrow, Artemis and Tresor) and medium early (Almera and Arnova) dutch potato varieties was conducted during 2010. and 2011. Trials were conducted in very different agro-ecological conditions and on different soil types: Nikši (800 meters above sea level, acid brown), Kolašin (900 m above sea level, alluvial-deluvial) and Žabljak (1450 m above sea level, black soil on limestone).

Tests were carried out using field trials, in a randomized block design with 4 replications. The surface of the elementary plot was 21 m^2. Potato planting was carried out manually on spacing of 70 cm and the distance between plants in a row of 33 cm, with the obtained density of 43300 plants per hectare. Overall agro-technology was conducted in a standard way for the crop of potatoes. Harvest of potatoes was carried out after the complete maturation of potato vine. The yield of potatoes in the trial was determined by measuring the tubers at each elementary plot, and then the yield per hectare was calculated.

Table 1. Chemical characteristics soil on experimental field

Depth (cm)	Locality	pH		CaCO₃	Humus	Soluble mg/100 g	
		H₂O	nKCl	%	%	P₂O₅	K₂O
40	Niksic	6.57	5.97	1.75	3.05	9.3	17.3
	Kolasin	6.29	5.55	1.1	4.53	2.4	16.0
	Zabljak	5.91	4.85	2.05	7.32	6.2	23.5

Soils on which the trials have been conducted are characterized by good water-air properties and high humus content. On the other hand, they are poor in phosphorus, low in calcium and moderately supplied with potassium *(Table 1)*. Meteorological data during the investigated period are presented in *Table 2*. Statistical analysis was done using factorial analysis of variance (ANOVA), and the score of differences between the mean values was performed using LSD test.

Table 2. Meteorological conditions during the experiment

Year	Locality	Month					Average
		May	June	July	August	September	
		Air temperature (^{0}C)					
2010	Nikši	14	18.6	22	23.3	16.1	18.8
	Kolašin	11.6	15.9	18	18.3	12.6	15.3
	Žabljak	9.2	14.1	16.0	17.1	10.7	13.4
2011	Nikši	15.6	18.5	21.8	22.8	18.1	19.4
	Kolašin	11.3	16.2	17.6	18	15.6	15.7
	Žabljak	8.8	13.9	15.9	16.5	14.1	13.8
		Amount of rainfall (mm)					Total
2010	Nikši	157	220	39	23	210	649
	Kolašin	202	103	34	12	117	468
	Žabljak	163	93	35	20	82	393
2011	Nikši	135	56	40	29	140	400
	Kolašin	148	72	70	40	101	431
	Žabljak	162	43	76	53	113	447

Results of the study and discussion

The results in *Table 3* show that the average potato yield in both years studied was under a highly significant effect of genotype and production sites, and their interaction (variety x location).

Variety Arnova had the highest yield of the two-year average (32.1 tha^{-1}), while the lowest yield was measured at variety Arrow (22.9 tha^{-1}). Arnova, in comparison to all other varieties (except Tresor in 2010), gave a significantly higher yield of tubers. The lowest yields were measured in the variety crops Arrow, Riviera and Artemis (22.9, 24.5, and 25.1 tha^{-1}).

As the agro-ecological conditions in the studied areas were very different, the reaction of varieties to such conditions had been also different. In the mountainous region of Montenegro, Žabljak, which is located at the highest altitude (1450 m), proved to be the most suitable site for the production of early and medium early varieties of potatoes (30.8 tha^{-1}), while the lowest productivity of potato varieties studied was manifested in Nikši (23.6 tha^{-1}). Statistical data analysis showed a significant increase in yield in Žabljak compared to other sites (with the exception of Nikši in 2010.).

Statistically significant differences in the average yield of potatoes were created by the influence of the interaction variety x location. Arnova x Žabljak, in 2010. (27.7) and interaction Almera (46.1 tha^{-1}) and Arnova (45.6 tha^{-1}) x Žabljak, in 2011. have caused a significant increase in yield of potatoes in comparison to all other interactions.

The lowest yields in both years studied were realized under the influence of interaction Arrow x Nikši , 19.0, i.e. 20.8 tha^{-1}. Such emphasized effect of the site on potato yield is in accordance with the results of earlier studies *(Jovovi et al, 2012; Hassanpanah, 2011).*

Comparing the studied years shows that higher potato yields were achieved in 2011. (31.1 tha-1) as a result of better distribution of rainfall in the growing season, but excessive amounts

Table 3. Average yield of potato (tha^{-1})

Lokal. (B)	Year	Variety (A)							Average
		Riviera	Monaco	Arrow	Artemis	Tresor	Almera	Arnova	
Nikši	2010.	24.1	22.7	19.0	22.9	24.1	21.5	23.0	22.5
	2011.	26.1	23.6	20.8	22.7	24.9	22.0	33.0	24.7
	Aver.	**25.1**	**23.2**	**19.9**	**22.8**	**24.5**	**21.8**	**28.0**	**23.6**
Kolašin	2010.	22.8	22.2	19.9	20.1	24.2	19.6	23.3	21.7
	2011.	21.7	30.9	26.2	30.3	31.7	30.8	40.4	30.3
	Aver.	**22.3**	**26.6**	**23.1**	**25.2**	**28.0**	**25.2**	**31.9**	**26.0**
Žabljak	2010.	21.3	25.2	20.6	21.5	24.5	20.7	27.7	23.1
	2011.	29.4	41.6	30.7	34.7	40.7	46.1	45.6	38.4
	Aver.	**25.4**	**33.4**	**25.7**	**28.1**	**32.6**	**33.4**	**36.7**	**30.7**
Average	2010.	23.2	22.4	19.8	21.0	24.3	20.6	24.6	22.3
	2011.	25.7	32.0	25.9	29.2	32.4	33.0	39.6	31.1
	Aver.	**24.5**	**27.2**	**22.9**	**25.1**	**28.4**	**26.8**	**32.1**	**26.7**
Nikši	2010.								22.5
	2011.								24.7
	Aver.								**23.6**
Kolašin	2010.								21.7
	2011.								30.3
	Aver.								**26.0**
Žabljak	2010.								23.1
	2011.								38.4
	Aver.								**30.8**

Lsd	*2010.*			*2011.*		
	A**	*B***	*AxB***	*A***	*B***	*AxB***
0.05	*0.939*	*0.615*	*1.627*	*1.687*	*1.104*	*2.922*
0.01	*1.249*	*0.817*	*2.162*	*2.242*	*1.468*	*3.884*

Comparation the studied years shows that higher potato yields were achieved in 2011. (31.1 tha^{-1}) as a result of better distribution of rainfall in the growing season, but the excessive amount of rainfall in May in 2010., with severe drought in the coming months (22.3 tha-1). Phenotypic variability of the main components of yield is primarily determined by the differences between the genotypes of tested varieties, while the variation of their derivatives (tuber number and yield per plant) is highly dependent on the interaction of genotype with environmental factors *(Nacheva, 2006)*. To ensure high and stable production, which means the maximum utilization of genetic potential, it is necessary to have as much information as possible about the different effects of interaction of the genotype x environment.

Conclusion

Based on the results of two-year study of seven Dutch potato varieties at three different sites in the mountain region of Montenegro, it can be concluded:
Arnova had the highest yield in the two-year average (32.1 tha^{-1}), while the lowest yield was measured in the case of variety Arrow (22.9 tha^{-1}). Arnova, in comparison to all other varieties (except from Tresor in 2010.), had a significantly higher yield of tubers.

Žabljak proved to be the most favorable site for the production of early and medium early varieties of potatoes (30.8 tha^{-1}), while the varieties studied showed the lowest productivity in Nikši (23.6 tha^{-1}).

Statistically very significant differences in the average yield of potatoes were created by the influenced of variety x location interaction. Interactions Arnova x Žabljak, in 2010. (27.7 tha[-1]) and Almera (46.1 tha[-1]) and Arnova (45.6 tha[-1]) x Žabljak, in 2011 gave significantly higher average yields of tubers in comparison to all other interactions.

The lowest yields in both years studied were achieved under the influence of interaction Arrow x Nikši (19.0 and 20.8 tha[-1]).

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THE EVALUATION OF COMBINING ABILITIES FOR GRAIN YIELD OF ZP MAIZE INBRED LINES USING THE LINE × TESTER ANALYSIS

Zoran CAMDZIJA[1*], Milomir FILIPOVIC[1], Jelena VANCETOVIC[1], Slaven PRODANOVIC[2], Sofija BOZINOVIC[1], Jovan PAVLOV[1], Aleksandar POPOVIC[2]

[1]Maize Research Institute, "Zemun Polje", Beograd, Serbia
[2]University of Belgrade, Faculty of Agriculture, Belgrade-Zemun, Serbia
(Corresponding author: zcamdzija@mrizp.rs)

Abstract

This study was performed with the aim to determine general (GCA) and specific combining abilities (SCA) of ZP maize inbred lines by the application of the inbred × tester analysis. Furthermore, the proportion of additive and non-additive (dominance and epistasis) genetic variance in the formation of maize grain yield was established. Results obtained on GCA and SCA pointed out to weak variation, provided that only the tester Z2 showed significant values of GCA (1.30**), due to which its use in maize selection was proposed, while there were no significant values of SCA. The GCA/SCA ratio, which is less than unity in both locations, showed a greater proportion of non-additive variance in the yield formation in both locations. The highest contribution in expression of grain yield in the locations of Zemun Polje and Školsko dobro went to testers (68.84%) and interactions (lines × testers) (46.81%), respectively.

Key words: *maize, combining abilities, inbred × tester analysis*

Introduction

Maize grain yield is a complex trait and the most important aim of breeders is to developed varieties and hybrids of high genetic potential and yielding. Maize, as an agricultural species, has become very important with the discovery of the phenomenon of heterosis, as a basis of modern breeding. Heterosis represents hybrid vigour of F_1 generation derived from crosses of distant maize inbred lines (Shull, 1909). A further step in modern breeding has been made by the discovery and defying of general and specific combining abilities (Sprague and Tatum, 1942). General combining ability (GCA) is an average performance of an individual in a particular series of crosses, while specific combining ability (SCA) is a performance of a parent X in a cross to a parent Y, where the average value of this combination can deviate from the average value of general combining abilities of these parents in comparison to some other parents (Borojevi , 1981).
The estimation of combining abilities of maize inbred lines contributes to revealing of genetic backgrounds of unknown and/or insufficiently studied genotypes. Obtained data can be used in the development of new hybrids. Observed genotypes with higher values of combining abilities, can result in improved hybrids when they are crossed to other materials from the maize germplasm collection.

Material and methods

Five inbred lines (A1, A2, A3, A4, A5) and three testers (Z1, Z2, Z3) from the collection of the Maize Research Institute, Zemun Polje, as well as, their 15 hybrids were used in the present study. Female components, five inbred lines, were of the BSSS background, while

testers originated from the Lancaster background. Crosses (hybrids) for the trial were performed in 2009. The two-replicate trial was set up according to the randomised block design (RCBD) in two locations during 2010. Two rows for each genotype were sown, hence there were 20 plants per row and the density amounted to 67,000 plants ha^{-1}. The row distance was 0.75 m. The row length was 4 m, while the elementary plot size amounted to 6 m^2 (1.5 m x 4.0 m). Identical cropping practices were applied in both locations. Yield ha^{-1} in t was calculated at 14% moisture.

Combining abilities were estimated by the inbred × tester analysis suggested by Kempthorne (1957), and applied by Singh and Chaundhary (1976). This analysis was performed in the Excel programme.

Results and discussion

Results on the initial analysis of variance showed statistically highly significant (P=0.01)differences for genotypes (treatments) (data not shown). The sum of squares of genotypes (treatments) further partitioned to sum of squares of parents (inbred lines and testers), parents vs. crosses, crosses, inbred lines (female component), testers (male components) and finally inbred lines × testers. Obtained results showed statistically significant (P=0.05) differences for parents (inbred lines and testers) and testers (location of Školsko dobro) and statistically very significant (P=0.01) differences for crosses and testers (location of Zemun Polje). Statistically very significant difference was also observed (P=0.01) for parents vs. crosses on both locations (data not shown).

Average grain yields of maize inbred lines and their GCA values pointed to weak variations (Table 1). The best GCA ranking inbred line was A1 (location of Zemun Polje), but its value was not significant. A highly significant difference was established for testers Z1 and Z2 by the test of significance. Moreover, the tester Z2, i.e. Z1 (location of Zemun Polje) proved to be the best, i.e. the poorest general combiner, respectively (Table 1). The tester Z2 was also the best general combiner in the location of Školsko dobro, although its GCA value did not exceed the level of significance.

Table 1. GCA values for inbred lines and testers for grain yield

Genotype	Zemun Polje		Školsko dobro	
	Mean	GCA	Mean	GCA
A1	7.5	0.78	6.2	-0.25
A2	6.4	-0.38	6.0	0.53
A3	6.1	-0.12	6.6	-0.08
A4	6.1	-0.13	6.8	0.17
A5	5.1	-0.15	3.8	-0.37
Z1	5.2	-1.01*	3.8	0.30
Z2	7.4	1.30**	5.7	0.50
Z3	5.2	-0.30	5.5	-0.79
SE GCA inbreds	-	0.3915	-	0.3915
SE(Gi-Gj) inbreds	-	0.5536	-	0.5536
SE GCA testers	-	0.3032	-	0.3032
SE (Gi-Gj)testers	-	0.4288	-	0.4288
LSD inbreds 0.05	-	1.1482	-	1.1482
LSD inbreds 0.01	-	1.5607	-	1.5607
LSD testers 0.05	-	0.8894	-	0.8894
LSD testers 0.01	-	1.2089	-	1.2089

Two good general combiners do not necessarily give the best SCA result (Borojevi , 1981). This statement was also confirmed by the SCA value of the hybrid A2 x Z1 (0.22) and A2 x

Z3 (0.46) on location of Zemun Polje, hybrid A3 x Z3 0.34 on second location (Table 2), where the combination of parents with negative GCA values resulted in a hybrid with positive SCA values. The combination of a parent with negative and a parent with positive GCA values, A1 x Z1 (1.06), A3 x Z2 (0.60) and A4 x Z2 (0.61) at Zemun Polje and the combination of A1 x Z2 and A2 x Z3 at the location of Školsko dobro resulted also in positive SCA values. The values of SCA were the highest in these hybrids, although they did not exceed the level of significance. The combinations of parents with positive and negative GCA values resulting with positive SCA values are in accordance with results gained by Wali (2010) and Živanovi et al (2010). The potentiality of the cross from a high x low combination is attributed to the interaction between dominant alleles from a good general combiner and a recessive allele from a poor combiner (Senthil and Bharathi, 2009). By the combination of parents with positive GCA values both parents gave a negative SCA value: A1 x Z2 at Zemun Polje and A2 x Z1 and A2 x Z2 at Školsko dobro.

Table 2. SCA values for hybrids for grain yield

Genotype	Zemun Polje		Školsko dobro	
	Mean	SCA	Mean	SCA
A1 x Z1	11.9	1.06	11.6	-0.18
A2 x Z1	9.9	0.22	11.9	-0.71
A3 x Z1	9.5	-0.44	11.9	-0.05
A4 x Z1	9.5	-0.43	12.3	0.10
A5 x Z1	9.5	-0.41	12.5	0.84
A1 x Z2	12.5	-0.70	13.1	1.12
A2 x Z2	11.3	-0.69	12.3	-0.46
A3 x Z2	12.8	0.60	11.9	-0.30
A4 x Z2	12.8	0.61	12.5	0.10
A5 x Z2	12.4	0.18	11.4	-0.46
A1 x Z3	11.2	-0.35	9.7	-0.94
A2 x Z3	10.9	0.46	12.6	1.18
A3 x Z3	10.5	-0.15	11.2	0.34
A4 x Z3	10.4	-0.19	10.9	-0.21
A5 x Z3	10.9	0.23	10.2	-0.37
SE SCA	-	0.6185	-	0.6781
SE (Sij-Skj)	-	0.8746	-	0.9589
LSD 0.05	-	1.8140	-	1.9888
LSD 0.01	-	2.4656	-	2.7032

The proportion of non-additive variance in the yield prevailed in this study, which is observable from Table 3 (GCA/SCA ratio is less then unity). These results are in accordance with Shams (2010) and Wali (2010).

Table 3. Components of genetic variance for grain yield

	Zemun Polje	Školsko dobro
Additive variance		
Va(F=1)	0.2049	0.0328
GCA variance	0.1024	0.0164
Dominant variance		
Vd(F=1)	0.1043	0.2408
SCA variance	0.1043	0.2408
GCA/SCA	0.9820	0.0681

The highest proportional contribution to grain yield at Zemun Polje goes to testers, while the proportional contribution of inbred × tester interaction was predominant at Školsko dobro (Table 4).

Table 4. The proportional contribution of inbreds, testers and their interactions in expression of grain yield (%)

Average contribution of	Zemun Polje%	Školsko dobro%
Inbreds	12.10	12.93
Testers	68.84	40.26
Inbred × testers interaction	19.15	46.81

Conclusion

Results obtained on GCA and SCA showed weak variations, provided that only the tester Z2 showed significant GCA values (1.30**); crosses to this tester had the highest results and it was suggested for further use in maize selection; on the other hand, there was no combination with inbreds lines that had a significant SCA value. Female components showed weak variations, which was an indicator of huge genetic closeness of the initial material. The GCA/SCA ratio pointed out to a greater proportion of non-additive variance in the grain yield formation in both locations. The highest contribution in the grain yield formation at the location of Zemun Polje was observed in testers (68.84%), while the corresponding contribution in the location of Školsko dobro was observed in the inbred × tester interaction (46.81%).

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LIGNOCELLULOSE FIBRES AND *IN VITRO* DIGESTIBILITY OF ZP MAIZE HYBRIDS AND THEIR PERENTAL INBRED LINES

Dusanka TERZIC[1], Milica RADOSAVLJEVIC[1*], Marija MILASINOVIC-SEREMESIC[1], Valentina SEMENCENKO[2], Goran TODOROVIC[1], Zorica PAJIC[1], Jelena VANCETOVIC[1]

[1]Maize Research Institute, Zemun Polje, Belgrade, Serbia
[2]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia
(Corresponding author: rmilica@mrizp.rs)

Abstract

In the present study the dry matter yield, cell wall contents and *in vitro* digestibility of the whole plant of different ZP maize hybrids and their parental inbred lines were observed. Obtained results showed that the dry matter yield of the whole plant and yield of digestible dry matter of the whole plant of the observed inbred lines varied from 9.0 to 14.7tha^{-1} and from 5.3 to 8.1tha^{-1}, respectively. However, the dry matter yield of the whole plant and yield of digestible dry matter of the whole plant of the observed ZP hybrids varied from 22.1 to 26.2tha^{-1} and from 14.1 to 15.5tha^{-1}, respectively. The contents of lignocelulose fibres such as NDF, ADF, hemicelullose and cellulose in the whole maize plant of the observed inbred lines were higher in comparison to the tested ZP hybrids. Only ADL contents in the whole maize plant of the observed inbred lines and hybrids were in withinthe same range, i.e. 1.8-3.1%. The dry matter digestibility of the whole maize inbred lines and hybrids plants variedfrom 51.61% to 61.09% and from 57.22 to 63.81%, respectively.The difference in the digestibility of the dry matter of the whole plant amounted to 6.6%, i.e. 9.5% in hybrids, i.e. inbred lines, respectively. The differences in the contents of lignocellulose fractions affected the differences in digestibility of thedry matter.
Key words: *Maizeinbred lines and hybrids, yield, lignocelullose fibres, digestibility*

Introduction

Maizeis one of themost important forageplants. In order to define the quality parameters of maize biomass it is necessary to study the structure of cell walls of the whole plant. It has beenproven that there have beensignificant changes in the content of lignocellulose fibres in the whole maize hybrid plant, which considerably affected the digestibility of the dry matter and therefore the yield of digestible dry matter as well (Deinum et al., 1981; Coors, 1996; Kim et al., 1999; Frey et al., 2004). Research has revealed that plant genetics couldaffect the quality and digestibility of the whole plant maize silage (Jung, 1997).Previously published our results point out to a great importance and necessity of the characterisation of the released maize hybrids and their inbreds for both, the determination of purposes of certain hybrids and the development of new high yield potential hybrids for silage (Peji , 1994, Terzi , 2006; Terzi et al., 2010 and Terzi et al., 2012). The objective of this study was to determine the dry matter yield, lignocellulose fibres contents and *in vitro* digestibility of the whole plant of newZP maize hybrids and their parental inbred lines.

Material and methods

Seven ZP maize hybrids of the FAO maturity groups 600-800 (ZP623, ZP735, ZP749, ZP789, ZP 802, ZP 812 and ZP 873) and nine maize inbred lines were used in this study. Three tested inbred lines (L2, L3 and L4) originate from the USA. They are public inbred lines from Iowa

State University derived from the BSSS synthetic population. Reminding six local inbred lines (L1, L5, L6, L7, L8 and L9) were developed at the Maize Research Institute (MRI) by the pedigree selection method. All nine maize inbred lines are parental components of tested ZP hybrids. Good combining ability for the yield of both, grain and biomass (silage) was estimated in the studied inbred lines.

The two-replicate trail was set up according to the randomised complete-block design in the experimental field of the MRI. The experimental plot size amounted to $21m^2$, while thesowing density was 60,000 plants ha^{-1}. Plants of each replicate were harvested atthe full waxy maturity stage from the area of $7m^2$ (two inner rows), and yields of fresh biomass of the whole plants, plants without ears and ears were estimated. Five average plants per replicate were selected for further tests. Samples of the whole plants were cut and dried at 60^oC for 48h. In order to determine the content of the dry matter the whole plant samples were ground in the 1-mm mesh mill. Then, the analysis of the absolute dry matter was done on the oven dry basis (105^oC for 12 h) in order to estimate the total dry matter. Moreover, the analysis of the content of forage fibres (NDF - neutral detergent fibres, ADF - acid detergent fibres, ADL - acid detergent lignin, hemicelluloses and cellulose) was performed by the modified Van Soest detergent method (Van Soest, 1963). The method was modified by Mertens(1992). *In vitro* digestibility of the whole maize plant was done by the Aufréré method *(*Aufréré,2006). This method is based on the hydrolysis of proteins of the whole plant in the pepsin acid solution (Merck 2000 FIP u/g Art 7190) at 40^oC for 24 h, and then on the hydrolysis of carbohydrates in the cellulase solution (cellulase Onozuka R10) in duration of 24 h.

Data reported for quality parameters of ZP hybrids and their parental inbred lines biomass were assessed by the analysis of variance (ANOVA) and the LSD multiple test was used for any significant differences at the $P<0.05$ level between the means. All the analyses were conducted using statistical software package STATISTICA 8.1. (StatSoft Inc. USA).

Results and discussion

The data in Table 1 show that the dry matter yield of the whole plant and yield of digestible dry matter of the whole plant of the observed maize inbred lines varied from 9.0 (L9) to 14.7tha^{-1} (L3) and from 5.3 (L9) to 8.1tha^{-1} (L3), respectively. Differences in digestibledry matteryieldswerenot statisticallysignificant amongthe inbred linesL1, L2, L3, L4andL7, and among thelinesL5, L6, L8andL9, as well. The inbred L3 had the highestyield of drymatter and theyieldof digestibledry matter perhectare, while the inbred L9 had the lowest yield of drymatter and digestibledry matter perhectare. The whole plant dry matter content of tested inbred lines ranged from 28.09 (L8) to 36.71% (L2).

Table 1. Yield of whole plant dry matter and digestible dry matter of Maize Inbred Lines

Inbred line	Dry matter content (%)	Whole plant dry matter yield (tha^{-1})	Yield of digestible dry matter of whole plant (tha^{-1})
L1	32.44	12.1[c]	7.4[a]
L2	36.71	13.1[b]	7.6[a]
L3	28.80	14.7[a]	8.1[a]
L4	31.66	13.6[b]	7.6[a]
L5	31.26	10.1[de]	5.7[b]
L6	33.22	9.6[ef]	5.8[b]
L7	33.13	12.9[bc]	7.7[a]
L8	28.09	10.7[d]	5.5[b]
L9	31.06	9.0[f]	5.3[b]
LSD $_{0.05}$		0.8	1.4

Means in the same column with different superscripts differ ($p<0.05$)

The dry matter yield of the whole plant and theyield of digestible dry matter of the whole plant of the observed ZP maize hybrids varied from 22.1 to 26.2tha[-1] and from 14.1 to 15.5tha[-1], respectively (Tables 2). For all testedparameters of the yield structure there are nosignificant differences among thehybrids(p <0.05). The hybridZP802had thehighestdry matter yield ofwhole plant (26.2tha[-1]), while thehybridZP812had thehighestyieldof digestibledry matter (15.5tha[-1]). The whole plant dry matter content of tested hybrids varied from 32.69 (ZP 735) to 42.47% (ZP 749).

Table 2. Yield Structure of ZP Maize Hybrids

Hybrid	Dry matter content (%)	Dry matter yield (tha[-1])			Yield of digestible dry matter of whole plant (tha[-1])
		Whole plant	Whole plant without ear	Ear	
ZP 623	36.82	25.2	11.5	13.7	14.4
ZP 735	32.69	26.0	14.0	12.0	15.4
ZP 749	42.47	23.2	11.2	12.0	14.8
ZP 789	36.02	22.1	9.8	12.3	14.1
ZP 802	37.10	26.2	13.0	13.2	15.0
ZP 812	38.74	25.2	12.1	13.1	15.5
ZP 873	37.53	23.0	10.9	12.1	14.1
LSD $_{0.05}$		-	-	-	-

Means in the same column with different superscripts differ ($p<0.05$)

The contents of NDF, ADF, ADL, hemicelluloses,cellulose and digestibility of the whole maize plant are presented in Tables 3 and 4. The results show that the NDF, ADF, ADL, hemicelluloses, cellulose contents and digestibility of dry matter in the whole maize plant of the observed different inbreds varied from 50.97 (L1) to 62.82% (L 8), 24.24 (L6) to 32.34% (L8), 1.84 (L7) to 3.07% (L8), 26.44 (L1) to 32.40% (L5), 21.94 (L6) to 29.27% (L8) and 51.61 (L8) to 61.09% (L1), respectively. Amongthe tested inbreds, the inbred L8 had thehighest NDF (62.82%), ADF(32.34%), ADL (3.07%) andcellulose(29.27%) and the lowest dry matter digestibility (51.61%). However, theinbred L1, which had the highestdry matter digestibility (61.09%) had thelowestNDF (50.97%) and hemicellulose (26.44%) content of the whole plant. The differencesin the dry matter digestibility among observed maize inbred lineswere not significant betweenL4and L5andbetween L6andL7 as well.

Table 3. Whole Plant Lignocellulose Fibres Content and Digestibility of Maize Inbred Lines

Inbred line	Content (%)					Dry matter digestibility (%)
	NDF	ADF	ADL	Hemicellulose	Cellulose	
L1	50.97[i]	24.54[e]	2.03[cd]	26.44[f]	22.51[ef]	61.09[a]
L2	55.98[f]	26.03[d]	1.91[cd]	29.95[bc]	24.12[d]	57.86[d]
L3	57.92[d]	28.50[c]	2.76[ab]	29.42[cd]	25.74[bc]	54.78[f]
L4	59.12[c]	28.44[c]	3.06[abc]	30.68[b]	25.38[c]	56.06[e]
L5	61.72[b]	29.32[b]	2.85[ab]	32.40[a]	26.47[b]	56.09[e]
L6	52.54[h]	24.24[e]	2.30[bcd]	28.30[e]	21.94[f]	60.27[b]
L7	53.56[g]	24.93[e]	1.84[d]	28.63[de]	23.09[e]	60.06[b]
L8	62.82[a]	32.34[a]	3.07[a]	30.48[b]	29.27[a]	51.61[g]
L9	56.67[e]	27.90[c]	2.33[bcd]	28.77[de]	25.57[c]	58.50[c]
LSD $_{0.05}$	0.68	0.81	0.67	0.88	0.77	0.48

Means in the same column with different superscripts differ ($p<0.05$)

The results also show that the NDF, ADF, ADL, hemicelluloses, cellulose contents and digestibility of dry matter in the whole maize plant of the observed different ZPmaize hybrids varied from 47.87 (ZP 749) to 52.71% (ZP 623), 23.53 (ZP 789) to 27.49% (ZP 735), 1.84

(ZP 873) to 2.99% (ZP 735), 22.14 (ZP 749) to 26.23% (ZP 873), 21.24 (ZP 789) to 24.50% (ZP 735) and 57.22 (ZP 623) to 63.81% (ZP 749), respectively. Amongthe testedhybrids, hybrid ZP749had the highest dry matterdigestibility of the whole plant(63.81%) and the lowestNDF (47.87%) and hemicellulose(22.14%). Thelowest digestibility (57.22%) and the highestcontents ofNDF (52.71%) were found for ZP623 maize hybrid. The differencesin the dry matter digestibility among observed ZP maize hybrids were not significant between the ZP 623and ZP 802,ZP 749andZP 789 and also between ZP 812 and ZP 873.

Table 4. Whole Plant Lignocellulose Fibres Content and Digestibility of ZP Maize Hybrids

Hybrid	Content (%)					Dry matter digestibility (%)
	NDF	ADF	ADL	Hemicellulose	Cellulose	
ZP 623	52.71[a]	26.60[bc]	2.33	26.11[a]	24.27[a]	57.22[d]
ZP 735	49.95[c]	27.49[a]	2.99	22.46[c]	24.50[a]	59.29[c]
ZP 749	47.87[d]	25.73[ab]	2.49	22.14[c]	23.24[b]	63.81[a]
ZP 789	48.29[d]	23.53[c]	2.29	24.76[b]	21.24[d]	63.71[a]
ZP 802	49.63[c]	25.48[b]	2.07	24.15[b]	23.41[b]	57.34[d]
ZP 812	48.37[d]	24.37[bc]	2.16	24.00[b]	22.21[c]	61.39[b]
ZP 873	50.99[b]	24.76[bc]	1.84	26.23[a]	22.92[b]	61.51[b]
LSD $_{0.05}$	0.79	1.83	-	0.83	0.59	0.67

Means in the same column with different superscripts differ ($p<0.05$)

The correlation dependence between the whole plant digestibility and lignocellulose fibres of ZP maize hybrids and their parental inbred lines are presented in Tables 5 and 6.

A very significant negative correlation was determined between the digestibility the whole maize inbred plants and NDF, ADF, ADL, hemicelluloses and cellulose content (r=-0.92, r=-0.94, r=-0.77, r=-0.68, r=-0.93). Furthermore, a highlysignificantcorrelationbetweenNDF and ADF, ADL, hemicelluloses and cellulose (r=0.95, r=0.77, r=0.87, r=0.94) and between ADF and ADL, hemicelluloses and the cellulose content (r=0.80, r=0.68, r=0.99) of the whole maize inbred plants and a significantcorrelation betweenthe content of ADL and the hemicellulose content (r=0.56) were established. A very significant correlation was determined between the contents of ADL and the cellulose (r=0.74) and between contents of hemicelluloses and cellulose of the whole maize inbred plants(r=0.66).

Table 5. Correlation Dependence between Whole Plant Digestibility and Lignocellulose Fibres of Maize Inbred Lines

	NDF	ADF	ADL	Hemicellulose	Cellulose
Digestibility	-0.92**	-0.94**	-0.77**	-0.68**	-0.93**
NDF		0.95**	0.77**	0.87**	0.94**
ADF			0.80**	0.68**	0.99**
ADL				0.56*	0.74**
Hemicellulose					0.66**

* and ** - significance at 0.05 and 0.01 probability levels, respectively.

A very significant negative correlation was determined between the digestibility and NDF and the cellulose content (r=-0.70, r=-0.67) and a significant negative correlation between the hemicelluloses content and ADF (r=-0.55). A highlysignificantcorrelationbetweenNDF and hemicelluloses (r=0.66) and between ADF and the cellulose content (r=0.76) of the whole maize hybrid plants and a significantcorrelation betweenthe content of NDF and the cellulose content (r=0.61) were established. The results gained in this study are in agreement with ones previously published (De Boever et al., 1997, Terzi , 2006, Terzi et al., 2010 and 2012).

Table 6. Correlation Dependence between Whole Plant Digestibility and Lignocellulose Fibres of ZP Maize Hybrids

	NDF	ADF	ADL	Hemicellulose	Cellulose
Digestibility	-0.70**	-0.35	-0.33	-0.27	-0.67**
NDF		0.17	0.47	0.66**	0.61*
ADF			0.29	-0.55*	0.76**
ADL				0.23	0.28
Hemicellulose					-0.16

* and ** - significance at 0.05 and 0.01 probability levels, respectively.

Conclusion

The inbred L3 had the highestyield of drymatter (14.7tha^{-1}) and theyieldof digestibledry matter (8.1tha^{-1}), while the inbred L9 had the lowest yield of drymatter (9.0tha^{-1})and digestibledry matter (5.3tha^{-1}). The hybridZP802had thehighestdry matter yield of the whole plant (26.2tha^{-1}),while thehybridZP812had thehighestyieldof digestibledry matter (15.5tha^{-1}). Amongthe tested inbreds, the inbred L8 had thehighest NDF (62.82%), ADF(32.34%), ADL (3.07%) andcellulose(29.27%) and the lowest dry matter digestibility (51.61%). Theinbred L1, which had the highestdry matter digestibility (61.09%) had thelowestNDF (50.97%) and hemicellulose (26.44%) content of the whole plant. The differencesin the dry matter digestibility among observed maize inbred lineswere not significant betweenL4and L5andbetween L6andL7 as well. The hybrid ZP749had the highest dry matterdigestibility of the whole plant(63.81%) and the lowestNDF (47.87%) and hemicellulose(22.14%). Thelowest digestibility (57.22%) and the highestcontents ofNDF (52.71%) were found for ZP623 maize hybrid. The differencesin the dry matter digestibility among observed ZP maize hybrids were not significant between the ZP 623and ZP 802,ZP 749andZP 789 and, also, between ZP 812 and ZP 873.
A very significant negative correlation was determined between the digestibility of the whole maize inbred plants and NDF, ADF, ADL, hemicelluloses and cellulose content (r=-0.92, r=-0.94, r=-0.77, r=-0.68, r=-0.93). However, a very significant negative correlation for tested whole maize hybrid plants was determined only between the digestibility and NDF and the cellulose content (r=-0.70, r=-0.67).

Acknowledgements

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THE EFFECT OF NITROGEN FERTILIZATION ON YIELD OF MAIZE

Ljubisa ZIVANOVIC[1*], Jela IKANOVIC[1], Vera POPOVIC[2], Miodrag KAJGANA[1], Sveto RAKIC[1], Marina MILUTINOVIC[1]

[1]University of Belgrade, Faculty of Agriculture, Zemun, Serbia
[2]Institute of Field and Vegetable Crops, Novi Sad, Serbia
(Corresponding author: ljuba@agrif.bg.ac.rs)

Abstract

During two-year period (2005 and 2007), the effects of different nitrogen rates (PKN_{30}, PKN_{60}, PKN_{120} and PKN_{180}) on the grain yield maize of different FAO maturity groups (ZP 434, ZP 578 and ZP 677) was examined. The research ws carried out by field micro experiments in agroecological conditions of the central Sumadija (Raca Kragujevacka) on eutric cambisol. Experiments were conducted using split plot design wih four repetition .
The results show significant differences in grain yield of maize between the examined nitrogen rates and hybrids in the years of research. In the year with favorable weather conditions (2005) during the vegetative period, the increased nitrogen nutrition had a stronger effect on grain yield, compared to 2007, when there were adverse weather conditions.

Keywords:*nitrogen, hybrid, maize, grain yield.*

Introduction

In Serbia, maize is a major crop, necessary for domestic use and a strategic export product as well. It is grown on an area of 1.17 to 1.27 million hectares; with a total annual production varying from 3.9 (in 2007) to 7.2 (in 2010) million tones and an average grain yield from 3.25 to 5.89 t ha^{-1} (*Republic Institute for Statistics, Republic of Serbia*, 2011). Considering maize production in Serbia is very important, special attention should be paid to its further development.

Improvement of maize production involves problem solving, especially in the field of cropping practices. In this context, nitrogen nutrition and hybrid selection have an important place. Due to rising prices and current costs of applying nitrogen fertilizers, the fertilizing system should be revised, in particular the amount of active ingredient per hectare. Moreover, the importance of this issue should be also taken into consideration from the aspect of environmental control.

On the other hand, nitrogen nutrition and hybrid selection must be examined and studied according to climatic conditions of a region (thermal conditions, precipitationamount, and distribution), soil type, etc. Regardless of regional character of such studies, they are fully justified even though there is a lot of information related to this issue (*Binder et al.,* 2000; *Blaži ,* 2006; *Dinnes et al.,* 2002; *Hojka,* 2004; *Latkovi ,* 2010; *Matei et al.,* 2009; *Živanovi et al.,* 2007).

The objective of this study was to determine an optimal nitrogen rate for the examined hybrids, choosing the top-yielding ones for the agro ecological conditions of central Šumadija and eutric cambisol.

Materials and methods

The research of the effect of nitrogen rates on the grain yield of maize hybrids with different length of vegetation period was carried out in the vicinity of Ra a Kragujeva ka (village of Miraševac) in 2005 and 2007. The experiments were carried out on eutric cambisol,characterized by the following important chemical properties: pH (KCl) - 5.58; humus content - 2.73%, total nitrogen content - 0.16%; P_2O_5 - 4.30 mg per 100 g of soil and K_2O - 18.90 mg per 100 g soil. pH was determined by a pHmeter with a glass electrode, humus content by the Kotzman method, total nitrogen content by the Kjeldahl method while the content of P_2O_5 and K_2O were determined by the AL method (Egner-Rhiem). The field micro trial was set up using a split-plot design with four repetitions. The main plot and a subplot surface were 201.6 m^2 and 16.8 m^2 (6.0 m x 2.8 m), respectively. The surface of the plot for billing grain yield was 8.4 m^2.

Two important elements for maize production were studied in this research, in the following variants:

Nitrogen rates (A): $P_{90}K_{60}N_{30}$ kg ha^{-1} (phon); $P_{90}K_{60}N_{60}$ kg ha^{-1}; $P_{90}K_{60}N_{120}$ kg ha^{-1}; $P_{90}K_{60}N_{180}$ kg ha^{-1};

Hybrids (B): ZPSC 434 (FAO 400), ZPSC 578 (FAO 500) and ZPSC 677 (FAO 600)

Standard cropping practices were applied. The harvest was carried out manually in the late September or early October depending on the year. Water content of maize hybrids had been determined by drying in an oven at 105^0C before the yield of dry grains (with 14% water) per hectare was calculated. The data were analyzed and tested using the analysis of variance and the LSD test.

Meteorological conditions

Table 1. Average monthly temperatures and precipitation for maize in the 2005 and 2007 growing seasons (Raca, Mirasevic)

Meteorological factor	Year	Month						Average
		IV	V	VI	VII	VIII	IX	
Temperature (^0C)	2005	12,1	16,5	19,1	22,0	20,5	18,1	18,1
	2007	12,8	18,3	22,5	24,1	23,4	16,3	19,6
Precipitation (mm)	2005	69,0	71,0	52,0	86,0	118,0	112,0	508,0
	2007	3,0	119,0	26,0	11,0	83,0	52,0	294,0

Monthly air temperatures and precipitation for the 2005 and 2007 growing seasons are presented in Table 1.The weather conditions for maize production in these two years were very different. The average temperature in 2007 was higher by 1.5^0 C and theamount of precipitation lower by 214.0 mm compared to the 2005 growing season. This difference was most pronounced in the summer months (June, July, August) when maize reacts strongly on adverse environmental conditions.

Results and discussion

This paper studies the effect of nitrogen rates on the grain yield of maize hybrids with different length of vegetation period. Table 2 shows that the average yield of dry maize grain (with 14% water) achieved over the two-year research was 9.2 t ha^{-1}. Weather conditions during the years of the research strongly affected the grain yields. Compared to 2005, when there were optimal conditions for maize growth and development, in 2007 the grain yield was lower by 41.6% due to dry weather.

Table 2. Effect of nitrogen fertilization on the grain yield of maize hybrids (t ha^{-1})

Nitrogen fertilization (A)	Hybrid (B)	Year		Average	Index (%)
		2005.	2007.		
PKN$_{fon}$	ZP 434	9,68	6,38	8,03	100,0
	ZP 578	10,73	6,57	8,65	107,7
	ZP 677	10,32	6,79	8,56	106,6
	Prosek	10,24	6,58	8,41	100,0
PKN$_{60}$	ZP 434	10,78	6,88	8,83	100,0
	ZP 578	11,14	6,99	9,07	102,7
	ZP 677	11,83	7,22	9,53	107,9
	Prosek	11,25	7,03	9,14	108,7
PKN$_{120}$	ZP 434	12,06	6,57	9,32	100,0
	ZP 578	12,36	6,88	9,62	103,2
	ZP 677	13,08	7,35	10,22	109,7
	Prosek	12,50	6,93	9,72	115,6
PKN$_{180}$	ZP 434	12,45	6,15	9,30	100,0
	ZP 578	12,60	6,59	9,60	103,2
	ZP 677	12,62	7,20	9,91	106,6
	Prosek	12,56	6,65	9,60	114,1
Prosek hibrida	ZP 434	11,24	6,50	8,87	100,0
	ZP 578	11,71	6,76	9,24	104,2
	ZP 677	11,96	7,14	9,55	107,7
The totalaverage		11,64	6,80	9,22	-
Index (%)		100,0	58,4	-	-

LSD	2005. godina				2007. godina			
	A	B	B x A	A x B	A	B	B x A	A x B
0,05	0,52	0,44	0,87	0,88	0,61	0,33	0,66	0,81
0,01	0,74	0,59	1,18	1,21	0,88	0,45	0,90	1,14

The biennial average with increasing of nitrogen rates up to 120 kg ha^{-1} shows that grain yield first increased, and then decreased. On average, this increase for the hybrids and years varied from 8.7% (N$_{60}$) to 15.6% (N$_{120}$). Thereby, these results confirm some previous research (*Blagojevi and Veskovi*, 1985; *Videnovi et al.*, 2007), which showed that it was the nitrogen rate of 120 kg ha^{-1} that had the biggest effect on the grain yield of maize on eutric cambisol in Šumadija (*Blagojevi*, 1985). When it comes to the nitrogen rates and years, on average, the highest grain yield (9.55 t ha^{-1}) was determined for ZP 677 hybrid. Then comes ZP 578 hybrid (9.24 t ha^{-1}), while the lowest grain yield (8.87 t ha^{-1}) had ZP 434 hybrid. As for the years, the effect of nitrogen fertilization on grain yield had a different character and intensity.

Grain yield in the 2005 growing season: The average yield in this year was 11.64 t ha^{-1}. The lowest yield was achieved by the phon (P$_{90}$K$_{60}$N$_{30}$) and amounted to 10.24 t ha^{-1}. With increasing of nitrogen rates from 60, and 120 to 180 kg ha^{-1}, grain yield also increased by 1.01, 2.26, and 2.32 t ha^{-1}. All the differences in grain yield using different nitrogen rates are statistically highly significant, except for the differences occurred with using 120 and 180 kg N ha^{-1}. Lengthening of vegetation period of the examined hybrids led to higher yields. The highest grain yield was achieved by ZP 677 hybrid (11.96 t ha^{-1}), lower yield by ZP 578 (11.71 t ha^{-1}), and the lowest by ZP 434 hybrid (11.24 t ha^{-1}). All the differences in grain yields of maize hybrids were statistically significant and highly significant, except for the differences between the grain yields of ZP 578 and ZP 677 hybrids.

Grain yield in the 2007 growing season: The average yield in this year was 6.80 t ha^{-1}. The lowest grain yield (6.58 t ha^{-1}) was achieved by the phon, and the highest (7.03 t ha^{-1}) by the variant with 60 kg N ha^{-1}. The differences in grain yields achieved by using different nitrogen rates are not statistically significant. The grain yield of ZP 677 hybrid was statistically

significant and highly significant compared to the yield of ZP 578 and ZP 443 hybrids. Between ZP 578 and ZP 434, there were no statistically significant differences in grain yields. A x B and B x A interactions had no statistically significant effect on grain yield of maize in this year of research.

Conclusion

Based on the results of the two-year research on the effect of nitrogen rates on the grain yield of maize hybrids of different FAO maturity groups from central Sumadija, it can be concluded that:

Grain yield mostly depended on weather conditions during the vegetation period. Compared to the 2005 growing season that had favorable weather conditions, grain yield in the 2007 growing season was lower by 41.6% due to dry weather.

When it comes to the hybrids and years, on average, the increased nitrogen rates of 60 and 120 kg ha^{-1} resulted in an increase in grain yield by 8.7 to 15.6% compared to the phon ($P_{90}K_{60}N_{30}$)variant.

As for the nitrogen rates and years, on average, the hybrids with longer vegetation period (ZP 578 and ZP 677) had higher grain yields by 4.2 and 7.7% compared to the early vegetation hybrid (ZP 434).

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HETEROSIS FOR GRAIN QUALITATIVE TRAIT AND YIELD IN ZP MAIZE HYBRIDS

Snezana MLADENOVIC-DRINIC[*], Milomir FILIPOVIC, Zoran CAMDZIJA, Milan STEVANOVIC, Violeta ANDJELKOVIC, Milosav BABIC, Goran STANKOVIC

Maize Research Institute Zemun Polje, Belgrade, Serbia,
(Corresponding author: msnezana@mrizp.rs)

Abstract

Maize has a various utilization and the main goal of maize breeding is to obtain new hybrids that will outperform the existing hybrids with respect to a number of traits. Nine parent inbred lines and their eight F1 single crosses were grown in RCBD at two location with two replication during 2010 and 2011. In kernal sample protein, oil and starch content were determined by NIRS. Heterosis for yield and grain quality traits was estimated as mid parent (MPH) and better parent heterosis (BPH). The mid-parent heterosis for yield varied from 149,4% to 207,3%, averaged 173,6% in 2010, and from 139,2% to 190%, averaged 161,8% in 2011. The cross L6xL5 had the highest MPH for yield and the cross L1xL7 the higest BPH in both years. Starch content expressed a positive MPH and BPH heterosis in both years whereas oil content mainly expressed positive heterosis over the midparent. The values for MPH for starch content of crosses varied from 0,85% to 2,5% (2010), and 0.78% to 2,98% (2011), respectively. The cross L4xL2 had the higest MPH and BPH for starch in 2010 and the cross L9xL6 in 2011. On the other hand positive MPH for oil content ranged from 4,0% to 19.6% and 2,6% to 21,6% for 2010 and 2011, respectively. The F1 crosses expressed both positive and negative heterotic effect for protein content in both years, varied from -8,1% to 5,1% (2010) and -6,04% to 7,98% (2011), respectively. The cross L4xL2 had the higest positive MPH for protein content for both years and positive BPH for 2010. Generally, the cross L1xL7 gave high positive heterotic value for oil and starch content, positive value for protein content and high heterosis for yield.

Key words: *maize, heterosis, protein, oil, starch*

Introduction

Maize has a various utilization and the main goal of maize breeding is to obtain new hybrids that will outperform the existing hybrids with respect to a number of traits. In working towards this goal, particular attention is paid to grain yield as the most important agronomic traits. Good results have been achieved in increasing maize yield through the successful exploitation of heterosis. Maize has great potential for heterotic manifestation and its exploitation. This could be the reason that number of hybrid varieties in maize is much higher than any other varietals types i.e. open pollinated, double cross, synthetics or three way crosses. Heterosis can be defined as the difference between the hybrid performance and the mean value of the inbred parents, which is known as mid-parent heterosis. However, the highest value of the best parent for a trait of interest, or high parent heterosis, is also used mainly for self-pollinated crops where breeders are interested in finding a hybrid with better performance than either of the parents (Lamkey and Edwards, 1999). Mid-parent heterosis and beter-parent heterosis are important parameters as they provide information about the presence of dominance and over dominance type of gene action in the expression of various

traits. The degree of heterosis depends on the relative performance of inbred parents and the corresponding hybrids.

Besides yield, the attention should be paid to the quality of kernel itself i.e. chemical composition, mainly if we take into consideration one of the most important maize uses as livestock feed. Also, the chemical constitution of the maize kernel not only defines its nutritional

value but also the ability to be used in industries. Kernels quality depends on outward factors influenced by the environment, management technology and genetic background (Fabrianac et al., 2006, Harrelson et al., 2008, Idikut et al., 2009). Based on the results of Reynolds et al (2005) the chemical composition of the grain of hybrids grown in the same location can vary significantly. Differences between hybrids emphasize the importance of genetic background and breeding as determinants of biochemical composition.

Material and methods

In this study a set of 8 hybrids of FAO maturity groups from 300 to 600 and their parental inbred lines was used. Hybrid H1 (L1×L7) belonged to FAO maturity group 300, H2 (L4×L2) belonged to FAO maturity group 400, H3 (L3×L7) and H4 (L9×L8) belonged to FAO maturity group 500, H5 (L9×L6), H6 (L3×L6), H7 (L3×L8) and H8 (L6×L5) belonged to FAO maturity group 600. From parental inbred lines L2 and L9 were from independent source germplasm, L1, L3 and L5 from BSSS heterotic group, and L4, L6, L7 and L8 from Lancaster germplasm. An experiment set up as randomized block design with two replications at two experimental fields of MRI, during 2010 and 2011. Four rows were planted for each genotypes, with 20 plants per row, resulting in a plant density of 67000 plants per ha. The identical cropping practices were applied for all genotypes in both locations during both years. Yield of each plot was used for calculation of grain yield per hectare (tha^{-1}) with 14% moisture. The protein, oil and starch content were determined by near-infrared reflectance spectroscopy NIR using Infratec 1241 grain analyzer (Foss Tecator, Sweden) and expressed in a percentage of dry mater.

Heterosis was determined as follows:
Mid-parent heterosis (%) = ((F1- MP)/MP) × 100
Best-parent hetrosis (%) = ((F1- BP)/BP) × 100
Where
F1 =Mean of F1 hybrid for a specific trait
MP=Mean of the two parents in a cross for a specific trait
BP= Mean of the best parent in a cross for a specific trait

Results and discussion

Hybrids yielded an overall mean of 12,1 tha^{-1}, with range from 10,60 to13,00 tha^{-1} in 2010 and range from 11,1 to 12,1 tha^{-1}, with average mean 11,5 tha^{-1} in 2011 (Table 1). Generally, the yield of hybrids and parental lines was lower in location 2 than location 1 in both years (data not shown). The highest yielding hybrids in both years was H5 (L9xL6), 13,0 tha^{-1} and 12,1 tha$^{-1,}$ respectively. Two hybrids, crosses between low x moderate yielding parental lines, had the lowest yield in 2010 (L4xL2), and H1 (L1xL7) in 2011.

The cross L6xL5 had the highest MPH for yield and the cross L1xL7 the higest BPH in both years. The mid-parent heterosis varied from 149,4% (L4xL2) to 207,3% (L6xL5), averaged 173,6% in 2010, and from 139,2% (L9xL6) to 190% (L6xL5), averaged 161,8% in 2011. The best parent heterosis ranged from 122,2% (L9xL8) to 195,55 (L1xL7), averaged 148,5% in 2010, and from 100% (L9XL8) to 177,5% (L1xL7), averaged 132.65% in 2011. The various

interactionsbetween alleles of theparental lines resulting in differentlevels of heterosis in crosses. The hybrid with the highest yield, combination of two good yielding inbred lines, has the low MPH and low BPH in both years.All hybrids, as crosses between inbred lines from different heterotic group, has positive yield heterosis which is in agreement with another investigators, who commonly assumed that the combination of lines of different heterotic groups originates hybrids with higher chances of genetic expression of the target effects of hybridization (Troyer, 1999; Tollenaar et al., 2004).

Table 1. Yield and heterotic effect for yield in maize hybrids

crosses	Yield tha⁻¹		MPH%		BPH%	
	2010	2011	2010	2011	2010	2011
L1xL7	11,8	11,1	203,1	184,6	195,5	177,5
L4xL2	10,6	11,2	149,4	163,5	140,9	148,0
L3xL7	12,0	11,3	165,1	151,1	135,5	117,3
L9xL8	12,2	11,4	168,5	150,5	122,2	100,0
L9xL6	13,0	12,1	157,4	139,2	136,3	112,6
L3xL6	12,3	11,8	153,1	148,2	140,2	126,9
L3xL8	12,4	11,5	185,1	167,4	143,1	121,2
L6xL5	12,6	11,6	207,3	190,0	173,9	157,7

Maize as the other cereal crops is relatively poor in kernel protein content as usually varies from 8.0 to 11.0% according to FAO reports. The values of protein content varied between 9,2 to 10,4% in 2010 and from 9,9 to 11,5 in 2011. The cross L4xL2 (high x low protein line), had high protein content and the lowest grain yield, and cross L6xL5 (low x moderate protein line) the lowest protein content and high yield, in both years. That is in accordance to Prassana et al., (2001) who reported that the high yielding hybrids usually have lower protein content. The F1 crosses expressed both positive and negative heterotic effect for grain protein content, Table 2. The values for protein content in studied crosses showed positive heterosis over mid-parents in two hybrids in 2010, and four hybrids in 2011. On the other hand, the four crosses in our study showed negative heterosis below the best and mid-parents in both years. Similar results for protein content in maize kernel and heterotic effects in different cross combinations of maize hybrids have been reported by Lou et al. (2005) and Ikramullah et al (2011). In some hybrids heterotic effect acts in the opposite sense to the desired, that there is reduction of the grain protein content compared to parental lines. This shows the dominance of the alleles for low protein content. In spite of the observed negative heterosis, different combination with positive heterosis can be observed. This demonstrates the existence of bidirectional dominance for protein content in the different loci, with prevalence of loci with dominance for low protein content.

Table 2. Protein content and heterotic effect for protein content in maize hybrids

crosses	Protein content%		MPH%		BPH%	
	2010	2011	2010	2011	2010	2011
L1xL7	10,2	10,6	1,3	6.5	-1.9	4.9
L4xL2	10,4	11,3	5.1	5.12	5.1	-1.74
L3xL7	10,3	11,5	-1.9	7.98	-2.8	0
L9xL8	9,3	10,2	-8.1	1.96	-9.7	0
L9xL6	9,4	10,2	-3.78	-0.48	-5.52	-1.9
L3xL6	9,5	10,2	-5.9	-5.55	-10.3	-11.3
L3xL8	9,9	10,1	-5.26	-6.04	-6,6	-12.1
L6xL5	9,2	9,9	-6.5	-5.26	-8.9	-8.33

The results on heterosis for oil content indicated existence of the positive MP heterosis in 6 hybrids with range varying from 2,68 to 21,6%. Negative mid-parent heterosis was expressed in two hybrids only in 2010. Positive values for averaged mid parent heterosis revealed that the alleles for high oil content were dominant. The highest positive MP heterosis was expressed by a cross L3x L8 (19,6%) in 2010, as well as cross L4xL2 (21,6%) in 2011. The estimates of positive better parent heterosis were observed in one hybrid in 2010 and 5 hybrids in 2011. The cross L3xL8, combination of low x high oil lines, that expressed high mid-parent heterosis and positive better parent heterosis have also high oil content. At the same time this hybrid has negative values for MPH and BPH for protein content in both years. Meanwhile, hybrid L4xL2 (high x low oil line) had positive MPH for oil and protein content. The positive significant heterosis over better parent for oil content was also reported by Mittelmann et al.(2006), and Oliveira et al. (2006). Dubey et al. (2009) found that the heterosis over mid-parents and better parent was observed for seed oil content and grain yield per plant. Kaushik et al. (2004) studied the protein and oil concentration in heterotic crosses of maize and find out that from 72 crosses studied, 30 crosses exhibited heterosis for protein and oil concentration.

Table 3. Oil content and heterotic effect for oil content in maize hybrids

crosses	oil content%		MPH%		BPH%	
	2010	2011	2010	2011	2010	2011
L1xL7	4,15	4,65	10,1	19	-5,14	4,49
L4xL2	4.1	4.45	10,8	21.6	-5,23	11.95
L3xL7	4,35	3.95	16	1,28	-0,57	-11,2
L9xL8	4,0	5,0	-1,53	17,6	-9,55	13,6
L9xL6	3,85	4,1	-1.91	8,14	-4,8	0
L3xL6	3,6	3,85	0	11,59	-12,1	8,3
L3xL8	4,5	4,7	19,6	18,87	1,1	5,6
L6xL5	3,9	3,8	4,0	2,68	-4,9	-2,6

The highest starch content in 2010 had two crosses L4xL2 and L3xL6, and in 2011 cross L9xL6, Table 4. The mid-parent heterosis varied from 0,85% (L9xL8) to 2,5% (L4xL2), averaged 1,38% in 2010, and from 0,78% (L3xL7) to 2,98% (L9xL6), averaged 1,88% in 2011. That revealed that the genes with positive effect were dominant. The best parent heterosis ranged from 0,28% (L9xL8) to 2,1% (L4xL2), averaged 0,99% in 2010, and from 0,71% (L4xL2) to 2,83% (L9xL6), averaged 1,39% in 2011. The presence of better parent heterosis indicated that over dominance played important role in the expression of starch content. The cross L4xL2, low x high starch lines, that had the highest starch content, expressed also the highest midparent and better parent heterosis in 2010. The cross L9xL6 (high x moderate starch lines), that had the highest starch content also expressed the highest MPH and BPH in 2011. The significant positive mid parent, better parent and standard heterosis for starch content were reported by Devi and Pradhan (2004).

Table 4. Starch content and heterotic effect for starch content in maize hybrids

crosses	starch content%		MPH%		BPH%	
	2010	2011	2010	2011	2010	2011
L1xL7	70,45	71,3	1,29	2,51	0,78	1,56
L4xL2	71,5	70,7	2,5	2,1	2,1	0,71
L3xL7	71,3	70,9	1,42	0,78	0,84	0,56
L9xL8	70,6	70,9	0,85	0,99	0,28	0,85
L9xL6	71,2	72,5	1,06	2,98	0,99	2,83
L3xL6	71,5	72,2	1,27	2,41	1,13	2,4
L3xL8	71,2	71,3	1,49	1,42	0,70	1,13
L6xL5	71,3	72,3	1,13	1,83	1,13	1,12

Conclusion

The obtained results demonstrate that analyzed hybrids have values for protein, oil and starch content that are typically for maize genotypes that were not specifically selected from those traits.

Some of the hybrids expressed high heterosis for protein, oil and starch content along with moderate yield potentials. The genetic background of parental lines affecting the grain chemical composition of hybrids. The cross L1xL7 gave high positive heterotic value for oil and starch content, positive value for protein content and high heterosis for yield. The highest heterosis for protein content and the highest protein content, as well as high heterosis for oil and starch content but low yield and heterosis for yield had the cross L4xL,2, with different genetic backgroundthan othercrosses. On other hand, the highest yielding hybrid L9xL6 had also the highest starch content and heterosis for starch content in 2011. Two hybrids, with similar genetic background, had moderate yield and yield heterosis, high protein content and negative heterosis for protein in 2010, moderate oil and starch content (L3xL7), and high yield and yield heterosis, moderate protein content and negative MPH and BPH for protein content, high oil content and heterosis for oil content, and moderate starch content (L3xL8), respectively. The utilization of maize for nutritional products, and ethanol demands a re-direction of breeding programs to modifying and increasing the kernel composition of starch, protein, and oil.

Acknowledgments

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POSSIBILITY OF GROWING RYE ON DEGRADED SOIL OF OPEN PIT MINES IN THE PROCESS OF BIOLOGICAL RECULTIVATION

Snezana JANKOVIC[1*], Sveto RAKIC[2], Jela IKANOVIC[2], Gordana DRAZIC[3], Nenad MALIC[4]

[1]Institute for Science Application in Agriculture, Belgrade, Serbia,
[2]University of Belgrade, Faculty of Agriculture, Zemun - Belgrade, Serbia
[3]Singidunum University, Faculty of Applied Ecology "Futura", Belgrade, Serbia
[4] EFT – Stanari mine and thermal power-plant, Stanari, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: sjankovic@ipn.bg.ac.rs)

Abstract

To avoid negative effects of open pit mining development, mining activities should be accompanied with biological recultivation of waste dumps and rehabilitation of degraded areas in order to establish different vegetation and other ecosystems on newly created deposols. The goal of this research is to identify possibilities for rye production in these areas, having rye as a rotating crop. Some amelioration practices were applied before planting, such as: lime treatments combined with different rates of mineral fertilizers (200 and 400 kg ha^{-1} of NPK) and treatments with no lime application with 200 and 400 kg ha^{-1} of NPK. Side dressing was carried out in spring with 200 and 400 kg N ha^{-1}. After sampling, in order to speed up the recultivation process, the biomass was mown, chopped and ploughed into the surface layer of deposol. The rye yields ranged 2.30-2.59 tha^{-1} were obtained on ameliorated deposol using pre-planting lime application combined with 200 and 400 kg ha^{-1} of NPK mineral fertilizers and 400 kg N ha^{-1} side dress. The treatments without pre-planting lime application yielded 0.95-1.85 tha^{-1}. Considering economic efficiency, it is recommended to use 200 kgha^{-1} of NPK and 200 kg N ha^{-1} side dress.

Key words: *Biological recultivation, degraded soil, yield, rye.*

Introduction

The development of open pit mines as energy-industrial complexes has many negative effects on environment, which obliges people to do integration planning, to revitalize and rehabilitate degraded areas and use them in the post exploitation period. Recultivation and restructuring of the furrow surface provide many opportunities (*Draži , 2011*). To avoid negative effects of open pit mining development, mining activities should be accompanied with biological recultivation of waste dumps and rehabilitation of degraded areas in order to establish different vegetation and other ecosystems on newly created deposols. Many research studies have shown (*Alen, 2000; Hadži et al, 2001; Lon ar, 2009; Mali et al, 2009*) it is possible to establish new agricultural, forest, aquatic, meadow and other ecosystems in such degraded areas. *Bolinder et al* (2002) pointed out that mineral resources are one of the main factors in the development of a society. However, mining activities in open pit coal mines have many potential effects on the quality of surface and underground water, soil, flora and fauna, etc. Waste is disposed of in an external waste dump until the space for an inner waste dump is provided in one particular open pit mine or in adjacent ones. Nowadays, the development of mines is planned according to their exploitation rate. Unlike old, relatively small open pit mines, today's mines are built to provide optimal and continual ore exploitation, which means they occupy vast land areas due to growing needs for fuels and the development of mining

techniques and technologies (*Resulovi et al*, 2008). The main goal of recultivation is not to achieve the condition similar to a pre-exploitation one but to revalorize the soil, meet the needs of local people and satisfy natural conditions. Biological recultivation includes a set of biotechnological, agro-technical, ameliorative and other practices for restoring fertility to damaged soils, disturbed ecosystems and landscapes (*Spasi et al*, 2005). Biological practises are applied in the last phase of recultivation. To speed up the recultivation process, it is necessary to apply large amounts of organic and mineral matter and therefore compensate for the lack of nutritional elements, especially nitrogen and phosphorus (*Draži ,* 2011). The selection of plants for recultivation depends on many factors. Some of them are soil degradation level, and its pedological properties, climatic conditions, future use of land and agro-ecological requirements of a plant species. When it comes to soil recultivation, rye is a widely used plant species because of its modest environmental requirements. Rye is distinctive for modest water and land requirements and its tolerance to low temperatures(*Glamo lija et al,* 2010). This is the reason why rye is grown within the program of recultivation of open pit mines, which combined with new mining technologies provide optimal ore exploitation with a minimum adverse impact on the environment. Rye can be used in biological recultivation as a siderate (green fertilizer) and for grain production, using plant residues for humification.

Materials and methods

The research was conducted from 2009 to 2011 on the degraded soil (deposol) in the Stanari coalmine. A two-factorial trial was set up using randomized block design with four replicates. The size of the plot was 20 m^2 (5 x 4 m). Agro-chemical parameters of soil fertility of deposol were also analysed. The trials started with planting (during the first ten days of October) grains of Oktavija rye variety, selected at the Agricultural Institute in Banja Luka. The factor A included ameliorative practises applied on deposol before planting, such as: lime treatments combined with different rates of mineral fertilizers (200 and 400 kg ha^{-1} of NPK) and treatments with no lime application with 200 and 400 kg ha^{-1} of NPK. Lime of 85-90% Ca was applied. The factor B included 400 and 200 kg N ha^{-1} side dress (N$_{400}$ andN$_{200}$)and control (N$_0$)without applying side dress fertilizer. At the end of dormant period, single-pass side dressing was applied with 400 and 200 kg N ha^{-1}. In the stage of technological maturity, grain was manually harvested and yield was measured with a method of counting the number of grain per plant from a determined plot. After sampling, the biomass was mown, chopped and ploughed into the surface layer of deposol. The data were analysed with the statistical package STATISTICA 8 for Windows (StatSoft).

Results and discussion

The agrochemical analysis showed (Table 1) high acidity of the soil from the trial plot, pH in nKCl 4.6.*Veselinovi* (1995), *Resulovi et al* (1999) and *Mali et al* (2011) pointed out that the acidity of deposols was higher in the Stanari than in Kolubara mining area, but lower than in the Majdanpek mining area. The soil had a very low percentage of organic matter and humus and no nitrogen salts in the surface layer. For its content of easily available phosphorus and potassium, it is classified in a category of very low availability. According to many authors, most technogenic soils contain very few nutritive elements (NPK) and organic matter and therefore have weak biological activities in their surface and deeper levels (table 1).

Table 1. Agro-chemical properties of soil fertility of deposols

Values	pH		Organic matter (%)	Humus (%)	N (%)	Easily available forms	
	N_2O	KCl				P_2O_5 mg/100g	K_2O mg/100g
	5.8	4.6	1.6	0.01	0.0	0.38	1.94

The results of average rye yields for the tested periods are shown in the Table 2 and Table 3. Rye yields mostly depend on nitrogen rates and pre-planting ameliorative practises applied.

Table 2. Average rye yield in the vegetation period 2009/10 (tha^{-1})

Lime application + starter (factor A)	Yield compared to the yield with nitrogen side dressing applied (factor B)			$\bar{X}_{(A)}$
	N_{400}	N_{200}	N_0	
5 t/ha CaCO$_3$+200 kgha^{-1} NPK 15:15:15 ($N_{30}P_{30}K_{30}$)	2.30	1.10	1.00	1.46
5 t/ha CaCO$_3$+400 kgha^{-1} NPK 15:15:15 ($N_{60}P_{60}K_{60}$)	2.39	1.05	0.50	1.31
200 kgha^{-1} NPK 15:15:15 ($N_{30}P_{30}K_{30}$)	1.35	1.60	0.60	1.18
400 kgha^{-1} NPK 15:15:15 ($N_{60}P_{60}K_{60}$)	1.53	0.95	0.20	0.89
$\bar{X}_{(B)}$	1.89	1.17	0.57	-
Basic factors:		B	B	
Analysis of variance – F$_{calculated}$	12.00**	11.86**	2.90**	
LSD	0.05	0.35	0.57	0.32
	0.01	0.65	0.58	0.46

N_0- control; N_{200}- 200 kg N ha-1side dress; N_{400}- 400 kg N ha-1side dress

Applied nitrogen rates had a significant effect on the increase in rye grain yields. The lime application affected the nitrogen side dressing both directly and indirectly, as well as the change in pH, which has a very important role in many soil processes and crop nutrition. Deposols are soils of very acid to medium acid reactions. To mitigate negative effects on an ecosystem, the recultivation process should be speeded up. Thus *Zhelceva-Bogdanova* (1995) pointed out that use of mineral fertilizers and sideration are the best way for improving chemical properties in the recultivation process.

Table 3. Average rye yield in the vegetation period2010/11 (tha^{-1})

Lime application + starter (factor A)	Yield compared to the yield with nitrogen side dressing applied (factor B)			$\bar{X}_{(A)}$
	N_{400}	N_{200}	N_0	
5 t/ha CaCO$_3$+200 kgha^{-1} NPK 15:15:15 ($N_{30}P_{30}K_{30}$)	2.56	1.55	1.04	1.72
5 t/ha CaCO$_3$+400 kgha^{-1} NPK 15:15:15 ($N_{60}P_{60}K_{60}$)	2.59	1.25	0.63	1.49
200 kgha^{-1} NPK 15:15:15 ($N_{30}P_{30}K_{30}$)	1.85	1.60	0.75	1.40
400 kgha^{-1} NPK 15:15:15 ($N_{60}P_{60}K_{60}$)	1.83	1.01	0.35	1.06
$\bar{X}_{(B)}$	2.20	1.35	0.69	-
Basic factors:		B	B	
Analysis of variance – F$_{calculated}$	12.40**	12.98**	3.24**	
LSD	0.05	0.49	0.77	0.44
	0.01	0.83	1.78	0.66

N_0- control; N_{200}- 200 kg N ha-1side dress; N_{400}- 400 kg N ha-1side dress

The highest rye yield(2.30-2.59 tha^{-1}) was achieved with pre-planting lime application combined with mineral fertilizers of 200 and 400 kgha^{-1} ofNPK and 400 kg N ha^{-1} side dress in both years of research. There was a significant difference in rye grain yields between the treatment with lime application and the ones without it. When it comes to the treatments in which mineral fertilizers were used without prior lime application, the yield ranged 0.95-1.85

tha[-1]. In both years the highest yield (1.85 tha [-1]) was achieved in the fertilization variant with 400 kg N ha^{-1}, and the lowest in the control. However, having in mind also economic efficiency of using different rates of mineral fertilizers in treatments without lime application, it is better to use 200 kgha[-1] of NPK and 200 kg N ha^{-1} side dress.

The comparison of the rye yields showed that higher yields had been obtained in the second year of the research, which makes sense because nitrogen fertilizers had a favourable effect on increasing the content of mineral matter in soil and consequently on higher yields. According to the results shown by *Bolinder et al*. (2002), ground biomass and roots of perennial papilionaceaes significantly improve physical and chemical properties of degraded soils. *Hadži et al* (2001) and *Draži* (2011) found that using higher rates of organic matter and mineral fertilizers (especially nitrogen and potassium) had a favourable effect on recultivation processes. Genetic potentials of this particular rye variety are much higher (*Mandi and urašinovi* , 2009), thus even better results could be expected from quality recultivation of deposols and using proper agro-technical practises.

Conclusion

Growing rye on technogenic soils gives good results, mostly because of its superiority, resistance, adaptability, and productivity. Significant differences in rye yields have been noted between the treatments with lime application and treatments without it. Those differences show statistical significance. The highest rye yields ranged 2.30-2.59 tha[-1] were obtained during both years of research on ameliorated deposol using pre-planting lime application combined with 200 and 400 kg ha^{-1} of NPK mineral fertilizers and 400 kg N ha^{-1} side dress. The treatments without pre-planting lime application yielded 0.95-1.85 kgha[-1]. Considering economic efficiency, it is recommended to use 200 kgha[-1] of NPK and 200 kg N ha^{-1} side dress. The process of deposol recultivation should be speeded up to diminish its negative effects. One of the best methods to improve chemical properties in the recultivation process is to use mineral fertilizers. The organic matter in deposols in Stanari is still one of the biggest issues, so future research should be focused on increasing organic matter in the surface layer of deposols and forming a more favourable adsorption complex.

Acknowledgment

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FORAGE YIELD OF RED CLOVER GROWN FOR COMBINED FORAGE AND SEED PRODUCTION

Vladeta STEVOVIC[1], Dalibor TOMIC[1*], Dragan DJUROVIC[1], Nikola BOKAN[1], Rade STANISAVLJEVIC[2], Djordje LAZAREVIC[1]

[1]University of Kragujevac, Faculty of Agronomy, Cacak, Serbia
[2]Institute of Forage Crops Krusevac, Krusevac, Serbia
(Corresponding author: dalibor@tfc.kg.ac.rs)

Abstract

The impact of precipitation on forage yield, hay yield and water content in the green forage of red clover *(Trifolium pratense* L.*)* was examined in field trials. The crop was grown for combined forage and seed production. The experiment was established on alluvium soil in a randomized block design. During period 2010-2012 four red clover cultivars (K-39, K-17, Una, and Viola) were analyzed for first cut in their second year. Significant differences between cultivars were observed for green forage yield, hay yield, and water content in the green forage, regardless of precipitation in the production year. It was determined that the green forage yield in 2010 was significantly higher compared to 2011 and 2012. year. Thereby the hay yield had no significant difference concerning 2010 and 2011. year, while significant reduction was reported in 2012. year. Green forage yield was positively correlated with both hay yield and the water content of green forage.

Key words:*red clover, forage yield, hay yield.*

Introduction

In order to increase and intensify livestock production, the solution should be searched in highly producive plant species, with good quality, which fit in the system of continuous production of livestock feed (green forage conveyor) (Peji et al., 2005). Together with efforts to reduce energy consumption and environmental pollution, intensify sustainable agricultural systems and conserve biodiversityRochon et al. (2003) proposed increases in forage legume acreage. Being nitrogen fixers, these plants are minimally treated with nitrogen fertilizers, whose residues easily leach from the soil, causing contamination of ground waters, local streams and ponds (Janzen and McGinn, 1991). One such plant is red clover *(Trifolium pratense* L.*)* which due to its high stable yields, varied use, relatively modest growing requirements and good forage quality plays an important part in the production of protein-rich livestock feed.As a perennial legume, red clover has a high ability to regenerate; therefore, depending on growing conditions, it can produce up to even three cuttings per year. Under natural water supply conditions, with adequate cultural practices used, green forage yields of up to 147.7 t ha^{-1} can be achieved during the utilization period (mostly three years) (Vasiljevi et al., 2010). Rochon et al. (2003) point out the advantages of the legume green forage usage which reflect in high protein content, high digestability and low level of tannins and flavonoids.However, green forage yields of red clover vary widely depending on weather conditions, most notably the amount and distribution of rainfall during the year. For these reasons, in order to obtain high and stabile yields of red clover and utilize its genetic potential of cropping, the possibilities of its production in different agroecological conditions must be known. Beside that, the red clover seed production in the Republic of Serbia is insufficient to ensure the needs of the local market

(Bara et al., 2011). In the Republic of Serbia, the combined production of red clover for both forage and seed has proved to be the most cost-effective production method (Lugi et al., 1996), with the first and second cuttings in the second year stand being used to produce forage and seed, respectively (Duroni, 2010).This manner of production involves harvesting the first-cut material at the stage of budding or at the beginning of flowering.

The objective of this study was to determine green forage yield, dry matter yield, water content of green forage as well as their interdependence, in the combined forage-and-seed production of red clover cultivars in years with different rainfall amounts.

Materials and methods

The experiment was established in 2009, 2010 and 2011in a ak(43°54'39.06" N, 20°19'10.21" E, 246m a.s.l.), on alluvial soil, acid reaction (pH 4.8), which contains 3.18% organic matter, 0% $CaCO_3$, 22.08 mg P_2O_5, 30.0 mg K_2O 100 g^{-1} soil. Along with tillage, 300 kg ha^{-1} $N_{15}P_{15}K_{15}$ was incorporated into the soil. The experiment wasset up ina completelyrandomized block design withfour replications, with a plot size of $5m^2$(5x1m). Red clover cultivars, including K-17, K-39 (Institute of Forage Crops Krusevac), Una (Institute of Field and Vegetable Crops Novi Sad) and Viola (a Polish cultivar) were planted at a 20cm row spacing, at a rate of 18 kg seed ha^{-1}. Mechanical weed control was performed on two occasions. The crop was grown without irrigation. The test cultivars werecutat the sametime(budding phase), on May 13, 2010, May 14, 2011 and May 19, 2012.

The rainfall amount for the prevegetation period and the begining of vegetation before the first cutting, November 2010 – May 2011, was 284.6 mm, and for the period November 2011 – May 2012, 286.5 mm, which is 174.7 mm and 172.8 mm less than the same period in 2009-2010. year, respectively.

Table 1.The amount anddistribution of rainfallby month(P) and mean monthly temperatures (T) for the period 2009 – 2012.

Month		I	II	III	VI	V	VI	VII	VIII	XI	X	XI	XII	$\bar{x}$ i$\sum$
2009	P (mm)	50	32	42.5	12.5	43	98.4	41.0	35.5	30	91.5	**72**	**97**	645.4
	T (°C)	0.7	2.6	8.1	14.8	20.2	21.4	24	24.7	19.2	11.6	8.7	3.7	13.3083
2010	P (mm)	**33**	**52**	**54.5**	**52**	**98.8**	81	90.0	28.5	25	63	**54.6**	**37**	669.4
	T (°C)	0.9	3.0	7.9	13.3	17.9	21.3	23.5	23.7	17.3	10	10.3	1.8	12.575
2011	P (mm)	**22**	**29**	**31**	**15.5**	**95.5**	47	30.5	9.5	42	21	**2.5**	**29**	374.5
	T (°C)	0.7	0.7	7.6	13.1	16.7	22	23.8	23.7	21.6	11.8	3.7	3	12.366
2012	P (mm)	**60**	**70**	**10**	**47**	**68**	38	22	0	-	-	-	-	-
	T (°C)	1.8	2.5	6.8	12.2	17.3	24.1	26.6	25.4	-	-	-	-	-

First-cut green forage (GF) yield in the second year of cultivation was determined by measuring the total weight of the plot immediately after cutting and recalculated to GF yield in t ha^{-1}. After drying at 65 ° C, the measured sample (500g) was used to calculate hay yield (t ha^{-1}) and the water content of the green forage.

The results were subjected to a single-factor analysis of variance (ANOVA) using the SPSS 4.5 software. Significant differences between mean values were tested by the LSD test. The interdependence of green forage yield, hay yield and water content in the green forage was evaluated by calculating the simple correlation coefficient.

Results and discussion

The highest yield of red clover green forage in combined forage and seed production was reported in year of the highest amount of rainfall (2010) (Tab 2.). With the significant reduction of rainfall amount during the prevegetation period and start of vegetation before the

first cutting, it also came to the significant reduction of green forage yield (2011 and 2012). As a confirmation of this report Hanson (1991) observed a reduction in alfalfa forage yield at inadequate soil moisture.Bošnjak (1993) reported an average 56-61% increase in green forage yield of alfalfa in dry years under irrigated conditions, with the effect of irrigation early in the season being somewhat more modest.

Table 2. Green forage yield (GFY) hay yield (HY) and water content of green forage (WGF) at the time of cutting in red clover cultivars in 2010-2012.

		GFY (t ha^{-1})	HY (t ha^{-1})	WGF (%)
Year	2010	48.8 a	7.19 a	85.29 a
	2011	39.9 b	7.62 a	80.85 b
	2012	19.1 c	4,07 b	78.73 c
Cultivar	K-39	33.7 bc	5.94 b	81.31b
	K-17	38.3 ab	6.40 b	82.44a
	UNA	39.6 a	7.18 a	81.09 b
	VIOLA	32.2 c	5.65 b	81.65 b
2010	K-39	48.0 ab	6.91 b	85.53 a
	K-17	52.5 a	7.58 ab	85.74 a
	UNA	52.3 a	8.00 ab	84.67 a
	VIOLA	42.5 abc	6.27 bc	85.20 a
2011	K-39	34.6 c	7.01 b	79.75 cd
	K-17	40.5 bc	7.00 b	82.77 b
	UNA	46.3 ab	9.24 a	79.95 cd
	VIOLA	38.0 bc	7.22 b	80.95 c
2012	K-39	18.4 d	3.92 d	78.65 d
	K-17	21.8 d	4.62 cd	78.8 d
	UNA	20.2 d	4.31 d	78.65 d
	VIOLA	16.2 d	3.45 d	78.80 d
LSD	Year (A)	*	*	*
	Cultivar (B)	*	*	*
	AxB	*	*	*

The values denoted with different small letters within columns are significantly different at (P<0.05) in accordance with the LSD test
* - F test significant at p<0.05; ns - F test non-significant.

Cultivar Una, regardless of year and rainfall, had a significantly higher GF yield (39,6 t ha^{-1}) as compared to cv. K-39 (33.7 t ha^{-1}) and cv. Viola (32,2 t ha^{-1}). Cv. Viola also had lower green forage yield as compared to cv. K-17. Vasiljevi et al. (2010) report differences in the first-cut green forage yield of red clover in its second year, ranging from 22.4 t ha^{-1} (Nike) to 40.0 t ha^{-1} (Una).The same authors obtained significantly lower forage yields in foreign cultivars and observed intense thinning in their stands until the end of the growing season in the second year, as compared to domestic cultivars.According to Radovi et al. (2004), red clover cultivars show better performance under the agroecological conditions in which they were selected. The same authors highlight the advantage of local red clover cultivars over foreign cultivars due to their better adaptation to the existing agroecological conditions. The interaction between year and cultivar reveals that cv. Una had higher yield as compared to cv. K-39 only in 2011. It indicates that cv. Una had the most favourable reaction in soil moisture deficiency.

Regardless of the differences in green forage yield, the different rainfall amount between years didn't significantly affect hay yield in 2010 and 2011 at any of the cultivars, while significant fall in hay yield was reported within all of the cultivars in 2012. This is caused by the fact that higher amount of rainfall influenced on a significant increase of water proportion in the fodder at the time of cutting within all of the cultivars in 2010. Additionally, expressed

lack of rainfall in the second part of vegetation period in 2011 and very low temperatures in february 2012 affected on bad preparedness of the plants, which led to the significant yield reduction in 2012. Cv. Una also had the highest hay yield, significantly higher as compared to the other cultivars. That is subsequence of its somewhat higher hay yield during 2011 (significancy of year/cultivar interaction).

Significantly higher water content of the forage at the time of cutting was reported at cv. K-37 as compared to the others in 2011 (year/cultivar interaction). Concerning that all of the cultivars were cut at the same time, this can be caused by slow growth of cultivar K-37. Seguinetal. (2002) report that soil moisture deficiency induced changes in the dry matter quality ofred clover, including an increasing content of acid detergent fiber (ADF) and neutral detergent insoluble protein,but decreasing content of acid detergent lignin (ADL) and reduced dry matter digestibility.

Table 3. Coefficients of correlation between green forage yield (GFY),
hay yield (HY) and water content of green forage (WGF)

	HY	WGF
GFY	0.91*	0.72*
HY		0.38*

* - Significant at $p < 0.05$

Green forage yield was positively correlated with hay yield (r=0.91), as well as with the water content in the green forage (r=0.72) (Tab. 3.). Hay yield was also positively correlated with water content in the green forage. According to Duncan and Woodmansee (1975), the correlation between rainfall amounts and green forage yield of grasses and legumes was significant at the stage of their intensive growth, which was accompanied with soil moisture deficiency. Bošnjak et al. (1995) observed complete correlation (r = 0.99) between GF yield and annual rainfall in alfalfa.

Conclusions

The highest green forage yield of red clover in combined production of fodder and seed was reported in year with the highest rainfall (2010). With the significant reduction of rainfall amount during the prevegetation period and start of vegetation till the first cutting (2011 and 2012), it also came to the significant reduction of green forage yield and water content in green forage. Additionally, expressed lack of rainfall during the second part of vegetation period in 2011, and very low temperatures in 2012 affected on bad preparedness of the plants, which led to the significant yield reduction in 2012.

Regardless on rainfall amount (years), there were significant differences between the cultivars in green forage yield, hay yield and also in water proportion in green forage. The highest green forage and hay yield obtained cv. Una, while the highest water content at the cutting had cv. K-17. This is mainly consenquence of their deviation from the other cultivars in 2011 which tells that cv. Una had acted more favourably on the conditions of lower rainfall. It further indicates that their different reaction on the different levels of soil water supply should be taken in consideration when choosing cultivars in certain agroecological conditions. Green forage yield positively corelated with hay yield and also with water content in green forage.

Acknowledgements

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EFFECT OF GENOTYPE AND ENVIRONMENT ON SPRING BARLEY AND OATS QUALITY

Vera DJEKIC[1*], Mirjana STALETIC[1],Jelena MILIVOJEVIC[1], Vera POPOVIC[2], Snezana BRANKOVIC[3]

[1] Small Grains Research Centre, Kragujevac, Serbia,
[2] Institute of Field and Vegetable Crops, Novi Sad, Serbia
[3] University of Kragujevac, Faculty of Science, Institute of Biology and Ecology, Kragujevac, Serbia
(Corresponding author: verarajicic@yahoo.com)

Abstract

The investigation was carried out on the experimental field of Small Grains Research Center, Kragujevac. This paper presents the results of Kragujevac cultivars of spring barley (Jadran and Dinarac) and spring varieties oats (Slavuj, Lovcen and Vranac). Grain yield, 1000 kernel weight and test weightin grain two cultivars of barley and three cultivars of oats was determined in a three-year field experiment.

Average grain yield of barley cultivars ranged from 1.925 t/ha to 5.667 t/ha, as well the oat cultivars ranged from 2.140 t/ha to 4.518 t/ha. Grain yield differed significantly between years and the average of all cultivars was higher in 2009. compared to 2010. and 2011. Average values of 1000 grain weight of barley cultivars varied in the range from 40.20 to 45.40 g, as well of oat cultivars varied of 25.58 to 30.90 g. Based on obtained data from variance, it could be concluded that there are very significant differences in grain yield regarding the year of investigation, while among the investigated barley cultivars the differences were not significant. Significant differences in 1000 grain weight at investigated oats cultivars were found relative to the cultivar and very significant differences at yield and grain test weight relative to environmental factors, respectively the year of investigation.

Key words: *barley, grain yield, oat, 1000 grain weight*

Introduction

Grain quality is a qualitative characteristic affected by genetic and environmental factors, as well as their interactions, and therefore the cultivar in individual years can acts as a beer or forage cultivar, what can be test determined and that way the grain can be direct for a particular purpose.

Barley is is used as an important component of beer and malt production, important and quality component in animal feeding, partially in human nutrition as well as a component in processing industry (Djekic et al., 2012.a). In pigs' diet barley can be used without any limitation as the only or primary source of energy. As a top-quality forage crop plant, barley is used as fodder unit in meals balancing in animal feed (Djekic et al., 2010).

Creation of genotypes with high yield potential, expressed through the yield components in appropriate environmental conditions, which in some of the new varieties successfully combined with good technological quality and high tolerance to drought represent barley production improvement (Malesevic et al., 2010). Agronomic cultivar value depends not only on its genetic potential for yield, but also on its ability to achieve genetic potential under different conditions of production (Mladenovic et al., 2009). Yield is largely dependent on the genetic potential, which could be defined as yield of variety which was grown in conditions

on which it had been adapted, with adequately amounts of water and nutrients and efficient control of pests, diseases, weeds and other stresses (Djekic et al., 2011). Yields considerably vary primarily as a result of agro-ecological conditions during the growing season (Djekic et al., 2010).

Barley cultivars which were in production until the end of the eighties were characterized by the lower yields, good technological quality and higher stem sensitive on lodging. Lower resistance on lodging, these cultivars were grown at modest soils and therefore they had lower yields due to. New varieties are characterized by good technological quality, better resistance on lodging and diseases, shorter stem and more efficient assimilates usage (Przulj et al., 2004). Malting barley is expected to have 1000 grain weight of 40 and 46 g and test weight of 68 to 75 kg/hl (Paunovic et al., 2006).

The oat is very important small grains cereal by many aspects. Its seed and straw have specific chemical quality. The seed is rich by qualitative and soluble protein, oil and vitamins.However, the oat is desirable as in rehabilitate diet however in childrenand older one, too. The oat grain is used in food, cosmetic and other industries for getting so plenty products (Nikolic et al., 2004). The most the widest oat using is in feeding, of course, addition its grain and straw in feeding of horses, cows, hens contribute to getting more qualitative animal origin products (Djekic et al., 2012.b).

The aim of this study was determination of the cultivars and ecological environmental which influence on affect diffferences in stability and adaptability of cultivars regard the grain yield, 1000 grains weight and test weight of tested spring barley and oats cultivars, as well as specificity cultivars exploring regard growing seasons conditions.

Materials and methods

Materials and field trials

Two cultivars of spring barley (Jadran and Dinarac) and three cultivars of spring oat (Slavuj, Lov en i Vranac)were investigated cultivated in the Center for Small Grains in Kragujevac during 2009, 2010 and 2011 growing seasons. Experiments have been conducted in randomized block systems, with a plot size of 10 m^2 (2 m x 5 m) in two replicates. The usual techniques for barley and oat production were applied, and it was done in the optimum sowing time. 250 kg/ha of fertilizer NPK 15:15:15 was added in the fall on the investigated plots, while during the spring fertilization, 250 kg/ha (KAN) was supplemented. The following properties were analyzed: grain yield (t/ha), 1000 grain weight (g) and test weight (kg/hl).

On the basis of achieved research results the usual variational statistical indicators were calculated: average values, error of the mean (arithmetic) and standard deviation. Statistical analysis was made in the module Analyst Program SAS/STAT (SAS Institute, 2000.).

Soil and weather conditions

Before the commencement of the experiment soil samples were taken from the sample surface and the chemical analysis of soil was performed. Accordin to obtained results it was revealed that the soil belongs to the smonitza type, with relatively high clay content, and unfavorable physical properties. The humus content in the surface layer of soil was low (2.15-2.85%), and a substitution and total hydrolytic acidity were quite high (pH H$_2$O=5.35-6.20, KCl=4.25-5.15). The soil was medium provided with total nitrogen (0,11-0,13% N) and easily accessible potassium (11-15 mg/100 g soil K$_2$O), while the available phosphorus content was low (under 10 mg/100 g of soil P$_2$O$_5$).

Table 1.Middle monthly air temperature (^{0}C) and precipitation amount (mm), Kragujevac

Interval	Months						Average
	III	IV	V	VI	VII	VIII	
Average	Mean monthly air temperature (^{o}C)						
2009	6.8	13.4	17.8	20.2	22.5	22.3	17.17
2010	7.2	12.1	16.5	20.2	23.1	22.1	16.87
2011	7.2	12.0	15.8	20.9	22.8	22.9	16.93
1980-2004	6.1	11.6	16.7	19.8	22.2	21.1	16.25
Average	The amount of rainfall (mm)						
2009	40.3	16.8	46.0	137.8	25.2	56.2	322.3
2010	43.3	142.2	116.7	196.7	14.8	59.6	573.3
2011	20.4	20.8	65.8	32.3	62.4	27.1	228.8
1980-2004	56.3	67.8	51.8	68.3	59.6	94.2	398.0

The area of Kragujevac characterized by moderate continental climate, which general feature is uneven distribution of rainfall by month. The data in Table 1 for the investigated period (2009-2011) clearly indicate that the years in which the researches were conducted differed from the typical multi-year average of Kragujevac region regard the meteorological conditions. The average air temperature in 2009, 2010 and 2011 years, increase 0.92°C, 0.62°and 0.68°C, respectively in the 2010 years more research to 175.3 mm and 75.7-169.2 mm lower than the average of 2009 and 2011 years and with a very uneven distribution of precipitation per month. Spring months April, May and June 2010 were with overly precipitation, which affected unfavorable on the crops. During the April in 2010 it was 142.2 mm of rainfall, what was 74.4 mm more compared with the perennial average. In May of 2010 it was 116.7 mm of rainfall, what was 64.9 mm more compared with the perennial average. In June of 2010 the amount of rainfallwas 128.4 mm higher compared to the average precipitation, while during 2011 it was lower by 36.0 mm compared to the perennial average. In the secondyear 2010 recorded large amounts of precipitation in April, May and June, leading to crop lodging and lower grain yield compared to the second year of research.

Results and discussion

Average values of yield (t/ha), 1000 grain weight (g) and test weight (kg/hl) of investigated Kragujevac's spring barley and oat cultivars grown at the Center for Small Grains in Kragujevac during three growing seasons, 2009, 2010 and 2011 years, presented in the Table 2.
Barley and oat yields have varied considerably in the 2009-2011 period. All genotypes had statistically significantly higher yields in 2009 compared to 2010 and 2011. Average grains yield observed in the of 2009 and 2010 years was the highest at Dinarac variety (5.667 t/ha and 2.037 t/ha).During the first year of investigations, cultivar of oats Lov en achieved the highest grains yield (4.518 t/ha), followed by Slavuj (4.481 t/ha), while the lowest yield was at Vranac cultivar (3.383 t/ha). During the second year of investigations (2010), the yield of Lov en cultivar was the highest with 2.592 t/ha, while the slightly lower yield was realized by Slavuj cultivar (2.333 t/ha). Vranac cultivar achieved significantly lower yields (2.140 t/ha). Achieved yields on tested varieties of barley in 2011 year were not significantly different. Average grains yield of barley observed in the three-year period was the highest at Dinarac variety (3.421 t/ha).The average yield for all investigated varieties oats was 3.143 t/ha, and varied from 2.977 t/ha (Vranac) to 3.293 t/ha (Slavuj). According Paunovic et al. (2006), Jelic et al. (2007) and Djekic et al., (2011) considerable variation on yield depending on years were established.

Table 2. Average values of investigated barley and oats cultivars characteristics

Spring barley	Grain yield, (t/ha)			
Cultivars	2009	2010	2011	Average
Jadran	5.148	1.925	2.571	3.215
Dinarac	5.667	2.037	2.560	3.421
Average	5.407	1.981	2.565	3.318
	1000 grain weight, (g)			
Jadran	41.70	42.60	45.40	43.23
Dinarac	40.20	42.30	43.20	41.90
Average	40.95	42.45	44.30	42.56
	Test weight, (kg/hl)			
Jadran	61.40	59.86	56.60	59.29
Dinarac	57.30	58.87	58.20	58.12
Average	59.35	59.36	57.40	58.70
Spring oats	Grain yield, (t/ha)			
Slavuj	4.481	2.333	3.036	3.283
Lovcen	4.518	2.592	2.393	3.168
Vranac	3.383	2.140	3.409	2.977
Average	4.127	2.355	2.946	3.143
	1000 grain weight, (g)			
Slavuj	29.52	25.58	28.14	27.75
Lovcen	30.72	27.08	26.90	28.23
Vranac	30.90	27.27	28.85	29.01
Average	30.38	26.64	27.96	28.33
	Test weight, (kg/hl)			
Slavuj	47.15	45.45	46.25	46.28
Lovcen	46.95	43.90	44.80	45.22
Vranac	47.85	46.00	46.30	46.72
Average	47.32	45.12	45.78	46.07

Statistically significantly higher yields in 2009 primarily were achieved because of the result of heavy rainfalls and their good distribution as well as favorable air temperatures during the vegetation period (Tab. 1). Djekic et al. (2012.a) in his research states that the air temperatures and the rainfall amount and distribution during the barley growing season have the greatest impact on high yields and grain quality. Yield is largely dependent on the genetic potential, which could be defined as yield of variety which was grown in conditions on which it had been adapted, with adequately amounts of water and nutrients and efficient control of pests, diseases, weeds and other stresses (Popovic et al. (2011).

Average 1000 grain weight observed in the period 2009, 2010 and 2011 years was the highest at barley Jadran variety. During the 2009, 2010 and 2011 years of investigation, Vranac cultivar achieved the highest average 1000 grain weight (30.90 g; 27.27 g and 28.85 g) compared with other tested oats cultivars.During the three-year period was of investigation the lowest average value of 1000 grain weight achieved the barley Dinarac cultivar (41.90 g), and oats by Slavujcultivar (27.75 g).

The highest test weight, 2009 and 2010, was achieved barley Jadran cultivar (61.40 kg/ha and 59.86 kg/ha). The oat cultivar Vranac has achieved the highest test weight in three years of investigation compared to other tested oat cultivars (47.85 kg/hl; 46.00 kg/hl and 46.30 kg/hl).The average three-year value of test weight at barley Jadran cultivar was 59.29 kg/hl, while the highest average three-year value was at oats Vranac cultivar (46.72 kg/hl).

Grain of investigated barley and oats cultivars was characterized by good physical characteristics; especially regard the test weight and 1000 grain weight. Realized average values of these characteristics in the study were slightly higher than the values obtained by Nikoli et al. (2004) and Djekic et al. (2011).

Table 3 Analysis of variance of the traits of spring barley and oats

	F_{exp}		F_{exp}	
	Cultivar	Year	Cultivar	Year
Parameter	Spring barley		Spring oats	
Grain yield, (t/ha)	0.019	142.962[**]	0.069	10.020[**]
1000 grain weight (g)	0.875	4.706	0.304	13.500[*]
Test weight (kg/hl)	0.613	0.753	1.288	5.365[**]

Based on the analysis of variance, it can be concluded that there are very significant differences in grain yield regard the year of investigation (F_{exp}=142.962[**]-barley and F_{exp}=10.020[**]-oats), while among the investigated barley and oats cultivars the differences were not significant. Significant differences in 1000 grain weight at investigated oats cultivars were found relative to the year and very significant differences at grain test weight relative to environmental factors, respectively the year of investigation. Our results are consistent with the results of Djekic et al. (2010), where the authors state that the growing conditions in the observed years had a significant impact on yield.

Conclusion

Based on the gain results during three-year investigation on four Kragujevac's two cultivars of spring barley and three cultivars of spring oat, it can be concluded that the highest yield achieved the barley Dinarac cultivar 3.421 t/ha, and spring oata Slavuj cultivar 3,283 t/ha.During 2009, statistically significantly higher grain yield per area unit as well as was achieved, compared with 2010 and 2011.Average values of 1000 grain weight of barley cultivars varied in the range from 40.20 to 45.40 g, during of oat cultivars varied of 25.58 to 30.90 g.Highly significant affect of the year on grain yields was established at investigated sping barley and oats cultivars by variance analysis. Significant differences in 1000 grain weight at investigated oats cultivars were found relative to the cultivar and very significant differences at grain test weight relative to environmental factors.

Acknowledgements

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MICROBIAL ABUNDANCE IN THE RHIZOSPHERE OF MAIZE AND SOYBEAN: CONVENTIONAL AND ORGANIC SYSTEM PRODUCTION

Nastasija MRKOVACKI[*], Ivica DJALOVIC, Jelena MARINKOVIC, Janko CERVENSKI, Biljana NAJVIRT

Institute of Field and Vegetable Crops, Novi Sad, Serbia
(Corresponding author: nastasija.mrkovacki@nsseme.com)

Abstract

Soil micro-organisms and the processes that they govern are essential for long–term sustainability of agricultural systems and a major component in soil formation and nutrient cycling. Microbial processes are important in organic farming system because a lot of organic matters are used in organic systems. Soil active microbial communities are vital in synchronizing nutrient release from organic matter and nutrient demands for plant growth in organic farming system. Soil microbial activities, populations and communities are governed by environmental variables and agricultural system, as conventional and organic system.

The objective of this study was to compare the effects of conventional and organic system production on microbial number in the rhizosphere of maize and soybean crops. Soil samples were collected from plots under conventional management (CNV) and organic management (ORG) in June, 2012. Soil microbial abundance was significantly greater in ORG compared with CNV. The total number of microorganisms, number of amonifiers, azotobacter, free N_2 fixing microorganisms and fungi was higher in rhizosphere in organic production of maize then in rhizosphere of maize in conventional production. Similar results was obtained with number of microorganisms in rhizosphere of soybean in organic production in comparison with conventional. Beside the higher number of all examined groups of microorganisms, in rhizosphere of soybean, the higher number of cellulolytic actinomycetes was obtained, too. The number of nodules on root of soybean, in organic production, was 3 x higher than in conventional.

Key words: *microbial abundance, rhizosphere, maize, soybean, conventional, organic, production.*

Introduction

Soil micro-organisms and the processes that they govern are essential for long–term sustainability of agricultural systems and a major component in soil formation and nutrient cycling (Nannipieri et. al., 2003). Microbial processes are important for the management of farming system and improvement of soil quality. Soil microbial activities, populations and communities are governed by environmental variables and agricultural system, as conventional and organic system.

In recent years, multiple studies comparing conventional and organic agriculture have reported differences in soil chemical properties, higher microbial activity and diversity in organically managed soils, or distinct microbial profiles between the two systems (Shannon et al., 2002; Bending et al., 2004; Cardelli et al., 2004; Monokrousos et al., 2006; Wang et al., 2012a). More information is needed about soil microbial populations, particularly the role of microbial biodiversity in soil quality and productivity, to better interpret measurements of soil biological properties with respect to agricultural sustainability (Bastida et al., 2008).

The objective of this study was to compare the effects of conventional and organic system production on microbial abundance in the rhizosphere of maize and soybean crops.

Material and methods

The trial was set up on chernozem soil at the Ba ki Petrovac experiment field of the Institute of Field and Vegetable Crops**.** Soil samples of rhizosphere were collected under conventional management (CNV) and organic menagement (ORG) of maize and soybean. Samples for microbiological analyses were taken at two dates (1st June and18th July). Soil samples were analyzed by the serial-dilution method followed by plating on different selective mediums. Total number of microorganisms was determined on agarized soil extract (10^6) and number of ammonifiers on MPA medium (10^6) (Pochon and Tardeux, 1962). For Azotobacter is used method of fertile drops, on Fjodorov medium (10^2) (Anderson, 1965). The number of fungi was determined on Czapek-Dox medium and actinomycetes on a syntetic medium (10^4). The number of cellulolytic microorganisms was done on Waksman-Carey medium (10^5). Fjodorov medium was used for determination of N-fixing microorganisms (10^6). All microbiological analyses were performed in three replications and the average number of microorganisms was calculated at 1.0 g absolutely dry soil (Jarak and uri , 2004).

Results and discussion

The application of organic and inorganic treatments differently affected the rhizosphere microbial population. Analyzing the response of microorganisms to different cultural practices is important because soil microbiota respond quickly to environmental changes, so they are expected to be efficient bioindicators of soil conditions (Avidano et al., 2005).
On average, the number of microorganisms was higher in plot with maize than in plot with soybean (Tab. 1, Tab. 2). On both time of sampling the total number of microorganisms, number of amonifiers, azotobacter, free N-fixing microorganisms and fungi was higher in rhizosphere of maize in organic production than in rhizosphere in conventional. At second sampling date the number of actinomycetes and cellulolytic microorganisms was higher in organic practice in maize, too (Tab. 1).

Table 1. Number of microorganisms in rhizosphere of maize

Time of sampling		Total number x 10^7	Ammo -nifiers x 10^6	Azoto- bacter x 10^2	N- fixing x 10^6	Fungi x 10^4	Actino- mycetes x 10^4	Cellulo- lytic actinomycetes x 10^5	Cellulo- lytic bacteria x 10^5	Cellulo- lytic fungi x 10^5
I 1st June 2012.	OP	149,43	265,45	132,44	123,24	12,37	21,75	2,95	0,59	4,72
	CP	133,06	183,31	79,36	97,06	10,04	45,60	17,55	26,49	7,02
II 18th July 2012.	OP	270,19	175,98	84,62	384,47	6,89	41,8	7,42	25,71	6,31
	CP	174,76	92,33	52,11	133,92	13,12	30,69	4,99	8,89	3,37
Average	OP	209,81	220,72	108,53	253,86	9,63	31,78	5,19	13,15	5,52
	CP	153,91	137,82	65,74	115,49	11,58	38,15	11,27	17,69	5,2

OP – organic production
CP – conventional production

Similar results was obtained with number of microorganisms in rhizosphere of soybean in organic production in comparison with conventional. Beside the higher number of amonifiers, azotobacter and free living N-fixing microorganisms, in rhizosphere of soybean, the higher number of cellulolytic microorganisms and actinomycetes was obtained, too (Tab. 2).

Table 2. Number of microorganisms in rhizosphere of soybean

Time of sampling		Total number x 10^7	Ammo-nifiers x 10^6	Azoto-bacter x 10^2	N-fixing x 10^6	Fungi x 10^4	Actino-mycetes x 10^4	Cellulo-lytic actinomycetes x 10^5	Cellulo-lytic bacteria x 10^5	Cellulo-lytic fungi x 10^5
I 1st June 2012.	OP	203,47	102,07	214,05	233,40	12,21	20,31	18,60	8,67	1,17
	CP	185,78	42,56	163,50	155,39	6,82	21,29	8,49	13,24	9,16
II 18th July 2012.	OP	199,84	293,18	89,16	342	12,57	101,22	9,84	37,95	6,55
	CP	225,25	95,47	6,64	186,08	26,08	5,25	15,48	13,85	2,61
Average	OP	201,66	197,63	151,61	287,7	12,39	60,77	14,22	23,31	3,86
	CP	205,52	69,02	85,07	170,74	16,45	13,27	11,99	13,55	5,89

OP – organic production
CP – conventional production

In a long-term field trial in which organic and conventional agricultural systems were compared, microbial biomass was higher in soils from organic plots (Fraser et al., 1994; Hu et al., 1997; Tu et al., 2005).

Araujo et. al. (2008) concluded that the organic practices rapidly improved soil microbial characteristics and slowly increase soil organic C. Okur et al (2009) concluded that organic management positively affected microbial biomass and enzyme activity due to enhacements in organic matter content. Wang et. al. (2012a) obtained results that the abundance and diversity of N-fixing bacteria tended to increase with duration of organic management but the highest number of nifH gene copies was observed in the rhizosphere and bulk soil of 5 years organic management. Abundance and diversity of amonia oxidizing bacteria tended to increase with duration of organic management (Wang et al., 2011).

Contrary, Buyer and Kaufman (1996) in their work on population of bacteria and fungi isolated from the rhizosphere of maize grown under both conventional and alternative agricultural systems concluded that systems had very little effect on microbial diversity. Microorganisms can bee stimulated or inhibited or there may be no effect at all on the structure of the indigenos population in organic production (Dobbelaere et al., 2003).

For a better understanding of conventional and organic farming systems, therefore, needs comprehensive knowledge and monitoring of soil properties and microbes in soil under conventional and organic farming systems (Wang et al., 2012b).

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THE INFLUENCE OF WEATHER CONDITIONS AND NITROGEN FERTILIZATION ON SOME CHARACTERISTICS OF WINTER BARLEY

Dragana LALEVIC[*], Milan BIBERDZIC

[1]University of Pristina, Faculty of Agriculture Kosovska Mitrovica – Lesak, Serbia
(Corresponding author: dragana.lalevic@gmail.com)

Abstract

This study examined the impact of weather conditions and increasing doses of nitrogen fertilization on the productivity (yield) and quality characteristics of two varieties of winter barley (Grand and Record). The two-year trial (2005-2007) was set in a randomized block system in four replications, which included control and three different doses of nitrogen fertilization (0, 80, 100 and 120 kg ha^{-1}). The soil on which the experiment was performed was of alluvium type and the size of the experimental plot was 10 m². The research has determined the optimum amount of nitrogen to achieve maximum yield and grain quality of winter barley genotypes which were studied. The tests have shown that the highest grain yield and quality of winter barley varieties was achieved with fertilization variant of 80 kg ha^{-1} and the lowest in the control variant. Winter barley variety Grand, in both tested years, had a significantly higher grain yield (4.48 t ha^{-1}) compared to the other studied variety Record (3.58 t ha^{-1}). Variety Grand also had higher values of a 1000 grain mass and hectoliter mass compared with variety Record.
Meteorological conditions, in two tested years, had a great influence on the yield and quality. The lack of rain and extreme heat in the second year caused the abrupt termination of grain filling stages which led to a decline in yield and grain quality. The results of these studies would be valuable in terms of its growing as forage crop as well as in terms of its breeding for grain quality and productivity.

Key words: *winter barley, nitrogen, weather conditions, a 1000 grain mass, hectoliter mass.*

Introduction

Barley (*Hordeum sativum* L.) represents one of 40 species of the grass family *Hordeum* (*fam.Poaceae*). It is one of the oldest cultivated plants, and it has been known as a plant species for 10 000 years. Its importance is reflected in the remarkable plasticity and the possibility of growing in different environmental conditions as well as in its versatile use. According to Djuric et al (2009), in recent years, the production of barley in Serbia is done on the surface of 70-80 000 ha, with an average yield of about 3 to 3.5 t ha^{-1}. In our country barley is mostly used for livestock feed and beer production, rather than for human consumption.

Unlike other small grains, winter barley has higher requirements of growing technology, particularly with respect to nitrogen nutrition of the plant. Barley plants have shallower root system compared with other small grains, so they adopt less soluble substances from the soil poorly. If we take into account the sensitivity of barley genotypes expressed in increased rates of nitrogen fertilizer, mineral nutrition of barley must be adapted to the requirements of individual species (Peric, 1982; Jelic et al., 2002).

The aim of the research was to determine the possibilities of cultivation of winter barley in agro-ecological conditions of Montenegro, as well as the optimum amount of nitrogen in addition to provide high yield and good grain quality.

Material and method of work

Two varieties of winter barley (Grand and Record), created in the Center for Small Grains in Kragujevac, and three variants of nitrogen fertilization (80,100 and 120 kg ha^{-1}) were used as the material for this research. The tests were conducted in the north of Montenegro during two growing seasons (2005-2007). The trial was set in a randomized block system in four replications. The trial was conducted on alluvial soil and the size of experimental plot was 10 m^2. The technology common in the production of winter barley was used during the research. After manually performed harvest, in the stage of full maturity, hectoliter mass was measured as well as a 1000 grain mass and grain yield adjusted to 14% moisture.
The obtained results are given in average values, processed by the analyses of variance, and the significance was tested by the LSD test.

Results and discussion

Before the beginning of this study, the samples of the soil, on which the trial was conducted, were taken and their analyses was carried out. Based on the results, it was found that the soil has slightly acid reaction with total carbonate content of 5.62 to 5.63%,it is humus rich 3.98-4.35% and poor in available phosphorus (5.68-8.71 mg/100g soil) and potassium (4.47-3.71 mg/100g soil).

Table 1. Middle monthly air temperature and precipitation amount

Year	Month										Average
	X	XI	XII	I	II	III	IV	V	VI	VII	
Middle monthly air temperature (°C)											
2005-06	9.7	3.3	1.2	-2.6	0.4	4.2	11.1	14.6	16.8	19.0	7.77
2006-07	11.4	2.6	0.3	1.8	4.8	7.0	11.5	16.0	19.8	21.9	9.71
Precipitation amount (mm)											
2005-06	85.2	116.1	182.5	36.6	87.7	180.8	58.4	78.6	119	52.9	890.7
2006-07	39.5	74.6	182.5	92.9	45.8	104.7	15.7	60.8	76.9	23.9	717.3

Meteorological conditions i.e. temperature and precipitation are the main non-genetic factors that determine the success of cultivation of winter barley and other small grains. In the growing season 2005/06 there were 997.8mm of rainfall which is 280.5mm more than in the second year of the research, while the average air temperature was lower by 1.9°C. also, in October and November 2005/06 there were 201.3mm of rainfall, which is 87.2mm more than in the same period of 2006/07, while the average air temperature was lower for 1°C. From the above it can be concluded that the conditions for germination, emergence and development of plants in the first year were more favourable. The rainfall in December was the same. Significantly less rainfall during February, March, April and May in 2007, with higher air temperatures, caused the shortening of the period of grain filling and accelerated ripening, which has resulted in significantly lower yield compared to 2006.
A 1000 grain mass and hectoliter mass are important indicators of technological value of seeds. Such features are very important because they directly affect the yield.

Absolute grain mass

A 1000 grain mass is an indicator of coarseness i.e. grain size and it represents the relationship between weight and number of grains.

Both varieties included in the trial, in the first year had a 1000 grain mass which was significantly much higher compared to the second year of study. High air temperatures and low humidity in June and July in 2007 caused the shortening of the grain filling period compared to 2006. A 1000 grain mass is affected by growing conditions to a large extent as Przulj et al (1997) indicated.

In both tested genotypes, a 1000 grain mass was highest in the variant fertilized with 80 kg ha^{-1} in both years. Further increase of nitrogen has led to a reduction of values of absolute mass. Variety Record had the highest absolute mass (45.1g) when fertilized with 80kg ha^{-1} of nitrogen, and the same variety had the lowest absolute mass (35.9g) when fertilized with 120 kg ha^{-1} of nitrogen. Our results are in agreement with the results of Przulj and Momcilovic (2002) where a dose of 80 kg ha^{-1} of nitrogen is referred to as optimal from the point of seed size.

Table 2. Absolute mass of grains of winter barley (g)

Year (C)	Cultivar (A)		(B) Fertilization (kg ha^{-1})				
			0	80	100	120	Average
2006	Grand		39	43	41.7	40.5	41.05
	Rekord		37.9	45.1	44.8	43	42.7
AVERAGE			38.45	44.05	43.25	41.75	41.9
2007	Grand		36	44	43	40	40.75
	Rekord		34.5	42	41	35.9	38.35
AVERAGE			35.25	43	42	37.95	39.55
Two-year average			36.85	43.5	42.6	39.85	40.7
LSD	A	B	AB	C	AC	BC	ABC
0.05	0.106	0.463	0.654	0.106	0.654	0.926	1.309
0.01	0.142	0.618	0.874	0.142	0.874	1.236	1.748

Hectoliter mass

Hectoliter mass is also an important indicator of the technological value of seed. The obtained results are in agreement with literature data, which point out that beside the variety and nutrition, meteorological conditions show significant influence on hectoliter mass. It can be seen from the table, that both varieties, in both years, had the highest value of hectoliter mass when fertilized with 80 kg ha^{-1} of nitrogen. Variety Grand had the highest hectoliter mass (63.4 kg) when fertilized with 80 kg ha^{-1} of nitrogen, while variety Record had the lowest hectoliter mass (60 kg) when fertilized with 120 kg ha^{-1} of nitrogen, that is in accordance with the results (Thompson and Woodward, 1994) which show that nitrogen in higher quantities can adversely affect the quality of the grain. The data in the table indicate the great dependence of hectoliter mass of meteorological conditions in the years of study, since both varieties had significantly higher values of the tested feature compared to the second year. Przulj et al., (1997) emphasized in their work the significant influence of the year on the hectoliter mass.

Table 3. Hectoliter mass of winter barley (kg)

Year (C)	Cultivar (A)		(B) Fertilization (kg ha^{-1})				
			0	80	100	120	Average
2006	Grand		60.1	63.4	62.4	60.8	61.7
	Rekord		61.2	63.3	62.2	60.6	61.9
AVERAGE			60.65	63.35	62.3	60.7	61.8
2007	Grand		59.3	62.5	62	60.2	61
	Rekord		60.2	62.3	62	60	61.1
AVERAGE			59.75	62.4	62	60.1	61.1
Two-year average			60.2	62.9	62.15	60.4	61.45
LSD	A	B	AB	C	AC	BC	ABC
0.05	0.476	0.673	0.673	0.476	0.673	0.952	1.346
0.01	0.635	0.898	0.898	0.635	0.898	1.271	1.797

Grain yield

Grain yield is a complex feature of polygenic mode of inheritance. It is the resultant of the interaction of the variety, the applied agro-techniques and growing conditions throughout the entire life cycle.

Table 4. Grain yield of winter barley (kg ha^{-1})

Year (C)	Cultivar (A)		(B) Fertilization (kg ha^{-1})				
			0	80	100	120	Average
2006	Grand		4475	4937.5	4840	4252.5	4626.25
	Rekord		3425	4060	3922.5	3275	3670.6
AVERAGE			3950	4498.75	4381.25	3763.75	4148.4
2007	Grand		4200	4640	4550	3982.5	4343.12
	Rekord		3180	3950	3880	2930	3485
AVERAGE			3690	4295	4215	3456.25	3914.1
Two-year average			3820	4396.9	4298.12	3610	4031.25
LSD	A	B	AB	C	AC	BC	ABC
0.05	172.98	244.64	345.977	172.979	244.643	345.977	489.285
0.01	231.04	326.69	462.009	231.040	326.690	462.009	653.379

The data in the table show that the application of nitrogen in the supplementary feeding of barley showed a significant increase in grain yield compared to the control. Both tested genotypes had the highest yield when the smallest amount of nitrogen (80 kg ha^{-1}) was used in the supplemental nutrition, while further increase in nitrogen led to a reduction in yield. Variety Grand, in both years, had very significantly higher yield (4484.7 kg ha^{-1})with all variants of fertilization compared to the other studied variety Record (3577.8 kg ha^{-1}). Variety Grand obtained the highest yield (4937.5 kg ha^{-1}) when using 80 kg ha^{-1} of nitrogen in the first year, while variety Record obtained the lowest yield (2930 kg ha^{-1}) at a dose of 120 kg ha^{-1} of nitrogen in the second year. Our results are in agreement with the results of Malesevic et al., (2010) which, according to their research, indicate that the highest yield was obtained when barley was fed with 80 kg ha^{-1} of nitrogen.

Conclusion

Using the results of this research of the effect of nitrogen and weather conditions on the yield and yield components of winter barley, the following conclusions can be drawn:

Favourable climatic conditions in the first year have influenced all the tested features to have a significantly higher values compared to the second year of the research.

Variety Grand, in both years, obtained higher values of hectoliter mass and grain yield in comparison with the other tested variety Record.

Variety Record had the highest absolute mass (45.1g) when fertilized with 80 kg ha^{-1} of nitrogen, and the same variety had the lowest absolute mass (35.9g) when fertilized with 120 kg ha^{-1} of nitrogen.

Variety Grand had the highest hectoliter mass (63.4 kg) when fertilized with 80 kg ha^{-1} of nitrogen, while variety Record had the lowest hectoliter mass (60 kg) when fertilized with 120 kg ha^{-1} of nitrogen.

Variety Grand obtained the highest yield (4937.5 kg ha^{-1}) when using 80 kg ha^{-1} of nitrogen, in the first year, while variety Record obtained the lowest yield (2930 kg ha^{-1}) at a dose of 120 kg ha^{-1} in the second year of the research.

Both varieties, in terms of yield, hectoliter mass and a 1000 grain mass, responded best at fertilizing dose of 80 kg ha^{-1} of nitrogen, while further increase of nitrogen led to a reduction in values of mentioned features.

For the research area in the production of barley, we recommend the lowest applied dose of 80 kg ha^{-1} of nitrogen, and for the choice of variety, taking into account the level and quality of yield, we prefer variety Grand.

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THE INFLUENCE OF TOP DRESSING ON MORPHOLOGICAL AND PRODUCTIVE PROPERTIES OF SPELT WHEAT ON DEGRADED SOIL

Djordje GLAMOCLIJA[1*], Slobodan DRAZIC[2], Marija SPASIC[3],
Nefreteta ZEKIC[1], Marina MILUTINOVIC[1]

[1]University of Belgrade, Faculty of Agriculture, Zemun, Serbia
[2]Institute for medicinal plants Josif Pancic, Belgrade, Serbia
[3]Institute of Agricultural Economics, Belgrade, Serbia
(Corresponding author: lami@agrif.bg.ac.rs)

Abstract

Spelt wheat is characterized with a lot of good productive traits, primarily well is adapted to the agroecological conditions and soils in hilly and mountainous areas, tolerant to drought, pathogens and insect attacks (*Flaksberger,* 1930). Grains are tightly wrapped glumes and paleas and protected from air pollution, so that can be cultivated in areas that are less suitable for the wheat. The flour, milled grain of provides all the necessary nutrients, ideal for the natural balance (*Bodroza-Solarov et al*., 2009). It is used for making special type of bread that is more digestible than the value of common wheat flour. Nutritional value flour gives the high gluten content, so it can be used for the preparation of pastries and variously pasta without adding eggs. If it used milling of kernels, we obtain the so called integral wheat flour (*Ruegger et al.,* 1990). The spelt can be cultivated without the use of chemicals and he is highly respected in organic agriculture (*Kohajdová and Karoviʾová,* 2008). Grain, obtained in this way is used for the preparation of healthy food. The large numbers of consumers that feed on and live in harmony use these products.

Introduction

Spelt wheat is one of oldest species which belongs of the genus *Triticum.* This wheat was well known even before 6,000 years. It was cultivated in ancient Egypt. The spelt grain used in the diet the ancient Romans who spread production throughout the Empire in today's Europe and North Africa. Growing was in mountainous areas of Southeast Europe until the 20th century (*Glamoclija et al*., 2011).

Nowadays spelt becomes interesting for cultivation, especially after studying the relationship of plants to the agroecological and soil conditions, and finding the most appropriate production technology (*Stallknech et al*., 1996). Studying the chemical properties of grain and flour *Zielinski et al.* (2008) point out that this is excellent raw material for making bread because has bigger nutritional value. In countries with a growing population and who eat more organic agricultural products special types of bread are well accepted. The special bread baking it was very well received, especially in countries where an increasing number of residents in the nutrition benefits of organic agriculture products (*Abdel-Aal et al.,* 1995).

Cultivation of wheat is becoming more and more interesting in Serbia. Areas under spelt increase in mountain areas, but also in the lowland areas. Association with organic farming includes this wheat in the crops rotation because it can be grown in conditions of alternative methods of crop protection (*Stallknecht et al.*, 1995).

Material and methods

During 2011/12 were conducted field micro experiments within thermo-electric power plant Nikola Tesla in village Usce on degraded land that is fallow over 15 years, that has been created to landfill of coal. The subject of research was the first domestic varieties spelt *Nirvana*. It was selected in the Institute of Field and Vegetable Crops, Novi Sad. The variety of winter spelt wheat is very tolerant to frost. Spelt wheat well grows in less fertile soils and drought better tolerated than common wheat. Spike is the average length of 10 cm to 15 cm with 22 flower spikelets. Kernel is chaffy because is strongly hulled with glumes and paleas after threshing. The hectoliter mass hulled grains is 75-78 kg and 1000 grain weight around 41g. The grain contains about 15% of total protein. The grain is rich in vitamin B and minerals. Compared to common wheat spelt has 7-8 times more calcium, magnesium, phosphorus and selenium. Mineral matters in grains are associated with organic carbon, and easy to adopted organism.

Before preparing for sowing of wheat was done cleaning the soil of various waste dumps. In late summer plowing was ploughed. Seedbed preparation was during October

In sowing period were used mineral fertilizers NPK 15:15:15 in the amount of 600 kg ha^{-1}. Wheat was sowed in late October. Top dressing was done in early March, with variations mineral fertilizers, as follows: V1 (ammonium nitrate - KAN, 220 kg ha^{-1}), V2 (urea - 40%, 150 kg ha^{-1}) and V3 (control, no nitrogen). During the growing season are not undertaken other crop tending or protection. Hand harvesting was in July and at the same time samples were taken for determining the following parameters: stem height, spike length, spikelet number, grain number, grain weight and mass of tailings. Data were analyzed using analysis of variance and tested LSD test.

Results and Discussion

Stem height. The average stem height at the time of wheat harvest was 97.7 cm and 89.6 cm control (Table 1). Top dressing of crops with KAN stem height is increased by about 11%. The use of urea for top dressing stem height is an average increase of over 16%. The top dressing of crops significantly increased stem height wheat.

Spike length. The average length of the spike at wheat harvest period was 10.23 cm, while the control was 8.9 cm (Table 1). The top dressing of crop spikes were longer by about 12%, but the effective top dressing was not significantly for the length of the spike.

The number of spikelets. The average number of spikelets was 18.87 in control 17.5 (Table 1). The top dressing of crops with KAN number of spikelets was increased by about 13%. Using of urea in top dressing of crops spikelets increased by 10%. The nutrition urea was not significantly influenced this morphological feature.

Number of grains per spike. The average number of grains per spike of wheat was 24.33 while the control was 20.1 grains per spike (Table 1). The top dressing of crops with KAN number of grains per spike was increased by about 40%. The use of urea in top dressing of crops of number grains per spike increased by 23%. The top dressing of crops KAN significantly increased the number of grains per spike in wheat, while nutrition did not significantly influenced the morphological properties.

The grain of weight. The average grain weight in spike at the time of wheat harvest was 1.06 g, while the control was 0.9 g (Table 1). The top dressing with KAN influenced on

weight of grains per spike. Increase was by about 33%. Grain weight spike in average increase of 22% using urea for top dressing However, top dressing is not statistically significant on increasing grain weight in spike.

The mass of grain chaff. The average weight of chaff (glumes and paleas) after kernel hulling was 0.46 g, while in the control was 0.4 g (Table 1). The top dressing of crops KAN and urea weight of chaff increased by 25%, but these differences were not statistically significant.

Table 1. Indicators of morphological and productive traits

Morphological and productive characteristics	The average values of treatment				LSD test	
	Control	KAN	Urea	Average		
Stem height, cm	89.6	99.3	104.3	97.7	0,05	9.4658
					0.01	14.3400
Spike length, cm	8.9	10.9	10.9	10.23	0,05	2.5272
					0.01	3.8286
The number of spikelets	17.5	19.8	19.3	18.87	0,05	2.9962
					0.01	4.5390
Number of grains per spike	20.1	28.1	24.8	24.33	0,05	7.0220
					0.01	10.6377
The mass of grain	0.9	1.2	1.1	1.06	0.05	0.3648
					0.01	0.5526
The mass of grain chaff	0.4	0.5	0.5	0.46	0.05	0.1998
					0.01	0.3627

Conclusions

Based on the research of the influence of crops on the morphological characteristics of spelt wheat production on degraded land, the following can be concluded:

- Top dressing significantly influenced the growth of stems. Using KAN they were increased by 11% while using Urea stems were higher about 16%.
- The length of the spike had is significant influenced in crops with top dressing. The both types of nutrients affected increase length of spike equally.
- The number of spikelets per spike, number of grains and 1000 grain weight were higher in variants with top dressing, but these differences were not significantly higher than in control.
- The mass of tailings in the grain chaff was also higher than in control variant, but the variations compared to the control were not significant.
- Top dressing did not significantly influence the morphological characteristics of plants and production, because in pre sowing preparation added 600 kg ha^{-1} NPK 15:15:15 mineral fertilizers. Nitrogen from top dressing significantly influences on wheat tillering in spring. An increased number of plants per area achieved higher grain yield in general.

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THE EFFECT OF CACO₃ ON THE K CONTENT IN OAT LEAF

Milena DJURIC[1*], Gordana SEKULARAC[1], Senad MURTIC[2], Milorad KRSMANOVIC[1], Dusko BRKOVIC[1]

[1]Faculty of Agronomy, University of Kragujevac, Cacak, Serbia
[2]Faculty of Agriculture and Food Science, University of Sarajevo, Sarajevo, Bosnia and Herzegovina
(Corresponding author: milenadjuric@tfc.kg.ac.rs)

Abstract

Acid soils have characteristic morphological properties and they undergo the process of gleying. They are also poor in water content, aeration and texture. Being of comparatively poor structure, the acid soils are deficient in alkalis and in organic matter so they are generally extremely acid. The current study was focused on liming as a soil amendment measure as well as on determining the oat leaf content of K in the cultivar Mediteran. Soil pH was 5.01 in 2007 and 5.11 in 2008. The variants used included increasing Ca rates compared to the control (the treatments were as follows: T1, T3 and T4 + control – without liming). The trial was conducted under the controlled conditions. The leaf content of K was determined during the flowering and full maturity phenophases. Gleying was performed using atomic absorption spectrophotometry. The content of K in oat leaf was the highest prior to liming with 4 g CaCO₃ in 2008 over the flowering phenophase (1.634% dry organic matter) and the lowest in the control variant over the same phase in 2008 (being 0.721% dry organic matter).

Key words: *oat, liming, pseudogley, leaf, calcium*

Introduction

The most limiting factors of plant cultivation on the pseudogley type of soil are considered to be its acid reaction, low content of humus as well as poorly contained phosphorus, potassium, calcium and nitrogen. Such soils also contain considerable amounts of mobile bonds of aluminum that are toxic to plants (Foy, 1984). The detrimental effects of aluminum and its presence were corroborated by the findings of Babovic (1960). In addition, Bartlett and Riceo (1972) found the solubility of the aluminum and iron hydroxides to be rather low at pH from 5.0 to 5.5, whereas, above these values, their content was none even in their modified form. One such measures is a more massive introduction of the recently released wheat, which have shown a high production potential even under stressful climatic conditions, and the significant measure is to increase and improve the soil fertility level (Dencic et al., 2006). The research results reveal more than 60% of acid soils accounting for low productivity soils and simultaneously acting as a highly limiting factor of plant production (Djalovic et al., 2010).

Materials and methods

The soil sample for the current research was taken from the region of Ivanjica being characteristic of acid soils and of the plant production being made rather difficult. The experiment lasted two years (2007 and 2008). It was done with five replications, with the experimental variants having increasing Ca rates (CaCO₃ added to already prepared soil) + the control one. Lime granulation was 0.3 mm. The trial variants were, as follows:
T_1 – control + 0.1% CaCO₃ of the soil weight per vegetation container
T_3 – control + 0.3% CaCO₃ of the soil weight per vegetation container

T_4 – control + 0.4% $CaCO_3$ of the soil weight per vegetation container.

At which, the control variant was the sample without any $CaCO_3$ added.

The experiment was carried out under the controlled conditions, with the potassium content in oat leaves, the cultivar Mediteran, being monitored over the flowering phenophase and the full maturity one. The pH value was measured, amounting to 5.01 in 2007 and to 5.11 in 2008. Leaves were first dried at 60^oC for 11 hours and then annealed at 550^oC for 12 hours. The sample was destroyed and then turned into its base solution.

As for potassium contained in leaf, its analysis was made through the absorption spectrophotometry. The obtained results were processed statistically using the method of variance using Dunett's test.

Results and discussion

The average content of potassium in oat leaves over the different developmental stages in 2007 and those in 2008, and depending on the liming rate, is given in the Table1.

Table 1. The average K content (% dry matter)

Liming rate	Developmental phase			
	Flowering		Full maturity	
	2007	2008	2007	2008
T_1	1.301	1.309	1.106	1.100
T_3	1.491	1.503	1.206	1.104
T_4	1.529	1.634	1.206	1.193
Control	0.730	0.721	0.737	0.733

$D_{0.05}=0.0143$ $D_{0.01}=0.0186$

Based on the data given in the Table 1, the lowest potassium content could be spotted in the control variant over the flowering phenophase in 2008 (0.721% dry matter) and the highest one in the liming variant with 4 g $CaCO_3$ applied throughout the flowering phenophase in 2008 (1.634% dry organic matter).

Potassium is the most necessary element for the growth of the individual plant organs. Thus, the research work of Saric (1983) and Radovanovic's (1995) done with maize, indicated that potassium presence was, as follows: 45% leaf, 32% stem, 4% root and 14% kernel.

The analysis of variance of the average potassium content in leaf along with the modes underway denoted to all the modes to highly significantly influence the K content in the oat leaves (Table 2). Also, the interaction effects among all the regimes underway could be found to be statistically highly significant. The analysis of interaction effects showed that K content in oat leaf had a changeable trend as the result of soil liming, which subsequently led to its indicative deviations which could not be disregarded at all.

Table 2. The analysis of variance of the average K content

The sources of variation	Degrees of freedom	Square means	F- exp.	Significance
Liming (A)	3	3.001	21404.193	**
Developmental stage (B)	1	1.006	7582.971	**
Year (C)	1	0.000208	1.482	Non-significant
Interaction AB	3	0.138	985.493	**
Interaction AC	3	0.000582	4.180	**
Interaction BC	1	0.000935	6.652	**
Interaction ABC	3	0.00158	11.253	**
Error	75	0.000140		

Namely, even though the general trend of the liming regimes denoted that K content in oat leaf increased with the increase in soil liming, K content and liming did not show such an interaction throughout all the developmental phases and study years so that higher liming rates gave rise even to a decrease in K content of oat leaves (Foy, 1984). This interaction effect should be taken into account when determining higher soil liming rates for oat crop.

However, irrespective of the liming rate and study year, K content in oat leaf was found to decrease from flowering phenophase to the full maturity one. The interaction effect between the developmental phases and modes underway, seemed to be the consequence of the small variations among the samples analysed.

It should be stressed that the deviations of K content from its basic trend were not significant compared to the lawfulness reached.

Thus, regardless of developmental stage and liming, the average K contained in oat leaf was lower than the allowable analytic deviation and therefore was not significant.

As pointed out by Jeleni (1985), the presence of K in wheat straw was found to range from 0.50 to 1.50% dry matter.

Conclusion

Based on the obtained results, it could be concluded that:

the highest K content was reported in 2008 in the flowering phenophase (1.643% dry organic matter) with liming using $4 g + CaCO_3$,

the lowest K content was reported in 2008 in the flowering phenophase in the control variant amounting to 0.721% dry matter,

K content also showed a decreasing trend in the control variant from the flowering to the full maturity phenophase, whereas liming brought about an opposite trend.

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BREEDING BARLEY (*Hordeum vulgarae* L.) FOR ABIOTIC AND BIOTIC LIMITING FACTORS

Milomirka MADIC[1*], Aleksandar PAUNOVIC[1], Dragan DJUROVIC[1], Desimir KNEZEVIC[2], Snezana TANASKOVIC[1]

[1]University of Kragujevac, Faculty of Agronomy, Cacak, Serbia
[2]Faculty of Agriculture, University of Pristina, , Lesak, (Kosovska Mitrovica), Serbia
(Corresponding author: mmadic@tfc.kg.ac.rs)

Abstract

This paper presents breeding work on malting and forage barley, specifically focusing on increased tolerance to abiotic and biotic stresses. Breeding for yield is generally aimed at improving certain yield components that directly or indirectly contribute to its realisation. Apart from high yield potential, new genotypes should have adequate drought resistance (tolerance) to be achieved by identifying sources of beneficial genes and ways to maintain or improve grain yield in dry years. The long-term traditional selection process and evidence of climate change demand a breeding strategy targeting adaptation to future production conditions in small grains, primarily barley and wheat. Selecting widely adaptable genotypes that produce stable yields and show resistance to economically important diseases and tolerance to different biotic and abiotic factors indirectly contributes to increasing the yield and quality of malting and forage barley.

Key words: *barley, breeding, length of growing season, lodging, drought*

Introduction

Cereals are the most widely grown crops in the world, accounting for about 61% of the total arable land (Leff et al., 2004). Among cereals, wheat ranks first in terms of land area, followed by maize, rice and barley (Takeda et al. 2008). In the first decade of this century, barley was annually grown on 57 million ha, with an average production of 140.8 million t grain and an average grain yield of 2.6 t ha^{-1}.

Since the early work on developing new barley cultivars, the main goal has been to increase grain yield potential. Apart from an increase in yield potential, new cultivars should have increased resistance to lodging (Dencic et al., 1992; Przulj et al., 2000; Przulj and Momcilovic, 2002). In the 1980s and 1990s, grain yield remained a permanent goal in creating new cultivars, with breeding being further expanded to include other traits, primarily quality and resistance to biotic and abiotic limiting factors (Knezevic et al., 2007).

Grain yield also depends on many other factors, such as length of growing season, lodging resistance, cold resistance, disease and pest resistance, etc. Directional selection has resulted in the creation of local cultivars of malting and forage barley belonging to the continental ecotype, which yield grain that exhibits good technological traits even under these conditions. Breeding programmes have involved the use of genotypes originating from Eastern Europe as donors of genes conferring adaptability to semi-arid conditions, as well as the use of genotypes originating from Western Europe as donors of genes providing good quality.

Selection for length of growing season

Earliness is a very important trait in barley adaptation to a production region. Under optimum growth conditions, longer growing seasons lead to increased grain yields. This trait is of greater importance for northern and upland regions located at higher altitudes (1000 m a.s.l. and above) where growing seasons are considerably shorter, with earliness often playing a decisive role in obtaining satisfactory yields. This trait is equally important in arid regions. Although yield is theoretically positively correlated with length of dry matter accumulation, higher yields under Serbian production conditions are produced by short-season cultivars. Early-maturing cultivars manage to produce most of their yield before the dry period, whereas forced maturity and reduced grain yield and quality occur in late-maturing cultivars (Pržulj and Mom ilovi , 1998). High yields and good grain traits require uniform optimum grain filling. Forced maturity in barley leads to poor starch accumulation, a low percentage of large uniform-sized grains and a higher dry matter content. Even under no-stress growing conditions, long-season cultivars spend a large part of dry matter to form vegetative parts; therefore, their yields may be lower that those of early-maturing cultivars (Borojevi and Wiliams, 1992).

However, in any production region, there are external factors constraining plant growth and development and, hence, largely determining the most favourable length of growing season for the particular production region. A certain length of growing season may be favourable for one production region but unfavourable for another. Therefore, breeding for length of growing season should also be adjusted to environmental conditions. Among the environmental factors, the highest effect is produced by temperature, day length, altitude, humidity and soil fertility. Length of growing season in the selection process is generally determined by number of days from emergence until earing.

Among the Novi Sad cultivars of winter malting barley, Novosadski 293 takes the longest to put forth ears (193 days); the growing season of new cultivars is 4-5 days shorter, whereas spring malting barley cultivars have a growing season of about 60 days (Pržulj and Mom ilovi , 1998).

Selection for drought resistance

Drought is a major environmental stress factor that limits crop production in many countries worldwide. Changes in regional climate are expected to include reduced rainfall, lower soil moisture, reduced water availability and more frequent extreme climate events (drought, heat waves, storms accompanied by precipitation, etc.) during the warm part of the year. Similar changes have been observed at the local level (Dodig 2004). Irrigation is the most comprehensive operation that can help mitigate the adverse effects of drought stress. Yet, only about 5.3% of Serbia's arable land is irrigated (Bošnjak, 1999). Both worldwide and in Serbia, barley is generally grown without irrigation. In order to solve the drought problem, breeding work should result in more resistant cultivars and adaptation of production technology to unfavourable drought conditions. To date, there has been no breeding strategy for drought resistance in wheat and barley in Serbia. Instead, breeding work was focused on developing genotypes showing high yield potential under optimum conditions that subsequently proved suitable for cultivation under dry conditions (Dodig 2004). As emphasised by Quarrie et al. (1999), progress in breeding for drought resistance can be achieved through selection for specific traits to improve plant water supply and, hence, increase water use efficiency and harvest index.

Drought resistance refers to the ability of a plant to adapt to a deficiency of soil water (soil drought) or air humidity (air drought) for some time, without any significant decrease in yield

size and quality. Drought resistance, particularly in the early period of plant development, is an important trait in spring barley.

The degree of drought-induced damage is dependent on a number of factors, notably stage of plant development during dry weather, drought intensity and length of drought.

Susceptibility to soil moisture deficiency shows variations across growth and development stages. The highest susceptibility is found in germinated seeds, emerging plants and young plants. Water deficiency at this stage induces poor development of the root system and, hence, the aboveground parts of the plant. Small grains also show susceptibility during earing, resulting in non-uniform earing, flowering and fertilisation, as well as in grain shrivelling.

Selection for drought resistance involves choice of plants that do not reduce their yield under dry conditions. Cultivars highly resistant to drought have been created under frequent long-term drought conditions (e. g. Central Asia). The inclusion of these cultivars in European breeding programmes can contribute to their increased resistance. Being tolerant of drought, some cultivars have relatively good agronomic and technological traits. Drought tolerance is controlled by polygenic inheritance, being determined by complex physiological processes, such as root absorption capacity, cell sap concentration, unbound water amount, etc.

Most barley production regions do not have optimum cultivation conditions due to inadequate water and temperature regimes during plant development and crop growth. Downing (1995) stated that southern parts of Europe would become more deficient in rainfall, whereas northern Europe would become more humid. Putari (1996) reported a 1-1.5 $^{\circ}$C increase in average temperature in Vojvodina during 1930-1965, and an annual decrease of 1.3 mm in rainfall. Jovanovi et al. (1996) observed that the severest droughts in the Republic of Serbia occurred after 1980, with drought spreading into regions where it had not occurred previously. A number of other authors have also observed the effects of climate change in the Serbian region including reduced amounts of available water and increasing temperatures, which forces breeders to create genotypes whose development rhythm will be largely adapted to the present climate conditions. Recently, important results in selecting barley for drought have been achieved using molecular markers. When adapting plant species to agroenvironmental conditions, particular importance is given to development genes since they exert a pleiotropic effect on numerous traits, including stress tolerance, among others (Foster et al., 2000).

Breeding barley for disease resistance

Assessment of disease-induced yield reduction is sometimes made difficult due to the absence of visible symptoms. Some diseases lead to reduced crop density and vigour, which can be partially compensated for by fertilisation and use of intensified cultural practices. Other diseases cause grain shrivelling, reduction in hectolitre weight and/or quality deterioration. Disease-induced losses can be reduced by the use of resistant tolerant cultivars, a higher level of production technology and fungicide applications (Pržulj and Mom ilovi 1995).

The largest problem in barley selection is a high pathogen variability causing resistant cultivars to rapidly become susceptible. Therefore, the selection process is considered completely successful if the production of a wheat or barley cultivar is maintained for 5-7 years. There are examples of cultivars retaining resistance to certain pathogens for a long period of time. Resistant cultivars exert pressure on pathogens, since only part of the pathogen population harbouring virulence genes for the cultivar are developed on them. This part of the population expands, causing changes in pathogen structure and relationship. In this way, cultivars favour the multiplication of pathogens to which they are resistant and become susceptible to them after several years. Susceptibility also occurs as a result of the emergence of new pathogen strains that are virulent to the cultivar. Therefore, plant selection for pathogen resistance is a long-lasting process (Borojevi , 1992).

Table 2. Major resistance genes against 15 fungal pathogens, four virus and two pests in barley (Chelkowski et al. 2003; Weibull et al. 2003)

Gene symbol	Pathogen, Pest & Disease	# of Genes
Rph	*Puccinia hordei* (leaf rust)	17
Rpg	*Puccinia graminis* (stem rust)	4
Rps	*Puccinia striiformis* f. sp. *hordei* (stripe rust of barley)	4
Ml (Mlo, Mla, MlLa&Reg)	*Blumeria graminis* f. sp. *hordei* (*Bgh*) (powdery mildew)	23
Rcs	*Cochliobolus sativus* (spot blotch)	5
Rpt	*Pyrenophora teres* (net blotch)	6
Rdg (Rhg)	*Pyrenophora graminea* (barley stripe)	3
Rrs (Rh)	*Rhynchosporium secalis* (scald)	14
Run (un)	*Ustilago nuda* (loose smut)	8
Ung	*Ustilago nigra* (semi-loose smut)	1
Ruh	*Ustilago hordei* (covered smut)	4
Rsp	*Ustilago hordei* (covered smut)	3
Rti	*Typhula incarnate* (gray snow mold)	1
Fb	*Fusarium* ssp. (scob)	1
Ryd	BYDV (barley yellow dwarf virus)	2
Rym	BaYMV (barley yellow mosaic virus) Ba MMV (barley mild mosaic virus)	13
Rsm	BSMV (barley stripe mosaic virus)	5
Rsg	*Schizaphisgraminum* (green bug aphid)	3
Rha	*Heterodera avenae* (cereal-cyst nematode)	3

As estimated from more than 15,700 literature references and 3,700 field trials, an average disease-induced yield loss in barley is 10.5 % (Oerke and Dehne, 1997). Jorgensen (1988) published a list containing 83 loci rendering resistance to important barley diseases. Graner (1996) provided an extensive review of molecular mapping of qualitative and quantitative disease resistance loci. Current state of resistance study and breeding for resistance were summarised by Kleinhofs and Han (2002), Chelkowski et al. (2003) and Weibull et al. (2003). Barley plants are mainly susceptible to fungal and viral diseases (Tab. 2). Fungal diseases include powdery mildew, scald, rust diseases (leaf rust, stem rust) and others. Barley is attacked by several viruses, viz. barley yellow dwarf virus, cereal yellow dwarf virus, barley mosaic virus, wheat dwarf virus, etc.

A summary of reported QTL in barley includes 757 QTL which cover the whole barley genome for abiotic stress resistance, agronomic traits, biotic stress resistance (Tab. 2), quality traits and others (Hayes et al, 2003).

The cultivars developed at the Small Grains Research Centre in Kragujevac exhibit satisfactory resistance to major (or important) barley diseases, primarily leaf rust, stem rust and powdery mildew.

Conclusion

Barley breeding through improvement in certain components has resulted in new cultivars that have high yield potential. Today, yield increases are much more difficult to attain than they were before. Breeding should be further expanded to include other traits, primarily quality and resistance to biotic and abiotic limiting factors. Apart from high yield potential, new genotypes should have adequate drought resistance (tolerance) to be achieved by identifying sources of beneficial genes and ways to maintain or improve grain yield in dry years.

The long-term traditional selection process and evidence of climate change demand a breeding strategy targeting adaptation to future production conditions in small grains, primarily barley and wheat.Selecting widely adaptable genotypes that produce stable yields and show resistance to economically important diseases and tolerance to different biotic and abiotic factors indirectly contributes to increasing the yield and quality of malting and forage barley.

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CLIMATE CHANGE IN SERBIA: DEPENDENCE OF MAIZE YIELD ON TEMPERATURES AND PRECIPITATION

Dusan KOVACEVIC[1,4*], Zeljko DOLIJANOVIC[1], Zivota JOVANOVIC[2], Milena SIMIC[2], Vesna MILIC[3]

[1]University of Belgrade, Faculty of Agriculture, Zemun, Serbia
[2]Maize Research Institute "Zemun Polje", Beograd, Serbia
[3]University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia and Herzegovina
[4]Academy of Engineering of Serbia, Belgrade, Serbia
(Corresponding author: dulekov@agrif.bg.ac.rs)

Abstract

High and quality maize yields largely depend on climatic conditions. Since climate in Serbia provides good light conditions and sufficient heat energy in a greater part of Serbian territory, the success of maize cultivation mainly depends on precipitation sums and their distribution.

The objective of the present study was to determine dependence of the average maize yields during the past two decades at the end of last and the beginning of the new millennium on weather conditions, i.e. on temperatures and precipitations.

The analysis of temeperature and precipitation regimes during the 1991-2010 period at both levels, full-year periods and growing seasons, show extremely dry years such as 1992, 2000 and 2007. Based on a detailed analysis of data it is observable that drought during sowing and emergence occurred more often during the last ten years. The analysis of temperatures and precipitation sums in the period from tasseling to the milk stage, drought occurred more frequently during the last twenty years and it jeopardised early and medium late maturity hybrids.

A precise multiple regression analysis of the mode and the intensity of maize yield dependence on meteorological conditions indicates to the following:

The higher air temperatures in all periods (summer, growing season and full-year period for the Belgrade region) were the lower grain yields of maize were, while these yield reductions were significantly only during summer periods. On the other hand, the higher precipitation sums were, the statistically significantly higher maize grain yields were. Of the two observed meteorological conditions, precipitations sums, particularly summer and total annual ones, had greater effects on maize grain yields.

Keywords: *climate change, temperature, precipitation, yield, maize, Serbia*

Introduction

Drought presents a long period of abnormally low rainfall that adversely affects growing and developing of crops. At the same time, such a period is characterised with high temperatures and low air humidity. Damages caused by drought depend on its duration and intensity. The longer drought lasts the greater damages are, and sometimes they can be catastrophic.

Lesser adverse physiological effects of drought can result in plant stunting, while more severe effects can lead to plant death. Due to drought, transpiration and photosynthesis are decreased, but respiration does not stop and reserve organic matters are used. Plants loose their weight, leaves wilt, and their tips dry. Complete plants dry if subjected to longer drought.

Causes of droughts are different. Insufficient annual precipitations and their distribution during the growing season of crops as well as the evaporation intensity of the falling rain are the most important causes of droughts (Kovacevic et al., 2009; Kovacevic and Milic Vesna 2010). Under climate conditions of our region drought is an occasional phenomenon, which can be moderate or extremely severe. The evaporation intensity depends on temperature, effects of wind and geographic location of a certain region and increases from west to east or from north to south of our country. The highest intensity has been recorded in the south-eastern part of the country (Cvetkovic et al., 1996). Temperatures largely affect this phenomenon. Evaporation is a product of high temperatures and is most closely related with the direction of the precipitation decrease. This fact can be a reason why our eastern and south-eastern regions often suffer more or less from effects of drought (Spasov P. and Spasova Danica, 2001 Spasov, P. (2003).

Material and methods

The data of the Republic Hydrometeorological Institute of Serbia (precipitation and air-temperature, for the Belgrade territory for the 1991-2012 period were transformed in average in three summer months, vegetative period and total per year and the Statistical Office of the Republic of Serbia (Statistical Yearbooks: maize yields for central part of Serbia) were used for this study.

The data were statistically processed by the multiple regression analysis and the correlation analysis using the software package Statistica V5.5. Based on the equation of the linear regression ($_i=a+b_1*x_1+b_2*X_2$), the average change (increase or decrease) in maize grain yield was established in dependence on air temperatures (b_1) and total precipitation sums (b_2). Difference testing of partial regression coefficients by the t test (b_1 and b_2:H_0:$\beta_1=0$ vs. H_a:$\beta_1 \# 0$ and H_0:$\beta_2=0$ vs. H_a:$\beta_2 \# 0$) shows that these differences were statistically significant. The significance of the linear regression model was tested by the F test (H_0:$\beta_1=\beta_2=0$ vs. H_a:$\beta_1 \# 0$ $\beta_2 \# 0$) and the simultaneous effect of the temperatures and precipitations on maize grain yield was established. The correlation dependence between variables was tested by the coefficient of multiple correlation (dependence of yield on the simultaneous effects of temperatures and precipitations) and by the coefficient of partial correlation (dependence of yield on the effect of one factor whereby the effect of the second factor is not considered). Testing of significance of correlation coefficients was done by the F and t tests.

Results and discussion

Climate in Serbia can be described as temperate-continental with less or more pronounced local characteristics. According to data of the Republic Hydrometeorological Institute of Serbia, the average annual air temperature for the regions with the altitude of up to 300 m amounted to 10.9^{o}C during the 1961-1990 period. The corresponding temperatures amounted to approximately 10.0^{o}C, i.e. 6.0^{o}C for the regions with the altitude of 300-500 m, i.e. over 1000 m, respectively.

Temporal and spatial distribution of precipitation over the territory of Serbia is irregular. A larger part of Serbia is characterised with the continental precipitation regime with greater amounts during the warmer half of the year. The greatest precipitation sums are recorded during May and June. Twelve to 13% of the total annual precipitation sums are detected in June. The lowest precipitation sums (5-6% of the total annual precipitation sum) are recorded in February or October. The higher altitude the higher annual precipitation sum. The annual

precipitation sum in lowland regions ranges from 540 to 820 mm. This amount seems to be sufficient to cultivate the majority of field and vegetable crops.

The precipitation amount has a crucial effect on occurrence of shorter or longer dry spells in crop cultivation under rainfed conditions. The favourable precipitation distribution during the year is the distribution that provides a proportionally large numbers rainy days and equal intervals between rainy and rainless periods, particularly during the growing season. The occurrence of longer rainless periods in spring and autumn, especially in years with dry summers, when drought continues from summer into autumn regularly affects grain crops due to uneven and long emergence. Drought during summer months (June, July and August) mostly affects broadcast crops germinating in spring.

Table1. Mean temperatures and precipitation sums during the maize growing season in the region of Central Serbia (1991-2010)

Year	Mean temperature (°C)			Total precipitation sum (mm)			Maize grain yield t ha⁻¹
	VI-VIII	IV-IX	Year	VI-VIII	IV-IX	Year	
1991	18.5	16.1	10.7	163.0	334.8	628.5	4.9
1992	23.4	19.4	12.3	247.8	351.2	586.2	2.7
1993	22.5	19.7	12.2	131.8	224.8	541.1	2.3
1994	23.1	20.4	13.6	348.8	484.3	683.6	3.0
1995	22.3	18.8	12.4	167.6	404.8	701.2	4.0
1996	22.0	17.8	11.1	159.2	427.2	788.8	3.0
1997	21.5	17.9	11.8	275.0	444.0	754.6	4.7
1998	21.8	18.5	11.7	159.2	348.9	627.1	3.1
1999	20.7	18.5	11.8	418.4	611.5	1030.4	4.3
2000	24.1	21.0	14.2	56.2	203.3	367.7	1.9
Average	22.0	18.8	12.2	212.7	383.5	670.9	3.4
2001	22.0	18.7	12.6	262.4	651.0	893.1	4.1
2002	23.3	20.1	14.1	249.0	375.0	585.0	4.3
2003	24.7	21.1	13.1	154.0	273.0	556.0	2.9
2004	22.0	18.9	12.8	288.9	466.5	822.9	5.0
2005	21.5	19.0	12.2	329.0	486.0	791.0	5.0
2006	22.2	19.6	13.1	282.0	445.0	745.0	4.3
2007	25.5	21.1	14.4	198.0	316.0	774.0	2.2
2008	23.6	20.3	14.4	155.0	319.0	597.0	4.3
2009	23.2	21.1	14.0	277.0	321.0	807.0	5.0
2010	23.4	20.1	13.3	275.0	452.0	853.0	5.0
Average	23.1	20.0	13.4	247.0	410.4	742.4	4.2
Difference	1.1	1.2	1.2	34.3	26.9	71.5	0.8

Under conditions of our climate, the greatest precipitation sums are recorded in June. If precipitation sums are well distributed over decades and if there are rainfalls during July, maize - our most important crop - rarely suffers from drought. Insufficiency of precipitation in July, and later on, a longer rainless period accompanied with high temperatures and heat waves cause the greatest problems. Under conditions of favourable precipitation distribution during the growing season it is not necessary that the annual precipitation sum is high.

The analysis of weather conditions in the 1991-2000 period related to maize shows that 1992, 1993, 1998 and especially 2000 were extremely dry years. Out of 12 years of 21st century four were favourable and high yield years (2004, 2005, 2009 and 2010), while the following three years were very dry: 2003, 2007 and 2012. The driest year was 2012, when very low amounts of rainfall were recorded, while maximum daily temperatures in the May-August period were

over 35°C.Frequent heat waves have been observed during summer months of the growing season. In the beginning, heat waves were characteristic for September and they contributed to faster maize maturing, but during the last few years, heat waves have been occurring in August, while in 2012 they occurred in the second half of July. Heat waves contributed to accelerated maturation and they disturbed grain filling. Today, this is becoming a problem.

According to the 20-year mean air summer temperatures presented in Table 1 a disturbing increase is observed in the last decade of the 20th century in relation to the reference period from 1961 to 1990, especially in July (increase by 1.5°C). The temperature increase in June, July and August by 0.7°C, 1.2°C and 1.1°C, respectively, or on the average for these three months by 1.1°Chad the highest effects on crops in certain extremely dry years, such as1992, 2000, 2007 and 2012. If the data of the first decade of the 21st century are compared with data of the reference period (1961-1990) the difference of exactly 2°C can be considered alarming. This is especially dangerous because these increases and a few heat waves increase nocturnal temperatures during July and August up to tropical temperatures not lower than 20°C.

Annual and maize growing season precipitation were greater in the first decade of the 21st century. Even in two months, June (with the greatest amount of rainfall under our climate conditions) and August precipitation sums were somewhat higher at the monthly level. Namely, there are rainfalls in the first half of June and the second half of August, which can additionally form dry conditions because these periods are critical for moisture in maize as they are the beginning of pollination and grain filling, respectively.

Table 2. Summer mean temperatures and precipitation sums in Belgrade (1991-2010 average)

Period	June	July	August	Summer average
1961-1990		Temperature (^{o}C)		21.1
1991-2000	21.0	22.6	22.4	22.0
2001-2010	21.7	24.1	23.6	23.1
Difference	0.7	1.5	1.2	1.1 2.0
1961-1990		Precipitation (mm)		208.1
1991-2000	87.9	73.0	51.8	212.7
2001-2010	112.3	60.6	74.2	247.0
Difference	24.4	12.4	22.4	34.3 38.9

Based on data for maize grain yield (Table 1) and the equation of multiple linear regression (Table 3), a statistically significant or a very significant simultaneous effect of average temperatures and total precipitation sums in the growing season and full-year period, especially summer period, was established. However, when observing individual factors affecting maize grain yield, the effect of total precipitation sums, particularly summer and annual, was more significant. The 1-mm precipitation increase resulted in grain yields higher by 5.3, that is 3.9 kg ha^{-1}. Considering the effects of the mean air temperatures, statistical significance was obtained only in the summer period, when the temperature increase of 1°C reduced grain yield by 290 kg ha^{-1}. According to stated values, the changes in grain yields in relation to observed meteorological conditions are more affected by precipitation sums, especially during summer months, although data presented in Table 1 show greater differences over temperatures than over precipitation sums between the two 10-year periods.

Table 3. Results of statistical analysis in maize

Effects of average summer air temperatures and total summer precipitation sums on grain yields		
Tabular values: $F_{0.05;2;17}=2.63$; $F_{0.01;2;17}=6.23$; $t_{0.05;17}=2.11$; $t_{0.01;17}=2.898$		Evaluation of significance
Equation of multiple linear regression	$Y_i=9.136 + -0.2903X_1 + 0.0053X_2$	$F=7.0894^{**}$
Regression coefficient	$b_1=-0.290$; $b_2=0.0053$	$t_{b1}=2.246^*$; $t_{b2}=2.362^*$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.6744$ $d=45.48\%$	$F=7.091^{**}$
Coefficient of partial determination	$r_{01.2}=-0.478$; $r_{02.1}=0.497$	$t_{01.2}=2.246^*$; $t_{02.1}=2.362^*$
Effects of average summer air temperatures and total growing season precipitation sums on grain yields		
Equation of multiple linear regression	$Y_i=5.4298 + -0.164X_1 + 0.0039X_2$	$F=3.4576^*$
Regression coefficient	$b_1=-0.164$; $b_2=0.0039$	$t_{b1}=0.920^{ns}$; $t_{b2}=1.915^{ns}$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.5377$ $d=28.92\%$	$F=3.457^*$
Coefficient of partial determination	$r_{01.2}=-0.218$; $r_{02.1}=0.421$	$t_{01.2}=0.920^{ns}$ $t_{02.1}=1.915^{ns}$
Effects of average annual air temperatures and total annual precipitation sums on grain yields		
Equation of multiple linear regression	$Y_i=1.379 + -0.025X_1 + 0.0039X_2$	$F=3.8645^*$
Regression coefficient	$b_1=-0.025$; $b_2=0.0039$	$t_{b1}=0.128^{ns}$ $t_{b2}=2.667^*$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.5591$ $d=31.25\%$	$F=3.865^*$
Coefficient of partial determination	$r_{01.2}=-0.031$; $r_{02.1}=0.543$	$t_{01.2}=0.128^{ns}$ $t_{02.1}=2.667^*$

*, ** significantly difference at p 0.05 and p 0.01. ^{ns} not significantly difference

The dependence of the maize grain yield on both observed factors, temperature and precipitation, or on individually observed factors, analysed by the coefficient of multiple correlation, was also the most significant in the summer period. Values of obtained coefficients of multiple linear determination ranged from d=28.92% (percentile dependence of yields on temperatures and precipitation sums in the growing period) to d=45.48% (percentile dependence of yields on temperatures and precipitation sums in the summer period). Values and evaluation of significance of coefficients of partial correlation, also indicate to a trend of greater dependence of maize grain yields on precipitation sums, particularly on total summer and annual sums.

Previous results (Kovacevic et al., 2005, 2007b, 2008; Dolijanovic et al., 2006, 2007, 2010) point out to effects of meteorological conditions, especially the precipitation distribution, on grain yield of maize. It could be added that the precipitation distribution in summer months is important, particularly if unfavourable, and if accompanied with high air temperatures can significantly reduce yields of the most widely grown crop in the sowing structure of the Republic of Serbia. Debreczeni et al., 2006, have studied the dependence of maize grain yields on growing season precipitations and have established a high dependence in variants without fertilisation (r=0.7357), while this dependence in variants with fertilisation amounted to r=0.6245. The same authors have determined that the 1-mm increase of precipitation increased grain yield by 6.4-24 kg ha^{-1} (variants without fertilisation) and by 16.1-42.9 kg ha^{-1} (variants with fertilisation).

Conclusion

According to the detailed analysis of temperature and precipitation regimes on the territory of Belgrade in the 1991-2010 period and the analysis of average maize yields in Serbia proper, the following can be concluded:

General global climate changes also affect the Balkan Peninsula including Serbia. Two most important climate parameters in agronomy, temperatures and precipitations, have been changing faster during the past two decades. The extremely dry years were 1992, 1993, 1998 and particularly 2000, 2003 and 2007.

The average temperature for the three summer months increased by $2^{o}C$ in the 1991-2010 period compared to period 1961-1990. Heat wave with extremely hot summer days and tropical nights contribute to the yield reduction. The temperature increase did not resulted in the precipitation reduction. Rainfalls were shifted more towards the first decade of June and the last decade of August and in such a way they simply masked the actual moisture insufficiency in the critical period for maize that lasts from the mid June to mid July under our climate conditions.

According to the detailed analysis of the form and the intensity of dependence of maize yields on meteorological conditions done by the method of multiple linear regression and correlation the following can be concluded:

The air temperature increase in all observed periods (summer, growing season and the full-year period for the region of Belgrade) resulted in the maize grain yield reduction. This reduction was statistically significant only for the summer period. On the other hand, the increase of the precipitation sums was regularly accompanied by the statistically significant maize grain yield increase. Of the two observed meteorological conditions, the greater effect on the maize grain yield was expressed by the precipitation sums, especially summer and annual ones. Maize grain yield variations over meteorological conditions (average air temperatures and total precipitation sums) ranged from 0.5377 (growing season), over 0.5591 (full-year period) to 0.6744 (summer period).

The changes in temperature and precipitation regimes show that the growing season starts earlier in this region. Based on these analyses it is necessary to consider the adaptation of many cropping practices that indirectly can reduce damages from drought starting from the adequate tillage systems, dates, depths, methods and densities of sowing, fertilising, cultivation methods during the growing season and selection of hybrids resistant to drought stress conditions. Certainly, irrigation, as a measure with the direct effect, can most efficiently eliminate effects of drought.

Acknowledgements

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CLIMATE CHANGE IN SERBIA:DEPENDENCE OF WINTER WHEAT YIELD ON TEMPERATURES AND PRECIPITATION

Dusan KOVACEVIC[*1,4], Zeljko DOLIJANOVIC[1], Zivota JOVANOVIC[2], Vesna MILIC[3]

[1]University of Belgrade, Faculty of Agriculture, Zemun, Serbia
[2]Maize Research Institute, Zemun Polje, Beograd, Serbia
[3]University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia and Herzegovina
[4]Academy of Engineering of Serbia, Belgrade, Serbia
(Corresponding author: dulekov@agrif.bg.ac.rs)

Abstract

High and quality yields of winter wheat, as well as other filed crops, largely depend on climatic conditions. Since climate provides good light conditions and sufficient heat energy in a greater part of Serbian territory, the success of the cultivation of this crop mainly depends on precipitation sums and their distribution.

The objective of the present study was to analyse temperature and precipitation regimes during the past two decades (1991-2010) and to determine the dependence of the average winter wheat yields on these climate parameters.

The analysis of temperature and precipitation regimes over full-year periods, growing seasons and three subperiods (autumn, winter and spring) during the 1990-2010 period show extremely dry years such as 1992/93, 1995/96, 2002/03 and 2006/07, but also extremely wet years such as 2003/04, 2008/09 and 2009/10, which also caused damages in crops.

The regression and correlation analysis of the simultaneous effect of observed factors on the winter wheat grain yield show statistical significance in autumn and during the growing season of winter wheat. The greatest dependence of winter wheat grain yield, expressed through the coefficients of correlation, is on autumnal and meteorological conditions during the growing season.

The regression equation shows that the 1-mm precipitation increase of autumnal, winter and total precipitation sums in the growing season resulted in grain yields increase with the exception of lower yields caused by spring rainfalls. Of the two observed meteorological conditions, air temperatures, particularly summer and temperatures during the winter wheat growing season, had greater effects on grain yields.

Keywords: *climate changes, temperature, precipitation, winter wheat yield, Serbia*

Introduction

The effects of a year on winter wheat cannot be avoided. Weather conditions during each production year significantly affect plants directly or indirectly through the soil. In recent decades, abiotic extremes caused by climate factors have had stress effects on filed crops (Kovacevic et al., 2005).

It is necessary to reconsider the following each year: the appliedagricultural management systems in all crops, each cropping practice, the period of its application that is meeting deadlines, types of tools, proper selection of cultivars and hybrids for certain regions, level intensities of wheat growing practices (high- and low-inputs), optimum sowing density, amounts of applied agrochemicals (fertilisers, pesticides), good agricultural practice.

The application of cropping practices can provide the undisturbed growth and development of grain crops and can neutralise extreme abiotic climate factors (precipitation, temperature) and their stress effects on crops (Kovacevic et al., 2009, 2010a; Dolijanovic et al., 2006; 2008).

The most powerful cropping practices related to winter wheat cultivation are: tillage systems, proper selection of fertilising methods in accordance with requirements of winter wheat plants, optimum sowing dates, selection of cultivars, optimum vegetation space for each plant as well as crop cultivation during the growing season, protection against pests, weeds and diseases, etc. All stated cultivation elements affect yield either individually, collectively or synergistically, but the optimum sowing date is one of the most important element. Furthermore, very important elements are fertilising and mineral nutrition necessary for cultivars of grain crops (Malesevic et al. 2008). Irrigation is the only efficient measure against drought. However, it is known that wheat is an extensive crop with the lowest inputs, but also with the lowest income, hence irrigation under our conditions is mainly applied to intensive or seed crops that provide greater yields and income.

Under climate conditions of our country, winter wheat primarily develops when there is a sufficient or even surplus amount of precipitation. The precipitation surplus adversely affects winter wheat. If there is a precipitation deficit the following indirect measures, which resulted in reduced water requirements by grain crops are employed: balanced NPK nutrition, optimum nitrogen rates, optimum density in accordance with cultivar properties and climate conditions, well developed crop free of disease and pests. The selection of a proper cultivar for certain agroecological conditions is increasingly important, because not only dry but also extremely wet years last in a longer period of time. These extremely wet years also cause problems that need to be solved with different agromelioration measures (Kovacevic et al., 2010b). All cultivars have a high potential for yield, but resistance to stress conditions, especially to high temperatures or drought, will be a very important criterion, particularly for more arid regions.

Material and methods

The data from Republic Hydrometeorological Service of Serbia (precipitation and air-temperature, initial data series for Belgrade territory in period 1991-2012 are transformed in average in the growing season and three subperiods: autumn, winter and spring) and Statistical Office of the Republic of Serbia (Statistical Yearbooks: winter wheat yields for central part of Serbia) were used for this study.

The obtained data were statistically processed by the multiple regression analysis and the correlation analysis using the software package Statistica V5.5. Based on the equation of the linear regression model ($_i=a+b_1*x_1+b_2*X_2$), the average change (increase or decrease) in wheatgrain yield was established in dependence on air temperatures (b_1) and total precipitation sums (b_2). Testing differences of partial regression coefficients by the t test (b_1 and b_2:H_0:$\beta_1=0$ vs. H_a:$\beta_1\#0$ and H_0:$\beta_2=0$ vs. H_a:$\beta_2\#0$) shows that these differences were statistically significant. The significance of the linear regression model was tested by the F test (H_0:$\beta_1=\beta_2=0$ vs. H_a:$\beta_1\#0$ $\beta_2\#0$) and the simultaneous effect of temperatures and precipitations on winter wheat grain yield was established. The correlation dependence between variables was tested by the coefficient of multiple correlation (dependence of yield on the simultaneous effects of temperatures and precipitations) and by the coefficient of partial correlation (dependence of yield on the effect of one factor whereby the effect of the second factor was not considered). Testing of significance of correlation coefficients was done by the F and t tests.

Results and discussion

In our country, the precipitation distribution in the crop cultivation under rainfed conditions has very often a decisive effect on the occurrence of longer or shorter dry spells. The favourable precipitation distribution during the year is the distribution that provides a proportionally large numbers rainy days and equal intervals between rainy and rainless periods, particularly during the growing season. The occurrence of longer rainless periods in spring and autumn, especially in years with dry summers, when drought continues from summer into autumn, regularly affects grain crops due to uneven and long emergence. Under conditions of our climate, the greatest precipitation sums are recorded in June. If precipitation sums are well distributed over decades and if there are rainfalls during July, maize - our mostimportant crop - rarely suffers from drought. Insufficiency of precipitation in July, and later on, a longer rainless period accompanied with high temperatures and heat waves cause the greatest problems (Spasov and Spasova Danica, 2001).

Table 1. Mean temperature and precipitation in different periods of winter wheat growing season and average grain yield in the region of Central Serbia (1991-2011)

Year	Temperature (°C)				Precipitation in mm				Average grain yield
	autumn	wint.	spring	grow. season	autumn	wint.	spring	grow. season	
	X-XII	I-III	IV-VI	X-VI	X-XII	I-III	IV-VI	X-VI	
1991/92	6.0	3.7	17.2	9.0	178.6	48.0	258.2	484.8	2.8
1992/93	6.5	5.9	18.1	8.9	187.0	130.8	91.9	409.7	2.8
1993/94	7.4	6.0	17.4	10.3	185.5	91.1	318.2	594.8	3.8
1994/95	7.4	5.2	16.6	9.7	108.2	172.0	209.3	489.5	3.1
1995/96	6.6	1.8	16.3	7.8	124.4	146.0	217.4	487.8	2.2
1996/97	8.1	3.6	15.6	9.1	215.6	93.6	169.0	478.2	3.4
1997/98	7.8	4.9	17.1	9.9	217.0	102.8	142.6	462.4	3.4
1998/99	4.9	3.8	16.8	8.5	175.4	145.3	273.2	593.9	2.9
1999/00	6.4	4.1	19.6	10.0	273.6	85.9	95.5	455.0	2.5
2000/01	10.6	7.1	16.4	11.4	78.5	128.1	390.9	597.5	3.0
Average	7.2	4.6	17.1	9.5	174.4	114.4	216.7	505.4	2.7
2001/02	5.9	7.1	18.4	10.5	114.0	43.0	156.0	313.0	2.2
2002/03	9.0	2.1	19.6	10.2	167.0	88.0	95.0	350.0	3.8
2003/04	8.3	3.9	16.8	9.7	195.0	145.7	238.9	579.6	3.1
2004/05	9.5	2.4	17.0	9.6	210.7	172.0	195.0	577.7	2.9
2005/06	8.2	3.0	17.3	9.5	133.0	206.0	274.0	613.0	2.7
2006/07	10.1	8.8	19.6	12.9	94.0	189.0	191.0	474.0	4.4
2007/08	6.4	6.6	18.8	10.6	269.0	131.0	141.0	541.0	3.7
2008/09	10.2	4.0	19.0	11.1	147.0	201.0	193.0	541.0	3.3
2009/10	9.8	4.5	17.9	10.7	285.0	246.0	306.0	837.0	3.9
2010/11	8.4	3.9	18.1	10.1	155.0	119.0	114.0	388.0	3.0
Average	8.6	4.6	18.2	10.5	177.0	154.1	190.3	521.4	3.3
Differ.	1.4	0	1.1	1.0	2.6	39.7	-26.4	16.0	0.6

Under conditions of a favourable precipitation distribution during the growing season it is not necessary that the annual precipitation sum is high.

Table 2. Results of statistical analysis in winter wheat

Effects of average autumnal air temperatures and total autumnal precipitation sums on grain yields		
Tabular values: $F_{0.05;2;17}=2.63$; $F_{0.01;2;17}=6.23$; $t_{0.05;17}=2.11$; $t_{0.01;17}=2.898$		Evaluation of significance
Equation of multiple linear regression	$Y_i=1.065 + 0.200X_1 + 0.0029X_2$	$F=4.4674^*$
Regression coefficient	$b_1=0.200$; $b_2=0.0029$	$t_{b1}=2.840^*$; $t_{b2}=1.465^{ns}$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.5869$ $d= 34.45\%$	$F=4.455^*$
Coefficient of partial determination	$r_{01.2}= 0.567$; $r_{02.1}=0.335$	$t_{01.2}=2.840^*$;$t_{02.1}=1.465^{ns}$
Effects of average winter air temperatures and total winter precipitation sums on grain yields		
Equation of multiple linear regression	$Y_i=2.134 + 0.115X_1 + 0.0036X_2$	$F=2.5373^{ns}$
Regression coefficient	$b_1=0.115$; $b_2=0.0036$	$t_{b1}=1.721^{ns}$; $t_{b2}=1.546^{ns}$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.4795$ $d= 22.99\%$	$F=2.538^{ns}$
Coefficient of partial determination	$r_{01.2}= 0.385$; $r_{02.1}=0.351$	$t_{01.2}=1.721^{ns}$ $t_{02.1}=1.546^{ns}$
Effects of average spring air temperatures and total spring precipitation sums on grain yields		
Equation of multiple linear regression	$Y_i=-1.261 + 0.224X_1 + 0.0022X_2$	$F=1.6667^{ns}$
Regression coefficient	$b_1=0.224$; $b_2=0.0022$	$t_{b1}=1.797^{ns}$ $t_{b2}=1.195^{ns}$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.4049$ $d= 16.39\%$	$F=1.667^{ns}$
Coefficient of partial determination	$r_{01.2}= 0.399$; $r_{02.1}= 0.278$	$t_{01.2}=1.797^{ns}$ $t_{02.1}=1.195^{ns}$
Uticaj prose nih temeperatura vazduha i ukupnih koli ina padavina u vegetacionom periodu na prinos Effects of average air temperatures and total precipitation sums during the growing season on grain yields		
Equation of multiple linear regression	$Y_i=-0.597 + 0.312X_1 + 0.0012X_2$	$F=6.8795^{**}$
Regression coefficient	$b_1=0.312$; $b_2=0.0012$	$t_{b1}=3.348^{**}$; $t_{b2}=1.340^{ns}$
Coefficient of multiple linear correlation and coefficient of determination	$R_{0.12}=0.6688$ $d= 44.73\%$	$F=6.879^{**}$
Coefficient of partial determination	$r_{01.2}= 0.630$; $r_{02.1}=0.309$	$t_{01.2}=3.348^{**}$;$t_{02.1}=1.340^{ns}$

*, ** significantly difference at p   0.05 and p   0.01. ^{ns}not significantly difference

The analysis of the past 20 years shows that 1992/93, 1995/96, 2002/03 and 2006/07 (Table 1) were extremely dry years for winter wheat. However, observations of the whole growing season of winter wheat show that there were extremely wet years, such as 2003/04, 2008/09 and 2009/10, which also caused damages such as complete smothering of crops in haevy soil with waterlogging and outbreak of diseases, which significantly reduced the yield, aggravated harvest and decreased grain quality. The greatest problems related to moisture is insufficient precipitation sums during October and November, as they aggravate emergence, inhibit the growth and accelerate later winter wheat getting around through in the other qualitative stages of organogenesis.

These analyses in which the growing season was divided into three subperiods (Table 1) show the increase in the average temperature of 1.4 ^{o}C and 1.1 ^{o}C in the autumnal and spring period in the second decade (2001/02-2010/11) in relation to the first decade (1991/92-2000/01), respectively, while the winter average temperatures were equal. At the same time, the average winter temperatures were equal in both decades. The three-month cumulative precipitations were insignificantly higher in autumn (2.6 mm), significantly higher in winter (39.7 mm) and lower in spring (26.4 mm), which is especially important as early and later spring when is a critical period for moisture for grain filling. The average winter wheat yield regardless of variable conditions was higher by 0.6 t ha^{-1} during the last decade.

Data on the 20-year average grain yields of winter wheat as well as the form and the intensity of the dependence of the yield on autumnal, winter, spring and meteorological conditions during the growing season are presented in Tables 1 and 2. The most significant dependence of the yield was established in the autumnal period and during the whole growing season in which the temperature increase of 1°C resulted in the yield increase of 200 and 312 kg ha^{-1}, respectively. On the other hand, the precipitation increase of 1 mm resulted in the yield increase that was not significant and amounted to 2.9 and 1.2 kg ha^{-1}, respectively, while the changes during winter and spring were also positive (3.6 and 2.2 kg ha^{-1}, respectively). The simultaneous effect of both observed factors was statistically significant and very significant, due to, first of all, a great impact of air temperatures (Table 1). The lowest positive change in winter wheat grain yields depending on the temperature, i.e. precipitation sums, was observed in winter (b_1=0.115), i.e. during the growing season (b_2=0.0012), respectively.

According to correlation coefficients and the dependence intensity, the lowest, insignificant dependence of the yield on the precipitation sums and average temperatures was observed during winter. This dependence was statistically significant in autumn and very significant during the whole growing season. Higher correlation coefficients in these periods can be mostly attributed to the greater effects of air temperatures that are presented by the values of coefficients of partial correlation ($r_{01.2}$=0.567 that is 0.630). Based on stated values of changes in wheat grain yields in relation to observed meteorological conditions, significance of air temperatures was significantly higher, particularly in autumnal months and during the growing season. Furthermore, according to data presented in Table 2, the differences between the two 10-year periods are greater in temperatures than in precipitation sums. The average precipitation sum for the growing season of 521.4 mm that is 505.4 mm is mostly sufficient to obtain optimum yields, because wheat can be successfully grown in regions with annual precipitation sums ranging from 650 to 750 mm and with their favourable distribution during the growing season.

The obtained correlation coefficients are significantly lower than coefficients established by Lithourgidis et al., (2006) who determined the very high dependence (r =0.71 and r =0.59) of winter wheat yields in 25-year continuous cropping on spring and total precipitation sums, respectively on sand soils. The corresponding values on clay soils amounted to r =0.89 and r =0.54. The equation of linear regression ($_i$=a + b*x$_i$) showed that the grain yield decrease in the 25-year period varied from 0.0054 to 0.0104 t ha^{-1}, depending on the soil type, which was mainly higher decrease than the one obtained in spring in our study (0.0013 t ha^{-1}). Moreover, in the present study, the increase of precipitation sums of 1 mm in autumn, winter and the whole growing season resulted in the grain yield higher by 0.0029, 0.0036 and 0.0012 t ha^{-1}, respectively, disregarding the effect of the second observed factor - air temperature. Machado et al., 2007, have studied the dependence of winter wheat grain yield on summer precipitation and established a high positive correlation that ranged from 0.32 in the non-fertilised continuous cropping variant with conventional tillage to 0.5932 in the non-fertilised continuous cropping variant with zero tillage. The corresponding values in fertilised variants

amounted to 0.76 that is 0.62, respectively. Debreczeni et al., 2006, studied the dependence of winter wheat grain yields on precipitation sums during the growing season and determined a high dependence (r=0.8047) in variants without fertilising, while this dependence in variants with fertilising was significantly lower (r=0.4841). Dolijanovic et. al., 2009, have studied the dependence of winter wheat in continuous cropping on winter, spring and total precipitations sums and determined that the 1-mm increase of winter precipitations resulted in the decrease of grain yields of 2.1 kg. ($_i$=4492 – 2.1* x_i). On the other hand, the 1-mm increase of spring and total precipitation sums resulted in the grain yield increase of 0.885 kg ($_i$=3605 + 0.885* x_i) and 1.16 kg ($_i$=3013 + 1.16* x_i), respectively. The dependence between studied parameters was not statistically significant, which was established by testing coefficients of simple linear regression. Correlation and regression coefficients obtained in the two-crop rotation were higher, while the lowest dependence of yields on precipitations was recorded in spring (r =0.094). In the same period, the regression equation ($_i$=3999 + 0.963*x_i) shows that the lowest yield increase (0.963 kg) was established when the precipitation sum increased by 1 mm. The 1-mm increase of winter precipitations in the two-crop rotation resulted in the yield increase of 2.3 kg ($_i$=3500 + 2.3*x_i), and the similar form of the dependence was observed when the total sum in the growing period was analysed ($_i$=3018 + 2.2*x_i).

Conclusion

According to the detailed analysis of temperature and precipitation regimes on the territory of Belgrade in the 1991/92-2010/11 period and the analysis of average winter wheat yields in Serbia proper, the following can be concluded:

General global climate changes also affect Serbia. Temperatures and precipitations have been changing faster during the past two decades. The exceedingly dry years for winter wheat were 1992/93, 1995/96, 2002/03 and 2006/07, while extremely wet years were 2003/04, 2008/09 and 2009/10.

The analysis of the last 20-year weather conditions (temperatures and precipitations) related to winter wheat shows the increase of autumnal and spring temperatures at the end of the first decade of the 21st century. There are somewhat higher precipitation sums in autumn, higher in winter and significantly lower in spring, when the critical period for moisture begins. Even the average yield of winter wheat was higher by 0.6 t ha^{-1}.

The analysis of the form and intensity of yields on meteorological conditions during the growing season and certain subperiods (autumn, winter and spring) performed by the method of multiple linear regression and correlation shows that the simultaneous effects of observed factors on winter wheat grain yields were statistically significant during the growing season and in autumn. The greatest dependence of winter wheat grain yields on weather conditions, expressed through coefficients of correlation, was established during the growing season and in autumn.

The regression equation shows that the 1-mm increase of precipitation sums in autumn, winter and during the growing season, resulted in the yield increase, with the exception of the yield decrease caused by the increase of spring precipitation sums. Of the two observed meteorological conditions, the greater effect on the grain yield was expressed by the air temperatures, especially during the winter wheat growing season and in autumn.

Acknowledgements

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YIELD COMPONENTS AND GRAIN QUALITY OF WINTER BARLEY CULTIVARS GROWN ON PSEUDOGLEY

Milomirka MADIC[1*], Aleksandar PAUNOVIC[1], Miodrag JELIC[2], Desimir KNEZEVIC[2], Dragan DJUROVIC[1]

[1]University of Kragujevac, Faculty of Agronomy, Cacak, Serbia
[2]University of Pristina, Faculty of Agriculture, Lesak, (Kosovska Mitrovica), Serbia
(Corresponding author: mmadic@tfc.kg.ac.rs)

Abstract

Four two-row winter barley cultivars Premium, Jagodinac, Record and Crystal were evaluated for grain yield components and grain quality. Parallel trials were conducted over a three-year period (2008-2011) at an experimental field of the Secondary School of Agriculture in Kraljevo. Data were subjected to a two-factor analysis of variance. The significance of differences between individual means was assessed using the LSD test. The cultivars showed significant differences in yield, stem length, grain weight per spike and germination energy, whereas no significant differences were observed in protein content. Yield, grain weight per spike and germination energy were significantly affected by growing conditions (year), as well as by genotype x year interaction. Barley cvs. Premium, Jagodinac and Crystal gave a significantly lower grain weight per spike in the first year of the study, and a tendency to increase grain weight in the second and third years, as compared to Record.

Key words: barley, cultivar, yield, protein content, acid soils

Introduction

Choice of cultivar, mineral nutrition and weather conditions during the growing season play an important role in achieving high grain yields and quality of barley. Bogdanovi et al. (1994) underline that the absence of mineral fertilisation leads to a reduction in crop yield, the highest being in barley (49%).

Increased amounts of mineral nutrients, nitrogen in particular, induce intensification of vegetative growth, an increase in spike number m^{-2}, a decline in grain number per spike and a variable effect on grain weight (Christensen and Killoran, 1981; Gonzales Ponce et al., 1993; Paunovi et al. 2006.). Gonzales Ponce et al. (1993) define the soil moisture x nitrogen level interaction as the major factor determining grain yield in barley.

Approximately 30-40% of the world's arable land is acidic, with a pH below 5.5 (von Uexkull and Mutert, 1995). In acid soils, a number of chemical limitations and interactions between chemical compounds have a depressive effect on plant growth. Apart from hydrogen ion activity, plant growth is also largely limited by the presence of toxic elements, particularly aluminium and manganese, as well as by the deficiency of P, N, K, Ca, Mg, S, Zn and Mo (Rao et al. 1993, Samac and Tesfaye, 2003). There is high variability among and within species in their resistance to Al toxicity. Barley has the highest susceptibility to Al toxicity of all small grains (Zhao et al. 2003). Among 600 barley lines, Ma et al. (1997) determined moderate susceptibility to Al toxicity in 19 lines, high susceptibility in 39 and susceptibility in the majority of lines.

Certain breeding methods, primarily directional selection, can be used to create genotypes that can retain a low protein content even under unfavourable growing conditions, with adequate cultural operations applied (Pržulj and Mom ilovi , 1998).

The objective of this study was to evaluate the effect of mineral fertilisers and liming on yield, yield components and grain quality in four two-row winter barley cultivars grown on acid soil.

Material and method

The study was conducted at the experimental field of the Secondary School of Agriculture in Kraljevo during 2008-2011. The soil used in the experiment was pseudogley, having poor physical properties (a high degree of compaction, a high percentage of silt and clay particles, low water permeability), acid reaction ($pH_{H2O} < 4.5$) and a humus content of 2.16%. The experiment involved four cultivars of two-row winter barley, viz. Premium, Jagodinac, Record, and Crystall.

The experiment was laid out as a randomised block design in three replications with a plot size of 5 x 1 m ($5m^2$). Seeding was performed using a small mechanical seed drill in mid-October at a row spacing of 12.5 cm and an intrarow spacing of 3 cm. Prior to seedbed preparation, 5000 kg ha^{-1} of "Njival Ca" lime fertiliser was manually broadcast on the surface of the field. The experiment also involved the use of complex NPK fertilisers (8:24:16), superphosphate (17% P_2O_5) (120 kg N ha^{-1}, 80 kg P_2O_5 ha^{-1} and 53 kg K_2O ha^{-1}) and ammonium nitrate containing 34.4% N used for top-dressing.

At full maturity, a sample consisting of 30 plants was collected from each plot for analysis of stem length (cm) and grain weight per spike. Grain yield was determined for each plot and calculated in t/ha at 14% moisture. Germination energy (%) and protein content were assessed four months after harvest. Grain protein content (% d.m.) was determined by the Kjeldahl method. The results were subjected to analysis of variance, using SPSS software (1995). Individual differences between means were assessed by the LSD test.

Results and discussion

Grain yield in barley is a complex economically important trait resulting from the effect of genotype and the environment throughout the life cycle of a plant. It is particularly difficult to develop cultivars that would carry positive traits under different growing conditions and show resistance to biotic and abiotic stress factors (Pržulj et al. 1998.; Kneževi et al. 2007). The analysis of variance for the average yield showed significant differences among cultivars, with cv. Record producing the highest yield, and cv. Crystal the lowest. Grain yield was significantly affected by growing conditions (year) as well as by the genotype x year interaction (Table 1). The analysis of the genotype x year interactions revealed that cvs. Jagodinac and Record exhibited a similar tendency in their response to growing conditions, in contrast to cv. Crystal. The significance of the interactions resulted from the different behaviour of cv. Crystal, whose yield in the third year was comparable to that in the second year, as induced by its unresponsiveness to improved environmental conditions.

Stem length is one of the most important initial selection criteria in barley breeding work, being a direct component of lodging resistance and an indirect component of both yield and quality. The cultivars analysed showed significant differences in stem length (Table 1). Stem length was significantly greater in Record than in Jagodinac and Crystal, which had the shortest stem. The cultivar x year interaction suggested different responses of the cultivars to growing conditions, i.e. a significant effect of year. Premium showed an identical response to a change in environmental conditions. Favourable external factors (effect of year) and

increased amounts of mineral nutrients, particularly N, cause vegetative growth intensification, an increase in spike number m^{-2}, a decrease in grain number per spike, and a variable effect on grain weight (Christensen and Killoran 1981; Gonzales Ponce et al. 1993; Paunovi et al. 2008).

Table 1. Grain yield, stem length, grain weight per spike, germination energy and protein content in winter barley cultivars over a three-year period

		Yield tha^{-1}	Stem length (cm)	Grain weight per spike	Germination energy (%)	Protein content (%)
cultivars	Premium	5.9ab	66.97ab	0.56ab	94.9b	10.71
	Jagodinac	5.8ab	66.52b	0.52b	96.8a	10.34
	Record	6.1a	69.69a	0.60ab	94.5b	11.11
	Crystal	5.7ab	58.88c	0.62ab	92.9bc	10.95
years	2009 (I)	4.6c	63.85c	0.57a	94.6	10.83
	2010 (II)	6.0b	67.99b	0.64a	94.3	10.62
	2011 (III)	6.8a	78.40a	0.62a	94.7	
Premium	I	5.2g	67.43bc	0.49cde	91.8fg	10.78
	II	6.1cde	68.90bc	0.61a d	95.3cde	10.55
	III	7.3a	81.27a	0.68abc	97.5a	
Jagodinac	I	5.4g	63.63cd	0.51b e	96.7abc	10.30
	II	6.1cde	71.43b	0.69ab	95.9abc	10.20
	III	7.1a	84.13a	0.54a-d	97.ab	
Record	I	5.3g	64.30cd	0.72a	91.5g	11.42
	II	6.5b e	71.27b	0.64abc	95.3cde	10.85
	III	7.5a	84.37a	0.56a-d	96.9abc	
Crystal	I	5.8fg	60.03d	0.56a-d	96.1abc	11.18
	II	6.6bcd	60.37d	0.64c	91.2g	10.72
	III	6.9bcd	63.83cd	0.71a	91.3g	
ANOVA	Cultivar	*	**	*	**	ns
	Year	**	**	**	Ns	ns
	AxB	**	**	*	**	ns

Mean values designated with the same lowercase letter are not significantly different at the 95% level according to the LSD test
** F-test significant at 0.01; * F-test significant at the 0.05 level; ns non-significant

Similar results were obtained for grain weight per spike which exhibited no marked positive correlation with grain yield in wheat under normal conditions, but the two traits were positively correlated under stress conditions (Dencic et al., 2006).
Significant differences in grain weight per spike were observed only in cvs. Crystal and Jagodinac, regardless of year (Table 1). The effect of year induced a significant increase in grain weight per spike. However, the cultivars showed different responses across years (cultivar/year). In Crystal and Premium, the effect of year on grain weight per spike was not significant. Knezevic et al. (2007) and Paunovic et al. (2007) indicated that increased rates of

mineral nutrients lead to a significant increase in grain weight per spike. Previously, Baethgen et al. (1995) reported no significant effect of increased rates of mineral nutrients, particularly nitrogen, on grain weight in malting barley. The different responses of the test cultivars to liming and P fertilisers are in agreement with the results obtained by Romer and Schenk (1998) and Gahoonia and Nielsen (2004) who found high levels of genetic variability in barley for P uptake and utilisation, particularly on acid soils, which have a low availability of P. Foy (1996) and Huttova et al. (2002) also observed significant differences in barley tolerance to low soil pH.

Since malt is defined as a germinated barley grain, barley suitable for the malting industry should preferably germinate for ten days after harvest to retain viability for 365 days regardless of storage conditions. Some grain traits, such as dormancy and hydrosensibility, are desirable in agronomic terms, but undesirable in technological terms; therefore, breeders are expected to satisfy production and storage requirements, on the one hand, and malting requirements, on the other (Pržulj et al., 2010). The cultivars displayed significant differences in germination energy, whereas the year effect was not significant. Germination energy was highest in cv. Jagodinac and lowest in cv. Crystal. The lowest variation across years was observed in cv. Jagodinac. Conversely, cvs. Record and Premium exhibited significantly higher values in the second and third years. The analysis of the effect of the cultivar x year interaction indicates a specific response of each cultivar to germination energy. All cultivars were found to have the required germination energy of above 90%.

Grain protein content is among key parameters of malting barley. The cultivars tested did not significantly differ in the trait, nor did growing conditions produce any significant effect. This finding suggests that all of the cultivars analysed can be used as equally valuable raw materials in the brewing industry. The choice of the most favourable cultivar can be determined by other production traits.

Conclusion

The three-year study suggests that the genotypes tested gave satisfactory values for the traits analysed.

Yield was significantly affected by growing conditions (year) as well as by the genotype x year interaction. Crystal exhibited the strongest response to variable environmental conditions, whereas the lowest variation was observed in Record and Premium, regardless of growing conditions. The analysis of the cultivar x year interaction effect indicates a specific response of each cultivar in terms of germination energy, with all cultivars having the germination energy of above 90%.

Growing conditions had no significant effect on grain protein content and extract content. This finding suggests that all cultivars can be used as equally valuable raw materials in the brewing industry.

Acknowledgements

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THE EFFECT OF GRAPEVINE SPACE ON SUGARS AND TOTAL ACIDS CONTENT IN THE MUST OF THE VARIETY CABERNET SAUVIGNON

Radisav KOJOVIC[1*], Dragoljub ZUNIC[2], Sasa MATIJASEVIC[2], D. BRKOVIC[1], M. KRSMANOVIC[1]

[1]Faculty of Agronomy, University of Kragujevac, Cacak, Serbia
[2]Faculty of Agriculture, University of Belgrade, Zemun – Belgrade, Serbia
(Corresponding author: gordasek@tfc.kg.ac.rs)

Abstract

Modern aspects of grape and wine production are reflected in how safe and appropriate as well as in how natural and beneficial for people's health it is. The wine grape fruits of the variety Cabernet Sauvignon are rich in sugars and in polyphenolic compounds hugely contributing to their taste, flavour and colour.

The paper aims to examine the effect of planting density of the variety Cabernet Sauvignon on the content of sugars and total acids in the must in 5 different planting densities. The highest average content of sugars was found in the variant I (3x0,75m) amounting to 19,1%, whereas the lowest one prevailed in the variant V (3x2,0m) being 18%. The content of the total acids was reported to range between 7,2 to 7,5g/l.

Keywords: *life space, vine, sugars, total acids*

Introduction

There are roughly 11.000 varieties of the grapevine *Vitis vinifera* L. worldwide. They differ from one another in terms of biological and productional-technological properties. However, among them far fewer are those which are economically significant and which can be grown on larger areas (Avramovi , 1980). One of the most significant black grape varieties highly present in almost all the grapevine growing countries worldwide is considered to be Cabernet Sauvignon (Browes et al. 1997), which is none the less thought to be one of the highest quality varieties used for coloured wines production. However, this variety has not still been grown enough in Serbia, yet it is gaining in significance, particularly its more productive and better quality clones.

The yield and quality of grapes of the variety we have been concerned above, depends both, on its genetic propensity and on the environmental conditions, growing mode and production potential (Avramov et al., 1996). In such a manner, a new relationship between the vigour and fertility as well as that between the yield and grape quality has been established.

In order to obtain the best quality of grapes per vine, the optimal number of shoots, foliage surface and grape quantity should be provided (Buri et al., 1987). Some findings suggest the foliage surface needed to obtain 1g of sugar be 250-400m^2 (Žuni , 2000).

Growing high quality varieties is an imperative of an up-to-date viticulture. In this regard, a more massive cultivation of the varieties such as Cabernet Sauvignon would help grape and grape produces quality be improved in our country.

Materials and method

The research work embraced studying the content of sugars and that of total acids in the must ofthe wine grape varietyCabernet Sauvignon.

The must had been obtained from the grapes of this variety grown on the locality Navit –DOO 'Jagodina Cellars' in Jagodina.

The variety Cabernet Sauvignon had been grafted on the rootstock Caber 5BB. This variety is considered to be one the best quality ones. The must was found to contain from 20-24% sugars and from 5,5-8 g /l total acids (Cvetkovi et al., 1996). It was also found to contain 11-13% alcohol, as well as to be good quality and of characteristic smell and uniform flavour. The research work embraced the wine grape strain from 2011.

Of the elements comprising wine grape quality, sugars and acids contained in the must, were determined. The sugar content was established using Exl must gauge in wine and expressed in %. The content of the total acids was established through offsetting with N/4 NaOH using an indicator being expressed in g/l wine acid. Both parameters were followed in 5 various planting densities (variants) being, as follows: 3x0,75m; 3x1,0m; 3x1,25m; 3x1,5m and 3x2,0m with four replicates in order to obtain as accurate average contents as possible.

The obtained values of the numerical indices were processed through the analysis of variance while the significance of the differences was assessed through LSD at the level of significance of 1 and 5%.

Results and discussion

Wine grape quality of a variety is generally determined by numerous elements. The quality of wine grape varieties is determined by determining sugars and the total acids content in the grape juice.

Table 1. The content of sugars and total acids in the must of the variety Cabernet Sauvignon

Variants	Replicates	Sugar content in must %	Total acids content g/l
I 3x0,75m	I	18,7	7,6
	II	18,9	7,4
	III	19,2	6,9
	IV	19,4	7,0
Average		19,1	7,2
II 3x1,0m	I	18,9	7,2
	II	18,4	7,5
	III	19,5	7,0
	IV	19,2	7,1
Average		19,0	7,2
III 3x1,25m	I	18,5	7,3
	II	17,9	7,4
	III	19,0	7,0
	IV	19,6	6,9
Average		18,7	7,2
IV 3x1,5m	I	18,5	7,9
	II	18,1	7,7
	III	19,4	7,0
	IV	18,9	7,4
Average		18,7	7,5
V 3x2,0m	I	17,7	7,9
	II	18,4	7,1
	III	17,9	7,6
	IV	18,1	7,4
Average		18,0	7,5
For the variants LSD			
0,01		2,43	0,36
0,05		1,97	0,31

Sugar accumulation in the must as well as the content of the total acids is considered to be, in the first place, a genetic trait. Thus, in respect of interaction effects existing between the wine grape yield and its quality, Stoev (1973) found out that, up to a certain level, the wine grape quality had been unaffected by its yield, but that any further increase in its yield beyond that level could have even considerably worsened its quality.

The research work of Stoev at al., (1961), Nenov (1968) and Pavlov (1963), showed that the higher number of shoots per grapevine, was, the higher amount of sugars in the grape juice was, which was not proportional to the increase of buds per vine at the time of pruning.

It can be seen from the Table 1 that the highest average value of sugar content in must was reported in the variant I with planting density 3x0,75m, amounting to 19,1% (meaning that the grapevine life space was the smallest, which coincided with the results of Žuni et al., 2000), and the lowest one in the variant II (planting density 3x1,25m). The content of the total acids was found to range from 7,2 to 7,5 g/l.

Conclusion

The average content of sugars in grape juice (must) during the study year (2011) was found to depend on the life space of the grapevine.

Thus, the highest sugar content was revealed at dense planting (3x0,75) amounting to 19,1%, whereas the lowest one was reported at the thinner (3x2,0) planting, being 18,0%. As for acids, their overall content was found to range from 7,2 to 7,5 g/l.

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DIFFERENT XENIA EFFECT ON STERILE AND FERTILE VERSIONS OF HYBRIDS IN MAIZE

SofijaBOZINOVIC[1*], Jelena VANCETOVIC[1], Slaven PRODANOVIC[2], Zoran CAMDZIJA[1], Milan STEVANOVIC[1], Nikola GRCIC[1], Milos CREVAR[1]

[1]Maize Research Institute ZemunPolje, Belgrade, Serbia,
[2]Faculty of Agriculture, University of Belgrade, Belgrade, Serbia
(Corresponding author: sbozinovic@mrizp.rs)

Abstract

Cytoplasmic male sterility (*cms*) in maize is used to increase the quality of hybrid seed production and reduce its costs. Xenia is a direct cross fertilisation effect on the grain traits of the female component in the year of crossing. The combined and individual effects of cytoplasmic male sterility and xenia on two ZP maize hybrids were studied. This effect is called plus-hybrid effect and can be used for improving grain yield and grain quality in maize. The trials with crossess between two cms hybrids and their fertile counterparts and five unrelated hybrids were set up at one location during three consecutive years.

By examining the individual effects of *cms* and xenia we have observed that the xenia effect on some of the traits differs for sterile and fertile versions of the same hybrid This was obsered for 1000 kernel weigth, grain number per m^2 and relative oil and starch kernel content.

It seems like there is a kind of interaction between the cytoplasmic male sterility and xenia.

Key words: *cytoplasmic male sterility, xenia, pollination, maize*

Introduction

Cytoplasmic male sterility (*cms*) in maize is used to increase the quality of hybrid seed production and reduce its costs. While many researchers (Duvick, 1958; Everett, 1960; Josephson and Kincer, 1962) reported an inconsistent or even negative effect of *cms* on maize grain yield, Rogers and Edwardson (1952), Duvick (1965), Sanford (1965) and Pinter (1986) found higher yields of *cms* individuals due to more prolific plants. Two studies confirmed the female advantage of *cms* hybrids in more modern plant material (compared to hermaphrodite individuals) as well as the effect of environmental conditions (Kalman et al., 1985; Stamp et al., 2000). These facts encourage growers to grow hybrids with partially recovered fertility, that is a mixture of sterile and fertile variants of the same hybrid (Vidakovic and Vancetovic, 1994).

Xenia is a direct cross fertilisation effect on the grain traits of the female component in the year of crossing. Hoekstra et al., (1985), Weiland (1992), Westgate etal.(1999), Weingartner et al. (2002a, b) and Bozinovic et al. (2010a) found out a significant grain yield increase obtained by crossing with different pollinators. Weingartner et al. (2002a, b) and Bozinovic et al. (2010a) also found out great xenia impact on kernel number. These modifications result from the impact of xenia on several physiological traits, which play key roles in kernel development (e.g. the kernel growth rate (Seka and Cross, 1995) and/or enzyme activities and the duration of the grain-filling period (Bulant and Gallais, 1998; Bulant et al., 2000)). The change of the grain composition due to xenia was studied by Lambert et al. (1998) Tsai and Tsai (1990) Weingartner et al. (2004) Vancetovic et al. (2009).The xenia effect on grain

quality has been in practice since the 1990s. The system to improve qualitative kernel traits (TopCross system) was patented by DuPont Specialty Grains, Des Moines, Iowa, USA.

A new approach, dating from the end of the 20th century consists of mixing a sterile version of a yielding hybrid with a fertile version of unrelated hybrid with the aim to express a positive effect of *cms* and xenia. The combined effect of *cms* and xenia is referred to as the Plus-hybrid effect (Weingartner et al. 2002 a, b). This phenomenon was also investigated by Vancetovic et al. (2009) and Bozinovic et al. (2010 a, b).

The aim of this experiment was to examine the Plus-hybrid effect on the most important agronomic traits. By examining the individual effects of *cms* and xenia we have observed that the xenia effect on some of the traits differs for sterile and fertile versions of the same hybrid, and that reffers to some kind of sterile cytoplasm × pollinator interaction. We will present our results related to this phenomenon.

Material and methods

The three-replicate trial was carried out in the experimental field of the Maize Research Institute, Zemun Polje, Beograd-Zemun, in 2008, 2009 and 2010 according to the randomised complete block (RCB) split-plot experimental design. Two sterile (*cms-S*) hybrids (ZP-1 st and ZP-2 st) and their fertile counterparts (with normal - N cytoplasm) were used in the experiment as females, while five fertile hybrids (ZP-1, ZP-2, ZP-3, ZP-4 and ZP-5) were selected as pollinators.

The observed female components represented the main plots (sterile and fertile versions of the hybrids ZP-1 and ZP-2). Fertile female component plants were detasseled prior to pollination. The fertile hybrid pollinator blocks (subplots) consisted of 14 rows, each 18 m long. The rows were 0.75 m apart and the plant density was 77,220 plants ha^{-1}. The trial was planted mechanically and harvested by hand.

A combined effect of *cms* and xenia was observed as a difference between effect of xenia on the fertile and sterile version of the same hybrid. The xenia effect was calculated on the basis of differences between average values of the traits of the non-isogenically and isogenically pollinated hybrid.

These traits were studied: grain yield (tha^{-1}), 1000 kernel weigth, kernel number per m^2, oil, protein and starch percentage in kernel.

To correct for non-normality all statistical analyses for percentage traits were done on arcsine transformed values. A *t*-test was performed to test the significance of differences between the appropriate means.

Results and discussion

Sterile and fertile versions of ZP 1 and ZP 2 showed different reaction to xenia (Table 1). Although xenia of ZP 4 influenced differently on ZP 1st and ZP 1ft and xenia of ZP 4 and ZP 5 influenced differently on ZP 2st and ZP 2ft for grain yield, it was not significant. ZP 5 xenia had negative impact at the same level of significance on both versions of ZP 1 for this trait. Xenia influenced differently on 1000 kernel weight for second hybrid. ZP 1 and ZP 3 had significant impact on ZP 2ft, but not on its sterile version ZP 2st. It is interesting that ZP 2st under the influence of ZP 1 had lower value for this trait, whereas ZP 2ft had significantly higher value for this trait in accordance to its sterile i.e. fertile version isogenically pollinated. Considering number of kernels per m^2 it can be concluded that fertile versions of both hybrids statistically significantly reacted on ZP 5 xenia, while their sterile versions didn't react so significant.

Table 1. Xenia effect on sterile and fertile hybrids for grain yield, 1000 kernel weight and kernel number per m^2 for all three years.

Hybrid[a]	Pollinator	GY (tha^{-1})		1000KW		KN/m^2	
		St	Ft	St	Ft	St	Ft
ZP 1	ZP 2	0.32ns	0.20ns	-3.85ns	8.64ns	58.07ns	-65.41ns
	ZP 3	-0.27ns	-0.31ns	8.48ns	6.38ns	-58.88ns	-9.16ns
	ZP 4	-0.21ns	0.05ns	3.54ns	-4.99ns	-13.53ns	11.92ns
	ZP 5	-0.76†	-0.71†	-6.38ns	-13.99	48.57ns	221.72†
ZP 2	ZP 1	-0.15ns	-0.33ns	-7.68ns	18.82*	2.31ns	105.45ns
	ZP 3	0.17ns	0.42ns	4.19ns	22.99*	-110.21	-34.77ns
	ZP 4	-0.02ns	0.33ns	-1.32ns	5.05ns	-43.07ns	28.57ns
	ZP 5	-0.71ns	0.20ns	-5.99ns	-1.98ns	127.95†	322.78**

GY - grain yield, 1000KW - 1000 kernel weight, KN/m^2 - kernel number per m^2. ns- statistically not significant, †- significant at the 0,1 probability level, * - significant at the 0,05 probability level, ** - significant at the 0.01 probability level.

[a] The values in all tables indicate differences of shown ZP 1 × pollinator combinations with regard to ZP 1 × ZP 1 for the first hybrid and ZP 2 × pollinator combinations with regard to ZP 2 × ZP 2 for the second hybrid, for both sterile an fertile versions.

It is observable (Table 2) that xenia effect on proportion of oil were statistically more significant in grain of ZP 1st than of ZP 1ft. Moreover, apart from ZP 4, xenia effects of remaining pollinators of both versions of the hybrid ZP1 were negative for this trait. Xenia effects of ZP 1, ZP 3 and ZP 4 for this trait were significantly positive on fertile ZP 2 and poor on ZP 2st. These effects on the grain protein content of both studied hybrids were not significant, although were different on their sterile and fertile versions. Xenia effects on the grain starch content were not statistically different in both versions of the hybrid ZP 1. It may be noted that the fertile hybrid ZP 2 responded more poorly to isogenic pollination for the starch proportion in grain. Two pollinators statistically negatively affected ZP 2, while ZP 5 positively affected both versions, but effects for this trait were significant only in the sterile version.

Table 2. Xenia effect on sterile and fertile hybrids for oil, protein and starch percentage for all three years.

Hybrid	Pollinator 2	Oil		Protein		Starch	
		St	Ft	St	Ft	St	Ft
ZP 1	ZP 2	-0.18*	-0.12ns	0.13ns	-0.12ns	0.29ns	0.03ns
	ZP 3	-0.31**	-0.19†	-0.14ns	-0.25ns	0.48†	0.27ns
	ZP 4	0.03ns	0.03ns	0.31ns	-0.11ns	0.02ns	-0.02ns
	ZP 5	-0.23 *	-0.12ns	0.30ns	0.15ns	0.34ns	0.12ns
ZP 2	ZP 1	0.07ns	0.25 **	-0.21ns	0.26ns	-0.30ns	-0.47†
	ZP 3	-0.08ns	0.14†	0.09ns	-0.10ns	0.18ns	-0.01ns
	ZP 4	0.04ns	0.23*	-0.23ns	-0.05ns	0.12ns	-0.48†
	ZP 5	-0.25*	-0.06ns	-0.36ns	-0.27ns	0.48**	0.13ns

ns- statistically not significant, †- significant at the 0,1 probability level, * - significant at the 0,05 probability level, ** - significant at the 0.01 probability level.

Although the effect of the phenomenon of xenia on the chemical composition of grain has been proved and explained, the xenia effects on the grain yield and the number of kernels in maize are not biologically quite clear. Bulant *et al.* (2000) investigated the enzyme activity in cross-fertilised kernels and found that differences in this activity were expressed soon after fertilisation but were insufficient to explain the xenia effects on kernel weight. Given data on existence of xenia effects on grain yield and the number of kernels per m^2 are in accordance with those obtained by Weingartner et al. (2002 a, b). Furthermore, Weingartner et al. (2004), as well as, Tsai and Tsai (1990) have recorded a significant oil and protein increase in maize grain under effects of xenia, but results obtained in our studies show that effects of xenia on oil differed between hybrid versions, while the protein contents were not significantly affected by xenia. Studying xenia effects on selected traits, Weingartner et al. (2002 a, b) and Weingartner et al. (2004) have estimated this effect as sterile hybrid nonisogenically pollinated with regard to sterile hybrid isogenically pollinated. In their experiment the effects of cms and xenia on the tested hybrids were not separately observed, while we did it, additionally evaluating xenia effects even on fertile versions of our hybrids. Theoretically, xenia effect on sterile and fertile versions of the same hybrid should be equal or at least should be positive or negative for the same hybrid. This study shows that this is not so, and that maybe cytoplasm in certain way modifies xenia effects on a hybrid. Even though such studies on the phenomenon of xenia have not been conducted in such a way, it is our opinion that it would be interesting and useful to determine the nature of this phenomenon.

Conclusion

The xenia mechanism of action on a certain traits has not been explored enough. By examining xenia effect through Plus-hybrid effect we concluded that it has different impact for some traits on sterile and fertile versions of one hybrid, but some kind of regularity could not be observed and confirmed. Besides the influence of the nuclear genome of a female component on this phenomenon, it is also necessary to study effects of sterility, because it is obvious that a certain modification occurs.

Acknowledgments

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VARIETAL SUSCEPTIBILITY OF POTATO TO THE BLACK CUTWORM, *AGROTIS IPSILON* (HFN) (LEPIDOPTERA: NOCTUIDAE)

Faiza E. E. SALAH[1*], Abdien M. Zein ELABDIEN[2], Salah EL –TOM[2], Adam K. AZRAG[3], Hayder ABDELGADER[4]

[1]Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan
[2]Faculty of Agriculture, University of Khartoum, Khartoum, Sudan
[3]Ministry of Agriculture, Department of Plant Protection, Eldamazin, Sudan
[4]Agricultural Research Corporation, Sudan
(Corresponding author: faizaruba@yahoo.com)

Abstract

The black cut worm (BCW), *Agrotis ipsilon* (HFN) (Lepidoptera: Noctuidae), is a highly polyphagous pest of several winter crops and became a major potato pest in lighter soils of Khartoum state. BCW inflicts serious damage on the tubers, resulting in drastic yield losses annually. Despite its economic importance, little attention has been directed to this pest in the Sudan.
Field experiments were conducted for two seasons at Karari, Khartoum state, central Sudan, to evaluate 10 potato varieties (lines/accessions) for resistance to BCW damage. The percentage damaged tubers numbers (%DTN) and weight (% DTW) as parameters were used for evaluation. Differences in both parameters were very highly significant, due to varieties and seasons (P < 0.001 for both parameters). The interaction between the varieties and seasons was also very highly significant (P < 0.001). Two parameters were found to correlate strongly and significantly (r = 0.83). The 10 potato varieties (lines/accessions) were also subjected to a series of no – choice tests in the laboratory for two seasons. The tests included testing the larval and pupal developmental rates on potato tubers. Significant differences were noted in larval weight gains (LWGs), due to differences in potato varieties across the various feeding tests. Alpha, Lesita and Bright varieties showed higher levels of resistance both in the field and in the laboratory, while Desiree and Spunta showed the highest level of susceptibility. Factors governing the causes for resistance were discussed.

Keywords:*Sudan, Varietal Susceptibility, Potato, Black Cutworm, Agrotis ipsilon*

Introduction

Potato, *Solanum tuberosum* L., is one of the main food crops in the world.
In the Sudan, the crop was initially introduced in 1935, since then the area has increased steadily to meet the increasing domestic demand.
The black cut worm (BCW), *Agrotisipsilon* (Hfn) (Lepidoptera: Noctuidae), is recognized as one of the most damaging insect pests of potato in the Sudan (Schmutterer, 1969, Salih, 1985) causing a loss as high as 50% in tubers of some fields (Siddig, 1987).
The objective of this study was to evaluate ten potato varieties for resistance to the BCW damage, both at field and Lab. levels in search for feasible control measures of the pest.

Materials and methods

A/ Field potato variety screening for resistance to the BCW:

Two field experiments were conducted for 2 seasons using 10 potato varieties, viz. Alpha, Ajax, Bright, lesita, Mondial, Draga, Spunta, Desiree, Escort and Famosa.

The tubers were planted on 27 and 16 November for season 1&2, respectively in a randomized complete blocked (RCB) design. Four replicates of plot measuring 8.0 m x 1.5 m at 20 cm distances between plants were used, but no chemical treatments.

At harvest, the following parameters were assessed:

1/ No. and weights (kg) of sound and damaged tubers.

2/ Percentages of damaged tubers (calculated).

The data were analyzed by ANOVA after arc-sin transformation, DMRT was used to separate means with significant differences.

The combined analysis was carried out using the method of Gomez & Gomez (1984).

B/ Lab. tests:

a) Effects of potato varieties leaves on the BCW development:

Three-day-old larvae were fed on excited leaves from the 10 potato varieties; one larva / 4.0 x 1.8 cm cup, 15 cups, replicated 4 times under laboratory conditions of 28±1°C, 25-40%R.H. and 12:12 L: D photoperiod till the pupal stage.

The following parameters were observed and recorded:

Mean larval weight (mg) after 25 days of feeding on their corresponding diet.

Mean larval duration (days).

Mean fresh pupal weight (mg).

Mean pupal duration (days).

For season (2) the mean larval weight (mg) after 18 days of feeding was the only parameter recorded.

The data were statistically analyzed and the means were separated by DMRT.

b) The effects of variety tubers on BCW development:

Similarly, 2 experiments were carried out in the Lab. simultaneously with the leaf feeding experiments except that the larvae were fed on the tubers of the 10 potato varieties.

The experiments were designed in the RCB of 4 replicates and 20 cups /treatment.

The following parameters were observed & recorded:

Mean larval weight (mg) after 25 days of feeding.

Mean larval duration (days).

Mean fresh pupal weight (mg).

4-   Mean pupal duration (days).

The data were statistically analyzed and the means were separated byDMRT.

C/ Biochemical factors for resistance:

Sliced tubers of the following six varieties: Alpha, Lesita, Desiree, Mondial, Escort and Draga were biochemically analyzed in the lab. for percentage dry matter content, starch, protien, tannins, glycoalkaloids(solanine ng/100g) to test for some nutrients and/or allelochemicals of the tuber of potato that might influence the potato susceptibility to injury caused by the BCW.

Results and discussion

A/ Field potato varieties screening for resistance to the BCW:

The field performance of the 10 potato varieties to the natural infestation of the BCW for seasons (1) and (2) is shown in tables (1) and (2),respectively where highly significant differences (P < 0.001) in % DTN were evident due to varietal susceptibility (table 1). For season (2) the differences between the means % DTN were significant (P < 0.05) but were highly significant (P < 0.01) for % DTW

Table 1. Ranked variety mean % DTN of 10 potato varieties screened naturally for cut worm resistance (season 1).

Variety	Mean % DTN[*1]
Escort	37.83 (37.94)[*2] a
Desiree	25.33 (29.60) ab
Spunta	21.20 (27.42) bc
Mondial	20.18 (26.49) bc[*3]
Ajax	18.34 (24.73) bcd
Draga	18.29 (24.50) bcd
Famosa	16.39 (21.86) bcde
Bright	9.04 (17.28) cde
Alpha	7.32 (15.60) de
Lesita	5.34 (12.88) e
G Mean	22.81
SE ±	3.059

[*1]Means of 4 replicate
[*2]Figures in parentheses were the angular transformed values
[*3]Means followed by the same letters(s) were not significantly different.

Table 2. Variety mean % DTN and % DTW of 10 potato varieties screened for resistance to the BCW (season 2)

Variety	Means[*1]	
	% DTN	% DTW
Desiree	47.90 a (43.80)[*2]	57.87 a (49.54)
Spunta	46.76a[*3] (43.14)	44.61 ab (41.90)
Ajax	34.95 ab (35.09)	37.82 abc (37.94)
Fomosa	32.03ab (34.41)	34.32 abcd (35.85)
Draga	29.63 ab (32.31)	32.36 abcd (34.70)
Alpha	23.68 ab (29.13)	15.63 cd (23.26)
Lesita	17.01 b (23.30)	22.07 bcd (28.04)
Bright	14.96 b (22.56) b	13.20 d (21.30)
Escort	19.00 b (22.31)	30.24 abcd (35.79)
Mondial	14.60 b (21.97)	15.28 cd (23.03)
G.M	30.802	33.133
SE ±	4.7265	4.888

[*1]Means of 3 replicates
[*2]Figures in parentheses are the arc – sin percent transformation.
[*3]Means followed by the same letters(s) were not significantly different.
(P > 0.05) in Duncan's MRT.

Further statistical analysis showed that the measured parameters viz. % DTN and % DTW correlated strongly and significantly (r = 0.83) (table 3), and that the varieties which have % DTN < Grand mean were found to have % DTW < Grand mean (table 2).

The combined analysis of variance on the percentage DTN of the to potato varieties screened for resistance to the BCW for season (1) gave very highly significant interaction between season and variety (P < 0.001) as well as highly significant differences (P < 0.001) in cut worm incidence (Table 4).

Table 3. Correlation matrix between the 2 susceptibility indices (% DTN and % DTW) of 10 potato varieties screened for cut worm damage.

Parameter	Correlation coefficient DF = 8	
	1	2
1% DTN	1.000	
3% DTW	0.832 **	1.000

**Significant at P = 0.01 (r ± 0.552)
%DTN = Percent damaged tuber numbers.
%DTW = Percent damaged tuber weight.

Table 4. Combined analysis of variance on the % DTN of 10 potato varieties screened for resistance to the BCW (season 1).

Source	df	SS	MS	F - Ratio
Seasons	1	2191.16	2191.16	46.0869***
Varieties	9	6136.23	681.80	14.340 ***
Interaction (Season x Var)	9	3925.00	436.12	9.173 ***
Pooled Error	36	1711.584	47.544	
SE ±	= 4.8757			

***Highly significant (P < 0.001)

The varietal weighted means for the mean % DTN (table 5) showed that 4 varieties were found to sustain weighted mean DTN < G. mean in the 2 seasons. These varieties were: Mondial, Alpha, Bright and Lesita and thus considered to be least susceptible (table 6).

Table 5. Weighted mean[*] damage of the BCW on the harvested tuber numbers of 10 potato varieties screened in season (1) and (2).

Variety	Mean percent damage of the harvested[*1] tuber number (% DTN)		
	Season (1)	Season (2)	Weighted mean DTN
Desiree	25.33(29.6)[*2] ab	47.90(43.80) a	(36.68) a
Spunta	21.20(27.60) bc	46.76(43.14) a	(35.23) ab
Escort	37.83(39.92) a	19.00(22.31) b	(31.11) abc
Ajax	18.34(24.73) bcd	34.95(35.09) ab	(29.91) abc
Draga	18.29(24.50) bcd	29.63(32.31) ab	(28.41) abc
Famosa	16.39(21.86) bcde	32.03(34.41) ab	(28.14) abc
Mondial	20.18(26.49) bc	14.60(21.97) b	(24.23) abc
Alpha	07.32(15.60) dc	23.68(29.13) ab	(22.35) abc
Bright	09.04(17.28) cde	14.96(22.56) b	(19.92) bc
Lesita	05.34(12.88) e	17.01(23.30) b	(18.09) c
G. Mean	17.93(22.81)	28.05(30.80)	(27.41)
SE ±	3.059	4.727	4.785[*3]

[*1]Variety mean for the mean DTN of the two seasons.
[*2]Figures in parentheses are the arc. sin percent.
[*3]Calculated from the combined analysis of variance.
[*]Means followed by the same letter(s) were not significantly different
(P > 0.05).

Table 6. Least susceptible (relatively resistant) potato varieties with both weighted mean DTN and DTW < G. mean compared to susceptible checks.

Variety	Weighted[1] Mean % DTN	Mean[2] DTW
Lesita	18.09 a[3]	28.04 abc
Bright	19.92 ab	21.30 a
Alpha	22.35 ab [4]	23.26 ab
Mondial	24.23 bc	23.26 ab
Mean	21.148	23.97
G. Mean	27.41	33.13
Desiree (S. check)	36.68	49.54
Spunta (S. check)	35.23	41.90

[1]Means of 3 replicates in two screening trials.
[2]Means of 3 replicates in one screening trial.
[3]Figures presented in the table are the angular transformed values.
[4]Means followed by the same letters were not significantly different according to Duncan's MRT.

B/ Laboratory tests:
a) Effects of potato varieties leaves on the BCW development.
From table 7 (Test 1) where the larvae were allowed to feed for 28 days, the 3 varieties: Spunta, Famosa and Desiree (described as susceptible varieties in the field screening trials) had the highest larval weight gain (LWG) > G. mean.

Table 7. Differential weight gains (mg) of the BCW larvae fed on excited leaves of 10 potato varieties for 28 and 18 days in tests (1) and (2), respectively.

Variety	Mean LWG (mg)	
	First test (1)	Second test (2)
Mondial	761.2 a	203.3 abcd
Spunta	741.1 ab	226.0 ab
Fomosa	634.2 abc	165.8 cd
Desiree	632.3 abc[1]	157.8 d
Lesita	601.4 abc	234.8 a
Escort	595.0 abc	49.7 e
Draga	594.0 abc	177.9 bcd
Bright	588.0 bc	38.7 e
Ajax	575.2 bc	212.7 abc
Alpha	503.3 c	219.9 ab
G.M	622.57	168.66
SE ±	49.315	14.824

[1]Mean of followed by the same letter(s) were not significantly different in Duncan's MRT.

The differences between the means LWG were significant (P < 0.05). However, in test (2) where the larvae were allowed to feed for 18 days only, the differences between the means LWGs were highly significant (P < 0.001, table 7).
Comparing the results of the 2 tests, the differences were much more prominent in the first than in the 2nd test and that resistance due to potato leaf feeding was more detectable in late than in early larval stages.
b) Effect of variety tubers on cut warm development:
Table (8) shows that the differences due to tuber varieties were highly significant (P < 0.001) for LWG, larval longevity (P < 0.001) and pupal weights (P < 0.05). It could be seen that 5 varieties sustained LWG > G mean, those were Desiree, Mondial, Escort, Spunta and Famosa. Those varieties (except Mondial), showed high susceptibility in the field screening trials and produced (including Monidal) higher larval weight gains in the leaf feeding tests.

Five varieties were found to have LWG < G. mean; of those Alpha and Bright produced the lowest LWG of 132.3 and 112.5 mg, respectively. Also, Alpha had the longest larval duration as well as the lowest pupal weight, while Desiree (susceptible) had the heaviest**.**

Table 8. Mean L. weight gain (mg), larval duration (days) and fresh pupal weight (mg) of the BCW larvae fed on sliced tubers of 10 potato varieties in a laboratory no-choice test.

Entry	Variety Means[*]		
	Larval Weight (mg)	Larval longevity (day)	Pupal Weight (mg)
Desiree	342.4 a	40.7 d	319.2 a
Mondial	336.5 a	43.4 cd	281.6 abc
Escort	312.9 ab	50.3 ab	269.2 bc
Spunta	294.1 abc	51.7 ab	272.4 abc
Famosa	264.3 abc	47.7 bc	318.8 a
Draga	220.5 bcd	47.9 bc	313.4 ab
Lesita	199.4 cd	53.2 ab	250.2 c
Ajax	192.3 cd	51.0 ab	283.6 abc
Alpha	132.3 d	56.7 a	250.0 c
Bright	112.5 d	48.7 bc	264.0 c
G. Mean	240.72	49.13	279.24
SE ±	34.5	2.09	14.04

[*]Means followed by the same letter(s) were not significantly different (P > 0.05).

The correlation matrix (Table 9 and 10) showed that the % starch correlated positively and significantly with LWGs, % DTN and % DTW (test 1 and 2).

Dry matter was negatively correlated with LWGs in both tests. The % protein and tannins of the tubers were found to have no significant correlation with LWGs in the laboratory or with tuber damage in the field.

A negative correlation was found between the amount of solanine in the variety tubers and the LWGs due to feeding on them in both tests, and damage observed in the field in terms of % DTN and % DTW.

Table 9. Mean biochemical constituents of 6 potato varieties with their mean LWG (mg) in the laboratory and the resulting % DTN and DTW in the field

Variety	Means								
	% Starch	% dry Matter	% Protein	Solanine ng/100 g	% Tannin	Mean % L.W test 1	Mean % DTN	Mean % DTW	Mean L.W tests 2 tubers
Escort	52.0	26.0	9.8	0.00	0.115	82.3	25.84	35.97	82.33
Mondial	52.0	22.7	7.2	15.0	0.150	133.15	22.46	23.03	135.58
Desiree	64.5	22.45	8.58	0.00	0.190	288.8	43.8	49.54	337.66
Draga	40.1	24.6	10.87	18.0	0.115	68.7	33.0	34.7	67.33
Alpha	40.1	27.23	7.86	31.0	0.06	51.1	29.13	23.26	52.83
Lesita	35.8	25.33	8.269	0.00	0.086	33.83	24.35	28.04	33.83
G.M	47.41	24.70	8.76	10.66	0.12	109.65	29.76	32.42	118.26

Table (10): Correlation matrix between susceptibility parameters (% DTN. % DTW. LWG) in season (1), LWG in season (2) and the 5 biochemical components of 6 potato varieties differing in the susceptibility

Parameters	Correlation coefficients df = 4								
	1	2	3	4	5	6	7	8	9
1.Starch %	1.000								
2.Dry Matte %	-0.618	1.000							
3.Protein %	-0.119	-0.146	1.000						
4.Tannins %	+0.884	-0.498	-0.013	1.000					
5.Solanine	-0.419	-0.328	-0.156	-0.487	1.000				
6.LWG (1991)	-0.799*	-0.376	0.095	0.738*	-0.418	1.000			
7.LWG (1992)	0.801*	-0.360	0.059	0.743*	-0.414	0.999**	1.000		
8.% DTN	0.553	-0.387	0.282	0.550	-0.141	0.913**	0.908**	1.000	
9.DTW	0.682	-0.277	0.450	0.688	-0.593	0.912**	0.898**	0.850**	1.000

* Significant at p = 0.05	r = 0. 739 at p = 0.05
** Significant at p = 0.01	r = 0. 811 at p = 0.01

From the results, it was apparent that the pest population level was sufficient enough to allow for adequate evaluation of resistance. This has resulted in significant differences (p<0.001 and p>0.005) in the number of damaged tubers (%DTN) of the varieties tested in the first and second screening season, respectively. It was also noted that the overall mean % DTN was higher in the second than in the first screening trials; it was 30.8 %, and 22.87, respectively, an indication of a higher injurious level of the pest in the second than in the first screening trial.

The results indicated that there were clear differences in the degree of reaction of the potato varieties with the BCW. Some have reflected only slight tuber damage, others were deleteriously damaged and none was immune. The results were in conformity with the findings of Parihar and Singh (1988) in India who concluded that none of the 12 varieties they screened was immune to *A. ipsilon* but miner damage was recorded in the tuber of some varieties. From the results, the varieties Lesita, Bright, Alpha and Mondial were the least susceptible in the field over the 2 experiments, with weighted mean DTN of 18.09, 19.9, 22.25 and 24.23%, respectively, and weighted mean DTW of 38.04,21.3, 23.26 and 23.36%, respectively. On the other hand the varieties Desiree and Sponta were found to be the most susceptible in the field with weighted mean DTN of 36.6 and 35.23%, respectively, and weighted mean DTW of 49.54 and 41.9% respectively.

The variety Desiree being one of the most susceptible varieties was also reported by Anon, (1986) to be highly susceptible to the golden nematode. However, Spunta which proved to be susceptible to the BCW in the present work was found by Doss (1987) in Egypt to be the only resistant variety among 17 varieties, he tested to *P. opercullela* (Zeller), *Gryllotalpa gryllotalpa* and *Euzophera ossentella*. This could be explained as stated by (Painter 1951) that the genes governing resistance to a certain pest could cause susceptibility to other pests.

The nearly perfect correlation (r = 0.9972) between the mean LWGs due to feeding on potato foliage and the LWGs due to feeding on the tubers strongly pointed out the presence of a shared antibiosis factor(s) in both the leaves and the tubers which confirmed the findings of Deahl et al. (1973) and Sanford et al. (1984) who showed that the toxic substance was found in both the leaves and the tubers.

The resistant varieties in the field i.e Lesita, Bright, Alpha except Mondial again showed higher tendency of resistance to the BCW larva, expressed as reduced LWG, prolonged larval duration, reduced pupal weight and higher mortality rates. However, duration of pupal stages did not differ significantly among the tested varieties. This result was confirmed by the

finding of Buching and Turpin (1977) who showed that pupal duration of the BCW did not differ significantly among the various plant species they tested.

On the other hand, the susceptible varieties in the field: Spunta and Ajax again were found to sustain consistently higher susceptibility levels across the various laboratory feeding tests. However, the resistance of Mondial which exhibited higher level of resistance in the field trails and revealed higher susceptibility level in the laboratory feeding tests, would be probably related to mechanisms other than antibiosis, e. g. non- preference or tolerance. Such mechanisms need further search.

In the present study, there appears to be a cause and effect relationship between the TGA (solanine) and resistance to BCW. Larval weights correlated negatively with solanine (r = 0.418, r = 0.414) in the 2 laboratory tests, respectively, and with tuber damage in the field (r = -0.593). Desiree with zero ng/100 g solanine was highly susceptible in the field and in the laboratory, while Alpha with 31 ng/100 g solanine was resistant.

Conclusion

The use of the resistant Alpha, Lesita and Bright should provide a foundation on which an IPM programme could be built. Resistant varieties are particularly valuable in the Sudan which often suffers from crop losses by insects in the presence of scarce resources. Resistant varieties are easily adopted by farmers at no extra cost.

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THE EFFECT OF DIFFERENT WAYS OF GROWING CELERY ON THE GROWTH DYNAMICS OF CELERY LEAF AND TOTAL CELERY WEIGHT

Goran PERKOVIC[1], Aleksandra GOVEDARICA - LUCIC[1], Natasa MIRECKI[2]

[1]Faculty of Agriculture, University East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
[2]Biotechnical Institute, Podgorica, Montenegro
(Corresponding author: perkan66@gmail.com)

Abstract

The aim of this study is to determine the effect of different modes of celery production on the dynamics of formation and growth of leaf weight, as well as to determine the dependence and correlation between the formation of leaf weight and root weight. Dynamics of celery growth depends on agro-technical measures applied during production process as well as agro ecological conditions that occur during the growing season. In the experiment, the effect of six different methods of cultivation was being studied, as follows:

celery from direct sowing,

bare-root seedlings,

seedling in containers,

soil mulching,

no soil mulching.

Every variance was cultivated on bare and mulching soil

The results clearly indicate that, regardless of the way of production, growth and development of the celery is happening through five different periods. The way of producing has a significant effect on weight gain dynamics and total celery weight. The most intense increase was found in celery produced from the container seedlings, while the weakest growth intensity was found in celery produced by direct sowing.

Key words: celery, direct sowing, seedling production, seedling in containers, method of cultivation, growth, yield.

Introduction

Celery production is a very long process that consists of a series of agricultural measures for which there should not be a failure. Any failure is reflected in the success of the production which is the reason why this production is extremely challenging and lucrative.

Specific growth rate, especially of thickened roots, and, high sensitivity in the phase of rooting stage make celery production one of the most complex productions. Slow germination (very small seed, a lot of essential oils), requires that the celery be most commonly produced from seedlings. Although the production of seedlings is the most sensitive stage in the production of celery, it enables the celery growth under the optimal conditions of the protected enclosures.

Leaf weight affects the amount of absorbed light energy, and therefore the yield is, up to a certain limit, in close relation with the dimension of the leaf weight and the length of its duration. Since thickened root is the result of the transition of nutrients from the leaves to hypocotyls, epycotyl and radical, the intensity of leaf weightincreas, its photosynthetic activity and duration affect the intensity of the increasing of root weight.

Celery seedlings at the time of planting must be optimally developed, allowing the quick recovery of the root, rooting and further growth of the plant. Too young seedlings root rapidly

but grow slowly, while too old seedlings slowly restore root system, and therefore a certain number of leaves dries out.

Materials and methods

Experiments were carried out on land belonging to gray-brown non-calcareous chernozem soil type (area of Semberija) ,where the two-factorial trial with three variants in four replications was set. The basic plot size was 5 m^2 with 40 plants each.

In the production of seedlings, planting was done in the land of hot bed and in containers (dimensions of the containers were 50x30x8 with 110 globoid dents) on 15th March and planting in the field on 17th April (1995) i.e. 20th April (1996).

Celery was planted (18th May 1995 i.e. 20th May in 1996) in the inter-row at a distance of 50 cm, and the distance in rows was 25 cm. Sowing and planting were done by hand in an optimal agro-technical term. Simultaneously with the sowing and planting, the mulching of soil with photodegradeable mulch (folium) was done.

During the growing season, every thirty days the plants were analyzed with the aim of monitoring the growth dynamics.On that occasion, the following was determined: the total weight of the plant, and weight of leaves, the weight of roots, the number of leaves, the length of the roots and leaves.

Results and discussion

Growth dynamics of celery weight and growth dynamics of leaf weight have five characteristic periods.The first period is the period from sowing to the formation of the first 4 leaves; the second period lasts from the time of planting to the period of the end of the rooting.The third period when the celery intensively increases leaf and root weight begins in July.During the fourth period, during the hot days of August, celery weight increases slowly. In the fifth period, the phase of the harvest maturity, the celery weight begins to increase more intensively.

Slower increase in weight in the first period of vegetation is characteristic for most vegetable crops.

The common feature is that in the beginning of vegetation leaf weight slowly increases (20th June),which is followed by the period of more intensive increasing of leaf weight,which coincides with the periods of the total intense of increase of plant (20th July) .

During August, the growth is slow, which is similar to the second period. Thus, daily increase in leaf weight, during June and August (second and fourth period) is 1.2 g / day.

Table 1. Average growth dynamics of leaf weight during the growing season

Period	20.3. - 20.5.	20.5. - 20.6.	20.6. - 20.7.	20.7. – 20.8.	20.8 – 20.9
Average (g/day)	0,033	1,31	4,90	1,25	3,28

However, in the period of harvest maturity (September), a new, more intensive, increase in leaf weight occurs with the formation of five to seven new leaves.

The specificity of increase of assimilation apparatus of celery is also reflected in the fact that during the period of maturation (20.8. - 20.9.) i.e. at the end of the growing season there is no reduction in leaf weight, which is specific for many root species.It is interesting that in this period increasing of leaf weight occurs more intensively (3.28 g / day).However, this rapid growth at the end of growing season is still somewhat more weakly expressed compared to the maximum intensity of growth, which is characteristic of the third decade of June and the first two decades of July.More intensive growth of leaf weight at the end of the growing season, takes place at the expense of nutrients from the root which is considered as harmful

effect.Different ways of growing celery significantly influenced the increase in the intensity of leaf weight throughout the growing season.

Different ways of growing celery had a significant impact on the intensity of increasing of leaf weight throughout the growing season, which is consistent with the results of research by *Dyduch, J (1980).*

Growth intensity of leaf weight in relation to the method of growing and growing season

At the beginning of the vegetation, during June, there are a significant differences in intensity of the increase in leaf weight produced using bare vessels and container seedlings with mulching.

Table 2. The average daily increase in leaf mass under different growing (g/plant/day)

Way of breeding	Growing season					
	I	II	III	IV	V	Average
Bare-root seedlings	0,042	1,58	8,33	0,83	0,63	**1,84**
seedling in containers	0,026	1,50	5,36	1,83	3,00	**2,02**
celery from direct sowing	0,030	1,16	3,10	2,33	3,65	**1,81**
Bare-root seedlings with mulching	0,042	1,58	4,83	0,50	3,80	**1,90**
seedling in containers with mulching	0,026	0,78	5,00	0,85	3,82	**1,85**
direct seeding with mulching celery	0,030	1,26	2,70	1,16	4,80	**1,82**
Average	**0,033**	**1,31**	**4,90**	**1,25**	**3,28**	**-**

Celery produced from direct seeding with and without mulching had the approximate intensity of the increase of leaf weight (1.1 - 1,2 g/day). Celery produced from direct sowing had a slower intensity of increase in leaf weight by 27%.For other types of growing celery the intensity of increase in leaf weight was constant (1.5 g / day).

During July, among other ways of growing celery, there are the greatest differences in intensity in leaf weight increase. During vegetation, there are two periods of intense increase in leaf weight.The most intense increase of leaf weight, in July, had celery seedlings produced from bare vessels (8.3 g/day).

The slow intensity in the increase of leaf weight, had celery produced from direct seeding with and without mulching.During this period, celery from direct seeding increases the weight by an average of 3.1 g / day, and celery produced from direct seeding with mulching increases weight by 2.7 g / day.Among other methods of cultivation there are no significant differences, but in relation to the production of celery seedlings from bare vessels, the intensity of the increase in leaf weight was 30-35% lesser.

The intensity of the growth of the total weight of celery in relation to the method of growing and growing season

The dynamics of growth of the variants examined is equable early in the season and during the first and second period and in the stage of technological maturity of celery root density (fifth term).

The biggest differences in the weight dynamics occurs between control (seedlings bare veins) and other ways of growing in the period of intensive growth of weight (period III) and in the fourth period when celery weight increases slowly.

The intensity of daily increase in weight of celery is equable in the first period and there are no significant differences between the various methods of cultivation. During the second period, daily increase in weight of celery produced from seedlings of bare veins is 2.38 g /

day, and the most intense daily increase in weight has celery produced from container seedlings (2.53 g / day). The lowest daily weight increase has celery seedlings produced from container with mulching (1.46 g / day), celery from direct seeding without mulching (1.7 g / day) and with mulching (1.8 g / day).

Celery seedlings produced from bare - vein seedlings have the highest intensity of growth of the total weight (11.66 g / day) compared to other methods of cultivation during the third period.

The smallest increase in the total weight has celery produced in direct seeding with and without mulching (4.1 and 5.86 g / day).

Celery seedlings produced from bare vein (2.83 g / day), the container seedlings (2.81 g / day) and from direct seeding with mulching (2.5 g / day) have the equal daily growth of total weight in the fourth period.

Celery produced from direct seeding (4.0 g / day) has the greatest increase in total weight in the fourth period. Celery seedlings produced from bare vein with mulching (1.0 g/day) has the smallest increase in the total weight in the fourth period.

Different ways of growing demand that the periods of slow and intensive growth of weight occur in different periods of vegetation, which is taken as the basic difference.

When considering the total mass of celery root density, the yield increases significantly with increasing leaf mass. Although there are different and often conflicting opinions, the prevailing attitude would be that the yield of the majority of cultivated plants increases with increasing leaf mass *(Kastori R., 1991.)*

Our results confirm that there is a positive correlation between the root mass density and leaf mass. (Table 3)

Table 3. Correlation coefficients, determination and undetermination of different ways of growing celery

Way of breeding	Coefficient		
	correlations	determination	undetermination
Bare-veins seedlings	0,8058	64,90	35,06
seedling in containers	0,8932	79,78	20,22
celery from direct sowing	0,9717	94,43	5,57
bare--veins seedlings with mulching	0,9360	87,61	12,39
seedling in containers with mulching	0,9183	84,34	15,66
direct seeding with mulching celery	0,9683	93,77	6,23
Average	0,9155	84,14	15,85

Interdependence increases leaf and root mass and being showed most clearly with the analysis at the celery plants produced by direct seeding. Specifically, the growth of all plants run continuously throughout the growing season and depends of the biological characteristics of species and production conditions. This is confirmed by the fact that it is precisely this mode of production that has a high correlation coefficient (r = 0.9717) and the lowest coefficient of undetermination (factor unanalyzed k2 = 5.57). Similar results come from *Borosic, J. (1990) and Markovic, V.et all (1992).* These authors emphasize the impact of development of root in container seedling on the intensity of the mass of the vegetation.

On average correlation coefficient was high in all the variants, which indicates that with an increase in leaf mass the mass of root density increases too, and that the greatest impact have unanalyzed factors in the production of seedlings and without mulching. Regression analysis showed that the dynamics of mass root density depends on the leaf mass and takes the form of second-order parabolic curve expressed general formula

$y = a + bx + cx^2$.

Less value is shown in these analyzed parameters and celery production of direct seeding in relation to the production of seedlings which corresponds to significant differences in relation to the production of seedlings.The parameter b indicates the change in value (mass of thickened root) which, depending on the value of leaf mass (x) has a positive value in the direct production of seeds directly reflecting the ever-growing and high significant value of the quadratic equation coefficieent.

Conclusion

Based on the two-year investigation of testing methods of growing influence on growth rate of leaf mass and total weight of celery, the following conclusions could be drawn:

During vegetation the most intense magnification of leaf mass has celery produced using containerized seedlings (2.02 g / day), and the lowest increase of leaf mass intensity (1.82 g / day) has celery produced by direct seeding with and without mulching

Celery manufactured with use of container seedlings increases its mass most intensily and achieves the highest total yield.

Production of celery in direct seeding gives significantly worse results in comparison with the production of celery seedlings which is a result of the great vulnerability of young plants in the initial phase of the open field..

The best method of production (for the Semberija and areas with similar climatic and soil conditions) is the production of celery from high quality, well-cultivated container seedlings.

Good results can be achieved by using celery seedlings bare veins, taking into account some benefits (social and biological) of such a mode of growing.

Mulching in these studies did not produce the expected results because of inadequate materials (PE foil) and absence of intertillage treatment which adversely affected the growth of roots. In addition to the celery mulching organic origin materials should be used, which will enable the application of some agricultural practices (interrow tillage, irrigation) at the time and in the manner that best suits celery.

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III

ENVIRONMENTAL PROTECTION AND ORGANIC AGRICULTURE

VARIATIONS IN NUTRIENTS AND DEVELOPMENT OF TOMATO PLANTS IN SOIL WITH OF URBAN SEWAGE SLUDGE

Fernando SENDRA[*], Francisco Javier MARTÍNEZ-CORTIJO

[1]Universitat Politècnica de València, Spain
(Corresponding author: fsendra@fis.upv.es)

Abstract

Accumulation of waste represents a huge problem for the urban development. One possibility of useful application of such waste is its application in agriculture. The effect of urban sewage sludge on the vegetative growth of tomatoes was checked on four types of soils from the Valencian region in Eastern Spain. Young plants were grown during four months in two experimental conditions, a control only with local irrigation water, and a treatment in which sewage sludge was added to each pot at the beginning of the experiment and watered with the same water type. Composition of soils, irrigation water and sewage sludge were analyzed and vegetative parameters, such as total length, length of stems and branches, and biomass of roots, stems, branches and leaves were measured. Plants achieved better vegetative development in the presence of sewage sludge in the four types of soils. The positive effect of the sludge is due to its high content in organic matter which clearly improves the qualities of Mediterranean soils, which are generally very poor.

Keywords: *water, macronutrients, micronutrients, vegetative growth, elemental composition*

Introduction

Lycopersicon esculentummill. is one of the most important horticulture plants in Europe, with very high levels of production, commercialization and consume. Besides, this species is object of study in many research centers, due to its enormous importance. The present work refers to the effects of urban sewage sludge on the vegetative growth of the variety Marmande, due to its high degree of tolerance for saline stress and good flavor of its fruits. This variety is also suitable for cultivation in pots since plants are not too high. The addition of sewage sludge is justified by its effect in stabilizing the soil pH and by the need to provide organic matter to the soils, which in the Mediterranean region are generally very poor, but mostly by the need of finding an efficient use of the enormous amounts of urban waste.

The aim of this work is to check the vegetative development of tomato plants in the presence of urban sewage sludge on four different types of local soils. The morphological characteristics of the plants were correlated with the soils variables, the irrigation water used and the presence of urban sewage sludge.

Materials and methods

The soil and water correspond to areas of Benirrama, Marjal, Ramers and Salobre, localities situated in La Marina Alta, Valencian region, in Spain.

In the experimental design the four soil types were placed in pots of 15 kg and in each a tomato plant, *cv.* Marmande was cultivated (three replicas for each soil type and treatment). Tomato plants were transferred in young stage (15 cm high) and experiments were carried out during four months. Two treatments were applied to each soil type: a control watered with local irrigation water, and a treatment with one kg of urban sludge added to each replica at the

beginning of the experiment and watered with the same water type as the corresponding control. The sewage sludge used was the same for all soil types, but irrigation waters correspond to their geographic area.

The quality of irrigation water was evaluated. For each type of water the pH, the electrical conductivity (EC), the content in cations (Na, K and Ca), chloride, sulfate, nitrate, bicarbonate, fluorine and boron were determined. Cations were determined by atomic spectroscopy and the other components were quantified according to classic volumetric and colorimetric methods as described by Gomez *et al.* (1992). All parameters of irrigation waters are related to plant nutrition, salinization and alkalization of soil and water (Rhoades, 1990).

Following characteristics of urban sewage sludge were analyzed: electric conductivity (EC), pH, organic matter (OM) and elemental composition (N, P, K, Na, Ca, Mg, Cu, Fe, Zn, B, Cd, Cr, Hg, Ni, Pb, Al) by the same methods as above. For each type of soil following characteristics were analyzed: texture, pH, salinity, the percentages of total carbonates (Carb.) and active lime (Al), organic matter (OM) (Olsen and Sommers, 1982a), total nitrogen, phosphorus (Olsenand Sommers, 1982) and cations of saturated paste extract (Na, K, Ca and Mg) by atomic spectroscopy.

Following morphological characteristics of the plants were analyzed at the end of the treatment: leaf biomass and length and biomass of stems, branches and roots (Jones, 1991). Data were analysed using the programme SPSS for Windows, v.16.00.

Results and discussion

The results on the characterization of irrigation water are synthesized in Table 1. The pH is slightly basic in all types; the highest conductivity was registered in the Salobre which has a significantly different amount of sodium and chloride, being very saline. Remarkably different is the level of nitrates, varying from very low values from Benirrama (8 mg/l) to Ramers (184 mg/l). Significantly lower is the level of sulfates in the Benirrama. Regarding the fluorine, Salobre has the highest value which was also the most saline.

Table 1. Characteristics and composition of local irrigation water

Name	pH	EC dS/m	Na mg/L	K mg/L	Ca mg/L	Mg mg/L	Cl⁻ mg/L	SO_4^{2-} mg/L	HCO_3^- mg/L	F mg/L	NO_3^- mg/L	B mg/L
Benirrama	7.56	1.04	198	8.3	30	30	290	58	133	0.31	8	0.13
Marjal	7.68	0.95	132	9.7	60	29	198	128	107	0.18	78	0.11
Ramers	7.49	1.01	95	3.7	108	20	143	218	92	0.30	184	0.40
Salobre	7.3	2.15	353	9.0	88	38	685	202	64	0.96	58	0.18

The values registered on the urban sewage sludge used in this experiment are shown in Table 2. All values registered are below the limits of toxicity allowed by the Spanish legislation.

Table 2. Characteristics and elemental composition of urban sewage sludge

pH	EC dS/m	OM %	N g/kg	P g/kg	K g/kg	Na g/kg	Ca g/kg	Mg g/kg	Fe g/kg	Mn mg/kg	Cu mg/kg	Zn mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Al mg/kg
5.5	6.35	52.6	36.2	25.1	1.8	6.1	50.3	5.9	3.9	68.1	539.8	834.9	1.0	115	189.1	7200

The results related to the chemical composition and electric conductivity of the different soil types are summarized in Table 3 for both control (1) and sewage sludge (treatment 2). Soils treated with sludge have significantly higher electric conductivity (EC) and percentage of organic matter (OM) than those in control. Only in Marjal soil, which is exceptionally rich, there is no increment in OM. Interesting is the increment of phosphorous in all soils, but especially in Salobre, where it increased almost 10-fold in respect to the control. This is

correlated with the high amount of P (25.1 g/kg) detected in the sludge. Table 3 shows the level of soil fertility at the beginning of the experiment. During the experiment the only new variable is that of irrigation water, which may affect the substrate-plant interaction.

Table 3. Chemical analysis of the soil in control (1) and treatment with sludge (2) at the beginning of the experiment (II)

Treatment	pH	EC dS/m	OM %	K g/kg	P mg/kg	N g/kg	Carb. %	A l %	Ca g/kg	Na g/kg	Mg g/kg
Benirrama 1	7.30	0.588	5.82	0.32	23.52	2.51	52	9.4	6.78	0.43	0.52
Benirrama 2	7.05	1.248	6.58	0.36	73.85	3.34	40	8.8	6.43	0.35	0.68
Marjal 1	7.27	0.802	14.85	0.34	14.68	6.34	43	14.2	7.58	0.34	0.93
Marjal 2	7.06	1.386	14.65	0.39	34.22	6.78	38	14.6	8.38	0.33	0.64
Ramers 1	7.27	0.598	2.00	0.49	272.70	2.32	15	0.9	5.20	0.30	0.36
Ramers 2	6.88	2.295	4.09	0.49	302.85	3.41	23	0.6	5.31	0.47	0.59
Salobre 1	7.01	0.613	1.66	0.37	14.22	1.72	25	1.0	5.67	0.43	0.54
Salobre 2	7.10	1.902	3.18	0.45	115.36	1.98	22	1.4	5.82	0.63	0.78

Once the crop growth cycle, we proceed to the extraction of plants from their substrate for subsequent chemical analysis of its various components (root, stem and branches and leaves). In addition, soils were analyzed to quantify the contributions of irrigation water and the removal of nutrients by plants. Table 4 shows the level of soil fertility at the end of the experiment. During the experiment the only new variable is that of irrigation water, which may affect the substrate-plant interaction.

Table 4. Chemical analysis of the soil in control (1) and treatment with sludge (2) at the end of the experiment (III)

Name	pH	EC dS/m	OM %	K g/kg	P mg/kg	N g/kg	Carb. %	A1 %	Ca g/kg	Na g/kg	Mg g/kg
Benirrama 1	7,36	0,554	4,67	0,21	16,70	2,23	49	6,1	5,75	1,24	0,15
Benirrama 2	7,11	1,718	6,10	0,26	90,02	4,02	42	6,9	5,05	0,95	0,59
Marjal 1	7,31	0,644	11,69	0,20	10,89	5,58	40	10,9	6,65	1,10	0,90
Marjal 2	7,16	2,190	14,50	0,21	46,54	7,56	40	11,4	6,65	1,16	0,92
Ramers 1	7,62	0,433	2,40	0,35	195,30	1,89	21	0,6	5,17	0,59	0,34
Ramers 2	7,23	1,006	4,06	0,32	225,83	3,11	15	1,0	3,98	0,54	0,41
Salobre 1	7,49	0,942	2,18	0,30	21,53	1,25	14	0,5	5,26	1,43	0,52
Salobre 2	7,51	1,024	3,12	0,35	101,66	1,92	17	1,9	5,34	1,24	0,60

The results in Table 4 in comparison with the results in Table 3 show the effect on plants have led to water-soil interaction. Among the most significant results are:
That in relation to the electrical conductivity and organic matter, salinity and organic fertilization clear influence on these two parameters. The irrigation with more saline waters (1) cause a further increase in the EC, not even taking the effect of ions by the plant fails to stop (not Salobre). The soils with the sludge (2) reached significantly higher values than in soils (1). The near equality in EC Salobre 2 and 1, both saline irrigated with enough water, it may be, firstly, the presence of more favored microbial biomass by organic matter, and secondly, the greater retention capacity ion that it manifests (Navarro-Pedreño, J, 1992).
With regard to macronutrients, the nitrogen content whose main contribution is the organic matter, shows a behavior in general, parallel evolution in all soils 1, down from II to III. It is in the organic treatment which clearly reflects the positive effect of increased nitrogen content compared to soils without sludge. Regarding phosphorus, the evolution followed by this macronutrient is parallel throughout the experiment, but more balanced, the evolution of nitrogen. Potassium is a distinctly minority element in these soils and waters, and even the sluge produced is relatively low in this nutrient.

The case of the Na ion is clearly significant influence of irrigation water. In all cases the sodium increases with time, with the largest increase in soil 1. In soils 2 sodium increased due to irrigation, is slightly stabilized by the buffering action of organic matter.

Calcium shows parallel developments in all cases and in all soils, coinciding minimum and maximum inflections in all samplings. The fact that its concentration is virtually uniform, perhaps due to the slight wobble in the content of active lime.

The evolution of magnesium compared to the values of the initial sampling, small maxima and minima coincidence with the minimum and maximum values of calcium (with the exception Salobre), perhaps due to antagonism attachment level, stay in the soil solution and plant absorption, which can be attributed to these nutrients.

The results of the concentration of macro and micronutrients of each of the parts of tomato plants at the end of its life cycle, are shown in Tables 5, 6 and 7.

Table 5. Chemical analysis of the leaves (mg/kg)

Name	N	P	Na	K	Ca	Mg	Fe	Cu	Mn	Zn
Benirrama 1	15,6	3,600	3,50	9,20	32,0	5,50	79,70	6,39	15,30	15,49
Benirrama 2	34,3	2,000	6,90	18,4	28,3	4,50	142,10	8,45	20,74	49,71
Marjal 1	32,0	1,950	6,60	16,2	23,2	5,50	90,80	1,24	11,67	14,92
Marjal 2	29,4	1,800	5,20	17,0	39,6	4,80	79,70	2,27	20,74	20,63
Ramers 1	36,9	3,600	4,40	25,4	12,3	3,10	152,50	13,59	11,67	36,60
Ramers 2	39,6	2,500	3,60	21,2	37,0	5,10	152,50	7,42	35,27	33,17
Salobre 1	19,7	1,400	5,90	12,8	42,1	6,00	183,70	4,33	28,00	19,49
Salobre 2	31,9	2,000	8,90	18,8	40,8	6,90	131,70	5,36	49,81	30,89

Table 6. Chemical analysis of the stem and branches (mg/kg)

Name	N	P	Na	K	Ca	Mg	Fe	Cu	Mn	Zn
Benirrama 1	6,70	1,900	4,10	25,5	11,9	3,20	48,50	4,33	0,76	76,52
Benirrama 2	21,3	2,300	6,40	28,0	23,2	6,00	90,10	6,39	6,21	68,54
Marjal 1	9,10	1,200	3,70	24,0	15,7	4,20	38,10	2,27	2,58	50,86
Marjal 2	23,5	2,200	4,40	21,6	25,7	5,10	48,50	1,24	4,39	49,14
Ramers 1	13,3	1,700	2,30	27,7	11,9	2,20	38,10	5,36	4,39	35,46
Ramers 2	22,3	2,500	3,10	28,1	18,2	3,70	48,50	2,27	6,21	56,56
Salobre 1	10,1	0,680	5,70	17,3	10,6	3,60	58,90	3,30	2,58	37,74
Salobre 2	16,7	1,250	8,70	18,6	22,0	5,90	58,90	2,27	8,03	53,71

Table 7. Chemical analysis of the root (mg/kg)

Name	N	P	Na	K	Ca	Mg	Fe	Cu	Mn	Zn
Benirrama 1	17,7	1,500	4,50	16,2	18,2	2,70	960,00	11,54	11,67	42,30
Benirrama 2	24,7	1,500	6,00	12,2	16,8	3,90	277,08	10,50	8,03	19,49
Marjal 1	18,3	1,200	4,30	11,8	27,0	4,00	1005,00	8,45	17,11	49,71
Marjal 2	18,3	2,100	5,90	7,70	47,1	5,00	2564,80	23,90	35,20	56,00
Ramers 1	14,5	0,640	1,90	2,80	13,1	1,00	1420,90	13,60	26,19	17,21
Ramers 2	17,7	2,500	6,30	11,6	27,0	5,00	2460,80	35,23	33,46	66,82
Salobre 1	12,2	0,750	6,50	10,9	15,7	3,10	1420,90	15,66	26,19	23,48
Salobre 2	19,7	1,500	7,10	9,00	18,2	3,70	1940,80	13,60	31,64	34,32

They revealed that the plants with a high nitrogen content reduced fruiting, delay ripening and produce excessive vegetation. In our study this fact manifests itself clearly in soils plants with the number 2, Benirrama, marshes, Ramers and less significance in the soil Salobre. In this case the positive influence of sewage sludge on soil and the plant is significant.

When a relative deficiency of nitrogen the leaves are usually pale yellow-green color due to the low chlorophyll synthesis. This is particularly evident in plants on soils Benirrama 1, Salobre 1 and Ramers 1. In general throughout the experiment are different behaviors in the block Salobre-Benirrama and Marjal-Ramers block, except as mentioned on the nitrogen. The

different behavior of the two plants in soil blocks in the first is due to their higher organic matter content and the second the effect of salinity on mineralization of organic matter.

The phosphorus concentration is more restricted in plants on soils with sludge, where it is stabilized and even decreased. This stabilization is more pronounced in soils plants with the highest proportion of organic matter. The explanation may be the most powerful chelator and buffer dissolution of soil as a result of increased soil organic matter.

The highest concentrations of sodium in the leaves, appear on the soles on the floor with mud, even in those with higher initial organic matter content (Marjal and Benirrama), there is a significant stabilizing effect that is absent in land plants Salobre. In the case of plants grown in soil Ramers, the result can be explained possibly as due to a combination of low sodium saline irrigation water and the dampening effect of organic matter in the sewage sludge. The sodium content in the stem and branches and roots in all soils follows the same sequence, ie higher in plants grown in soil with sludge and lowest in bare soil.

The results obtained show that the potassium content decreases along the evolutionary cycle, unlike sodium developments discussed above. Its concentration increases from the root to the stem and branches and leaves.The evolution of the potassium in the stem and branches and roots, also appears to show some antagonism with sodium. As a confirmation of previous results and comments on macronutrients have the values for the overall development of plants in length and mass. The data obtained on plant development are shown in tables 8 and 9

Table 8. Physical parameters of tomato plants in control (1) and treatment with sludge (2)

Name	Plant Height (cm)	Biomass stem (g)	Branches length(m)	Branches Biomass (g)	Leaves Biomass (g)	Roots Biomass(g)	Total biomass(g)
Benirrama 1	105	41.33	6.18	60.58	38.26	8.55	148.99
Benirrama 2	88	42.22	10.32	148.63	105.25	10.72	306.82
Marjal 1	92	57.97	11.83	186.36	111.54	23.05	378.92
Marjal 2	150	95.5	18.31	252.83	279.47	40.74	668.54
Ramers 1	79	68.29	6.10	139.60	22.13	10.00	240.02
Ramers 2	91	51.65	12.25	183.88	147.03	27.36	409.92
Salobre 1	111	58.34	8.25	101.07	69.51	13.80	242.72
Salobre 2	98	52.58	11.25	143.04	131.60	9.76	346.98

When comparing the two treatments it is clear that plants improved their vegetative growth when sludge was added. Plants from Treatment 2 (with sludge) are more vigorous: total biomass and height, as well as branches and leaves biomass significantly increased. This finding indicates the sewage sludge treatment is effective on all type of soils. Regarding the different types of soils, the most developed plant material was obtained from Marjal, followed by plants grown in soils Ramers, Salobre and Benirrama.

Tab. 9 Dry weight of tomato plants in control (1) and treatment with sludge (2)

Name	Stem + branches biomass (g)	Leaves biomass (g)	Root biomass (g)	Total biomass (g)
Benirrama 1	19.38	6.58	2.11	28.07
Benirrama 2	31.84	21.08	2.06	54.98
Marjal 1	44.39	19.56	4.74	68.69
Marjal 2	58.64	47.97	7.49	114.10
Ramers 1	42.70	5.54	2.75	50.99
Ramers 2	41.08	29.21	5.44	75.73
Salobre 1	31.10	11.05	2.82	44.97
Salobre 2	32.89	20.65	2.43	55.97

The analysis of the total dry weight also indicates that the application of sludge is effective, the values in treatment 2 being generally higher than in controls in all soil types.

Conclusions

Once the analysis leaves, branches and stem and root of each plant can manifest as more significant the following considerations:

In the steady increase in foliar concentrations of sodium in all samples in the expected order, greater in the plants on the amendment for soil (soil 2) and lowest in plants grown in soil 1. This same pattern occurs in the stems and branches and roots. On the other hand, presents a different evolution of magnesium content and decreasing the concentration in plants grown from the soil 1 to 2 of soil.As for the micronutrient copper, this generally exhibits a continuing sharp decline in plants on soils with sludge.

On the stem and branches, as well as the evolution of sodium previously mentioned, we found a significant increase in calcium in the soil plants 2, with respect to other plants in which calcium increases from the soil 1, except those grown in soil in Benirrama produced the opposite result.

In the root is worth noting, in addition to the sequence obtained for sodium, the lowest concentration of the element potassium in plants on soils 2 with the exception of Ramers soil where the concentration of soil 1 is less the soil 2.

Concerning micronutrients, notwithstanding the evolution of each soil where there are significantly higher concentrations of iron in all samples. The concentrations are focused in the roots. There are significant differences in the concentrations of other micronutrients in different parts of the plant, without reachingthe levels of iron. Here evolution does not follow a defined sequence, as it is higher in the plants in soils 2 except the Salobre plant, which is larger the plant 1.

We can conclude that the vegetative development of plants clearly improved in the in the treatment with sewage sludge due to nutrient supply and improving the soil physical properties. For this reason we consider that the use of this type of waste as fertilizer in tomato cultivation is a good strategy.

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YIELD OF RED MAIZE INTERCROPPED WITH BLACK SOYABEAN IN ORGANIC CROPPING SYSTEM

Snezana OLJACA[1*], Zeljko DOLIJANOVIC[1], Milena SIMIC[2], Mico OLJACA[1]

[1]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia,
[2]Maize Research Institute, Zemun Polje, Serbia
(Corresponding author:soljaca@agrif.bg.ac.rs)

Abstract

The aim of this paper is to outline the potential interests for alternative red maize for organic crop production. This paper deals with results of the effects of different intercropping pattern and fertilizers on red maize grain yield in two-year period (2011-2012). Trial was set up on chernozem soil type in the experimental field ofMaize Research Institute in Zemun Polje, Serbia. Red maize ZP Rumenka cultivar (FAO 700 group of maturity) and black soyabean, cultivar Dukat (maturity group 0) were included in the experiment. The intercrops were created according to the method of replacement series. Two different spatial designs were applied: the sowing of maize and soybean in strips or alternate rows and sole crops. The treatments of fertilization consisted of following variants: control, mineral fertilizer AN, organic fertilizer under the trade name "Royal Bio-Humus Offert" and microbiological fertilizer Uniker.
The results shows that yield of red maize were higher in first year of study with better meteorological conditions. When comparing grain yields between intercrop variant we can see that significantly the highest yield is obtained in variant alternated row of maize and soyabean in both years of trial and the lowest was in sole maize. Individually observed, the highest yield was achieved in the interaction intercrop alternated rows with organic and microbiological fertilizer in more favorable 2011.

Key words: *red maize, black soyabean, intercropping, organic cropping system, yield.*

Introduction

Republic Serbia has significant heterogeneous natural resources and favorable conditions for agricultural production that can meet the basic requirements for the establishment of organic agricultural production, due to lower land and water pollution, less application of pesticides and other chemicals (Olja a et al 2012). The transformation from conventional to organic field crop technology requires changes and adaptation of many cultural practices. Organic production is very specific and for alternative crops is necessary to develop appropriate technology based on ecological principles (Kova evi et al., 2011).

However, when it comes to organic production it is necessary to choose the type of field crop that do not have normal use (alternative) that would be suitable for such production (Kova evi et al., 2007). Some of these crops can be with local significance or in limited markets, and some may be of interest and on farms that are so oriented. Red maize and black soyabean are interesting crops for organic production specially grown in intercropping system.

Intercropping system is very suitable for organic production because these cropping systems ensure more efficient use of land, greater yield stability, spreading of labour input, greater diversity of produce, less dependence on storage, greater market opportunities and better soil and water conservation (Olja a et al., 2000, Dolijanovi et al 2007). The practice of growing

soybean as an intercrop with maize is predominant in the drier southern and western hills, where crop productivity is limited by rainfall (Prasad and Brook, 2005). Apart from crop productivity, legume-based cropping could also help to increase soil organic matter levels, thereby enhancing soil quality, as well as having the additional benefit of sequestering atmospheric C (Gregorich et al., 2001).

Red maize provides twenty percent more protein than white or yellow maize, it has a coarser, sweeter and nuttier taste than other maize grown for flour or meal. Anthocyanin, the pigment that creates the red color in this maize, is antioxidant flavonoids that protect many body systems (Žili et al 2011). Besides chlorophyll, anthocyanins are probably the most important group of visible plant pigments. Anthocyanins have anti-inflammatory properties, have been linked to reversing nervous system damage and can also reverse affects of diabetes, tonify circulation and helps prevent colon cancer. Red maize contains 350% more antioxidants than common white or yellow ones.Maize genotypes with naturally rich pigments would promise a potential for the development of functional foods and/or functional food colorants (Žili et al., 2012).

This paper aims at finding a growing technology by modifying the basic cultural practices in alternative crop production that are of particular interest for organic producers. All this is inseparable from each type of crop is therefore necessary to choose those that are adaptable to our agroecological conditions.

Materials and methods

The experiment was established according to a randomized complete block design plan with four replications on the experimental field of Maize Research Institute in Zemun Polje, Serbia. The experiment was done during the 2011 and 2012 growing seasons on the chernozem soil type. The size of the experimental plots was 16,80 m^2. The sowing time was May 11th 2011 and 2012. Red maize ZP Rumenka cultivar (FAO 700 group of maturity) and black soyabean, cultivar Dukat from maturity group 0 were included in the experiment. The intercrops were created according to the method of replacement series. Two different spatial designs were applied: the sowing of maize and soybean in strips or alternate rows. The intercrop treatments consisted of each maize alone (six rows) or soybean alone (six rows), and two mixtures: 3 rows of maize and 3 rows of soyabean in strips, 3 rows of maize and 3 rows of soyabean in alternated rows. Maize was planted in rows 70 cm apart and within-row spacing of 22 cm in pure stands and for soyabean spacing was 70 cm inter-row and 3 cm within-row spacing. Within-row spacing in mixtures was the same as in the sole crops. The basic tillage was done in autumn at the depth of 25 cm, and spring soil preparation 10 to 15 days prior to planting. Two hand inter-row cultivations were done on all plots.

The treatments of fertilization consisted of following variants: mineral fertilizer AN (ammonium-nitrate 34,4% N) in amount of 75 kg/ha N, organic fertilizer under the trade name "Royal Bio-Humus Offert" in amount of 3t/ha was applied just before basic tillage (pH 8, 2,1% N, 3,6% P_2O_5, 2,2% K_2O), microbiological fertilizer Uniker in amount of 10 l/ha. Uniker is experimental microbiological fertilizer witch consisted of following strains of bacteria: *Bacillus megaterium, Bacillus lichenioirmis i Bacillus suptilis.* It is applied by incorporation into soil prior to sowing, in order to improve soil microbiological activity and increase mineralization of organic matter. The forth treatment was control with no fertilizer.

After harvest (September 30th 2011 and September 18th 2012), the yield was measured by experimental plots immediately after threshing and reduced to a moisture level of 14%. All data were subjected to analysis of variance. For individual comparisons, we used the LSD test.

Results and discussion

Meteorological data on the experimental field during two years of trial are shown in figure 1.The data shows better meteorological conditions for crops in first year of this experiment. This year is characterized by small amounts of rainfall (annual sum was 488 mm) specially in April and August. Annual temperature mean 13.5^{o}C was significantly higher than long term temperature mean for Zemun Polje. Relatively high average monthly air temperature was in July and August 24.1^{o}C and 24.7^{o}C, respectively. The second year of experiment 2012 had significantly small amount and bad rainfall distribution compared with first year. Long term severe drought is appeared from June to September and caused very significant decrease of maize yield. Regarding temperature conditions in this period, extremely high temperature means is recorded in June (24.6 ^{o}C), July (27.1 ^{o}C) and August, (26,2 ^{o}C).

The results of the effect of different intercropping pattern and fertilizers on red maize grain yield are shown in table 1. These results show that grain yield of red maize was significantly higher (3.18 t/ha) in first year (factor A) with better meteorological conditions compared with yield in the second year (1.77 t/ha). When comparing grain yields between intercrop variant as a distinct factor (B) we can see that significantly the highest yield is obtained in variant alternated row of maize and soyabean in both years of trial and the lowest was in sole maize. This result is in accordance with the results of Olja a et al 2000 and Dolijanovi et al 2007 on the same experimental field.
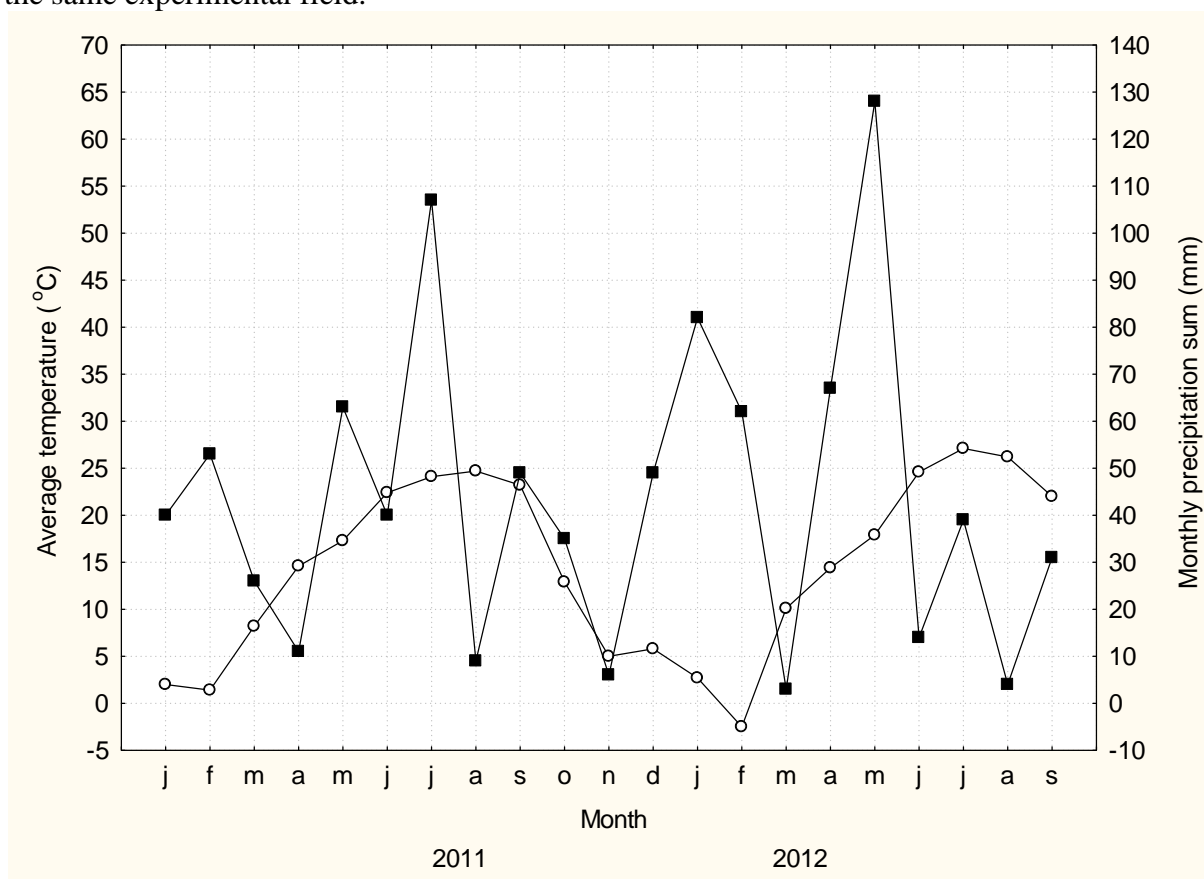
Figure 1. Climate diagram for meteorological conditions in Belgrade for 2011 and 2012

Fertilizers are important factor of organic field production technology as indicated by our results. In 2011 all fertilization treatment have higher yield compared with control, but in 2012 on plots with mineral fertilizer AN we obtain the lowest yield of red maize 1.34 t/ha.. This is evidence that plants can not use mineral nutrients in extremely dry conditions. Much better situation was on plots with organic and microbiological fertilizer in both seasons.

If we compare the interaction between two AB factors (years x intercrop) it can be seen that all interactions in the first year of study had a significantly higher yields than the same interaction in the second years. Yield results in the interaction AC (years x fertilization) shows the same tendency as in the previous case. In BC interaction (intercrop x fertilization), in general a significantly higher yields were obtained in combinations intercrop alternated rows with organic and microbiological fertilizers 3.38 and 3.25 t/ha.

Individually observed the highest yield was achieved in the interaction intercrop alternated rows with organic (4.49 t/ha) and microbiological fertilizer (4.44 t/ha) in more favorable 2011.

Table 1. The effect of different intercropping pattern and fertilizer on yield of red maize (t/ha)

Year A	Intercrop variant B	Fertilizer C				AverageAB
		Mineral	Organic	Microb.	Control	
2011	Sole maize	1.66	1.87	1.74	1.53	**1.70**
	Alternated rows	4.30	4.49	4.44	4.33	**4.39**
	Strips	3.56	3.37	3.86	3.00	**3.44**
Average	AC	**3.17**	**3.24**	**3.35**	**2.95**	**3.18**
2012	Sole maize	1.21	1.53	1.87	1.47	**1.52**
	Alternated rows	1.31	2.27	2.06	2.08	**1.93**
	Strips	1.50	1.85	2.17	1.90	**1.86**
Average	AC	**1.34**	**1.88**	**2.03**	**1.82**	**1.77**
BC	Sole maize	**1.44**	**1.70**	**1.81**	**1.50**	**1.61**
	Alternated rows	**2.81**	**3.38**	**3.25**	**3.21**	**3.16**
	Strips	**2.53**	**2.61**	**3.02**	**2.45**	**2.56**
Average 2011/2012		**2.26**	**2.56**	**2.69**	**2.39**	**2.48**

LSD 0.05	LSD 0.01	
0.067441	0.096217	A
0.098383	0.168273	B
0.113602	0.194305	C
0.160658	0.274789	AC
0.139134	0.237974	AB
0.196765	0.336546	BC
0.278268	0.475948	ABC

Dolijanovi et al., (2007) emphasized that the intercropping system uses the water better than monocrops in dry seasons, which can be observed in the results of these experiment. Two types of crops will similarly overyield if their mutual competition is sufficiently weak, or more formally, the interspecific competition is weaker than the intraspecific competition. The various mechanisms of intercropping advantage act by reducing competition between the component species. Spatial separation of the species, different time of maturity or different resource use might be expected to reduce or postpone competition. There ought to be real advantages in photosynthetic production from combining these two crops, which have contrasting leaf area patterns over time. Row arrangement improves the amount of light transmitted to the lower legume canopy, especially alternate rows. At least where the productivity of mixture is dominated by one species, as with maize in maize-bean intercropping, the competitive effect of the recessive species on the dominant is small (Olja a

et al.,1999). The optimal spatial arrangement in our experiment was maize and soybean in alternate rows. In the favorable season (2011) fertilization with organic and microbial fertilizers can be recommended, while in less favorable seasons (such as 2012) microbial fertilizers are more suitable.

Conclusion

According to the obtained results during investigations of effects of fertilization and different intercrop pattern under organic farming practice, the following conclusions can be made: yield of red maize was higher in first year with better meteorological conditions. In less favorable meteorological conditions due to lack of moisture is missing the full effect of mineral fertilizing did not come into expression. Organic field crop technology that includes a combination of basic fertilization with organic Bio-Humus and microbial fertilizer Uniker gives the highest yield in intercrop variant alternated rows. Considering the numerous ecological and socio-economic constraints prevalent in the farming systems of small-scale farmers in Serbia, intercropping involving maize and soybean as the integral components crops, specially in organic farming is an attractive system and hence, needs to be improved. Researchers dealing with organic cropping system should also pay attention on neglected alternative crops such as red maize due to lack of relevant scientific information.

Acknowledgement

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DETERMINATION OF GROSS AND ACTIVITIES IN SOIL SAMPLES FROM DRAZLJEVO LANDFILL (POWER PLANT GACKO)

Natasa SARAP[1*], Vesna KRAISNIK[2], Marija JANKOVIC[1]

[1]University of Belgrade, Institute of Vinca, Radiation and Environmental Protection Department, Serbia,
[2]University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: natasas@vinca.rs)

Abstract

The concentrations of the natural radioactivity in 8 different soil samples collected from Dražljevo landfill near the coal–fired power plant Gacko (Republic of Srpska) were determined. The instrumentation used to count the gross alpha and gross beta activities was / low level proportional counter Thermo Eberline FHT 770 T. The obtained results show that the gross alpha and gross beta activitiesranged from 66.7 to 102.4 Bq/kg and 285.7 to 607.4 Bq/kg, respectively.

Keywords: *Gross alpha, gross beta, soil, natural radioactivity*

Introduction

Monitoring of any release of radioactivity material to the environment is necessary for environmental protection. Measurement of natural radioactivity in soil is very important to determine the amount of change of the natural background activity with time as a result of any radioactivity release (Yalcin and Gurler, 2007).

A significant part of the total dose contribution in the form of natural sources comes from terrestrial gamma radionuclides. Only nuclides with half–lives comparable with the age of the earth or their corresponding decay products, existing in terrestrial materials, such as ^{40}K, ^{238}U and ^{232}Th radionuclides, are of great interest (Jankovi et al., 2008).

The concept of technologically enhanced natural radioactivity (TE NORM) was introduced in the mid-seventies. It represents the unintentional exposure to natural sources of radiation which would not exist without the technological activity (UNSCEAR, 2000). Earlier studies have shown that the main sources of technologically enhanced natural radioactivity are coal-fired power plants and artificial fertilizers applied in agriculture. Coal-fired power plants have been neglected as a radiation source for a long time.

They became important for investigations as a result of the advancement of the scientific knowledge of biological effects of radiation on humans and after dose limits reduction in international recommendations and standards. Coal combustion in power plants leads to a redistribution of natural radionuclides originating from coal, and to their concentration in ash and slag. The basic problem of technologically enhanced natural radioactivity caused by coal-fired power plants is the increase of the background gamma radiation level. Therefore, the local population is exposed to higher gamma radiation doses than in absence of coal-fired power plant (Jankovi et al., 2011).

In the combustion process, most of the mineral material in coal is converted into ash. Coal, like most materials found in nature, contains trace quantities of naturally occurring radionuclides, ^{238}U, ^{232}Th and ^{40}K (Mondal et al., 2006). Combustion of coal thus enhances natural radiation in the vicinity of the coal–fired power plants by release of these radionuclides and their daughters into the surrounding ecosystem.

Gacko coal basin is located in GackoValley in the southeastern part of the Republic of Srpska. It covers an area of about 40 km^2, at an altitude of about 940 feet in a typical karst area. The area is characterized by a distinctive climate, where temperatures range from -30 to +37 ^{0}C, with an average atmospheric precipitation of 1 750 mm per year. The terrain is mostly flat. The Dražljevo landfill is poorly positioned, the distance from the power plant Gacko 6.5 km and 210 m height difference, also located above the dispositional primary source of water supply of the population located downstream ("Vrba" and "Klinje"). Area Dražljevo former ash landfill is approximately 300 000 m^2. Thickness of the buried humus layer is about 10−15cm. The smaller northwestern part of the (landfill entrance) there is no humus (Plan aktivnosti TE Gacko, 2007).

The aim of this study was to determine the level of gross alpha and beta activity in soil samples taken from various locations of the Dražljevo landfill. Since the Dražljevo landfill is located near the reservoirs which is used for water supply, it is necessary to periodically monitor the content of radionuclides in samples from the landfill.

Materials and methods

Soil samples were collected during May 2012 from various locations of the Dražljevo landfill near power plant Gacko. The sampling location is shown in Figure 1. Samples were taken at the surface of the landfill, in areas with vegetation and without vegetation, and on the south side and the north side of the landfill. Samples were taken from two depths of 0−10 cm and 10−20 cm, with a probe. Thickness of the buried humus layer is about 10−15 cm. At the smaller northwestern part (the entrance to the landfill) there is no topsoil or vegetation, but the rest of the landfill is under the humus and vegetation. It is interesting that on the slopes of the southern exposure of the landfill, vegetation is less frequent than the northern exposure of the landfill.

Figure 1. The former ash landfill "Drazljevo"

The soil samples (about 2 kg) were placed into polyethylene bags and transported to the laboratory. After removing the stones and vegetation, all soil samples were dried up to 105 ^{0}C during 24 h. The samples were sieved through a stainless steel sieve (diameter 3 mm) and reduced to a powder. About 1 g of powdered soil of each sample was transferred into a stainless−steel planchet. Technicallyalcohol was used to evenly spread the soil on the planchet.Planchet was put under the UV lamp to evaporate alcohol and then the planchet placed directly into the detector.The counting time was 3600 s for gross alpha and beta activities.

Gross alpha and beta activity in soil samples were determined by / low level proportional counter Thermo Eberline FHT 770 T. Calibration was performed by using standard source of [90]Sr (EM145, Prague) with an activity of 189.4 Bq on the day 01.08.2z11. for beta activity and standard source of [241]Am(EM445, Prague) with an activity of 224 Bq on the day 1. 8. 2011. for alpha activity. The counting gas was a mixture of 90 % argon and 10 % methane. The counting efficiencies for the system are 23 % for alpha and 33 % for beta.The background of each detector was determined by counting an empty planchet for 3600 s. To assure that radiological monitoring are reasonably valid, quality assurance programs necessary. These programs are needed to identify deficiencies in the sampling and measurement processes. Quality of sampling and measurement and calculated uncertainty are very important for predicting the dose for population. In addition, validation monitoring aims to prove whether the results are acceptable. The accuracy and reproducibility of gas proportional counter were verified on a periodic basis – every week. Total backgroundcount rate without a source is monitored to verify that the detector and shield have not been contaminated by radioactive materials. Alpha and beta efficiencies of gas proportional counter were checked with [241]Am and ^{90}Sr sources respectively.

Gross alpha and beta activity was calculated using the following formula:

$$A_{rs} = \frac{I}{m} \qquad (1)$$

where A_{rs} is the activity of the sample (Bq/kg), m is the mass of the sample in planchet , I is given by the formula:

$$I = \frac{(N - B)}{ef} \qquad (2)$$

where N is the count rate for the sample (1/s), B is background (1/s) and ef is the efficiency of the detectors for alpha and beta measurements.

Minimum detectable activity was calculated by the equation (3):

$$MDA = \frac{LLD}{m} \qquad (3)$$

where LLD is the detection limit (1/s) and m is the mass of the sample.

Measurement uncertainty determined as expanded measurement uncertainty was 30−40 % for alpha and 15 % for beta.

Results and discussion

The results of measurements the gross alpha and gross beta activities for 8 soil samples collected from different locations of the Dražljevo landfill, are presented in Table 1. The activity concentrations are expressed in Bq/kg. As can be seen from Table 1that the gross activity is generally higher than the gross   activity. The gross alpha and gross beta activities varied between 66.7 and 102.4 Bq/kg and between 285.7 and 607.4 Bq/kg, respectively.

Table1. The gross alpha and beta activity concentrations of soil samples from Drazljevo landfill (Bq/kg).

Sample location	Gross alpha activity	Gross beta activity
southern exposure (0–10 cm)	78.8 ± 16.4	562.0 ± 39.0
southern exposure (10–20 cm)	101.8 ± 20.5	502.7 ± 39.6
northern exposure (0–10 cm)	67.2 ± 14.6	607.4 ± 42.7
northern exposure (10–20 cm)	70.1 ± 14.7	374.3 ± 30.2
part with vegetation (0–10 cm)	102.4 ± 19.4	543.9 ± 39.8
part with vegetation (10–20 cm)	71.3 ± 15.6	495.3 ± 37.7
part without vegetation (0–10 cm)	72.8 ± 16.3	309.6 ± 29.8
part without vegetation (10–20 cm)	66.7 ± 15.5	285.7 ± 28.6

For comparison, the results of the gross   and gross   activity concentrations in soil samples from different studies are presented in Table 2.

Table 2. Comparison of results for the gross alpha and beta activites (Bq/kg) in soil samples between Drazljevo landfill and other studies

Origin	Gross alpha activity	Gross beta activity	Reference
Dražljevo (Republic of Srpska)	66.7 – 102.4	285.7 – 607.4	This study
Obrenovac (Serbia)	–	93 – 262	Vukovi et al.,1996
Van (Turkey)	686 – 4713	73 – 11773	Zorer et al., 2009
Marmara (Turkey)	–	500 –830	Yalcin et al., 2007

Our results for the gross alpha activity in soil samples are lower than Van (Turkey). The gross beta activity is between the minimum and maximum values obtained in other studies, except for Obrenovac. World Health Organization recommends for the limits of gross alpha and gross beta radioactivity concentration in drinking water below 0.5 and 1.0 Bq/L, respectively (WHO, 2004; Official Gazette of the Republic of Serbia, 2011). Given the fact that in the Republic of Srpska there is no regulation for limit values for gross alpha and beta activity in the soil, we can not know that what is the limit value of the total beta activity which can represent hazard to population.

We know that the total beta activity in the soil samples is certainly great because of the presence of natural radionuclides ^{40}K in the soil (Jankovi et al., 2008). Beside the ^{40}K, in soil samples ^{90}Sr and ^{3}H can be found. The contribution of ^{40}K in total beta activity can be determined by gamma spectrometry.

Conclusion

The main target of this study was to determine the gross alpha and beta activities in soil samples from Dražljevo landfill in the Republic of Srpska. The obtained values for the gross alpha and beta activity ranged between 66.7–102.4 and 285.7–607.4 Bq/kg, respectively. It

was found that the concentrations of gross alpha and gross beta radioactivity in soil samples were relatively lower than those in Turkey, but higher than Serbia. This is the first detailed study of the gross alpha and beta activity concentrations in soil samples of Dražljevo landfill. It is necessary to continuously monitor the natural radioactivity in the environment samples from Dražljevo landfill, due to the impact of radiation on the population.

Acknowledgement

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GOVERNANCE OF ADAPTATION TO AND MITIGATION OF CLIMATE CHANGE ON AGRICULTURAL, FOREST AND WATER RESOURCES IN BOSNIA

Sabrija CADRO[1*], Sinisa BERJAN[2], Hamid El BILALI[3], Ognjen ZUROVEC[1], Jasmina SIMIC[4], Bojan RAJCEVIC[5]

[1]Faculty of Agriculture and Food Sciences, University of Sarajevo, Bosnia and Herzegovina
[2]Faculty of Agriculture, University of East Sarajevo,Republic of Srpska, Bosnia and Herzegovina
[3]Department of Sustainable Agriculture and Rural Development, Mediterranean Agronomic Institute of Bari, Italy
[4]Cooperative Union of the Republic of Srpska, Bosnia and Herzegovina
[5]Agricultural Institute of the Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: s.cadro@hotmail.com)

Abstract

Bosnia and Herzegovina (BiH); due to its geographical position, natural capital, and the socio-economic relevance of climate-sensitive sectors such as agriculture and forestry; is highly vulnerable to climate change (CC). Using the EH5OM model, temperature is projected to increase (+0.7-1.6°C during 2031-2060) and average net precipitation to decrease. The paper aims at analysing governance of climate change in BiH with a special focus on water resources, agriculture, and forestry (WRAF). The paper is mainly based on a literature review. The research approach adopted was exploratory, descriptive and deductive. The paper (i) provides the state-of-the-art of WRAF and climate; (ii) analyses impacts of CC on WRAF and agriculture and forestry contribution to GHGs; (iii) provides an overview of state and entity policy frameworks and institutions dealing with CC; (iv) highlights international organizations and donors operating in this field and Balkan and international commitments of BiH; and (v) provides some recommendations for enhancing WRAF adaptability and resilience to CC. The paper analyses as well the focus on CC and budget of the ongoing projects in 2011 in the sectors of environmental protection, and agriculture and forestry, 16 and 12, respectively. Agriculture, water resources management and forestry represent priority areas in which the policy and legislative framework should be improved and integrated projects should be implemented. Moreover, BiH should design and implement a national climate change mitigation strategy and action plan.

Keywords: *climate change; Bosnia; governance; agriculture.*

Introduction

Climate change (CC) and climate variability are among the top issues facing governments today. They pose real threats to the environment, food production and human systems specifically agricultural production (IPCC, 2007).Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. Climate change may be due to natural internal processes or anthropogenic ones (WMO, 2012).The United Nations Framework Convention on Climate Change (UNFCCC), makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes (United Nations, 1992).

Bosnia and Herzegovina (BiH) covers an area of 5,112,879 ha of which the Federation of Bosnia and Herzegovina (FBiH) occupies 2,607,579 ha and the Republic of Srpska (RS)

2,505,300 ha. Of the total land area, 5% is lowlands, 24% hills, 42% mountains and 29% karst. Agricultural land covers approximately 2,525,000 ha (around 52%). According to the Initial National Communication (INC) of BiH under the UNFCCC, BiH is highly vulnerable to climate change. BiH has a high sensitivity to climate change threats because of the economic role of "climate-sensitive" sectors, such as agriculture and forestry, with significant secondary impacts. Increasing variability in the weather has been noted in all seasons, with rapid changes of short periods of extremely cold or warm weather - heat and cold waves - and periods with extremely high levels of rainfall, as well as droughts. In all model runs examined, average annual temperature increased, and average net precipitation decreased in projections. Using the EH5OM global model, temperature in BiH is projected to increase from 0.7 to 1.6°C per 1°C of global increase during the period 2031-2060. For precipitation, using the EH5OM global model, the summer climate will be noticeably drier (Vukmir *et al*., 2009). The objective of the paper is to analyze governance of climate change in BiH with a special focus on water resources, agriculture, and forestry (WRAF).

Material and methods

The paper is mainly based on secondary data from different sources such as the INC of BiH under the UNFCCC and the Donor Coordination Forum (DCF). Collected secondary data were cross-checked for avoiding inconsistencies and contradictions. The paper (i) provides the state-of-the-art of WRAF and climate; (ii) analyses impacts of CC on WRAF; (iii) provides an overview of the policy framework and institutions dealing with CC; (iv) enumerates international organizations and donors operating in this field; (v) analyses references to CC in the main agriculture, forestry, and rural development policies; and (vi) provides some recommendations for enhancing WRAF adaptability and resilience to CC. The paper analyses as well the focus on CC and budget of the ongoing projects in 2011 dealing with CC. The lack of and/or difficult access to some data was the main problem faced in the course of the present paper preparation.

Results and discussion

Bosnia is situated between the continental and Mediterranean climatic zones, which creates three climatic areas: the northern part has a moderate continental climate; the mountain areas above 700 m have a mountainous climate; and the southern part has an Adriatic-Mediterranean climate.

BiH is sensitive to global climate change impacts, primarily in relation to agriculture and food production. Projections for BiH indicate a rise in temperature, with reduction in precipitation which would contribute to reducing soil moisture. Water supplies are also expected to change due to alterations in river flow. High-mountain and mountain ecosystems are exposed to the greatest impact of climate change. Peripannonian and hilly ecosystems are the second most in danger after high-mountain and mountain ecosystems (Vukmir *et al*., 2009).

Out of the total BiH area, 76% belongs to the SavaRiver and 24% belongs to the Adriatic Sea catchment. Precipitation represents the greatest water resource. The annual average precipitation is about 1250 mm. The seasonal variability is characterized by unfavourable distribution of precipitation over the year, particularly manifested in the southern parts of BiH (Vlahini , 2000).

Forestland covers about 2.5 million ha or 48% of the total land area (Spasova *et al*., 2007). The country is geographicallyoptimally positioned in terms of diverse climatic influences and is home to over one hundred tree species. Extensive presence of forests in BiH and the variety of climatic conditions to which they are subject, puts them in a critical situation in the context

of climate change, and are sensitive to its effects. A key problem is the slow rate of adaptation of forest ecosystems to climate change (Vojnikovi , 2010).

Total emissions of CO_2 equivalents in BiH in 1990 amounted to 34,043.49 gigagrams (Gg). The major source of CO_2 emissions is the energy sector, which contributes 74%, followed by agriculture (12%), industrial processes (11%) and the waste sector (3%). The main sources of methane (CH_4) are agriculture (livestock), uncontrolled emissions from coal mining and waste disposal. The largest volume of N_2O emissions comes from agricultural soil as a result of crop cultivation. Forests represent an important sink for CO_2, at 7,423.53 Gg of CO_2 for the reference year 1990. Emissions of CO_2 equivalents from agriculture are made up of methane (CH_4) and nitrous oxide (N_2O). Total emissions of CO_2 equivalents from agriculture is 4,084 (Gg) (Vukmir *et al.*, 2009). According to INC, measures to reduce greenhouse gas emission from agriculture in BiH are: the use of biomass in biogas production; introducing new livestock breeding and feeding practices; improving the application of mineral and organic fertilizers; and introducing organic production.

Climate change can transform entire forest systems, shifting forest distribution and composition. Severe temperatures and climate conditions can affect individual trees as it can lead to greater susceptibility to pests, pathogens and severe weather events (Vukmir *et al.*, 2009). Another significant threat to forest ecosystems is caused by an increase in forest fires (Vojnikovi , 2010). The response of crop yields to climate change varies widely, depending on species, cultivar, soil conditions, treatment of CO_2 direct effects, and other location factors. Vulnerability of the agricultural sector in BiH can be seen through appearance and frequency of drought which can cause a significant yield loss or reduction. Soil drought and atmospheric drought are highly interrelated (Vukmir *et al.*, 2009).The average yield decrease as a result of drought is about 20% in BiH. Drought effect is most strongly expressed in the southern parts of BiH (Vlahini , 2000). Research showed yield reduction for most important crops (*e.g.* tobacco, pepper, maize, soybean, potato, alfalfa) in the northern part of BiH (Žurovec *et al.*, 2010).

Environmental issues in BiH are under the responsibility of entity governments. The competent authorities are the Federal Ministry for Tourism and Environment in the FBiH; the Ministry for Physical Planning, Civil Engineering and Ecology in the Republic of Srpska; and Department for Communal Works in Br ko District. In accordance with the law on meteorological and hydrological activities of RS, the Hydrometeorological Institute, as a governmental organization, is responsible for climate change monitoring and climate predictions. The Federal Institute for Meteorology, as an independent institution, is responsible for climate issues in the FBiH. Important stakeholders include also, the BiH Ministry of Foreign Trade and Economic relations – political and operational focal point of the Global Environment Facility (GEF); the state Committee for the Environment and Sub-Committees for Climate Change; and the Committee for Sustainable Development (Vukmir *et al.*, 2009).

The main state legal and political documents analyzing, directly or indirectly, interrelations between climate change and agriculture and forestry sectors are the National Environmental Action Plan BiH – NEAP (2003); the INC to UNFCC (2008) and the Environmental Performance Review (2011). The main strategic documents regarding environment in the FBiH are the Federal Environmental Strategy and the Cantonal and Local Environmental Action Plans. In the case of the RS the main strategic documents are the Environmental Protection Strategy and the Strategy on Nature Protection. In the case of Br ko District it is worth mentioning the Strategy of Environment Protection and the Strategic Plan for Environment Protection.

The current state of politics in BiH leads to very little climate change-oriented activity. Thus, it comes as no surprise that climate change policy issues are not visible at every level of the

policy-making agenda in Bosnia. Numerous regulating bodies - ministries, associated institutions and institutes - complemented by a great number of laws have created an administrational and procedural "mess". In sum, there is too much room for misinterpretation and confusion and the climate change policy-making arena in BiH is fairly weak. The low level of interest of the governmental structures in this domain probably lies in the low social mobilization existing around the issue and the low level of staff capacity in climate changer elated spheres. An overall weakness of existing policy and strategy documents is that they are not specifically endorsed and integrated by the ministries responsible for sector policies. Therefore, environmental concerns should be integrated into sector policies (REC, 2008).

No strategy or action plan on the state, entities, regional and local level has been developed to foster Bosnian agriculture and forestry adaptation to climate change. Complicated governance structures, a lack of key strategic documents and supporting regulations, limited human resource capacity, and financial constraints lead to very limited capacity to respond to climate threats and adapt to climate change in a systematic and integrated way. At the same time, low public awareness and economic constraints limit the capacity of those potentially affected by climate threats to undertake autonomous adaptation measures. Political as well as economic factors dominate when deciding adaptation measures to climate change. Developing countries, such as BiH, have major problem due to having weaker capacity for adaptation (Vukmir *et al.*, 2009).

BiH has an "adaptation deficit" that will grow with the projected climate change. These issues increase the threat to agriculture, undermine the sector sustainability, and reduce its ability to take advantage of opportunities that may emerge. BiH should integrate climate change adaptation and environmental sustainability into agricultural policies, programs, and investments. To succeed in agriculture, producers and governments will have to adapt by reducing agriculture vulnerability to current climate variability (World Bank, 2010).

Bosnia ratified the UNFCCC in 2000 and, as a developing country, it is a non Annex I country of the UNFCCC (*i.e.* it has no obligation regarding the reduction of GHGs). BiH became in 2004 eligible to the Global Environmental Facility (GEF) support and ratified in 2008 the Kyoto Protocol. BiH submitted its INC to UNFCC in 2010. The Second National Communication (SNC) to the UNFCCC is under preparation. The SNC will update and strengthen information provided regarding climate change, greenhouse gas inventories, climate change mitigation, vulnerability to climate change and steps taken to adapt to climate change, as well as information on public awareness, education, training and systematic research (Vukmir *et al.,* 2009). Other relevant international and regional cooperation agreements and initiatives include: The Mediterranean Action Plan (MAP); the Belgrade Climate Change Initiative (2007); and the South East European Climate Change Framework Action Plan for Adaptation.

The most important donors and organizations dealing with environment protection, agriculture and forestry sectors in BiH are: UNDP, the World Bank, the EC, USA/USAID, Sweden/SIDA, Norway, the Netherlands, CzechRepublic, Italy/IC, Switzerland/SDC/SECO, and Hungary. The number of ongoing projects in the environmental sector (EPS) is 16 with a total budget of €29,006,945. In the agriculture and forestry sector (AFS) there are currently 12 projects with a total budget of €34,288,886 (DCF, 2011). In table 1 are shown ongoing projects dealing, directly or indirectly, with CC in BiH. Only 4% (€1,279,390) of EPS budget and 1% (€230,876) of AFS budget is allocated to projects dealing with CC. There is weak support to projects in EPS and AFS regarding CC issues. BiH is highly vulnerable to climate so support has to increase both in terms of projects number and funding.Increasing investments and international aid in the sectors of environmental protection and agriculture and forestry is vital.

Tab. 1. Projects in environmental protection, agriculture and forestry sectors dealing with CC.

Sector: Environment Protection

	Name of project	Donor	Implementing Agency	Start - End	Amount (€)
1	Bosnia and Herzegovina Biomass Energy for Employment and Energy Security Project	UNDP	UNDP	21.10.2009 – 31.12.2013	681,215
2	Climate Change Facility for BiH Cities	UNDP	UNDP	1.12.2009 – 31.12.2011	243,175
3	PIMS 4497 CC EA Preparation of the BiH SNC to the UNFCCC/EE	UNDP	UNDP	1.10.2010 – 1.10.2013	355,000
				Total	1,279,390

Sector: Agriculture and Forestry

	Name of project	Donor	Implementing Agency	Start - End	Amount €
1	CapacityBuilding of Agricultural Business in Drought Adaptation in BiH	Sweden/SIDA	USAID	23.9.2010 – 22.3.2012	230,876
				Total	230,876

Source: Donor Coordination Forum, 2012.

No donor or international body has assumed a lead role in the environmental sector. Ideally, either the EU or the OSCE would take a lead role in advancing environmental policy in BiH in partnership with domestic institutions. The EU invested EUR 91.280 million in Bosnia under the 2011 budget of the Instrument for Pre-Accession Assistance (IPA). The funding focuses also on environment and climate change (EC, 2011). The Ministry of Environment and Tourism of FBiH, supporting a project of consulting companies and non-governmental organizations, has financed the formation of a climate change web portal. The portal was made by the RegionalCenter for Education and Information on Sustainable Development in Southeastern Europe (REIC). Several Clean Development Mechanism (CDM) projects are under development. Projects are designed to reduce emissions of N_2O (coke industry), CH_4, SF_6, and CO_2 (Vukmir *et al*., 2009).

Important tasks for the successful adaptation of agriculture to climate change include improving climate monitoring; and providing timely climate forecasting information. For fostering WRAF sectors adaptation to CC, the following measures are needed (Vukmir *et al*., 2009): increasing investments and international aid in building capacity; creation of an Environmental Protection Agency that would ensure the full, coordinated implementation of environmental action plans; drafting a strategy and action plan for climate change adaptation; improving early warning and response systems; undertaking research on the development of drought-resistant varieties and crops; building multi-purpose water management facilities; modifying crop rotations according to the natural soil water regime; harvesting water by constructing farm ponds for catching precipitation runoff; introducing drip irrigation and techniques that save water (windbreaks, mulch, etc.); etc.

Conclusions

Bosnia is a non-Annex I Party to UNFCCC and has no obligations to reduce its GHG emissions; nevertheless it has already experienced climate change consequences. Climate change affect the sustainability of agricultural and forestry systems as well as water resources. The climate change policy-making arena in BiH is weak. The current state of politics in BiH leads to very little climate change-oriented activity. Moreover, there is weak support of donors

to projects regarding CC issues. BiH should integrate climate change adaptation into agricultural and forestry policies and research and investment programs to reduce their vulnerability to the current climate variability.Agriculture, water resources management and forestry represent priority policy and activity areas in which the policy and legislative framework should be improved and far-reaching, cross-cutting and integrated projects should be implemented. Future implementation of environmental policies in Bosnia is not possible without integrating environmental concerns into sector policies. In order to address properly the challenges represented by climate change and its effects, BiH should develop and implement a national climate change mitigation strategy and action plan, national Clean Development Mechanism strategy and take tangible steps to implement its international and regional commitments.It is important to increase interest in and capacity of state institutions to address the problem of CC; that's why the creation of a state agency that deals with CC issues is highly recommended. Moreover, better cooperation is needed on this issue between the two entities.

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MARKETING MODEL ORGANIC FOOD

Jovan BABOVIC[*], Radivoj PRODANOVIC

Faculty of Economics and Engineering Management in Novi Sad, Serbia
(Corresponding author:babovic@fimek.edu.rs)

Abstract

The aim of the paper is creation of marketing model, determination of supply and demand, as well as perception of organic products` marketing mix.

Marketing of organic products is the delivery of high-quality, certified food products that will meet consumer needs, earn profits and protect the environment.

Supply and demand for organic products have recorded a dynamic growth. Offer organic products in the world is smaller than demand. Organic production deals with producers over 1.8 million in 160 countries. Land under organic production in 2009. amounted to 37.2 million ha and a trend growth rate of 12%.The turnover of organic products in 2010 amounted 58.9 billion US dollars, resulting in a rising trend, at a rate of 10.9%.

Forecasts show that the expected sales of organic food in 2015 will worth 88.6 billion US dollars, with an annual growth rate of 8.5%.

Vegetable Turnover of 19.5 billion. $ Accounts for 33% of the total market value. Leading market segment of organic products in the world of fruits and vegetables, bread and cereals, beverages, milk and meat.

Products from organic agriculture are high-quality, safe and have higher nutritive value than conventional ones.Organic products contain more minerals, especially potassium, calcium, iron, magnesium, phosphorus, and vitamin C, less nitrates. Prices of organic products are higher and the differences are encouraged premiums. The share of traditional channels of distribution with retail chains organic food tend to increase and decrease the proportion of specialized and other distribution channels. The perspective is achieved through the development of safe certified high quality and strictly controlled in organic food production and processing, recognizable brand, the desired design for consumers in the domestic, regional and global markets.

Keywords: *marketing, certified organic product, supply and demand, nutritive value, marketing mix*

Introduction

Under the marketing of organic products means the placing on the market of certified organic agro food products to meet customer needs, make profits and environmental protection. Demand for organic products has influenced the development of marketing organic products.

Marketing of organic products should be viewed in terms of the benefits of organic products over conventional foods. Studies show that the demand for organic food products determined by the level of income, price, consumer perception of quality, information about products, security, range, supply, distribution channels and consumer behavior.

It is necessary to conduct consumer education and intensified promotional activities on organic products and their features and benefits. The growing demand for organic products, so it is necessary to define the model of marketing organic products will encourage organic production, and thereby make a profit and preserve the environment.

Materials and methods

This study was conducted quantitative - qualitative research methods. Original model was defined marketing of organic products. Used as original research and studies of various researchers, research papers and statistical publications.

Results and discussion

Model of marketing organic products
Production of organic food is regulated by the law and regulations, meaning that control production and trade - from farm to fork consumers.

Table 1. Model marketing of organic products

MARKET SUPPLY -DOMESTIC AND INTERNATIONAL -	Maketing research, inputs, transport, storage, quality control.
ORGANIC AGRICULTURE	Resources, agro technology, products, transportation, storage, own consumption, direct sales, quality control, certification.
PURCHASE AND SALE OF PRODUCTS	Products, sale, transport, storage, quality control.
PROCESSING OF ORGANIC PRODUCTS	Resources, food technology, products, transportation, storage, quality control, certification.
COMMERCIALIZATION OF PRODUCTS	Transport, storage, transport technology, preparation of goods for sale, quality control.
CHANNELS OF DISTRIBUTION AND MARKETING ORGANIC PRODUCTS	*Direct channels:* selling the farm, durable orders, sales on markets, trade show sales, stores organic products and farming households. *Indirect channels:* wholesale and retail trade. *Wholesale:* buying products, transportation, warehousing, wholesale, tourism and hospitality, large consumers, retail sales, quality control. *Retail:* Sales of organic products in super and hypermarkets, supermarkets, organic food stores, organic food organic product discounts, sales, health food stores, shops organic teas, spices and herbs, eco dairy, butchers, bakers' shops, quality control. *Special channels:* supply hotels, restaurants, cafes, canteens, schools, kindergartens, hospitals, military, ecotourism, quality control. *Exports and Imports*: products, transportation, storage, transport, buyers, quality control.
MARKET SALES -CUSTOMER (CONSUMER)-	***Delivery of Consumer Satisfaction***

On the supply of organic products affect the micro and macro economic factors. In microeconomic factors, including zoning organic production, suppliers of inputs for organic production and processing, distribution channels, financing, economics and the effects of supplemental organic versus conventional production and processing. The macroeconomic factors, including legislative regulations, subsidies, professional services, inspection, certification of products and consumer awareness about the benefits of organic food consumption (Sudarevi , 2010).

Marketing of organic food products
Organic production in the world was organized in 2009. year in 160 countries, an area of 37.2 million hectares, including land acquisition, and rising at a rate of 12%. Producers of organic

food in the world in 2010. year generated sales of $ 58.9 billion. Traffic is increased the range of over 2006. year at a rate of 10.9%. Vegetables with revenue of $ 19.5 billion, accounts for 33% of the total turnover of organic products. Projections show that the 2015th expected sales of organic food worth $ 88.6 billion with an annual growth rate of 8.5%. Leading market segments of organic products on the world market are fruits and vegetables, bread and cereals, beverages, milk and meat. The growth of traffic shows that there is demand for organic products.

Manufacturers in Europe generated sales of organic products valued at $ 24.7 billion. $ And rising with respect to 2006. year at a rate of 8.9%. Organic farmers in the U.S. market generate traffic value of 28.7 billion. $ In 2010. year with a growth rate of 11.6% (Dataminator, 2011, Dimitri and Oberholtzer, 2009, Helga Willer, 2011).

Products from organic farming are good quality, health, safe and more nutritive value. Studies in Germany have shown that organic produce contains more minerals, especially K, Fe, Mg, P, and vitamin C. The U.S. has found that organic products have over 63% K, 73% Fe, 125% more calcium and 60% more Zn quantity of products of conventional production (Mirecki, N., 2008).

Table 2. Differences in nutrient content of organic and conventional products in ppm

product	Ka	Ca	P	Mg	Fe	Na	Vit.C mg
snap beans	+ 58	+ 63	+ 6	+ 0,2	+ 63	+ 25	
cabbage	+ 11	+ 36	+ 4	+ 0,2	+ 48	+ 43	+ 43
lettuce	+ 168	+ 31	+ 17	+ 0,2	+ 57	+ 55	+ 17
tomato	+ 67	+ 33	+ 8	+ 0,2	+ 53	+ 19	
spinach	+ 116	+ 76	+ 16	+ 0,2	+ 32	+ 49	+ 52
in total	+ 420	+ 239	+ 51	+ 1,0	+ 253	+ 191	+ 112

Source: Fruhwald, F., Bioholmi, Ekime, Budapest, 2008. and National Quality of Organic Versus Conventional Fruts Vegetables and Grains, Virginia Worthington, M.S., Se.D., C.N.S. Calculation author.

Organic products contain more minerals (1155 ppm) and vitamin C (112 mg) than conventional products. Mineral content of organic products increased by 7 times compared to conventional products.

Aesthetics organic products affects the growth of demand. Aesthetic packaging emotional, technical and marketing attracts customers. Design is an important factor in the sale. Brand and brand is a trademark of the manufacturer, organic product, region and state. They raise the confidence of the customer to the product. Packaging is an important factor in product recognition.

Price is an important component of the sale and export of organic products. It must be acceptable to both producers and consumers. Wherein, the consumer has to pay for quality organic product at a higher price.

Table 3. Comparative analysis of the price of organic and conventional products ($/kg)

		2004	2005	2006	2007	Median	Index
Milk	Org.	3,22	4,18	4,26	4,42	4,02	**196**
	Con.	1,72	2,05	2,16	2,28	2,05	1oo
Egg	Org.	4,21	4,06	4,00	-	4,09	**296**
	Con.	1,52	1,26	1,36	-	1,38	100
Carrot	Org.	2,09	2,08	2,20	-	2,12	**136**
	Con.	1,53	1,58	1,59	-	1,56	100

Source: ERS Calculations using Nielsen Homescan data

Promotion is the communication between the manufacturer and the customer, in order to build an attitude toward the product and dynamic sales. It creates an image of the manufacturer and

contributes to its popularity and informs consumers and products. Logo signifies an organic product, and implies continuity of quality products from organic production.

Distribution implies that the real stuff is found at the right time in the right place. Distribution should be done through specialized sales channels and special places on the shelves of retail and wholesale, but also on the doorstep. Organic food products are available to consumers in health food stores, hypermarkets, direct sales, internet shops and restaurants. In the U.S. There is an increase of the traditional distribution channels, and reduce the proportion of organic food sold in health food stores and direct sales (Dimitri, 2009., OTA, 2011b). According Václavík (2009) in the European Union, the share of traditional channels of distribution of organic food has a tendency to increase the dynamic and reduces the share of specialized and other distribution channels.

Offer organic food in the world is less than demand. In Serbia, the organic produce sold in stores "health food" shops and supermarket, farmers' markets, as well as through home sales. Organic products are exported in small quantities, and there are all the conditions for a substantial increase in both production and exports. The economics of production and government incentives are important factors to develop faster production and processing of organic products. It is essential that producers and processors connected in business organizations and associations.

How to identify organic products?

Given that in our country there is still no specialized retail locations for this type of product, we recommend that no matter whether you are buying in large supermarkets or health food stores, pay attention to whether there is a sign on the packaging "organic product" and a sign that logo certification company that is responsible to monitor the entire production process. In Serbia, the Ministry of Agriculture is the guarantee that every product that bears this sign is produced according to the principles of organic agriculture.

On the market there is the symbol for products that have not been given the status of an organic product because of the production in the conversion. Such products are not fully organic, but they are on the road to organic and marked "Product of the conversion period."

Law on organic production and organic products in Serbia in 2010. was prescribed by the rules of production, processing, storage, transportation, transport, labeling of organic products and other issues in this area, and was elected to the national character that can mark the certified products. On the basis of prescribed rules on methods of organic crop, livestock production and processing, graphic symbol and a national character, the conditions and the way of traffic, keeping records, packaging, storage and transportation, the duties of the legal entity, certification, legitimizing the inspectors' proposal and Regulation incentive resources . Founded the National Association for the development of organic farming, "Organika Serbia."

Conclusion

Marketing of organic products need to be viewed in terms of the benefits of organic products compared to conventional food products. Organic products are better quality, health, are safer and their production does not threaten the environment. Model of organic products defining actions to be implemented to make this production was not economically viable.

Demand for organic food products is steadily developing trend. It is necessary to invest in organic production and processing, to develop a variety of quality improvement of safe range of certified organic products, financial and advertising to encourage the production and shape of organic products in order to realize profits, satisfy desires and needs of consumers and the preservation of the environment.

Products from organic production must be certified, labeled, packaged in appropriate containers, distributed with proper type of transport and accompanying documentation (Declarations, certificates, quality control) with adequate storage and marketing channels of traffic.

Perspective is in the production of quality certified organic food, recognizable brand, the broader range of products, the desired design for consumers in the domestic, regional and global markets.

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LEVEL AND IMPORTANCE OF CONSUMER ORIENTATION IN ORGANIC FOOD PRODUCTION

Dusko JOVANOVIC[1*], Snezana MILICEVIC[2]

[1]Business Economics Academy, Cacak, Serbia
[2]University of Kragujevac, Faculty of Hotel Management and Tourism, Vrnjacka Banja, Serbia
(Corresponding author: dule.jovanovic.kg@gmail.com)

Abstract

Organic production implies the harmonization of the development with the market needs and the preservation of the environment, but also reduction of the quantity of food at the expense of quality. In view of massive development of organic production it is necessary to have the participation of the state institutions, in terms of determining the strategy and the necessary measures for the promotion of organic production. The market of organic food is still not sufficiently developed. The results indicate that there is still not developed and built the awareness of consumers about organic food. It is necessary to expand the range of products from organic agriculture and food industry, to have a continuous supply and to develop an appropriate marketing. With proper consumer informing and education the production can be elevated to a higher level.

Key words:_organic food, consumer orientation, marketing, agriculture_

Introduction

The main goal of organic agriculture is the production of high quality food, or food with high nutritional value, but also the development of sustainable agriculture and the preservation of the ecosystem and maintaining and increasing of soil fertility. Organic agriculture is a production management system which promotes the healing of ecosystems, including biodiversity, biological cycles and emphasizes the use of methods that largely exclude the use of inputs outside the farm. That means maximum utilization of renewable sources of energy, reduction of all forms of pollution, preservation of the environment, but also creation of the conditions for meeting the basic needs of agricultural producers and acquiring adequate profit. Organic production is based on natural processes and the use of organic and natural materials[1]. In contrast, the growing demand for food has led to the situation where agricultural production primarily relies on the use of chemicals, with the aim of achieving the highest possible yields and profits. However, uncontrollable, excessive and unprofessional use of such funds (various pesticides, fertilizers) leads to a reduction in quality and soil fertility. This leads to a series of questions such as the issue of food quality, food safety, environmental protection, conservation of agro ecosystems, etc. It is believed that the organic production is the solution, that organic production puts the spotlight on human health and respects the natural balance and avoids various kinds of pollutants.[2]

Self-sustaining, organic agriculture is an attempt to identify the methods that should enable the production of organic food while reducing the negative impacts of intensive agriculture on

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[1] Lazi ,B., Lazi ,S.,(2008),Organska poljoprivreda, Tom I, Institut za ratarstvo i povrtarstvo Novi Sad
[2]Cerani , S., Paunovi , T. (2010). Organska proizvodnja u MSP - šanse i izazovi za razvoj poljoprivrede. Nau ni simpozijum sa me unarodnim u eš em, AgroSym (I), zbornik radova, Jahorina.

the ecosystem[3]. In order to achieve the highest possible profit, ignoring the basic biological principles without much hesitation, human population for centuries with their activities affects the complex structure of the ecosystem. The development of industry and supporting infrastructure affected the global living world leading to major changes in the biosphere. Although the intensification of agricultural production brought many benefits to human society, mankind has realized the negative effects only when in the 20th century faced with problems such as reduced natural populations and production problems that have arisen as a result of agricultural practices, especially reclamation, chemical contamination, and uncontrolled use of modern pharmaceuticals in order to increase the monoculture production.[4] The main negative effects that accompany conventional intensive agricultural production are reflected in erosion of soil and biodiversity, animal products made from animals that are grown under conditions of chronic stress, the presence of the residues of antibiotics and chemical plant protection products. According to the definition given by the FAO organic agriculture means the process of sustainable development of rural regions in line with available resources, tradition, biodegradable potential of habitats and represents a comprehensive and holistic farm agricultural and livestock production, which includes also the preservation and restoration of natural resources as well as the return to traditional values and knowledge.

It is believed that the production of organic food is potentially one of the most profitable businesses in the world. Although Serbia has a good potential for organic agriculture, it is not fully used and farmers are not motivated for this kind of production[5]. Serbia has so far developed a small and fragmented organic food production and research in this field provide the indications that this type of production has significant opportunities for growth, but have identified some very important weaknesses and limitations. This form of food production is still in its initial phase of development, making it difficult to define the developmental trends with a high degree of probability. During the past few years, certified area has significantly increased and it is very difficult to get reliable data on the income of the sector because in Serbia official records of organic production still have not been kept.[6]

The law on organic production in Serbia regulates the label for organic foods. This sign is promoted and there are indications that consumers recognize the sign and understand its meaning. Advertising is not a continuous activity and it is developed and applied only when there is a financial support of donors. In any case, advertising is not sophisticated and the main message is related to healthy food, which confuses the consumers and limits proper separation of the organic food market. Low marketing knowledge and skills related to sales promotion are and will be an important limiting factor for the future development of the sector.[7] Interested individuals in this sector are highly successful in promoting the sector indirectly through various special TV and radio programs, etc. In supermarkets there is a lack of trained dealers who would respond to direct questions about the characteristics of organic products.

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[3] Cvijanovi ,D., Savremeni marketing u funkciji ekologije, Proizvodnja bezbedne hrane ekonomsko-ekološki aspekt, Institut za ekonomiku poljoprivrede Beograd, Novi Sad, monografija, str.103-112

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Materials and methods

In order to obtain the results the method that was used in the research is a questionnaire. The survey was conducted on a random sample of four hundred subjects, with the personal communication technique. In marketing research, the main goal of each sample is to ensure the reliability of the information that is required at minimum cost and to maximize the degree of reliability of the information obtained at a given cost. The study sample was defined in accordance with the specific research problem and the research objectives. Although we are aware of the fact that this is a relatively small sample size for the full representation, we believe that the obtained responses are indicative enough and that they can demonstrate basic indicators related to consumer orientation in relation to organic food products. The survey is based on so-called "field research", with the application of standard statistical-mathematical methods[8]. The first part of the questionnaire consisted of general questions about age, education level, family members number and monthly income of the respondents. The second part of the questionnaire relates to the questions that have helped to explore consumer preferences, attitudes, and motives of respondents when purchasing organic food products.

Results and discussion

Table 1.Questionnaire of research

Question	a)	b)	c)	d)	e)
1. How do you to distinguish conventional and organic products?	By price	By the sign the organic foods have	By certificates	By taste	By their apperance
2.Where you encountered the term "organic food"?	In the media	In stores	Throught friends	Trought the Internet	Do not know
3. "Organic" stands for ..?	Natural	Healthy	High quality	Do not know	
4. Are you ready to pay more for organic products and how much more?	I`m not redy	Up to 10% more	From 10 to 30%	Do not know	
5. When buying organic food, I pay attention to:	Quality	Price	Health	Do not know	
6. Do you prefer domestic or imported organic products?	Domestic products	Imported products	There in no difference	Do not know	
7. Why do you buy organic produce?	For their price	For the taste	The way they are displayed	For their packaging	Do not know
8. Organic products are healthier?	Yes	Basically no	Do not know		
9. Where do you buy organic food?	At the market	In the suoermarket	In the hypermarket	In specialized stores	Do not know
10. How easy it is to find organic products in stores?	Not easy	It is easy	Do not know		
11. Are the organic products sufficiently represented in advertisements and in the media?	No	They are represented enough	Catalogs & Brochures	Do not know	
12. How should consumers be advised to the benefits of organic food?	Television	Promotions in the stores	Catalogs & Brochures	Do not know	

[8] Jovanovi ,D. (2011), Nivo i zna aj potroša ke orijentacije u hotelijerstvu u Srbiji, Magistarska teza, Privredna akademija Novi Sad

When it comes to knowing the difference between conventional and organic food products, the majority of respondents declared that they see the difference between the organic compared to conventional products basing on the price (30%) and the organic food label (30%). The certificate is a sign of recognition for 19%, the taste for 13% and appearance for 8% of the respondents. Organic products in the market are identified by legally defined label. Consumers by purchase the products with the label "organic" can be sure that at least 95% of the ingredients of this product has organic origin, that the product is in line with the inspection regulations which these products undergo, it is packed in biodegradable packaging, and the agency that performed the inspection. Certified organic products must be marked with "organic product". We can conclude that organic products are not clearly differentiated from the conventional ones.

With the term "organic" food a little more than half of respondents (52%) have been informed through the media, followed by the responses in the shop (19%), 14% by friends, while 10% of respondents get informed via the internet. The opinion of the respondents that the organic products are "natural" is present in a third of respondents, that it is "healthy" food considers 30%, while 13% think it is distinguished by the high quality of products. More than half of the respondents are willing to pay more for organic products, while 21% are not ready for additional financial allocations. This is important from the point of view of future demand for these products. The largest number of respondents (43%) are willing to pay 10% more for organic products, 27% are prepared to allocate 10-30% more for the same purchase. This indicates that nearly three quarters (70%) of respondents are ready to allocate up to 30% more to buy organic food.

Analyzing the factors that are most important when purchasing organic foods, the results show that more than a third of the respondents are focused on the quality of the product (35%). The financial impact is marked as dominant in quarter of the respondents, while health is a decisive factor in 16% of respondents. The biggest part of the respondents (40%) prefers organic agricultural products from local producers. Nearly a quarter of respondents prefer foreign organic products. At the same time 10% of respondents stated that there is no difference between organic products of domestic and foreign origin. Analyzing motives for buying it is evident that most of the respondents, or more than a third (36%), opted for the price as the most important factor when purchasing. The next motive is the taste that is dominant in a third of the respondents, followed by the exposure and visibility at the point of sale with 15%, while the packaging is the most important for 13% of respondents. With the statement that organic products are "healthy for nutrition" entirely agreed almost two-thirds (60%) of the respondents and mostly 22%. So, about 85% of the respondents agreed that organic products are good for the health of consumers.

Respondents mostly buy organic food in street markets (40%), followed by supermarkets where buy 28% and hypermarkets with 21%. In specialized shops buys relatively small percentage, only 8% of the respondents. It can be seen that there are changes in the supply structure of consumers. This suggests that organic food "moves" more to the classic retail stores, so in addition to buying conventional food consumers can be supplied with organic products. However, the positioning of organic products in supermarkets is very weak because it is not separated and appropriately differentiated from conventional products. When it comes to the market supply of organic products, nearly half of respondents agree that they are hard to find in stores, and on the other hand, one third of respondents believe that it is not difficult to find these products in stores.

The research results show that there is a clear need for intensifying promotional activities, which was declared by 61% of respondents, in order to increase the demand for organic products, while 10% of respondents have the opposite view. Therefore, the promotional activities of business entities need to come more to the fore in order to increase the influence

of the consumer's decision to purchase. When it comes to the most appropriate way to inform potential consumers about organic products, the respondents largely (52%) opted for television. The promotion at the point of sale is of utmost importance for 29%, and various catalogs and brochures for 17% of the respondents. Answers to this question should indicate in what direction promotional activities should be conceived, and to point out the best and most effective tool in the promotional activities.

Table 2. Results of research

Question	Answer a	Answer b	Answer c	Answer d	Answer e	Total
1	119	119	78	52	32	400
2	207	78	56	40	19	400
3	132	120	52	96	/	400
4	83	172	107	38	/	400
5	140	100	64	96	/	400
6	160	96	40	104	/	400
7	144	132	60	52	12	400
8	242	90	0	70	/	400
9	160	112	84	32	12	400
10	192	136	72	/	/	400
11	244	40	116	/	/	400
12	208	116	68	8	/	400
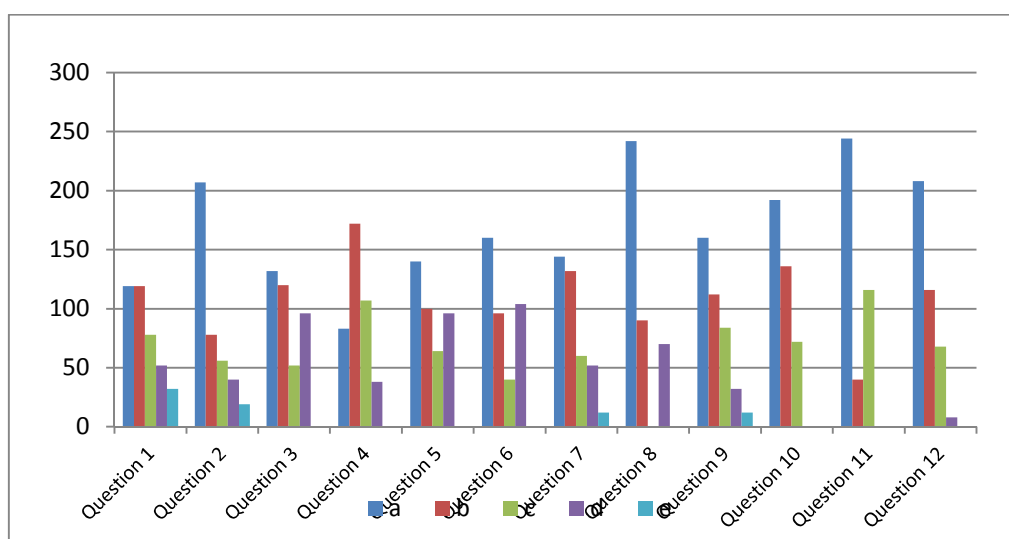
Figure 1. Graphical presentation of results

When analyzing answers from the survey, we used basic mathematical and statistical methods, survey and counting, as well as empirical and analytical evaluation of responses received.

Conclusion

The consumers of organic agricultural products are the main drivers of everything that is done in this sector. Their needs and desires are the main motive in the conduct of all the marketing activities involving what is to be done, from the choice of what to produce, how to recycle, how to inform consumers to how and where and at what price to sell the final product, with a permanent collection of information to what extent they are satisfied with the existing products[9]. The starting point in all this is the research of opinion and consumer attitudes.

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[9] Jobber,D., Fahy.J, (2006), Osnovi marketinga, Data status, Beograd

Advertising is not a continuous activity and it is developed and applied only when there is a financial support of donors. In any case, advertising is not sophisticated and the main message is related to healthy food, which confuses the consumers and limits proper separation of the organic food market. Low marketing knowledge and skills related to sales promotion are and will be an important limiting factor for the future development of the sector. The promotional activities of business entities need to come more to the fore in order to increase the influence of the consumer's decision to purchase. Organic products market is still not developed enough. In order to achieve this, that the consumption of organic food is elevated on a higher level, it is needed to:

Expand the range of products of organic agriculture and food industry;

Have a continuous supply;

Develop appropriate marketing;

Make sure that costumers are well informed;

Organize proper consumer education.

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AGROMETEOROLOGICAL FORECASTING BY METEOROLOGICAL FACTORS

Aferdita LASKA MERKOCI[1*], Vangjel MUSTAQI[1], Magdalena CARA[2], Mirela DVORANI[1]

[1]Polytechnic University of Tirana, Institute of Geosciences, Energy, Water and Environment, Albania
[2]Agricultural University of Tirana, Faculty of Agriculture and Environment, Albania
(Corresponding author: aferditamerkoci@yahoo.it)

Abstract

The influence of the climate conditions in the crop production is of a special importance. For this reason taking and the importance of the wheat in world level, undertaken this study for the product estimations two weeks before the reaping (harvest).

In this study are considerate the diverse contemporary models. After certain analyses are choosing the model the result, more agree for the condition of our country. This model is base in the linear equation of regression, where include all the climate elements like average temperature, the effective and active temperature for the threshold 5ºC, 8ºC, 9ºC, 12ºC, Winter severe evaluated like sum of difference of diurnal minimum temperature with the minimum temperature <5ºC like the value of relative calnm of wheat, the rainfall, the amplitude and the evaporation.

After that, are chose the more signification periods for the wheat plant, which impute in this equation and is do the crop evaluation for some zones with the diverse climatic change of the Albanian region and with diverse productivity, according as crop. In this study, are evaluated the zones with diverse agro climate characteristics of Albania.

The highest value of forecasting error is 1.3 qu/ha (4.5%) to 2.2 qu/ha. These results show that this forecastimg model can be used for the condition of Albania.

Key words: *coefficient of correlation, multiplier regression, evaluation of productivity, equation, wheat.*

Introduction

Determination of the market price for agricultural production nowadays around the world is closely connected, with the expected quantity and quality of this production. With the new economical regulations in Albania, estimating the production have a special interest, not only for an economy or zone, but also for the entire country, since it is directly related with the foreign market. Thus a great attention must be dedicated to this problem because recently the market price of the wheat around the world is increasing.

Many sciences can be profitably applied to the agriculture; however, meteorology is most helpful of all, since the air and the water play the important role in every part of agricultural science. Of course, no single science can produce all the necessary practical knowledge and information required by agricultural management, therefore meteorology must be closely adjusted with agricultural science. .(Brochet PM et al, 1977).

Many factors affect the success and failure of the agricultural production, but among them the weather plays the most decisive role. The agricultural yield product depends directly and indirectly on the weather and climate. The knowledge on weather and climate conditions has considerably increased recently and is increasingly applied to help agricultural activities of all kind (Horie et al, 2003).

Considering that our country is mainly an agricultural one, we must intend to increase the plant areas in general and those planted with wheat in particular, and use the new accessible technology available as well as utilize our climate conditions to achieve a high production gain

Material and method

The statistical model is usually used to differentiate between empirical statistical models and physical-statistical models.(Luis S et al. 2010). In the empirical models, one or several variables are related to crop response, such as crop production (Horie et al, 2003). The independent variables are often the two agriculturally important meteorological elements like temperature and precipitation which are generally measured in every meteorological station, or derived agro meteorological indices (e.g. sum of temperature, photosintetically active radiation etc), and agro meteorological values determined by different equations (soil moisture calculated bay aid of water-balance equation etc.) The relationship is determined by means of regression techniques.(Varga-Hazsonits, 1983).

In our case we used the statistical method to estimate the wheat yield. The data used are: the bank of climate data obtained from Institute of Geosciences, Energy, Water and Environmental Institute for 1967-2005 period and the yield of wheat obtained from Statistical Office at Agricultural and Food Ministry.

In this study we considered some   regions that are characterized by a diverse climate conditions. For the Western Lowland we selected the region of Lushnja and Shkodra, for the south east with a cold weather we selected the Korca region, Peshkopia and Gramsh regions in the North East, and Gjirokastra for the South of Albania.(Climate Atlas of Albania 1984).

The relationship between two factors, the yield product deviation and the deviation of climate elements, is carried out by the coefficient of correlation. This coefficient determines the amount, strength and direction of this relationship.

The correlative relationships can be of different kinds. Based on the form they fall in two groups, linear or curved. Also, based on the direction they can be positive or negative, while based on the number they can be simple or complex.(Zorba P 1998). In our case the relationship between the climate elements such as temperature with its threshold, the precipitation, the evaporation, and amplitude, is linear, while the relationship between the yield and the winter severity is curved.(AL.Merkoci et al. 2011).

Yield product has always fluctuated from year to year. The tendency include the impact of technology in wheat yields, introduction of new varieties, which best suit the environmental conditions and have a high productivity, the development of new cultural techniques, mechanization, phytosanitary, interventions more effective, etc. which is associated with a progressive and regular growth of production for a period of time(J. I. Chircov 1989).

Deviations from this trend represent the effect of climatic factors, which give to the production a multi-year variability.(James W et al. 2004). Their action is positive (increasing productivity) when there are favorable climate condition or negative. The application of the model to forecast crop production passes in three phases:

The definition of trend yield of wheat product in time, which is the definition as yield productivity "theory" to normal climatic conditions, is the first step. The tendency is evaluated by linear regression equation:

$$R_t(i) = a \cdot i + b \quad (1)$$

Where: $R_t(i)$ is the theoretical yield of-year, *(i)* is the range of the year(often expressed in the last two digits of the year(e.g. 67 for year 1967). The deviation between actual yield and theoretical yield $E_{(i)} = R_{(i)} - R_{t(i)}$ is the deviation which belongs to the influence of meteorological factors.

The chosen correlations (second step) are proven with the Student's Test with P=0.05 for the 1967 – 2005 period. Note here that, after the correlation analyses, when two factors had the same correlation coefficient during the same period of time, we selected that correlation coefficient with the highest physiological impact on wheat for the period of time under consideration. For this data series the coefficient of correlation is accepted 0.35.

The model of yield product forecastwill bebased onthe analysis ofmultipleregression.

$$E_{(p)} = m + n \cdot x_{(p)} + q \cdot y_{(p)} + r \cdot z_{(p)} + \ldots \qquad (2)$$

Where ($x_{(p)}$, $y_{(p)}$, $z_{(p)}$, ...) are the climatic parameters selected above, $E_{(p)}$is deviation of wheat yield of year p from line trend.(WMO 1982).

Where *m, n, q, r, ...* etc. are coefficients calculated for the period up to 1992. Relationship of winter severity with production is chosen of parabolic form. Forecasted product for the year p will be as the sum of "theoretical" yield for that year and $E_{(p)}$.

Results and discusions

In building the statistical models of wheat forecasting, the first phase is to build the tendency line, which in other words is the theoretical efficiency for the normal climate conditions. For this reason there are data for the wheat crop for the periods 1967-2005. However, the equation of regression used the line of tendency from 1991 to the year that will calculate the forecast. There are a number of papers published that adjust this problem.

Figure 1 presents the tendency of wheat yield for the 1967-2005 time period. The x axis represents years (1967-2005).The y axis represents the efficiency of the plant of wheat.

To choose the agro climate indices and influence periods, are found the significant correlations between the values of agro meteorological elements for the vegetation period with the plant deviation. The forecasting month for wheat yield will be until May 30 in the cold regions, while for Lowland zone will be in May 15. Thus, the period of time under consideration will be from October 1st to May 30.

The factors considered in the correlation, are: the deviations of yield with the climate elements, the five day rainfall, the winter severity, as the difference of the diurnal minimal temperature with the minimal temperature <5°C, the value of transition from the condition of relative calmness of the wheat, the value of evaporation, the minimal temperature, the temperatures with diverse threshold according to the phenological phase, the amplitude, etc. Hereinafter in the tabl.1,2,3,4,5,6,7, we present the results of our calculations and comparisons considering the climate factors and the significant periods with positive or negative effects on the deviation of yield of wheat.
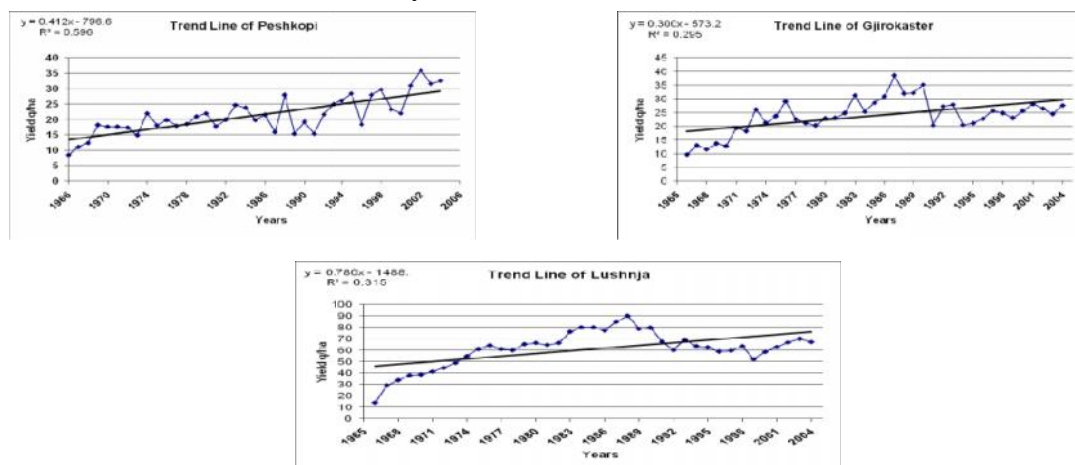
Figure 1. Trend Line of wheat production for periods 1967-2005

Table 1. Correlations between deviation of yield and rainfall

Regions	Periods	Coeff. R Number of days	Periods	Coeff. R Number of days	Periods	Coeff. R Number of days
Peshkopi	21.XII – 2.I	R=-0.33 30 days	21.I –15.II	R=-0.33 25 days	26.III –25.V	R=0.33 60 days
Shkodër	6.XI –31.XII	R=-0.64 55 days	1.II –15.III	R=-0.47 45 days		
Lushnje	5.XI –15.I	R=-0.67 70 days			21.III –15.IV	R=0.38 25 days
Gjirokastër	21.XI –10.II	R=-0.54 80 days				
Gramsh					6.III –25.IV	R=0.63 25 days
Korçë	10.II –20.III	R=-0.40 45 days	15.III		16.IV –15.V	R=0.37 30 days

Table. 2. Correlations between deviation of yield and effective and active temperature for diverse threshold (5°C)

Regions	Efektive Temperature R and period		Duration in day	Aktive Temperature R and period		Duration in day
Gjirokastër	r =-0.54 r =-0.46	20.XI—26.XII 26.II-25.III	35 30	r =-0.63 r =-0.48	26.XI-31.XII 21.II-25.III	35 35
Gramsh	r =0.49 r =-0.41	10.XII-30.I 20.III-25.IV	50 35	r =-0.36 r =-0.46	21.XI-15.XII 26.III-20.IV	25 25
Lushnje	r =-0.37	26.II-15.III	25	r =-0.4	26.II-20.III	25
Peshkopi	r =0.4 r =-0.38 r =-0.47	15.XII-10.I 25.II-20.IV 25.III-20.IV	25 55 25	r =0.45 r =0.43 r =-0.47	21.XII-10.II 21.I-20.II 21.II-15.III	50 30 25
Sarandë	r =-0.46 r =-0.49	6-31.XII 16.II-25.III	25 40	r =-0.52 r =-0.55	11.XII-5.I 11.II-25.III	25 45
Shkodër	r =-0.35 r =-0.41	26.XI-31.XII 21.I-20.III	35 60	r =-0.35 r =-0.41	26.XI-31.XII 21.I-20.III	35 60

Table 3. Correlations between deviation of yield and effective and active temperature for diverse threshold (8°C)

Regions	Efektive Temperature R and period		Duration in day	Aktive Temperature R and period		Duration in day
Gjirokastër	-		-	r =-0.38	6.III-30.III	25
Gramsh	r =-0.43 r =0.34	1.III-25.IV 1-25.VI	55 25	r =-0.43 r =0.35	6.IV-30.I 1.VI-25.VI	25 25
Korçë	-		-	-		-
Lushnjë	-		-	-		-
Peshkopi	r =-0.51	26.III-20.IV	25	r =-0.47	26.III-20.IV	25
Sarandë	r =-0.42	1.III-25.III	25	r =-0.6	1-25.III	25
Shkodër	r =-0.4	6.V-25.VI	35	r =-0.42 r =-0.4	1-25.III 6.V-25.VI	25 50
Vlorë	-		-	-		-

Table 4. Correlations between deviation of yield and effective and active temperature for diverse threshold (12°C)

Regions	Efektive Temperature R and period		Duration in day	Aktive Temperature R and period		Duration in day
Gramsh	r =0.35	1-25.VI	25	r =0.34	1-25.VI	25
Gjirokastër	-		-	-		-
Korçe	-		-	-		-
Lushnje	r =-0.34	25.V-25.VI	30	r =-0.47	6-30.VI	25
Peshkopi	-		-	-		-
Shkodër	r =-0.33	26.V-20.VI	25	r =-0.33	26.V-20.VI	25

Table 5. Correlations between deviations of yield and amplitude

Regions	r and period		Duration in day	Regions	r and period	Duration in day
Lushnje	r =0.49 5.III	5.II-	30	Lushnje	r =-0.38 26.V.-25.VI	25
Gramsh	r =-0.39 20.IV	26.III-	25	Peshkopi	-	-
	r =0.34 10.VI	16.V-	25			
Korçë	r =-0.38 15.V	21.IV-	25	Shkodër	-	-
Gjirokaster	-		-			

Table 6. Correlations between deviations of yield and evaporation

Regions	r and period		Duration in day	Region	r and period		Duration in day
Peshkopi	r = -0.46	26.III-20.IV	25	Lushnje	r = -0.34	26.V-25.VI	30
Gjirokastër	r = -0.5	20.II-20.III	30	Shkodër	r = -0.45	1-25.III	25
Gramsh	r = -0.5	1- 25.IV	25	Korçë	r =-0.34	6.IV-5.V	30
	r = 0.35	1-25..VI	25				

Table 7. Correlations between deviations of yield and winter severity

Regions	Equation and . Koefficient of determination R²	Correlation coefficient r and period	Duration in day
Gjirokastër	$y = -0.0001x^2 + 0.0896x - 12.262$ $R^2 = 0.2177$	r=0.47 15.XII-30.I	25
Gramsh	$y = -0.0004x^2 + 0.1177x - 7.2622$ $R^2 = 0.1952$	r = 0.44 10.I-25.II	45
Korçë	$y = -0.0001x^2 + 0.1092x - 2.1396$ $R^2 = 0.1729$	r = 0.42 15.I-28.II	45
Lushnje	$y = -0.0004x^2 + 0.0746x + 2.7648$ $R^2 = 0.0981$	r = 0.31 15.I-25.II	40
Peshkopi	$y = -9E - 0.5x^2 + 0.0409x - 1.9914$ $R^2 = 0.3735$	r = 0.61 15.XII-30.I	45
Sarandë	$y = -0.0028x^2 + 0.1633x - 1.2237$ $R^2 = 0.0799$	r = 0.29 1.I-15.II	45
Shkodër	$y = -0.0006x^2 + 0.1328x - 5.7798$ $R^2 = 0.1262$	r = 0.36 20.I-20.II	30

The results from these tables are used in the multiple equations of regression. The equation of forecasting of the wheat yield for the North, Center and South regions under study are as follows:

Peshkopi
$$\Delta Y = 44.72576 - 0.03297 x_1 + 0.0055096 x_2 - 0.00963 x_3 + 0.258532 x_4$$
$$+0.000841 x_5 - 0.05468 x_6 + 0.010283 x_7 - 0.02246 x_8 + 3.36E - 06 x_8^2$$

Tendency$(y = 0.9844x - 70.613)$

Lushnje
$$\Delta Y = -0.99386 - 0.01321 x_1 + 0.006389 x_2 - 0.00658 x_3 + 0.715872 x_4$$
$$-0.00875 x_5 + 0.0000131 x_5^2$$

Tendency$(y = 0.264x - 495.97)$

Gjirokaster
$$\Delta Y = 8.818169 - 0.00522 x_1 - 0.06079 x_2 - 0.01272 x_3 - 1.19302 x_4$$
$$+0.016742 x_5 - 1.8E - 05 x_5^2$$

Tendency$(y = 0.9339x - 50.28)$

Where x_1, x_2, ... x_n are the indipendent variable (meteorological factors) and the tendency is the trend line for the period 1992-2005. Considering $Y = \Delta Y + y$ for the years 2002, 2003, 2004 and substituting these values, we will get the expected forecast values of wheat crop.
Results for the years 2002, 2003, 2004 are shown that he error varies from 07 to 1.5 in the absolute value and 2.2 to 4.5%. Figure 2 denotes the actual difference between the forecasting yield for year 2004, for the Lushnja.
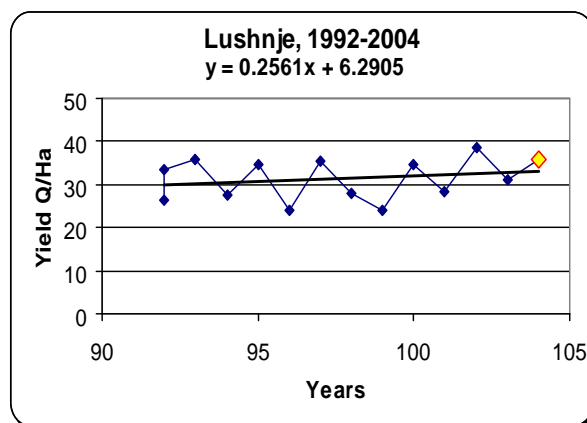
Fig.2. The graphic presentation between the forecast yields with the respective tactic for 2004 for Lushnja

Conclusions

From evaluation of yield of wheat, we conclude that from the agrometeorological viewpoint of production, responsible are: the rainfall for the periods December-April, Severerity of winter, and the air temperature in the more sensible phase of the wheat crop against this element. The rainfall between February 11 and March 25 has a negative effect. Any rainfall before this period and based on the soil humidity it is necessary to keep a working infiltration system. For the rainfall during 11 April-10 May period, time when the requirement for water is high, the above results indicate decrease of this element. So it is necessary for an artificial irrigation during this period.
The wheat plant has necessity for a sum of lower temperature for the periods December-April. This is valid in the cold regions, while in the West Lowland the sum of this temperature is

smaller. For the cold regions   this sum is about 360 to 400°C, when in other regions is about 190ºC.

According to analyses and the results obtained we conclude that the application of this model, of forecasting the wheat crop, for Albania is correct and can be applied if all the agrometeorological elements are used correctly.

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FUZZY LOGIC MODELING IN PREDICTIVE ECOLOGY

Saddek BOUHARATI[1,2], D. HARZALLAH[2], F. ALLAG[3], M. BOUNECHADA[3]

[1]Intelligent systems laboratory. Faculty of Technology, UFAS, Setif, Algeria
[2]Laboratory of applied microbiology, Faculty of SNV, UFAS, Setif, Algeria
[3]Department of animal biology, Faculty of SNV, UFAS, Setif, Algeria
(Corresponding author: sbouharati@yahoo.fr)

Abstract

In terms of ecology forecast effects of climate change, the purpose of our study is to develop a predictive model of growth and adaptation of species in environmental and bioclimatic conditions. The impact of climate change on forests is the result of combined effects in magnitude and frequency of these phenomena. Like the data involved in the growth process of the species occur in an uncertain environment due to their complexity, it becomes necessary to have a suitable methodology for the analysis of these variables. The basic principles of fuzzy logic those are perfectly suited to this process. As input variables, we consider the temperature, rainfall, humidity, soil type, plant species concerned. The result output variable is the adaptability of the species expressed by the growth rate or extinction. As a conclusion, we prevent the possible strategies for adaptation, with or without shifting areas of cultivation and forestry.

Keywords: *Climate changes; Ecology, Predictive model, Fuzzy logic*

Introduction

Most atmospheric scientists agree that climate changes are going to increase the mean temperature with increased frequency of climatic extremes, such as drought, floods, and storms. Under such conditions, there is high probability that forests will be subject to increased frequency and intensity of stress due to climatic extremes (La Porta et al., 2008)

Most scientific studies of climate change use models to generate projections at the global and regional levels. Scientific studies on climate change typically provide discipline-specific results, based for example on climatic variables (temperature, precipitation, etc.)

In general, Ecosystems are nested systems and typically show variation in spatial and temporal scales, making them extremely difficult to predict and control. In a local knowledge the fuzzy cognitive maps are qualitative models of a system consisting of variables and the causal relationships between those variables (Ozesmi & Ozesmi, 2004).

It is therefore essential to understand the impacts of climate change on forests to be able to develop strategies and adaptations necessary to maximize the potential for mitigation. Since these data are characterized by their bioclimatic uncertainty and imprecision, a fuzzy system is proposed for remedying them. The forecasting model takes into account the impact of different parameters that often interfere.

The proposed system is extensible to other factors that are not supported in this study. As several factors affect each measured value, and the term climatic changes are also relative, it becomes necessary to analyze such data with the tools of artificial intelligence especially fuzzy logic inference. The nonlinear systems difficult to model mathematically are usually monitored by fuzzy logic. It is a system of logic and based on set theory and continuous variables. Fuzzy logic is a methodology for problem solving or in other words "problem

solving control system methodology". Its implementation can be performed in hardware or software or by combining both. Conclusions that are based on vague, imprecise, missing input information are simply provided by fuzzy logic (Faran Baig et al., 2011).

The proposed system utilizes fuzzy logic. Fuzzy logic is an extension of classical logic. In our situation it is very difficult to use classical logic to model a system with the available knowledge. Classical logic does not allow working with uncertainty in the information when knowledge about the behavior of the systems is imprecise (Alayón et al., 2008).

Presentation of the study area

Boutaleb forest is located in the district of Setif in Algeria on its southern border with the province making M'sila southwest of Batna.

Statement of vegetation

The statement phytoecological is a floristic inventory which corresponds to the list of species present in the area is minimal or optimal in our case 200m in the dense forest of *CedrusatlanticaManneti* and *Pinushalepensis*

Different dominant species in the massive Boutaleb are studied:

Cedrusatlantica, *Artemisiaherbaalba*, *Retamaretam*, *oxycedrusJuniperus*, *Quercusilex*, *Pinus halepensis, Echinops spinosus.ec.*

Materials and methods

Presentation of spices

The Atlas cedar (*Cedrus atlantica or*).

This is a tree species of the family *Pinaceae*. Although often with a peak tabular adulthood durability is important. This species is adapted to the Mediterranean climate tolerant to water stress, IL can withstand summer drought as atmospheric drought. Some sources are more susceptible to spring frosts (early bud. From the perspective of global warming, the area of introduction could extend northward.

(1 to 2 meters, sometimes less requires the following exhibitions: light, sun, perfectly adapted to drought, tolerates all well drained soils same limestone. The plant dies from of -10 °C. The aerial parts are damaged from.

Cade juniper (Juniperus oxycedrus)

Is an evergreen shrub in warm climates, upright rather conical. It is a tree that can reach 14 meters, but the dimensions are usually much smaller -10 ° C.

Holm oak (Quercus ilex)

It is a tree of 5-20 meters high. It is mesophanérophyte microphone. The foliage is evergreen. It has a life span of 200-500 years. It is a monoecious species.

Quercus ilex tolerate many extreme weather and grows well, albeit slowly, with little or no summer irrigation once established. It supports up to -12 ° C. Holm like aridity, drought and sun. The plant supports winds, which allows him to enjoy the sea edge.

Aleppo pine (Pinus halepensis)

Is a conifer family *Pinaceae*. Tree about 20-30m and often leaning slightly right, the branches are quite spread out. The Aleppo pine is yet the only large tree to grow easily and naturally in the limestone to poor soil and dry. Highly resistant to the Mediterranean coast, it appears even in semi-arid regions.

It is an essence of light that supports strong illumination and long periods of drought.

Aleppo pine present in the arid, semi arid and sub-humid in the wet. Penetrates widely throughout the Mediterranean and supra locally reach much higher altitudes.

Table 1. Number of newborns according areas with anatomic parameters

Species	temperature		pluviometry		soil		Moisture	
	ideal	*reel*	*ideal*	*Boutaleb*	*Nature*	*Boutaleb*	*species*	*Boutaleb*
Junipersus oxycedrus	10°C	2.8-23.5	300-400 mm	427mm/ year	Limestone acid	Mineral-stony limestone	Not support	Wet 8.5 months, 3.5 months dry
Cedrus atlantica	-1°-+10°C	2.8-23.5	500-2000mm	427mm/ year	Brown stony forest-	Mineral-stony limestone	strong	Wet 8.5 months, 3.5 months dry
Pinus halepensis	Resistant to high temperature	2.8-23.5	350-700mm	427mm/ year	limestone	Mineral-stony limestone	strong	Wet 8.5 months, 3.5 months dry
Quercus ilex	12°C	2.8-23.5	low	427mm/ year	stony	Mineral-stony limestone	strong	Wet 8.5 months, 3.5 months dry

Fuzzy logic inference

The fuzzy logic approaches, a sub-field of intelligent systems, are being widely used to solve a wide variety of problems in medical, biological and environmental applications. One of the most important areas of application of fuzzy set theory as developed by Zadeh (1965) Fuzzy sets. Information and Control 1; 8:338–353.is Fuzzy Rule-Based System. These fuzzy logic systems constitute an extension of the classical rule-based systems, because they deal with "if-then" rules whose antecedents and consequences are composed of fuzzy logic statements, instead of classical logic ones. In a broad sense, a fuzzy rule-based system is a rule-based system where fuzzy logic is used as a tool for representing different forms of knowledge about a problem, as well as for modeling the interactions and relationships that exist between its variables. Due to this property, fuzzy logic principles have been successfully applied to a wide range of problems in different domains for which uncertainty and vagueness emerge in varying ways. Fuzzy modeling (Pedrycz, 1996), fuzzy control (Driankov, 1993).and fuzzy classification (Chi et al., 1996) are the most common applications.

Fuzzy logic deals with reasoning on a higher level, using linguistic information acquired from domain experts. The above-mentioned capabilities make fuzzy logic a very powerful tool to solve many ecological problems, where data may be complex or in an insufficient amount. The fuzzy logic concept provides a natural way of dealing with problems where the source of imprecision is an absence of sharply defined criteria rather than the presence of random variables (Bouharati et al., 2008).The fuzzy approach considers cases where linguistic uncertainties play some role in the control mechanism of the phenomena concerned (Demir & Korkmaz, 2008). Fuzzy inference systems (FIS) are powerful tools for the simulation of nonlinear behaviors with the help of fuzzy logic and linguistic fuzzy rules (Mamdani, 1977).

Fuzzification

In order to make fuzzification the linguistic expressions below are used. The proposed fuzzy logic factors impact control system consists of five input variables.
Fuzzy variable "Rainfall" has the linguistic values height, medium, and height.
Fuzzy variable "Temperature" has the linguistic values low; medium; height
The variable "Wind-speed" has (low, medium, and height).
The variable "Frost" has (little and big)
The variable "Wind-speed" has (low, medium, and height).

The mapping values of input variable through the membership function are the linguistic values. Fig.1. The linguistic values of inputs are shown as a result:
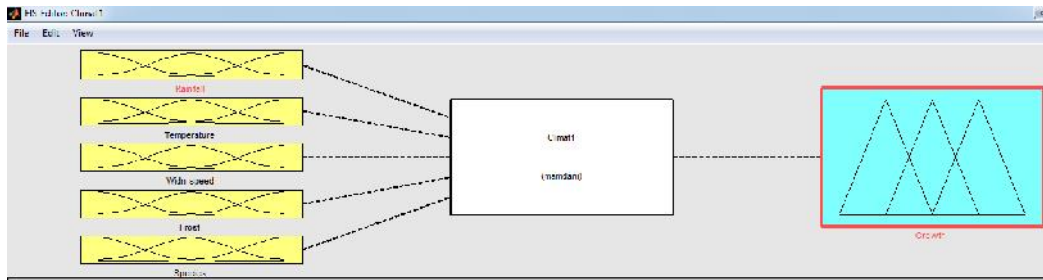
Figure 1. Plot of inputs-output fuzzy system

Fuzzyfication the input variable "Temperature"

The entry that represents the temperature is composed of three fuzzy intervals and membership functions defining the cold, warm and hot temperature. Fig.2
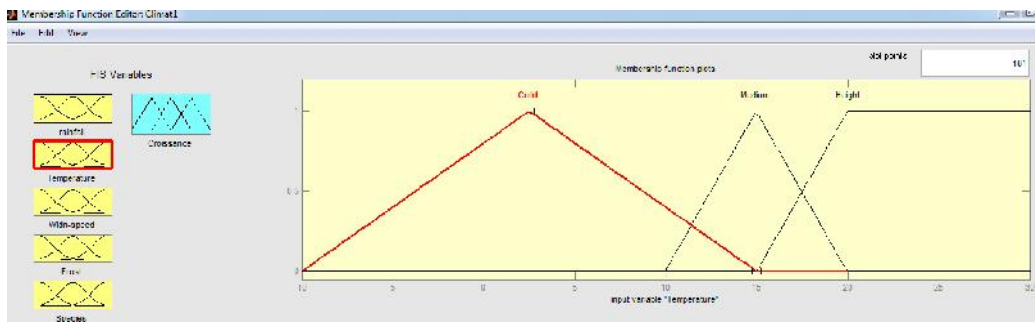
Figure 2. Plot of membership functions for fuzzy input variable "Temperature"

Representation of the input variable "Species"

The entry that represents the species is composed of five non intervals and fuzzy membership functions defining the nature of species. Fig.3.
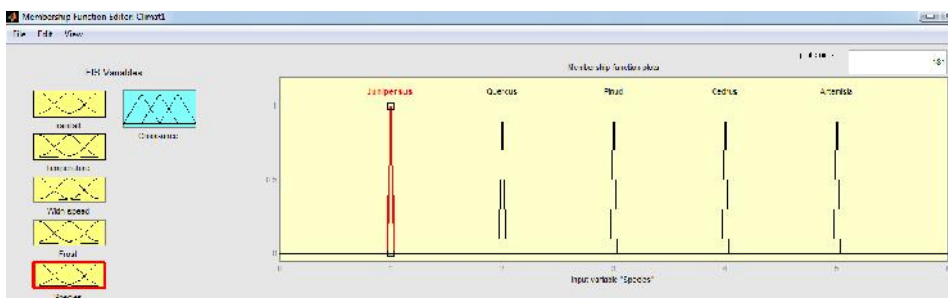
Figure 3. Plot of membership functions for fuzzy input variable "Spices"

Fuzzyfication of the output variable

As output variable we define three variables representing the expected growth rate of the species. We represent each membership function defining the three rate "low growth" corresponding to a value between 0 and 2 "growth medium" between 1 and 3 as a "great growth" number between 2 and 4. Fig.4
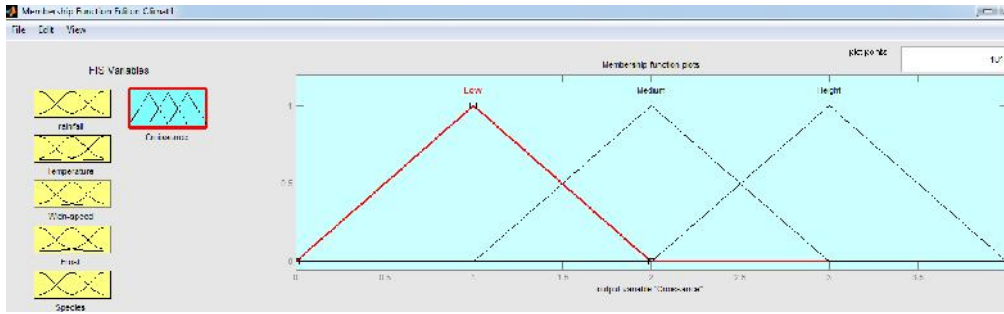
Figure 4. Plot of membership functions for output fuzzy variable

Inference engine

The inference engine consists of AND operator, in fact this operator select minimum input value for the output and also this is not the logical AND. This inference engine takes five inputs from the fuzzifier to produce the output Result value according to the min-max composition. This method uses min-max operation between the five inputs. According to Table 1, fuzzy rules are established. According the results of the fuzzification of input and output variables, the rules must include all possible combinations. As all the variables are independent of each other, therefore all the variables may lie in any of the regions. Therefore all combinations rules are required because input variables do not depend upon each other. Each input variable behaves an individual effect on output. Fig. 5
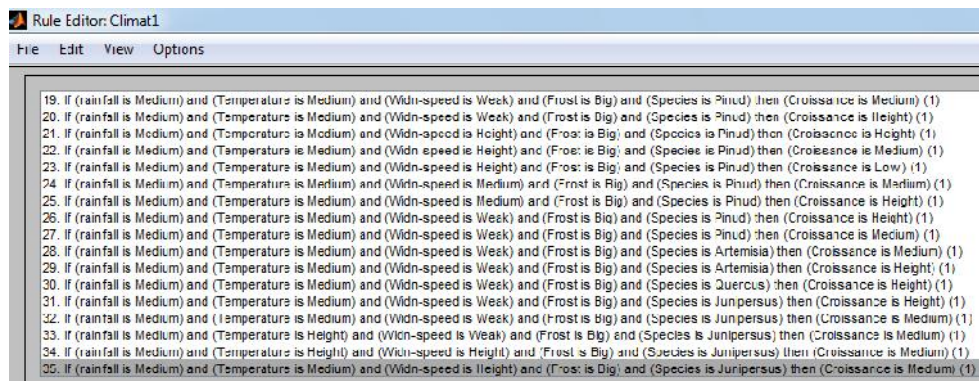
Figure 5. Plot of inference rules

Defuzzifier

This system has one output that describes the function of growth rate, in fact explains the effect of climate parameters on rate growth of any spices. The crisp value output is given by the defuzzification process after estimating its input value.

In this system we have center of average (C.O.A) method which has the mathematical expression that is. In the defuzzification the exact expression is obtained with "centroid" method according to validity degree. The output value according to the input values obtained from the designed fuzzy engine system. Fig. 6.

Figure 6- Plot of defuzzyfication result

Conclusion

One plot at a time shows the relation between any five inputs with one output. The output rate growth shows the dependences on inputs.

The designed system can be extended for any number of inputs. We can define this system for any number of inputs. The design work is being carried out to design state of the art fuzzy logic climate changes effect control system in future using hybrid neuro-fuzzy system.

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INFLUENCE OF METEOROLOGICAL PARAMETERS ON SOIL WATER BALANCE FOR THE AREA OF METEOROLOGICAL STATION BUTMIR

Tanja JAKISIC[1*], Gordana SEKULARAC[2], Milena DJURIC[2], Dragica STOJILJKOVIC[3]

[1]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina,
[2]Faculty of Agronomy, University of Kragujevac, Cacak, Serbia
[3]Department of Water Management, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
(Corresponding author: tanjaj26@yahoo.com)

Abstract

This thesis evaluates the soil water balance in the region of Sarajevo for the average, driest and wettest hydrological years over the period 1991-2010.

High air temperatures in summer period cause significantly high values of potential evapotranspiration, which reaches maximum in July and August .High air temperatures and high values of potential evapotranspiration lead to deficits of soil water during summer months, while low air temperatures, reduced values of potential evapotranspiration and increase of rainfall's during winter months lead to excessive amount of water in it.

The predominant type of soil in the area of meteorological station Butmir is alluvial soil (fluvisol) and it has favorable chemical characteristics on the aspect of mechanical composition it can be listed as light mechanical composition soil.

Key words: *climate elements, water deficits, water suficits, potential evapotranspiration*

Introduction

Primary task of designing irrigation systems is to determine rational system of irrigation. Irrigation system is determined by climate conditions, evaporation, optimal content of accessible water in the area of root system and depth of first outcrop.

Climate conditions determinate annual precipitation income, consumption of water, evapotranspiration as well as necessity for irrigation. The most significant ones are natural precipitation because they should provide constant of water for normal growth of plants. Different plants have different needs for water. Amount of water needed for growth of agricultural plants is determined by potential evapotranspiration..

Needs of agricultural plants for water is expressed through evapotranspiration (Doorenbos and Pruitt,1977), including plant transpiration and evaporation emitted from plant covered soil.

Base for quantity change of water amount in soil (water balance) during certain time period in specific area is provided by elements that contribute such water fluctuation. Those elements are water income (precipitation, P, capillary rise, irrigation, subsurface inflow), as well as water outlay emitted from soil (evapotranspiration, PET, runoff, deep percolation, change in soil water content). Issue of calculating water balance has been occupation of many authors, insufficiency of soil water for the area of meteorologicalstation Vrsac appear in july-october in amount of 340 mm (Stojiljkovi et al., 2001).

Yearly forecast of soil water balance of bare soil deficit for the area of Cacak is 285 mm every 10, 235 mm every 5 and 143 mm every 2 years. (Šekularac and Pavlovi , 1996).

Results of water balance of the bare soil unsaturatedzonefor the area of Cacak points out deficits of soil water from May until November.

Maximum insufficiency is in August and July. Exercisable amount of water is apparent throughout whole year not in significant values for June-October but in sufficient values throughout November - May (Šekularac, 2003).

Analyzing crop needs for water on locations under irrigation systems it is necessary to use methods which will adequately approximate average values of evapotranspiration. Those are mainly empirical and semi empirical methods based on regional relation of evapotranspiration and climate conditions, Thornthwait, Turc, Blaney-Criddle and Penmans methods are frequently used. Calculation of potential evaportranspiration by Thornthwait method is presented in this study since it gives best results in sub humid climate conditions.

Thornthwait method is used world wide, it is very suitable because only records of average daily air temperatures are needed and those are acquired as quotient value of maximal and minimal air temperature. Camargo et al. (1999) states that Thornthwait method is more reliable on monthly level if instead of average daily temperature, effective temperature is used.

For calculate the potential evapotranspiration used are two climatic parameters air temperature and precipitation (Thornthwaite methods), and based on the obtained values of potential evapotranspiration calculated that the water balance. Ability to absorb and remain saturation depends on type, profile depth and characteristics of soil, this was used as base fact for calculation of water balance by Thornthwait method (Mihali and sar.,1978). Thornthwait maid this method for soil that has water capacity of 300 mm. However his approach has been modified in practice, by calculating water balance it is assumed that soil contains 100 mm of water in reserve in the area of rhizoshpereand that it is fully saturated.

Goal of this study is to complete analysis of soil water balance for the area of meteorological station Butmir and to determine water deficiency and surpluses. Soil water balance has been determined for average, driest and rainy year.

Materials and methods

Climate elements (air temperature and precipitation) for the area of meteorological station Butmir in twenty year period (1991-2010) have been used in this study. Based on collected records reference potential evapotranspiration for each month of every analyzed year has been determined, and based on values of ETP and rainfalls, water balance has been determined as well as deficiency and accession of water in the area of meteorological station Butmir.

Determining potential evapotranspiration has been calculated by Thornthwait method based on air temperatures and then corrected with appropriated coefficient for reference area with respect to the latitude of 43 degrees Sarajevo area is then found in the appropriate table corresponding correction coefficient for the area Saraevo where is meteorological station Butmir.

Water balance was calculated starting from the fourth month when the soil contains 100 mm of rainfall, and when it is completely in the rhizosphere zone is saturated with water.

Results and discussion

Out of all exterior factors climate has biggest influence on crop production. To evaluate climate of a certain area requireslong term observation and knowledge of its elements, such: yearly and monthly average temperatures, amount and sum of rainfall's, number of non frost days, frequency and wind strength, hail etc. Crop production is mostly conditioned by air temperatures and rainfalls commonly based on them certain area climate is determinate.

Table 1. Average monthly air temperatures (˚C) and average monthly sum of rainfall (mm) for m.s. Butmir (1991-2010).

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	**M**
Temperature of air (°C)	-0,1	1,1	4,7	9,3	14,8	18,1	19,6	19,9	15,3	10,8	5,0	1,4	**10,1**
Rainfall (mm)	71	67	70	74	82	91	79	71	70	77	91	85	**929**

Average yearly air temperature for tested period (1991-2010) was 10,1 0C, and average yearly rainflls was 929 mm (Table. 1). Coldest months were January, February and December with average temperature of -0,1; 1,1 i 1,4 ˚C, while warmest months were July and August with average temperature of 19,6 i 19,9˚C (Table 1).

Low temperatures during winter months lead to low potential evapotranspiration while during summer months potential evapotraspiration has maximal values as result of high air temperatures.

Alluvial soil (fluvisol) is predominant in the area of m.s. Butmir (Resulovi et al, 2008). That soil is distinguished by favorable chemical characteristics (neutral reaction, good sufficiency of accessible phosphorus and potassium) regarding mechanical composition it belongs to light mechanical composition soil.

Table 2. Water balance for average hydrological year in the area of m.s. Butmir

Months	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	Sum of years
METEOROLOGICAL STATION BUTMIR													
P (mm)	45	63	148	26	32	95	48	113	100	105	70	62	907
PET (mm)	45	77	115	124	116	68	30	26	0	0	0	18	619
AET(mm)	45	77	115	98	84	68	30	26	0	0	0	18	561
RWR (mm)	100	86	86	0	0	0	18	87	100	100	100	100	-
M(-) (mm)	0	0	0	-98	-84	0	0	0	0	0	0	0	-182
S (+) (mm)	0	0	0	0	0	0	0	0	+100	+105	+70	+44	+319

RWR-reserwe water in the soil
M- deficits water in the soil
S- suficits water in the soil

Because of practice of hydro-meliorative works values used were reserve of water in the soil 100 mm.

Study results of water balance for average hydrological year points out that yearly sum of precipitations for the area of m.s. Butmir is 907 mm, potential evapotraspiration (PET) is 619 mm, and actual evaporation (AET) 561 mm. Actual evapotranspiration is obtained from the relation rainfall, water reserves in the soil compared with the values of potential evapotranspiration. Water deficits (M) is displayed during summer months July and August totaling 182 mm, while water surpluses occured during winter months of December, January, February and March when soil is saturated with water. Total yearly water surpluses (S) is 319 mm (Table 2).

Table 3. Water balance for driest year of the area m.s. Butmir

Months	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	Sum of years
METEOROLOGICAL STATION BUTMIR													
P (mm)	51	72	23	52	16	67	83	75	94	32	50	32	647
PET (mm)	46	78	104	119	126	63	45	28	10	0	0	30	649
AET (mm)	46	78	104	67	110	63	45	28	10	0	0	30	571
RWR (mm)	100	94	14	0	0	0	38	47	100	100	100	100	-
M (-) (mm)	0	0	0	-53	-110	0	0	0	0	0	0	0	-163
S (+) (mm)	+5	0	0	0	0	0	0	0	+16	+32	+50	+2	+105

Table.3 of water balance for dry year shows sum of yearly rainfall's for area of m.s. Butmir is 64 mm, potential evapotranspiration (PET) is 649 mm and actual evapotranspiration (AET) 571 mm. Water deficits (M) is displayed during summer months july and august totaling 163 mm, while water surpluses present during winter months but in significantly smaller amount than what they are in years with increased rainfall's, that water surpluses (V) is 105 mm.

Table 4. Water balance for wettest year in the area of m.s. Butmir

Months	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	Sum of years
METEOROLOGICAL STATION BUTMIR													
P (mm)	109	68	75	99	84	103	57	137	294	49	57	58	1.190
PET (mm)	50	98	123	126	120	79	45	10	0	0	0	13	664
AET (mm)	50	98	123	27	36	79	45	10	0	0	0	13	481
RWR (mm)	100	70	22	0	0	0	12	127	100	100	100	100	-
M (-) (mm)	0	0	0	-5	-36	0	0	0	0	0	0	0	-41
S (+) (mm)	+59	0	0	0	0	0	0	0	+294	+49	+57	+45	+504

Analysis of water balance for the rainy year in the area of m.s. Butmir points out that rainfall total 1.190 mm, potential evapotranspiration (PET) is 664 mm, and actual evapotranspiration (AET) 481 mm. Deficits water in this hydrological year is present only in summer months (July and August) in relatively small amount of 41 mm, while surpluses water occured during the winter months totaling 504 mm (Table 4).

Conclusion

During an average, driest and wettest hydrological year in the area of meteorological station Butmir water deficits is expressed during summer months (July and August),while water surpluses is expressed during December, January, February, March and April, with exception of average hydrological year that in April has no water surpluses in soil.

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PRELIMINARY RESULTS LENGTH AND WEIGHT GROWTH RATES OF SPECIES *Oncorhynchus mykiss* (WALBAUM, 1792) (Salmoniformes, Salmonidae) ON THE POND "NORFISH" IN BLAGAJ

Aida PELO[1*], Denisa ZUJO-ZEKIC[1], Avdul ADROVIC[2]

[1]BiologyDepartment, FacultyofEducation, University „DzemalBijedic", Mostar, BosniaandHerzegovina,
[2]Biology Department, Faculty of Science and Mathematics, University of Tuzla, Tuzla,Bosnia and Herzegovina.
(Corresponding author: ape621@hotmail.com)

Abstract

Phenotypic plasticity in the biological properties of rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) is the main reason for the prevalence of this type of intensive cage rearing process in the trout ponds across Europe. Cold water fish ponds are characterized by large variations in physical and chemical characteristics of water. In addition to morphological and physiological adaptive nature this is characterized by high quality meat with a significant fat and protein gain in their biochemical composition. Also, rainbow trout has a great feature to achieve growth of biomass in a short period of time. Nutritive value of meat as well as achieving high biomass value is sufficient reason why the rainbow trout has become one of the dominant fish species in the world market of fish meat. Notes from previous explorations are saying that rainbow trout growth achieved during the drab months of breeding and the key role in biomass growth is composition of a food and the number of meals during the day. To this is added that the growth of rainbow trout depends on small variations in the physical and chemical nature of the water medium. Therefore, the issue of this paper highlights the need to be in the pond "Norfish" in Blagaj, during the three-month study period, the 2011th year, to substantiate or refute earlier results, which show a uniform increase in the analyzed species in deep cages, a water temperature of 7 °C to 9 °C with a constant number of daily meals during the three-month research period.

Keywords: *biomass, intensive cultivation, phenotypic plasticity, rainbow trout - Oncorhynchus mykiss (Walbaum, 1792), the pond "Norfish" Blagaj.*

Introduction

Fishing, as an agricultural industry in this country is able to manufacture large quantities of fish of different species and categories. The data indicate that Bosnia and Herzegovina if they want to keep up with the rest of the World with the economic progress in the sphere of the industry has to significantly increase the diversity, quality and overall fish production. However, despite the favorable conditions in recent years in our country there has been a steady decline in production in carp (carp) pond, with a smaller increase in production achieved in trout (trout) fisheries (FAO, the Food and Agriculture Organization of the United Nations, 1997). Therefore, Hamzi (1993) highlights the need for further development of the legal and institutional support for the development of fisheries in Bosnia and Herzegovina. Statistics FAO (1997) showed an annual increase of 8 to 10% higher compared to that of 1970. Total production of about 42.7 million tons in 1999 year's record also shows that the prediction accuracy of the FAO for the need to increase production in the fishery.
The most important fish species that are grown here in the trout ponds is the rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792). Cultivation of fish species requires special

conditions, sufficient water flow, adequate temperature, high water quality, and the content of dissolved oxygen in the water shall not be less than 7-8 mg/l (uk, et al., 2006). Rainbow trout are grown in concrete or earthed pools and per hectare basin can achieve a yield of 100,000 to 500,000 kg trout. Period of growing intensively managed mainly for 18 months (Hamzi , 1993).

Types of biological adaptation caused the intensive farming of rainbow trout - *Oncorhynchus mykiss* (Walbaum, 1792) in the pond "Norfish" Blagaj situated on the River Buna. Due to the relatively shallow and rapid flow of the entire water column, the water in the river Buna gets constantly mixed and the result is not only a large amount of dissolved oxygen but its uniform distribution of the entire course. Such uniformity and vertical distributions related to temperature and other physical and chemical characters of the Buna (Mi ijevi , 2004).

The interesting biology and a significant economic importance caused great interest from people in the profession and have studied this type of numerous authors from the region: Boj i and Bunjevac (1982), Klontz (1988), Marinus et al., (1992), Mari (2002), Savi et al., (2003), Mikhail (2004) Mikavica et al., (2005), Savi et al., (2005), Saeed and Purser (2005), Velebit et al., (2005), Trebovi et al., (2005), Be iraj et al., (2006).

Based on the above it can be seen, a very great interest and the number of published works whose subject matter deals with growth of rainbow trout under different environmental conditions. Driven by various allegations during the 2011. period the quarterly survey on the pond "Norfish" Blagaj was done in an independent research project by student Aida Pelo. The research was done intentionally to compare that the available scientific literature is a reference, corroborate or reject of the findings which show a significant growth (length and weight) of rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) in the cages with adequate nutritional substrates with an approximate fat and protein.

Materials and methods

Research work done on the pond "Norfish" in Blagaj, which is located some 600 meters from the source of the Buna. Close proximity of the source had impact on the physical-chemical water quality (Table 1.), which meets the demanding habitat for rainbow trout. Research was conducted in February, March and April months of the year 2011. In this time period there were six continuous measurements and weighings of fish from the two pools (numbered 9 and 12). The weight of each specimen was measured by a digital scale brand Mettler-Toledo JL-601 61, and the length was analyzed using ihtiometra. Each individual is taken out of the cage was photographed with the camera brand Samsung, A750, and returned back again. During the study, the average water temperature range from 7 °C to 9 °C were observed during the measurement cycle. For working was used a descriptive- comparative research methods, the method of theoretical analysis, discussion of methods, methods of observation and statistical methods of data processing. All listed methods have been applied in each month study. During operation used the following accessories: camera, netting, feeders, tweezers, containers for water sampling, fish sorting machine, scales, etc. .. ihtiometar Laboratory analysis of water was carried out in the month of April, in the laboratory of the Veterinary Faculty of the University of Sarajevo, where they are processed main physio-chemical parameters of water (Table 1).

Table 1. Physio-chemical characteristics of water from the pond "Norfish" Blagaj (made in the laboratory of the Veterinary Faculty in Sarajevo

PARAMETER	VALUES
Water temperature (° C)	8, 03
pH	7,32
Oxygen (mg/l)	7,02
Carbon dioxide (mg/l)	2
Amonioni (mg/L)	<0. 01
Ammonia (mg/L)	<0, 001
m-alkalinity,	10, 75
Turbidity	6
Carbonate hardness (°dH)	12, 38

Figure 1. Pool pond "Norfish" Blagaj (photo: A, Pelo)

Figure 2. Pool pond "Norfish" Blagaj

Figure 3. Pool pond "Norfish" Blagaj (photo: A. Pelo)

Results and discussion

Data on the length and weight of all rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) individuals cought in the pond "Norfish" in Blagaj are shown in Table 2 In addition to the data in Table 2. There are also preliminary results of increasing length and body weight at intervals of research. Statisticalanalysisconsistedintheapplicationofcomparativestatisticalproceduresusingthe software program "SPSSforWindows 17.0." Statistical analysis of the results are reported to show that rainbow trout ranged from 0 to 15 days achieved by uneven growth of body length,

as and observed during the measurement the length of the body. Based on comparison of the results observed value body length ranging from a minimum of 90,00 mm to a maximum of 170,70 mm. increase in the total for all measurement interval is 24.496 mm. Growth in length and weight of the body at intervals analyzed the F-test (ANOVA - Single actor), and the results do not point out the significant statistical difference in the increase of body weight per day and on average ranged from a minimum to a maximum of 0.029 g 0.080 g. The total increase in the mass of all six intervals was 0.053 g. Coefficients of variation – CV shows a decline in the growth dynamics of the body length of rainbow trout that range from a minimum of 6.01 to a maximum of 7.04 which means that the average increase in body length per day going in the range of 0.491 to 0.974 mm in all six stages of measurement.

Cage farming system is specific for the large seasonal and daily variations in the physio-chemical properties of water, which has a direct impact on the entire breeding process.

Table 2. Review data on length and weight of specimens of rainbow trout - *Oncorhynchus mykiss* (Walbaum, 1792) in the pond "Norfish" in Blagaj and statistically derived values

		POOL 9th			POOL 12th		
Dated		**15.02. 2011.**	**28. 02. 2011**	**14.03. 2011.**	**29. 03. 2011**	**14.04. 2011.**	**29. 04. 2011**
1.st	**mm**	120,34	120,40	130,50	130,80	150,90	140,29
	g.	80,20	109,90	120,80	120,20	143,80	150,00
2.nd	**mm**	100,23	130,57	150,77	140,23	150,00	160,17
	g.	72,10	110,10	132,50	130,60	139,80	165,00
3.rd	**mm**	150,11	110,98	160,90	110,11	140,90	150,80
	g.	120,10	102,40	152,90	100,70	143,70	154,80
4.th	**mm**	120,50	130,23	140,03	160,15	150,83	160,10
	g.	102,50	100,00	130,10	153,60	163,90	164,70
5. th	**mm**	90,00	130,03	140,10	130,90	170,53	150,90
	g.	80,00	102,00	130,20	123,40	183,50	183,50
6.th	**mm**	120,73.	160,34	160,49	120,54	140,60	160,50
	g.	112,60	143,40	155,20	123,80	133,70	165,50
7.th	**mm**	110,04	110,95	130,80	110,53	150,40	170,00
	g.	90,00	130,00	120,80	103,80	153,80	186,00
8.th	**mm**	150,00	140,34	110,37	170,34	190,41	140,30
	g.	112,90	112,90	103,20	160,70	200,70	156,00
9.th	**mm**	170,70	130,39	140,20	110,62	150,03	160,10
	g.	130,60	110,80	130,00	103,90	160,80	176,80
10.th	**mm**	120,10	130,20	130,09	140,00	130,53	150,56
	g.	120,05	129,15	123,00	139,00	133,50	14,60
CV		**6.80**	**6.81**	**6.01**	**7.04**	**6.20**	**6.32**
Average growth mm in		**15,39**	**30,21**	**20,71**	**30,52**	**30,00**	**20,15**
Growth average length in mm				**min. 0.491 mm** **max. 0.974 mm**			
Growth average length in mm				**24,496 mm**			
The increase in mass per interval		**0.050 g.**	**0.080 g.**	**0.071 g.**	**0.049 g.**	**0.043 g.**	**0.029 g.**
Total growth mass in all intervals 0.053 g							

According Radevi et al., (1997) fish growth rates is equalized by months at a constant water temperature of 7°C. Fish in the intensive rearing receive the same average body length of up to 6 months of cultivation, some 0.530 mm per day, and the rapid growth of 9 months starts when double length per day. Our results support the findings and allegations Radevi a et al., (1997), because the average temperature of the water in the pond during all the study ranged from 7 to 9°C.

Also, Filipovi and Stamenkovi (2001) concluded that the direct effect of cultivation is the quality of the physical and chemical properties of water. According to their statement to achieve the best rainbow trout growth is the small variations in the character of the water, as well as in meeting its energy needs for food, which in itself has a certain level of fat and protein. They point out that with the increase of the share of fats and proteins increases the growth of fish and the shorter the period of growing up to commercial size. Rainbow trout in the pond of the Blagaj was not achieving so significant weight gain per day is probably because it was fed with food that had the same proportion of fat and protein in each meal during the three month study. It seems to be one of the reasons, where the results obtained in the pond in Blagaj disagree with the allegations Filipovi and Stamenkovi (2001) note that higher growth due to increase in fat and protein in meals. Thus, the resulting small increase in the pond in Blagaj can be found in the monotonous diet, and a great variation of some physico-chemical parameters of the water.   uk et al., (2006), and Filipovi and Stoli , (2007) suggest that low weight gain and body length per day may be a consequence of the high variability of water flowing through the pond.

Statistical analysis of the results show no significant increase in weight and thus in body length during our research.

Data on length and a weight gain of rainbow trout from the pond "Norfish" in Blagaj coincide with those obtained by Klontz (1988), Mikavica (1992), Marinus et al., (1992), Yıldız (2004), which relate to daily gain in the cages. The reasons why results from the pond "Norfish" Blagaj in line with their results can be found in the water temperature, the variability of other physico-chemical properties of water, as well as a constant proportion of fat and protein in the food that the fish are fed. Results of daily gain body length with a water temperature of 7°C in the pond "Norfish" in Blagaj ranged from 0.491 to 0.974 mm during the study. The results of the increasing length of the body is consistent with the results Klontz (1988) and Mikavica (1992) who state that a water temperature of 7 °C, daily weight gain of rainbow trout body length is a 0.432 mm, while the water temperature of 8 °C daily gain of body length was 0.537 mm. According to data Mikavica (1992) rise in water temperature of 13.24 °C for the Spring-Summer linear growth of rainbow trout becomes more intense. However, our results do not agree with the allegations Mikavica (1992) because in the process of breeding pond in Blagaj declined in increasing body weight and length, as water temperature increased in the month of April. Presented with no agreement made by Mikavica (1992) probably due to the composition of the food that is the share of fats and proteins as well as the number of daily meals in the diet of rainbow trout in the pond "Norfish" Blagaj. Similarly, Marinus et al., (1992), suggest that a water temperature of 13 °C daily gain of the body length is 1.006 mm, and the daily increase in body length season spring - summer of 1990.the pond Gornji Ribnik ranged from a minimum of 0.462 mm to 0.551 mm maximum. In this regard, the reason for the low daily gain in the pond in Blagaj agree with their data, because the increase in body length per day ranged from 0.491 to 0.974 mm in all six measurements.

According to Saeed and Purser (2010) length and weight gain also depends on the method and amount of food and the number of daily meals. Thus, the reason for the low weight gain can be found in the type of food used in the breeding process and the number of meals that were present during the study period.

Conclusion

Because of its adaptive capabilities rainbow trout - *Oncorhynchus mykiss* (Walbaum, 1792) has become one of the dominant fish species in deep cages in the world. Rainbow trout - *Oncorhynchus mykiss* (Walbaum, 1792) in many countries of the world have become known and recognized as a breeding species, due to the rapid growth and excellent nutritional quality of meat. The economic importance of this fish is enough reason why, nowadays more and more attention to its cultivation, which is directly related to the physico-chemical properties of water, as well as diet. For this reason the pond "Norfish" Blagaj research conducted for a period of three months. During this study it was found that rainbow trout in deep cages does not achieve a balanced growth in biomass during each month of cultivation, although food substrate which in itself has the same fat and protein. Also, it was found that the most intense rainbow trout achieved growth at a constant temperature water and large variations in other physico-chemical properties of water is not conducive to growing them.

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SOLID WASTE DISPOSAL AMONG URBAN AGRICULTURAL HOUSEHOLDS IN LOWLAND AREA OF YAOUNDE

Lucien Armel AWAH MANGA

Faculty of Economics and Management, University of Yaoundé, Cameroon
(Corresponding author:armelpipo@yahoo.fr)

Abstract

Low waste collecting rates make waste a growing problem in lowland areas of the capital of Cameroon Yaoundé. However, the biodegradable proportion of waste is high and could be reused. The aim of this study is to understand the behavior of farm households in view of managing their solid waste. Indeed, this paper seeks to identify factors that affect the choice of a method of solid waste disposal by agricultural households in the lowland area of Yaoundé. Data from a survey conducted by the French Agricultural Research Centre for International Development (CIRAD) have been used. The results from multinomial Logit indicate that household size and the accessibility of the area of residence increase the probability of choosing municipal infrastructures relative to recycling waste and/or illegal dumping. Compared to bins and garbage trucks, the number of years in the area, agricultural experience and the distance to the communal containers promote illegal dumping or recycling. In this context, transfer stations for household waste, should be constructed in or near the lowland areas to facilitate their management of waste by the collectors and by households for their farming activities.

Key words: *Solid Waste Recycling, Farm Households, Multinomial Logit Model.*

Introduction

Due to urban population growth and expansion of the space occupied, the management of solid waste is a big problem in cities in developing countries. As in many African countries, in Cameroon, many neighborhoods do not receive collection municipal service for solid waste (Parrot *et al*., 2009). In Yaounde, rates of solid waste collection remain low in particular in lowland areas. Indeed the average collection rate is estimated at only 43% (Sotamenou, 2010). Household wastes in cities of developing countries have different alternative destinations (Tadesse, 2007). Although wastes are used as organic amendments (Ngeugang, 2008; N'dienor, 2006; Nkamleu, 1996), very few people in the lowland areas of Yaounde have tapped this economic potential. However, agriculture is mainly practiced in these lowlands which are also a refuge for poor households who live mainly by their production (Masocha, 2006).

In a context where public service of solid waste management is ineffective (Sotamenou, 2010) especially in the lowland areas and that, the use of organic wastes emerges as a credible alternative to firstly ensure the sustainability of farms urban and secondly reduce waste pollution. It is imperative to understand behavior of farm households in the logic of managing their solid waste.

Materials and methods

The data used in this study are those of the French Agricultural Research Centre for International Development (CIRAD). They were collected in 2005 during the development

project of the lowland areas of Yaoundé in partnership with the Ministries of Agriculture and Scientific Research. The sampling frame consisted of all "agricultural" households of the urban area of Yaoundé. As far as this study is concerned, the survey highlights the socio-economic characteristics of household heads, household socioeconomic indicators, types of inputs used, types and quantities of waste utilized and waste disposal practices.

In microeconomic theory, consumers consume goods or services so as to optimize the utility they derive from it. Following Tadesse (2007), in this study, agricultural households are assumed to choose the disposal alternative[10] that maximizes the unobserved (indirect) utility.

The determinants for solid waste disposal among agricultural urban households were analyzed using multinomial logistic regression models, for this purpose the econometrics software Stata was used.

Results and discussion

Disposal practices among agricultural households

Actuallyahousehold can useoneora combination of thesealternatives. Then, **table 1** shows only the primary mode of solid waste disposal in each household. Indeed, in the agricultural lowlands area, recycling in agriculture is the primary solid waste disposal method. In fact, on average 50 percent of households use this method to sustainably manage their waste. While remaining the most commonly used alternative, recycling differs considerably depending on the accessibility of the area of residence. Indeed, 60% of farm households who reside in areas with difficult access recycle their waste against only 45% of people living in areas with easy access.The communal containers are the most demanded infrastructure in the lowland areas of the city (INS, 2002), thus only 17 percent of agricultural households discharge their garbage in trucks and communal containers and 33 percent of them prefer to dispose their waste directly in open areas or burning it either burying it in their home. Since the accessibility of the area of residence influences the availability and use of communal services, the results show how the use of communal containers differs significantly depending on the accessibility of the neighborhood. Indeed, 26% of farm households in accessible areas against only 6% in inaccessible areas evacuate their garbage in communal containers.

Table 1: Primary household solid waste management mechanisms.

Waste management types	Proportion
Communal containers	17%
Dumping in open areas, burning and illegal landfill at home	33%
Recycling in agriculture	50%

Few heads of households (26%) affirm to have no academic standard level and 75 percent of family heads of the agricultural areas of Yaoundé are men. In reference to the theory of human capital, this could explain the relatively low levels of income. Indeed average 47 percent of farm managers earn monthly less than 90,000 FCFA[11]($ 179). Range between 15 and 68 years, the average age of farm household heads is 40 years. Household size ranges from 1 to 9 persons with six persons per household at mean, for an average production of solid waste per day equal to 3.4 kilograms. In lowland areas, the practice of farming is

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[10] In this study, there are three waste disposal alternative destinations available to farm households. The first waste disposal alternative is communal waste containers provided by the municipality (alternative 1). The second alternative is dumping in open areas and roadsides (alternative 2). The third alternative is recycling into agriculture.

[11]$ 1 egal 503,151 Fcfa

relatively new compared to the arrival of households in these areas.In fact, the mean age of agricultural experience of respondents is 11 years when they had spent on average 22 years in these areas, yet their homes are still relatively distant from municipal containers. Indeed, they must cover 615 meters at mean to evacuate their residues. This situation can explain the low utilization rate of communal waste disposal infrastructures. Due to the organic nature of waste, the respondents prefer simply to manage their waste by recycling it into agriculture. In these zones, plots are usually cultivated near homes. Despite the very high land pressure and low levels of income, 48 percent of households engaged in agricultural activities are owners of their plots, 75 percent of their homes and, furthermore, 66 percent on average among them live in easily accessible neighbourhoods.

Factors influencing solid waste disposal decision making by agricultural households

The results indicate that the variables number of years in the area, agricultural experience, distance to the communal containers, household size and the accessibility of the area of residence (table 2)were significant and explained the choice of waste destinations among farm households.

Table 2. Multinomial logit estimation for solid waste disposal.

Variables	Illegal dumping		Recycling	
	Coefficients	P>z	Coefficients	P>z
Age of household head	.035(0.038)	0.356	-.015(0.0404)	0.696
Household head education				
Elementary	.727(0.911)	0.425	1.302(0.960)	0.175
Secondary	.237(0.953)	0.804	.890(0.992)	0.370
Higher	-.171(1.257)	0.891	-.388(1.303)	0.766
Family size	**.0427814(0.161)**	**0.791**	**-.293(0.173)**	**0.091***
Total income of household head				
Income2 (between 50,000 and 90,000)	-1.150(1.046)	0.272	.061(1.102)	0.955
Income3 (between 90,000 and 200,000)	-.280(0.953)	0.769	-.104(1.036)	0.920
Income4 (more than 200,000)	13.574(1317.22)	0.992	16.803(1317.226)	0.990
Years of stay in the neighborhood	**.084(0.032)**	**0.011****	**.068(0.035)**	**0.050****
Household head agricultural experience	**.122 (0.076)**	**0.108***	**.280(0.079)**	**0.000***
Location of the household	**-2.420(0.886)**	**0.006***	**-4.095(.970)**	**0.000***
Distance to waste containers				
Between 100 and 500m	**2.395(1.352)**	**0.076*****	**2.836(1.387)**	**0.041****
Between 500 and 2,000m	.447(0.861)	0.603	-.151(0.959)	0.875
More than 2,000m	-.417(1.023)	0.684	-.704(1.131)	0.534
Ownership of home	-.2218917(0.797)	0.781	.923(0.868)	0.288
Constant	1.252(1.812)	0.490	.683(1.881)	0.716

Number of years in the neighborhood has a positive impact on the probability of choosing alternatives such as illegal dumping and recycling into agriculture. Indeed, as far as illegal dumping is concerned, this result finds an explanation when the marginal disutility of pollution is decreasing. In terms of recycling, having integrated the lack of waste collection infrastructures in their management program, farm households have no better other choices than recycling. Accessibility of the residential area negatively influences the probability of choosing management methods such as illegal dumping and recycling. This result is explained

by the fact that accessible area receives more municipal waste infrastructure. Because recycling activities require a lot of physical effort and time; farmers may eventually prefer to confide their waste to municipal waste collection services. The farming experience of household head positively affects the probability of choosing recycling of household waste. By this action, farm households significantly reduce the mass of their waste which have to be evacuated and at the same time receive benefits in terms of improving soil quality. The distance between home and communal containers positively influences the probability of managing household waste by methods such as organic recycling and illegal landfills. This result is consistent with results from Tadesse (2007) and INS (2002).Household size negatively significantly affects probability of choosing recycling. If this result seems paradoxical, since the practice of recycling requires much muscular effort, an explanation is found in that; it is usually the children (proxy of family size) that carry waste from the house to the communal containers (De la Laurencie, 2002).

Conclusion

In the lowland areas, household wastes are reused into agriculture. The results of this study show that demographic characteristics, geographic features and waste facility attributes appear to influence disposal behavior among agricultural households in lowland areas of Yaoundé.
Several policy implications arising therefore:First, it appears useful to reduce distances between collection infrastructures and homes by the establishment of waste facilities which collect waste and get it to assembly centers. Second, improving the accessibility of residential areas. The goal is to increase the provision of waste collection services. Third, promotes waste recycling in agriculture by some sort of awareness or by encouraging the farm household heads to join agricultural organizations.

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THE EFFECT OF NITROGEN FERTILIZATION ON NITRATE LEACHING UNDER POTATO PRODUCTION

Aleksandra BENSA[*],Vedran RUBINIC, Zdravka SEVER-STRUKIL

Faculty of Agriculture, University Zagreb, Croatia
(Corresponding author: abensa@agr.hr)

Abstract

The aim of this study was to determine the effect of different fertilization by nitrogen on nitrate leaching from the soil during potato production. The study was conducted in Belica, north-west region of Croatia, in the period 2009-2010 on Fluvisol. Fied trial was designed as a completely randomized block design with four levels of nitrogen fertilization (50, 100, 150, 200 kg N/ha), with three replications. Water samples were taken monthly by lysimeters during the growing period of potato and soil samples three times a year. Nitrates in soil and water were determined spectrophotometrically, using a complex yellow phenolsulphonic acid (USDA- SCC-NSCS, 1992). Increase in applied fertilizer rates (50–200 kg N/ha) led to an expected increase in the nitrate concentration in the arable soil layer (0.04–9.51 mg NO_3^-/100 g soil) with significantly highest concentrations on variant fertilized with 200 kg N/ha.Nitrate concentrations in percolating water varied in wide range, 4.1–283.5 mg NO_3^-/l, in dependance of nitrogen fertilization, precipitation, soil moisture regime and stage of growth of potato. Increased nitrogen fertilization of potato was accompanied by an increase in nitrogen leaching (1.1 to 13.9+kg NO_3-N/ha) as well as increase in yields of fresh mass of potato tubers from 8.2 to 37.7 t/ha.

Key words: *nitrogen fertilization, nitrate leaching, potato*

Introduction

Intensive production of potato implies fertilization as an unavoidable measure for high and stable yields, which in turn may lead to contamination of the agroecosystem and its contact ecosystems, primarily water. While N provides large responses in crop yield and is an extremely valuable nutrient, it is the major nutrient of concern in water pollution, Davies (2000). Nitrate leaching is mainly affected by fertilization (quantitiy and type of fertilizer, time of application), precipitation, soil properties and crops consumption of nitrogen. The following research objectives have been defined: a) to determine impact of different nitrogen fertilization of potato on dynamics of nitrate concentrations in arable soil layer and percolating water during growing period of potato, b) to calculate quantitiy of leached nitrate nitrogen from rhizosphere soil layer and c) to determine yields of potato under increasing nitrogen rates.

Material and methods

Investigation was performed in 2009 and 2010 growing seasons of potato, in Belica, north-west region of Croatia. Stationary field trial was laid up on Fluvisols, according to completely randomized block design, which involved four levels of nitrogen fertilization (50, 100, 150 i 200 kg N/ha), with three replications. In both year of investigation, basic fertilization was conducted by same quantitiy of fertilizers on whole area, 300 kg/ha NPK 7:20:30 + 61 kg/ha

UREA in 2009 and 333 kg/ha NPK 15:15:15 in 2010. Differences between fertilization treatment were achieved by top-dressing (0, 185, 370 and 555 kg of KAN/ha). Soil sampling was conducted before planting potatoes, 60 days after planting and in harvest. Tensiometric lysimeters for collecting percolating water were installed at 60 cm below the soil surface. Water samples were extracted monthly during growing seasons of potato, April-September. Soil content of nitrate nitrogen was determined spectrophotometrically, with the aid of the yellow colour complex by phenoldisulphonic acid, *(USDA-SCS-NSCS, 1992)*, and nitrate nitrogen in water by the standard APHA method (1992). Total fresh tuber yield was determined in harvest. Analytical data were statistically analyzed using analysis of variance. According to the data of agrometeorological station akovec, annual rainfall in 2009. amounted 663,3 mm, which is significantly below the long time average for period 1971-2000. (843,1 mm), and in 2010, 837,2 mm.

Results and discussion

Nitrates in soil

Average nitrate concentrations in arable layer of soil varied in range 1.59 - 9.25 mg NO_3^-/100 g of soil during growing season of potato in 2009, and 0.04 - 9.51 mg NO_3^-/100 g of soil in 2010. The first soil sampling showed no statistically significant differences in nitrate concentrations, in both year of investigation, suggesting uniformity of experimental plots at planting potatoes. Increasing nitrogen fertilization had a significant effect on the increase of nitrate concentrations in the arable layer of soil, in June 2009, from 2.98 mg NO_3^-/100 g of soil to 9.25 mg NO_3^-/100 g of soil. In September 2009 (potato harvest) significantly higher nitrate concentrations were found only in soil of variant fertilized with a total of 200 kg N/ha compared to other variants, indicating a greater potential for leaching in autumn.

Significantly lower nitrate concentrations were found in soil of variants ferilized with 50 and 100 kg N/ha compared to other variants, during June and September in 2010. In soil of variant fertilized with 200 kg N/ha significantly higher nitrate concentrations compared with variant ferilized with 150 kg N/ha were found only in June, while in September those differences were not statistically significant, Table1.

Table 1. Average nitrate concentrations in arable layer of soil due to the nitrogen fertilization

Fertilization treatment, kg N/ha	mg NO_3^-/100g of soil					
	2009.			2010.		
	14.04.	19.06.	18.09.	23.04.	04.06.	14.09.
50	2.17	2.98	0.49	0.05	6.41	0.04
100	1.59	4.38.	0.92	0.04	6.44	0.12
150	1.91	7.01	0.90	0.04	7.09	0.92
200	2.75	9.25	4.63	0.06	9.51	1.09
LSD p=5%	-	0.83	0.52	-	0,64	0,28
p=1%	-	1.26	0,98	-	1,07	0,69

Nitrates in water

Nitrate concentrations in percolating water during 2009 varied in a very wide range (4.1–283.5 mg NO_3^-/l), due to nitrogen fertilization, amount of percolating water, and consumption of nitrate by plants. In April 2009, nitrate concentrations in percolating water exceeded

maximum allowed concentrations (MAC), as a result of nitrogen fertilization with 50 kg N/ha on all experimental plots and minimal consumption of nitrates by small potato plants. Increased top-dressing by nitrogen from 50 to 150 kg N/ha led to an increase in nitrate concentrations in percolating water from 184.1 to 283.5 mg NO_3^-/l, while percolating water on variant without top-dressing contained significantly lower nitrate conencentrations, 88.1 mg NO_3^-/l, in May. There was no water percolation in June, as well as in August and September. In July 2009, percolating water was recorded only on variants fertilized with 50 and 100 kg N/ha, containing minimal nitrate concentrations 4.1-4.4 mg NO_3^-/l.

During growing season of potato in 2010, nitrate concentrations in percolating water ranged from 19.9 to 277.1 mg NO_3^-/l. The most pronounced differences of nitrate concentrations in percolating water between variant fertilized with 200 kg N/ha and other fertilization treatment were recorded in August and September. Percolating water of variant fertilized with 200 kg N/ha contained 277.1 mg NO_3^-/l in August, and 209.8 mg $NO_3^-/$ in September, which significantly exceeding MAC, while nitrate concentrations in percolating water of other variants were significantly lower, in range 26.9-47.5 mg NO_3^-/l in August and 40.7-57.6 mg NO_3^-/l in September, below MAC, Graph 1.
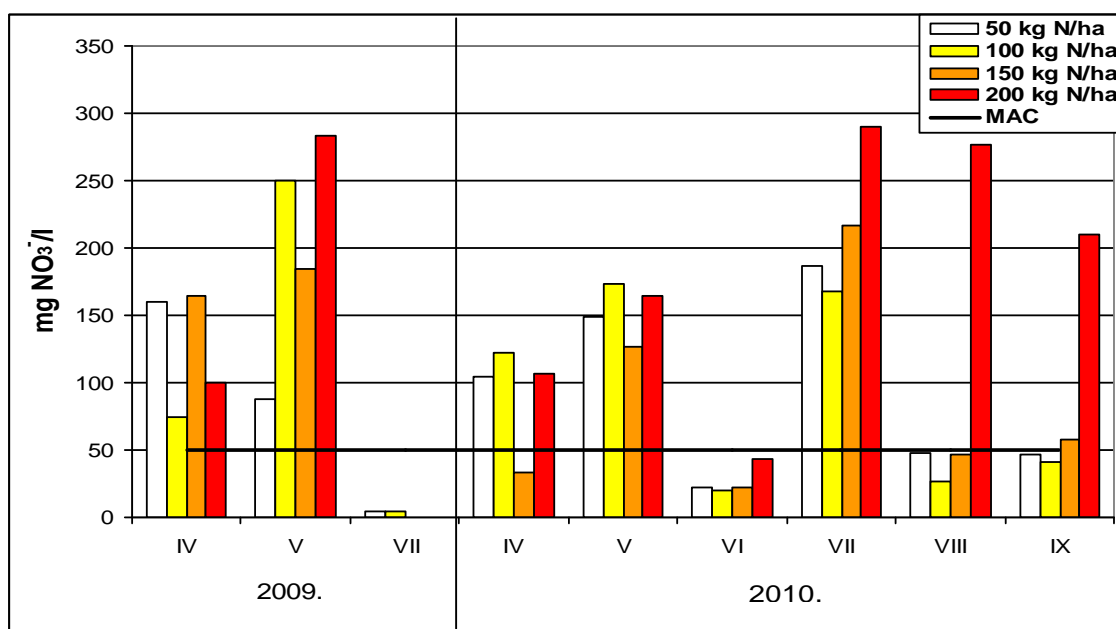
Graph 1. Dynamics of nitrate concentrations in percolating water, 2009–2010

Similar variations of nitrate concentrations in percolating water, in a very wide range (4.4 – 288.1 mg NO_3^-/l) during growing season of potato, was determined by study of Milburn et al (1990). Slightly lower nitrate concentrations in percolating water, 22.1-110.8 mg NO_3^-/l, was reported by Vos et al (2004). Their research was conducted on sandy soils under potato production, including extraction of percolating water at depth of 80 cm below soil surface. Jalali (2005) also found pronounced dynamics of nitrate concentrations in percolating water under potato production, 3-252 mg NO_3^-/l, due to nitrogen fertilization and soil water regime.

Nitrate leaching

Annual nitrate leaching from soil in dry 2009 ranged 1.1 kg NO_3-N/ha (variant fertilized with 50 kg N/ha) to 1.9 kg NO_3-N/ha (variant fertilized with 200 kg N/ha). Maximum monthly nitrate leaching was registered in April, on all fertilization treatmens, in range 0.54–1.30 kg NO_3-N/ha, Table 2.

Table 2. Monthly and annual nitrate leaching in 2009

Fertilization kg N/ha	kg NO$_3$-N/ha			
	IV	V	VII	Annual
50	0.83	0.22	0.07	1.10
100	0.54	0.73	0.09	1.29
150	1.30	0.46	-	1.76
200	0.92	0.96	-	1.88

Annual nitrate leaching in 2010 ranged from 7.5 to 13.9 kg NO$_3$-N/ha. Maximum monthly amount of nitrate nitrogen (4.83 kgNO$_3$-N/ha) was leached by percolating water in overly wet August 2010 (192 mm of precipitation), Table 3.

Table 3. Monthly and annual nitrate leaching in 2010

Fertilization kg N/ha	kg NO$_3$-N/ha						
	IV	V	VI	VII	VIII	IX	Annual
50	0.99	1.58	0.47	0.55	2.20	2.14	7.92
100	1.62	1.88	0.64	0.34	1.20	1.82	7.50
150	0.49	2.23	0.46	0.78	2.13	2.61	8.71
200	1.25	2.55	0.85	0.59	4.83	3,82	13.9

Above mentioned quantities of leached nitrate nitrogen are lower compared to reasearch of Zvomuya et al (2003). They determined nitrate leaching in range 5-33 kg NO$_3$-N/ha, on sandy loam soil under potato production, including fertilization with 140 to 280 kg N/ha. Linear increase of leached nitrate nitrogen was also proved by Errebhi et al (1988), on loamy sand soil under potato production, with increasing fertilization 45, 90, 135 and 270 kg N/ha.

Potato yields

Statistical analysis showed significant differences in the yields of fresh mass of potato tuber in 2009 with respect to nitrogen fertilization. Average yields ranged from 33.3 to 37.7 t/ha. Significantly lower yield of fresh mass of potato tuber was determined on variant without top-dressing (fertilization with 50 kg N/ha) compared to other fertilization treatments. Significantly the highest yield was determined on variant fertilized with 200 kg N/ha, while differences between variants fertilized with 100 and 150 kg N/ha were not significant, Graph 2.
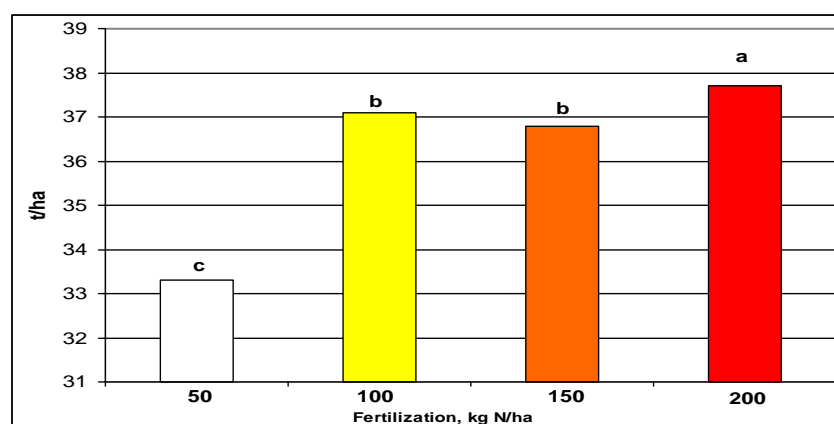
Graph 2. The yields of fresh mass of potato tuber in 2009

Increasing nitrogen fertilizaton from 50 to 200 kg N/ha had no significant influence on potato yields, which varied from 8.2 to 24.2 t/ha in 2010. Due to the extremely rainy August and

September, and consequently several days of stagnation of water on soil surface, especially on one part of experimental plots, lower potato yields than expected were achieved, Graph 3.
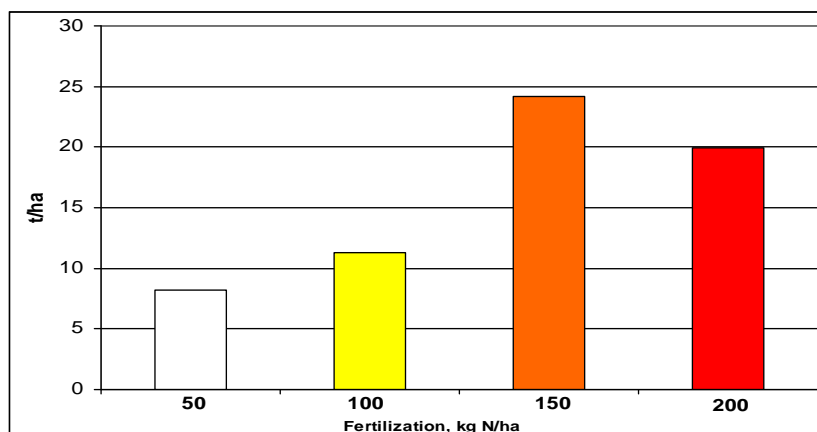
Graph 3. The yields of fresh mass of potato tuber in 2010

Conclusion

Significantly higher nitrate concentrations in arable layer of soil were determined on variant fertilized with 200 kg N/ha compared to others variants (fertilization 50-150 kg N/ha). Nitrate concentrations in percolating water varied in a very wide range (4.1–283.5 mg NO_3^-/l), due to applied nitrogen fertilization, amount of percolating water and consumption of nitrate by plants, occassionaly surplasing maximum allowed concentrations (50 mg NO_3^-/l). Potato fertilization with 50 to 200 kg N/ha increased annual nitrate leaching by percolating water, from 1.1 to 1.9 kg NO_3-N/ha in dry 2009, and from 7.5-13.9 kg NO_3-N/ha in wet 2010. Yields of fresh mass of potato tuber rose significantly from 33.3 to 37.7 t/ha in 2009. In 2010, lower potato yields were achieved (8.2.-24.2 t/ha) due to stagnation of water on soil surface and increased nitrogen fertilization had no influence on it.

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AGRICULTURAL LAND OF ISLAND RAB AND HOW TO PRESERVE IT ?

Bosko MILOS[1*], Aleksandra BENSA[2]

[1]Institute for Adriatic Crops and Karst Recalamation, Split, Croatia
[2]Faculty of Agriculture, University of Zagreb, Zagreb, Croatia
(Corresponding author: bosko@krs.hr)

Abstract

The objective of this paper was perfomed evaluating the quality of agricultural land of the island of Rab in order to contribute to better use and prevent from conversion to non-agricultural purposes. Land quality is defined by the parameters of soil, climate and terrain and was determined by the standards of Croatian legislation (N.N. 53/10). Based on the results of soil research, climatological data and terrain parameters generated from the 3 D terrain model, and using the GIS system has made Map of the land quality categories of island Rab. The above mentioned analysis showed that the largest area, 239 ha of total 543 ha, occupying P2 categories (valuable arable land), the P3 (other arable land) 123 ha, complex categorie (P2/P3) 150 ha and other agricultural land only 31 ha. Agricultural land is characterized by fragmentation, depravation of property (overgrown by weeds and forestry) and lack of irrigation systems. Studies have shown that the land of the island of Rab with its quality, diversity and area is great potential for agricultural development, but in organizational and technological terms it is necessary to remove these constraints and to protect it from key risk – the conversion to non-production purposes. The project has created an expert basis for the protection of agricultural land and the results can be used to support local farmers and decision makers in managing the resources of the island of Rab.

Key words: agriculture, land quality, Rab, GIS

Introduction

Agricultural production ofthe islandof Rab,like the most ofthe Adriatic islands, is characterized by fragmentation, split into small fractions, abandoned of holdings and lack of irrigation systems.Agricultural land defined by spatial Plan of Rab(2004)occupies 543 hectares.In addition to traditional agricultural crops: vineyards, olive groves, fruit orchards and vegetable gardens, a large proportion of the area is not being cultivated. The overall condition of the soil arrangement and agricultural production is low with the ongoing trend of the reduction of agricultural land, as well as the increasing trend of the forest and unproductive land.The project has created an expert basis for better use and protection valuable agricultural land from conversion to non-production purposes and the results can be used to support local farmers and decision makers in managing the land resources of the island of Rab.

Material and methods

Preliminary work involved the analysis of soil, geology, climate, vegetation, land use data, spatial planning documents, legislative regulationandacquisition of cartographic base. During the field research was opened and described a total of 33 soil profiles from which 78 samples were taken for laboratory analysis of the physical and chemical properties. Spatial delineation of different soil types, was performed using Basic Croatian map 1:5000 (HOH), Digital

Orthophoto Maps 1:5000 (DOF) and GPS device. On the collected soil samples were carried out standard laboratory analysis, including: pH (ISO 10390:2004), EC (ISO 11265:2004), $CaCO_3$ (ISO 10693:2004), CaO - Drouinou Galette method, humus content - Kotzman method, K_2O and P_2O_5 - Al method and textural wet sieving and sedimentation after disaggregation in Na-pyrophosphate (ISO 11277:2004). Soil map and Map of Land quality categories in scale 1:25.000 were prepared using the software package ArcView 3.1. and ArcGIS 10.0. All spatial data were geocoded in the national coordinate system (5 Gauss zone and - Mercator projection).

Morphometric analysis of the terrain involved the calculation of the inclination and aspect based on a digital elevation model (DEM). Digital elevation model is raster grid structure, cell size 5 meters interpolated from contour lines and height points of the topographic map 1: 5000. Assessment of the quality of the agricultural land (Q) was made, in accordance with the Croatian regulation (N.N. 53/10), by the formula: $Q = \sqrt{S \times Cl \times R}$, where:

S - soil, Cl - climate and R – relief.

Quality of the soil (S) was determined on the basis of the soil development stage, texture and geological origin (parent material) and valuated from 7 to 100 points. The basis for determination of the land quality categories is Soil map. Quality of the climate (Cl) is valuated with 1 to 10 points. According to the Regulation (N.N. 53/10) the climate of island of Rab isdefined with 5-6 points. Quality of the relief (R) is defined according to the classification of the terain slope and valuated with 1 to 10 points. Classifying of the land quality categories was made as follows:

P1 - Especially valuable arable land 80-100 points.

P2 - Valuable arable land 60-79 points

P3 - Other arable land 40-59 points.

PŠ - Other agricultural land 7-39 points.

Results and discussion

Soil classification and properties

The results of field, laboratory and cameralanalysis has shown great soil diversity that is reflected in the presence of different soil types and variability of their properties. Key factors for soil properties variability are: geological, geomorphological and hydrological conditions and man impact. According to the Basic geological map of the Croatia 1:100.000 (Mamužic, P. et al. 1966) investigated area build Tertiary and Quaternary deposits, and Mesozoic limestones with dolomite occupy a very small area. In the hypsometrically lower positions and flattened Flysch sediments are covered by Quaternary sediments, mainly sands. Quaternary sediments are well developed and consist of flysch slope deposits, eolian sands and deluvial gravel deposits to weakly related breccias. In the eolian sands, transferred with the wind from the Alps in the interglacials (Riss-Wirm) dominates quartz (79-90%). The thickness of these sandy layers varies from a few decimetres to several meters. They are often mixed with the flysch slope deposites. Granulometrical Quaternary colluvial deposits are poorly sorted gravels and associated breccias sized debris up to 8mm.$CaCO_3$varies from 55 to 90%. Based on field and laboratory research, and according to actual soil classification (Škoric, A et al 1985), soils are classified as follows:

Automorphic anthropogenic soil (Rigosols) formed on:

• Gravel and breccias

• Flysch sediments and eolian sand

Hydromorphic anthropogenic soil (Rigosols) formed on:

• Pseudogley and pseudogley-gley soil on the Eolian sand and Flysch sediments

Halomorphic soil

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Rigosols on the gravel and breccia

Colluvial deposits, have a high percentage (72.3) of limestone fragments - skeleton (particle size>2 mm) and 27.7% of the soil particles (particles <2 mm). They are classified as gravels, because the greatest portion of particles measuring 2-4 mm (average 33.9%) and 4-8 mm (average 29.5%). According to granulometric composition of the soil samples analyzed (particles <2 mm) were classified as loamy sands, sandy loam and sandy clay loam. These soils are structureless, mealy consistency, extensive permeability, low water retention and high air capacity. The depth at which hardened gravel (breccia) occurs varies and defines their basic properties and suitability for use in agriculture. The soils on the colluvial deposites are predominantly deep, because the breccia occurs deeper than 100 cm. These soils are alkaline and strongly alkaline reaction (pH in water, ranging from 7.52 to 8.91), the variable total carbonate content ranging from 33.2 to 87.6% $CaCO_3$ and the low active lime (CaO) 1.78 to 4.67 %. Topsoil humus content is medium, average 3.92%. Physiologically active potassium are well stocked, with marked variations in the range from 19.6 to 145.1mg K_2O/100gr. soil. Plants accessible phosphorus ranged between 1.1 to 8.9 mg P_2O_5/100gr.

Rigosols on the Flysch sediments and Eolian sand

Basic characteristics of these soils are in close connection with the geological structure and terrain physiography. According to the mechanical composition this soils are clay loam texture and poorly developed structure. These are very alkaline and alkaline soils, with variable content of total carbonate ($CaCO_3$ 7.4 to 28.0%). Humus content in the soil is low. Physiologically active phosphorus ranging from poor to good amount. These soils are moderately to well stocked with physiologically active potassium.

Rigosols formed on the pseudogley and pseudogley-gley soil on the Eolian sand and Flysch sediments

These soils are characterized by Pg-Cg, P-EG-Bg-Cg or P-EG-BG-G morphogenetical soil profile structure.Signs of gleying are pronounced in soils of central, the lowest parts of the field, exposed to prolonged excessive wetting.These soils are sandy loam to silty clay loam texture and low grade structure, weakly calcareous, and slightly alkaline reaction. Humus content in the topsoil and subsoil horizons is low and very low, respectively. The supply of soil with the physiologically active phosphorus is medium and potassium good.

Halomorphic soils

Halomorphic soil are undeveloped, structureless, sandy clay loam soils located in the lowest terrain along the coast in the intertidal zone. Electrical conductivity (EC), measured in a suspension of soil and water in the ratio 1:5, ranging from 4.63 to 6.48 dS/m, which indicates the high salt content. These chemical properties and high sea level make them unsuitable for any agricultural production.

Spatial distribution of soil

The spatial distribution of different soils is shown on the soil map M = 1:25.000 which was allocated to the six mapping units. The largest area occupied automorphic anthropogenic soil (304 ha), which includes the Rigosols on the gravel and breccias (100 ha), and the Rigosols on the flysch slope deposites and eolian sand (204 ha). Hydromorphic anthropogenic soil on eolian sand and Flysch sediments formed on the pseudogley and pseudogley-gley soils occupy 239 hectares and is located on the lower, flattened parts - the fields and valleys. Halomorphic soils occupy 15 ha and they are located in the zone of influence of the sea - the tides. Since the mapping unit are pedosystematic homogeneous, land quality evaluation was done within mapping units using relief parameters.

Climate
According to W. Köppen climatic classification (Köppen, W. 1936) of island of Rab has a moderately warm and humid climate with hot summers (Cfa). According to the data of the meteorological station of Rab for the period 1989-2010. mean annual air temperature is 15.6 °C, and the average amount of annual rainfall is 1087.1 mm. Precipitation regime is maritime, which means that the warm part of the year is relatively arid, especially the summer months, while more precipitation falls in the winter months. Climate of the island of Rab was valuated with 6 points according to the Regulation (N.N.53/10).

Relief
Terrain analysis included the calculation and making maps of the slope and aspect. The percentage share of each category of inclination and aspect is shown in Tables 1 and 2.

Table 1: Percentage of the inclination of the analyzed area

Inclination (degrees)	0-2	2-6	6-9	9-12	12-17	17-24	24-33	>33
Percentage	35,7	30,3	16,7	8,8	6,1	2,2	0,4	0,001

Table 2: Percentage of aspect of the analyzed area

Aspect	straight	N	NE	E	SE	S	SW	W	NW
Percentage	18,5	2,5	6,8	1,4	3,2	6,8	35,3	18,8	6,6

Tables 1. and2. shows a great variety of inclination and aspect with dominant landforms with gentle slope and warm southwestern and western aspect.

Qality categories of the agricultural land
Results of the investigation are shown in Map of the quality categories of the agricultural land (Figure 1) and Table 3.

Table 3. Quality categories of agricultural land

Quality categories	Description of the quality categories of the agricultural land	Area (ha)
P2	Valuable arable land	239
P2/P3	Valuable arable land/ Other arable land	150
P3	Other arable land	123
PŠ	Other agricultural land	31
Total area		543

P2 quality category includes deep, sandy and clay loam soils, low carbonate and soil humus content formed on Eolian sand Flysch sediments, occupying flattened terrain, incline to 6^0.
P3 quality category includes medium deep soils with a slope greater than 6^0 and / or deep soil formed on the colluvial gravel deposits.
P2/P3 quality category was singed out as the complex due to the map scale limitations, composed of the P2 category, which occupies 68.7% and P3 which occupies 31.3% of the investigated area. P2 quality land category includes deep, sandy loam and clay loam soils in the predominantly flattened slopes, coves and wellies. Capability category P3 of land are designated terraced, medium deep and deep, loamy and clay loam Rigosols formed on the steeper terrain.
PŠ quality category occupies steeper and terraced terrains with shallow soils overgrown with the various forms and stages of forest succession, especially Aleppo pine. Halomorphic soils are unfavorable for use in agriculture and therefore not evaluated.
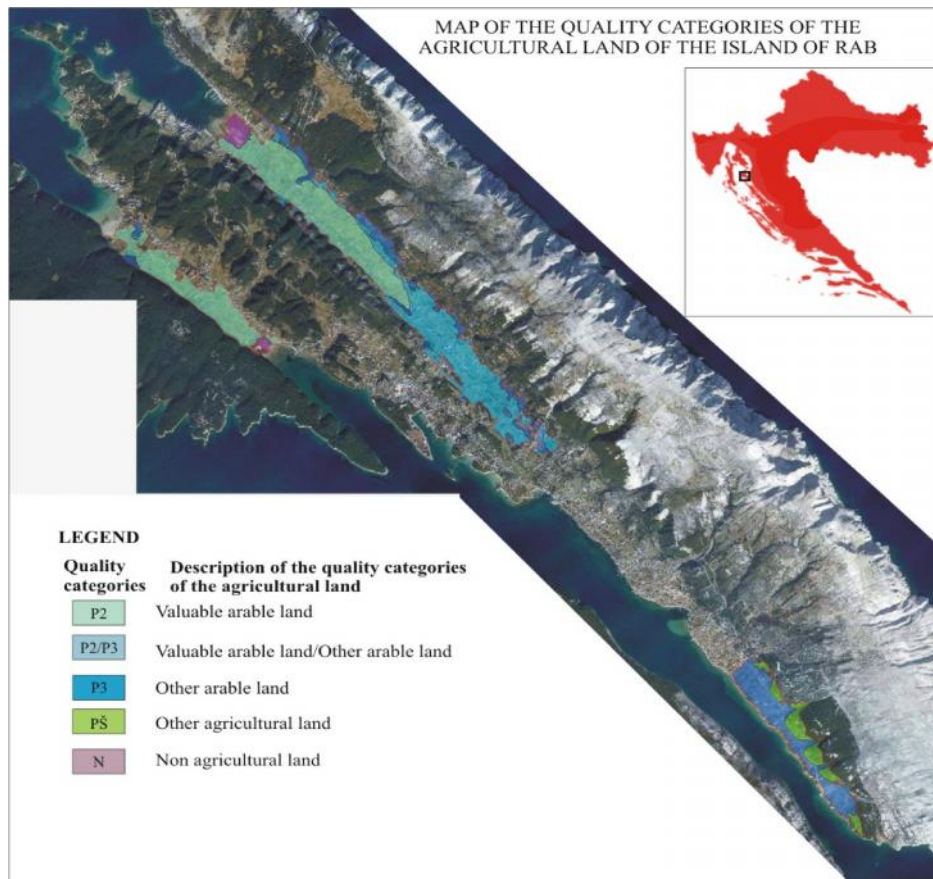
Figure 1. Map of the quality categories of the agricultural land of the island of Rab

Conclusion

Our research has shown (Table 3) that the largest area occupies quality category P2 (valuable arable land) and complex land category P2/P3 (valuable arable land in combination with other arable lands). Category P3 (other arable land) occupies 123 ha while other agricultural land (category PŠ) have the smallest share (31 ha). Above shows that the favorable naturalconditions, especially the diversity andsoil fertility are great potential for organizing a variety of agriculture. Since the land quality was assessed at the general level, it can only serve as a framework, while for each specific use should make a special suitability evaluation. In order to improve agricultural production, it is necessary to:

Make regionalization of agricultural land for cultivation of the domesticated crops

Monitor the state of the soil fertility

Build a Soil information system

Providing professional assistance toindividualfarmers

Spatial planning to protect valuable agricultural land from conversion to non-agricultura lpurposes

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CS - 137 AND K - 40 CONCENTRATION IN SOIL AND THEIR TRANSFER TO PLANT

Fokion. K. VOSNIAKOS

Alexander Technological Educational Institute. of Thessaloniki, Thessaloniki, Greece
(Corresponding author: bena@gen.teithe.gr)

Abstract

A total number of 780 samples of soil collected over Greece and measured with gamma-rays spectroscopy, sixteen years after the arrival of the Chernobyl "cloud" and its fallout all over the country. An analysis for the long- lived isotope of ^{137}Cs and the natural exist ^{40}K has been performed. It seems that still ^{137}Cs presents a remarkable geographical variability and an inversely proportionality with the natural ^{40}K concentration of soil. According to the present data regarding the ^{137}Cs deposition on Greece, the uneven spotted distribution has been confirmed.
Follow up representative measurements for soil contaminations have indicated minor migration of ^{137}Cs beyond to 5 cm from the surface layer. The insignificant in depth (beyond 5 cm) radiocesium contamination in Greek soils it was expected knowing the composition of these soils, the majority of which are rich in clay and silt, and contain in excess exchangeable potassium. The radioactivity range varies from 0.4 to 14.4 kBq/m^2.The transfer of ^{137}Cs from soil to corn plant was investigated 16 years after a similar work done soon after the Chernobyl accident. Correlations were made between ^{137}Cs transfer factors and (i) ^{40}K in plant and soil, (ii) pH of water and KC1. (iii) Exchangeable K, Ca and Mg. The uptake of ^{137}Cs by corn plant in 2010 seems to be unchanged when compared to the situation in 1988.

Keywords:*Radioactivity, soil, plant, transfer factor (TF)*

Introduction

During Chernobyl accident, radioactive contamination with radionuclides, that reaches Greece, was due to tropospheric fallout (Greek Atomic Energy Commission, 1988). and. thus, crops were, sown six months after the accident or later - until today - contaminated with radionuclides, almost exclusively through their root system. The main characteristics, which determine how dangerous are the radionuclides, are their physical and biological half-life and the kind and the energy of their radiation emitted by them. From the long-living radionuclides, cesium (^{134}Cs and ^{137}Cs) and strontium (^{89}Sr and ^{90}Sr) isotopes burden the environment for greater time period. The absorbance of radioactive substances by the plants, by the man and animals can be direct and indirect. In the direct absorbance the plant but, also, man and animals are directly incorporating the radioactive substances. This way of incorporation plays an important role in the first days after the accident. The second way of incorporation - the indirect - presupposes the absorbance of radionuclides through the way ground - roots - plant - animal - man. The indirect way of contamination is the most important and influences the food for greater period of time. Soil to plant transfer of various radionuclides is known to be affected by soil properties, plant species and variety, climatic condition and cultural practices. From the soil properties texture, pH, exchangeable potassium and calcium, kind and amount of clays and organic matter content are amongst the most important (Papanikolaou, 1972). Variation of the concentration of radionuclides on the soil surface depends mainly on its

mineralogical composition; its chemical and physical properties, meteorological conditions and the possible transfer of material to deeper soil layers (Missaelidis et al., 1987), (Vosniakos et al. (1998). The possibility of fixation of Cs isotopes by geological material and soil has been the subject of previous studies (Sikalidis et al., 1988). The mechanism of fixation depends strongly on the mineral composition of the soil. For example, soils in Northern Greece have high clay content with vermiculite (mica family) being the predominant mineral, which is a well-known potassium and cesium fixing material (Sikalidis et al., 1988). The existence of ^{137}Cs in the soil is important because of its possible transfer to the cultivated plants and eventually to animals and humans. It also increases the direct exposure doses received by humans from terrestrial natural radioisotopes by 10% (Kritidis and Kollas, 1992). The majority of N. Greece soils have pH values between 7 and 8, exchangeable potassium. 0.5 meq / 100g (typical value), and are heavy textured because of its high clay (49% typical) and silt (37% typical) contents (Antonopoulos-Domis, 1990). Finally, the transfer of Cs is increased with increasing organic matter content (Berfeijk et al.,1992). Compared to the transfer of Cs in soils with an organic matter content of less than 5%, the effect was approximately 2-5 to 20% increasing up to a factor of 10 on soils with an organic matter content of more than 50%. Organic matter in Greek soils is less than 5% and does not favor the uptake of Cs by plants (Antonopoulos-Domis, 1990). In the pH range of 3.9 - 8.4, transfer of Cs is not affected by soil pH (Berfeijk et al.,1992). Transfer of Cs in clay and loam is lower than in sand, by 5 and 3 times, respectively (Berfeijk et al.,1992). ^{137}Cs and ^{40}K have the same oxidation number and almost the same diameter. Absorption of Cs by plant, though, is smaller than the absorption of K probably because of smaller contiguity of Cs with the carriers of the cellular membranes of the plant roots (Mavrogiannnopoulos, 1992). Obviously, another reason is that ^{40}K concentrations are about one order of magnitude greater than ^{137}Cs in the soil and Cs has to compete with stable K too, which is even in higher (a further 4 orders of magnitute) concentrations.

Firstly the aim of the present work is to identify the level of the existing ^{137}Cs contamination over Greece sixteen years after the Chernobyl accident and a comparison between the 1986 ^{137}Cs - distribution and the present measured one in more - less the same areas of Greece, has been attempted. The ^{40}K (0.0118% of natural K) concentration in soils as ratio ^{137}Cs/ ^{40}K has been, examined, even this ratio is not as constant in biological systems as the ratio Sr/Ca (Eisenbud, 1973).Secondly, is to investigate the soil to plant transfer of ^{137}Cs and ^{40}K. The areas chosen were Drama (East Macedonia) and Thessaloniki (Central Macedonia). The sites are characterized by different soil contamination levels (^{137}Cs contamination increases in the East – Central – West direction). The plant chosen was corn because it constitutes main kind of food for cows in the country.

Materials and methods

During the period of January 2003 - May 2010, 780 soil samples of surface soil (0-5 cm) were collected over Greece (Fig. 1). It was tried the soil samples to be taken from apparently undisturbed sites in open areas at the ground surface. Deeper soil samples (5-50 cm) were collected as well, but no didactable amount of ^{137}Cs has been recorded, as it was expected since the mobility for Cs is very low, 0.2 y^{-1} (Bonazzola et al., 1993). The sampling of surface soil, of about 500 cm^3 each, were taken from geographic divisions of Greece with emphasis to those where in 1986 serious depositions of ^{137}Cs (from 15 kBq/m^2 and more) were observed (JRC-Rem Project, 1986). The ^{137}Cs concentration, near the soil surface is strongly time dependent, because of its variable deposition rates over many years and its gradual depletion by decay, erosion and leaching (NCRP Reports, 1988). The uptake of ^{137}Cs from soil has been show to be inversely proportional to the K content of soils (Eisenbud, 1973) that was also the

case in the present work.

The ^{137}Cs average deposition in Greece was ranged in 1986 between, 0.01 to 14.4 kBq/m^2(Simopoulos, 1989). Similar measurements of 137Cs concentration in England for the period of 1990-1991, shows, a range of 0.7-0.8 kBq/m^2 (Aarkrog et al., 1988), in Denmark the total deposition of ^{137}Cs ranged from 0.66 to 3.6 kBq/m^2 (Aarkrog et al., 1988) while the ^{137}Cs deposition in Italian soils had a mean value of 30 $\pm$17 kBq/m^2 immediately after the Chernobyl accident (Kritidis and Kollas, 1992). The present work estimates the ^{137}Cs accumulation in the Greek soils sixteen years after the Chernobyl accident, to be ranged between 0.4-14.4 kBq/m^2. The ^{40}Kactivity is between 5.1 and 16.5 kBq/m^2. ^{40}K and the radionuclides of the U and Th series contribute most of the naturally occurring radioactivity in soils. It is known that ^{40}K concentration in soils ranges between 0.51-15.54 kBq/m^2 (Eisenbud,1973). All samples were kept in sealed containers for at least 15 days to allow equilibration between the isotopes ^{226}Ra and ^{222}Rn.

Plant and soil sample collection and preparation.

At least 15 plants (5 from each site) were collected. Each plant was taken by digging the soils carefully to collect the whole plant (roots, plant and grain) and the soil surrounding the roots. Collection points were at least 40 m apart to cover as much variability of the site as possible. Plants were harvested at maturity from openfields. Corn plants were separated from their roots and grains, thoroughly washed, and cut to small pieces. They were air-dried for two days in the laboratory and then in the oven (Melag) kept at 80 ºC. They were weighed (mass of dry plant) and burned at 500 ºC in another oven (Nabertherm) for at least 24 hours to get carbon free white ash. This was done because Cs in a certain volume of ash is 8-9 times more than the Cs in the same volume of dry plant. It should be mentioned that Cs is not lost by oven-drying at 500 °C (boiling points of Cs and K, 687°C and >750°C). Plant ash was filled in the standard geometry white cup (cylindrical. 7 cm d. and 2 cm h.), recommended for measurement by the Greek Nuclear Research Centre - Demokritos.

Soil samples were also air-dried, oven-dried (80 °C), pulverized, sifted (2 mm sieve) and weighed (mass dry soil). Then they were put to fill standard cups.

Measuring device (Gamma ray spectroscopy)

Detector: Hp Ge semiconductor coaxial p-type. CP series Tennelec;

Energy range: 40 KeV - 10 MeV;

Detector temperature: Liquid nitrogen in vacuum cryostat;

Sample chamber: Low background shielding (5 cm lead. 0.5 cm copper);

High voltage: 2100 volts DC;

Amplifier: Tennelec 242 TC;

PC-system: In place of pulse generator and MCA;

Energy calibration: ^{60}Co and ^{137}Cs standard sources linear CHL - KeV relation (R = 0.99999);

Activity calibration: Standards, dry soils and dry plants (^{137}Cs: 1 count/sec corresponds to 90 Bq; ^{40}K: 1 count/sec corresponds to 276 Bq.);

Counting times: 76000 sec;

Resolution: FWHM 1.95 KeV at 1332 KeVof ^{60}Co. *Dead time: 0-3%.*

Results and discussion

In Fig.2 the ^{137}Cs concentration versus that of ^{40}K is plotted. From this figure it seems that ^{137}Cs is inversely proportional with ^{40}K in the soil. Besides in Fig. 3 where the logarithm of ^{137}Cs concentration is plotted versus that of ^{40}K, it is clear that the experimental data are concentrated along the solid line described by the equation y= C [1-Aexp (Bx)] where y=log^{137}Cs, x=log^{40}K and A, B, C are constant coefficients estimated by the experimental data, showing that the uptake of ^{137}Cs from soil is inversely proportional to ^{40}K content of

soil, in which there is a potassium deficiency. It is obvious from Fig. 4 shows that, the ratio of ^{137}Cs / ^{40}K is not constant, even cesium is a congener of potassium (Eisenbud, 1973).

Activities of ^{137}Cs and ^{40}K in Bq/kg dry wt are given in Table 1. Transfer factors are defined as activity concentration in plant over activity concentration in soil. ^{137}Cs activities in plant vary between 0.01-2.13 Bq/kg and in soil between 23.1-51.1 Bq/kg. Transfer factors vary between 0.0015-0.0771. Transfer factor values are in agreement with the ones found 16 years ago by another group (Aarkrog et al., 1988) meaning that Cs fixation mechanism in the soil has not really affected the availability of Cs and its uptake by the plants.

^{137}Cs concentration in the plant decreases as ^{40}K in the plants increases. The correlation coefficient is -0.66 for a linear fit. Fig. 5 shows a similar correlation for ^{137}Cs transfer factor versus ^{40}K in the soil. This finding implies that plants grown in soils poor in K (airport case) are expected to have higher Cs uptake.

Table 1 shows the pH variation of water and KCI ranging between 7.53-8.32 and 7.08-7.56 respectively. Low R values (Fig. 6) show that pH does not affect transfer factors (TF) at least when pH is less than 8.4. This is in agreement with other results (Berfeijk et al., 1992).

Table 1. Activities of Cs and K, transfer factor and soil pH and exchangeable cation status

Site	Activities and transfer factor and soil properties (Ag = Agios, Air = Airport, Dr = Drama; Exch. = exchangeable cations)										
	Activities (Bq kg^{-1})				Transfer		Soil pH		Exch. (meq kg^{-1})		
	Plant		Soil		factor		pH_{H2O}	pH_{KCl}	K	Ca	Mg
	Cs	K	Cs	K	Cs	K					
Ag1	0.07	428	42.4	549	0.0015	0.780	7.6	7.3	11.0	240	29
Ag2	0.02	391	-	-	-	-	7.5	7.2	10.0	225	39
Ag3	-	-	-	-	-	-	7.8	7.3	9.3	242	33
Ag4	0.00	333	51.1	531	0.0000	0.628	7.6	7.1	14.0	240	32
Ag5	0.01	314	41.5	530	0.0003	0.593	7.8	7.4	11.0	244	27
Air1	1.68	297	38.3	199	0.044	1.488	8.3	7.6	5.4	261	62
Air2	2.10	251	27.8	219	0.075	1.146	8.2	7.5	5.9	267	72
Air3	0.90	337	39.8	211	0.023	1.593	8.2	7.5	6.2	263	64
Air4	2.06	246	34.5	204	0.060	1.203	8.1	7.5	6.1	256	63
Air5	2.13	233	27.6	234	0.077	0.998	8.3	7.5	4.6	255	60
Dr1	1.17	352	23.6	545	0.050	0.646	7.7	7.2	7.8	248	15
Dr2	1.13	321	23.6	464	0.048	0.692	7.6	7.2	7.3	244	16
Dr3	1.16	411	25.9	430	0.045	0.956	7.8	7.2	9.2	260	16
Dr4	0.97	405	26.2	466	0.037	0.868	7.8	7.3	8.5	255	17
Dr5	1.34	423	23.1	472	0.058	0.896	7.6	7.1	9.4	257	16

Figure 1. Map of radioactive contamination in Greece
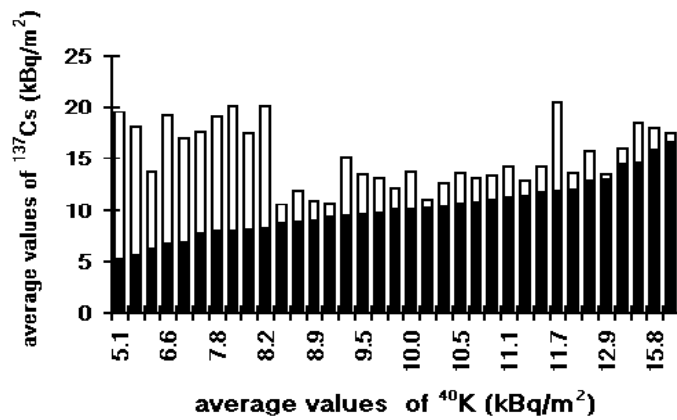
Figure 2. The ^{40}K average concentrations versus that of ^{137}Cs (kBq/m^2)
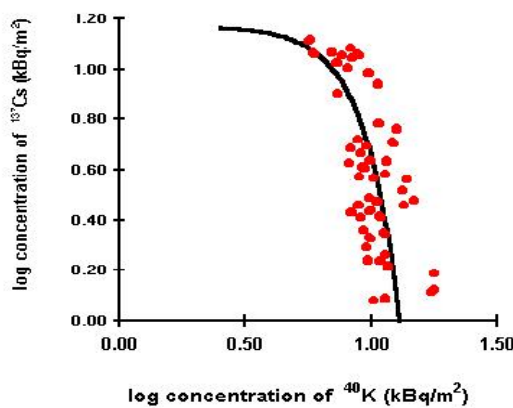
Figure 3. The logarithm of ^{40}K concentration versus that of ^{137}Cs (kBq/m^2)
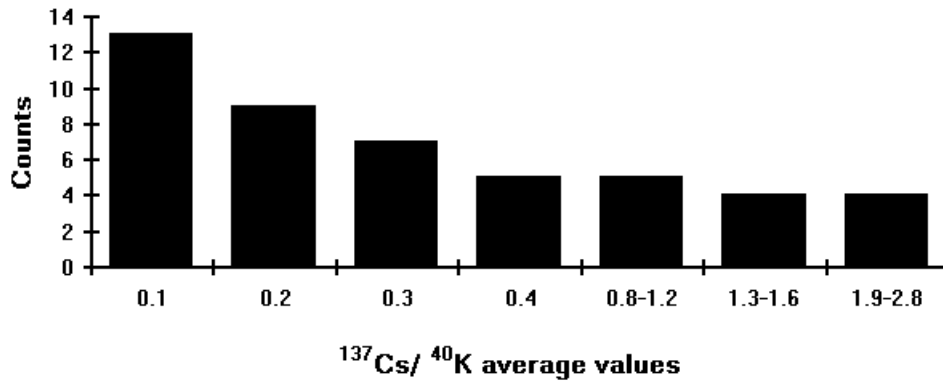
Figure 4. The ratio $^{137}Cs/^{40}K$ from average values
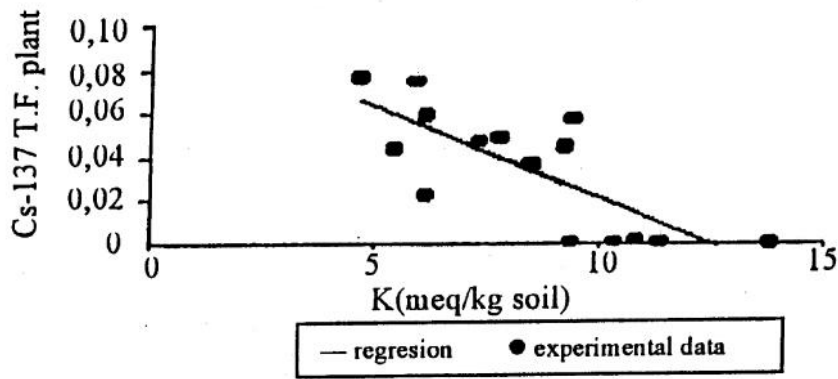
Figure 5. ^{137}Cs transfer factor versus ^{40}K in soil
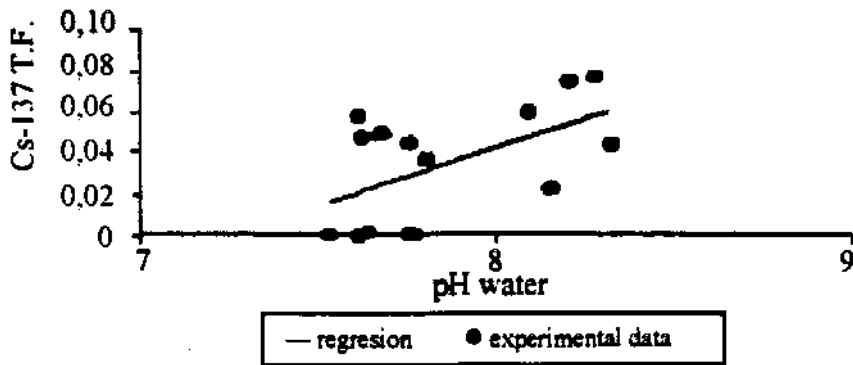
Figure 6. Variation of transfer factor versus pH.

Table 3 shows the content of exchangeable K, Ca and Mg in soil. Fig. 7 shows the correlation between Cs TF and exchangeable K in soil (R=-0.78).
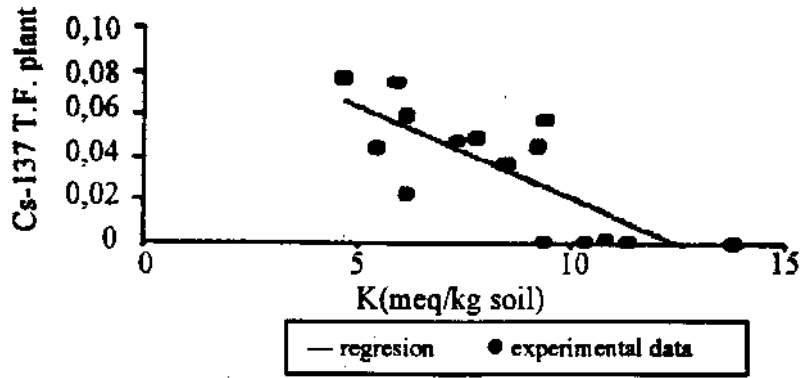
Figure 7. ^{137}Cs transfer factor versus k$^+$ in soil

Fig. 8 shows the correlation between Cs TF and exchangeable Ca in soil (R=0.70). Fig. 9 shows the poor fit for Mg (R=0.29). Table 2. shows the mean values of %clay, silt and sand.

Table 2. % clay, silt and sand in soil.

Name	% clay	% silt	% sand
Agios1	30,1	45,9	24,4
Drama	27,8	24,5	48,6
Airport	34,5	41,8	24,5
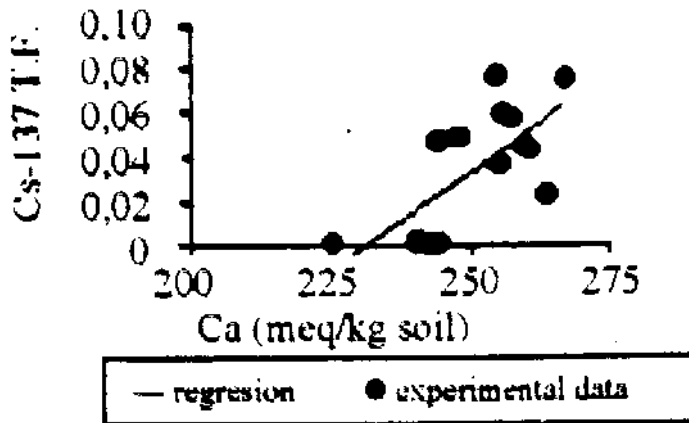
Figure 8. 137Cs transfer factor versus Ca ++ in soil
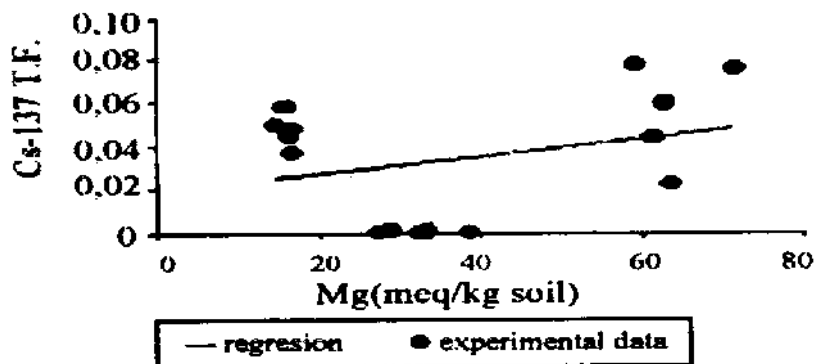
Figure 9. ^{137}Cs transfer factor versus Mg + in soil.

Conclusions

It may be concluded that ^{137}Cs uptake by corn in 2010 has not changed compared to diesituation in 2003. The Cs fixation in soil does not seem to have affected the uptake as much atinitially anticipated.

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ASSESSING EFFECTIVE FACTORS IN DEVELOPMENT OF ORGANIC AGRICULTURE IN ARDABIL PROVINCE

Leila KARPISHE[1*], Mehdi ALIYARI[2], Mohammad CHIZARI[3]

[1]Department of Agriculture, Parsabad Moghan Branch, Islamic Azad University, parsabad Moghan, Iran
[2]Academic centre for education , Culture and Research, Occupation Cooperative Organization of Academic Graduates, Tehran, Iran.
[3]Department of Agricultural Extension and Education,Tarbiat Modares University, Tehran, Iran
(Corresponding author: karpisheh2003@yahoo.com)

Abstract

Organic Agriculture (OA) is a sustainable system of economical, social and ecological that is considered as one of the strategies to reduce negative impacts of industrial agriculture in many countries. The purpose of this study was identifying factors affecting the development of organic agriculture in Ardabil province. A descriptive–correlation survey approach was used in this study. The study population consists of agriculturalspecialists of Jihad-Keshavarzi Organization in the province of Ardabil-Iran (N=313) .Research samples was selected using randomly stratified method with using Cochrane formula (n=126). Reliability of instruments was determined by pilot test and calculating Cronbach alpha coefficient. Cronbach alpha values were 0.81. Validity of instrument was determined by investigating the attitudes of agricultural specialists in universities of Tehran and Ardabil. The results showed that almost of specialists' perception (56.7%) toward organic agriculture development was in agreed level. Results also demonstrated that from the perspective of specialists the most important factors in developing organic agriculture are: governmental and policy, infrastructure, extension and education, and economic factors. The results of bivariate correlation test showed that there was a positive and significant correlation (p=.05) between variables such as: age, job background, barriers, infrastructures and the specialists' perception toward organic agriculture.

Keywords: *organic agriculture, Effective Factors, specialists, perception.*

Introduction

Many writers argue that conventional agriculture is not sustainable and that radical changes will be needed. Although the extent of the necessary changes may be questioned, there is a general consensus about society's desire to internalize some of the externalities of agriculture. Different parties suggest that agriculture: organic as a silver bullet may provide solutions to the current problems in conventional agriculture. The goal of OA is to give priority to long-term ecological health, such as biodiversity and soil quality, rather than short-term productivity gains. A question many scholars ask is whether OA is a pre-modern technology or a technology for today's world. Proponents argue that it is both, being an innovation that opposes some forms of modernity, with visions of returning farming to certain pre-modern structures, as well as an innovation that provides solutions to current agricultural problems (ie Pretty 1995). Although authors such as Macilwain and Gewin (2004), Mäder et al (2002), Stolze et al (2000) and O'Riordan and Cobb (2001) have detailed scientific evidence on the environmental, economic and health benefits of organics, many professionals still question OA's financial viability, environmental credentials and overall efficiency and productivity,

and reject it as an alternative farming system (ie Avery 1995). Increasingly, writers are referring to OA as a "new paradigm" in agriculture (Dimara et al 2003, Abaidoo & Dickinson 2002, Beus & Dunlap 1990, Dahlberg 1986) challenging the status quo of conventional agriculture[12].

Studies such as Fuglie and Kascak (2001), Marsh et al (2000), Kromm and White (1991), Van den Ban and Hawkins (1988) and Feder and Slade (1984) have illustrated quantitatively the positive role that extension officers play in diffusing agricultural innovations. Agricultural research also plays a critical role in creating and further developing new innovations for farmer adoption..

More specifically, acceptance of an agricultural innovation can occur at different levels, namely research, extension, farmer and community. The development and acceptance of any innovation is not a purely rational process, but one that involves conflicting beliefs, values, perceptions and social interaction.

Organic farming must be accepted as an innovation in the four broad contexts namely research, extension, farmers and consumers. Thus, agricultural specialists play an important role to develop organic farming. The review of related literatures shows that various factors affect the experts' views toward the development of organic farming. The studies of Stobbelaar and his colleagues (2006) revealed that the specialists' attitudes toward the environment are positively related to their attitudes regarding the development of organic farming. Lavik (2002) in his(her) research found that people's concerns regarding environmental problems is the most important factor in acquiring more knowledge about a sustainable agricultural system which is less harmful to the environment. The study of Travisi & Nijkam (2005) represented the effect of the variable agricultural experience on the knowledge of experts regarding organic farming.

This study was designed to identify factors affecting the development of organic agriculture in Ardabil province. Results of another study about factors influencing in development of organic agriculture in others areas in Iran indicated that the factors were categorized into seven groups, namely research, social and cultural, political, education, extension, economical and, medias.

Materials and methods

The methodological approach of this study employed an analytical method (correlation study). Agricultural specialists of Jihad-Keshavarzi Organization in Ardabil province, Iran are the target population that have been selected by using stratified randomization method (n=126). From review of literature, a questionnaire was developed to collect data. Content and face validity of instrument were established by investigating the attitudes of agriculture specialists in universities of Tehran and Ardabil. A pilot study was conducted with 25 respondents. Questionnaire reliability was estimated by calculating Cronbach's Alpha. Reliability for the overall instrument was estimated at 0.81. The final questionnaire covered three areas: 1) demographic characteristics such as age, sex, level education …2) Attitude toward organic agriculture development which were measured on a five-point Likert-Type attitude scale which ranged from 1(Strongly disagree) to 5 (Strongly agree). 3) Factors strengthening the organic agriculture in Ardabil province which were measured on a five-point scale. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS16). Appropriate statistical procedures for description (frequencies, percent, means, and standard deviations) and inference (bivariate correlation test) were used.

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[12]Conventional agriculture is defined here as standard practice utilized by the majority of Australian farmers. The term 'paradigm' derives from Kuhn (1970) and is often used to mean a way of looking at things: a set of shared assumptions, beliefs, dogmas, conventions, and theories and is closely linked to 'normal science'.

Results and discussion

Descriptive statistics
Agricultural specialists who participated in the study ranged in age from 32 to 65 years. The mean age of respondents was 35.9 years. 82% of them were male and 18% were female. In terms of education level, 69.3 percent of the respondents had a BS degree, 21.5 percent had a M.S and only 9.2 percent PhD degree.

Attitude toward organic agriculture development
Attitude toward organic agriculture developmentwas measured using a five-item, Likert-Type attitude scale (Table 3). All item means are abovethe median score of 3. These findings show that specialist' attitudes about the development of organic agriculture are positive.

Table 1. Attitude toward organic agriculture development: n, $N = 126$.

Statement	Mean	S.D.	CV
Development of organic farming should be considered along with the human cultural, economic and, political development.	4.34	0.63	1
Development of organic farming is a powerful tool to achieve for achieving of a sustainable development	3.99	.65	2
Developing the organic farming will improve farmers' economic status.	4.03	0.69	3
Development of organic farming will result in conserving the national and natural resources.	4.16	0.75	4
Food security can be achieved by developing the organic farming.	4.06	0.76	5
Development of organic farming increases agro ecosystem health considering biodiversity, soil microbial and biological activities	4.11	0.80	6
Development of organic farming produces crops which characterized as higher quality and better taste products	3.83	0.94	7
Development of organic farming reduces agricultural wastes due use of them in preparing compost.	3.81	1.00	8
Development of organic farming improve the quality and taste of products	3.68	1.08	9
Development of organic farming improves farmers' income	3.51	1.1	10
Development of organic farming is one of the solutions which help to take advantage from indigenous knowledge during the production process.	3.57	1.14	11
By developing organic farming, labor forces will be more useful in agriculture.	3.31	1.15	12

Responses weighted 1–5 from strongly disagree to strongly agree.

Factors affecting the development of organic agriculture
Factors enhance the development of organic were measured with 29 questions (were classified into four factors) through five levels Likert range(see Appendix 1). The results is shown in Table 2.

Table 2. Factors affecting the development of organic agriculture

Factors	Mean.	SD	C.V.
Governmental and policy	3.42	0.65	1
Infrastructure	3.29	0.68	2
Extension and education,	3.27	0.65	3
Economic	3.24	0/80	4

Scale: 1) Very little…………….. 5) Very much

As indicated in Table 2, the respondents rated all the factors studied more than 3. This finding means that from the perspective of agricultural specialist's all the above factors are effective in strengthening organic agriculture.

Relationship between specialists' attitudes toward organic agriculture development and selected variables

In order to investigate the relationship between specialists' attitudes and selection variables, considering the scale of variables and normal distribution of data, Pearson correlation coefficient was used. The results are presented in Table 3.

Table 3. Correlation between specialists' attitudes and selected variables

Variables	r	P
Agricultural experience	0.154	0.009
Job background	0.080	0.201
Attitude towards environment	0.207	0.001
Attitude towards health	0.188	0.003
Attitude towards nutrition	0.222	0.000
Knowledge about organic agriculture	0.252	0.000
Barriersof strengthening organic agriculture	0.217	0.007
education level	0.089	0.154
Age	0.152	0.161

As Table 3 shows, among the 9 scale (measurement level) variables selected as factors, six variables had a positive and significant relationship ($P<0.05$) with specialist' attitudes toward organic agriculture development. (Table 3).Knowledge about organic agriculture showed the highest correlation with specialists' attitudes toward organic agriculture development.

Results indicate that the following variables: Agricultural experience, Job background, education level and age did not show any significant correlation with specialists' attitudes toward organic agriculture development.

Conclusion

This paper has reviewed effective factors in development of organic agriculture in Ardabil province. These findings show that specialist' attitudes about the development of organic agriculture are positive. Studies about organic agriculture in other areas such Maleksaeedi, et al (2009) have been confirm this finding. According to the result of research on factors affecting organic agriculture strengthening (governmental and policy, infrastructure, extension and education, economic) should be emphasis. Also, Knowledge about organic agriculture showed the highest correlation with specialists' attitudes toward organic agriculture development, therefore providing public and specialized training for specialists of agricultural is recommended.

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Appendix 1. Factors and variables affecting the development of organic agriculture

Factors	Variables
Governmental and policy	- Providing urgent facilities and possibilities to develop and launch research projects on organic farming
	- Recognition and analyzing the weaknesses of organic farming methods in our country in order to eliminate them
	-Extensive, comprehensive and long-term Planning
	-Providing Long-term loans with low interest to farmers
	- Developing necessary policies and legal framework on organic farming to improve international markets
	- Emphasizing on organic farming into the developmental macro plans
	- Investing in infrastructural development of organic farming by government
	- Developing cooperation between the related organizations (e.g. Customs department, Ministry of Commerce, International Trade Committee) in order to implement initiate the export of organic products
Infrastructure	- Establishing the cultural centres to improve the people's acceptance rate of organic crops (farming etc.)
	- Creating Information and Marketing Centres
	- Creating specific insurance centres for organic products
	- Creating specific custom districts
	- Creating standard and criteria-setting centers for issuing organic products certificates
	- Establishing field farmer schools
	- Establishing science and technology parks
Extension and education	- Reflecting the farmers' needs of farmers to country's research domain
	- Dissemination of studies' results and research achievements regarding organic farming
	- Training progressives farmers and early adopter farmers to accept (or use) and develop the organic farming
	- Notification and dissemination of information about on organic farming
	- Informing farmers and public regarding (or about) the importance of consuming healthy foods which are free of chemical matters
	- Informing farmers and public regarding (or about) the disadvantageous of using pesticides and chemical fertilizers in production of agricultural crops
	- Publication of specialized journals in the field of agriculture and organic products
	- Holding exhibition regarding organic crops at the province level.
	- Holding workshops for farmers on the benefits of consuming organic products
Economic	- Providing enough financial sources) for doing research studies in the field of organic farming at farm level
	- Providing convenient and adequate credits to produce organic crops by farmers
	- Providing appropriate financial incentives such as subsides for farmers in order to produce organic crops
	- Establishing and developing international and national markets for organic products

Scale: 1) Very little…………….. 5) Very much

AGRICULTURAL WASTE UTILIZATION FOR HEALTHY ENVIRONMENT AND SUSTAINABLE LIFESTYLE

P.S. SHEHRAWAT[*], Nitu SINDHU

Department of Agricultural Extension, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India
(Corresponding author: psshehrawat@hau.ernet)

Abstract

The study was conducted in two districts of Haryana state namely; Hisar and Sonipat, and a total no. of one hundred twenty farmers were selected and interviewed with the help of well structured schedule. The study revealed that awareness about the utilization of biogas plant waste, mushroom waste, wheat waste, mustard and horticultural waste was more than 70 percent. Thus, overall awareness about utilization of agricultural waste was very high but utilization of agricultural waste by the farmers was very less.

Results pertaining to benefits to farmers after utilization of agricultural waste revealed that most of the farmers were benefited in very ordinary ways like high milk yield, addition income by selling waste to brick yards, reduced expenditure on chemical fertilizers, reduced waste available for disposal, clean and safe environment, etc.

Employment opportunities will increase if industries like processing units for making value added products, handicrafts industries for making bags, mats, hats, carpets, etc., handmade paper industry, development of waste collection centers in villages and others are developed in villages.

Keywords: *Agricultural Wastes, Awareness, Utilization and sustainability*

Introduction

Agricultural wastes are basically unusable substances which may be either liquid or solid produced as result of cultivation processes such as fertilizers, pesticides, crop residues and animal waste. Agricultural waste management is part, of the ecological cycle in which everything is cycled and recycled such that an interdependent relationship is maintained in the eco-system. By waste management, all the plant wastes are placed at the right place and right time for the best utilization in order to convert into useful products and pollution control. Globally, 140 billion metric tons of biomass is generated every year from agriculture. Ministry of New and Renewable Energy (MNRE 2009), Govt. of India estimated that about 500 Mt of crop residue is generated every year. These wastes are destroyed by burning or allowed to decay in public places in the open air creating environmental pollution. Thus by managing these crop wastes in a well planned manner we can maintain a healthy environment for ourselves and all other living creatures. This study will highlight some of the trends that could be adopted in the agricultural waste management so that the farmers become aware and take full advantage of the various possibilities of plant waste cycling, recycling and further utilization for economic purpose.

Materials and methods

The study was conducted in two districts of Haryana state, Hisar and Sonipat, purposively selected. Further 6 villages were selected randomly and ten farmers were selected randomly

from each village and thereby a total number of 120 farmers having multiple cropping systems were interviewed for the study.

Results and discussion

Personal profile of the farmers (Table 1): Personal profile of the farmers indicated that most of the farmers were from middle age group (36-50 years), were educated up to metric, belonged to joint family of medium size with 4-6 members. Majority of the farmers had their main occupation as farming and land holding up to 5 acres. Among mass media exposure, utilization of newspaper among the farmers was maximum followed by TV, radio, kisan seva kendra and magazine. The extent of utilization of newspaper, radio and T.V. was daily and magazine and kisan seva Kendra was often. Out of 120 farmers only 55 (44.85 percent) farmers underwent training or workshop related to management of their waste. Among the contacts with extension officials maximum contact of farmers was with progressive farmers, followed by scientist, ADO, SDAO/SMS and NGO. The frequency of contact with progressive farmers and scientists was weekly, ADO and SDAO/SMS was whenever needed and monthly with NGO.

Table 1. Profile of the respondents

S. No.	Variable(s)	Category	No. of Respondents	Percentage (s)
1	Age (years)	Middle (36-50)	60	50.00
2	Education	Metric	43	35.83
3	Family type	Joint	85	70.83
4	Family size	Medium (5-6members)	48	40.00
5	Occupation of respondent	Only farming	98	81.67
6	Land holding	Up to 5 acres	36	30.00

Facilities available with the farmers (Table 2): Facilities available with the farmers either personal or public indicated that only 63.33% of farmers could easily avail to laborers/manpower, 39.16 % of farmers had transport facility for waste, 42.50% of farmers had personal composting units, 34.17% farmers had personal biogas plants, only 8.33% of farmers had the facility of community waste collection centers and famers did not have any common waste dumping sites or block making machine in their villages.

Awareness among the farmers about the products made from agricultural wastes
Awareness: awareness among the farmers about the utilization of agricultural waste was noticed to be very high. The result was apposite as the farmers were well educated and had regular mass media contact. Radio and TV were the most common and easily accessible source of agriculture information for farmers including contact and non contact groups, (Ahmed 2009). Farmers had regular contact with extension officials and often visited to KVKs, Sheikh *et al.* (2007) reported that ATIC is performing excellent role of information spread.

Table 2: Facilities available with the farmers

S. No	Particulars	No. of Respondents	Percentage
1	Compost plant	51	42.50
2	Transportation facility for waste	47	39.16
3	Biogas plant	41	34.17
4	Community waste collection centre	10	08.33
5	Common waste dumping site	0	00.00
6	Block making machine	0	00.00

Awareness among the farmers about the products made from agricultural wastes

Awareness: awareness among the farmers about the utilization of agricultural waste was noticed to be very high. The result was apposite as the farmers were well educated and had regular mass media contact. Radio and TV were the most common and easily accessible source of agriculture information for farmers including contact and non contact groups, (Ahmed 2009). Farmers had regular contact with extension officials and often visited to KVKs, Sheikh *et al.* (2007) reported that ATIC is performing excellent role of information spread.

One hundred twenty farmers from two districts of Haryana state, namely, Hisar and Sonipat were interviewed. It was observed that 100 percent farmers were aware regarding the use of agricultural waste to make animal feed, biogas, animal shelter and its use as energy source. Awareness regarding making compost, vermicompost and organic manure was found 97.50 percent. Awareness about making poultry litter was 96.67, for generating electricity was 90.00 percent, mulching and handicrafts was 85.00 percent, making beauty products was 80.83 percent, paper, cardboard and particle board was 75.83, making briquettes was 52.50, planting bed was 51.67 and awareness about making chemicals was 40.00 percent. Low percentage of awareness was noticed regarding making activated carbon (29.17 percent) followed by Bioplastics (24.17 percent), textile fiber (20.83 percent) and utensils (00.83 percent).

Overall awareness about the utilization of agricultural wastes

The overall awareness among the farmers about utilization of different crop waste is presented in the figure 1. The figure clearly describes the awareness about the utilization of different crop waste. Awareness about utilization of wheat straw was 72.33 percent and paddy waste was observed 63.94 percent. Awareness about utilization of sugarcane waste was 62.73 percent. Awareness about utilization of cotton sticks was 61.33 percent and about utilization of mustard sticks was observed 70.08 percent. Awareness about utilization horticultural waste was 70.54, about utilization of floricultural waste was 64.12, utilization of mushroom waste was 72.50 percent, utilization of livestock waste, biogas plant waste and poultry was 68.33, 98.75 and 58.75 percent respectively.
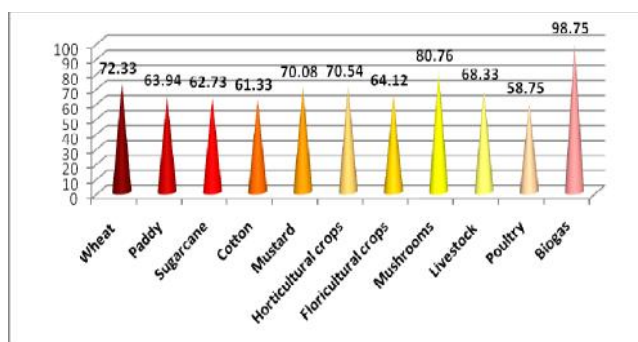
Figure 1: Overall awareness about utilization of agricultural wastes

Overall utilization of different agricultural wastes

Paddy waste: From paddy crop the byproducts or residues are paddy straw, paddy husk and rice bran but only paddy straw is being utilized by farmers. Sixty seven farmers cultivated paddy crop and all of them stored it for future use as animal feed and for making animal bed and shelter (100.00 percent), about 82.08 percent farmers sold it, 77.61 percent use it for mulching purpose, 56.72 percent used it for composting and vermicomposting and only 1.47 percent farmers used it for fuel purpose. Paddy straw can be used as a source of energy for in

small scale processing units, for carrying out various processes like washing, boiling, canning, etc. A mushroom processing unit is being run by a farmer in village Aterna of district Sonipat, his processing unit works under biomass energy. Paddy straw, cotton sticks, mustard sticks and husk is utilized as a source of energy in the processing unit.

Wheat waste: Straw is a byproduct of wheat crop. Wheat straw can be used for making many products but all the farmers store it and use it for animal feed and 57.50 percent farmers sell wheat straw as feed for animals. It was reported that, 81.67 percent farmers are aware that wheat straw can used for making particle board but neither they sell wheat straw to particle board industries nor they utilize it to make other products like briquettes, dry flowers, hats, mats, carpets and other handicrafts. The results has been found consonant with the result of Rose Marie Garay *et al*. (2009) who found that particle board can be made with crop residues mixed with wood from *pinus radit,* all the crop residues like wheat straw, corn and rice straw are suitable for making particle boards but best results were with wheat straw and corn stubbles.

Sugarcane waste: From sugarcane crop, residues are sugarcane trash and bagasse. From the farmers those who cultivated sugarcane (43farmers), 48.83 percent used the bagasse as fuel in making jaggery, 46.51 percent turned it into compost/vermicompost and only 11.62 percent sold it to paper/cardboard industry or power plant. Farmers used sugarcane trash to feed their animals (100.00), composting/vermicomposting (46.51), sell as animal feed (16.28) and use it for mulching (1.67). Apart from composting and feeding bagasse and trash to animal, bagasse can also be used as planting for growing green fodder. Beside this sugarcane bagasse has one more important use which is production of biogas; this is similar to the findings of Dellepiane et.al (2003) who conducted the study due to the existing difficulty of finding energy sources and reducing pollution, the use of renewable sources and highly efficient technologies for electrical energy production, the combination of these two aspects, namely, a molten carbonate fuel cell system fed with biomass derived syngas. In particular, the biogas comes from bagasse and barbojo, the sugarcane residues. So far in developing countries they have been wasted or partly used with poorly efficient technology.

Cotton waste: Seventy five farmers cultivated cotton crop. Cotton sticks which are left after the picking of cotton are used as fuel and stored by all the farmers. Cotton sticks were not utilized for any other purpose. If the farmers sell the cotton sticks to power plants, plywood industries, particle board industries they can add to their income. Another way of changing the waste cotton sticks into useful material is by chipping and converting them into compost. Cotton waste can also be used in biogas production by treating it anaerobically. This was similar to the findings of Isci A et.al (2006), who found out that cotton wastes are a good source of biogas. Approximately 65, 86 and 78 ml CH_4 were produced in 23 days from 1g of cotton stalks, cotton seed hull and cotton oil cake in the presence of basal medium (BM), respectively. BM supplementation had an important positive effect on the production of biogas.

Mustard waste: Mustard was cultivated by 102 farmers. Mustard sticks and husk are two major byproducts from mustard crop. Mustard sticks and husk are sold to brick industries by all the farmers who cultivate it (100.00), 90.19 percent farmers stored it for future use, percent 73.52 percent used it for burning in chulha and only 16.66 percent farmers use it for composting. A profitable way of managing mustard sticks is chipping and composting or feeding to animals after treating with ammonia. Another important material which can be made from mustard sticks are briquettes. Mustard stalk, mixed waste of tree leaves and grasses in 3:1 proportion and wood waste along with three organic binding materials (molasses, press mud and distillers dry grain) with varying concentration of 5, 10, 15 and 20% can be used for preparing briquettes. Press mud was is a better binding agent, followed by distiller's dry grain and molasses. This was similar to the finding of the result by Andrade *et*

al. (2001) who reported the physical characteristics like moisture content, bulk density, compression ratio and compressive strength desired for better utilization and safe handling and transportation are found to be best for briquettes made from press mud and mustard stalk at die pressure of 123.42 MPa.

Horticultural waste: Horticultural crops were cultivated by 64 farmers. Damaged or spoiled fruits and vegetables, dead plants, branches, leaves and unsold fruits and vegetables are the horticultural wastes. Among these damaged fruits and vegetables are turned into compost/vermicompost or fed to animals by 70.31 percent of farmers. The dead plants, branches and leaves were fed to animal by 100.00 percent and composted by 70.31 percent of farmers. Unsold fruits and vegetables are fed to animals by 100.00 percent, composted by 70.31 percent, and 26.56 percent farmers sold it after processing. Value added products can be made from surplus fruits and vegetables and then sold in market this will not only help the farmers avoid wastage but to earn more. Another way of preserving the unsold fruits and vegetables is drying them and then selling. Various chemical can also be extracted from waste fruits and vegetables like citric acid, lactic acid, acetic acid, etc. Production of Lactic acid was studied by Manoj *et al.* (2012) that it can be produced through the batch & fed batch fermentation method using hydrolyzed potato starch, results from the findings of Chunpeng Znang *et al.* (2011) concluded that potato residues can also be used for extraction of pectin.

Floricultural waste: Flowers were cultivated by only 14 farmers. After picking of flowers the whole plant is a waste along with the damaged and unsold flowers. The left flowers are generally sold at least price by 100.00 percent of farmers, used in composting, vermicomposting and green manuring by 71.43 percent of flowers. The dead plants and waste flowers are either used in composting, vermicomposting or in green manuring by 8.33 percent of farmers. The left out flowers can be dried and powdered and cut flowers can be used for making dry flowers which is an upcoming industry. The dry-flowers can be painted, colored, dyed and various floral products such as cards, pictures, wall hangings, arrangements, pot-pouris and pomanders can be prepared out of them. This was relevant to the result of study conducted by Bharati *et al.* (2007) who reported that the dry flower can be painted, colored, dyed and sold at very high prices.

Mushroom waste: Mushrooms are produced on natural materials taken from agriculture, woodlands, animal husbandry, and manufacturing industries. After mushroom crops are harvested, millions of tonnes of "spent" (used) mushroom substrate become available for other uses. The used growing medium is far from spent. It is clear from table 25 that; it is used as manure, for gardening, for making nurseries and growing vegetables by all the farmers those who grow mushrooms use the waste mushrooms for composting and vermicomposting, 16.67 percent farmers fed it to animals and used for biogas generation. The spent compost was used for vermicomposting, manuring and planting bed by 100.00 percent of farmers. Surplus mushrooms were sold at least price by all the farmers and sold after processing by 33.33 percent of farmers. Another way of handling spent substrate from *Agaricus bisporus* production is relevant with the study conducted by Danny Lee Rinker (2002), which is already in wide use in horticulture as a component of potting soil mixes; in agriculture or landscape trades to enrich soil; as a casing material in the cultivation of subsequent *Agaricus* crops, in vermiculture as a growing medium, in wetlands for remediation of contaminated water, in stabilizing severely disturbed soils, in the bio-remediation of contaminated soils, as a bedding for animals, as an animal feed, and to control plant diseases. Spent substrate from other mushroom species has found acceptance as food for animals, as ingredients in the cultivation of other mushroom species, as fuel, as a medium for vermiculture, to enrich soils, and as a matrix for bio-remediation.

Biogas plant waste: Forty one farmers possessed biogas plant. Slurry thrown out of the biogas plant is utilized by the farmers (100.00) as manure and for composting and vermicomposting

by 78.04 percent of farmers. This result was analogous with the findings of Ponni *et al.* (2007) that vermicompost can be used as manure on farm, the application of FYM + vermicompost @ 2.5t/ha along with the panchagavya 3% proved to be the best treatment as it was found to record the highest plant height (83.17cm), no. of branches (38.23) and leave (1115.87) and also recorded the mass herbage (44.81g/plant).

Livestock waste: livestock was owned by all the farmers. All the farmers used the waste to make dung cakes this was relevant to the study conducted by Mehta *et al.* (2002), who reported that in Haryana all the farmers make dung cakes daily and the problems faced by the respondent in procurement of fuel were time constraint health and drudgery psychological and lastly economical problems. Only 34.17 percent of farmers used to generate biogas, 42.5 percent farmers used it for composting/vermicomposting and only 1.67 percent farmers used it for making bio insecticide. Currently the energy consumption is rising and there is need of an alternate energy source, this problem can be solved by utilizing the agriculture biomass for generating energy. A study was conducted in this context by Chaiprasert (2011) in Thailand and reported that the potential of biogas production from major sources of animal manure, agro-industrial wastes, and organic fraction municipal solid waste was annually produced 1060, 1005, and 870 million m^3, respectively. Major agro-industrial wastes, animal farm waste and municipal solid waste were sources of biogas feedstock in biogas technology. Thus a better way of producing clean energy is biogas technology.
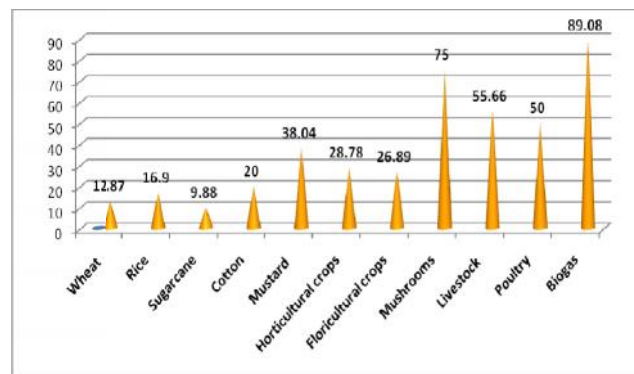
Figure 2: Overall utilization of various agricultural wastes

Gap between awareness and utilization of agricultural wastes

The huge gap between awareness and utilization is shown in the figure 3. The awareness about the utilization of wheat waste was 72.33 percent and utilization of wheat waste was 12.87 percent. Awareness about utilization of paddy waste was 69.94 percent and utilization was computed as 16.90 percent, awareness about utilization of sugarcane waste was 62.73 percent and utilization was 9.88 percent, awareness about utilization of cotton waste was computed as 61.33 percent and utilization as 20.00 percent, awareness about utilization of mustard waste was 70.08 percent and utilization was 38.04 percent, awareness about utilization of horticultural waste was computed as 70.54 percent and utilization was computed as 28.78 percent, awareness about utilization of floricultural waste was 64.12 percent and utilization was computed as 26.89 percent, awareness about utilization of mushroom waste was 80.76 percent and utilization was 75.00 percent, awareness about utilization of livestock waste was 68.33 percent and utilization was 55.66 percent, awareness about utilization of poultry waste was 58.75 percent and utilization was 50.00 percent and awareness about utilization on of biogas waste was computed as 98.75 percent and utilization was 89.08 percent.
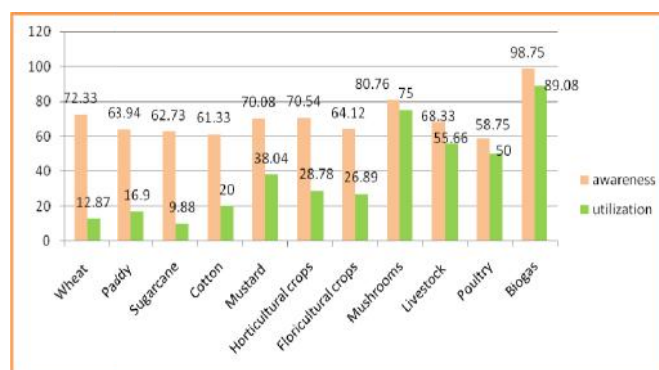
Figure 3: Gap between awareness and utilization

Conclusion

The study revealed that there was a huge difference between the awareness and utilization of agricultural waste. This difference existed due to lack of interest among the framers. Thus there is need to motivate farmers which can be made possible by organizing trainings, lectures, showing films to farmers or demonstrating waste management techniques on field.

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SURFACE WATER QUALITY OF FRUSKA GORA

Dragica STOJILJKOVIC[1*], Milica RAJIC[1], Biserka DIMISKOVSKA[2]

[1]Faculty of Agriculture, Novi Sad, Serbia
[2]University "Sc. Cyril and Methodius ", Skopje, Republic of Macedonia
(Corresponding author: dragica@polj.uns.ac.rs)

Abstract

During the period from September 2011 to February 2012 was carried out monitoring of spring, surface and groundwater of Fruska Gora to 8 permanent and 15 temporary points for sampling. Selected river basins on the southern and northern slopes of the as interesting from the point of view of production of organic agricultural products. The waters were determined ammonia content (0-3.5 mg / l), nitrite (0-18.3 mg / l), $KMnO_4$ consumption (7.6-10.9), orthophosphate (0.15-2.8 mg / l) and phenol (0-0093 mg / l). These parameters are over MAC (by legislation) for use in drinking water, bottling and productive use in ponds of fish. Samples were taken in outside the growing season of low temperatures and exceptional dry year.

Keywords: *orthophosphates, phenols, ponds*

Introduction

Fruska Gora belongs to the low mountains, because only the highest peak Crveni Cot barely exceeding 500 m a.s.l.. Morphologically any mountainous stretches from east - west length of about 80 km and a width of up to 15 km. The northern border of the Danube, while the southern boundary of approximate contour 100.00 m a. s. l. and offers a line of Sid - Erdevik - Irig - Maradik - Krcedin - Stari Slankamen.

On the northern slopes of the majority of whom are permanent watercourses with a crest on the fan-source terrain elevations above 400 m. In the band density of river network is 0.778. Regional erosion basis for all river flows and the Danube and for a river basins covered by research: Kozarski, Kamenarski and Ešikova kistream.All three basins have a permanent or intermittent sources along the valley side of the crest headwaters to the mouth of the Danube. They have a steady flow variable, even in arid 2011th year (Koscal et all., 2005; Stojiljkovic and Stanic, 2007).

Unfortunately none of the basins as well as the storage reservoir at Mount Fruska Meteorological Service of Serbia has no interest to establish the monitoring of water resources.

Method and material

In the annual study determines the 8 observational points for field and laboratory testing of water. The basic unit of a reinterpretation of existing documentation and setting up a network of observation points was topographical and hydrological basin.Water resources are the type of porosity, sediment genesis and occurrence in the basin divided in spring, surface and ground water (Stojiljkovi , 1980, 2003, 2004; Stojiljkovic and Zrnic, 2004; Zrni , et al., 2005).

In interpreting the results were used for longer time series of various parameters of the chemical composition of spring water and groundwater, which enabled the application of methods of statistics. The paper presents preliminary results for the surface water to the northern slopes of the basin on the following: Kozarski in Beocin creek, Kamenarski stream in Novi Ledinci and Esikovac stream in Sremski Karlovci .

Results and Discussion

On the northern slopes of the basin Kozarski, Kamenarski and Esikovac streams were placed point under the catastralnumber 3, 4 and 7 (Fig. 1). On all the streams were made two complete analysis and two truncated, only some micro-components and organic matter (Table1).

Figure 1. The geographical position of points 3, 5 and 7 at the Kozarski creek in Beocin, Kamenarski stream in Ledinci and Esikovac creek in Sremski Karlovci

Based on the results of chemical analysis of groundwater, water are analyzed hydrocarbon classes, magnesium-calcium-sodium group (according to the classification AleKino's). On Selerovom diagram shows a variability in the major anions and cations in water as a result of pollution in the basin (Fig. 2,3,4). In table one you are given the maximum and minimum values of the parameters in the water according to the criteria of the MAC in ponds.
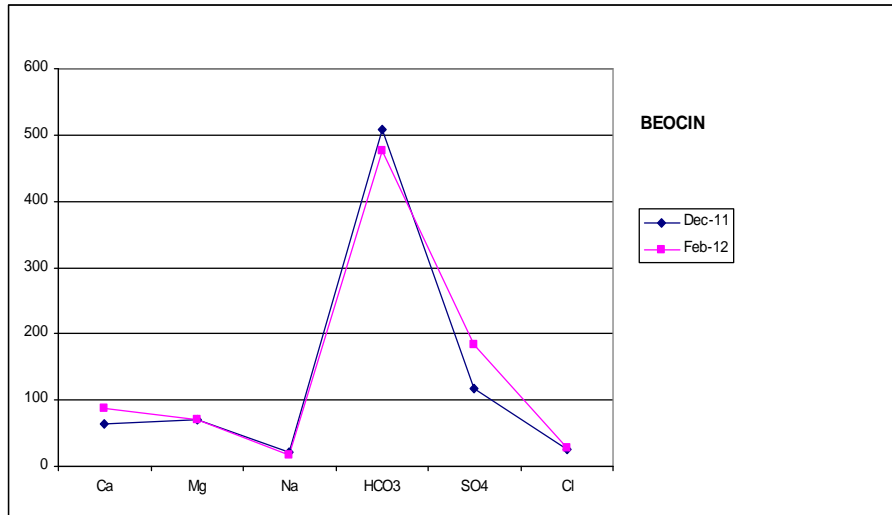
Figure 2. Diagram of Seler of permanence in the major ions in leather surface water stream in Beocin

The waters are set high content of ammonia nitrogen triad (0 - 0.33 mg / l), nitrate (0-8.96 mg / l), nitrate (10.09-38.07), and KMnO4 consumption (an indicator of organic pollution 7.6-13.7). Anions and cations from water containing excess calcium (63.3-112.7), magnesium (47-72) chloride (24.8-85.5) and sulfate (49.2-182.6). In this case, sulfates were detected in the chemical analysis, and MDK in water is related to sulfur. Water contains orthophosphates (0.83-1.35 mg / l) and phenols (0-0036 mg / l). Some parameters are less than the MDK in drinking water.
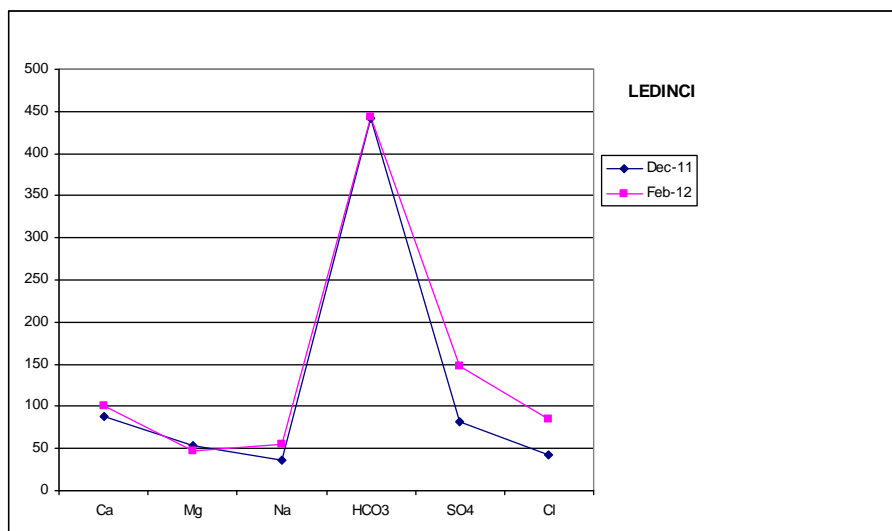
Figure 3. Diagram of Seler of permanence in the major ions in leather surface water stream in Ledinci
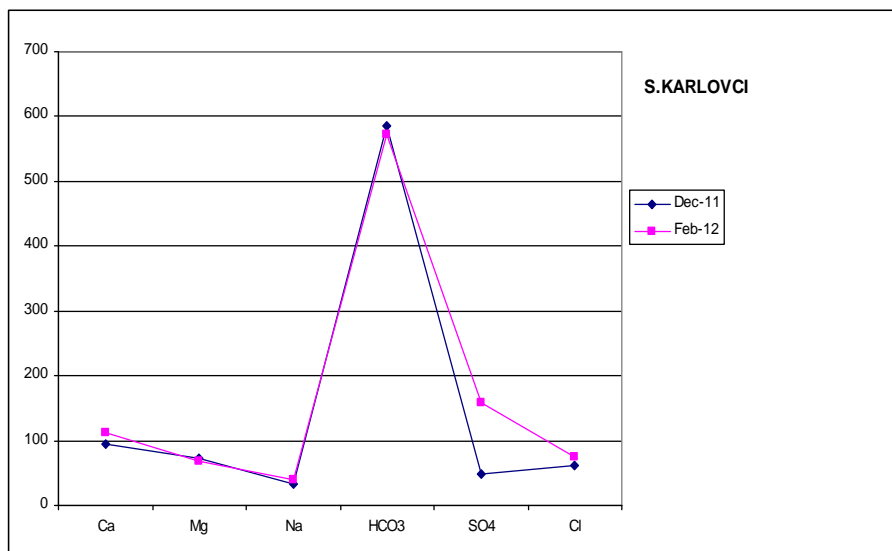
Figure 4. Diagram of Seler of permanence in the major ions in leather surface water stream in Sremski Karlovci

Conclusion

Surface waters were observed with one monthly; modern sample in three watersheds on the northern slopes of Fruska Gora. According to the classification of Alekin all waters are hydrocarbon-class magnesium - calcium - sodium group. In all analyzes, the criteria for the production of surface water fish-ponds Fruška Gora maximal above contain (MAC) over prescribed. following parameters: **ammonia, nitrites, nitrates, organic matter, calcium, magnesium, potassium, then sulfates and chlorides, orthophosphates, phenols, chromium and boron.** Analysis of water quality by Water Quality Index (WQI) puts this water into another class with a tendency to transition into the third class. Due to the extremely dry years and low temperatures we believe that there was a large dissolution and transport of pollutants from higher terrain to the local and regional erosion basis and that picture of the quality of surface water is not realistic. According WQI water can be used in production ponds, but when the strict application of standards for the quality of surface waters in the fishing pattern in a single observation period does not meet the standards of usability water.

Table 1. The results of complete physical and chemical analysis of surface water at three locations

Parameters (mg/l)	Kozarski , Beo in	cat. No 3	Kamenarski Ledinci	cat. No 5	Ešikova ki, S. Karlovci	cat. No 7	MAC For ponds (US Envir.Protec. Agen.)
Dat.	22.12.2011	23.2.2012	22.12.2011	23.2.2012	22.12.2011	23.2.2012	
EC	1107	1211	1170	1250	1257	1332	1000
NH4	0.33	0.18	0.27	0.06	0	0.3	<0,02*
NO3	10.17	13.1	10.09	12.7	38.07	34.15	3*
NO2	0.39	10.1	0.57	8.96	0	0.75	<0,1
KMnO4	11.8	13.7	10.6	7.6	9.6	10.1	8
HPK	2.97	3.4	2.67	1.9	2.42	2.55	-
TDS	728.9	786.3	788.9	776.3	807.1	822.4	-
Cl	24.8	27.3	42.9	85.5	60.9	75.9	<0.003*
HCO3	508.7	475.8	442.3	444.1	586.2	573.4	-
SO4 (S)	117.1	182.6	81.8	147.7	49.2	159.2	<1
Fe	0.04	0.07	0.03	0.07	0.03	0.07	<0.1*
Ca	63.3	88.2	87.9	100	94.3	112.7	50-80*
Mg	70.5	69.5	54	47	72	68.5	<15*
Na	20.5	17.5	36.8	54.3	33.3	39	<75*
K	8.4	9.9	7.7	8.8	3.3	3.6	<5*
pH	8.3	8.1	8.2	8.1	7.9	7.9	6.5-8*
ortofosfati	1.35	2.8	0.91	0.83	1	0.85	0.15
Fenoli	0	0.036	0.004	0.077	0	0	0.001
Ba	0.46	0.50	0.48	0.13	0.53	0.35	5
Cr	0.03	0.04	0.04	0.03	0.04	0.04	0.03*
Pb	0.01	0.01	0.02	0.01	0.03	0.01	<0,02
B	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	0.3

Values marked **bold** above MAC water for pond

MAC for ponds marked * are less than the MAC values for drinking water

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BIOLOGICAL PRODUCTIVITY OF VERTISOL CULTIVATED WITH FIELD PEA UNDER NITROGEN FERTILIZATION CONDITIONS

Leka MANDIC[1*], Dragutin DJUKIC[1], Snezana ANDJELKOVIC[2], Aleksandra STANOJKOVIC[3], Ivana BOSKOVIC[4]

[1]University of Kragujevac, Faculty of Agronomy, Cacak, Serbia,
[2]Forage Crops Research Institute, Krusevac, Serbia
[3]Institute of Soil Science, Belgrade, Serbia
[4]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: lekamg@tfc.kg.ac.rs)

Abstract

This study evaluates the effect of different rates of mineral nitrogen fertilizer on ammonifier counts, protease activity and some chemical characteristics of vertisol (pH, phosphorus and potassium levels) under field pea cultivation. Increasing rates of mineral nitrogen fertilizers (20, 40 and 60 kg ha^{-1}) combined with standard rates of phosphorus and potassium (75 and 60 kg ha^{-1}, respectively) were incorporated prior to seeding, with their effect on the above biological parameters being monitored during two stages of field pea development (pod formation and wax-ripe stage), and their effect on soil chemical characteristics after field pea harvest. The results show that the use of these fertilizers led to a significant decrease in ammonifier counts in the first stage of the study (particularly the 60 kg ha^{-1} rate), and a non-significant effect in the wax-ripe stage. Conversely, protease activity was significantly increased by lower fertilization rates (20 and 40 kg ha^{-1}) during the first period of the study, and by all three nitrogen fertilization rates at the milk-wax ripeness stage. The use of these fertilizers did not affect soil pH, unlike readily available phosphorus and potassium levels.

Keywords: *ammonifiers, nitrogen fertilizers, proteolytic activity, vertisol, field pea*.

Introduction

As a legume having a marked ability to establish an effective symbiosis with active nitrogen-fixing bacterial strains, field pea does not require significant amounts of mineral nitrogen fertilizers for its growth and development (uki et al., 2009). However, this fact is often neglected in intensive production systems which use inadequate (higher) rates of these fertilizers, thereby risking having unfavourable physicochemical and biological characteristics of the soil and, eventually, crop yield and quality. Therefore, the judicious efficient use of mineral fertilizers (notably nitrogen fertilizers, in these plants) can be possible only if a complex approach involving microbiological research is adopted. The importance of microbiological research lies in the fact that microorganisms, as the most active component of biogeocenosis in biogeochemical terms, are a vital factor of soil biological productivity, environmental status and quality of crop production (Miloševi et al., 2004; Essah and Delgado, 2009). Moreover, the count and activity of soil microorganisms can serve as an indication of the economic justifiability of the use of different types, combinations and rates of fertilizers (erny et al., 2003; Stark et al., 2007). As a rule, mineral fertilization, used as a radical method for improving soil nutrient balance, intensifies microbial processes (Fauci and Dick, 1994). However, long-term fertilization, particularly with high rates of nitrogen fertilizers, can have deleterious effects, leading to increased gaseous nitrogen losses,

deteriorated physicochemical and biological properties of the soil and, eventually, diminished safety of the crop produced (Barabasz et al., 2002; Ayoola and Adeniyan, 2006). This is particularly the case under long-term fertilization which results in failure to obtain expected crop yields. The dual nature of mineral fertilizers, once they provide nutrient supply to the plant, allows them to ensure yield increases, while at the same time deteriorating soil properties and acting as a hidden cause of soil degradation (Mandić et al., 2004). Changes in the count of certain groups of soil microorganisms under the effect of different types of mineral fertilizers suggest their justifiable use as an indicator of soil fertility and crop yield (uki and Mandi , 2000). Hole et al. (2005) showed that a change in microbial biomass is a parameter that provides a clearer faster response to the incorporation of mineral fertilizers into the soil, which eventually affects its potential and effective productivity.

The objective of this study was to evaluate the effect of different rates of mineral nitrogen and constant rates of phosphorus and potassium on ammonifier counts, protease activity and some chemical characteristics of vertisol under field pea cultivation.

Material and methods

TheexperimentwascarriedoutattheFacultyofAgronomyin   a ak (2006) onvertisol (acid in reaction - pH_{KCl} 5.01, having a moderate supply of humus - 2.68% and nitrogen - 0.134%, a good supply of readily available potassium - 0.264 $mgg^{-1}$and a low supply of readily available phosphorus   - 0.029 mgg^{-1}), inarandomizedblockdesigninfourreplications. The study involvedthefollowingtreatments (factorA): unfertilizedcontrol; N_1PK (20: 75: 60 $kgha^{-1}$); N_2PK (40:75:60 $kgha^{-1}$) andN_3PK (60: 75: 60 $kgha^{-1}$). The fertilizers were applied before sowing in the form of urea (nitrogen fertilizer), superphosphate (phosphorus fertilizer) and KCl (potassium fertilizer). The experimental plot was 10 m^2 in size, with a spacing of 0.5 m between plots. Field pea cv. Junior was sown by a mechanical seed drill at a rate of 40 kg ha^{-1}. During the growing season, common crop care practices were employed, including chemical weed control and mechanical preparation of the soil between the plots. Soil samples were collected for microbiological analysis aseptically up to 25 cm depth during two periods of field pea development (factor B): period I: onset of pod formation; period II – full wax ripeness.

Microbiological analyses involved determination of ammonifier counts, by the indirect method of growth on MPA medium (Pochon and Tardieux, 1962), and protease activity (Romejko, 1969). Soil chemical analysis, across treatments, was carried out after harvest, involving determination of readily available phosphorus and potassium using the Egner Riehm AL method (P_2O_5 – spectrophotometry, K_2O – flame photometry and pH (potentiometric method).

The results obtained were subjected to a two-factor analysis of variance (fertilization, growing season). Testing of the significance of differences was performed by LSD test (Statistica SPSS 5).

Results and discussion

The analysis of variance of ammonifier counts suggests a significant effect of nitrogen fertilizers and growing season on the presence of this physiological group of microorganisms.

The results obtained show that all nitrogen application rates, excepting the lowest rate (20 kg ha^{-1}), induced a decrease in ammonifier count during the first period of the study (Table 1), with the most depressive effect being observed in the treatment with 60 kg ha^{-1}.

This effect is often associated with changes in soil physicochemical characteristics (Stark et al., 2007) or, more likely in this case, alterations in the structure of soil microbial cenosis expressed through the predominance of toxinogenic and phytopathogenic fungi, as induced by excess nitrogen remaining unused by the plant. Their predominance, along with the increase in ammonifier count, can cause a decline in the count of Gram-negative bacteria, in particular, and

other poorly competing types of soil microorganisms (Barabasz et al., 2002). The same authors underline that inadequate nitrogen fertilization can result in the production of toxic metabolites (nitrosamines, nitrosamides, etc.) which can, apart from their depressing effect on most soil microorganisms, cause teratogenic, carcinogenic and allergic effects in higher organisms (plants, animals and humans) through the food chain. A somewhat lower depressive effect of nitrogen fertilizers at the first stage of the study was observed in treatments with 40 kg ha^{-1}. During the second period of the study, the three nitrogen rates had a non-significant effect on ammonifier count. This can be attributed to the decrease in free nitrogen levels in the soil and, hence, their lower impact on this group of microorganisms in the final vegetation stages of field pea development (Žukić, 1984).

Overall, the significantly lower count of ammonifiers in the second sampling period can be due to the effect of environmental factors (low soil moisture and high temperature) and reduced root metabolism of the crop (Bolton et al., 1992).

Table 1. Average ammonifier count in the soil (10^6 g^{-1} absolutely dry soil) and protease activity (number of gelatine-like units g[-1] air-dry soil) as dependent upon the fertilizers used

		Ammonifier count	Proteolytic activity
Fertilization (A)			
Control		40,7 a	34,83 b
N$_1$PK		39,7 ab	58,75 a
N$_2$PK		35,0 b	57,50 a
N$_3$PK		21,0c	55,3 a
Periods (B)			
	I	65,3 a	44.87 b
	II	2,63 b	57,92 a
Control	I	78,0 a	41,5 de
	II	3,5 d	26,7 f
N$_1$PK	I	76,5 a	45,0 cd
	II	3,0 d	72,5 a
N$_2$PK	I	68,0 b	47,5 b
	II	2,0 d	67,5 b
N$_3$PK	I	40,0 c	45,5 c
	II	2.0 d	65,0 b
Anova			
	A	**	**
	B	**	**
	AB	**	**

Values followed by different small letters within columns are significantly different (P≥0.05) according to LSD test

As opposed to ammonifiers, soil protease activity was significantly increased by mineral fertilization (Table 1), primarily by lower nitrogen application rates (20 and 40 kg ha^{-1}) in the first and most notably in the second period of the study. The higher nitrogen rate (60 kg ha^{-1}) is not economically justified, since it did not have a significant effect on the activity of proteolytic enzymes, as compared to the lower nitrogen rates. Similar results were reported by other authors who stressed the positive effect of lower rates of mineral fertilizers on most soil hydrolytic enzymes (Sarić et al., 1986, Blecharczyk et al., 1993, Koper and Piotrowska, 2003).

In all treatments, excepting the untreated control, protease activity was higher in the second period of the study, showing an opposite tendency relative to the count of ammonifiers. This finding complies with the results of other authors who found that soil protease activity is dependent more

upon the metabolic activity of the root than upon weather factors during the plant growing season (Kandeler et al., 1999).

The test fertilizers also had an effect, although somewhat lower, on soil chemical characteristics (Table 2).

Table 2. Major chemical characteristics of vertisol as dependent upon mineral fertilizer after field pea harvest

	pH (nKCl)	P_2O_5 (mg g^{-1} soil)	K_2O (mg g^{-1} soil)
Control	4.97	0.018	0.267
N_1PK	4.88	0.019	0.293
N_2PK	5.00	0.028	0.299
N_3PK	4.94	0.025	0.268

The smallest changes were observed in soil pH. The lower values for readily available phosphorus, recorded after pea harvest in the untreated control and in the treatments with the lowest nitrogen fertilizer rate, suggest marked plant requirements for this nutrient as well as its removal from the soil by the crop. Similar results were obtained by other authors (irovi and Joci , 1992, Boškovi , 1993). Higher nitrogen rates incorporated into the soil (N_2 and N_3) can largely prevent the uptake of phosphorus by the crop, which can result in higher levels of phosphorus in these treatments as compared to the untreated control and treatment with the lowest nitrogen rate. Higher nitrogen rates had a similar effect on the level of readily available phosphorus in the soil. Since substantial changes in soil chemical characteristics can be expected only after the long-term use of mineral fertilizers (Lebedeva and Zagumennikov, 1977, Jeli , 1997), the changes observed in this study can be considered fully expected.

Conclusion

The nitrogen fertilizers used for field pea production induced a change in the count of ammonifiers and protease activity, whereas their effect on soil chemical parameters was lower.

The decline in ammonifier count was observed in the initial stage of pod formation in treatments with 40 and 60 kg ha^{-1} nitrogen, whereas their effect in the milk wax ripeness stage, in all fertilization treatments, was statistically non-significant. Overall, throughout the pea growing season, differences in ammonifier counts in the treatments with 20 kg ha^{-1} and 40 kg ha^{-1} were statistically non-significant, whereas the count in the treatment with 60 kg ha^{-1} was statistically significantly lower as compared to the two treatments and the control.

In both periods of the study, soil protease activity was particularly stimulated by lower nitrogen fertilization rates (20 and 40 kg ha^{-1} N). The non-significant effect of the highest nitrogen rate (60 kg ha^{-1}) on the activity of proteolytic enzymes as compared to the two lower rates suggests that the highest nitrogen rate is not economically justified in field pea production.

The fertilizers applied did not have a significant effect on soil pH. However, all fertilizers, particularly the higher nitrogen rates, induced a certain increase in the levels of readily available phosphorus and potassium in the soil under field pea.

Acknowledgement

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ECOLOGICAL FOOTPRINT AND BIOCAPACITY

Maja STRBAC[*]

[1]Institute of Agricultural Economics, Belgrade, Serbia
(Corresponding author: maja.strbac@EUnet.rs)

Abstract

Agricultural production is affected by how natural resource is managed. Governments using ecological footprint are able to assess the ecological value of assets. Ecological biocapacity (EB) includes five sub-categories: cropland, grazing, forest, fishing and built land. Ecological deficit means that the ecological footprint is larger than the country's biological capacity. The paper discusses the ecological footprint, biocapacity and share of energy from renewable sources in the following countries: Hungary, Romania, Serbia, Bosnia and Herzegovina, Croatia, Bulgaria, Austria, Greece, Italy and Macedonia (FYR). It is obvious that Hungary has the highest value, while Macedonia has the lowest ecological footprint. Austria has the largest share of energy from renewable sources, while Bulgaria has the lowest share in relation to the other analyzed countries. The author emphasizes the importance of measuring investment in natural resources and their impact on agriculture. Farming practices and greening of technologies in agriculture include, for example, enhancing soil fertility, improving the efficiency of water use, reducing the use of chemical pesticides and herbicides. Sustainable management of natural resources is very important for the "green" development in agriculture and energy production. This is one of the ways to provide resources and security for future generations.

Keywords: *ecological footprint, biocapacity, green agriculture*

Introduction

There is no area of man's social and individual life in which globalization has such local implications as it has in the sphere of environment conservation. The ever-growing ecological problems, have become universal global problems, and the ecological crisis has turned into global crisis. Sociologists have been warning that the modern society has found itself in confrontation with fundamental life principles (*Nikoli &Galjak*, 2009). In today's world, where humanity is already exceeding planetary limits, ecological assets are becoming more critical. Each country has its own ecological risk profile. Many are running ecological deficits, with footprints larger than their own biological capacity. Others depend heavily on resources from elsewhere, which are under increasing pressure (*Footprintnetwork*, 2012). Natural capital accounting can provide detailed statistics for better management of the economy. For example, land and water accounts can help countries interested in increasing hydro-power capacity to assess the value of competing land uses and the optimal way to meet this goal. Ecosystem accounts can help biodiversity-rich countries design a management strategy that balances tradeoffs among ecotourism, agriculture, subsistence livelihoods, and ecosystem services like flood protection and groundwater recharge (*Rizni et al.,* 2010). Business companies in earlier times were focused on achieving growth in the volume of production as a base for increase in profits. Increase of the physical volume of production in response to the growing needs of consumers and society, caused a disturbance of the environment by increasing pollution of the environment, but also increased awareness of environmental

protection (*Premovi et al.,* 2011). Sustainable management of natural capital underlies green growth in key sectors, such as agriculture, manufacturing and energy is vital for resilience and welfare gains (*The World Bank*, 2012). Serbia should follow the practice of developed European countries and their know-how in the field, which is of invaluable importance (*Rizni et al.,* 2010).

Materials and methods

The paper discusses the ecological footprint and biocapacity, share of energy from renewable sources/patents - renewable energy, based on data from Global Innovation Index and the OECD in the following countries: Hungary, Romania, Serbia, Bosnia and Herzegovina, Croatia, Bulgaria, Austria, Greece, Italy and Macedonia (FYR). The Ecological Footprint is a resource accounting tool that helps countries understand their ecological balance sheet and gives them the data necessary to manage their resources and secure their future (*Footprintnetwork*, 2012). The simplest way to define ecological footprint would be to call it the impact of human activities measured in terms of the area of biologically productive land and water required to produce the goods consumed and to assimilate the wastes generated. More simply, it is the amount of the environment necessary to produce the goods and services necessary to support a particular lifestyle (*WWF*, 2012). Biocapacity is shorthand for biological capacity, which is the ability of an ecosystem to produce useful biological materials and to absorb carbon dioxide emissions (*Footprintnetwork*, 2012). In many parts of the world, agriculture is damaging its natural resource base. In low-input farming, characteristic of the poorer parts of the developing world, the main concerns are soil depletion, water scarcity and habitat loss due to over-cropping, over-grazing and deforestation. In many developed countries, high-input farming practices and farming on environmentally fragile lands are responsible for soil and water depletion; nutrient pollution of groundwater, internal waterways and estuaries; reduced agricultural and natural biodiversity; and landscape degradation (*OECD*, 2008). The paper emphasizes the importance of indicators for measuring progress towards green agriculture. Research results are presented in graphs and table.

Results and discussion

The bridge between ecology and economy is sustainable growth and development whose essence is growth that meets the current needs while using rationally natural resources to ensure meeting the needs of future generations. Ecological management is a new concept for solving environmental problems which include organizational structure, processes, procedures, resources for the implementation of environmental policy and accountability in the region (*Premovi et al.,* 2011). We can see the difference in ecological footprint and biocapacity in the analyzed countries (Figure 1).
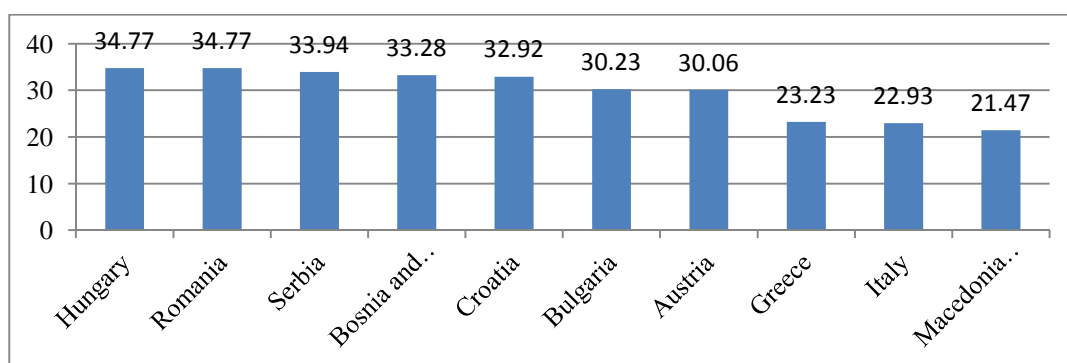
Figure 1: Ecological footprint and biocapacity

Source: Author based on Global Innovation Index, 2012.

In some areas of the world, the implications of ecological deficits can be devastating, leading to resource loss, ecosystem collapse, debt, poverty, famine and war (*Footprintnetwork*, 2012). By adopting the National Strategy for Sustainable Development in 2008 the Republic of Serbia has accepted that sustainable development becomes its permanent development orientation and of course one of the prerequisites for entry into the family of modern European states (*Nadi*, 2011). Urged on by WWF, countries in Eastern Europe made major commitments toward protecting the Danube-Carpathian region. Progress this year included a declaration by Austria, Croatia, Hungary, Serbia and Slovenia to create the world's first five-country protected area around the Danube, Drava and Mura rivers, and a seven-country sustainable forestry protocol that will protect old-growth forests (*WWF*, 2012). Necessity of regulated and environmentally friendly behavior of economies becomes clear at times of enormous population growth and economic development depleting natural resources and planet's biodiversity. Biodiversity, *i.e.* variety of species and diverseness of ecosystems, is the main prerequisite of planet's survival (*Rizni et al.,* 2010). Patents are important in the implementation of new solutions and it is evident that Greece had the highest values as compared to the other analyzed countries (Figure 2).
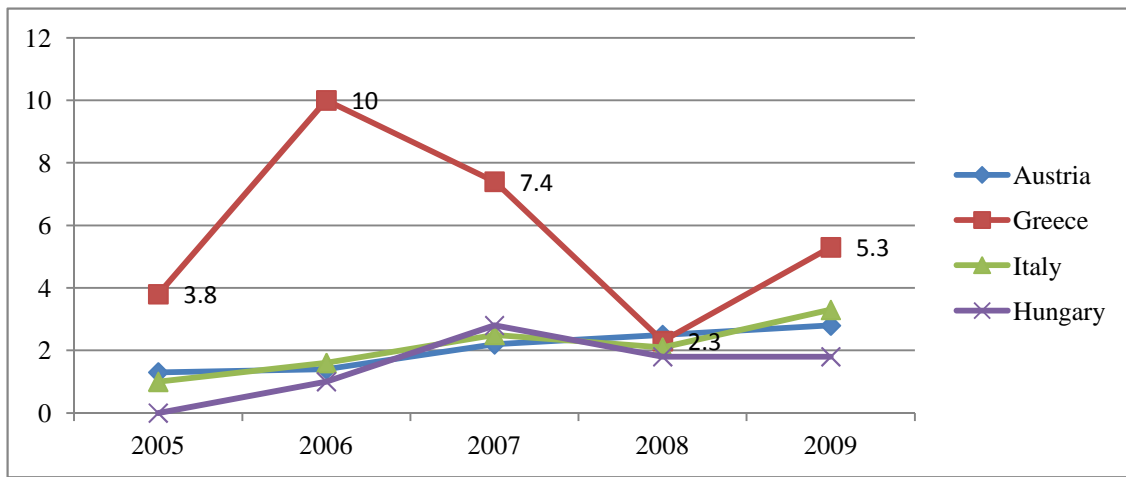
Figure 2: Patents - Renewable energy, %

Source: Author based on OECD databases, 2012.

Renewable sources include: hydro, geothermal, solar, wind, tide, renewable combustibles, and waste. Although the idea of sustainable development should be approached from a critical standpoint, there is no doubt that by its political ignorance in the politics of the Serbian government it loses the necessary and costly time needed to strengthen the process of environmental protection and modernization of the society in Serbia (*Nadi*, 2011). The difference between the highest and lowest share of energy from renewable sources in the analyzed countries is 13.99 % (Figure 3).
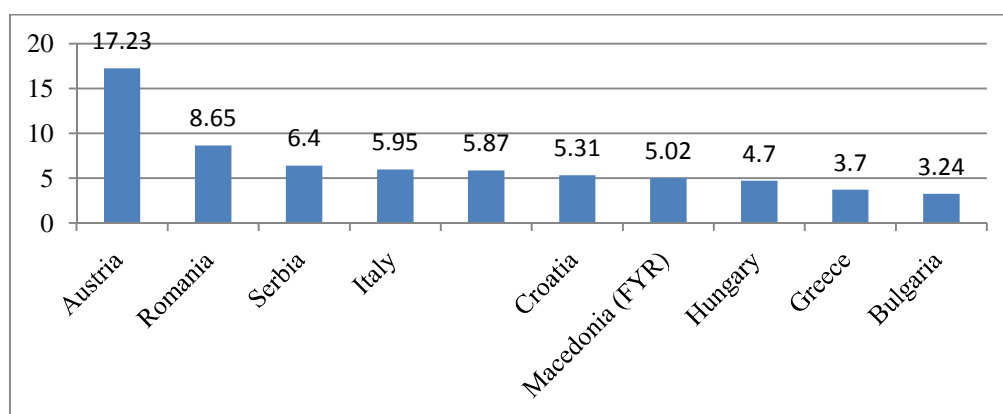
Figure 3: Share of energy from renewable sources (%)

Source: Author based on Global Innovation Index, 2012.

Companies that want to work successfully must respect the presumption of sustainable development and environmental standards in planning their business activities and defining the goals (*Premovi et al.,* 2011). Environment is the surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. Environmental objective is overall environmental goal, consistent with the environmental policy, that an organization sets itself to achieve. Environmental Performance Evaluation (EPE) ensures that any business can continually monitor and improve environmental performance (*Štrbac Maja,* 2008). Ecosystems accounting not only provides a tool to maximize economic growth but is also a means to measure who benefits and bears the cost of ecosystem changes, helping governments gauge whether their growth is inclusive (*The World Bank*, 2012). National governments using the Footprint concept are able to: assess the value of their country's ecological assets; monitor and manage their assets; identify the risks associated with ecological deficits; set policy that is informed by ecological reality and makes safeguarding resources a top priority; measure progress toward their goals (*Footprintnetwork*, 2012).

Table 1: Potential indicators for measuring progress towards green agriculture

Action indicators	Outcome indicators
Number of enacted and implemented policy measures and officially approved plans that promote sustainable agriculture (including trade and export policy measures, payment for ecosystem services through agriculture, etc.).	Percentage and amount of land under different forms of green agriculture (organic, GAP-good agriculture practices, conservation, etc.).
Level of governmental support to encourage farmers to invest in conversion to green agriculture and get the farm and the product certified.	Decline in use of agro-chemicals as a result of conversion to green agriculture; and the number and percentage of farmers converting to green agriculture.
Percentage of agricultural budget that is earmarked for environmental objectives.	Increasing proportion of Payments for Environmental Services as a percentage of total farm income.
Proportion of available producer support utilised for environmental objectives as a percentage of total agricultural producer support.	Number of agriculture extension officers trained in green agriculture practices.
Approved measures that reduce or eliminate barriers to trade in technologies and services needed for a transition to a green agriculture.	Number of enterprises set up in rural areas, especially those that produce local natural agricultural inputs, to offer off-farm employment opportunities.

Source: UNEP, 2011.

Important contributions to the economy of natural capital like forests, wetlands, and agricultural land are not fully captured in national accounts or may be hidden. Forestry is an example-timber resources counted in national accounts, but forest carbon sequestration is not included. Other services like water regulation, that benefits crop irrigation, are hidden and the value is (wrongly) attributed to agriculture in a country's GDP (*The World Bank*, 2012). Farming practices and technologies that are instrumental in greening agriculture include: restoring and enhancing soil fertility through the increased use of naturally and sustainably produced nutrient inputs; diversified crop rotations; and livestock and crop integration; reducing soil erosion and improving the efficiency of water use by applying minimum tillage and cover crop cultivation techniques; reducing chemical pesticide and herbicide use by implementing integrated and other environmental friendly biological pest and weed management practices; and reducing food spoilage and loss by expanding the use of post-harvest storage and processing facilities (*UNEP*, 2011). Ecological Footprint data show that humanity is using resources and producing CO2 emissions at a rate 44% greater than what nature can regenerate and reabsorb. This gap, known as ecological overshoot, results in the depletion of the natural capital that all species, depend on for their livelihood. It also results in the accumulation of carbon dioxide that leads to climate change, with profound implications for ecosystems and the species they support as well as for our societies well being and economic stability (*Footprintnetwork*, 2012). The greening of agriculture refers to the increasing use of farming practices and technologies that simultaneously: maintain and increase farm productivity and profitability while ensuring the provision of food and ecosystem services on a sustainable basis; reduce negative externalities and gradually lead to positive ones; and rebuild ecological resources (*i.e.* soil, water, air and biodiversity natural capital assets) by reducing pollution and using resources more efficiently (*UNEP*, 2011). Preservation of biodiversity calls for principles of ecological economy, action plans for local communities, as well as revision of national income accounting principles in order to include amortization of natural assets. Inability to predict long-term effects also calls for caution (*Rizni et al.,* 2010). The concept of sustainable development combines the dual aims of improving the present conditions for much of the world's population and providing for the needs of future generations. However, current land management efforts to address a multitude of interrelated problems, including deforestation, desertification, air and water pollution, and uncontrolled expansion of human settlements in urban and rural areas, are hindered by a piecemeal and uncoordinated approach, often with duplication of effort or conflicting sectoral goals. A more holistic and integrated approach would improve land management for agriculture and other uses (*OECD*, 2008).

Conclusion

Governments, senior officials and civil society need to promote the economic, social and environmental future development. All this is to ensure adequate management of natural resources, ecosystem conservation, sustainable patterns of consumption and production, equitable economic growth (poverty eradication), increasing the basic standard of living and more. Climate change has a negative impact (especially in developing countries), which requires urgent and ambitious actions. Agricultural production depends on the available natural resources (energy, land, water, forest). Agriculture consumes fresh water and the land. Also, agriculture uses fuels, for example, transport and pumping water for irrigation. Austria has the largest share of energy from renewable sources (17.23%), while Bulgaria has the lowest share (3.24%) of the analised countries. Countries should formulate regional development objectives to create opportunities (*e.g.*, improvement of production capacity) for all residents, reducing inequalities and fostering balanced development. All countries are

responsible for regulations respect proper use of the opportunities at regional, national and local levels, significantly affect the lives and future of people.

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CONTENT OF TOTAL AND AVAILABLE COPPER AND ZINC IN THE PSEUDOGLEY SOIL IN KRALJEVO AND KRUSEVAC BASIN

Nebojsa GUDZIC[*], Miroljub AKSIC, Aleksandar DJIKIC, Jasmina KNEZEVIC, Slavisa GUDZIC

Faculty of Agriculture, University of PristinaKosovska Mitrovica, Lesak, Serbia
(Corresponding author: nasagudzic@gmail.com)

Abstract

Notorious acidity of pseudogley, and negative properties caused by it, consequently complicate plant nutrition on this soil type. One ought to pay a special attention to potentially high concentrations of some nutritive elements' available forms. Thus, nutritive elements content higher than allowable limits disqualifies their necessity, making them harmful for crops, and putting pseudogley among soil types that do not give appropriate conditions for soil nutrition. The objective of the paper was to compare content of copper and zinc, with a maximum permissible concentrations (MPC) in the Kraljevo and Krusevac area, on the soil type pseudogley. The district in which researches have been done is a part of pseudogley area situated in the Zapadna Morava valley, at the Kraljevo region, and Krusevac region. Content of total and available copper has been determined up to 60 cm of soil depth. By these researches it has been detected that content of total Cu (20.6-24.2 mg $\cdot$ kg^{-1}) and Zn (43.6-49.2 mg $\cdot$ kg^{-1}) is bellow the maximum allowed concentrations, which excludes their toxicity for crops. Results of the study offer possibility for defining dynamics of available forms of copper and zinc in pseudogley profile.

Key words: *pseudogley, copper, zinc, total, available*

Introduction

Zapadna Morava valey, in which are situated regions of Kraljevo and Krusevac, represents important and well developed agriculture region in Serbia, in which pseudogley is significantly represented. General physico-chemical properties of the pseudogley at the region, particularily expressed acidity (Boskovic-Rakocevic and Bokan, 2005; Dugali et al., 2002) and unfavorable texture (Dugali et al., 2004) are limiting intensive crop production.

Acidity of the soil is global limiting factor of crop production (Sumner and Noble, 2003). No matter on the acidity origin (natural or anthropogenic) various specific factors and their interraction can inhibit plant growth, starting from direct harmful influence of high concentrations of H$^+$, Al^{3+} and some organic acids, to the different solubility which leads to the different availabilities of the elements. Particularly sensitive question is mobilization and acquisition of heavy metals, among which some of them, as copper and zinc is, essential in plant nutrition, and which overdoses are toxic for plants (Arsova, 1996; Mery et al., 1986).

Chemism of copper and zinc, and their behavior in soil (as well as of other metals), depends on pH and Eh, but of soil texture and it's properties, i.e. content of soil filosilicates, organic matter, hidratized oxides etc. (Adriano, 2001; Charlatchka and Cambier, 2000; Lair et al. 2007). Their natural source is parent soil material. However, today'human is becoming more influent factor on content of heavy metal changes, very often increasing their content up to the toxic level. The highest anthropogenic origin contaminations are in the vicinities of industrial centers (primary polutants), but nowadays are more and more actual secondary polutants, who

are in a long term also very very dangerous polutants. So, on the copper concentration in soils human is more and more influent, by applying numerous pesticides and fertilizers, which has taken to the increase its content, particulary in the topsoil (Facchinelli et al., 2001; Topalovi et al., 2011).

Numerous sources of zinc in the soil have anthropogenic character as well. Mobility of antghropogenic origin zinc is much higher than of natural released from the parent soil substrate (Chlopecka et al., 1996).

Material and the methods

Investigation of Cu i Zn at the pseudogley area in the Zapadna Morava river has been done in two regions: Kraljevo and Krusevac. Localities for sampling for the Kraljevo region (I) were Gra ac - Ia and Vrnjacka banja - Ib (15 and 23 km south from Kraljevo), and for Krusevac region (II) itluk - IIa and Globoder - IIb (5 and 12 km north from Kruševac). Total number of analyzed samples was 154 (48 samples for depth 0-20 cm, 48 samples for depth 20 - 40 cm and 48 samples for depth 40 - 60 cm).

Soil pH has been determined by glass electrode in soil-water slurry and suspension with 1M KCl (1:2,5). Humus has been determined by Kotzman method. Available P_2O_5 and K_2O by AL-method acording to Egner-Riehm, after extraction in 0.1M ammonium-lactate. Available K has been detected directly from the soil extract, by emission spectrophotometry, on flame photometer. Available phosphorous has been detected on spectrophotometer, after a coloring of extract with ammonium-molibdate and $SnCl_2$.

Copper and zinc have been determined by atomic absorption spectrophotometry (AAS), total content after the soil digestion with concentrated HNO_3, and available after the extraction in DTPA (Soltanpour et al., 1996).

Statistical analysis has been done by variance analysis, using PC applications, Microsoft Excel and Statistics.

Results and the discussion

Average values of the investigated basic parameters of soil fertility are given in the table 1. Results of analyzes indicates on similar chemical and physical properties, and accordingly on equalization of pseudogley soils at the area.

Table 1. Basic properties of the pseudogley

Location	Depth (cm)	pH		Humus (%)	Available (mg · 100g^{-1})		Particles < 0,02 mm
		H$_2$O	KCl		P$_2$O$_5$	K$_2$O	
Ia Gra ac	0 - 20	5.48	4.35	2.47	4.57	14.9	61.5
	20 - 40	5.33	4.18	1.17	3.97	12.6	58.9
	40 - 60	5.32	4.45	0.21	1.43	13.8	62.1
Ib V. Banja	0 - 20	5.85	4.72	2.18	7.7	15.0	62.7
	20 - 40	5.72	4.53	1.02	0.9	8.6	64.4
	40 - 60	5.28	4.80	0.39	0.7	8.2	72.3
IIa itluk	0 - 20	5.57	4,41	2.63	8.9	17.3	62.4
	20 - 40	5.64	4.57	1.84	6.2	13.8	65.6
	40 - 60	5.86	4.52	0.77	3.4	13.4	67.8
IIb Globoder	0 - 20	5.78	4.43	2.38	7.2	14.1	57.8
	20 - 40	5.51	4.51	1.53	5.3	12.8	58.4
	40 - 60	5.69	4.68	0.62	1.8	13.2	59.7

As it has been expected, very high acidity has been determined, low content of available phosphorous, medium content of humus and available potassium, as well as high content of physical clay. So unfavorable agrichemical and agriphysical properties of pseudogley, are

limitating it's suitability for succesful plant production, and are forcing obligatory applying pedo-meliorative measures, which confirm numerous cases in the region. (Boškovi - Rako evi and Bokan, 2005; Dugali et al., 2002; Jeli et, al., 2011).

Total Cu content in the investigated areas ranged from 20.6 - 24.2 mg kg^{-1}, which is significantly less than the maximum permissible concentration - MPC (Table 2). Bu this it has eliminated any doubt that high concentrations of this element could potentially be a limiting factor of crop production at the soil type pseudogley. Reviewing of the results, it can be noticed a clear difference between the copper content between the regions, but no difference between the localities within the region.In the region of Krusevac pseudogley has higher content of total Cu in comparison to the region of Kraljevo.Also, it should be noted that in all the localities, the surface layer (0 - 20 cm) is characterized by a higher content of total Cu compared to the other two analyzed depths. Approximately the same total Cu content in pseudogley has been determined near Sabac - Varna (Cakmak et all., 2010) and around Lajkovac (Pivi et all., 2011). And more precise, in these areas the value of total copper were slightly lower compared to those determined in the region of Krusevac and Kraljevo.

Table 2. Content of total and available Cu (mg kg^{-1})

Locality (B)	Depth (cm)	Total Cu (mg · kg^{-1})	Available Cu (mg · kg^{-1})			
			x (A)	SD	CV	Range
Ia Gra ac	0 - 20	22.5	4,70	0.77	16.32	3.5 - 5.7
	20 - 40	21.7	3.48	0.75	21.64	2.1 - 4.5
	40 - 60	21.2	3.08	0.37	11.98	2.5 - 3.7
Ib Vrnja ka banja	0 - 20	22.3	5.98	1.02	17.02	4.5 - 7.7
	20 - 40	21.8	4.66	0.88	18.80	3.1 - 6.1
	40 - 60	20.6	4.28	0.39	9.18	3.7 - 5.0
IIa itluk	0 - 20	23.8	8.74	1.65	18.85	6.7 - 12.2
	20 - 40	22.4	5.56	0.85	15.22	4.1 - 6.6
	40 - 60	22.6	5.40	0.54	9.93	4.5 - 6.1
IIb Globoder	0 - 20	24.2	7.02	1.25	17.86	4.9 - 8.6
	20 - 40	22.1	4.64	1.16	24.93	2.6 - 6.2
	40 - 60	21.9	4.68	0.84	17.93	3.5 - 6.4
** MPC Cu (total) 100 mg · kg^{-1}			LSD	A	B	
			0.05	0.86	0.72	
			0.01	1.17	0.98	

**MPC - maximum permissible concentration according to Guidelines on Permissible Amounts of Dangerous and Harmful Substances in Soil and Irrigation Water and Methods of testing Them

Differences between the regions and between the investigated depths are especially evident when it comes to the content of available forms of copper. There is clearly a higher content of available copper at the localities in the vicinity of Krusevac than in the region near the Kraljevo, and the noticed differences were statistically significant. In all cases, very high content appears in pseudogley, similar to other areas. Thus, in pseudogley of the headwaters Western Morava river (Boskovic-Rakocevic and Bokan, 2005; Dugali , et all., 2002), as well as pseudogley near Sabac - Varna (Cakmak et all., 2010) and Lajkovac (Pivi et all. , 2011) have been determined very high values of available Cu.

Particular attention has appeared due to the fact that at the surface layer has been determined significantly higher content of physiologically active form of copper, compared to deeper horizons. The differences were statistically significant and were characteristic at all four localities. For explaining the differences among the horizons, it should be noted that an unequal conditions are present, especially water-air regime for transition of inaccessible Cu to the easily available forms for plants vice versa. However, besides the favorable water-air conditions for the mobilization of Cu, as well as factors that have significantly contributed to its visible accumulation at surface layer such as are organic matter and texture. The organic

matter shows a high sorption affinity towards copper (Fernandez - Calvia et all., 2009), building active complexes with it, especially with humic and fulvic acids. On the other hand, copper has property of exchangable adsorption for colloidal fraction, limiting its transfer to the deeper layers. Since at all the localities, very high content of the clay total (Table 1) has been recorded, as well as organic matter, its rinsing has ben prevented. However, taking into consideration the more odten oppinions about very significant impact of human (anthropogenic factors) on the dynamics of copper in the soil, especially in its accumulation in the surface layer (Facchineli et all., 2001; Topalovi et all., 2011), we can complete the picture about the causes of larger concentrations of this element. Thus, to the natural reserves of available Cu in surface horizons potentially can be added and annual quantities added with protective means, and fertilizers enriched with microelements, including Cu as well.

Total zinc content of the treated localities of Kraljevo and Krusevac in all the cases was below the maximum permited limits (Table 3). The average values of total reserves of zinc, depending on location and depth at which it was measured, ranged from 43.6-49.2 mg $\cdot$kg^{-1}, which is about the content of the same soil type in Lajkovac (Pivi et all., 2011). Generally, for level of zinc can be concluded that it is not a danger to the crops.

Table 3. Content of total and available Zn (mg kg^{-1})

Locality	Depth (cm)	Total Zn (mg $\cdot$ kg^{-1})	Available Zn (mg $\cdot$ kg^{-1})			
			x	SD	CV	Range
Ia Gra ac	0 - 20	45.3	2.10	0.51	24.15	1.7 - 3.4
	20 - 40	47.2	1.12	0.29	25.57	0.6 - 1.7
	40 - 60	45.9	1.12	0.47	41.72	0.4 - 2.1
Ib Vrnja ka banja	0 - 20	46.8	2.66	0.74	27.89	1.4 - 3.7
	20 - 40	46.1	1.20	0.48	39.72	0.6 - 2.3
	40 - 60	43.6	1.04	0.42	40.28	0.5 - 1.9
IIa itluk	0 - 20	47.1	2.60	0.54	20.75	2.1 - 3.7
	20 - 40	49.2	1.28	0.39	30.32	0.9 - 2.1
	40 - 60	47.7	1.18	0.54	45.83	0.5 - 2.4
IIb Globoder	0 - 20	48.5	2.56	1.07	41.84	1.2 - 4.6
	20 - 40	46.8	1.20	0.56	46.70	0.6 - 2.4
	40 - 60	47.9	1.14	0.35	30.72	0.8 - 2.1
** MPC Zn (total) 300 mg $\cdot$ kg^{-1}			LSD	A	B	
			0.05	0.37	0.29	
			0.01	0.50	0.39	

**MPC - maximum permissible concentration according to Guidelines on Permissible Amounts of Dangerous and Harmful Substances in Soil and Irrigation Water and Methods of testing Them

Similar to available copper, it has been noticed it's higher concentration in the topsoil, and differences compared to the content in the subsoil were statisticaly very signifficant. Between the investigated localities there were not signifficant differences, and the detremined values are mainly similar to the other authors (Boskovi -Rakocevic i Bokan, 2005; Cakmak et al., 2010; Dugali et al., 2002; Pivi et. al., 2011).

Assumption that anthropogenic factor could be the cause of appeared difference of content of available zinc by the layers, in this case is without the ground. Distribution of zinc, by depth without clearly visible leyers in which it has been accumulated like total, as well as like available, indicate that specifficaly status of this element in the investigated soil is result of it's chemism.

Conclusion

Content of total copper and zinc in the investigated region was considerable under the maximum permissible concentrations, and these elements do not represent potential threat for the cultivated plants. The content and distribution of Cu within the depths, and its

accumulation in the surface layer are primarily result of unequal conditions for mobilization through the horizons, and partialy the result of human activities related to the application of pesticides. Types of available zinc within the depths is the result of natural resources of this element in pseudogley, and the conditions for its mobilization and immobilization.

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CONTENTS OF PB, CU AND HG IN SOIL AND IN PLANT MATERIAL ON AGRICULTURAL LAND SURROUNDING THE MOTORWAY E75 IN THE SECTION BELGRADE-PRESEVO

Radmila PIVIC[*], Aleksandra STANOJKOVIC SEBIC, Dragana JOSIC

Institute of Soil Science, Belgrade, Serbia
(Corresponding author: drradmila@pivic.com)

Abstract

The study included examination of soil and plant material for the contents of some elements along the motorway E 75 through Serbia, the section from Belgrade to Presevo, a length of 400 km. Samples of soil and aerial parts of plant material were sampled from both sides of lanes at a distance of about 8 km and at 10, 30, 50 and 400 m perpendicular to the direction of the highway. In the study area it was registered over forty varieties of soil, where twelve separate zones different plant cover was registered.

In the soil samples was determined pH in 1MKCl and content of total forms of Pb, Cu and Hg. The plant materials were analyzed for Pb, Cu and Hg.

The content of total forms of Pb above the MAC (maximum allowable concentration), was found in 5.28%, Cu in 0.25%, Hg in 0.75% of the studied samples.

In the examined plant material there were not detected toxic concentrations of Hg. Toxic Pb content above the value recorded in 3.3% of plant samples in zones in the distance from 10 m to 50 m from the road. The element Cu in the plant material is present in toxic concentrations in 1.27% samples of which two samples were from the vineyards at a distance of 50 m from the motorway, while the three samples from the zone at distance of 400 m.

By the analysis of obtained results it can be concluded that besides of anthropogenic pollutions, which is reflected in the excessive use of plant protection products and fertilizers, also the impact of air pollution from motor vehicles in certain sections of the examination, including the available literary sources, the dominant contamination of examined elements comes from geochemical composition of bedrock.

Key words: *soil, plant, highway*

Introduction

The highway is the highest traffic class of roads. It is exclusively designed for fast motor traffic, which is operating in physically separated carriageway, usually width of 27.5 meters, with at least two running and one stopping lane.

Observations presented in this paper were performed on the section of the highway E75, which is very frequent throughout the year, so the impact of emissions from motor vehicles on soil and plant is especially emphasized. Since the soil along the highway mainly belongs to agricultural area, examinations were aimed to determine whether there is and what is the level of the pollution of the soil in the examined area.

Soil as an essential natural element represents a very complex system, sensitive to different influences. It responds to small changes and this can cause a degradation of its main characteristics. Therefore, the relations arising from the different spheres of influence on soil also define the whole question of the relationship between the highway and the environment.
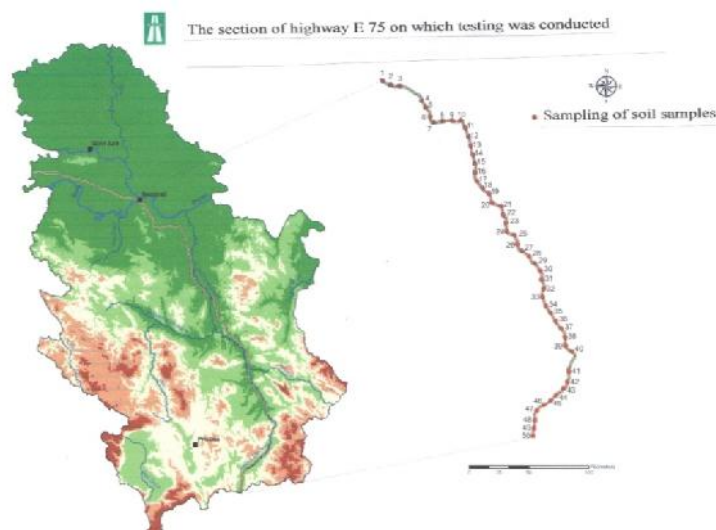
Figure 1.-The route of the highway and sampling spots

Materials and methods

The area of study included the route of the E 75 in the section from Belgrade, capital city of Serbia, to the Preševo, near the border with FYROM, (Figure 1.), a distance of about 400 km. Composite soil samples were taken from each side of the lane at a distance of 8 km and at 10, 30, 50 and 400 m perpendicular to the direction of the highway from a depth of 0 do30 cm. Sampling was conducted during August and September 2010.

Composite soils samples were carried to the laboratory, dried, and passed through a 2-mm sieve. Soil pH in water and 1M KCl was analyzed potentiometric with glass electrode (SRPS ISO 10390:2007- Determination of pH). Microelements and heavy metals were determined on ISP emission spectrometer ICAP 6300 (ICP-OES), after the soils were digested with concentrated HNO_3 for extraction of total forms (Soltanpour et al., 1996).

The concentration of trace elements Hg was determined by a flame atomic adsorption spectrophoto-meter (AAS, GBC, SENSA DUAL HG), method by hydration after the so-called "wet" combustion of samples, i.e. boiled in the mixture of concentrated acids: HNO_3 and H_2O_2, with filtration and the necessary dilution.

Reference soils NCS ZC 73005, Soil Certificate of Certified Reference Materials approved by China National Analysis Center Beijing China, and reagent blanks were used as the quality assurance and quality control (QA/QC) samples during the analysis.

Analyzed aboveground parts of the study plant species were dried at 105°C for a period of 2 hours, using gravimetric method for determination of dry matter content of plant tissue. The dry matter determination is used to correct the sample element concentration to an absolute dry matter basis (Miller R.O.1988).

The content of heavy metals (Pb, Cu) in selected plants was determined with an inductively coupled plasma optical emission spectrometer ICAP 630 (ICP-OES), after the samples were digested with concentrated HNO_3/H_2O_2 for total form extraction (Soltanpour et al., 1996).

The concentration of trace element Hg in plant materials was determined by AAS method by hydration after the "wet "combustion of plant samples, that is boiling in the mixture of concentrated acids: HNO_3 and $HClO_4$, with filtration and the necessary dilution.

Statistical analyses were performed with SPSS version 16 software. The effects of treatments are presented in Tables 1 and 2 for all the variables using Analysis of Variance (ANOVA) method.

Cartographic data processing was performed by using ArcView GIS 8.3.

Results and discussion

Based on the exanimations, (398 soil samples), the following results were obtained:

In the examined area it is represented forty types of soil, with twelve separate zones with different plant cover. Fields are dominating with 43% of examined area, abandoned production areas (neglected land) with of about 23% of areas and meadows with about 20%. The rest of the area is occupied by orchards, vineyards, gardens, vegetable gardens, forests, industrial crops and swamp surface.

Based on the results of some basic parameters of fertility, it was noted that about 40% of soil samples has limitations, such as strong acid reaction. In Table 1, statistical description of pH in 1MKCl and heavy metals in soils samples in the study areais shown.

The content of heavy metals in soil and their impact upon ecosystems can be influenced by many natural factors, such as parent material, climate, soil processes, and anthropogenic activities such as industry, agriculture, and transportation (Wei et al. 2007).

Urban roadside soils are the ''recipients'' of large amounts of heavy metals from a variety of sources including vehicle emissions, coal burning waste and other activities (Jose A. Acosta et al.2009; Mohsen S. et al. 2009). Averages of Cu and Pb are compared with other cities around the world are significantly lower (Ruiz-Cortes et al. 2005;Ljung et al. 2006; Bretzel and Calderisi 2006),meaning the anthropic activities have a low impact on the soil heavy metal concentrations in the study area. The content of total forms of copper above the MAC(maximum allowable concentration) Official Gazette of Republic of Serbia, 23/94, was found in 0.25% of the studied samples. Of these, half were located in the vineyards, so the reason for the appearance of increased concentrations of this element may be excessive use of plant protection products based on copper, which are used on these surfaces.

The content of total forms of Pb above the MAC was registered in 28.5% of the samples, except that in one sample at a distance of 10m from the highway route registered an extremely high concentration of this element of 215.45 mg kg^{-1}.

The content of total Hg above the MAC was determined in 0.75% of samples in the zone of 10-50 m, from the traffic lanes.

Table 1.- Statistical description of pH in 1MKCl and heavy metals in soils samples in the study area

	Statistical parameters	Soil pH (1MKCl)	Total Pb	Total Cu	Total Hg
			(mg·kg^{-1})		
Surface layer (0-30 cm)	Total N° of soils samples	398	398	398	398
	Min	3.60	0.00	4.64	0.00
	Max	7.50	1108.16	223.82	4.84
	Mean	6.02	74.56	25.25	0.13
	SD	0.93	81.34	19.53	0.39
	VC	0.86	1501.86	1108.16	2398.00
	Mediana	6.00	37.72	67.71	66.05
	Modus	7.30	37.67	43.85	71.05
Limits	Lower			/	
	Usual		<50	<50	>0.1
	Higher		50-100	50-100	1-2
	MAC*		100	100	2
	Extreme		>150	>200	

SD-standard deviation; VC-variation coefficient
*Official Gazette of Republic of Serbia, 23/94

Numerous studies on roadside soil pollution have focused on total emission loads of heavy metals into open grassland and agricultural areas (Donaldson and Bennett 2004; Hjortenkrans et al. 2006; Nabulo et al.2006). Generally, total heavy metal contents in roadside soils were found strongly dependent on traffic density and showed an exponential-like decrease with distance from the road, reaching background levels within tens to hundreds of meters. Recently, roadside soils have been an increasingly important sampling medium for assessing anthropogenic metal concentrations. A variety of heavy metals have been measured in roadside soils and reported by many researchers (Wang et al. 2005; Manta et al. 2002; Zhang et al. 2006; Xue-Song Wang 2008). The most frequently reported heavy metals of concern have been lead, zinc and copper. These heavy metals in roadside soils are principally derived from vehicle emissions, wear and tear on automobile parts (Xue-Song Wang and Yong Qin , 2007).It can be concluded that the addition of anthropogenic pollution (excessive use of plant protection products and fertilizers, as well as the impact of air pollution from motor vehicles originating in the valley of the Morava dominant geochemical pollution (based on the available literary sources). The geological parent materials are river sediments and loess, and the geochemical background concentrations (in topsoil) range from, 8.7 to 17.5 mg kg^{-1} for Cu, 18 to 23mg kg^{-1} for Pb (Geochemical Atlas of Europe, www.gtk.fi/publ/foregsatlas).The origin of increased contents of Pb is so closely associated only with these rocks, but the causes of pollution and should be linked to anthropogenic influence.

Along with the sampling of soil material it was sampled also and plant material (vegetative mass) on corresponding locations (394), in order to determine contents of Pb,Cu,Hg.

Plants are the intermediaries through which elements from the soil and partly from the air and water are transferred to the human body by consumption. Some of the elements are necessary for growth and development of crops and without them they cannot survive, some of them have stimulating effect on plant growth, while a group of elements at high concentrations affects very toxically on the plants.

Plant metal uptake is influenced by soil factors including pH, organic matter, and cat ion exchange capacity as well as plant species, cultivars and age. The mobility and availability of heavy metals in the soil are generally low, especially when the soil is high in pH, clay and organic matter (Jung and Thornton, 1996; Rosselli et al., 2003).

Table 2 presents average critical and toxic concentration of heavy metals in plats according to Kloke et al. 1984*, Kastori et al., 1997**.

Table 2.- Average and toxic concentration of heavy metals in plants

Element	Normal content in plants Kloke et al. *	Critical contents for plant food Kloke et al. *	Critical concentration Kastori**	Toxical concentration Kastori**
	(mg·kg^{-1})		(μg·g^{-1})	
Cu	3-15	15-20	15	20
Pb	1-5	10-20	10	20
Hg	<0.1-0.5	0.5-1	2	5

Table 3., presents the percentages of Cu, Hg and Pb in the aboveground plant material tested depending on the distance from the road and values of desirable, critical and toxic value of the tested elements.

Table 3.-Percentages of Cu,Pb i Hg in the aboveground plant material tested depending on the distance from the road

Element	Limit values	Distance 10m	Distance 30m	Distance 50m	Distance 400m	Total for 394 samples
Cu	(mg·kg⁻¹)					
<15	Desirable	96,97%	99,00%	93,00%	91,58%	95,18%
15-20	Critical	3,03%	1,00%	5,00%	5,26%	3,55%
>20	Toxic	0,00%	0,00%	2,00%	3,16%	1,27%
Pb	(mg·kg⁻¹)					
<10	Desirable	89,90%	90,00%	90,00%	93,68%	90,86%
10-20	Critical	7,07%	6,00%	6,00%	4,21%	5,84%
>20	Toxic	3,03%	4,00%	4,00%	2,11%	3,30%
Hg	(mg·kg⁻¹)					
<2	Desirable	100,00%	100,00%	100,00%	100,00%	100,00%
2-5	Critical	0,00%	0,00%	0,00%	0,00%	0,00%
>5	Toxic	0,00%	0,00%	0,00%	0,00%	0,00%

Conclusions

By the analysis of obtained results it can be concluded that besides of anthropogenic pollutions, which is reflected in the excessive use of plant protection products and fertilizers, also the impact of air pollution from motor vehicles in certain sections of the examination, including the available literary sources, the dominant contamination of examined elements comes from geochemical composition of bedrock. The content of total forms of Pb above the MAC (maximum allowable concentration), was found in 5.28%, Cu in 0.25%, Hg in 0.75% of the studied samples.

In the examined plant material there was not detected toxic concentrations of mercury. Toxic Pb content above the value recorded in 3.3% of plant samples in zones in the distance from 10 m to 50 m from the road.

The element Cu in the plant material is present in toxic concentrations in 1.27% samples of which two samples were from the vineyards at a distance of 50 m from the motorway, while the three samples from the zone at distance of 400 m.

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IMPLEMENTATION OF MAIZE GENETIC RESOURCES IN DROUGHT TOLERANCE AND GRAIN QUALITY IMPROVEMENTAT MAIZE RESEARCH INSTITUTE "ZEMUN POLJE".

VioletaANDJELKOVIC[*], Dragana IGNJATOVIC – MICIC, Snezana MLADENOVIC DRINIC, Jelena VANCETOVIC[1]

[1]Maize Research Institute „Zemun Polje", Belgrade, Serbia
(Corresponding author: avioleta@mrizp.rs)

Abstract

The world population is expected to reach eight billion by the year 2020 and food grain production will have to be doubled from the current level of about five billion tons per year. With global climatic changes drought has become the most important limiting factor for crop production worldwide. It has been estimated that approximately US $10 billion of primary food production is lost annually because of insufficient rainfall or lack of rain. The necessity to obtain global food security increased importance of plant genetic resources for agriculture. The treasure of genetic material contained in landraces, crop wild relatives and other wild species provides plant breeders with options to develop more productive crops, adapted to changing environments. Prebreeding activities include introduction, evaluation and improvement of germplasm resources for use in conventional breeding. Conservation and exploitation of maize accessions are the most important tasks. Maize Research Institute genebank with more than 6000 accessions is among the ten largest collections in the world. Testing these accessions under controlled drought stress and in temperate climate resulted in core collection formation. The chosen accessions were further tested for grain quality (protein, oil and starch content), as well as for the presence of *opaque2* mutation and tryptophan content which are the basis for developing quality protein maize. Selected genotypes could be used for creation of new hybrids with higher yielding potential, quality and adaptability.

Key words: *drought, food quality, genebank, prebreeding, Zea mays.*

Introduction

Plant diversity, kept in genebanks worldwide, provides valuable sources needed for future challenges, such as climatic changing, occurrence of new diseases or increased food demands (Araus et al., 2008). Considering that global food security depends on few major crops (rice, wheat and maize) conservation of their diversity is one of the main tasks in agriculture nowadays. Although a huge number of maize accessions are stored within gene banks worldwide there is still a lack of diversity in the conventional breeding programs (FAOSTAT, 2010). Usually the size of germplasm collections limits their utilization in plant breeding research. Identification of genotypes with favorable traits is very hard, expensive and long term process and breeders are rather focused on their already adapted working collections (Marshall, 1989).

Maize is the third most important crop for mankind and very likely that by 2025 it will become the crop with the greatest production globally (Rosegrant et al., 2008), due to growing demand for dairy and meat products in developing countries, as well as, for animal feed and industrial raw material in developed countries. Maize grain is complete in macro (starch, oil and proteins) and micronutrients (carotenoids, tocopherols, minerals, phytic acid,

anthocyanins etc.) compared to other cereals. However, chemical composition, biological and nutritional value of maize grain is depending on both, genetic and environmental factors. Characterization of genetic diversity of maize landraces aids more efficiently exploring the allelic variation for genetic improvement of economically desirable traits as grain quality traits.In this context, the landraces represents a good source of genetic variability to explore and may help to identify the most suitable materials for the development of more nutritious foods.

The single most important abiotic factor limiting maize production is drought. At the same time, increasing human population requires increase in food production. Therefore, there is a great need for maize genotypes that yield better and more stable in both optimal and drought environments. However, selection of genotypes with tolerance to drought in the field and stable yield is very difficult to obtain due to fluctuation of agroecological and climatic conditions (Frova et al., 1999).

In Serbia, maize is the most important crop, grown at more than one million hectares annually. Drought occurs in two to three years out of five, resulting in large annual yield fluctuations. Optimal rainfalls for maize growth range from 500 to 700mm, but in Serbia the precipitation sum during the growing season varied from 278.9mm in 2011 to 458.1mm in 2010. Breeding maize hybrids which have drought tolerance is one of the possible approaches to solving this problem. However, a longer period of breeding hybrids and lower efficiency for incorporation of polygenic traits, such as drought, is making this task very difficult.

A project on identification of new sources of drought tolerance among more than 6 000 genebank accessions at Maize Research Institute "Zemun Polje" has been initiated in 2007. Creation of core collection for drought tolerance was the aim of the project and the results of further testing of grain quality within chosen genotypes are presented in this paper.

Material and methods

All accessions from Maize Research Institute gene bank collection (about 6000) were screened under controlled water stress in Egypt, at Sids Agricultural Research Station (150 km south of Cairo). A total of 672 accessions (10.5%) were selected on the basis of ASI, bareness, seed set and grain filing for further experiments (Brown, 1989). Chosen genotypes were tested during the following season in Egypt, as well as, in two locations in temperate zones (Zemun Polje and Macedonia); 41 (13 landraces, 13 introduced populations and 15 inbred lines) genotypes were selected on the basis of previously observed traits, as well as, for ear, cob and kernel weight (Babi et al., 2011). The seeds of 41 accessions were multiplied and grain quality (protein, starch and oil content) was analysed by Near Infrared Spectroscopy (Infratec 1241 Grain Analyser, Foss Tecator, Sweden).

The 13 landraces were also surveyed for the possible presence of *opaque2* mutation through kernel modification assessment, content of the essential amino-acid tryptophan, quality index of the protein and SSR analysis. Kernel modification was visually assessed using light table, according to the scoring scale from 1 (completely translucent, with no opaqueness) to 5 (completely opaque). Modification score 2 is given to the kernel which is 25% opaque, while scores 3 and 4 are given to 50% and 75% opaque kernels, respectively.

For biochemical analyses each genotype was presented with 30 randomly chosen kernels. Tryptophan content was determined using the colorimetric method of Nurit et al (2009), while the protein content was determined by the standard Kjedahl method based on nitrogen determination as explained in Vivek et al. (2008). The protein was estimated from the nitrogen value as % protein = % nitrogen x 6.25 (conversion factor for maize). Quality index (QI), defined as tryptophan to protein ratio in the sample was calculated as QI = 100*tryptophan content in the sample / protein content in the sample.

SSR analysis was done with the phi057 primer specific for the *opaque2* gene. The amplification reaction was carried out in 20μl reaction volume containing 1x enzyme buffer, 3mM MgCl2, 200μM dNTPs, 0.25μM primers, 1.25U *Taq* polymerase and 50ng of DNA. The amplification profiles followed were: an initial denaturation at 94^0C/2min, followed by 40 cycles each of denaturation at 94^0C/1min, annealing at 60^0C/2min and extension at 72^0C/2min, with final extension at 72^0C/10min. Amplified fragments were first separated on 4% agarose gels in TBE buffer. After electrophoresis gels were stained with ethidium bromide and photographed.

Results and discussion

Pre-breeding is the best link between genetic resources and breeding programmes and encompasses the identification of desirable traits and/or genes from the non-adapted, as well as, from the adapted material, that will be under certain selection pressure (Nass and Paterniani, 2000). A result is formation of new populations for breeding purposes. The aim of pre-breeding activities is the establishment of core collections that represent genetic diversity with the minimum repetitiveness. The core usually encompasses approximately 10% of the collection what makes almost 70% of its genetic variability (Brown, 1989).

Assigning of maize genotypes into heterotic groups has been the key to the economic success of the crop because it allows the exploitation of heterosis, particularly for grain yield (Reif et al., 2005). Heterotic groups are crucial for the utilisation of germplasm for developing hybrids with better performances (Eberhart et al., 1995). Beside drought tolerance, the information about combining ability and classification into heterotic groups was necessary for further utilization of the core collection (Table 1). Based on good general combining ability, 41 genotypes were further selected and among them, six accessions produced superior crosses with three lines representing different heterotic groups (Andjelkovic and Ignjatovic-Micic, 2012).

Table 1. Combining ability and the genetic relatedness with observed heterotic sources

Origin	Number of accessions	Good combining ability
BSSS	1	Lancaster, independent
Lancaster	10	BSSS, independent
Lancaster, BSSS	7	independent
unknown	**6**	**BSSS, Lancaster, independent**
independent	6	BSSS, Lancaster
independent, BSSS	2	Lancaster
independent, Lancaster	9	BSSS
inapplicable	10	None

Maize landraces, due to their high genetic variability, are an important source for breeding programmes aimed at improving nutritional and health traits of maize grains (Uarrota et al., 2011). Unfortunately, studies on the chemical composition of maize accession are still scarce in literature. Typical kernel composition values for the yellow dent maize on a dry matter basis are 71,7% starch, 9,5% protein, 4,3% oil, 1,4% ash, and 2,6% sugar (Watson, 2003). The results in this experiment differ from these values, but there was no significant difference between the three groups (Table 2). The average values of starch content were somewhat lower and oil values in the range compared to the commodity yellow dent maize. However,

protein content was higher in all the genotypes analyzed, meaning that these genotypes could be a good source of proteins in quality breeding programs.

Table 2. Macronutrient composition of the analyzed accessions

Macronutrient Content (%)	Inbred lines (mean)	Introduced populations (mean)	Landraces (mean)
Oil	4,25	4,66	4,30
Protein	12,98	12,18	11,86
Starch	68,30	69,26	68,71

The presence of *opaque2* specific allele was found in 11 genotypes (Illustration 1). In one genotype it was absent (genotype 7) and in another (genotype 6) the allele pattern was unspecific. Genotype six will be further analyzed on individual samples and other specific *opaque2* primers.
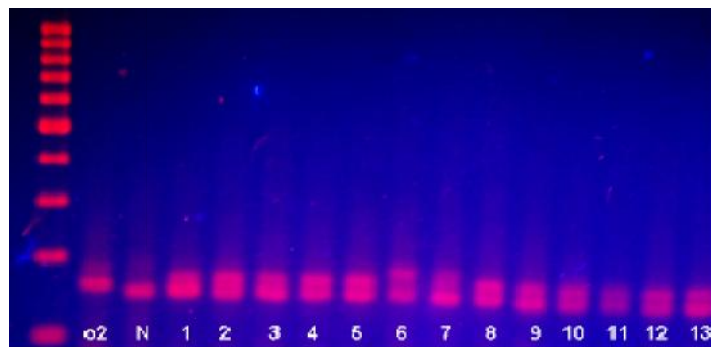
Illustration 1. Electrophoregram of SSR analysis with phi057 (maize landraces). o2 –positive control for *opaque2* allele, N – negative control for *opaque2* allele, 1 to 13 – analyzed landraces.

The results of kernel modifications, tryptophan content and QI are given in Table 3. All the values were compared with threshold limits for quality protein maize given in Vivek et al. (2008). High tryptophan content (over 0.075) was found in nine genotypes. Genotype 7 which lacked the *opaque2* allele had low tryptophan content (0.065). QI was generally low and its improvement could be the main task in using these genotypes as a source of high quality protein. Three genotypes were singled out (genotypes 2, 5 and 9) as potentially outstanding sources of protein quality. They were with good kernel modifications and high tryptophan content, indicating the presence of good modifier genes necessary for developing quality protein genotypes with good agronomic performances (Krivanek et al., 2007).

Table 3. Kernel modifications, tryptophan content, protein content and quality index (QI) of the analyzed landraces

	Accession	Kernel modifications (%)		Tryptophan content	Protein content	QI
		Good (type 1 and 2)	Bad (type 3, 4 and 5)	(%)	(%)	
1	87	92	8	0.072	13.55	0.53
2	**169**	**92**	**8**	**0.077**	**13.52**	**0.57**
3	244	76	24	0.079	13.57	0.58
4	632	70	30	0.081	11.79	0.69
5	**1513**	**86**	**14**	**0.080**	**12.51**	**0.64**
6	1720	84	16	0.073	12.20	0.60
7	1855	95	5	0.065	14.20	0.46
8	2005	74	26	0.086	13.33	0.65
9	**2013**	**92**	**8**	**0.081**	**11.66**	**0.69**
10	2217	74	26	0.081	12.86	0.63

11	2236	84	16	0.072	11.16	0.65
12	1961	76	24	0.082	11.90	0.69
13	2033	78	22	0.081	12.11	0.67

Conclusion

The chosen accessions could broaden the genetic base of the present breeding material and most probably new elite inbred lines with increased drought tolerance and/or protein quality could be developed. The core collection may represent the base for new generations of maize ZP hybrids of higher yielding potential, grain quality and adaptability.

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EFFECT OF SOIL CONDITIONER ON YIELD AND QUALITY OF ORGANIC SOYBEAN

VeraPOPOVIC[1*], Vladimir SIKORA[1], Đorđe GLAMOCLIJA[2],Janko CERVENSKI[1], Mirjana VASIC[1], Jelica GVOZDANOVIC VARGA[1], Livija MAKSIMOVIC[1]

[1]Institute of Field and Vegetable Crops, Novi Sad; Serbia
[2]University of Belgrade, Faculty of Agriculture, Zemun - Belgrade, Serbia
(Corresponding author: vera.popovic@ifvcns.ns.ac.rs)

Abstract

We studied the effect of a soil conditioner on the yield and quality components of organic soybean. The study object was the cultivar Galina, maturity group 0. Experiments in four replications were performed in a field of Institute of Field and Vegetable Crops in Backi Petrovac using organic farming methods. The experiments included two variants: an untreated variant (control) and a fertilized variant (applying Fertdolomit, a commercial soil conditioner). The following soybean characteristics were analyzed: grain yield (kg/ha), protein and oil contents (%), yields of total proteins and oil (kg/ha), and their correlations. Extremely high yields of soybean were achieved. The average soybean yield was 5732 kg/ha. The yield in the treated variant was higher by 256 kg/ha or 4.57% than that in the control. The control and the treated variant showed no statistically significant differences in the protein and oil contents. The yields of protein and oil were higher in the treated variant than in the control by 4.67% and 5.85%, respectively.

The correlation analysis showed that the variables were mutually dependable. Highly significant positive correlations were found between grain yield and oil content, grain yield and protein yield and between grain yield and oil yield. Negative and nonsignificant correlations were found between grain yield and protein content and between oil content and protein content in soybean grains. Soil conditioning showed to be a feasible method of improving grain yield and protein and oil yields of organic soybean.

Key words:*Glycine max, organic farming, yield, content and yield of protein and oil, top dressing*

Introduction

Soybean (*Glycine max* (L.) Merrill) is the most important legume crop. Its importance is primarily due to the chemical composition of grain (Miladinovic et all. 2008, Popovic, 2010). It is a major source of vegetable proteins. Soybean grain contains about 40% of proteins which include all essential amino acids - lysine, tryptophan, methionine, etc. It also contains 20 - 25% of oil which has a favorable fatty acid composition and large amounts of minerals and vitamins A, B1, B2, C, D, E and K. Soybean is capable of fixing nitrogen, it fits well into crop rotations and it is a good preceding crop. Best proceeding crops for soybean are wheat, corn and sugar beet (Malesevic et all, 2008). Soy is suitable for growing in organic production.

Organic farming facilitates the conservation of soil and water, protection of plant, animal and human health, biodiversity and agrobiodiversity. The Regulations on the Methods of Organic Crop Production stipulate: "Fertilization in organic production is carried out in accordance with soil fertility status and type of organic production employed. Use of fertilizers of organic origin and natural mineral fertilizers is allowed in organic production, in order to maintain and

improve soil fertility"(Babovic et al., 2005). Popovic et al. (2012) reported that the application of top dressing brought significant yields of grain, and increased protein and oil contents in soybean grain.

Organic farming places emphasis on the control, quality and safety of the produce, along with the application of ecological principles. Control over the production of organic soybeans is required for customers to obtain high quality produce. High yields and grain quality (Popovi et al., 2012) prove that soybeans can be successfully grown in organic production if proper zoning and proper production technology are applied. Organic farming maintains and improves soil fertility in the long run. Soil fertility is maintained by a production system - crop rotation harmonized with proper soil cultivation, fertilization based on soil fertility level (organic and other permitted fertilizers), and other cultural practices (Bavec F, M Bavec, 2006). To be successful, organic farming must be established on a soil well-provided with organic matter and possessing good structure and water-air properties. Soil tillage is a central point of organic production. Crop rotation and field rotation are important in the development of integrated systems. The following weed control measures are important in the production of organic soybean: proper treatment of crop residues and by-products of primary agricultural production, crop rotation, intercropping, companion cropping, exploitation of allelopathic relations, etc. Crops that contain natural chemical toxins or possess allelopathic properties should be used in the control of weeds, diseases and pests (Malesevic et al., 2008). An important mechanism of weed control in organic production is the competitiveness of organic varieties, i.e., their capacity to suppress weeds (Berenji and Sikora, 2009).

Soybean is sensitive to moisture shortage, especially in the stages of pod forming and grain filling. Irrigation improves growing conditions in dry periods, providing optimal conditions for the growth and development of soybean plants and resulting in high yields of quality grain (Bosnjak, 2008).

The aim of this study was to determine the impact of top dressing on the yields of grain, contents and quality of protein and oil in organic soybean.

Material and Method

The experiment was carried out in the plot Veliki Bodonj, of Institute of Field and Vegetable Crops in Backi Petrovac, in 2011. The experiment with an NS soybean cultivar, maturity group 0, was in the third year of conversion,using organic farming methods, and it was established according to the split plot method with four replications. The experimental unit size was 10 m^2, with the row spacing of 50 cm. The preceding crop was corn. The soybean cultivar Galina was grown in the stand of 500,000 plants/ha. The soil type in the experimental plot was chernozem.

Table 1. Chemical soil properties, Backi Petrovac, 2011.

Depth	Humus %	pH in KCl	pH in H_2O	$CaCO_3$ %	Total N	P_2O_5 mg/100g	K_2O mg/100 g
0-30	2.65	6.85	7.48	3.26	0.204	15.40	21.40
30-60	2.10	7.28	8.41	12.62	0.163	6.70	13.60

Ther chemical analysis of the soil showed that the soil layer of 0-30 cm was slightly alkaline, poorly supplied with humus, medium calcareous, and well supplied with nitrogen, available phosphorus and available potassium. The soil layer of 30-60 cm was moderately alkaline, poorly supplied with humus, very calcareous, medium provided with N and K_2O and low in P_2O_5 (Table 1). Soybean sowing was performed on April 30. Seed inoculation with Nitragin, a

microbiological preparation, was done immediately before sowing. The experiment included two variants:
1 Control variant, without soil conditioner + Nitragin
2 Fertilization variant, with soil conditioner + Nitragin

In this study we compared the impact of top dressing on soybean traits in the treated variant against the untreated control. We examined Fertdolomit, a soil conditioner, which was applied in the concentration of 40 kg/ha at the vegetative stage (V1). season Conventional cultural practices for soybean were applied during the growing. Irrigation was applied three times during the growing season (June 4, June 21 and September 16) with 30 liters of water per m^2. Harvest was done by hand. After harvest, samples were measured for moisture content. The yield was calculated per unit area, on 14% moisture basis. Protein and oil contents were determined with Perten DA 7000 spectrophotometer using a non-destructive method.
The analysis of the experimental data was performed by descriptive and analytical statistics using the statistical package STATISTICA 10for Windows. The analysis of variance with one variability factor (top dressing) was presented as the linear model (Maletic, 2005):
$Y_{ij} = \sim + r_i + v_{ij}$,   i=1,2,...,k;   j=1,2,...,n.
Significance of results was estimated by the LSD test for significance levels of 5% and 1%. Relative dependence was determined by the correlation analysis and the obtained coefficients were tested by the t-test for significance levels of 5% and 1%. The results were presented in tables and graphic forms.
Meteorological conditions: During the 2011 growing season, the mean monthly temperature was 19.53°C, 1.65°C higher than long-term average for Backi Petrovac. The rainfall (417.5 mm) was at the level of the long-term average (Graph 1).
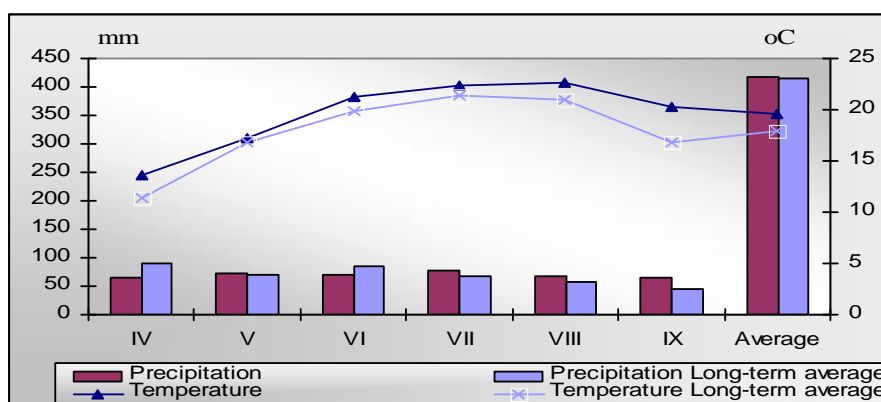
Graph 1. Average temperature (^{o}C) and precipitation sum (mm), Backi Petrovac, 2011

Since we cannot predict the environmental conditions suitable for seed production in a region, it is important to monitor the variation of environmental factors and their effects on physiological processes that determine seed quality (Malesevic et al 2010, Popovic, 2010, 2012).

Results and discussion

The main objectives of soybean production are to achieve high and stable yields, through maximum utilization of the genetic yield potentials, and a high quality of grain.

Table 2. Yield of organic soybean (kg/ha),2011

Variety	Variant	Yield (kg/ha)	Average yield (kg/ha)
Galina	Control	5.604	5.732
	Fertdolomit	5.860	

Indicator	LSD test	Variant
Yield	0.05%	365.956
	0.01%	554.392

The results showed that the top dressed variant had a higher grain yield than the control (5860 kg/ha and 5604 kg/ha, respectively), however, the difference was not statistically significant (p > 0.05). The average yields in the top dressed variant were higher by 256 kg/ha or 4.57% compared with the control (Table 2). Top dressing proved to be a feasible method for increasing the grain yield of soybean.

Our results were in agreement with those of Senevirante et al. (2000) who reported that seed inoculation and fertilizer application increased grain yield of soybean.

Soybean grain quality is considerably reduced if there occurs a water deficit during pod formation. Yield reduction is caused by the abortiveness of young pods. If plants are grown in the presence of excess water, the yield is reduced too. In such conditions, the percentage of seed oil increases and the protein content decreases (Norman, 1978).

The obtained results indicated that top dressing did not affect the average protein content in soybean grain. The percentages of proteins were the same in the two variants, while the yield of proteins was higher in the top dressed variant by 99 kg/ha or 4.67% as compared with the control (Table 3).

Table 3. Protein content and protein yield in soybean grain, 2011

Variety	Variant	Protein content (%)	Protein yield (kg/ha)
Galina	Control	37.88	2.122
	Fertdolomit	37.89	2.221

Indikator	LSD test	Variant
Protein content	0.05 %	0.8959
	0.01 %	1.3573
Protein yield	0.05 %	138.926
	0.01 %	210.461

The average oil content was higher in the variants with top dressing by 1%, while the yield of oil was higher by 71 kg/ha or 5.85% compared with the control (Table 4).

Table 4. Oil content and oil yield in soybean grain, 2011

Variety	Variant	Oil content (%)	Oil yield (kg/ha)
Galina	Control	21.74	1215
	Fertdolomit	21.95	1286

Indicator	LSD test	Variant
Oil content	0.05 %	0.6610
	0.01 %	1.0014
Oil yield	0.05 %	114.1992
	0.01 %	173.0021

Studies have shown that the application of fertilizers in an early growth stage (V1) has positive effects on soybean growth and development. Soybean plants need a certain amount of

nitrogen during the early stages of growth and establishment of vegetative organs, up to the formation of nodules and the establishment of symbiotic association (Senevirante et al, 2000).

Mutual relationships among the traits

Correlations are important indicators in soybean breeding programs. As soybean is primarily grown for protein and oil contents, the chemical composition in grain is important in breeding programs.

The correlation analysis showed that the variables mutually affected each other. Some effects were statistically significant. There were highly significant positive correlations between grain yield and oil content (r = 0.92 **) and grain yield on one side and protein and oil yields on the other (r = 0.95 **, r = 0.99 **, respectively). Highly significant positive correlations were found between oil content on one side and protein and oil yields on the other (r = 0.87**, r = 0.96**, respectively) and between protein yield and oil yield (r = 0.95**). Negative nonsignificant correlations were found between grain yield and protein content (r = -0.17) and protein content on one side and oil content and yield on the other (r = -0.16) (Table 5).

Table 5. Coefficients of correlation (r) between the tested traits

Trait	Yield	Protein content	Oil content	Protein yield	Oil yield
Yield	-	-0.17[ns]	0.92**	0.95**	0.99**
Protein content	-	-	-0.16[ns]	0.14[ns]	-0.16[ns]
Oil content	-	-	-	0.87**	0,96**
Protein yield	-	-	-	-	0.95**

[ns] -nonsignificant; ** - significant at 0.01 level

Highly significant positive correlations between grain yield and oil content and negative correlations between protein and oil contents were reported by Chung et al. (2003) and Popovic et al. (2012b).

Conclusion

Preliminary results showed that the top dressing of organic soybean had positive effects on the studied parameters, the yields of grain, protein and oil. Top dressing proved to be a feasible method for improving the yield and chemical composition of grain of organic soybean. Organic farming integrates different approaches and methods which contribute to healthy living, working and preserving the natural environment, biodiversity and the ability to sell in the market of organic food.

Highly significant positive correlations were found between grain yield on one side and oil content, protein yield and oil yield on the other (r = 0.92**, r = 0.95**, r = 0.99**, respectively), between oil content on one side and protein yield and oil yield on the other (r = 0.87** and r = 0.96**, respectively), and between protein yield and oil yield (r = 0.95**). Nonsignificant negative correlations were found between protein yield and protein content (r = -0.17), and between oil content and protein content (r = -0.16) in soybean grain.

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SOIL EROSION OF RUJEVAC SMALL BASIN (WEST SERBIA)

Gordana SEKULARAC[1*], Milena DJURIC[1], Dragica STOJILJKOVIC[2], Vesna MILIC[3], Mirko KULINA[3], Tanja JAKISIC[3]

[1]Faculty of Agronomy, University of Kragujevac, Cacak, Serbia
[2]Department of Water Management, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
[3]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: gordasek@tfc.kg.ac.rs)

Abstract

Various factors of erosion, natural and anthropogenic, and general conditions of the area of Rujevac torrential flow contribute to the understanding of the intensity of basin soil erosion. Midterm amount of erosion sediments is W_{year} 233.57 m^3/year, and the specific amount of the total annual erosion sediments that reaches the mouth of the Rujevac in Kamenica ($G_{yr/sp}$), is 60.36 m^3/km^2/year.

Key words: *erosion, soil, small basin, sediment production*

Introduction

Soil is the basis of agricultural production, and thus for the survival of the human race. Formation of soil is a continuing process, but at the same time, there are processes of soil degradation. Process of soil regeneration is very slow. The effects of different factors of erosion change the soil and geological substrate. Changes in soil can be slow or fast, as a result erosion characteristics are slow or fast. In Serbia more than 90% of the total soil area is affected by erosion of various types and intensity (Djorovi and Kadovi, 1997). In the Republic of Serbia, it is registered that each year from an area of 21,000 ha layer of soil depth of 16.0 cm has been removed. (Spalevi, 1997). In the Republic of Serbia (Central Serbia) there is 1.221 million ha of eroded soil and 36,000 ha is steady now (Statisti ki godišnjak, 2008).

In the region of a ak trends of increase in temperature and decrease in rainfall are evident (Šekularac, 2002). That climatic changes cause deterioration of the physical characteristics of the soil, increasing its erodibility, reducing the role of protective vegetation, and aggravated its natural and artificial regeneration. All this affects intensification of the process of erosion, both surface and deep forms. Negative impact of the erosion endangers agriculture, forestry and water management, thus there is an increasing need for erosion protection and soil reclamation.

Quantitative amount of erosion and regarding how much sediment it causes, is shown on the part of the river basin Kamenica (part of the West Morava river basin), its sub-basin, the area of which is its left tributary of the first order, Rujevac.

Materials and methods

Using the method of reconnaissance of the ground, the elements of the configuration of the basin were monitored and shown. This basic method is complemented by the use of topographic, geologic and soil maps of certain scales, allowing for defining the nature and impact of natural erosion agents in the studied basin. Using the method of rainfall

interpolation by rain-gradient (Bonacci, 1984) and calculation of air temperature for any altitude (Duki , 1984), meteorological parameters were calculated for the basin. Quantitative indicators of soil erosion were calculated using the analytical Gavrilovi 's method (1972).

Results and discussion

The basic elements of the basin, which are important for the occurrence of soil erosion, are size, length, volume and its shape. The characteristics of the Rujevac basin: area (F) is 0.89 km^2, length (L) 1.12 km, circumference (C) 4.15 km. Rujevac basin has elongated shape with underdeveloped network of tributaries, which causes that there are no conditions causing the rainfalls to get concentrated, and therefore there is no erosion. The presented basic elements of Rujevac basin and the special features of its relief, the geological substrate, the distribution of soil, and the soil use have contributed that the process of erosion of the basin has specific quantitative indicators. The main parameters of the Rujevac basin relief, agents which have the primary responsibility for the occurrence of erosion, are shown in the Table 1.

Table 1. The basis of the Rujevac basin relief parameters

The name of the basin: Rujevac	
The lowest point of the main watercourse and basin (B), m	410
The highest point of the main watercourse (C), m	518
The highest point of the basin (E), m	580
Average basin main watercourse bed slope (I_a), %	6.3
Mean basin altitude (M_{sl}), m	505.73
Mean basin altitudial difference (D), m	95.73
Mean basin slope (I_m), %	19.0
Coefficient of basin relief erosion energy (E_r), m/km$^{1/2}$	55.55

The greater parameters of the relief influence the greater occurrence of soil erosion.

The mean sea level (M_{sl}) of Rujevac basin is 505.73 m (Table 1), which is calculated by the method of the separation of contour lines every 100 m in height.

Mean basin altitudial difference (D) of Rujevac basin is 95.73 m, a result of the difference of the mean basin altitude and altitude of estuary (Table 1).

For the definition of mean basin slope (I_m=19.0%), it is assumed that the vertical distance between contour lines (h) is 100 m (Table 1). The condition of the relief of an area is indicated by the coefficient of basin relief erosion energy (E_r), m/km$^{1/2}$, (55.55 m/km$^{1/2}$), Table 1.

The following agents of erosion, geologic substrates, with their characteristics and diversity contributed to the emergence of the process of erosion in Rujevac basin (Table 2).

Table 2. The Rujevac basin geological supstrates, coefficijent of their water permeability (S_1) and their erosion resistance.

The name of the basin: Rujevac		
F_{ppr}-Poorly permeable rocks		
Diabase	km^2	0.54
	%	61.20
Lake sediments of tertiary clay and loam	km^2	0.35
	%	38.80
Coefficient of geological substrate water permeability (S_1)	1.00	
Resistance of geological substrate to erosion	Nonresistant	

The geological substrates of Rujevac basin are: diabase (0.54 km^2, i.e. 61.20%), lake sediments of tertiary clay and loam (0.35 km^2, i.e. 38.80%), characterized by properties that are poorly permeable rocks, which contributes to the nonresistance soil erosion process. Coefficient of geological substrate water permeability (S_1=1.00), indicates nonresistance of Rujevac basin (Table 2). The soil and their properties as an agent of erosion, to a lesser or greater extent, contributed to this process. In the area of Rujevac basin, effects of pedogenetic factors are present as well as following soils: eroded vertisol and skeletoidal brown soil on the diabase.

Eroded vertisol is profile type A_h–A_hC–C. Eroded vertisol belongs to the deep soil, in Rujevac basin low level of process erosion is expressed. Group of shallow soil of Rujevac basin belongs to brown skeletoidal soil on diabase, with the profile type of Ah-C. In this soil of the studied basin a strong degree process of erosion was represented (Šekularac, 2000). The elements of climate which contribute to the occurrence of the process of soil erosion are rainfall, air temperature and soil temperature. The average annual rainfall (R) in Rujevac basin is 752.3 mm, and the mean annual air temperature (t) is 9.2^0 C, which indicates thet these two elements of climate play an important role on soil erosion in study area. Representation of the another factor of the process erosion, vegetation, both domestic as well as those of anthropogenic origin, and vegetation cover coefficient (S_2), are shown in Table 3.

Table 3. Plant cadastre and vegetative cover coefficient (S_2) of the Rujevac basin

The name of the basin: Rujevac			
F_f	Forests and coppice of good spacing	km^2	0.36
		%	40.45
F_g	Orchards	km^2	0.17
		%	19.10
	Meadows	km^2	0.14
		%	15.73
	Pastures and devastated forests and coppices	km^2	0.04
		%	4.49
$\sum f_g$		km^2	0.35
		%	39.32
F_b	rable land	km^2	0.18
		%	20.23
	Infertile soil	km^2	0.00
		%	0.00
$\sum f_b$		km^2	0.18
		%	20.23
Vegetation cover coefficient (S_2)			0.76

The total area under forests and coppice of good spacing ($\sum F_f$) in the basin Rujevac is 0.36 km^2 (40.45%), the amount of grasses vegetation ($\sum F_g$) is 0.35 km^2 (39.32%), and the barren land ($\sum f_b$) is 0.18 km^2 (20.23%), so the study area is protected from the effects of erosion (coefficient of vegetative cover, $S_2 = 0.76$), Table 3.

In which scope the potential of Rujevac watercourse presents great destructive power and a factor of erosion, can be indicated by elements of hydrographic and hydrological characteristics of the study area. Characteristics of family of torrential flow of the Rujevac basin are: F_b: E; IV; Z=0,23 which means that Rujevac torrential flow is IV class with destructive erosion coefficient (Z) of 0.23 (weak intensity of erosion processes, surface type). Due to all these characteristic of Rujevac basin a certain amount of sediment is produced and certain intensity of erosion is manifested. Size of process erosion of the Rujevac basin is

shown by mean annual erosion sediment (W_{year}=233.57 m^3/year). Measured midterm total volume of sediment (G_{year}), which reachs the mouth of Rujevac is 53.72 m^3/year, and the total specific annual erosion sediment that reaches the mouth of the Kamenica ($G_{yr/sp}$), is 60.36 m^3/km^2/year. These data indicate that from the Rujevac basin areas disappear per year 0.12 ha of soil by the effect of erosion, the depth of 0.2 m, and 0.02 mm soil disappears from the basin area per year. In addition to acceptance of the mean bulk density of 1.5 g/cm^3 per year 0.18 t/ha is lost.

Conclusion

Rujevac torrential flow has its own specific features: IV class destructiveness, coefficient of erosion (Z) 0.23, which indicates the strength of weak erosion of surface type. The above, and other factors of erosion of the basin has contributed that annual erosion sediment was 233.57 m^3/year, while the intensity of erosion was 60.36 m^3/km^2/year.

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EFFECTS OF BOTANICAL INSECTICIDES ON THE EGG PARASITOID *TRICHOGRAMMA CACOECIAE* MARCHAL (HYM. TRICHOGRAMMATIDAE).

Hayder ABDELGADER[1][*], S. HASSAN[2]

[1]Agricultural Research Corportaion, Crop Protection Reserach Center, Entomology Section, Sudan
[2] Institute for Biological Control, JKI, Heinrichstr. Darmstadt, Germany
(Corresponding author: abdelgaderh@yahoo.com)

Abstract

Laboratory studies were carried to investigate the side effects on *Trichogramma cacoeciae* of two formulated products of each of two botanical insecticides: Azadirachtine (Neemazal T/S Blank and Celaflor®) and Quassin (alcoholic or water extracts). The results showed that by exposing adults *T. cacoeciae* to residues of Neemazal formulations on glass plates, the tested preparations were either harmful (Neemazal-Blank) or moderately harmful (Celaflor). The two Quassin formulations tested were harmless. When treated host eggs were offered to adults *T. cacoeciae,* all tested chemicals were almost harmless. In a further test, host eggs parasitized at different time intervals (1-8 days), were sprayed at the same day. The results indicated that only Neemazal T/S-Blank formulation was slightly to moderately harmful reducing adult emergence.

Keywords: Side effects, Trichogramma, Botanical insecticides, Neemazal, Quassin.

Introduction

Parasitoids of the genus *Trichogramma* occure naturaly worldwide and play an important role as natural enemies of lepidopterous pests on a wide range of agricultural crops. During the past two decades *Trichogramma* wasps have been used as biological control agents for pest suppression. Results of augmentative releases of *Trichogramma* can be affected by the use of broad-spectrum insecticides in or near release plots (Stinners *et al.* 1974, Ables *et al.* 1979, King *et al.* 1984). The search for selective insecticides to be used with Trichogramma releases is of great importance. The recent laboratory studies were carried out to investigate the side effects on *Trichogramma cacoeciae* of two formulated products of each of two botanical insecticides: Azadirachtine (Neemazal T/S Blank and Celaflor®) and Quassin (alcoholic or water extracts) to study there possible use with Trichogramma releases, since these insecticides are coming from plant origing they are belived also to have the advantage of having the lease impact on the environment..

Materials and methods

Test InsecticidesTwo formulations of the botanical active ingredient, azadrichtine (Neemazal T/s Blank and Celaflor) as well as two extracts of Quassin (Alcohlic and Water extracts) were included in the tests. The field recommended concentrations were prepared for the tests.
a. Susceptible life stage (adults of parasites):
1- Exposing adults of Trichogramma to sprayed glass plates:

The initial toxicity was tested by exposing the adult parasites to a fresh dry pesticide film applied on glass plates at the highest recommended field rate. The method described by Hassan et al. (2000) was followed. The exposure cage consisted of two square glass plates and an aluminium frame (13 cm long, 1.5 cm high and 1 cm wide). Each of three sides of the frame contained 6 ventilation holes (1 cm diameter), covered with black tight material. Two portable opening on the fourth side of the frame were used to introduce the Trichogramma, host eggs and food. The cage was held together with two clamps. The glass plates were sprayed with the pesticide at the recommended field rates. The experiment started with a 24 h period of forced exposure. At the end of the 24 h exposure, the parasites were given host eggs to measure their capacity of parasitism. Eggs of the Angoumois grain moth *Sitotroga cerealella* (Oliv.) were offered on the 2, 3 and 5 day of the experiment. The capacity of parasitism per Trichogramma-adult female and the reduction in capacity compared with the control (treated with water) was used to measure the effect of the chemical. The pesticides were then classified in four categories based on the IOBC classification (Hassan et al. 2000).

2-Exposing adults of Trichogramma to sprayed host eggs:
 In another experiment adult Trichogramma were offered sprayed host eggs for parasitsations. The treated host eggs were either offered directly after drying of the spray or the eggs were hold at 15 °C and offered to adults after 6 days. In these experiments, the adults were anthesised for short period (ca. 45 seconds) with Co_2 and put onto treated host eggs. The start population was then determined through direct counts. The parasitism rate per female was calculated and the reduction in parasitism relative to the control was then determined. The tested insecticides were classified accordingly.

b-Less susceptible life stage (parasites within their hosts):
The method described by Hassan and Abdelgader (2001) was followed. Accordingly seven day old *T. cacoeciae* pupae within *Sitotroga*-eggs were directly sprayed with the same insecticides and concentrations used during the adults tests. The study included spraying of parasitised host eggs at different interval after parasitisation ranging from 1 – 8 days. The percentage of adult emergence and the reduction in emergence relative to the control were then determind and the pesticides were categorized accordingly.

Results and discussion:

Effects on adults
Results of tested Botanicals on adults are presented in Table (1). The results showed that by exposing adults *T. cacoeciae* to residues of Neemazal formulations on glass plates (standard test method, Hassan et al. 2000), the preparations were either harmful (Neemazal-Blank) or moderately harmful (Celaflor). The two Quassin formulations tested were harmless. In another set of experiments, where treated host eggs were offered to adults *T. cacoeciae,* all tested chemicals were almost harmless.
By exposing adults to treated host eggs both Quassin formulations were harmless. Celaflor was slightly toxic for adults, both when freshly or 6-day old sprayed host eggs were offered to adults of T. cacoeciae. Neemazal-Blank formulation was only slightly toxic when 6 day old sprayed host eggs were offered to the adults.

Table 1. Effects of exposing adult Trichogramma cacoeciae to treated glass plates on rate of parasitism (Initial Laboratory adults Test).

Trteatment	Reps	eggs/female	**	SE	% RC	Class
Control	4	18.87	abc	4.8		
Quassin-Alcohol	4	21.22	bc	4.8	-12.5	1
Quassin-Water	4	21.59	c	4.8	-14.4	1
Neemazal-Blank	4	0.00	a	4.8	100	4
Celaflor	4	0.96	ab	4.8	94.89	3

** = Figures followed by the same letter are not significantly different (Multiple Range Test , 5%)
SE = Standard Error
% RC = Percentage Reduction relative to the control
Class = IOBC classification

Table (2). Effects of exposing adult *Trichogramma cacoeciae* to treated eggs on rate of parasitism.

Treatment	Reps	Fresh Residues					6 day old Residues				
		eggs/ female	**	SE	% R	Class	eggs/ female	**	SE	% R	Class
Control	4	28.84	bc	2.0			36	b	3.1		
Quassin-Alcohol	4	23.11	ab	2.0	19.88	1	31.63	ab	3.1	12.15	1
Quassin-Water	4	33	c	2.0	-14.4	1	33.9	b	3.1	5.83	1
Neemazal-Blank	4	24.01	ab	2.0	16.75	1	23.98	a	3.1	33.4	2
Celaflor	4	20.33	a	2.0	29.5	1-2	23.15	a	3.1	35.69	2

** = Figures followed by the same letter are not significantly different (Multiple Range Test , 5%)
SE = Standard Error
% RC = Percentage Reduction relative to the control
Class = IOBC classification

Effects on immature stages

Results of spraying parasitized host eggs at different time intervals (1-8 days) are presented in Table 3 and 4.

Spraying parasitised host eggs one day after parasitism resulted in a significantly lower number of black eggs (i.e. lower pupation), when host eggs were sprayed one day after parasitism with Azadirachtine formulation. The reduction in pupation caused by Neemazal T/S formulation was more pronounced. All tested insecticides significantly reduced pupation, when host eggs where sprayed two days after parasitism, indicating that Trichogramma was very sensitive during this stage. This might have coincided with the hatching of the vulnerable neonate larvae of Trichogramma from laid eggs. The pupation rate was not reduced as a result of treatment, when host eggs were sprayed on the third and subsequent days after parasitism (Table 3 a). This trend can also be seen clearly when the percentage reduction relative to the control and the categorisation according to the IOBC classification was determined (Table 3b).

In regard to the percentage developing adults from larvae reaching pupation, Neemazal formulation consistently resulted in significantly lower percentage of developing females. The other azadrichtine formulation (Celaflor) resulted in significantly lower percentage of emerging adults, when the eggs were sprayed one day after parasitism (Table 4 a). However, based of the IOBC classification Neemazal T/S was slightly toxic for immature stages, when parasitised host eggs where sprayed after the third day or afterwards (Table 4b)

Table 3a. Developing Black eggs after treating parasitsed eggs at various days after parasitism

Treatment	Count	1 day			2 days			3 days			5 days			7 days			8 days		
		Mean	**	SE	Mean	**	SE	Mean	**	SE	Mean	**	SE	Mean	*	SE	Mean	**	SE
Control	6	427.33	c	17.45	329.00	a	20.85	388.3	ab	19.3	465.17	ab	26.04	440.17	b	19.45	355.50	ab	20.79
Quassin-Alcohol	6	400.83	c	17.45	189.83	b	20.85	441.7	bc	19.3	464.17	a	26.04	420.67	b	19.45	388.50	bc	20.79
Quassin-Water	6	401.67	c	17.45	247.83	b	20.85	448.8	c	19.3	506.33	b	26.04	412.00	b	19.45	421.33	c	20.79
Neemazal-Blank	6	219.00	a	17.45	219.83	b	20.85	357.5	a	19.3	437.50	a	26.04	340.33	a	19.45	325.33	a	20.79
Celaflor	6	334.33	b	17.45	197.00	b	20.85	466.5	c	19.3	430.17	a	26.04	420.00	b	19.45	323.17	a	20.79

** = Figures followed by the same letter are not significantly different (Multiple Range Test , 5%)

SE = Standard Error

Table 3b. Developing Black eggs after treating parasitsed eggs at various days after parasitism (IOBC – Classification)

Treatment	Reps	1 day		2 days		3 days		5 days		7 days		8 days	
		% RC	Class	% RC	Class	% RC	Class	% RC	Class	% RC	Class	% RC	Class
Control	6												
Quassin-Alcohol	6	6.20	1	42.30	2	-13.73	1	0.21	1	4.43	1	-9.28	1
Quassin-Water	6	6.01	1	24.67	1	-15.58	1	-8.85	1	6.40	1	-18.52	1
Neemazal-Blank	6	48.75	2	33.18	2	7.94	1	5.95	1	22.68	1	8.49	1
Celaflor	6	21.76	1	40.12	2	-20.13	1	7.52	1	4.58	1	9.10	1

% RC = Percentage Reduction relative to the control

Class = IOBC classification

Table 4 a. Percentage of developing adults after treating parasitsed eggs at various days after parasitism

Treatment	Count	1 day			2 days			3 days			5 days			7 days			8 days		
		Mean	**	SE	Mean	* *	SE	Mean	**	SE	Mean	**	SE	Mean	**	SE	Mean	**	SE
Control	6	89.05	b	2.46	91.81	b	3.27	97.14	c	3.54	95.67	bc	3.07	97.97	b	2.89	91.25	b	3.50
Quassin-Alcohol	6	86.38	b	2.46	95.13	b	3.27	91.03	bc	3.54	93.61	bc	3.07	97.52	b	2.89	90.42	b	3.50
Quassin-Water	6	91.02	b	2.46	91.78	b	3.27	96.12	c	3.54	98.22	c	3.07	94.20	b	2.89	87.58	b	3.50
Neemazal-Blank	6	77.78	a	2.46	66.57	a	3.27	52.55	a	3.54	50.51	a	3.07	57.33	a	2.89	56.60	a	3.50
Celaflor	6	75.10	a	2.46	92.96	b	3.27	80.73	b	3.54	89.28	b	3.07	91.64	b	2.89	92.70	b	3.50

** = Figures followed by the same letter are not significantly different (Multiple Range Test , 5%)

SE = Standard Error

Table 4 b. Percentage of developing adults after treating parasitsed eggs at various days after parasitism

Treatment	Reps	1 day		2 days		3 days		5 days		7 days		8 days	
		% RC	Class	% RC	Class	% RC	Class	% RC	Class	% RC	Class	% RC	Class
Control	6												
Quassin-Alcohol	6	3.00	1	-3.61	1	6.29	1	2.15	1	0.46	1	0.92	1
Quassin-Water	6	-2.20	1	0.04	1	1.05	1	-2.66	1	3.85	1	4.03	1
Neemazal-Blank	6	12.66	1	27.50	1	45.91	2	47.21	2	41.48	2	37.97	2
Celaflor	6	15.67	1	-1.25	1	16.90	1	6.68	1	6.46	1	-1.59	1

% RC = Percentage Reduction relative to the control

Class = IOBC classification

Conclusion

The results showed, in general, that both Azadirachtine and Quassin were relatively safe to the tested parasitoid and could therefore be used in combination with *Trichogramma* releases.

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IV

ANIMAL PRODUCTION

TRUE REPRODUCTIVE AND RELATED DISORDERS IN DAIRY FARMS OF DIFFERENT BIOSECURITY LEVEL

Branislav STANKOVIC[1*], Slavca HRISTOV[1], Zvonko ZLATANOVIC[2], Mirjana TODOROVIC-JOKSIMOVIC[1], Vesna DAVIDOVIC[1]

[1]University of Belgrade, Faculty of Agriculture, Serbia
[2]College of agriculture and food technology, Prokuplje, Serbia;
(Corresponding author:baxton@agrif.bg.ac.rs)

Abstract

Incidence of the most significant true reproductive and related disorders in six dairy farms with total of 766 cows (farm 1 – 107; farm 2 –175; farm 3 – 49; farm 4 – 400; farm 5 –20 and farm 6 – 11 milking cows) with different system of rearing and different biosecurity level were analysed in this paper. Reproductive efficiency in dairy cows is a key factor for milk producers, and numerous studies have identified impaired reproductive performance as a major cause of reduced production efficiency in the dairy industry.

Biosecurity level and information regarding reproductive disorders were collected by questionnaire (Hristov and Stankovi , 2009), and analysed and compared by method of multidimensional criteria of total discriminating effect.

Two of farms (farms 1 and 2) were assessed as very good with marks 4.00 and 4.10, two of them (farms 3 and 4) as good with marks 3.19 and 3.48, and another two (farms 5 and 6) as insufficient with marks 1.91 and 1.97, respectively. According total discriminating effect in respect to the biosecurity level lowest ranked farm (farm 6), farms 1, 2, 3, 4, 5 and 6 were ranked as 2nd, 1st, 3rd, 4th, 5th and 6th, respectively, but in respect to reproductive disorders occurrence rate lowest ranked farm (farm 4), farms 1, 2, 3, 4, 5 and 6 were ranked as 1st, 4th, 2nd, 6th, 5th and 3rd, respectively.

Partial discrepancy between estimated biosecurity level and reproductive parameters of the farms derives from the fact that reproduction data were collected for entire year, while achieved biosecurity level, although resulting from the prior efforts and work done, describes obtained level of biosecurity in on particular moment of time and do not cover all potential causes of reproductive disorders. Assessed biosecurity level provides important information about herd health, and therefore potential reproduction problems.

Keywords:biosecurity, dairy, disorder, farm, reproduction

Introduction

Reproductive efficiency in dairy cows is a key factor for milk producers, and numerous studies have identified impaired reproductive performance as a major cause of reduced production efficiency in the dairy industry.

Proper animal health care considers not only the veterinary and zootechnical, but also the microbiological and epidemiological aspects, managerial and economic relevance, and furthermore product and production process quality assurance related features. As an ultimate outcome of such approach, veterinary herd health and production management programmes may be designed, as well as biosecurity plans, and/or quality risk control programmes (Lievaart *et al*., 2005; Noordhuizen and Jorritsma, 2005).

Pre-harvest food safety is the complex of measures that needs to be taken at farm level (farm supply and on-farm procedures) that aim at preventing and/or minimizing the amount of food-borne health risks to humans carried into the food chain via animals and animal products (Blaha, 2005).

According to Anon. (2009), reproductive disorders reflect prolonged or short-term poor welfare, such as lack of oestrus, embryonic loss or early abortion due to stress experienced for longer or shorter time periods around parturition and in early lactation, or related to the poor welfare directly, particularly dystocia and genital infections associated with pain or inflammatory reactions. Good hygiene is essential at calving to reduce risk of genital infections.

The fertility of dairy cows is multi-factorial, and many factors influence the reproductive performance. Such factors include management regime (Bielfeldt et al., 2006), environment (Windig et al., 2005), genetics (Roxstrom, 2001), nutrition (Butler, 2000), and biological and health status (Fourichon et al., 2000). The heat detection rate or heat detection efficiency (HDE) is crucial when wanting to impregnate cows. If few cows in heat are detected, few cows will subsequently be inseminated and few cows will become pregnant. Herds with good HDE can achieve better results according to many reproductive performance indicators (Mayne et al., 2002).

Similar to the situation with mastitis, reports of the relationships between health status, expressed through condition scoring (CS) and calving-related problems are equivocal. Markusfeld et al. (1997) reported that poor body condition is associated with a risk of retained placenta and uterine infection after calving while Berry et al. (2007) could find no relationship between body condition and dystocia or still births. Cows in low body condition have poorer reproductive performance even when data was adjusted to account for differences in yield (Pryce et al., 2001). Failure to get in calf, especially where the farming system has a high level of reliance on seasonal pasture growth, is a major cause of culling in New Zealand dairy systems (Xu and Burton, 2000) hence survival characteristics and longevity are negative correlated to CS. However, the full extent to which this attribute of longevity is a valid indicator of welfare, particularly where shortened life is based upon a management decision to cull, is subject for debate. Moderate body condition at calving for mature cows and some over it for first and second calvers is advised because cows calving at less than moderate will produce less milk and are more likely to have reproductive problems (Macdonald and Roche, 2004).

Material and method

Incidence of the most significant reproductive disorders in six dairy farms with total of 766 cows (farm 1 – 107; farm 2 –175; farm 3 – 49; farm 4 – 400; farm 5 –20 and farm 6 – 11 milking cows) with different system of rearing and different biosecurity level were analysed.

Biosecurity level and information regarding reproductive disorders were collected by questionnaire (Hristov and Stankovi , 2009). Biosecurity indicators related to isolation of the farm (position and isolation level, introduction of newly acquired animals into the herd, traffic control, attitude towards visitors, feeding and watering control, manure management, attitude towards other animals, rodents and birds' control, sanitation) were considered and evaluated. In order to evaluate relevant biosecurity indicators, grades were defined: 5 - excellent, 4 – very good, 3 - good, 2 - sufficient, 1 - insufficient, there are resources for improvement 0 - insufficient, with no resources for improvement, and rating scale: 0-1,99 as insufficient, 2,00-2,49 sufficient, 2,5-3,49 good, 3,5 – 4,49 very good and 4,5 – 5,00 excellent, were defined. SWOT analysis (Strength, Weakness, Opportunity and Treat) was performed afterwards, completing data of possibilities of dairy farms isolation as biosecurity aspect of production.

The obtained data were analysed and compared by method of multidimensional criteria of total discriminating effect.

Results and discussion

In table 1 is presented biosecurity level assessment of six dairy farms. Two of farms (farms 1 and 2) were assessed as very good with marks 4.00 and 4.10, two of them (farms 3 and 4) as good with marks 3.19 and 3.48, and another two (farms 5 and 6) were assessed as insufficient with marks 1.91 and 1.97, respectively.

Although heard health status was the best assessed indicator of biosecurity level of the farms, from good (farm 6 – 3.40) to excellent (farm 1), many other indicators revealed weaknesses threatening reproduction success on these farms, such as biosecurity organisation on thefarm (1.30 and 133 respectively both farms 5 and 6), attitude towards equipment (1.33 for both farms 5 and 6), traffic control (1.10 and 1.33 for the same farms) and visitors policy (1.44, 1.83 and 1.42 respectively for farms 4, 5 and 6).

Table 1. Dairy farms biosecurity level assessment

	farm 1	farm 2	farm 3	farm 4	farm 5	farm 6
System of rearing	loose	loose	loose	loose	loose	tied
1. Biosecurity organisation on thefarm	4.67	4.33	4.00	3.22	1.30	1.33
2. Isolation	5.00	4.40	3.25	3.60	1.83	2.20
3. Quarantine	5.00	5.00	5.00	4.71	2.14	1.33
4. Herd health status	4.80	4.70	4.20	3.60	3.90	3.40
5. Attitude towards equipment	5.00	3.67	3.33	5.00	1.33	1.33
6. Traffic control	4.10	3.40	2.40	2.1	1.10	1.33
7. Visitors policy	2.29	2.71	2.43	1.44	1.83	1.42
8. Feeding and watering	4.71	5.00	3.33	4.14	3.57	2.43
9. Manure management	5.00	5.00	3.50	5.00	3.33	3.33
10. Dead animals disposal	5.00	2.67	2.00	2.50	2.33	2.00
11. Attitude toother animals on the farm	3.67	3.00	2.33	3.33	1.67	1.33
12. Pest control	3.17	5.00	3.25	3.33	2.33	2.67
13. Sanitation	4.53	4.38	2.40	3.28	1.77	1.53
*Average grade**	*4.00*	*4.10*	*3.19*	*3.48*	*1.91*	*1.97*
total discriminating effect	*22.421*	*22.451*	*17.338*	*16.583*	*16.164*	*5.680*
rank	*II*	*I*	*III*	*IV*	*V*	*VI*

* $F=29.909**$, $S_d=0.3522$

The farms were ranked by method of multidimensional criteria of total discriminating effect as sum of the discriminating effects in respect to the biosecurity level lowest ranked farm (farm 6), farms 1, 2, 3, 4, 5 and 6 were ranked as 2nd, 1st, 3rd, 4th, 5th and 6th, respectively. The first ranked (farm 1 and 2) are those with highest value of total discriminating effect (22.451 and 22.421, respectively), and the last was farm 5 with total discriminating effect of 5.680, reviling extreme heterogeneity of obtained results.

According obtained data, biosecurity status of the farm could partly indicate reproductive status of the farm, due to indicators related to cows health and other issues that could be closely related to the reproduction on the farm, such as isolation of the farm in respect of pathogen introduction, quarantine of the newly acquired animals, attitude towards working equipment, traffic control and visitors policy, and of course, efficacy of sanitation protocols on the farm. These indicators revealed obvious vulnerability of reproduction success, threatening dairy production on the farm.

Occurrences of reproductive disorders are presented in table 2. According total discriminating effect in respect to the reproductive disorders occurrence rate lowest ranked farm (farm 4), farms 1, 2, 3, 4, 5 and 6 were ranked as 1st, 4th, 2nd, 6th, 5th and 3rd, respectively. Rather high

rates of certain reproductive disorders were noticed on farm 5, especially placenta retention, metritis and finally mastitis (17.39, 13.70 and 13.04, respectively), which was moderate high on farm 6 (8.33).

Partial discrepancy between estimated biosecurity level and reproductive parameters of the farms derives from the fact that reproduction data were collected for entire year, while reached biosecurity level, although resulting from the previous efforts and work done, describes obtained level of biosecurity in on particular moment of time and do not cover all potential causes of reproductive disorders.

Table 2. Reproductive indicators

Observation (in the last 12 months)	farm 1	farm 2	farm 3	farm 4	farm 5	farm 6
System of rearing	Loose	loose	loose	loose	loose	tied
				n		
Total herd size	280	400	102	750	23	12
Milking sows	107	175	49	400	20	11
				%		
Calves lost	0.5	2	2	5	3	2
Cows lost	0	0.25	0.98	2	8.70	0
Mastitis	2.89	4.25	1.96	4	13.04	8.33
Puerperal paresis	1.76	1.75	0	0	8.70	0
Retention of placenta	3.57	4.25	0	2	17.39	0
Metritis	0	4.25	0	6.93	13.70	0
Heath detection and insemination	100	90	85	95	90	80
Conception rate	50	50	70	50	30	30
Dystokia	0.71	2.25	0	1.33	0	0
total discriminating effect	22.4513	16.58309	22.42150	16.16071	5.68021	17.38789
rank	I	IV	II	VI	V	III

Disease risk identification and disease risk management as primary preventive issues are pivotal in modern animal health care on both the small and larger dairy farms. Biosecurity and quality risk management can both be integrated into current operational veterinary herd health and production management programs (Noordhuizen and Da Silva, 2009), particularly in monitoring and protocols of reproduction, such as insemination, calving and postpartal regimes on farms.

Proper animal health care takes into consideration not only the veterinary and zootechnical issues, but also the microbiological and epidemiological disease aspects, managerial and economic relevance, and furthermore product and production process quality assurance related features. As an ultimate outcome of such exercises, veterinary herd health and production management programmes may be designed, as well as biosecurity plans, and/or quality risk control programmes (Noordhuizen, 2003; Lievaart *et al.*, 2005).

Herd managing staff that perform inseminations themselves instead of using specialized technicians risk reduced herd reproductive performance. Some researchers (Morton, 2000; O'Farrell and Crilly, 2001; McCoy *et al.*, 2006) have proposed that unqualified inseminators contribute to poorer reproductive performance (Buckley *et al.*, 2003). Poorer performance could be caused by worse insemination technique, possibly due to lack of training.

Free-stall herds have displayed better reproductive efficiency (Valde *et al.*, 1997), and studies have demonstrated that the interval between calving and first ovulation and oestrus is shorter in free-stall than tie-stall herds, enabling earlier insemination in free-stall herds (Petersson *et al.*, 2006). When examining the effects of automatic milking on fertility, Kruip *et al.* (2002) found that automatic milking increases the number of days to first service. Fahey *et al.* (2002) reported lower calving rates in larger herds, whereas Simensen *et al.* (2010) found that larger herds had better fertility.

Lame cows have been reported to have poorer reproductive performance. Sprecher *et al.* (1997) found that cows with high lameness scores had longer intervals from calving to first service and to conception and also required more services per pregnancy. In addition, Hultgren *et al.* (2004) found that the first-service conception risk was lower for cows with sole ulcer. Garbarino *et al.* (2004) found that cows classified as lame had 3.5 times greater odds of delayed cyclicity than did cows classified as non-lame.

Cows with reproductive-related diseases have been associated with impaired reproductive performance (LeBlanc *et al.*, 2002; Dubuc *et al.*, 2011). Oltenacu *et al.* (1990) found that cystic ovarian disease and silent heat syndrome each increased the days open interval by 40 days. They also found that metritis prolonged the interval by 20 days and retained placenta by seven days. Dematawewa and Berger (1997) found that cows with dystocia had more days open and needed more services to become pregnant. Cows calving twins are at greater risk of reproductive disorders, including retained placenta, dystocia, and metritis, which increase average days open and services per conception following the subsequent lactation (Nielen *et al.*, 1989). Peake *et al.* (2011) found prolongation of the interval from calving to onset of the first luteal phase for cows with one or more of three production stressors: lameness, subclinical mastitis, and body condition score loss. However, no significant associations were found between disease events and overall reproductive performance.

According Löf (2012), breed is a factor that should be considered in impaired reproductive performance analyze. Herds of predominantly black and white cows risk poorer reproductive performance and should therefore be closely monitored to obtain higher reproductive performance. Herds with managers who are unqualified inseminators may risk poor reproductive efficiency; consequently, these herds should be closely monitored and herdsmen could be offered refresher courses to eliminate negative factors causing suboptimal conception rates. Heath detection should be addressed by herd advisory services and resources and allocated to herds with low heat detection efficiency. Healthy cows have better reproductive performance, which emphasizes that one should strive to prevent diseases to maintain high reproductive performance. In tie-stall herds should be payed greater attention to the reproductive performance in order to improve the reproductive efficiency. The milk fat/protein ratio could be a good candidate indicator to use in identifying cows at risk of poor fertility, and to determine where preventive measures should be taken.

Risk conditions can be identified through monitoring plans, their impact assessed by adaptive conjoint analysis procedures involving experts (Horst *et al.*, 1996) or quantified by epidemiological studies yielding odds ratios or relative risks (Noordhuizen *et al.*, 2001). Risk conditions can be found at the animal/herd level (e.g. parity; milk yield; breed; lactation stage), the level of cows' environment and management (e.g. barn climate; housing conditions; feed quality), and farm information (milk recording; feedstuff analysis).

Biosecurity plans refer to health management strategies and comprise key components like formal disease risk identification and risk assessment on a particular farm. These plans make proper use of the issues addressed in forenamed paragraphs and convert these into a set of so-called working instructions or protocols (Noordhuizen and da Silva, 2009). For example, a Protocol on General Hygiene procedures, a Protocol on Entrance Procedures for animals, cars, professionals, cattle, a Protocol on Disease diagnostics and Animal treatment, or a Protocol on Good Medicine Application Practice. Therefore, biosecurity builds on further on a general good farming practice attitude.

Conclusions

Taking into account all presented data concerning assessed biosecurity level of six observed dairy farms, it could be concluded:

according total discriminating effect in respect to the biosecurity level lowest ranked farm (farm 6), farms 1, 2, 3, 4, 5 and 6 were ranked as 2nd, 1st, 3rd, 4th, 5th and 6th, respectively, but in respect to the true reproductive and related disorders occurrence rate lowest ranked farm (farm 4), farms 1, 2, 3, 4, 5 and 6 were ranked as 1st, 4th, 2nd, 6th, 5th and 3rd, respectively;

partial discrepancy between estimated biosecurity level and reproductive parameters of the farms derives from the fact that reproduction data were collected for entire year, while reached biosecurity level, although consequently from the previous efforts and work done, describes obtained level of biosecurity in on particular moment of time and do not cover all potential causes of reproductive disorders;

nevertheless, assessed biosecurity level provides important information about herd health, and therefore potential reproduction problems.

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MODERN PROCEDURES TO INCREASE AND PRESERVE THE NUTRITIONAL VALUE OF THE CORN SILAGE

Nenad DJORDJEVIC[1*], Goran GRUBIC[1], Bora DINIC[2], Bojan STOJANOVIC[1], Aleksa BOZICKOVIC[1], Aleksandra IVETIC[1], Nenad MILENKOVIC[3]

[1]University of Belgrade, Faculty of Agriculture, Serbia,
[2]Institute for Forage Crops, Krusevac, Serbia
[3]Municipal Assembly of Velika Plana
(Corresponding author: nesadj@agrif.bg.ac.rs)

Abstract

In this paper we have given the review of domestic as well as foreign experiences connected to increasing of the protein amount and aerobic stability of corn silage.

Today corn silage is the base of intensive and economic cattle breeding, and nowadays the usage of corn silage has increased in diet of sheep and goats as well. However, corn silage is above all the carbohydrate meal with low protein count, it has low aerobic stability and very often losses are great due to secondary fermentation.

In order to increase nitrogen maters (raw proteins) urea is being added (0.5-1.0%). With the same purpose corn is being grown as a joint crop along with soybean or horse bean or these annual legumes are being added while filling the silos. Solution for small aerobic stability of corn silage is in using hetero fermentative bacterial inoculants. These bacteria synthesize, besides milk acid, volatile acetic acid which is an excellent fungicide and stops the development of microorganisms.

Key words: *corn silage, additives, urea, inoculants.*

Introduction

The importance of corn as a crop species for animal and human nutrition is significantly increased with the spreading of ensiling conserving technology of the whole plant. That procedure is achieving more efficient use of agricultural land, higher yield of digestible dry matter, ruminant feeding with high moisture feedstuffs all through the year (independent of the time of vegetation), consistent composition of the ration as prerequisite for stabile milk production and others (or evi et al., 2005). However, corn silage has its shortcomings. First, this is high energy half-concentrated feedstuff, with low protein and mineral content. Although corn is easy to ensile, there is a big problem with its useful value, considering low aerobic stability (or evi et al., 2010). Because of all that corn is today used in many experiments that are conducted all over the world. In this paper we summarize the overview of most important foreign and domestic investigations in the technology of corn ensiling.

Selection of hybrids in order to increase nutritive value

Corn was selected for grain yield and resistance to diseases for a long period of time. It was considered that standard (grain) hybrids are also good for silage (Kamalak et al., 2003). The main goal in production of corn for silage is to obtain as much green mass (and dry matter) as possible, and high percentage of grains in the total mass. This is so because the grains have the highest amount of nutrients. This is why it was important to take care about

the optimal plant density in corn produced for silage. Modern maize hybrids have such habitus that allows them to be grown in more dense rows, which allows higher yield (Subedi et al., 2006). Increase of crop density in process of growing the silage maize is justified only from aspect of yield increase per acre, only if nutritional value of produced silage is not changed (Budakli et al., 2010).

In recent times the attention is given to the digestibility of the corn silage. Theoretically this problem can be solved with the use of fibrolytic enzymes and bacterial-enzyme inoculants. In some experiments it was confirmed that this kind of additives have complex influence on silage quality and nutritive value, and on animal performances (or evi et al., 1998). This is mostly concerning the alfalfa and other legume silages (or evi et al., 2006a). However, it has been proven that fibrolitic enzymes have effect mainly on easily digestible fiber fractions. Besides, for cellulase to work it is needed that pH is higher than 4.5. Moreover, the optimal combination of different cellulose solvents is needed to get the glucose. Because of all that results of usage of the fibrolitic enzymes during making of silage are more negative than positive (Kung and Muck, 1997). Therefore, because of the quoted problems nowadays in practice fibrolitic enzymes are added directly in to the meal and not during silaging. (Giraldo et al., 2008).

Especially interesting for silage is brow midrib hybrids because they have low content of lignin and therefore increased digestibility (Bal et al., 2000). In experiments with brown-midrib hybrids (bm3) the significantly lower level of lignin was determined and an increased *in vitro* digestibility of NDF and therefore higher milk production in cows (Barlow et al., 2012). However, these hybrids are not suitable for commercial production since they have low yield of grain and biomass for ensiling. For the last couple of years in scientific institutes which produce commercial hybrids of corn, digestibility has been intensively researched. Digestibility parameter for entire maize plant, with dry mater yield can contribute even bigger affirmation of the well known and new hybrids. Therefore, for example, Jovanovi (2007) in his PhD thesis has proven that between four researched hybrids produced in Corn institute Zemun Polje are siginficant differences of digestibility, as well on productive characteristics of calfs that were fed with those hybrids.

In order to increase nutritive value of maize silage various other hybrids are produced such as high-oil (Weiss and Wyatt, 2000), waxy (Akay and Jackson, 2001) and others.

Procedures for increase of aerobic stability in silages

Corn is one of the plant species that are easily ensiled, due to its abundance of fermentable carbohydrates. This is why in its ensiling it is unnecessary (and even harmful) to use homofermentative bacterial inoculants to enhance lactic acid fermentation. (or evi et al., 2007). Because of the shorter duration of fermentation and high amount of sugars that remain unfermented, such silage is perfect substrate for the activity of aerobic microorganisms when the silo is opened. Low aerobic stability of corn silage is one of the largest problems with that feedstuff. It is occurring when silage is not used regularly and remains on the open air for longer periods of time. Several years ago it was confirmed that inoculation with Lactobacillus buchneri increases the aerobic stability in corn silages (Ranjit and Kung, 2000), which can be explained with the fact that it is a heterofermentative bacteria which is converting lactic acid do acetates. Lactic acid, as the main product of homofermentative processes of sugar fermentation in the ensiled mass, is a strong anti bacterial but weak fungicide agents. Contrary to that, acetic, propionic and butyric acid in corn silages are desirable to some degree. In the experiment performed by Hu et al. (2009) in was confirmed that with the use of Lactobacillus buchneri inoculant better results are achieved with dryer material, which is important for practical application (table 1).

Table 1. Quality and erobic stability of corn silage (Hu et al., 2009)

Parameters	Dry matter %	Without Lactobacillus buchneri		With Lactobacillus buchneri	
		Without Lactobacillus plantarum	With Lactobacillus plantarum	Without Lactobacillus plantarum	With Lactobacillus plantarum
pH	33.1	3.54	3.56	3.65	3.66
	40.6	3.60	3.65	3.73	3.78
Lactic acid, %	33.1	3.39	4.12	1.97	2.60
	40.6	2.97	3.13	3.83	2.91
Acetic acid, %	33.1	0.84	1.02	1.33	2.23
	40.6	0.55	0.60	2.58	1.69
Aerobic stability, h	33.1	53	47	112	106
	40.6	49	53	236	300

The procedures to enhance nitrogen value (crude protein) in corn silages

Corn silage is considered as a half-concentrate feedstuff, with low concentration of crude proteins and minerals. The amount of nitrogen in corn silage can be increased with the addition of non protein nitrogen compounds, or with combination of corn with legumes.

The addition of nonprotein nitrogen compounds. The use of nonprotein nitrogen compounds in ruminant feeding has a long tradition. As a non protein source of nitrogen, in practice most significant is urea $[CO(NH_2)_2]$, which averagely contains 42-46 % nitrogen, and 1kg of urea theoretically replaces around 2.8 kg of protein.Urea is being used as additive in concentrated part of the meal or during entire corn plant, wet corn grind or cob silage preparation. Because of its negative influence on fermentation today it is considered that better application of urea is in the concentrated part of the meal. Adding of urea has to be done with great caution regarding the amount of added urea, as if too much of urea is added or if it is not distributed evenly health problems will arise (or evi and Dini , 2011). However, results of domestic research show that change in pH value of corn silage while using 0.5-1.0 % of urea have no significance on silage quality (Dini et al., 2001; or evi et al., 2004a; 2006b). On the contrary to that, the significant increase in ammonia nitrogen and nitrogen soluble in ammonia, this can be a great problem in diet of rumnivorae. Therefore today urea is not being used as additive for silage in its pure form, but attached to some carrier which slows down its hydrolysis (or evi et al., 2006c).

Combination of corn with legumes. It is performed with the companion cropping techniques (with soya or faba beans), or by mixing with perennial legumes in the moment when silage is produced. The simultaneous production of corn and annual legumes is improving the high buffer capacity in legumes and providing better energy / protein ratio in ruminant diets (or evi et al., 2001; 2004b). With the production of companion crops there is a problem that legumes are in the shade of corn which is higher. This is why it is recommended to plant companion crops in alternating rows or ribbons. Dolijanovi et al. (2006) found that corn and soybeans as companion crops had higher yields than when they were produced alone. Based on the experiment with 12 silage combinations Dini et al. (1999) recommend that the amount of annual legume (particularly soybeans) should not be more than 50%. or evi et al. (2002) produced corn as a sole crop or in combination with Tetovac (white) beans. Corn was ensiled when its grains were in the milky-wax phase. The beans reached the top of corn plants and was 35.29% of the silo mass. The authors found higher yields of all nutrients when the two plants were produced as companion crops (table 2).

Table 2. Yield of green mass and nutritive matters, kg/ha (Đorđević et al., 2006b)

Parameters	Whole maize plant	Whole maize plant + bean	%, ±
Green mass	70764	82372	+16.40
Dry matter	18495.59	20998.27	+13.53
Crude protein	1731.04	2275.37	+31.45
Crude fiber	3240.74	4165.43	+28.53
Crude fat	656.65	747.96	+13.91
NFE	11711.32	12295.33	+4.99
Ash	1155.84	1514.19	+31.00

The combination of corn with perennial legumes (alfalfa) in the moment of ensiling also provides higher protein content in silage. Such method of ensiling is performed during the autumn, when corn and the last cut of alfalfa coincide. However, the different types of silo-combines are needed for those two crops. Also, the problem is how to mix those two plant species (Đorđević et al., 2002). It was experimentally confirmed that the best quality of produced silages is obtained when corn and alfalfa were included as 50:50% (Dinić et al., 1988).

Conclusion

Modern technologies of corn ensiling have the aim to obtain the starting material with as high nutritive value as possible, and the use of such techniques and additives to provide maximal preservation and increase in nutritive value of the silage. For corn silage today very important are additives based on heterofermentative lactic acid bacteria, which enable achieving of the high aerobic stability in the silage. That way many problems which exist in the practice of small farmers are avoided. The increase of nutritive value of corn silage can be obtained with companion crops (with annual legumes) oar with combination with perennial legumes (alfalfa) at the moment of ensiling. It this case it should be done in a way to prevent shade from corn in companion crops. This implies the use of right hybrid (corn) and cultivars (legume), and selection of proper seeding technique and agrotechnical procedures. Selection of corn hybrids with the increased digestibility and nutritive value is also providing significant results.

Acnowlegdements

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TEMPERATURE AND HUMIDITY AS STRESS FACTORS IN MILK PRODUCTION

Ljiljana SAMOLOVAC[1*], Petar STOJIC[2], Radmila BESKOROVAJNI[2], Milutin JOVANOVIC[1]

[1]PKB Korporacija, Beograd, Serbia
[2]Institut "PKB Agroekonomik", Beograd, Serbia
(Corresponding author: ljiljanasamolovac@gmail.com)

Abstract

Among the most important paragenetic factors which have a very big influence on the production of cow milk are temperature and air humidity of the surroundings, i.e. temperature index.

Long therm deviation of one or more climate factors from their optimal values causes heat stress to these animals. Heat stress can often lead to decreased milk production, decrease in nutrient consummation, decrease in conception etc.

Data, analyses and conclusions which are shown in this paper are referring to production of milk at "PKB Corporation" farms during the year of 2010. Production and milk quality have been monitored on 7 farms located in the same climate conditions in which air humidity is frequently near its maximum. Average air humidity (by months) has varied in intervals of 75.48% to 93.39%, temperatures have varied between -0.84 and 22.21^{0}C, temperature index has varied between 31.80 and 70.48.

Milk yield, expressed via the milking average, was lowest in months when external air temperatures, as well as THI values were the highest (July and August), amounting to approximately 21.5kg, while in periods with relatively low temperatures and THI, from late autumn until the spring, this value was the highest, remaining in the interval between 22.5 and 24.3kg.

Milk quality follows milk yield, with the lowest values for the content of butterfat, protein, and nonfat dry matter recorded in July and August (3.37 and 3.39% for butterfat, 3.15% for protein and approximately 8.5% for nonfat dry matter), and the highest values recorded in various months in the autumn-winter period, which is in accordance with environmental conditions. The highest contents were 3.84% for butterfat (in January), 3.37% for protein (in October and November), and 8.71% for nonfat dry matter (in November).

Keywords: *milk production, temperature, air humidity, temperature index.*

Introduction

As one of the most important agricultural activities, milk production is exposed to the effects of numerous mutually interacting factors, such as genetic, as well as paragenetic.

Paragenetic effects are especially pronounced in herds with uniform genetic potentials. Among them, climate factors (temperature and humidity, level of precipitation, airflow, etc.) play a prominent role.

In case of a prolonged action of extreme climate factors on cows in lactation, in most cases heat stress will appear. The term heat stress implies the state of a body exposed to long-term adverse effects of one or more climate factors, where the more productive the animal, the more pronounced is the stress (Bohman et al., 2007.).

The most common causes of heat stress are temperature and humidity, based on which values

the temperature index, THI, is calculated (Buraoui et al., 2002.). As a measure of the level of heat stress THI, began to develop in the mid 20th century, first in human medicine, and then also in cattle rearing (Berry et al., 1964.). A THI value of 72 is considered as the limit for the onset of heat stress (Ravagnolo et al., 2000.). THI values from 72 to 79 indicate an external temperature stressogenic for the cow's body. When THI is above 79, the external temperature has a very stressogenic effect on the animal's health, especially in the case of lactating cows, who are not able to use mechanisms of thermoregulation to maintain their body temperature within physiological limits under such conditions. (West, 2003).

Unfavorable environmental conditions most often lead to a decrease of the quantity and quality of milk, reduced food intake, increased water intake, reproductive disorders, etc.

Materials and methods

The effect of climate factors on milk yield investigated in 2010, on a herd of some 8500 dairy cows of the HF breed, on seven farms of the PKB Corporation.

Farms belonging to the system of the PKB Corporation are located in the vicinity of Beograd in Pancevacki rit, with a temperate continental climate, characterized by a very hot and relatively dry summer, warm temperate autumn, a cold winter, and a short spring. One of the specific features of the climate is the seasonal wind Kosava, a southeastern wind that brings clear and dry weather.

Housing technology, nutrition and care are uniform on all dairy farms. All farms have gerds with a similar genetic structure. The average share of HF genes in the population is over 90%. The housing system for animals are tie-stalls. Barn capacity is 120-130 cows. Buildings are relatively low, not exceeding 5m. Equipment for milking and milk cooling is the same on all farms. The formula used to prepare meals is similar on all farms, as well as nutrients used, with small variations in the composition and quality of forage. Meals are uniform throughout the year.

Data on air temperature and humidity were obtained by measuring, using the iMETOS automated measuring station in Institute "PKB Agroekonomik", located in the same geographical and climate environment as the farms. The humidity index was calculated using the following formula (Mader et al., 2006):

$$THI = 0.8xT + ((H/100)x(T-14.3)) + 46.4$$

THI was measured and calculated only for external conditions, but not in buildings. Daily milk yield, milk delivered to the dairy, number of cows milked, and total number of cows were registered daily, while milk quality was tested once weekly, alternately at the morning and the evening milking, for each barn separately, and represents the weighted arithmetic mean for the last four analyses for all parameters, with the exception of somatic cell count, where the geometric mean of the last three analyses is used (AT4 milk control method).

Results and discussion

High external temperatures during summer months are one of the main limiting factors for milk production, especially if they are also accompanied by high humidity. External temperature conditions when the body temperature of animals is within physiological limits, and the quantity of metabolic energy is minimal are called a thermo-neutral environment (Johnson, 1987). The lower limit of a thermo-neutral environment for cows in lactation with a daily milk yield of 30kg, with 4% butterfat, is within the -16 to -37ºC interval (Hamada, 1971), while the upper limit is in the interval between 25 and 26ºC (Berman et al., 1985).

Table 1: Average values and variability of certain climate condition indicators in the investigated area for 2010

Indicator	N	Average	SD	Min	Max
HUMID	365	84.09	9.37	53	100
Taver	365	10.99	8.72	-10.12	26.9
Tmin	365	4.9	7.25	-16.3	19.8
Tmax	365	16.99	10.7	-7.8	38
PREC	365	2.03	4.93	0	35.2
THIaver	365	52.01	14.62	14.37	77.5
THImin	365	42.19	12.39	3.37	66.48
THImax	365	61.69	17.61	18.28	94.02

HUMID-relative air humidity, %; Taver-average daily temperature, ℃; Tmin – min. daily temperature, ℃; Tmax – max. daily temperature, ℃; PREC – total daily precipitation, mm; THIa – temperature humidity index – average temperature; THImin – temperature humidity index – min. temperature; THImax – temperature humidity index – max. Temperature.

Average values for climate indicators were within the usual limits for Beograd and its surroundings. The average annual temperature was 10.99℃, humidity 84.09%, precipitation 2.03l/m², and THI 52.01. However, extreme values for these mentioned indicators indicate the possibility of heat stress, since temperatures dropped to -16.3℃ and grew to 38℃, while THI variations were within the 42.19 to 94.02 interval.

Table 2: Average values for certain climate condition indicators in the investigated area, by months, for 2010

Month	HUMID	Taver	Tmin	Tmax	PREC	THIaver	THImin	THImax
I	92.5	-0.84	-3.7	1.7	1.9	31.8	26.9	36.2
II	90.1	1.66	-2.33	5.5	2.3	36.3	29.5	42.7
III	75.5	6.63	1.7	12.1	1.4	45.5	38.1	53.8
IV	78.8	11.7	4.2	18.4	1	53.6	41.9	64.1
V	81.9	16.1	9.4	22.9	4.7	60.6	49.8	71.4
VI	84.5	19.5	12.4	26.3	3	66.1	54.7	77.2
VII	80.9	22.2	13.8	29.6	1.5	70.5	57.1	82.4
VIII	78.8	21.1	12.4	29.6	0.9	68.7	54.9	82
IX	82.7	15.5	7.8	22.8	2.1	59.8	47.2	71.6
X	85.3	8.5	3	15.5	1.5	48.3	39.2	58.1
XI	85	9	3.2	15.9	2.6	48.9	39.4	60.2
XII	93.4	0.2	-3.57	3.8	1.3	33.2	26.7	39.5
Total	84.1	11	4.9	17	2	52	42.2	61.7

Average temperature values for 2010, by months, were within the interval from -0.84ºC (January) to 22.21ºC (August). Minimum average temperatures were recorded in December and January (below -3ºC), and maximum average temperatures were recorded in July and August (above 29ºC).

By months, humidity was lowest in April and August (78.8), and highest in December (93.4). Average relative humidity was 84.1.

By months, THI was within the interval from 31.8 (January) to 70.5 (July), with an average value of 52.01. Lowest average THI values, below 30, were recorded in the months with the lowest average temperatures (December, January, February) while the highest, above 82, were recorded in July and August.

Table 3: Average production indicators

Month	N	No. of cows milked	cow	Milk delivered to the dairy	Average yield *	BM %	PROT %	NFDM %	CFU	SCC
I	31	7405	8758	173069	23.4	3.84	3.25	8.52	20487	260663
II	28	7522	8788	176687	23.5	3.82	3.26	8.55	20078	274678
III	31	7619	8797	180925	23.8	3.73	3.26	8.53	20251	307524
IV	30	7495	8744	182168	24.3	3.56	3.25	8.6	20209	299595
V	31	7288	8688	175575	24.1	3.42	3.23	8.69	20496	287212
VI	30	7033	8634	159349	22.7	3.44	3.2	8.57	20880	298795
VII	31	6867	8650	146857	21.4	3.39	3.15	8.51	20442	327373
VIII	31	6903	8642	148614	21.5	3.37	3.15	8.46	20780	312872
IX	30	6931	8668	160016	23.1	3.47	3.23	8.55	23060	340483
X	31	6929	8720	158337	22.9	3.54	3.37	8.7	20683	297880
XI	30	7033	8738	158500	22.5	3.55	3.37	8.71	20607	268381
XII	31	7222	8803	164294	22.8	3.46	3.33	8.66	15736	273497
Total	365	7185	8719	165277	23	3.55	3.25	8.58	20301	295853

* milking average – value calculated as the ratio between the quantity of milk delivered to the dairy and the number of cows milked

Temperature stress in cows has an extremely unfavorable effect on milk yield and quality (lower butterfat content, increased somatic cell and bacteria counts), and its physico-chemical characteristics (Milosevic, M., 2002).

Milk yield, expressed via the milking average, was lowest in months when external air temperatures, as well as THI values were the highest (July and August), amounting to approximately 21.5kg, while in periods with relatively low temperatures and THI, from late autumn until the spring, this value was the highest, remaining in the interval between 22.5 and 24.3kg. In summer months (June-August), the quantity of milk delivered to the dairy was also considerably lower compared to the remainder of the year.

The number of cows in milking droped in summer months, as a direct consequence of cows being dried off after 7 months of pregnancy, i.e. of good results in reproduction in the November-March period. On the other hand, due to unfavorable climate conditions in July and August (high temperatures and THI), freshly calved cows did not exhibit their full production potential.

Milk quality follows milk yield, with the lowest values for the content of butterfat, protein, and nonfat dry matter recorded in July and August (3.37 and 3.39% for butterfat, 3.15% for

protein and approximately 8.5% for nonfat dry matter), and the highest values recorded in various months in the autumn-winter period, which is in accordance with environmental conditions. The highest contents were 3.84% for butterfat (in January), 3.37% for protein (in October and November), and 8.71% for nonfat dry matter (in November).

Highest bacteria and somatic cell counts were registered in September (23060 and 340483), with the lowest bacteria counts registered in December (15736), and the lowest somatic cell counts registered in January (260663). In any case, bacteria and somatic cell counts were within acceptable limits according to technological norms and milk quality standards (100000 CFU and 400000 somatic cells for extra class milk).

Table 4: Correlation between THI, milk quantity and quality

	Milk kg	Butterfat %	Protein %	NFDM %	CFU	SCC
THI	-0.37	-0.69	-0.55	-0.25	0.42	0.59
THImin	-0.36	-0.63	-0.53	-0.25	0.4	0.54
THImax	-0.36	-0.69	-0.5	-0.21	0.42	0.59

Correlations between THI and characteristics of milk production were negative, medium and strong (from -0.36 to -0.69), while between THI and indicators of hygiene (bacteria and somatic cell counts) they were positive, within the interval from 0.4 to 0.59 (medium and strong).

For overcoming issues in production caused by unfortable climate factors, it is necessary to adjust conditions of dairy cattle housing i. e. it is necessary to adapt existing objects or build new ones that would satisfay technological for extreme environmental conditions.

Conclusion

Investigation results indicate that milk production on farms of the PKB Corporation drastically decreases in summer months, resulting to a large extent from unfavorable climate factors, i.e. the exposure of dairy cows to heat stress. The negative effect is evident, both in the quantity of milk produced, and in its quality. In the hottest part of the year, the butterfat and nonfat dry matter content in milk decreases, with a somewhat less pronounced decrease in protein, and an increase in bacterial and somatic cell counts, which all has a negative influence on the quality and nutritional value of milk and dairy products.

The adapting of technological solutions (opening up barns, improving barn ventilation, thermal insulation of roofs, etc.), nutrition (new feeds, a more favorable relation between energy and protein in the diet, better feed digestibility, etc.), of the manner of housing, etc., is required in order to find a way to permanently eliminate or at least mitigate the consequences of temperature stress on lactating cows. In view of the tendency toward climate change, these problems will become more present and more intensive, while economic operating results will depend on the speed and quality of adapting existing technologies to the new situation.

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TRADITIONAL MEAT PRODUCTS IN FUNCTION OF A MARKET OFFER

Radoslav GRUJIC[1*], Bogoljub ANTONIC[2], Milan VUKIC[1]

[1]University ofEast Sarajevo, Bosnia and Herzegovina
[2] Pan-European Universitiy APEIRON Banja Luka, Bosnia and Herzegovina
(Corresponding author: grujicr@blic.net)

Abstract

Dried cured products are one of the most important groups of traditional forms of food. They are produced in the world during **many** centuries. They have certain **properties** that are related to culture and habits of consumers in different parts of the world.

These meat products, depending on factors, have different texture and different flavor. They make up a significant share of the economic production of local residents, their cultural heritage and are an important part of their national cuisine and gastronomy.

In this paper the authors gave **a** description of the traditional procedure of making pork products, known under the title "banjalu ka pe enica". The amount of salt that was used during the development plays **a** significant role in establishing the quality and sensory properties of products. The influence of amounts of addition salt (three concentrations), the speed of salt penetration into the meat and the quality and sensory properties of finished **the** product describes in the paper. Product is manufactured according to the traditional process characterized by the specific aroma, taste and odor, and color and texture. The potential for placing the product on the domestic and foreign markets are given at the end of the paper.

Key words: *pig meat products, traditional methods of production, quality, economic importance*

Introduction

Traditional food products have had a major role in the development and preservation of cultural characteristics of different regions for thousands of years. They include foods that have been consumed locally and regionally for an extended time period.

Preparation methods of traditional foods are part of the folklore of a country or a region. Due to changes occurring in the lifestyle of today's population, some of the traditional products are at a risk of disappearing. Therefore, it is very important that these products are researched and documented and saved as part of a national, state or region culture (Weichelbaum et al, 2009).

To define the term "traditional food" is not easy as it could be presumed. The most comprehensive definition of this term is given by European Food Information Resource (EuroFIR), which under the "traditional food includes food products with a specific function that sets it apart from all other similar products in the same category." These differences may originate due to different causes: use of "traditional ingredients" - the raw materials from which primary product is made, "traditional composition" or "traditional methods of preparation and / or production method" (Weichelbaum et al, 2009). This implies that throughout the preparation process of traditional foods, raw or primary products are used, either alone or as ingredients, which are identifiable in a specific geographical region and remain in use today (regardless of the possibility that use of some was abandoned for a time and then reinstated)

Traditional production and / or food processing involves that the process of product making is established prior to the Second World War and passed down through generations by oral or

other means, and it has continued to be used, taking into account cases where composition was abandoned for a time and then reinstated. Despite of technological progress andthe obligation to comply with modern food-safety regulations, production and/or processing must still be consistent with the methods that were originally used, and obtained food products must preserve the intrinsic features (physical, chemical, and microbiological). The European Union traditional products associate with geographical origin or with the traditional methods of production.

The definition of traditional food products may not necessarily reflect opinions of consumers. According to research conducted by Vanhonacker et al. (2008) European consumers under traditional products include well-known food, food they have eaten already or their ancestors did. When comparing opinions in several countries of the European Union on this matter of traditional food products, the least cross-country differences were found for statements related to the common character of the product and its long existence, while the highest discrepancies were found for specific sensory properties.

The term "dry meat product" is used to refer to a large number of meat products. The basic meaning of the term may vary depending on product and country of origin. The term "cured products" is used when one wants to emphasize that during the production of a product curing mixture has been used (which is mostly composed of sodium chloride, sodium nitrite and nitrate and other ingredients) in order to create typical color and flavor in a product. If during this process, only salt is used, process is called salting. The process of salting / curing essentially can be implemented in two ways: in the dry salting / curing, surface is rubbed with a piece of meat with salt or curing mixture and wet salting / curing, when pieces of meat are immersed in salt solution or curing mixture or are injected into meat pieces.

In traditional preparation of meat products dry curing process is commonly used. After curing, the meat is smoked and dried. In the past, methods of drying food were necessarily applied in areas with mild climates, such as the Mediterranean area (Toldra, 2002). In the opinion of the mentioned author, the production and consumption of dry cured meat products originates from southern Europe, because specific climate allows natural drying and maturing of products. There is numerous historical evidence about dry curing meat practices use in ancient Egypt, Greece and Rome (Toldra, 2002). It is thought that modern method for production of dry cured fermented sausages, originates in 1730 in Italy and 1780 in Germany (Leistner, 1992). Climatic conditions have a significant influence on the production process. Particularly significant are humidity, altitude and temperature changes, windiness, etc.

From dry cured pig meat in the longest use are dried ham and meat in pieces, shoulder blade meat, aitchbone and meat of leg muscles "M.longissimus dorsi". Harnidez et al. (1999) have had outlined a process for the production of traditional cured pork products in pieces in Spain and Italy. The essence of this procedure is the following: the surface of the whole muscle piece is rubbed with moist mixture consisting mainly of salt, nitrite, nitrate, sugar and spices, pepper, garlic. After that, the meat should remain in pickling mixture for at least a week, depending on the outside temperature. During this period the mixture ingredients and spices shoulddiffuse into the pieces of meat. When salting stage is completed meat surface is washed, the excess salt is removed, and pieces of meat are hung on rods and leaved to hang in drying chambers up to a month. During this period it is necessary to reach equilibrium salt concentration in all sections of the meat pieces. The temperature in the drying chamber is about 8°C and relative humidity of 72-82%. Afterwards, the meat dries for 15 to 20 days at 20-22°C, water content is reduced to the required value, and specific flavor is formed (Harnidez et al., 1999). At the end of the process, the pieces of meat lost 35-45% of its original mass.

Production of dried meat products from pork in pieces has a long tradition in Bosnia and Herzegovina. Specialties of this product group, because of its remarkable and specific sensory properties, are highly valued on a market (Antoni et al., 2006a, b).

One of the most famous products of dry cured meat is pork ham. It is made from the best body sections of the meaty pig breed and in detail processed and specifically molded pig musculature. After forming, the pieces of meat are dry salted or pickle, and dried dime. Depending on the applied forming and procesing during the procedure, products are obtained that have specific properties which are associated with the region in which a product is developed (Uzice ham, Romanija ham etc) (Vukovic, 1998; Radovanovic et al., 1990). Final product has the characteristic properties, quality and purpose. Significant impact unto quality of the finished product has phases of salting/pickling, smoking, drying and fermentation. Specific flavor and texture of the products are formed during the production process. During this period, due to the large number of biochemical reactions, a change within the structure of muscle tissue occurs. Biochemical changes are taking place under the influence of endogenous proteolytic and lipolytic enzymes from meat (Toldra, 1998) and presence of a positive microflora. The quality of the finished products is significantly impacted by micro conditions in a particular region (Radovanovic et al., 1990; Antonic, 2006, a, b, c; Brenjo, 2011).

Having in mind a quality of the meat, duration of the process, work and the quality properties of the final product, acceptance and demand for dry meat products by consumers and high price they reach on the market can be explained. Obtained specific properties of products depend upon numerous factors, but primarily on the quality of materials and workmanship. Regardless of the effort invested, products which quality is not uniform and often deviates from the typical primarily sensory properties, can be find on a market. Given the above, we have chosentodetermine in our workthe parameters that most intensely affect the traditional process of making dry meat products from pork meat "banjalu ka pršuta" and formation of product properties. In addition, we want to point out two directions in the production of this product: product manufacture according to the traditional procedure in strict compliance with all stages during the production and production of new products in industrial conditions based on the traditional procedure, but with the possibility for applying certain innovations to accelerate some of the phases in the production process.

Materials and methods

For examination in this study, 18 bodies' samples of meaty breed pigs ware used the average weight of 102.0 kg. Slaughter of pigs and primary processing of a body were prepared in the usual way. Cooling of a body was carried out for 20 hours at $2 \pm 2°$ C, or until reaching $5 \pm 2°$ C in the depth of leg. Cutting of chilled pork into basic sections is done in a way that is characteristic for the local food industry. Special attention was given to formatting and processing of M. Longissimus thoracis et lumborum, which is used during the preparation of hams. Process involves muscle separation from fat and connective tissues from the surface, as well as the formation of meat pieces into the final form ready for further production of pork ham.

Samples of handled and formatted muscles are salted by rubbing a certain amount of salt (4.0% compared to muscle mass), without the addition of nitrite.Salting process lasted for 8 days at $2 \pm 2°$ C, after which the samples were squeezed and salt stripped of for 2 days at the same temperature. During the next 20 days, phases of smoking, drying and maturation were carried out. The total duration of the process was 30 days.

For the first 10 days of salting, measuring of weight and length was done daily and then every fourth day (from the caudal edge of the loins to the cranial edge of the back) and volume

(three positions; around 5 cm from each end - A and C and in the middle of the longitudinal muscle axis - B) in all 18 samples of *M. Longissimus thoracis et lumborum* (Fig. 1).

For the first 10 days of salting, content of salt was studied daily and then every fourth day. Salt content was studied in two coaxial layers of muscles A and B (Fig. 2). Sampling was done by forming steaks of meat thick about 1 cm (transverse to the longitudinal axis of the cut muscle. For layer A part of the muscle was taken 1 cm away from the edge of the steak, and the B layer was taken at central part of the steak. Contents of salt, according to the above schedule with two repetitions, were determined using the standard method (ISO 1941-1, 1999). Sensory Analysis of final products of pork ham ("banjalu ka pršuta") was performed by a group of 20 trained evaluators by scoring method (ISO 8587, 1988) in a specialized laboratory for sensoric analysis.

Results and discussion

The results obtained in this study are presented in three tables. Comparing these results with the results of other authors, it can be concluded that the process of making pork ham in Banja Luka area is very similar to the procedures used in other parts of the Balkans and the Mediterranean. Basic difference is in a recipe of a product, related to nitrite and nitrate, which are not used in theregion of Banja Luka during the preparation of pork ham according to the traditional procedure. The length of each phase, primarily salting, depend on external factors (temperature and humidity).

Considering that the analyzed product is very appreciated by consumers, it is recommended to make it according to traditional process and simultaneous production of this product in industrial conditions by a modified procedure, while preserving majority of production parameters in traditional conditions. In order that this and other meat products preserve completely authentic qualities, it is necessary that during its preparation, besides using a traditional procedure, meat of indigenous varieties of pigs is used . Unfortunately, indigenous varieties of pigs are "lost", and dry meat products can only be made by traditional technology, without marks of authenticity.

Simultaneously, with the globalization of the world food market, consumer's interest in food quality is growing. This consumer interest refers not only to healthier and safer products, but also to the origin and production methods. Consumers increasingly require better quality food products associated with the notion of traditional, because it is "nostalgia" that brings them back to the roots (Gellynck and Viaene, 2002). Traditional food products, which are associated with specific geographic regions and specific gastronomic heritage, have a chance to take a significant role on the market, as more and more consumers are seeking thereturn to a tradition. These changes provide the opportunity for small businesses to secure market for their products, by changing their strategies (Gellynck et al., 2012).

The authors share the opinion that the production of dry meat products and offer on the market, both locally and for export is possible, that effort should be implemented on renewal of local breeds of pigs and to carry out education for rural population how to apply traditional methods of production in new conditions, especially how to comply with new requirements concerning hygiene and food safety.
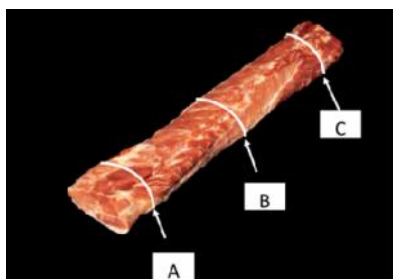
Fugure 1. Sampling of samples from investigation of **ham**weigh, lenth and circuit durig production pork's
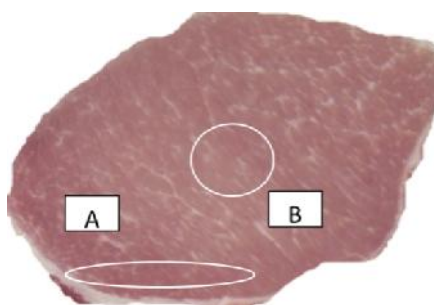
Figure 2.Sampling of samples from investigation of content of NaCl durig production pork's prosciuuto

Table 1. Change of weight, lenth and circuit of samples M.longissimus dorsi during production pork's ham

	Weight (g)	Lenth (cm)	Circuit (%)
Initial	2596	58,67	27,58
End salting	2669	58,83	27,67
End post-salting	2714	59,17	25,08
Mid drying	2342	59,75	22,58
End drying	1702	59,25	19,92

Table 2. Change of sodium hloride concent in samples M.longissimus dorsi during production pork ham

Fase of production	Layer A	Layer B
Initial	2,12	1,13
End salting	3,38	3,45
End post-salting	2,28	2,37
Mid drying	2,85	2,76
End drying	4,32	4,36

Table 3. Results of sensory analysis of pork's ham

	Q	Calculated indicators
Appearance	3	14,40
Composition and appearance of cross section	3	14,03
Colour and its stability	3	13,73
Smell and taste	7	31,33
Texture	4	18,70
% of maximum possible quality		92,28
Pondered mean value		4,61

Conclusion

Based on results presented and defined conditions of production shown in this paper, the following conclusions can be made:

The average weight loss during the manufacturing process of pork ham is about 34%. The average increase in length of the test musculature is about 1.2%, the average reduction in the volume of the test musculature during the preparation ham is least pronounced at the ends (position A-18.43% and position C 21.38 %), while the least pronounced reduction is in the central position,

At all times of production an average salt content properly increased in both observed layers (surface A and central B). The most intense increase of salt concentration in both layers was

measured during the first four days. After the entire production process, an average increase of salt content in the surface layer ranges between 50% and 60%, and in the central part of 72-76%,

Salt content in the finished product is balanced and satisfying. All samples of pork ham in sensoryevaluation are high ranked with an average ponderedmean value of 4.61.

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THE ECONOMIC AND CULTURAL IMPORTANCE OF ANIMAL FIBERS PRODUCTION IN TURKEY

Gursel DELLAL[1*], Ayşem YANAR[2], Erkan PEHLİVAN[1], Ozdal KOKSAL[3], Feryal SOYLEMEZOGLU[2], Zeynep ERDOGAN[2], S. Seçkin TUNCER[4]

[1]Ankara University, Agricultural Faculty, Department of Animal Sciences, Ankara, Turkey,
[2]Ankara University, School of Home Economics, Department of Handicrafts, Ankara, Turkey.
[3] Ankara University, Agricultural Faculty, Department of Agricultural Economy, Ankara, Turkey.
[4] Yuzuncu Yıl University, Agricultural Faculty, Department of Animal Sciences, Van, Turkey.
(Corresponding author: gdellal@agri.ankara.edu.tr)

Abstract

In today's world almost nine different animal kinds are used to produce fiber for trading purposes. All of these animals are mammals except silkworm. Mainly in Turkey wool, mohair, silk, goat coarse hair production is made and cashmere fiber and Angora rabbit wool production is made in very low levels. Between the years 1991 and 2011; the production of wool, mohair, goat coarse hair and silk decreased significantly. Also there is not enough data about production levels of cashmere fibers and Angora rabbit wool. The reasons of the decrease in animal fiber production in Turkey are rapid increase in the use of chemical fibers, changes in fashion which have negative impacts on the consumption of fibers especially mohair, the import of wool, and mohair in low prices and systematic problems on production of sheep, Angora goat, hair goat and silkworm. In contrast to the situation in Turkey, in recent years EU countries have attempted to increase both industrial production and income of small agricultural establishments which are on non-agricultural lands with different animal fiber production systems. However, Turkey has significant potential in animal fiber production. Therefore, in order to utilize this potential effectively, the development of different models, especially increasing the consumption of fiber products, will regularly provide raw materials needed for the textile industry and it will also considerably contribute to the rural development and conservation of the native animal's genetic resources and national culture at an important level.

Keywords: *Turkey, animal fiber, textile industry, rural development, culture.*

Introduction

For the last 50 years, there has been a significant decrease in the production of natural plant fibers and animal fibers especially because these natural fiber types are unable to compete with the production of petrochemical fibers. In the recent years however, the importance given to the natural fibers has increased once again depending on the increased importance of these fibers in organic agriculture and in the protection of rural economy and ecosystem (Anonymous 2009a). In addition, there have been various studies in international arena to reduce the negative effects of competition with the synthetic fibers and the existing economic crisis on millions of people who work in the production and utilization of natural fibers. To give an example, there have been various fine animal fiber development projects in the European Union (EU) to utilize non-agricultural lands and to financially support small family businesses in other rural areas (Russel 1993). In accordance of this purpose, Food and Agriculture Organization of the United Nations declared the year 2009 as the international day of natural fibers (Anonymous 2009b). The number of similar studies is expected to increase in

the future. In this study, the economic and cultural importance of animal fibers production in Turkey is going to be throughly examined and some suggestions are going to be made for the better development of this production area.

Animal Fiber Production in the World

In the World, mainly there are three different groups of fiber production, namely; fibers of mammals (especially wool and luxury animal fibers), silk and poultry feathers. The total production of grease wool in the World is about 2.042.372 tons. However, there has been a decrease of 37% in total production of grease wool in the last decade depending on various factors (Anonymous 2011a). In today's world, grease wool production changes in two different directions. The first change is the transition from the production of medium-sized wool to the production of finer wool because of the increased demand of clothes which are made of light and soft wool. The second change is the increase in the production of coarse wool with more mutton for the instability of medium-sized wool market makes it difficult to market medium-sized wool thereby increasing its price (Cardellino 2003).

There are 11 different types of luxury fiber produced commercially in the World. These fiber types are grouped as luxury because of their low fiber diameters and low production levels. In recent years, there has been a decrease in the production of mohair, cashmere and cashgora and there has been an increase in the production of Angora rabbit, llama, vicuna and guanaco wools while there has not been any change in the production of alpaca wool (McGregor, 2012).

Silk is produced in more than 20 countries in the World and a very high labour force is employed in the sector of raw silk production and utilization. The total production of silkworm cocoons (reelable) in the World in 2010 is 485.906 tons and the foremost producers are China and India. There has been an increase of 31% in the production of silk in the last decade (Anonymous 2011a).

Production of Animal Fiber in the European Union (EU)

Silk along with bad and middle quality wools form most of the fibers produced in the European Union. However, the production amounts of these fibers are of low level. In 2010, 185 028 tons grease wool and 930 tons wet silkworm cocoons were produced in the European Union (Anonymous 2011a). In the last ten years, there was a decrease in the total wool and wet silkworm cocoons production (30% and 46%, respectively). However, in the recent years there have been important changes in the policies of animal fiber production in the EU. Activities to develop the produciton of fine animal fiber like fine wool, cashmere, mohair and Angora rabbit wool have increased in order to use non-agricultural lands and to increase the incomes of small family businesses in rural areas (Russel 1993,Hopkins 1993).

The Economic and Cultural Importance of Animal Fiber Production in Turkey

The Level of animal fiber production
At the present time, there are four different animal fibers as wool, mohair, cahmere, coarse hair and silk commercially important produced in Turkey. According to 2011 data, there are 23.811.036 head native sheep and 1.220.529 head Merino sheep and 42.739 and 3.847 tons of grease wool are produced from these animals, respectively. Most of the wool produced from native sheep is of coarse quality and mainly appropriate for carpet production. In the last ten years, there occured a decrease of 26% in the amount of wool produced from native sheep. This decrease can be mainly said to result from the rapid decrease (40%) in the number of sheep. The decreasing in the number of sheep is resulted from generaly negative changes in

the characteristic of the structural, technical and socioeconomic of sheep raising. Although there has been an increase in the number of Merino sheep and in the production of fine wool in the last decade, this level also can not be said to sufficient.

Table 1. Production of animal fiber in Turkey (Anonymous 2011b)

Resources of animal fiber production	The number of animals and production amounts	1991	1995	2000	2005	2011	1991-2011 Change (%)
Native Sheep	The number of sheep	39 590 493	32 985 000	27 719 000	24 551 972	23 811 036	- 40
	Wool production (Ton)	57 902	48 288	40 706	43 801	42 739	- 26
Merino Sheep	The number of sheep	841 847	806 336	773 000	752 353	1 220 529	+ 45
	Wool production(Ton)	2 590	2 492	2 435	2 374	3 847	+ 49
Hair Goat	The number of hair goat	9 579 256	8 397 000	6 828 000	6 284 498	7 126 862	- 26
	Hair production(Ton)	3 955	3 397	2 697	2 654	3 062	- 23
Angora Goat	The number of Angora Goat	1 184 942	714 000	373 000	232 966	151 091	- 87
	Mohair production (Ton)	1 379	797	421	302	194	- 86
Silkworm	The number of silkworm boxes opened	50 623	9 702	3 147	5 669	5 808	- 89
	Production amount of wet cocoon(Ton)	1 353	271	60	157	151	- 89

Mohair is produced only from Angora goat in the World and native country of Angora goat is Turkey. According to 2011 data, the number of Angora goat and the amount of mohair production are 151.091 head and 194 tons, respectively and in the last decade there has been a significant decrease for both (87% and 86%, respectively) (Anonymous 2011b). The main factor for this significant fall in mohair production is that most of the mohair producers left Angora goat breeding. This situaition is mainly due to the decrasing of the demand of knitted products made of mohair, the reducing of the prices of native mohair because of the import of cheaper prices of mohair from abroad, the not making use of Angora goats fot meat and milk production, effectively and the other systematic problems which adversely affect this goat breed. However, in the recent years in Turkey Angora goat has been taken under protection within the context of project for the conservation of native animal's genetic resources and financially supported for mohair and this goat breed by the state.

Cashmere and goat coarse hair are mainly produced from Hair goat in Turkey. The number of Hair goat is 7.126. 862 head and the amount of produced goat coarse hair is about 3.062 tons (Table 1). For this goat breed is not effectively benefited for cashmere fiber, there is not any data regarding the values of cashmere production (Anonymous 2011b).

The number of silkworm boxes opened is 5.808 and the production amount of wet cocoons is 151 tons in 2011 in Turkey. However, in the last decade there has been a decrease of 89% in the number of silkworm boxes opened and in the production amount of wet cocoons because of swift rural depopulation, cut of mulberry trees, increased utilization of agricultural and chemical pesticides and substances. Besides, other alternative agricultural production areas bring better income than sericulture and it is an another reason for this 89% decrease (Dikici 2008, Anonymous 2011b).

The Economic value of animal fiber production
Total agricultural production value of Turkey in 2011 is 73 billion USD. Within this figure, 49.4 billion USD is crop production while 23.6 billion USD is animal production (Anonymous2012a). The highest 3 production values in animal products belong to red meat (34.3%), milk (32.3%) and white meat (20.5%). The value rates of animal fibers, however, are of quite low level. The production values of wool (native and merino), mohair, goat coarse hair and silk are 0.3%, 0.02%, 0.01% and 0.04% respectively (Anonymous2012b).

Table 2. Agricultural Product Production Values of Turkey (Anonymous2012a)

Production \ Year	Agricultural Production Values (Million USD)			
	2010	Share	2011	Share
Crop	44 466	67,8	49 406	67,7
Animal	21 183	32,2	23 651	32,3
TOTAL	65 649	100	73 057	100

Table 3. Animal Product Production Values of Turkey (Anonymous2012b)

Product \ Year	Animal Product Production Values (Million USD)			
	2010	Share	2011	Share
Red Meat	7 948	37,5	8 114	34,3
Milk	6 822	33,6	7 659	32,3
White Meat	3 843	18,1	4 842	20,5
Egg	1 323	6,2	1 916	8,1
Honey	793	3,8	959	4,2
Leaf	66	0,3	70	0,3
Wool	57	0,3	70	0,3
Beeswax	27	0,1	29	0,1
Mohair	0.6	0,02	0.6	0,02
Hair	2	0,01	3	0,01
Silkworm Cocoon	1	0,05	1	0,04
Total	21 182	100[*]	23 318	100[*]

*Figures on the table may not add up to the total figure because of rounding off the numbers.

Raw animal fiber and the sector of fiber products

Turkey's total export value of raw wool, clean wool and raw goat coarse hair is 24.7 million USD while the total import value of the same materials is 148.8 million USD in 2010. Within this import value, raw and clean wool have an important share. Turkey is among the important countries which utilize wool in yarn sector although wool production is at low levels in Turkey. Total import values of grease and clean wool is higher than the total export value in 2010 and it can be said to result from this case. Turkey's total export value of wool thread in 2010 is 49.8 million USD while its total import value of wool thread is 59.6 million USD. Mohair produced in Turkey is bought and distributed to the domestic market solely by Mohair Association. Turkey's total export value of raw mohair in 2010 is 1.194 million USD and this year there is not any import (Anonim 2011c,d, Sevim 2011).

Cashmere production and processing sector has not sufficiently developed in Turkey. It mainly results from the low of (decreased) amount of cashmere (about 40-50 gr per a goat) produced from hair goats. However, cashmeres collected in the spring may be sold to the markets of foreign countries as well as to domestic market by some merchants. Despite being in very low levels, Turkey exports and imports goat coarse hair and this fiber type is used in different textile areas asthe production of interlining and tents.

Sericulture has a past of about 1500 years in Turkey. The importance of this sector's place continues in the country's economy despite the fact that there have been various significant decreases in silk production in the last decade. Premiums and subsidies given by the state have an important effect in this situation (Dikici 2008). In Turkey, total value of raw silk exported in 2009 is 503 000 USD while total value of raw silk imported is 1.202 million USD. In 2010, however, total value of exported clean silk and silk thread is 400 000 USD while the total value of imported clean silk and silk yarn (thread) is 6.5 million USD (Anonim 2011c,d, Sevim 2011). In Turkey, this production area is also important to supply employment. About 500 000 people work in the production of raw silk, in its processing and marketing. All of the produced wet silk cocoons in Turkey is bought by cooperative associations which are affiliated to Kozabirlik and these cacoons are given to the domestic and foreign market (Dikici 2008).

Turkey is also the native country of Angora rabbit but the data of the wool production and the number of this rabbit bred are not sufficient. At the beginning of 1990's, there was a significant increase in the number of businesses established for Angora rabbits. However; the cheaper importation of the necessary raw Angora rabbit wool for the sector mainly from

China and from other foreign countries caused most of these businesses to be closed down. At the present time, the data regarding the amount of this sector's demand of this fiber and the way how this demand is met is also insufficient.

The cultural importance of animal fiber production

The production of animal fibers in Turkey contributes to the formation and protection of folkloric culture at an important level. As it is clearly seen on the Table 4, different handicrafts like carpets, rugs, sacks and pullovers are produced depending on different fiber types produced in different regions. Most of these handcrafts meet the basic needs of families living in rural areas and reflect historical, cultural, ecologic and geographic features of these regions through different types, designs and colours.

Table 4. Handicrafts produced according to the type of animal fibers in Turkey

Type of animal fiber	Handicrafts
wool	rug weaving, flatweavings, felting, tablet weaving, knitting, fabric weaving (regional weavings)
mohair	fabric weaving (Siirt blanket, Sof weaving in the past), flatweavings, rug weaving, tablet weaving, knitting
silk	rug weaving, flatweavings ,fabric weaving, needlework, embroidery
goat coarse hair	fabric weaving (tent, floor covering, nosebag, bag, animal covering), tablet weaving, flatweavings, knitting (blended coarse hair and down fiber)
down fiber (Cashmere)	knitting (hat, glove, footwear, scarf)
angora rabbit wool	knitting (hat, glove, scarf)
camel wool	knitting (hat, glove, footwear, scarf)
camel hair	fabric weaving (floor covering, bag), tablet weaving

The future of animal fiber production in Turkey

In Turkey, the share of animal fiber production in the economy is quite low when it is compared with meat and milk production. It can be said that this situation is maily due to the continuing of using of synthetic/chemical fibers in the textile and other sectors, the negatif changes in the consumers' demand of products made of primarily mohair and other animal fibers and other systematic problems which adversely affect on animal fiber production resources. Economic and cultural contribution of animal fiber production is expected to decrease in the coming years if these problems are not overcome or their adverse effects are not reduced. For this reason, the following applications can be suggested to develop animal fiber production in Turkey in the near future:

The production of fine quality wool is at a quite low level. For this reason, it is necessary to work for the domestic production of at least a small part of currrently imported fine quality wool.

It is necessary to work for the domestic production of quality and amount of mohair demanded by mohair processing sector instead of importing it and to increase the efficiency of projects for the protection and breeding of Angora goats.

Cashmeres produced from Hair goats in Turkey is at World standards in terms of its quality features (Dellal et al. 2001). But its production is not sufficient to make production at an industrial level. For this reason, it is necessary to carry out genetic and environmental improvement studies in order to increase the production of cashmere in reaquired amount and quality.

At the present time in Turkey, both raw silk production and processing sectors can be said to contribute much more to the country's economy than the production of animal fibers by having higher level of employment. For this reason, it is necessary to enable agricultural businesses with low sufficient income levels and/or other families to produce raw silk which is imported by this sector.

It is necessary to work to increase the consumption of products made of Angora rabbit wool. Besides, developing meat rabbit raisingwill make it possible to benefit from these rabbits in the production of fiber and fur.

It is necessary to carry out some activities for the developing of animal fibers production and handicrafts from these fibersin the agricultural businesses with low sufficient family income levels exist in the various rural areas, specially in the forestlands and mountainsides, amied at agro, eco and othertourism branchs. These activities will also contribute to the solution of goat breeding and forestry relations problem.

Turkish carpets and rugs have an important place in the national and international folkloric culture for hundreds of years. But it is a reality that Turkey's importance in this field in the World has decreased in recent years. For this reason, it is necessary to work on developing new colours and designs which can affect customers' preference in a positive way for the restoration of carpet and rug production.

It is necessary to work to increase customer demand of woven and knitwears made of animal fibers mainly from mohair and it is equally important to work for the creation of new areas of utilization.

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CLUSTERING IN CATTLE INDUSTRY: AN EXAMPLE FROM KASTAMONU, NOTHERN TURKEY

Yaşar AKTAŞ

Kastamonu University, Economics and Administrative Sciences Faculty, Turkey
(Corresponding author: a.yaktas@kastamonu.edu.tr)

Abstract

Clustering concept was generated in 1990s by Michael Porter and describes condensation of corporations as firms, suppliers, universities, which operate at same sector and compete and collaborate each other, at the same geographic zone. SMEs are losing competition advantages about supply, production and marketing day by day at the system of today's world economy is unifying, empowering and centralizing big capital groups. Because of that reason, collaboration of SMEs is an inevitable necessity for keeping alive and gaining competitive advantage against big capital groups.

The Purpose of this study is putting forward analysis results of approach changes of breeders about clustering in cattle sector. Theoretical base of the study is the Situation-Specific Approach generated by H. Albrecht (1869-1989). In this study, clustering process, which was performed successfully at Kastamonu province in 2010-2012 years about cattle sector, which has a sustainable and competitive structure, was analyzed. This analysis based on the following hypotheses:

- Kastamonu province has objective conditions for clustering.
- Clustering is a need but there are no incentives.
- Breeders don't have enough information and knowledge about clusters and clustering.
- Breeders are suspicious about clustering.
- In this context, clustering is a process which needs long-term, laborious and patience efforts."

Paper includes purposes, hypotheses, research questions and details of the clustering concept. Finally, conclusions and assessments are presented.

Keywords: Clustering, Cattle Industry, Agricultural Economics

Introduction

Level of specialization in particular sectors highly depends on the relationship, commitment and cooperation among the companies, suppliers and other stakeholders operating in that sector. Besides affecting the level and strength of competition, these relationships determine and affect the level of development of the sector. Moreover, technology, level of knowledge and innovation are the factors that play an important role in today's business. Understanding and applying these factors are of critical importance in order to be successful and competitive in the markets where global competition takes place. (Vucic, 2009).

A high level of standardization brought about by globalization and the fact that the world has turned into the market of large firms put the small and medium-sized firms into a difficult position. Small and medium-sized firms that do not have the facilities in terms of the supply and production systems as well as marketing that large and global-scale are unable to compete (Nordin, 2003).

Through the concept of globalization, production and marketing conditions have changed almost all around the world. With the rapid decline of the importance and meaning of local

elements, the ratio of financial elements to human factors increases by day. Thus, the new business concepts based on the material have the tendency to destroy the local elements and the internationally recognized methods of international and large-scale firms become relevant. In this case, particularly small and medium-sized firms face the necessity to adapt their processes of production, marketing and supply to the new global conditions. Adapting to this new system emerging out of their control is difficult for these firms due to the fact that they do not have the necessary expertise in the production and marketing methods.

Material and Methods

In this study, many data acquisition processes were used determine, understand and conclude problems of the cattle sector in Kastamonu. Data acquisition processes maintained via many interviews. Interviews practiced at face to face meetings with producers, breeders, state employees and non-governmental organization representatives.

1. The Concept of Clustering

Clustering, which can increase the regional and local competitiveness and at the same time is seen as a developmental model, is defined as a web created by firms including interdependent suppliers, knowledge-producing institutions (universities, research institutes, engineering companies, and so on.), supporting institutions (agencies, consulting firms, banks, insurance companies, etc.), customers, public institutions that support clustering (provincial administrations, KOSGEB, etc.), sectoral non-governmental organizations and local governments which are connected to each other by value-added production chain and their concentration in a particular region. (Eraslan, 2008)

2. Major Actors and Functions of Clustering

The roles of each institution in the cluster activities and weights are different. While some institutions are fulfilling the organization's core functions, the others support or encourage the activities.
Functions of different clustering actors in the embodiment of cluster are summarized as follows.

- *Firms*

- *Knowledge Producing Institutions*

- *Supporting Institutions*

- *Customers*

- *Public Institutions Supporting Clusters*

- *Sector Non-Profit Organizations and Local Governments*

- *Media for the Sector*

- *Institutions organizing Control and Standards*

Concentration of industry in certain areas enables specialization and easy access to the necessary resources. Contributions of concentration and geographic proximity based co-operation to companies and sectors are not limited to material elements, also development in terms of management and workforce is concerned.

Extensive and institutionalized organizational structure provided by clustering contributes to firms and industries in terms of the following basic elements:

• It becomes possible for the firms which cannot benefit from economies of scale on their own to have an advantage in raw materials supplying. Firms operating as small or medium-sized actors in the sectors start to act as an organization on a larger scale through the power the cluster-joint movement gave them, and this supplies them power and financial advantages in face of suppliers.

• In an atmosphere where global-scale firms take over the sovereignty in almost all the markets, small and medium-sized companies coming together with their standardized products and services derive competitive advantage by acting as a single large firm. In this context, small firms may have power on issues such as market share, profitability, competitiveness.

• The investment opportunity which is another item that will affect the competitiveness of companies takes place much more professionally through the clusters that the firms formed by coming together. Clusters which are large structures in terms of scale can make much larger and more appropriate investments through the benefits such as credit and incentive than the ones that firms can perform alone. The advantages that clusters provide to firms are not only financial resources; professional planning, application and management of the investments are of importance.

• Continuing the efforts for maintenance is a problematic issue for small and medium-sized firms that have great difficulty in meeting advertising and marketing expenses. Firms that keep limited to their local region through the advertising and promotional efforts they perform alone come together and may become more powerful and sufficient in many marketing activities such as distribution, product development and pricing by utilizing the opportunities provided by the clusters.

• Firms that do not have adequate opportunities for infrastructure due to financial and bureaucratic constraints benefit from the advantages of geographical association and investments done by the cluster.

• Innovation which is one of the indispensable elements of today's global economy is another benefit that is provided by the concept of the clustering. Traditional factors of production is not sufficient for innovation and development; thus, knowledge and technology today are factors that are expected to be continuously supplied and updated. Innovation capacities of the members of the cluster increase through research and development activities that are required for innovation by the support of cluster management and public bodies.

3. Examples of Successful Clusters

There are many examples of successful clusters both in Turkey and in the world. Examples in Turkey are mostly a combination of small and medium-sized enterprises which want to achieve competitiveness and aim to provide added value to union power. In the examples abroad, it can be observed that even the world-renowned global companies take part in clusters or in similar structures to take advantage of the sectoral development and to expand their scope and scale.

In Turkey, some examples of successful clusters most of which are local products manufacturers who are enjoying the geographical proximity are: flush and synthetic filament yarn and fabrics in Bursa, towels, bathrobes and home textile in Denizli; straygham yarn and

blankets in U ak; circular knitting in Çorlu and Çerkezköy; cotton textiles in Adana, cotton yarn in Kahramanmara ; polypropylene in Gaizantep (Sayın, 2007).

Along with the domestic examples, there are examples from abroad, one of the most striking ones of which is the Silicon Valley that arose from the initiatives of Stanford University in the 1950s. Described as the world's manufacturing and R & D center in technology and IT sectors, this region has become one of the most important examples of university-private sector co-operation by hosting the global-scale R & D that activities companies carry out.

4. Clustering in Kastamonu Province

Kastamonu, as is the case with other clusters with local features in Turkey, is a suitable province for clustering efforts due to the fact that local products are produced here and manufacturers have geographic proximity.

4.1. Clustering Needs of Producers in Kastamonu

The importance of Kastamonu province in terms of cluster studies and the clustering needs of the province have first been examined in the context of a basic sector seen as appropriate in terms of cluster studies. This sector is the animal husbandry sector that came to the fore because of the geographical and socio-economic structure of Kastamonu.

It will be helpful to understand the appropriate environment that brought the breeders in the city together under the umbrella of the cluster to indicate the main obstacles and problems they face:

- It is difficult to find skilled labor in the sector. Employing unskilled labor compulsorily both affects production efficiency in a negative way and prevents specialization by increasing the circulation of personnel.

- In terms of supply, small and medium-sized firms that do not have bargaining power remain fairly small-scale, thus, face higher costs of supplies and raw materials. Financial barriers and low level of information prevent firms to supply from foreign markets, which results in a negative reflection of the power of suppliers in the domestic market to the firms.

- There are shortcomings in marketing. When considering the subject especially in the context of advertising and promotional efforts, it can be seen that very few companies can allocate advertising and promotion budget, however, the number of firms having a professional marketing management seem to be very few. Without any doubt, the main causes of these shortcomings are financial difficulties and lack of information.

- Another problem of the firms in the area is the lack of capital. Financial resources necessary for the implementation of fast-growing technology are often difficult to achieve for the companies. This prevents companies from competing with large companies and regions. One of the main reasons for lack of capital is financing problems. It is either very difficult or limited and not sufficient for firms inadequate in terms of the scale and equity capital to obtain loans from banks or other financial institutions, it is very difficult.

- In connection with the problems of funding and qualified workforce, the company owners do not achieve their desired size, this makes higher production volumes impossible.

Kastamonu province is very appropriate for the development of the cattle and livestock breeding due to having a lot of villages and due to the fact that these villages host the appropriate fields. The main problems that lead animal producers to clustering and barriers that producers face are listed below:

- The majority of cattle and sheep producers compulsorily pursue this profession inherited from families and all the professional knowledge they have on the subject is thanks to their families. Thus they usually do not follow the developments and are confined to their villages.

- Animal husbandry staff, however, are mostly from the family. Therefore, there is the problem of skilled labor in this sector and the shortcomings in vocational training and specialization appear to be another obstacle in front of development.

- Animal husbandry sector has financial problems. Although producers may try to survive through the government-sponsored loans and similar supports, these efforts are insufficient. For this reason, studies care and rehabilitation in environments where animals are grown and investments for amplification of the scale have not reached a sufficient level.

- Very few producers are knowledgeable about the conditions for breeding. Shortcomings of the physical environments of shelter and barns, decrease efficiency and cause animal diseases, deaths, less breeding. The investments needed to improve the physical media by eliminating the problems cannot be realized due to the financial obstacles mentioned above.

- Supply of fodder which is vital for the sector is one of the biggest problems faced by firms. Lack of knowledge about the quality of fodder that needs to be used for high efficiency causes inappropriate feeding and efficiency problems are experienced. However, fodder supply brings high costs for the small-scale firms and-it increases the financial difficulties faced by the firms.

The conditions that are affected by the negative social and financial conditions company owners and employees have and at the same time affect them make clustering activities indispensable both to enable the companies to be available in the future and improve their situation, as well as to contribute to the economy of Kastamonu. In fact, financial problems, lack of knowledge and administrative problems gained almost equal importance in the region.

4.2. The Mistaken Belief That Clustering Cannot Happen in Kastamonu Province

So far, studies on cluster-like structures in animal husbandry sector, have not reached a concrete result. The first interviews with producers and institutions in the region have found out despair due to the fact that previous efforts for clustering have produced no results. The reasons and false beliefs lying on the basis of this despair, together with their reasons, are listed below:

- There is a false belief that the owners of the companies would lose their property because of clustering. Particularly in the animal husbandry sector where there is a relatively low level of education, the owners are suspicious of losing their livestock and their possessions due to the newly established company. However, clustering activities planned for the region is a strategic co-operation among the companies while maintaining ownership of the companies.

- Another concern raised as a result of the problems experienced in partnerships in the past is the inability to have a say in the management. These concerns which are thought to arise from the fact not comprehending the importance of professional management techniques are resulted from that people want to have a say in management, so they do not want others to have a say on their own right to save on their own factors of production. However, as noted

earlier, it is planned that the cluster will be governed by a management team whose members are given the authority to represent.

4.3. Clustering Studies Performed in Kastamonu Province

By clustering project, it is planned to create a comprehensive and forward-looking envisaged policy to increase the competitiveness of Kastamonu in national and international markets, to support sustainable, social, environmental and economic development. Through the studies taking unconditional support for every step by Kastamonu Governor's Office and the Presidency of Kastamonu University, it is aimed at adopting the concept of clustering primarily and then studying it for achieving concrete results.

In this context, apart from activities to increase the local capacity to develop and implement the cluster policy, it was aimed to create the cluster maps of Kastamonu. In this context, under the leadership of Kastamonu University Faculty of Economics and Administrative Sciences, primarily problems and shortcomings of the related sectors in the city were determined then the clustering strategies to follow were determined by the help of the provincial co-operation and contribution of civil society organizations and public institutions.

The following steps were taken within the frame of the clustering that started in 2009;

• Informative meetings were arranged several times with representatives of professional organizations in the region, the concept of clustering, the sector and its necessity for the economy of Kastamonu were presented in detail to producers and other industry representatives.

• Kastamonu University Faculty of Economics and Administrative Sciences, paid visits to other cities where the successful examples of clustering were available and representatives of civil society and of professional organizations participated in these visits. In these visits quite extensive and comprehensive information was obtained.

• Findings gained through the visits paid to the regions where successful examples clustering were available were shared with the breeders and significant progress was made in terms of eliminating question marks about clustering.

Breeders belonging to the animal husbandry sector in Kastamonu and professional organizations were contacted and information meetings were held several times. At these meetings, the problems of the industry were identified, solutions to the problems were sought, significance of clustering for the sector was revealed and manufacturers' approach to the matter was observed. The majority of the producers who had hesitations at the beginning, especially on ownership and management, decided to participate effectively in the work of the cluster following the informative meetings held several times.

• As a result of the aforementioned positive studies, in July of 2012, animal breeders in Kastamonu were brought together and the "Kastamonu Livestock Clustering Association" was founded. Thus, not only in Kastamonu, Turkey also started to work on creating the first official cluster of animal husbandry.

• Devrekani, a town of Kastamonu Province, where producers are geographically concentrated was chosen to establish a second cluster of animal breeders due to its potential and density of manufacturers, and professional organizations agreed to establish a cluster there. The cluster is called Devrekani Livestock Cluster Association.

Results and Discussion

The concept of clustering which suggests a unity among the people or institutions that are directly or indirectly related in terms of the production of a particular product or service and

that have the geographical proximity to act in cooperation is an important development which is often the preferred in many sectors and countries.

The position of small and medium-sized firms against the global-scale firms having the power of competing puts their future position in danger. For the firms that are insufficient in both financial issues and expertise related to production, marketing, distribution, supply, labor, investment, it seems quite difficult to get rid of these shortcomings as long as they operate alone.

Clustering allows enterprises, primarily the chance to benefit from the advantages of economies of scale which they cannot utilize alone. Acting together on issues such as supply, marketing, and production, has the effect of increasing the competitiveness of firms. However, there are a number of financial advantages. Thanks to integrated power and scale of clusters, firms with financing difficulties can reach more appropriate and convenient financing options, which increases the level of investment both in the company and in the industry. Firms and sectors are stronger economically, which, offers the firms increased communication opportunities and due to the fact that training and development opportunities increase, the level of specialization in sectors approaches to the desired levels.

Kastamonu province has been the scene for clustering studies that can serve as a model for clustering studies in animal husbandry due to its geographical proximity. Clustering studies which aim at bringing animal breeders together have been carried out since April 2010 under the leadership of Kastamonu University, Faculty of Economics and Administrative Sciences and with the support of public institutions and non-governmental and professional organizations. As a result of these studies, two different clusters were established in Kastamonu city center and the district of Devrekâni. The charter of the Kastamonu Province Livestock cluster was approved thus it is officially the first cluster of animal breeding established in Turkey. The charter of the Clustering Livestock Association, established in the town of Devrekâni has been created and is expected to be approved in a short time.

An notable issue noticed during the studies carried out in the province of Kastamonu is that manufacturers will have suspicion about clustering unless they are informed on clustering in a convincing way. That knowledge on the subject is insufficient and that the concept is relatively new for our country are the main factors that cause this suspicion. At the beginning of the process, the manufacturers had concerns regarding the ownership and management. However, it has been seen that as a result of years of education and training a great deal about the subject have been digested by the manufacturers.In fact, almost all of the producers which have a high level of derogation signed the charters of the recently established clusters.

Conclusion

Studies carried out in the province of Kastamonu, and the results obtained so far, have revealed the following points;

• Company owners and managers, as long as they do not have sufficient knowledge of the concept of clustering are looking at with suspicion.

• That company owners and managers approach the concept of clustering with suspicion results mainly from their false belief that they were to lose control over their companies.

• Company owners approach to the concept with suspicion, is also influenced by socio-economic conditions.

• Educational and informative activities related to the concept of clustering have an important role in changing the ideas of manufacturers on the subject.

• A long and arduous process is required for manufacturers to get used to the idea of clustering and internalization of the concept.

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STUDY OF BIODIVERSITY IN GOATS IN ALBANIA

Kristaq KUME[1]*, Lumturi PAPA[2], Fehmi XHEMO[3]

[1]Albagene Association, Rr. "Abdyl Frasheri", Tirana, Albania.
[2]Agricultural University,Tirana, Albania.
[3]Agricultural University, Korça, Albania
(Corresponding author: Kkume09@gmail.com)

Abstract

Goats are well adapted to Albanian climatic conditions. Goat breeding is primarily found in the mountains, natural - pastures and hilly regions of the country. Goat variability is high in Albania. They are farmed under traditional extensive production systems. The objective of this study was the identification and phenotypic characterisation of various goat breeds/ecotypes or populations in Albania. Qualitative and quantitative traits of horns (form and length), coat cover, ears, hair, teeth, the cutting, etc., are used to distinguish among phenotypes representing sub-populations of goats. There are identified ten local goat populations and two exotic breeds. The animals of "Has", "Dragobia", "Skuqja of Mati", "Velipoja" and "Lara of Kallmeti" ecotypes have high -medium body size, developed skeleton, thin and strong feet. The body size of "Capore of Mokra" and "Liqenasi" ecotypes is medium-small and the animals of "Dukati" and "Muzhake" ecotypes are of smaller body size. The native populations which are not classified can be considered as part of Balkan goat population. The differences between local and exotic goat breeds are significant (P<0.05) for all morphological and production traits. Morphological differences among various local ecotypes/populations and high level of polymorphism of the visible phenotypic profile indicate a high diversity of goats in Albania. Analyses of principal component of the Albanian local goat population show that 3-4 subpopulations can be identified..

Key words: *goat, polymorphism, local population, principal component*

Introduction

The goat population in Albania counted 775 thousand goats (576 thousand milked goats). After 1996, the size of goat population was decreased, with an average decrease rate of about 2.9% /year (Statistical yearbook, 2011. MoAFCP). Goats in Albania represent a high diversity and heterogeneity. Therefore, it is not difficult to distinguish among well-defined genetic entities. Based on different indicators of body conformation and level of production several subpopulation/ecotypes of Albanian goat population could be noted (Dema, 1985; Bleta, et al., 2002). In general they are isolated populations. Their evolution has been product of human being and natural selection interaction for adaptation to the agro-ecological conditions. The name of their geographical region is used frequently to name these ecotypes..

The study of the features and the productive behaviour of a population are of considerable utility, especially, when animal resources display some authentic details, biologic, technical or environmental. The characterization of local goats, raised in different regions of Albania, presents scientific and technical interests, especially to the genetic improvement and also to the conservation of animal genetic resources.

Lauvergne (1982) introduced the concept of standardized breeds, derived from traditional populations determined by a group of alleles in a homozygosis state. This state was due to selectivity over succeeding generations in a population deemed traditional and that may

originally have been very variable in its extension and purposes owing to the practice of many types of reproduction.

The aim of this study was to characterize the local Albanian goats on their morphological appearances and to link morphological characteristics to genetic determinism.

Materials and methods

A total of 26 herds were surveyed and sampled. Animals were 491 females and 73 males. Regions of populations/ecotypes of local goat that are observed and measured for morphological features, and their size are presented Table 1.

Table 1. Regions, population/ecotypes and number of animals

Local population/ecotype		Number of animal	
Acron	Name	Female	Male
HA	Hasi	41	7
DR	Dragobia	36	6
SMA	Skuqe e Matit	44	7
VE	Velipoja	51	6
LAK	Lara of Kallmeti	34	8
CA	Caporre of Mokrra	61	7
LI	Liqenas	46	6
DU	Black of Dukati	55	9
MU	Muzhake	62	8
NUC	Non classifiable	61	9
	Total	491	73

To estimate different morphometric traits the measurements were done ion adult animals. The traits measured were: body length, wither height, heart girth, udder circumference, teats length, tibia circumference.

The genetic profiling was done following the standards proposed by Lauvergne (1986), Cogovica (1987) and Lauvergne et al (1987). Those standards recommend various scales such as length of horns, colour pattern, length of the ear, etc. Phenotypes that are qualitative in nature were marked in terms of presence or absence while quantitative variables were measured.

Elementary statistics (mean, standard deviation) of morphometric traits that were observed and measured were determined. The methods of studying whole characters rest on the principles of multi-dimensional analysis. Analyse of variances was performed following the GML model with fixed factors:

$Y_{ijkl} = \mu + + a_i + b_j + (a\,b)_{ij} + {}_{ijk}$

Where

y_{ijkl} = a quantitative variable (body length, wither height, heart girth, tibia circumference),

μ = general mean of population,

a_i = effect of the ith ecotype/local population,

b_j = effect of the jth sex,

$(a \times b)_{jk}$ = effect of sex within ecotype

${}_{ijl}$ = residual error.

In above statistical model the sex factor and the interaction effect of breed x sex or effect of bread and sex were removed for udder circumference and teat length traits.

Qualitative measures were analysed according to norms defined by Lauvergne (1986) and Cogovica (1987).Absolute frequencies of phenotypes were determined in each ecotype/population. These frequencies were complemented by relative gene frequencies coding for the observed phenotypes with presumably established genetic determinism. A principal component analysis was performed on the quantitative variables: body length, wither height, heart girth, udder circumference and data of polymorphism of locus: ear length, horns, wattles,beard and hair length, that were used for study of genetic profile of Albanian local goat population.

Results and discussion

Descriptive statistics for quantitative characters

The estimations of main statistical indicators of measured quantitative traits of Albanian local goat population are presented in Table 2. The variance values and variance coefficient highlight the significant level of the variability of these traits in goat population. Udder conformation indicators have the highest variation. The variance coefficient of udder circumference is estimated to be about 35.7% and that of teat length 33.3%. The variation of hearth girth indicator is also high. The wither height has minimal and maximal values respectively 51 cm and 75cm. The differences of body length of smaller animals up to those with greater body size are estimated to be about 39.6%.Referring average values of these indicators and their respective variances we can say that distinguished goat subpopulations are present in Albania. To verify this hypotheses the variance analyses according to above linear model was carried out (Table 2) accepting in advance the classification in local ecotypes/populations (Dema, 1985).

Table 2. Descriptive statistics of quantitative variables

Parameter	Body length	Wither height	Heart girth	Tibia circumference	Udder circumference	Teat length
N	564	564	564	564	491	491
Mean	68.02	64.16	80.08	7.58	34.75	3.75
STD	0.762	0.612	0.957	0.09	0.159	0.08
Variance	18.1	14.5	22.7	2.12	12.4	1.25
Minimum	58	51	67	6.3	18	3.01
Maximum	81	75	93	10.4	45	4.24
CV%	26.61	22.66	28.39	27.96	35.7	33.3

Analyzes of variance

The genetic factor (ecotype) effects on phenotypic variance of all analysed traits. The effect is particularity larger on body length (P<0.001), wither height (P<0.001) and udder circumference (P<0.01). The effect of sex appears to be a tendency on tibia circumference. The effect of "sex x ecotype" is significant only for body length trait (P<0.05). These results show that the classification in ecotypes to distinguish different subpopulations in Albanian goat population using body conformation traits reflects properly its variability. This classification could be used successfully for preservation and development of genetic fund of Albanian local goats.

Table 3. Analyses of variance

Variable	df	Body length	Wither height	Heart girth	Tibia circumference	df	Udder circumference	Teat length
Ecopype	9	***	***	*	*	9	**	*
Sex	1	**	**	**	NS			
Sex x ecotype	9	*	NS	NS	NS			
Residual	546	Variance 46723	Variance 32165	Variance 51294	Variance 2126	483	Variance 18452	Variance 1328
R² (%)		45.4	41.2	46.7	32.1		23.7	32.6

*df: degrees of freedom, NS: non significant; *** : P < 0.001; **: P< 0.01 ; *:P <0.05*

The least squares means and their standard errors of analysed traits of different ecotypes are presented in Table 4.

Table 4. The least squares means and their standard errors

Ecotype/ population	N	Body length	Wither height	Heart girth	Tibia circumference	N	Udder circumference	Teat length
Hasi	48	69.8±1.1	67.4±0.7	80.3±1.0	8.5±0.09	41	33.5±0.12	3.9±0.09
Dragobia	42	72.4±2.2	68.9±1.1	84.7±0.7	8.9±0.07	36	37.3±0.13	4.2±0.14
Skuqe of Matit	51	74.1±2.6	69.1±2.0	86.8±0.9	7.8±0.09	44	37.8±0.18	3.8±0.09
Velipoja	57	77.4±1.3	68.6±0.8	87.2±1.2	9.2±0.13	51	39.6±0.12	4.1±0.01
Lara of Kallmeti	42	76.9±2.4	70.1±0.6	86.8±1.6	7.7±0.11	34	37.1±0.19	4.3±0.07
Caporre of Mokrres	68	65.4±2.3	61.8±1.0	81.2±0.7	6.9±0.04	61	36.8±0.14	3.6±0.11
Liqenas	52	65. 1±2.2	66.2±1.1	78.3±0.9	7.2±0.06	46	33.6±0.16	3.7±0.08
Black ofe Dukati	64	62.5±2.7	56.8±0.8	72.6±1.0	6.4±0.09	55	30.6±0.16	3.3±0.08
Muzhake	70	64.8±2.1	61.1±0.7	75.8±0.8	7.2±0.04	62	31.2±0.15	3.6±0.06
Non classifiable	70	63.8±2.2	58.9±0.9	73.8±1.2	7.0±0.06	61	32.7±0.17	3.5±0.04

Referring to the last squares means of body length, wither height and heart girth two main groups of studied ecotypes could be distinguished: first group, animals with great/average body size - Hasi, Dragobia, Velipoja, Skuqe of Matit and Lara of Kallmeti and the second group include animals with small/average body size: Capore of Mokrra, Liqenas, Black of Dukati, Muzhake dhe non classifiable. Based on udder indicators ecotypes of Dragobia, Velipoja and Lara of Kallmeti could be distinguished. The second group could be classified as the best one for milk production. These results are in accordance with those reported by Dema (1985); Kume et al., (1994, 1995); Bleta et al. (2002)

The visible phenotypic profile

Frequencies of observable phenotypes tended towards one (Table 4). The obedient characters to this tendency were the presence of the horns, the presence of beard, the absence of the wattles and the pigment alteration.

From the phenotypic frequencies the genetic profile was deduced for the Albanian local goat population (Table 5) and for each ecotype (Table 6). These frequencies show the dominance of the wild character which supposes that the studied goat populations belong to the traditional type according to Lauvergne (1986).

Table 5. Genetic profile of Albanian local goat population.

Name of locus	Alleles		Allelic frequencies
	Name	**Symbol**	
Ear length	Wild	EL^+	0.69
	Reduced	EL	0.31
Horns	Wild	Ho^+	0.97
	Polled	Ho^p	0.03
Wattles	Wild	Wa^+	0.74
	Wattled	Wa^w	0.26
Beard	Wild	Br^+	0.99
	Bearded	Br^b	0.01
Hair Length	Wild	HL^+	0.17
	Long	HL^L	0.83
Pigment alteration	Black	Rn^+	0.88
	Ruane White	Rn^R	0.12
Type of eumelanine	Back	B^+	0.58
	Brown	B^b	0.42

Table 6. Genetic profile of Albanian local goat ecotype/populations

Ecotype / population	Alleles						
	EL^+	**Ho^+**	**Wa^+**	**Br^+**	**HL^+**	**Rn^+**	**B^+**
Hasi	0.95±0.02	0.98±0.01	0.85±0.04	1.00±0.0	0.48±0.12	0.97±0.02	0.15±0.03
Dragobia	0.73±0.05	0.99±0.01	0.89±0.03	1.00±0.0	0.55±0.23	0.99±0.01	0.79±0.04
Skuqe e Matit	0.78±0.04	0.98±0.01	0.82±0.04	1.00±0.0	0.12±0.07	0.98±0.01	0.39±0.06
Velipoja	0.74±0.04	0.96±0.02	0.72±0.01	1.00±0.0	0.04±0.05	0.91±0.02	0.11±0.02
Lara e Kallmetit	0.72±0.03	0.96±0.01	0.89±0.02	1.00±0.0	0.11±0.06	0.89±0.02	0.12±0.02
Caporre e Mokrres	0.81±0.03	0.96±0.01	0.81±0.03	0.98±0.01	0.03±0.05	0.87±0.03	0.21±0.03
Liqenas	0.81±0.04	0.96±0.03	0.79±0.04	1.00±0.0	0.12±0.07	0.89±0.02	0.81±0.07
E zeza e Dukati	0.39±0.06	0.99±0.00	0.88±0.03	1.00±0.0	0.15±0.02	0.98±0.01	0.88±0.07
Muzhake	0.41±0.05	0.98±0.01	0.72±0.04	1.00±0.0	0.01±0.05	0.66±0.04	0.85±0.06
Non classifiable	0.52±0.03	0.98±0.00	0.68±0.09	0.99±0.01	0.02±0.04	0.72±0.05	0.81±0.07

According to Cogovica 1987 a gene controls the length of the ears with intermediate dominance. Short ears result from the EL^r/El^r heterozygote. Ear size appears to be conditioned by a gene series where small ears are dominant or additive to large ears (Pattie et Restall 1989). In the Albanian goat population, the most frequent is the EL^+ allele with a frequency equals to 0.69. In ecotype Hasi, Capore e Mokrres and Liqenas the frequency of this allele tend to be equal to 1. Ecotype e Zeza e Dukati and Muzhake were characterised by the dominance of small ears.

The polled character (Ho^p) is an autosomal gene bound to the sex. In the homozygous state, HO^p exercises a pleitropic action leading to partial or total sterility (French, 1971; Dolling,

1999; Pattie and Restall, 1989; Vivicorsi 1998). This is not the case of Albanian local goat population. The allelic frequency of Ho^+ in all ecotypes is equal to 1.

The presence of the wattles is controlled by a dominant autosomal gene (Wa^w) (Lauvergne, 1987). The presence of wattles on the neck is dominant and is common in some strains of feral and milking goat (Pattie and Restall, 1989). But in this study, the absence of wattles dominates with the wild allele Wa^+ and an allelic frequency nearing 0.74.

The beard is controlled by the autosomal allele Br bound to the sex, dominating in males and recessive in females (Lauvergne, 1987). The Albanian local goat population characterize by the presence of the beard. The allelic frequency of Br^+ is equal to 1.

A pair of autosomal alleles controls the length of the hairs with intermediate dominance of the short hair HL^+ in relation to the HL^L gene with long hairs (Lauvergne et al., 1987, Pattie and Restall, 1989). In our study we observed a greater proportion of the long-haired animals HL, with 83% of HL^L. Only in ecotype of Dragobia and Has the allelic frequency of long hair is respectively 0.52 and 0.45. The similar results were reported by Lanari et al. (2003) with proportion 53% and 47% for long and short hairs, respectively, in Criollo goat population and Naft, M. et al (2009) 0.57 and 0.43 for HL^+ and HL^L in goats in the Tunisian oasis.

For Coat colour the locus Rn for pigment alterations with the ruane allele Rn^R and the recessive wi1d allele Rn^+ was verified. The B locus that induces eumelanine with two phenotypes, one black and one brown along with two alleles: the B^+, black and the B^b, brown was verified, also. The little frequency of Rn^+ was identified in ecotype Muzhake and non classifiable population, meanwhile in these ecotype the alellic frequency of B^+, has the high value.

Analyse of principal component

Analyse of principal component was performed on the quantitative variables: body length, wither height, heart girth, udder circumference and data of polymorphism of locus: ear length, horns, wattles, beard and hair length. The presentation of ten ecotypes in the plan of first two principal components that explains about 92% of the general variance is given in Figure 1.
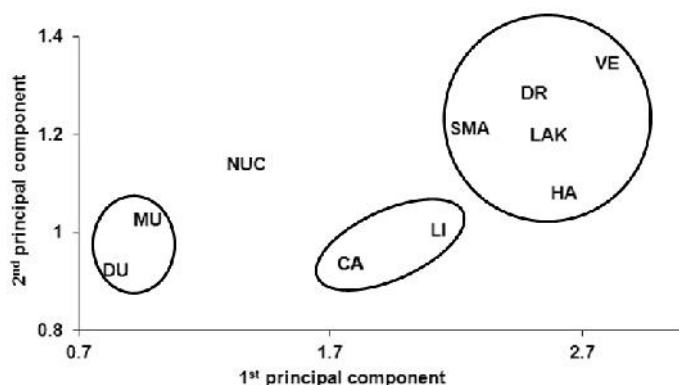
Figure 1. Scatter of ten Albanian goat populations in the plan of first two principal components

Local population: HA –Hasi, DR-Dragobia, SMA-Skuqe e Matit, VE-Velipoja, LAK-Lara e Kallmetit, CA-Capore e Mokrres, DU-Dukati, MU-Muzhake, LI- Liqenasi, NUC- Native breed not classifiable

Three groups can be distinguished in this figure: (1) Velipoja, Dragobia, Skuqe of Mati, Lara of Kallmet and Has; (2) Capore of Mokrra, Liqenasi; (3) Black of Dukatit, Muzhake. Goats subpopulation considered as non classifiable that constitutes about 82% of the whole Albanian goat population cannot be included in none of above groups. In fact this population is

constituted by herds that hardly could be identified as distinguished groups of animals. Referring to morphometric indicators and traits of phenotypic profile different animals could be noticed in the same herd. Comparing the above groups of ecotypes/subpopulations of Albanian local goats with their geographical region location certain hypothesis can rise up:

- the evolution process of Albanian local goat population is developed in accordance with the principle of isolation in distance

- the phenomena of local differentiation of Albanian local goat population is present which is characterised by distinct genetic niches. Based on them is carried out the classification of subpopulations as ecotypes.

Conclusions

Albania local goat population is characterised by high level of variability of morphometric and polymorphism of phenotypic profile traits. Evolution process of these populations and human being actions have created several distinguished subpopulations/ecotypes. The phenomena of local differentiation resulted by isolation in distance is evidenced as well as the creation of distinguished genetic niches. This work may constitute the basis for microsatellite studies to help implementing breeding strategies for the genetic improvement and conservation of Albanian goat populations.

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PRELIMINARY DATA ON COMPARISON OF SMALL AND MEDIUM DAIRY FARMS IN ALBANIA

Ylli BIÇOKU[1], Enkelejda SALLAKU[1], Kujtim GJONI[2], Agron KALO[3]

[1]Agricultural University of Tirana, Albania
[2]Agricultural Directory of Elbasan, Albania;
[3]Agricultural Directory of Durres, Albania
(Corresponding author: bicokuy@yahoo.com)

Abstract

The objective of the study was to compare the performance of the small dairy farms (2-4 cows) and medium dairy farms (6 cows) in Albania, with reference to the annual farm income, the cost of milk production and the problems faced. Data on production, expenses and returns were recorded on a monthly basis for each farm over a period of 12 months. Data such as using milking machine, artificial insemination, needs for training, fodder production and feed bought in the market were collected.
The difference in milk yield is very little between such farms (2.1%).The annual profit per farm for the small farms is 106.8 Euro and for the medium ones is 254.4Euro.The small farms sells 79,1% of the milk production while the medium ones 88,9%. In both cases the fodder production and part of concentrate feed is produced in the farm however the small farms bought 1064 kg/cow concentrate while the medium ones 1,682 kg/cow. All farmers are asking for trainings how to prepare silage and good quality hay, as well as learning livestock good practices.

Keywords:*dairy farm, farm income, small and medium farms.*

Introduction

In 2010, in Albania are operating 219,952 farms with cattle (out of 350,654 farms in total) or 62.7% . The average of cows per farm is 1.5 units. Only 14.5% (3,188 unit) of the farms have more than 6 cows and they produce 20% of the total cow milk (Agricultural Statistical Year Book, 2010)
The last decade witnessed the emergence of the so-called medium size dairy farms owning 6-20 cows. These farmers have been looking at dairying as an economic activity and they are looking forward to modernize their activities. Another reason to study farms with more than six cows is the Instruments Pre-Accession and Rural Development-Like (IPARD) Program which will support such farms.
Little information is available on the economics of production on the small and medium size dairy farms, so the study was therefore undertaken to collect on farm data pertaining to revenue and expenses on both types of farms and make an economic analysis.

Materials and methods

The study was conducted in the central part of Albania, Elbasan and Durres districts. 40 small and medium sized farms (20 per each district) were monitored. Data collection lasted from September 2010 till August 2011. Small farms were defined as those having 2 to 4 cows and medium farms those having 6 or more cows. Both districts are breeding 10% of the cows

population in Albania and the milk yield is 3120 kg/year compare with 2631 kg of the average of the country {1, 2}

The medium farms were selected with 6 or more cows because the IPARD-Like Program that will start during autumn 2012 will support farms that are managing 6 or more cows.
Data collection:Each farm was visited monthly over a period of 12 months. The following data were recorded (according to the questionnaire prepared and tested):
Income and expenses:

Milk yield: the amount of milk produced by each cow,

Quantity of milk sold in the market or to the dairy processor (quantity and price),

Quantity of milk used for the calves and for the family consumption,

Incomes from sales (milk),

Expenses for the fodder production, like alfalfa hay and silage,

Expenses for the animal feed bought in the market,

Expenses for veterinary service, including insemination,

Expenses for fuel, electricity, water, trips, lease on land, and land tax.

Estimated cost of labor needed to take care of the herd per year

Technical data, such as:
Insemination (artificial or natural mating),
Milking (milking machine or by hand),
Type of animal feed used (including microelements or premix),
Animal health (diseases and parasites),
Training needs.
Data analysis:A model was developed in Microsoft Excel program for data analysis, and statistical data processing was done with Statgraphics Centurion XVI.

Results and discussions

Data on milk yield, Incomes per Farm (IpF) (Frank & Vanderlin, 2001) cost of milk (Frank & Vanderlin, 2001) and the ratio milk quantity sold in the market vs. total milk production are summarized in Table 1, as shown below:

Table 1: Milk yield, IpF, milk cost according to the farm size (number of cows).

Number of heads	Milk yield	IpF (Euro)	Milk cost (Euro/kg)	Milk sold vs milk produced (%)
2-4 cows	4695	106,8	0,29	79,1
6+ cows	4796	254,4	0,25	88,9

Statgraphics Centurion XVI was used for statistical data processing and results are shown below:
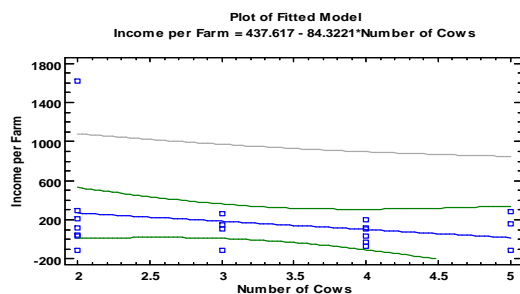
Fig. 1: Small farms IpF (Euro) vs. Number of cows/year

Income per Farm = 437.617 - 84.3221*Number of Cows

Since the P-value in the ANOVA table is greater or equal to 0.05, there is not a statistically significant relationship between Income per Farm and Number of Cows at the 95.0% or higher confidence level.
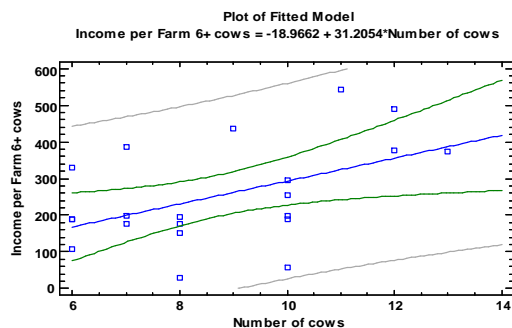
Fig. 2: Medium farm (Euro) vs. Number of cows/year

Income per Farm 6+ cows = -18.96 + 31.20*Number of cows

Since the P-value in the ANOVA table is less than 0.05, there is a statistically significant relationship between Income per Farm 6+ cows and Number of cows at the 95.0% confidence level.
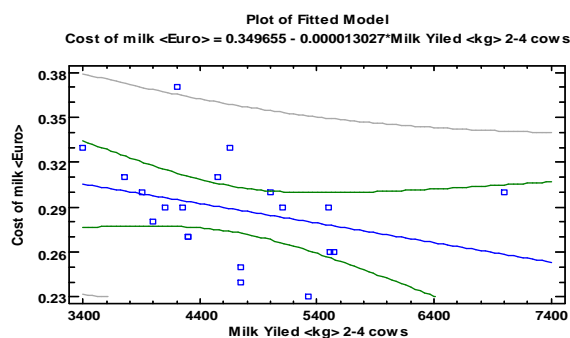
Fig 3. Small farm Milk Cost (cent/Euro) vs. Milk Yield

Cost of milk <Euro> = 0.349655 - 0.000013027*Milk Yiled <kg> 2-4 cows
Since the P-value in the ANOVA table is greater or equal to 0.05, there is not a statistically significant relationship between Cost of milk <Euro> and Milk Yield <kg> 2-4 cows at the 95.0% or higher confidence level.
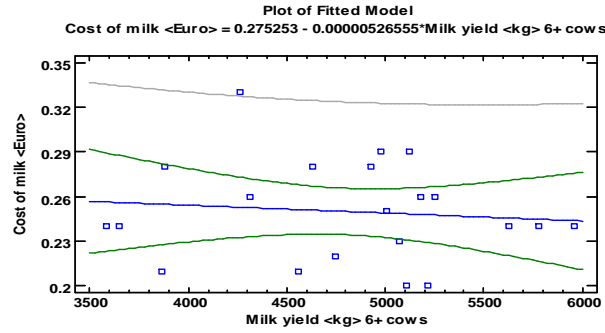
Fig 4: Medium farm Milk Cost (euro) vs. Milk Yield
Cost of milk <Euro> = 0.275253 - 0.00000526555*Milk yield <kg> 6+ cows

Since the P-value in the ANOVA table is greater or equal to 0.05, there is not a statistically significant relationship between Cost of milk <Euro> and Milk yield <kg> 6+ cows at the 95.0% or higher confidence level.

The comparisons of IpF for small and medium sized farms are shown in Table 2:

Table 2: Statistics of IpF for the two sized farms

	Income per farm 2-4 co
Count	20
Average	118.215
Standard deviation	142.282
Coeff. of variation	120.359%
Minimum	-117.2
Maximum	427.7
Range	544.9
Stnd. skewness	0.265922
Stnd. Kurtosis	-0.116564

Table 3: Statistics of the Milk Yield of the two sized farms.

	Milk yield farms with 2-4 cows	Milk yield Farms with 6+ cows
Count	20	21
Average	4694.5	4795.9
Standard deviation	822.061	671.952
Coeff. of variation	17.5111%	14.011%
Minimum	3400.0	3580.0
Maximum	7000.0	5960.0
Range	3600.0	2380.0
Stnd. skewness	1.90359	-0.587996
Stnd. kurtosis	1.73047	-0.527109

The results of table 1 shows that cows of medium farms have produces 101 kg (2,1%) than the cows of small farms.

The Income per Farm in the medium sized farms id 254.4 Euro/year compare with 106.8 Euro/year in the small sized farms or 138% more.

The value of IpF is affected mainly by changes in inventory (increase or decrease in number of animals) and number of kg milk sold on a yearly basis.

The R-Squared statistic indicates that the model as fitted explains 6.57678% of the variability in Income per Farm for the small sized farms and 23.9633% of the variability of IpF for the medium sized farms. The correlation coefficient equals -0.256452 for small sized farms and 0.489523 for the medium sized farms, indicating a relatively weak relationship between the variables.

The average cost of producing a liter of milk for small sized farms was 0,29 Euro/liter and 0,24 Euro/liter for the medium sized farms. Since the P-value in the ANOVA table is greater or equal to 0.05, there is not a statistically significant relationship between Milk Yield and Milk Cost, for both types of farms, at the 95.0% or higher confidence level.

In addition the small sized farms are selling 79,1% of their production and the rest is used for the calves and for the home consumption while the medium sized farms 88,9%.

These preliminary data of our study shows that medium sized farms had better results than the small sized farms for milk yield, production cost and sales.

This is the first study comparing small and medium sized farms and we consider all the preliminary data because the sample that we worked with is considered small and for the future is needed to study it in bigger number of farms. Also, in the next step of the study we will include the calves selling in the farm income.

Conclusion

On the bases on the obtained preliminary data on comparison of small and medium farms in Albania could be concluded:

The economic results are better for medium sized farms than for small sized farms however in other studies we need to consider the beef performance as farmers are using same components of feed for cows and calves.

The most important is that medium farms have better financial indicators than the small ones.

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EFFECT OF REDUCTION OF FEEDING TIME ON THE PERFORMANCE OF GROWING RABBITS

Lumturi SENA[*], Sabah SENA, Ylli BIÇOKU

Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania,
(Corresponding author: lumturisena@yahoo.com)

Abstract

The effect of restricted feeding through a longer time period on the performance parameters and carcasses' qualitative traits of the fattening rabbits was studied. 42 rabbits of six weeks old were grouped into three identical groups. The rabbits under the control group were fed *ad libitum*, while the ones under the two other groups (experimental groups) were fed through some feeding time restrictions, as the following: (7 hours/day) during the two and three first weeks of fattening respectively. Afterwards, up to the age of 14 weeks, all of them were fed *ad libitum* again. At the end of the trial, it was concluded that both the body weight and daily gain were statistically not influenced by the time duration of the restricted feeding. Although the second group of experiment showed a substantial daily feed intake (p 0.01), non significant effects on the feed conversion rate was demonstrated. Feed restriction time for two and three weeks didn't show the same effect on the carcasses' parameters. While percentage of internal organs increased, abdominal fat percentage was reduced with the length of time feed restriction aged at 14 weeks.

Key words: *Rabbits, carcass, feed restriction, performance, body weight.*

Introduction

In the last years, there has been an increased interest in studying feed restriction in rabbits (Tumova *et al.,* 2004; Yakubu *et al*., 2007). Feed restriction has been studied in order to improve biological and economic performance (Tumova *et al*., 2006), i.e. as a means of reducing the costs of production (Yakubu *et al*., 2007).

Feeding strategy in growing rabbits should be used to produce animals with maximum lean body mass, highest feed conversion ratio and maximum body weight. Feeding techniques with potential impacts to improve feed efficiency (Tumova E, et al., 2002) include limiting the intake of energy and protein (qualitative restriction of food) and quantitative feed restriction (Feugier, 2002, Perrier, 1998).A "quantitative" restriction can be applied according to two methods: the time for access to the feeder or the quantity of feed distributed can be reduced (Feugier, 2002; Szendrö *et al*., 2000).

Feed restriction increases feed efficiency (Perrier and Ouhayoun, 1996; T mová *et al.*, 2002; Dalle Zotte *et al.*, 2005), improves digestibility of nutrients in a restricted feeding period (T mová *etal.*, 2004; Di Meo *et al.*, 2007) and can prevent post-weaning digestive disorders (Gidenne *et al.*, 2003).

Limiting the time of feed consumption and availability can avoid feed losses and consumption of larger quantities by the rabbits. This technique can easily be applied in practice and it has some priorities due to a better growth rate of rabbits and a better use of the feed ingredients.

The objective of our investigation was to determine the effects of feed restriction's time duration on growth performance and carcass's traits in growing rabbits.

Material and Methods

The present work was carried out at the rabbit farm in Albania. 42 California Breed rabbits of 6 weeks old were put under the trial. The rabbits were divided into 3 groups of 14 heads each. The control group was fed *ad libitum* throughout the trial's period, while the two other groups were fed within a limited time; as following: the first two weeks (6-8 weeks of age) for one/first group and the first three weeks (from age 6-9 weeks) for the other/second group under the trial. After the feed restriction period of time, the rabbits of both groups were fed *ad libitum*. During the feed restriction time, the rabbits were fed daily within the time interval of 08.00 - 15.00 hrs. Every day, at the end of feeding period (after 15.00) in the experimental group the feed troughs were cleaned to be filled in the next morning. The drinking water was available and not limited all the time. At the beginning of the experiment, the average weight of rabbits under the three groups was similar.

Table 1. Methodical scheme of the experiment

Age in weeks	Control	Experiment 1 (E.1)	Experiment 2 (E.2)
6-14	Ad libitum	6-8 weeks (restricted feeding)	6-9 weeks (restricted feeding)
		8-14 weeks (Ad libitum)	9-14 weeks (Ad libitum)

Rabbits were fed with pelleted feed, containing 17.7% protein and 2890 kcal ME/kg.
All the data were recorded and calculated for each week until week 14, such as: body weight, gained weight, feed consumption and feed conversion.
At the age of 14 week from each group 4 rabbits were starved for about 16 hours, individually weighed, slaughtered, skinned and eviscerated. Eviscerated carcasses with giblets (liver, kidneys and heart) and without the head were weighed individually and dressing percentage was calculated (eviscerated carcass; liver, kidneys and heart in relation to pre-slaughter weight). Cleaned carcasses were divided into parts: hindquarter, forequarter, and loin. These parts, the giblets and the abdominal fat were individually weighed and were calculated as a percentage of their weight in relation to the carcass's weight.
The statistical analyzes were carried out according to SAS program using the following model:

$$Yijk = \mu + Di + Aj + (DA)\,ij + eijk$$

Where:
Yijk = observed value for the requested trait;
μ = overall mean for the requested trait;
Di = fixed effect due to duration of severe restriction;
Aj = fixed effect because of the age;
(DA) ij = effect of correlation between the duration of feed restriction and age;
eijk = random error.

Results and Discussion

Growth performance indicators
Growth performance indicators of the rabbits are presented in Table 2.

Table 2. Performance indicators of rabbits by groups (calculated with the average small squares)

Indicators	Control Group	Experiment 1 (E.1)	Experiment 2 (E.2)
Initial body weight of rabbits (kg)	0.638±0.020	0.635±0.020	0.636±0.020
6-14 weeks (56 days)			
Body weight (kg)	2.243±0.420	2.320±0.420	2.056±0.420
Daily gain (g)	28.661±0.76	30.089±0.76	25.357±0.76
Daily feed consumption (g)	114.82±2.45	110.50±2.45	93.260±2.45
Feed conversion	4.006±0.800	3.672±0.800	3.678±0.800

The rabbits of the E1 group, demonstrated to have a higher body weight than the other two groups at 14 weeks, compared with the ones fed *ad libitum* even higher than the ones restricted fed during three weeks (3.43 and 12.84 %).

The weight gain demonstrated the same tendency as the body weight. Rabbits under the first group of experiment (E1), at 14 weeks gained more than the ones fed *ad libitum* (4.98%) even more than the rabbits under the (E2) second group of experiment (18.66%). The depression in daily gain (in experiment 2) was attributed to the reduction in daily feed intake with increasing the duration of feed restriction. However, for both indicators (body weight and weight gain) differences were statistically non significant ($p > 0.05$).

The survey data are consistent with literature sources. After the feed restriction period, when rabbits were fed *ad libitum* again, there was observed a compensatory growth, while the intensity of this growth is related to the intensity of restriction (Gidenne et al., 2003). The distinctive capability of rabbits to a compensatory growth after feed restriction period was studied about 30 years ago (Lebas and Laplace, 1982; Ledin, 1984) and in recent years (Szendro et al.,1988; Matics et al., 2008).

Statistically significant differences were verified for the amount of daily feed consumption during the week 14 (p 0.01) where the group E.2 seems to be more inferior in comparison with the two other groups. During the week 14, the restricted daily feed for the E.1 and E.2 groups, represents 3.76% and 18.78% of the amount consumed by the *ad-libidum* fed group.

Extension in time, for two and three weeks, of the feed restriction didn't show any significant improvement in the feed conversion of these two groups. The optimal feed conversion was observed in the E.1 group, although differences between groups were not statistically significant. The feed consumption respectively of the E.1 and E.2 group during the 14 weeks of age was 8.34% and 8.19% lower/unit of weight compared with the control group.

These results are close to other sources of literature (Rao et al., 1978) stating that the time limitation of feed consumption/availability in less than 9 hours/day, for the period 4-12 weeks, led to the reduction of the quantity of daily consumed feed in 6-15%, but feed conversion was improved to the extent of 7-13%, while the rabbits' daily weight gain remained unchanged.

Carcass traits

Table 3: Carcass traits of growing rabbits according to the group (average small squares + SE)

Trait	Week	Control Group	Experiment 1 (E.1)	Experiment 2 (E.2)
Starved body weight (g)	14	2140,73±89.95	2250.20±45.98	2007.35±84.70
Carcass's Weight (g)	14	1193.46±60.21	1251.56±20.73	1110.73±17.20
Dressing (%)	14	55.75±0. 54	55.62±0. 85	55.33±1.05
Hindquarter (%)	14	34.94±0. 80	34.11±0. 68	34.20±0.82
Forequarter (%)	14	35.28±0. 88	35.74±1.04	36.08±0.56
Loin (%)	14	19.20±0. 80	19.05±0. 74	19.10±0.73
Giblets (%)	14	6.35±0.035	6.75±0.027	7.20±0.27
Abdominal fat (%)	14	4.23±0.082	4.05±0.030	3.02±0.41

Data in Table 3 indicated that E.1 group was superior in starved body weight at 14 weeks, but differences among treatments were insignificant ($p \quad 0.05$). Dressing percentage was insignificantly decreased with increasing the duration of severe feed restriction at 14 weeks of age. Carcass cut-up parts were not significantly influenced by increasing the duration of severe feed restriction. Feed restriction during two and three weeks did not uniformly affect the carcass's parts. Percentage of giblets increased with the length of time feed restriction aged at 14 weeks. Abdominal fat percentage was reduced to the length of time feed restriction at 14 weeks.

Conclusions

On the bases of obtained results about effect of reduction of feeding time on the performance of growing rabbits could be concluded:
Body weight and daily gain were not statistically influenced by increasing the duration of restricted feeding;

Extension of feed restriction's time reduced the feed consumption by the rabbits,

No significant effect was observed on feed conversion rate while the rabbits were fed restricted during a 2 or 3 weeks period of time,

Carcass traits were not affected by increasing the duration of restricted feeding.

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FEEDING EFFICIENCY OF POLLEN SUBSTITUTES IN A HONEY BEE COLONY

Lumturi SENA[*], Sabah SENA, Anila HODA

Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania
(Corresponding author: lumturisena@yahoo.com)

Abstract

The effect of use of two alternative feed supplies on brood rearing and honey production from the bee colonies during the spring season was tested. Two groups of 9 bee colonies each were established, where the control group was fed with *Bee Food,* as a source of energy, while the experiment group was fed with *Feedbee,* as a pollen substitute. The bee colonies, were almost similar as far as their strength and queen's age (two years old queens). The following indicators were recorded and monitored: brooding rate, caped brooding cells per frame/per group and the respective honey production as well. At the end of the trial's period, it was concluded that the use of *Feedbee*, had a remarkable effect on the number of frames with brood, contributing in the strenght of the bee colonies. During the main inspection in Spring, the supremacy of the group fed on *Feedbee,* over the one fed on *Bee Food,* was easily seen (62.18 cm^2 vs. 59.77cm^2) as far as the caped brood area/frame (cm^2), per $P<0.05$. Feeding the bee colonies with *Feedbee,* starting at the end of winter period, showed a slight effect on the quantity of produced honey per colony (as an average: 630g more honey per colony).

Keywords*: Bee food, bees, Feedbee, honey production, pollen substitute.*

Introduction

Honey bees use pollen as their only source of protein. Nurseries have high demands for protein, since they are producing the high quality protein secretion – the Royal Jelly (Schmickl & Crailsheim, 2001). Honey bees consume abundant protein, to prepare for their function as brood raisers. This protein is stored in the form of vitelloginin in the fat cells (Amdam et al, 2003).

In early spring before pollen and nectar are available or at other times of the year when these materials are in short supply, supplementary feeding may help the colony survive or make it more populous and productive (Standifer L.N, 1977).

The recently developed bee production technologies, pay a much higher attention towards use of manmade,"artificial" protein sources and pollen substitutes. These substitutes content a wide range of components, mainly soybean based products (Kulin evi et al, 1982), yeast micelle and in a lot of cases powder milk (Zaytoon et al, 1988, Ranna et al, 1996). Chemically, these substances might satisfy the bees' requirements for nutrients (for brood production, colony's strengthening and honey production), but they have shown to be inefficient in comparison with pollen (Saffari et al, 2010).

The new diet, named Feedbee, is claimed by the manufacturers (Bee Processing Enterprises Ltd., Toronto, Ontario, Canada) to be constituted as a practically balanced diet based on several factors. These factors include: knowledge of the nutritional requirements, digestive capacity, and pollen consumption by honeybees (Herbert, 2000; Cohen, 2004), nutritional composition of animal feed stuffs (NRC, 1994; Novus International, 1994), chemical content of a honeybee's body and royal jelly (Knecht and Kaatz, 1990), availability of the ingredients in the market, animal and insect feeds and feeding (Jouanin et al., 1998; Wilson et al., 2005;

Cheek, 2005; Macdonald et al., 2002), palatability and anti-nutritional issues (Baumont, 1995; Burgess et al., 1996; Pham-Delègue et al., 2000), pollen chemistry (Somerville, 2001), and production cost.

Based on the above mentioned statements, in order to test the efficiency of this new product within the common situation of normal honey bee colonies activity during the spring time, the following study was carried out.

The aim of the research **was** to test and prove the effect of pollen substitutes (Feedbee) use aiming the improvement of bee colonies performance.

Material and methods

The experiment was performed in an apiary with 30 bee colonies in the surroundings of Tirana within the time frame February –April 2011.

The targeted bee colonies were kept in standard Langstroth beehives with 10 frames. For the purpose of this study, 18 colonies, very much equal to each-other as far as the queen's age and strength were concerned, were selected (2 years old): 9 colonies were dedicated to the Control treatment and were fed with Bee Food (energy food), while the other 9 colonies were put under the Experimental treatment and were fed with Feedbee (as pollen substitute).

During the trial period, the control treatment colonies were fed with 2 kg of bee food and 2.5 kg of sugar syrup (1:1 concentration)/colony. While the ones of the experiment treatment, were fed with 3 kg of Feedbee/colony. Two different kinds of Feedbee were used in this trial, each of them having a specific formula (38.28% and 35% Feedbee). For both treatments the feed was given in a thick patty form. Patty was made by mixing powdered Feedbee with sugar syrup and honey (Standifer et al, 1978). The patties were wrapped with kitchen wax paper to prevent rapid moisture loss. Patties were 1cm thick and 15-20cm in diameter and weighed 500g. After the Feedbee sacks (500g/sack) were placed on the top of frames, they were inspected every 3-4 days. After these sacks were used they were replaced with other ones, avoiding having the bees without feed even for a few hours.

The recorded parameters:

The colony growth rate (for each individual colony in both treatments). The number of frames with brood during the trial.

The total area of caped brooding cells in the colony. Measurement of caped brooding cells determined by measuring sealed brood to the nearest cm^2 using Adobe Photoshop CS3, Version 10.0. This method based estimating capped and uncapped brood (Knopp et al, 2006; Berna Emsen, 2006). Through this operation, two figures were captured: number of pixels which represents the caped brood area (A) and the number of pixels which are included within the image (B), meaning that within the same picture both capped and uncapped parts were selected. Based on these data, the total amount of the caped brood area was calculated and given as a percentage (C) of the total frame's area (C = (A/B) x100%).

Honey production per each colony of each group during the first honey harvesting.

All the recorded results were statistically processed and tested through ANOVA and descreptive analyses, while the comparisons were done thrugh the *t Test*.

Results and discussion

Bee colonies' development (bee population and brooded frames)

Table 1 gives a clear picture on the bee colonies' development between the four inspections. Although the number of brooded frames during the first inspection of the experimental group fed with Feedbee is only 0.65 more, the differences are significant (P 0.05). The application

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of Feedbee immediately after the wintering period, gave its positive impact on the revival and strengthening of the bee colonies. This situation pushed the queens to increase the number of the laid eggs in an average of four frames. During the other two consecutive inspections a light tendency of increased number of caped brood frames can be seen. During the last inspection, the supremacy of the experimental group can be clearly evidenced. The queen has expanded the laid eggs in 0.72 frames more, or in an area which is 8.8% bigger. So, it can be stated that in the colonies fed with Feedbee, the queen has clearly expanded the laying area; a fact which is confirmed by the literature sources as well (Kevan, 2005). But, in order to be able to draw a final conclusion in relation with this factor, it is necessary to measure the average caped brooded areas in each frame of each colony in each group.

Table 1. Number of brooded frames per each colony and each group during the trial

Parameters		M±SD	Variance	T stat	T crit
Control	I	3.4±0.52	0.27	**2.18**	1.83
	II	5.7±1.95	3.79	0.56	1.83
	III	5.7±1.83	3.34	0.84	1.78
	IV	7.5± 0.76	0.57	**-1.86**	1.75
Experiment	I	4.05±0.60	0.36	**2.18**	1.83
	II	6.1±0.88	0.77	0.56	1.83
	III	6.22±0.67	0.44	0.84	1.78
	IV	8.22±0.83	0.69	**-1.86**	1.75

The caped brood area (in cm^2)/frame (digitally measured)
An alternative method of measuring the caped brood area is digital photography. The caped brood area is presented with cm^2/one side of frame in each colony and per group.
On the Table 2, it can be marked the supremacy of the experimental group (4.03% more) related to the size of the area occupied by the caped brood area within the frame and 13.52% more for colony. The mean capped brood area of colonies treated with feedbee were significantly higher (P 0.05) than the colonies fed with bee food (tCrit = 1.65, tStat = 1.83). According to the literatures' recommendations, Feedbee encourages brood-rearing (Kevan, 2005)

Table 2. Total mean capped brood area (cm^2/one side of frame and cm^2/colony) as measured via the Adobe Photoshop CS3 10.0

No.	Control			Experiment		
	M	SD	Variance	M	SD	Variance
1	64.62	2.60	6.76	59.09	8.77	76.97
2	62.80	13.09	171.23	64.31	9.51	90.60
3	60.32	6.11	37.36	61.00	7.28	52.93
4	67.00	14.87	221.08	68.82	8.45	71.32
5	58.94	9.32	86.87	63.98	10.66	113.53
6	59.75	8.92	79.57	62.00	4.15	17.21
7	54.74	7.96	63.35	55.62	10.70	114.55
8	51.45	4.96	24.59	67.44	8.57	73.57
9	55.82	4.16	17.29	61.22	7.11	50.48
Mean (cm^2/one side of frame)	**59.77**	9.88	97.55	**62.18**	9.38	87.98
Total (cm^2/colony)	681.38			773.52		

Honey Production in each group
Honey was harvested on July 30. It should be noted that this year was not a very good year for honey production all over the country, just because of the inappropriate weather conditions. The large amount of precipitations starting in February, March and especially in May and

besides this inappropriate temperatures i. e. low temperature during March and a long draught and hot July, caused an abnormal use of natural feed resources by the bees.
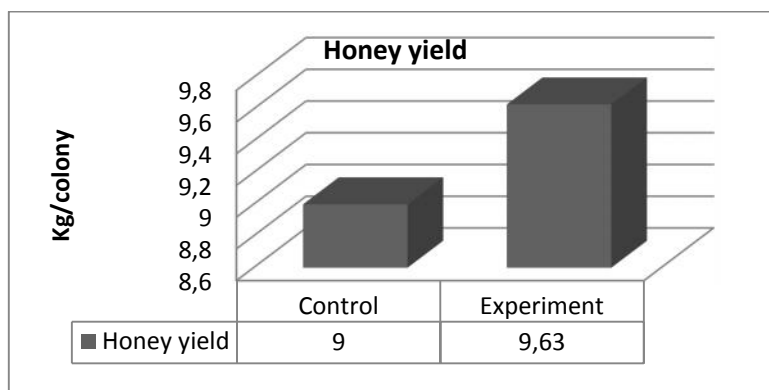
Figure 1. Honey yield by the treatments (Kg/colony)

Referring to the figure 1, it can be seen that the experimental treatment (fed with Feedbee) produced, in average, 630g (6.6%) more honey/colony. Anyhow, there are no statistically significant differences between the two treatments for this indicator.

Feeding supplemental pollen to honey bee colonies improved their performance, as would be expected, but the similar results obtained from feeding Feedbee indicate its high potential for improving colony maintenance, build up and production during a shortage of natural pollen (A Saffari, P G Kevan, J L Atkinson, 2010).

Conclusions

Feedbee was easily accepted by the bees and positively influenced on their performance of the following indicators, during the Spring time:

Feeding with Feedbee had an indicative effect on the increase of brooded frames/colony at the beginning of Spring season (evidenced during the first inspection) influencing on the colonies' revival. Even during the last inspection, the queens of the experimental group expanded the brooding area at a rate of 8.8% more compared with the control treatment.

The use of Feedbee has stimulated the increase of the caped brood area size.

Feeding the beecolonies with Feedbee, starting in early Spring, showed a slight effect on the amount of honey produced/colony.

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BIOLOGICAL CONTROL OF FALL WEBWORM

Miranda TSERODZE[1*], Nikoloz MESKHI[2]

[1]Batumi Shota Rustaveli State University
[2]Georgian Agrarian University
(Corresponding author: miranda.tserodze@googlemail.com)

Abstract

Biological control of *Hyphantria cuanea Druru* (fall webworm) with entomopathogenic fungus Metarhizium anisopliae are given in this article.

Different concentrations of *Metarhizium anisopliae* was tested against on the various developmental larval stages of fall webworm. First and second larval instars were more susceptible than the third instar. At the highest concentration ($1X10^{10}$ spores/ml) of *Metarhizium anisopliae* mortality of first larval instars after 20th days were 100%. Also was tasted affectivity of fungus with different methods of infection. The best infection method of larvae is the method of applying dry preparation of the fungus on the integument. After 10-12 day of infection begins the mass death of pest larvae.

Keywords: *Hyphantria cuanea Druru, Metarhizium anisopliae, Biological control*

Introduction

Insects are the most abundant and diverse organisms that inhabit our planet and are found in all the world's forest ecosystems. Many feed or breed on parts of trees. Some perform important functions, such as pollination or break-down of dead vegetation. Others weaken, deform or kill trees, and compete with humans for the many goods and services that trees and forests provide (1,2).

The most common forest pest in Georgia is Fall webworm (*Hyphantria cuanea* Druru). It's a serious pest of many tries. The larvae feed upon leaves and may cause complete defoliation of trees.

Since 1978 the American fall webworm has been intruded and spread almost on 40,000 ha of land mainly in the West part of Georgia. At present it becomes a serious problem both for forest and agriculture. It should be also mentioned that this pest has high potential for destroy all vegetation that will have very negative influence on the biodiversity and ecological balance.

During many years Georgia is fighting against this pest using different chemical control techniques, certain insecticidal treatments were effective in preventing excessive losses, but increasing restrictions on the use of chemicals has made it imperative to search for other ways to control this pest because chemical control lead to the development of high level resistance and to the negative impact on environment.

As this pest is spread in the populated area (it should be mentioned that it is also spread on Black Coast as well, that is Georgia's main see resort), it is very important to use biological control techniques against this pest to make the pest under control without harming the environment.

Microbial control aims at biological suppression of insect pests by the use of entomopathogens like viruses, fungi, bacteria, protozoa (3,4).

Metarhizium anisopliae (Met.) is entomopathogenic fungus, belonging to the Hyphomycetes group that is natural inhabitants of soil, where it is found infecting a wide range of insect species that spend at least one stage of its life cycle in the soil. It is also found in agricultural crops as epizooties on defoliator lepidopteron larval populations (5,6,7,8).

During sporulation it produce crystal proteins (proteinaceous inclusions), called endotoxins, that have insecticidal action.

Pathogens as biological control agents are receiving increased attention because they provide environmentally safe insect control (7,8).

Material and methods

To control of American white moth with *Metarhizium anisopliae* were tasted 1st, 2nd and 3rd larval instarsof Fall webworm, which were collected from nut tries.

Pathogens were collected from dead larvae of fall webworm and were cultured on glucose agar. 100 larvae's of each instar were inoculated by spraying 30ml of suspension with 2 dosages $1X10^{10}$ and $1X10^{2}$ spores/ml of test concentration.

Affectivity of fungus was tasted from different method of infection. Larvae were infected by applying dry preparation, spraying and feeding of fungal suspension. Fungus was cultured on glucose agar. Mycelia of fungus period of abundant sporulation (after 10-15 days) were dried and made a powder. Suspension where prepared by diluted powder with double distilled sterilized water (1mg/1ml).

Results and discussion

The result showed that the 1st, 2nd larval instars were more susceptible than the 3rd instar. At the highest concentration of *Metarhizium anisopliae* ($1X10^{10}$spores ml) mortality of first larval instars was 100% after 20 days.

Comparatively low concentrations were also effective. In general increasing trend in mortality was a linear positive association between mortality and days of observation (table 1).

The best method of infection is applying dry preparation. After 10-12 day of infection begins the mass death of pest larvae (Table 2).

Table 1. Mortality of Fall webworm with *Metarhizium anisopliae*

	Concentration spores/ml	Mortality %		
		6 days	15 days	20 days
1st	$1X10^{10}$	60	80	100
	$1X10^{2}$	30	65	90
2nd	$1X10^{10}$	40	60	87
	$1X10^{2}$	25	59	85
3rd	$1X10^{10}$	39	57	83
	$1X10^{2}$	20	50	80

Table 2. Death of larvae with different methods of infection

Methods of infection	Instars	Mortality%	
		Days	
		7	10
Applying dry preparation	I	71	98
	II	65	87
	III	55	70
spraying of suspension	I	50	83
	II	44	60
	III	30	50
feeding of fungal suspension	I	42	65
	II	36	55
	III	25	30

Conclusions

Strategies for the use of pathogenic organisms for insect control are basically the same as that for other biological control agents. They may be used to augment naturally occurring pathogens, conserved or activated in nature, introduced into pest populations as classical biological control agents to become established and exert long-term regulation of the pest or are used for rapid short-term control.

The results reported here indicate that *Metarhizium anisopliae* is effective pathogen for the biological control of fall webworm. The present study agrees with the reports where higher doses produced the highest Percentage of mortality. The best infection method of larvae is the method of applying dry preparation of the fungus on the integument.

From the above maintained It is recommended that this strain could be used in Insect Pest Management

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ANALYZE OF ALBANIAN LEGAL FRAMEWORK RELEVANT TO ANIMAL WELFARE

Andon KUME[*]

Faculty of Law, University of Macerata, Italy,
(Corresponding author:andonkume@gmail.com)

Abstract

Currently, Albania doesn't have a specific law regarding issues associated with animal welfare and protection. The only one containing some provisions on this regard is Act No. 10465, 29/9/2011 "On the Veterinary Service in the Republic of Albania" It is the first attempt and accomplishment in the field of animal protection which creates the conditions and the necessary spaces to approximate the Albanian legislation with EU directives and regulations.

A comparison analysis of the Albanian legal framework with different International Convention, as well as, other countries legislations, reveals a general approach of the Albanian legislator and makes obvious the necessity for further developments.

These developments should treat in detail issues related to: (i) animal welfare at slaughter and during transportation, (ii) animals used for experimental purposes and for the production of biological preparations, (iii) pets welfare and protection, d) animals kept in zoos, circuses, pet shops etc, (iv) abandoned or lost animals, (v) wildlife animals protection.

Key words:_welfare, animal, legislation, Albania_

Introduction

Animal welfare is a complex, multi-faceted public policy issue that includes important scientific, ethical, economic and political dimensions. Because food animals are important to human welfare – as a source of nutrition and income – concern for animal welfare is inextricable from concern for human needs. This is particularly the case in countries with developing economies, where current and expected population increases are putting pressure on food security and economic growth (FAO, 2002)

In Europe, animal welfare has been the subject of national legislation and regional agreements for more than a generation, largely due to more exposure to and discomfort with the treatment of animals in industrialized farms and slaughterhouses. In light of increased international trade, globalization of animal health concerns and pressure for harmonization of food safety standards, many other countries are also choosing to regulate animal welfare (Harper & Henson,2001;Mitchell, 2000).

Currently, Albania doesn't have a specific law regarding issues related to animal welfare. The only law containing some provisions on this regard is Act No. 10465, 29/9/2011 "On the Veterinary Service in the Republic of Albania"

The aims of this study is analyze of Albanian legal framework relevant to animal welfare in light of the international legal framework

Animal welfare-European Union
The first animal welfare legislation by the then-European Economic Community (EEC) dates to 1974 when Council Directive 74/577/EEC on the stunning of animals before slaughter was

adopted. EEC legislation on animal welfare mainly involved adopting or incorporating the Coe conventions into the laws of the EEC, and after 1992, into the regulations of the European Community (EC) common agricultural policy and internal market (Horgan, 2006).

The three Council of Europe (Coe) conventions of principal interest for farm animal welfare are:

The European convention for the protection of animals kept for farming purposes(ETS No. 87) of 1976, revised in 1992 (ETS No. 145)[13]. The Convention is a framework convention introducing principles for the housing and management of farm animals, in particular for animals in intensive farming systems. It is complemented by 12 recommendations for specific species (including goats, sheep, pigs, cattle, turkey and other domestic fowl).

The European convention for the protection of animals during international transport (ETS No. 65) of 1968, revised in 2003 (ETS No. 193)[14]. The convention is supplemented by detailed recommendations for the international transport of cattle, sheep, goats, pigs, poultry and horses.

The European convention for the protection of animals for slaughter (ETS No. 102) of 1979[15]. ETS No. 102 covers the treatment of animals in slaughterhouses and slaughter operations.

Two other significant documents that address the future objectives and strategies on animal welfare in the EU are: first, the Community Action Plan on the Protection and Welfare of Animals 2006-2010 (Com (2006) 13) and second, the Animal Health Strategy for the European Union 2007-2013 (Com 539 (2007)) (Horgan, 2006)

National regulation of animal welfare in some European countries

There is much diversity in national legislation on animal welfare. Animal welfare provisions may appear in a free-standing animal welfare law or may form part of a broader law on animal health and welfare or veterinary matters in general. Several countries have adopted constitutional provisions that provides basis for the protection of animals. The most common form of legislation, around the world, criminalizes cruelty against animals. Many nations limit animal welfare statutes to certain animals used in scientific research or entertainment, whereas for farm animals they regulate only slaughter methods (FAO, 2010)

Different European and Balkan region countries have developed animal welfare legislation in multiple forms and levels and for different categories and activities conducted with animals. For example, Czech Republic "Animal Protection Act" (283/1992)requires animal experiments to be approved by the Central Commission for Animal Welfare (CCAW). Legal regulations to protect animals in human care, including laboratory animals, include No. 246/1992 Coll. (Act) on the protection of animals against cruelty and 311/1997 Coll. (Decree) on breeding and use of experimental animals.

In Italy the legislative decree 116 of January 1992, implementing Directive 86/609/ECcontains specific provisions for experiments involving genetically modified animals. Animal experiments are licensed by the Veterinary Department of the Ministry of Health.

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[13]Was adopted by Council Decision 78/923/EEC and then Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes [Official Journal L 221/23 of 8.8.1998].
Council Directive 98/58/EC applied without prejudice to other pre-existing instruments, namely, Directive 88/166/EEC, Directive 91/629/EEC and Directive 91/630/EEC. See Council Directive 98/58/EC, art. 1.3.
[14]Council Regulation (EC) No. 1/2005 on the protection of animals during transport and related operations of 22 December 2004 [Official Journal L 3 of 5.1.2005]
[15]Was adopted by Council Decision 88/306/EEC and updated by Council Directive 93/119/EC. Council Regulation (EC) No. 1099/2009 on the protection of animals at the time of killing of 24 September 2009 [Official Journal L 303/1 of 18.11.2009]

Greece ratified the Convention of the Council of Europe for the protection of vertebrate animals used for experimental and other scientific purposes (1986) by Act 2015/1992. Directive 86/609/EC was transposed into Greek law by p.d. 160/1991, it places control over who is entitled to apply for conducting animal experiments on vertebrate animals under the auspices of the Ministry of Agriculture.

In Romania, "Protection of Animals Act" (205/2004) contains specific provisions with regards to the welfare of laboratory animals. Law no. 305 (2006) ratified the European Convention on the Protection of Vertebrate Animals used for Experiments and Other Scientific Purposes (1986). The Hungarian XXVIII "Animal Welfare Act" of 1998 promotes, the protection of individual animals, the sense of responsibility in humans towards humane treatment of animals, as well as defines the basic rules for the protection of animals.

In Croatia "Animal Protection Act", Zagreb, December 1, 2006, contains provisions regarding:(i)Protection of animals during transport. (ii) Protection at the time of slaughter or humane killing of animals kept for production purposes. (iii) The protection of animals used in experiments and for the production of biological preparations, (iv) Protection of wild animals in nature and Protection of wild animals while they are kept or raised,(v)Protection of companion animals, (vi) Protection of animals in zoological gardens,(vii)Protection of animals used in circuses and other performances involving animals, (viii) Protection of animals used in film and television productions, exhibitions and competitions, (ix)Protection of abandoned and lost animals, (x)Protection of animals in pet shops. Slovenia is one of the Balkan region countries that currently has the most developed legislation in animal welfare field. This legislation contains among others: "Animal Protection Act" (1999). The rules including farm animals that followed the act: Transport rules (2000), Rules on the protection of farm animals (2003), Rules on the killing methods (due to veterinary reasons, for animals, one-day-old chickens and embryos) – 2003, Rules on animals in experiments (2004), Slaughter rules (2005), Animal welfare council rules (2000), Rules on Ethical committee for the animals in experiments (2000). Other important acts and rules including the procedures with farm animals: "Livestock Production Act" (2002), Ecological farming rules (2001), "Agriculture Act" (2000), "Veterinary Service Act" (2001)

The Macedonian "Animal Welfare Act" (January 2008) contains provisions addressing issues related to: (i) protection and welfare of animals kept for farming purposes; (ii) protection and welfare of animals during transport; (iii) protection of animals at slaughter and killing (in slaughterhouses and in diseases control situations); (iv) protection of pets and zoo animals; (v) protection of animals used for experimental or other scientific purposes and (vi) protection of stray animals.

Reflection on Albanian legislation

Currently, Albania doesn't have a specific law regarding issues related to animal welfare. The only law containing some provisions on this regard is Act No. 10465, 29/9/2011 "On the Veterinary Service in the Republic of Albania". It is the first attempt and accomplishment in animal protection field. It creates the conditions and the necessary spaces to approximate the Albanian legislation with EU directives and regulations. The main goals of this law can be listed as follows: (i) protection and improvement of animal and public health, (ii)environment protection and animal reproductive health, (iii) protection of animals from torture and of animal welfare provision, (iv) protection of wild animals. Its objective is to set out the basic principles in animal protection and welfare, according to the international standards of OIE and the EU. It is partially harmonized with 14 directives and 11 regulation of the EU. It defines the concept of "animal welfare", and on these bases develops a legal provision which aims to achieve it.

Section one of Chapter IV lays down general requirements for animal protection and welfare. It states that the animal owners are responsible to comply with these requirements.

Referring to the formulation and the content of these provisions, it is evident, that in some cases, they contain general and repeated statement. For example, art. 64 states: in any case, despite the keeping system used in animal farms, animals should have sufficient spaces to be able to move around freely, in such way to eliminate all the factors that can cause them suffering or injuries, and enable the normal fulfillment of their physiological needs. While the same demands, but much more detailed, are present in art. 66, paragraph c, (ii), (iii), (iv), (v).

Art. 65 contain three different provisions which lack coherence to be part of the same article. In paragraph one is given a general statement that, in unequivocally terms renews one of the main aims of the law (art. 1). Paragraph 2 is a provision which appears to be disconnected and isolated from the others, while paragraph 3 contains a delegation provision, which serves as legal base for bylaw production, and as such it seems to be forcibly involved in this article.

Art. 67, composed of 4 paragraphs, treats issues regarding the welfare of animals used for experimental purposes. This article, compared with provisions that addresses the same matter in other countries legislations, shows that the Albanian legislature has chosen to treat only in general terms issues associated with the welfare of animals used for experimental purposes.

In addition, this article does not treat the case of animals used for the production of biological preparations. The Croatian law on animal welfare contains 14 articles regarding animals used for experimental purposes and for the production of biological preparations, and the Hungarian one contains 11 articles for the same issue. Paragraph 4 of art. 67 states that the breakdown of legal requirements for this matter is to be implemented at the level of regulations/orders that must be approved by the Minister of Agriculture.

Experimental animals are, among others, the subjects who are mostly exposed to action or factors that can cause pain, stress, suffering, etc. While, it is not rare to encounter situations, where scientific staffs, interested in results, omit issues related to animal welfare. In particular, this problem is present in Albania where the experience and culture, but also the legal obligations for the protection of animals used for experimental purposes, have been absent. In order to create a new social behavior, all the requirements are to be set by law. For a better approximation with the EU legislation and international standards, it is necessary to integrate this legislation with provisions regarding to: (i)The breeding of animals for use in experiments and for the production of biological preparations, (ii) Prohibition of the use of animals in experiments, (iii) Notification of experiments, (iv) Examination required to work with animals used for experimental purposes, (v) Notification of the use of animals for the production of biological preparations etc…

In developing countries, as is the case of Albania, it is recommended to create law enforcement public facilities. In Croatia the "Animal Protection Act" established the Ethic Committee as a public institution, which treats problems regarding the use of animals for experimental purposes and for the production of biological preparations. This experience is recommended to be taken in consideration by the Albanian Assembly.

Section 2 treats issues related to animal welfare at slaughter and during transportation.

Art. 68 states that the slaughter of animals should be performed in the most expeditious way, after stunning. The animal must be in a state of complete absence of feeling and sensitivity during all the period of exsanguination. It requires that the remove of extremities and the treatment of a carcass is to be performed only after the animal is totally exsanguinated. This provision establishes in which cases is permitted the slaughter of animals. Notwithstanding this, the provision is not exhaustive. In particular, it lacks the requirement to be met for holding and handling of animals intended to be slaughtered. For a better approximation to the EU standards and legislation it is necessary to add provisions such as: (i) The slaughterhouse must have a covered area with feeding and drinking facilities, and, if necessary, means to tie

the animals. (ii) Animals hostile to each another due to their species, sex, age, or any other reason must be separated, (iii) If the animal is not slaughtered immediately after its arrival to the slaughterhouse food, water, and undisturbed rest must be provided for the animal during its waiting, for slaughter. Sick, weak, or injured animals must be separated without delay and have to be slaughtered separately, (iv) Where animals are slaughtered without previous stunning they have to be fixed in a way suitable to prevent all avoidable pain of the animal, (v) Stunning must cause a state of loss of sensory perception that lasts until exsanguination of the animal after slaughter, (vi) Separate provisions can apply to the slaughter of animals in the following cases: a) slaughter of fowl and rabbits with a method causing immediate death; b)emergency slaughter, if stunning is not possible; c)killing of fur animals, and of farmed game and d)ritual slaughter.

Issues related to animal protection and welfare during transportation are addressed by the Albanian legislator only in general terms. Art. 72, Act No. 10465, 29/9/2011 "On the Veterinary Service in Republic of Albania" states that: During transportation animal health, welfare, physiological and behaviors needs, should be ensured avoiding injuries or unnecessary pain. Animal transportation must take place with specially furnished vehicles. Carriers are required to be equipped with transport license and use vehicles approved by the competent authority. The carriers must be trained and should keep a travel register. This provision empowers the Minister of Agriculture to adopt bylaws for animal welfare during transportation. Likewise, procedures and documentations required for transportation are approved by the Minister. In case of long journey, water feed and rest must be offered to the animals at suitable intervals and should be appropriate in quality and quantity to their species and size. During transportation, transporters and carriers must provide as soon as possible, to sick animals, veterinary medical assistance. In general terms, this legislative solution creates the necessary conditions to develop a legal framework aligned with international standards and EU directives and regulations. It is necessary to draft, in accordance with Art. 72, the respective by law framework. Among others, it must treat issues related to: (i) determination of minimum distances, means of transport and transporter authorization, taking into account the road quality and the Albanian terrain, (ii) transporters training requirements, (iii) conditions of resting or transfer places and assembly centers, (iv) rules of control and maintenance of transport means, (v) parameters regarding sufficient floor area and height, required for animal resting during transportation, in accordance to the animal species, age and physiological conditions, (vii) in case of aquatic animals transportation, parameters regarding the quantity of water needed, adequate temperature, oxygenation facilities etc… according to each species needs.

Section III of Chapter IV treat issues related to animal welfare and protection, with regard to pets and dogs used for professional purposes, like hunting etc… Art. 73 states that dogs or pets owners must, in any case, obtain the veterinary medical passport and should implement the protocol for periodic control and animal vaccination. The same article contains provisions regarding animal housing, feeding, reproduction control and pets behavior in public places.

These provisions are necessary but insufficient. In Albania the pets keeping phenomenon, in particular dogs and cats, is relatively new. The spreading frequencies of this phenomenon are progressively growing. In the meantime the public level of knowledge about animal needs and requirements to ensure their welfare is low. This new culture, in Albania, is now on a formation stage. This fact requires a detailed development of the legislation regarding this category of animals. It should provide, among others, obligation for: (i) local establishment of training centers for the owners (ii) mandatory owners training and equipment with the keeping permission, (iii) local authority control for the fulfillment of the conditions that enable animal welfare and protection, (iv) protection of pets that belong to an alien species, or that are protected by the biodiversity legislation.

Regarding animals that are kept in zoos, circuses or pet shops, art. 74 obliges owners/managers to fulfill the conditions that enable animal welfare and protection. This provision, formulated in such way, expresses only a general requirement, also encountered in other parts of this act. For this category of animals, it is necessary to establish legal conditions, that arises due to the characteristics of activities, for which these animals are kept. It is necessary to establish by law which is the competent authority for permission release and which are the conditions for setting up a zoological garden or for using animals for exhibition or competition.

It is necessary to establish by law special provisions for the protection of animals used in circuses and other performance involving animals. The Croatian law can be a good reference point for this issue.

The Albanian legislation for animal protection and welfare does not contain provisions regarding the protection of abandoned and lost animals, the establishment of an animal shelter and promotion of animal protection.

The provisions regarding wildlife animals established in art. 75, refers only to the case when animals are kept outside their natural environment, in zoos, aquariums, terrariums, circuses, farms etc. Meanwhile, human economic and non, activities produces consequences on wildlife species. This situation is particularly faced in cases of activities related to the exploitation of environmental resources. In order to prevent their negative effects to wildlife animal welfare, it is necessary to establish legal provisions that prohibits actions, by which wild animals in nature are subjected to torture, either as a population or an individual animal, or are prevented from satisfying their physiological needs (eating, drinking, reproduction etc.).

Another disposition which draws attention is art. 76 "Actions contrary to animal welfare". This disposition lists 15 actions which are prohibited by law. It only repeats provisions of other dispositions and does not bring any added legal effects, therefore it should either be reworded or removed.

The Albanian legislation on animal protection and welfare, aims to create a legislative environment which is aligned with the international standards and EU directives and regulations. It is an effort, which has made its first products in terms of this new development of the Albanian legislation, and as such, it should be accepted and considered as a good base for further developments.

Conclusions

Currently, Albania doesn't have a specific law regarding issues associated with animal welfare and protection. The only one containing some provisions on this regard is Act No. 10465, 29/9/2011 "On the Veterinary Service in the Republic of Albania" It is the first attempt and accomplishment in the field of animal protection which creates the conditions and the necessary spaces to approximate the Albanian legislation with EU directives and regulations. A comparison analysis of the Albanian legal framework with the different International Convention, as well as, other countries legislations, reveals a general approach of the Albanian legislator and makes obvious the necessity for further developments. These developments should treat in detail issues related to: (i) animal welfare at slaughter and during transportation, (ii) animals used for experimental purposes and for the production of biological preparations, (iii) pets welfare and protection, d) animals kept in zoos, circuses, pet shops etc, (iv) abandoned or lost animals, (v) wildlife animals protection.

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TRADITIONAL PRODUCTION OF BEATEN CHEESE

Goce TALEVSKI[1*]

[1]IMB "Mlekara"-Bitola, Macedonia
(Corresponding author: g.talevski@t-home.mk)

Abstract

Cheese production in Macedonia is mainly based on 4 products including: White brined cheese, Kashkaval, Urda (whey cheese) and Beaten cheese.

The Beaten cheese is an indigenous dairy product which dates from the Ottoman Empire, formerly produced by sheep milk, but today mostly from cow's milk, and have a real chance to get a protected denomination of origin.

This paper presents the results of examination of the traditional production of Beaten cheese from cow's milk in Mariovo region.After 45 days of ripening the Beaten cheese had average results for following parameters: pH (5.35), titrable acidity (66 ^{0}SH), moisture (38.78%), dry matter (61.22%), milk fat (25.73%), milk fat in dry matter (42.16%), protein (27.44%), ash (9.18%) and salt (5.15%).

Lack of hygienic procedures during the manufacture of Beaten cheese was the reason for detection of *E. coli, Enterobacteriaceae* and coagulase positive staphylococci in the final product.

Key words: *Beaten chees , traditional production, Mariovo region.*

Introduction

Beaten cheese is a typical indigenous dairy product in Macedonia with the central area of production in Mariovo region. Depending on the production site there are more varieties of beaten cheese: Kumanovsko zolto sirenje, Tetovsko, Malesevsko etc.,whichare based on the same technology with minimal differences among them.

According to some literature data it was invented by Vlach pastoralists - nomads and was known as Vlach cheese (Matkovski, 1996).

Specific manner of production when the curd is beating, contributed to appoint as "beaten cheese", while the high content of salt 5-10% allowed to be consumed in small amounts by the poor population was reason to get the name "sirotinsko sirenje" (cheese for poor) (Kapac-Parka eva, 1988).

Negative trend in sheep breeding in Macedonia have contributed to reduce the number of sheep, from the golden age in the mid-19th century when there were about 7-9 million sheep, the number reducing to around 767.000 according to official statistics(Državen zavod za statistika, 2012).

Thus the main raw material base for production of beaten cheese is cow's milk, while smaller quantities are produced from sheep, goat and mixed milk.

Beaten cheese is hard, fat cheese with spongy appearance, which ripened in brine, with a great diversity in production and unequalnon-standard quality. By adopting the quality laws of agricultural products (Služben vesnik na RM, 2010) as well as secondary legislation, in the Republic of Macedonia are established three protected designations: protected designation of origin, protected geographical indication and traditional speciality guaranteed. The creation of a national standard for beaten cheese makes an opportunity for this indigenous milk product to receive some of the protected designations, and consequently higher market value.

The aim of this paper is to present the indigenous technology, chemical composition and microbiological quality of beaten cheese produced in the traditional way.

Materials and methods

Field research in this paper was conducted in households in Mariovo region which produces beaten cheese on the indigenous way. Analysis of raw cow's milk was performed in independent laboratory "Pelagonija-Mlekokontrol" - Bitola on the following methods:
Milk fat, protein, lactose and dry matter with an infrared analyzer Lactoscope (Delta Instruments - Holland)
Active acidity (pH) (with pH-meter Mettler Toledo)
Titrable acidity (^{0}SH) (by the method of Soxhlet – Henkel)
Total number of somatic cells (with instrument Somascope)
Total number of bacteria (with instrument Bactoscan FC).
Ten samples of beaten cheese were analyzed at the Faculty of Agriculture and Food in Skopje by the following methods described by Cari et al. (2000):
pH of cheese (with a pH-meter, mark Mettler Toledo)
Titrable acidity (by the method of Soxhlet-Henkel, modified by Moress)
Dry matter (drying to constant weight, standard AOAC: 1995)
Contents of milk fat (by the method of Soxhlet - Henkel)
Content of total protein (by the method of Kjeldahl, standard AOAC: 1995)
Content of ash and salt (by methods according Inihov, 1971);

Microbiological analyzes of cheese after 45 days ripening were made at the Faculty of Veterinary Medicine - Skopje, under the Regulation for specific requirements for food safety in terms of microbiological criteria (Služben vesnik na RM, 2008). Statistical data processing was performed using the program package STATISTICA-Stat Soft, Inc. Version 6. (2001).

Results and discussion

The quality of raw cow's milk was used for the production of beaten cheese is shown in Table 1 and can be found that is relatively good. The individual milk producers often in the case of unconditioned milk, which appears with increased acidity, being processed in beaten cheese as a final compromised solution.

Table 1. Chemical-physical characteristics and hygienic quality of milk for beaten cheese (n=10).

Parameter	x̄	SD	CV (%)
Milk fat (%)	3.65	0.19	5.22
Proteins (%)	3.27	0.10	2.98
Lactose (%)	4.47	0.05	1.01
Dry matter (%)	12.75	0.24	1.89
pH	6.62	0.09	1.39
Titrable acidity (^{0}SH)	6.76	0.21	3.06
TCSC/ml	339800	36533.55	10.75
TCB/ml	257600	91917.35	35.68

Weak sanitation procedures in the processing of milk in the traditional way are noted by Kakurinov (2002), who found that raw milk contains from 2.7×10^6 to 1.0×10^8/ ml total number of bacteria. In 66.6% of examined varieties of beaten cheese, the author found 1×10^6/g cheese coliform bacteria and yeasts that cause early blowing and other sensory defects in cheese.

Poor microbiological situation is the result of the use of wooden vessels, vats, kjurkalo (wooden stick for processing curd) which are difficult to wash and then use the wool strainers, and in the past by using homemade rennet of lamb stomachs. Indigenous way of making beaten cheese is shown in Scheme 1, while the chemical composition of cheese is shown inTable 2.

In the past in the processing of the curd, a part of the fat was separated and used in the diet of the population so that the cheese belonged in fat cheese. The scalding of the curd has also seen a lot of changes because in the past a hollow black stones were heated in the fire and put directly in the curd. This cheese got dirty gray color, parts of the stones fell into the cheese and the curd was improperly heated. Later the scalding is changed by adding hot water or heating fire.

This thermal treatment of curd enhances microbial status and leads to a significant reduction in the total number of bacteria according with the results of Šuti (1964), whoindicates that after the scalding of baskija at 75 ^{0}C 13% of the total number of bacteria remains,while at 85 ^{0}C 0.05% of the initial number of bacteria before scalding of the baskija remains.

Scheme 1. Technological scheme for indigenous manufacture of beaten cheese.

Draining the milk through cloth

Heating to 35-36 ^{0}C and coagulation with liquid rennet (1:5000 strength)

Processing of curd (beaten with kjurkalo, drainage of whey)

Heating of curd on 53-55 ^{0}C (with hot water or heater)

Kneading and collecting of curd in ball

Self pressing with hanging in the cloth 16-18 h

Ripening at 25-30 ^{0}C, 5-7 days, sunbathing of balls

Cutting strips and dry salting with coarsesalt 1-2 days

Packaging in cans and filling with brine (15-25 ^{0}Be)

Ripening at 16-20 ^{0}C

Storage

Lethal effect of high heat treatment on coliform bacteria highlighted Spano et al. (2003) where afterthe heat treatment of curd at temperature of 80 ^{0}C for 5 minutes in the manufacture of Mozzarella cheese the presence of *E.coli* was not identified.

Kneading the curd, self pressing with hanging in the cloth and ripening, aims to remove excess whey and properly directed the lactic acid fermentation.

The most important bacteria in the initial stage of beaten cheese ripening was lactic acid cocci with main representative species *(Cit $^{-}$) Lactococcus lactis ssp. lactis* and in the further course of fermentation predominate rod-shaped lactic acid bacteria with the highest representation of *Lactobacterium plantarum* (Levkov and Kakurinov, 2007).

During ripening some manufacturers wash the cheese with warm whey and sunbathe it, so it gets a nice yellow color and in certain areas is called yellow cheese.

Salting is also quite specific procedure for this type of cheese because brine with high strength 15-25 ^{0}Be is usedwhich causes intense migration of moisture giving cheese with a hard consistency.

Salting wasformerly done by making holes in cheese itself and putting coarse salt in them.

The average salt content of 5.15% in our tests compared with previous research of beatencheese (Kapac-Parka eva, 1988; Micev, 1966) shows lower values compared to their scores from 6.75-7.93% salt.

Table 2. Physico-chemical composition of beaten cheese during ripening (n=10).

Investigated parameters (%)	Period of ripening (day)		
	2 (day)	20 (days)	45 (days)
Moisture	47.02	39.60	38.78
Dry matter	52.98	60.40	61.22
Milk fat	23.43	26.39	25.73
MFDM	44.25	43.68	42.16
Proteins	27.06	27.20	27.44
Ash	2.91	8.49	9.18
Salt	0	5.08	5.15
Titrable acidity (^{0}SH)	46	64	66
pH	5.61	5.42	5.37

Moisture after 45 days ripening reached 38.78%, which affects the ripening of this cheese andis slower compared to cheeses with higher moisture (semihard, soft cheese).

The slow ripening can be noted from achieved pH value of 5.37 and titrable acidity of 66 ^{0}SH. Total protein contenthad similar values as the beaten cheese produced in industrial way described by Radevska et al. (2003).

The ash content in cheese is directly correlated with its amount in the milk and affect on rheological characteristics of the final product. From the results shown in Table 2 it could instead can be concluded that the dynamics of ash shows continuous increase from2.91% at the beginning to 9.18% at the end of the ripening of cheese.

Production of beaten cheese from raw cow's milk results with the appearance of enterococci that according Giraffa (2003), are tolerant on temperatures of 10-45 ^{0}C, pH of 4.0-9.0 and salt concentration of 6.5%.

The presence of *E.coli* is a sign of fecal contamination of milk and poor hygiene in primary production, while the low number of coagulase positive staphylococci is result of scalding of curd with hot water carrying their reduction (Gomez-Lucia et al., 2008).

The yield of beaten cheese from cow's milk produced in the traditional way ranges from 10 to 11 liters of milk per 1 kg of cheese.

Table 3. Microbiological quality of beaten cheese (n=10).

Bacterial species	x̄	Min	max
Enterobacteriaceae	1420	260	3000
E. coli	477	0	1300
Coagulase positive staphylococcus	40	5	110
Listeria monocitogenes	0	0	0
Salmonella spp.	0	0	0

Beaten cheese as an indigenous dairy product in Macedonia has a real chance to get a protected denomination of origin. According to Babcock and Clemens (2004), products with protected geographical designations achieve higher market prices, support rural development, contribute to the protection of biodiversity, have been promoting certain regions, opening of new jobs etc.

Protecting of the beaten cheese will prevent possible fakes in the market and keep the unique and original flavor. For this purpose, besides the already adopted legislation, the state together with municipalities and scientific institutions should undertake a media campaign, financial support and appropriate training for producers, support for the development of scientific studies, elaborate and specifications and other activities that would preserve the traditional way of producing this indigenous product.

Conclusion

The beaten cheese in the past is used mostly by poor population, but today is a valued product in Macedonian kitchen. Production from raw milk contributes to the presence of a wide range of bacterial species that give a unique and distinctive taste, but poor hygiene in rural households can contribute to the presence of pathogenic species.

This indigenous product have a real chance to get a protected denomination of origin which would have mutual benefit for producers and consumers of this type of cheese.

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PHEASANT AND HARE REARING IN CONTROLLED ENVIRONMENT AS A MEASURE FOR SECURING THEIR NUMBERS AT THE HUNTING GROUNDS

Nenad DJORDJEVIC[1*], Zoran POPOVIC[1], Dejan BEUKOVIC[2], Milos BEUKOVIC[2], Milutin DJORDJEVIC[3]

[1]University of Belgrade, Faculty of Agriculture, Serbia,
[2]University of Novi Sad, Faculty of Agriculture, Serbia
[3]University of Belgrade, Faculty of veterinary medicine, Serbia
(Corresponding author: nesadj@agrif.bg.ac.rs)

Abstract

In this paper we have given the review of domestic as well as foreign experiences connected to pheasant and hare controlled breeding with goal to inhabit them at hunting grounds that with heavily changed habitat.

Technology of rearing pheasant in pheasant farms is almost brought to perfection. Production per peahen is couple of tens of chicks during year (in Serbian farm conditions 18-27). This technology has two segments: a) rearing the mother flock and production of incubation eggs; b) rearing of chicks up to the age of 8 weeks and their inhabiting at the hunting grounds. Except proper rearing conditions (housing, temperature...) it is very important to provide good diet for all age categories. Compared to pheasant farms, rearing hares in controlled environment has not given significant results. Per couple during year it is possible to get kindle of only 2-2.5 kits, which does not justify the finances invested in their rearing. Even today the best solution is to capture live hares from hunting grounds where they are in large numbers and their transporting to the other grounds where they are in smaller numbers.

Key words: *pheasant, hare, breeding farm.*

Introduction

Pheasant and hare are the favourite and the most numerous wild game species in Serbia. In recent years, it is evident a significant reduction in the number of population of these game here and in Europe. This reduction in the case of hare population in many countries is alarming (Jennings et al., 2006). The reasons are numerous, but the most important are significantly modified living conditions, which reduce the ability of natural reproduction and limited natural food resources (or evi et al., 2008, 2012), with increased hunting percentage (Popovi et al., 2012). In such changed conditions there are two possibilities: one is the protection of certain populations of pheasants and hares (complete prohibition or limitation of hunting ...) and the second is the settlement of the animals from other hunting grounds (hare) or grown in the facilities - aviaries and cages (pheasant, eventually hare). Protection of game populations with hunting prohibition gives limited results. Therefore, it is being intensively worked on finding the most effective solutions for artificial breeding of pheasants and hare and settlement of the hunting grounds. For the practice significant results were achieved in the pheasant breeding in aviaries, after which they were settled in the hunting grounds (or evi et al., 2010a, 2012c), whereas the hare breeding in facilities still have no greater significance due to a number of unsolved problems.

Pheasant breeding in the facilities

The main reasons for the evident reduction in the number of pheasants in the hunting grounds in Serbia are: significantly reduced range, bad natural resources of food, agriculture machinery and chemicals use, various predators and others. In experiments, Hoodles et al. (2001) has shown that additional feeding of pheasants in the nature during the spring breeding period did not affect the number of laid eggs. Therefore, the pheasant breeding is controlled in the breeding house and the bred offspring with the appropriate age and after an appropriate adaptation is settled in hunting grounds (or evi et al., 2011a).

There are over thirty registered breeding unit in Serbia and the largest pheasant farm is "Ristova a" in Ba , owned by PC "Vojvodina sume", whose capacity is about 11,000 units in the parent flock (Popovi et al., 2011a). Breeding technology is consisted of several segments: parent flock breading, eggs production for incubation and breeding of pheasant chickens under controlled conditions until the age of 6 weeks (Popovi et al., 2011b). Farm hatchery involves keeping different categories of pheasants in large numbers in a small area that is a major health risk (or evi et al., 2012d).

There are two basic modes of production, one is the completed process (production of eggs in the parent flock, egg incubation, breeding of the pheasant chickens), and the second involves only breeding pheasant chickens (originating from other pheasant farm is). In the completed process parent flock of pheasants is kept in aviaries with the floor area per unit of 5-10 m^2. In earlier years, it was practiced the holding of the parent flock in families, with a sex ratio 1:8 in favour of females. Today collectively keeping is applied (80-140 birds per box), which proved to be more practical. In this method of holding, the capacity is from 5 to 10% lower, but the percentage of fertility ranges from 80 to 95% (Popovi and Stankovi , 2009). Feeding and egg collecting is done twice a day.

The pheasants began to lay eggs in mid-April (selected parental flock and earlier) and laying period lasts until the end of June and beginning of July. The pheasant's needs are different out of egg laying period and in the laying season. Abstained need for pheasants in captivity amounts 40-55 g of grains or a simpler mixture. However, the needs of the pheasant hens and pheasant chickens are significantly higher. The pheasant hen in the nature lays 12-18 egg mass of 28-29 g per egg, while in the aviary lays up to 60 eggs for about 3 months (Popovi and or evi , 2009). The parent flock of pheasants should be fed with cattle feed containing for layers from January. In the laying period, the daily amount of the pelleted concentrate is 80 g, respectively, for the entire period of laying approximately 7,2 kg.

Pheasant chickens are exclusively obtained by incubating the eggs for 24 days. In Serbia is registered 15 pheasant farm dealing with incubating eggs, 14 of which have their own production of hatching eggs. However, used equipment (incubators) is very old and only three pheasant farm have incubators that are manufactured after 2000. (Popovi et al., 2011a). Homemade testing on pheasant farms of Vinik and Rit have confirmed the existence of large differences in the percentage of hatched chickens as a result of various factors (Table 1).

Standard way breeding pheasant chickens up to 6 weeks of age is based on the floor or breeding battery cage system. After the second week of age, pheasant chickens can come out from the closed facility through drains, and after 30 days (eventually 35) they are settled in aviaries. From that moment begins the preparation for the settlement in the hunting grounds (the so-called getting wild). Pheasant chickens old eighth weeks should be fully prepared for the life in the hunting grounds. Feeding in the breeding house is very intensive and early breeding of the pheasant chickens it is exclusively conducted with concentrates (Popovi and or evi , 2009). Later, in order to imitate natural food, meals are supplemented with grainy and green food (Kokoszynski et al., 2008). According to the NRP (1994) levels of protein in

the mixtures for the first phase of breeding pheasants (0-4 weeks) was 28% for the second (4-9 weeks) it was 24% and for the third (9-16 weeks) it was 18%.

Ristić et al. (1995) state that in Ireland about 70% of the pheasant chickens of settled hunting grounds get killed for various reasons until the age of 12 weeks. That is why more and more pheasant chickens are settled gradually, from the special facilities-shelters. In these facilities pheasant chickens got food and water for some time, until completely customize the hunting conditions. Young pheasants should be supplemental fed until hunting season to reduce mortality and increase the hunting supply (Đorđević et al., 2009, 2010b,c, 2011b, 2012b). In some Western countries, this measure is a regular in the hunting ground management (Sage et al., 2002).

Table 1. The percentage of hatched to the number of eggs to lay (Popović and Stanković, 2009)

Pheasant farm	Year	Number to lay eggs	Percentage to lay out of eggs laid	Total number of hatched pheasant chicken during the season	Percentage hatched pheasant chicken of total to lay eggs in a season	Average number hatched pheasant chicken per pheasant femail per year
Vinik	2002nd	27,720	91.14	14,109	50.90[b]	21.12
	2003rd	20,135	94.69	14,027	69.66[a]	27.67
	2004th	24,172	99.30	14,800	61.23[ab]	26.76
Rit	2002nd	25,000	55.87	17,700	70.80[ns]	18.04
	2003rd	34,000	77.16	23,410	68.85[ns]	23.89
	2004th	40,000	76.00	28,210	70.53[ns]	24.24
Significance examined the impact of factors						
Year		-	-	-	$P > 0.05$	-
Pheasant farm		-	-	-	$P < 0.05$	-
Year ×Pheasant farm		-	-	-	$P < 0.05$	-

Growing hares in facilities

According to Popović et al. (2012) in the last decade, the largest number of hares was found in Serbia in 2005 (629 639 animals) followed by decrease, with the exception of Vojvodina (Beuković et al., 2011a). At the same time, there has been an increase in the percentage of hunting, from 14.26% to 18.02%. For obvious trend of decreasing of abundance the most responsible are: significantly modified living conditions, increased use of herbicides, as well as a variety of infectious diseases (Popović et al., 2008) and should be added the direct influence of man. The biggest impacts on the size of the game population in the hunting grounds have the users of the hunting grounds through the degree of utilization of the game populations.

Attempts of the cage breeding of the hares for the settlement of the hunting grounds so far have not been satisfactory, in order to be widely accepted in the hunting industry. On this issue so far is mostly done in Italy and France. As stated Gajić and Popović (2010), in technology of the hares breeding cage there are many problems, and just few have been solved until now: a) feeding forages (dry and fresh), b) hygiene of boxes, and prophylaxis and c) releasing three months young hares in the hunting ground d) the profitability of production.

Problem of the hares feding in cage system was partly solved by using pelled food (Beukovi et al., 2011b). Should have in mind that feeding hares is very diverse in the nature and it is based on green foods. Frylestam (1986) in Sweden found that hares prefer wild plant species and their feeding is significantly varied in areas with natural grasslands (37 species consumed) of the relation to the area under monocultures (14 species consumed). Reichlin et al. (2006), stated that although in the European hares feeding dominated cultivated plants, the animal prefers weeds and wild grass, if they are available. As for the other problems, cage hygiene and prophylactic measures can be well controlled, although sometimes there are some increased losses. However, releasing „semi tame" hares in the hunting grounds has not been solved in an appropriate manner until now so that predators (Popovi et al., 2009) kill a significant number of young.

Production of the hares is carried out in the cages consisting of open and closed (wired) part. For easier hygiene, floors are made of wire. Males and females are separately held throughout the year and they are together only during the mating season. Good results are considered when per litter gets 4-5 of young during 3-4 braking (Gaji and Popovi, 2010). In studies Slame ka et al. (1997) in three-year period of the cage breeding hares decided upon 3.6 to 6.9 young, although the authors give very different results found in the available literature. There are great losses of young that are19 to 36%. Reproductive period is similar in wild hares, and gestation lasts 42 days. However, these results are less profitable than pheasants breeding of the in aviaries (Mertin et al., 2010). Intensive work on solving the remaining problems, such action may become significant in the near future to maintain the number of hares.

Conclusion

The abundance of pheasants and hares in the hunting grounds of the Serbia in recent years is constantly decreasing. Reproduction of pheasant in the pheasants farm is crucial to maintain the number of population of the game, while of the hares cages breeding does not give good results. For the maximum use of the potential of a large number of pheasant farm in Serbia it is necessary to fix the financial situation of hunting organizations that will buy young pheasants (for example, improvement of hunting tourism as a source of income). In addition, it should continue to examine the opportunities for greater survival of young pheasants that are settled in the hunting grounds (for now only 30%). In contrast, for the hares cage breeding is necessary to increase profitability, and significantly improve the preparedness of young rabbits for settlement.

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HIGH DOSES OF MICROELEMENTS AND ORGANIC ACIDS IN THE DIET OF WEANED PIGLETS

Vidica STANACEV[1*], Sava ZARIC[1], Dragan MILIC[2], Milos BEUKOVIC[1], Nikola PUVACA[1], Vladislav STANACEV[2]

[1]University of Novi Sad, Faculty of Agriculture, Department of Animal Science, Novi Sad, Serbia
[2]Perutnina Ptuj - Topiko a.d., Backa Topola, Serbia
(Corresponding author: vidica.stanacev@stocarstvo.edu.rs)

Abstract

Maybe weaning, regardless of age, represent a strong stress caused by the loss of the sow milk, changing places and groups for transfer to the nursery and the changing structure of the meal. In such conditions of stress occurs long delay in growth, followed by serious disorders of the digestive tract, often in huge losses. The aim of this paper was to show the effect of high doses of zinc and copper, and citric acid in the diet of weaned piglets on the dynamics of growth, consumption and feed conversion, health status and cost of feeding. The experiment was conducted in production on a total of 381 piglets which was divided according to gender, age and body weight into two groups. Two mixtures were used, the starter and grower. Starter mixture was different, while the grower mixture was similar in both groups. Control group (I) were fed with diet containing 20% protein, while the experimental group (II) was fed with diet containing 18% protein with addition of extended premix, containing high doses of zinc, copper and citric acid. Based on the results it can be concluded that the use of citric acid and high stimulation doses of copper and zinc in the experimental group led to the improvement of all parameters. In the first 16 days, daily weight gain of piglets in the experimental group (II) was increased by 203.85% and feed conversion decreased by 25% compared to the control group. Mortality of the piglets decreased from 7.33%, as it was in the control group to 4.21% in group II. Price for one kilogram of weight gain in group (I) was 198.2 din/kg, while in group (II) price was 107, 7 din/kg. The inclusion of high stimulation doses of zinc and copper and organic acids led to a significant increase in daily gain, better feed utilization, reduced piglet mortality and lower feeding costs.

Key words: *piglets, nutrition, citric acid, zinc, copper.*

Introduction

Maybe weaning of piglets in intensive farm conditions production is great stress, without matter on their age in time of maybe weaning. Reason for this is transfer of piglets in diametrically different conditions in view of nutrition conditions, accommodation and transport. If the maybe weaningof piglets is done earlier their requirements in view conditions accommodation and meals are larger, and it is more difficult the provide adequate condition and for more is stress larger, and often leaves serious consequences which represent the negative reflection on later production. With the process of maybe weaning, piglets currently lose sows milk, which is the most important and only source of nutrient substances during the sucking period. In time of maybe weaning, enzymatic system of digestive tract of piglets is not adjusted for efficiently utilization of dry feed, which after weaning is only source of nutrient substances, which structure and utilization is incomparably lower in compared with sows milk (Kov in 1993, Hopwood and Hampson 2003). It inevitably leads to great delay in

growth, which can be followed by high economic losses, often influenced by inadequate medical treatment. Time of piglets maybe weaning is reduced from about 8 weeks on average weaneding time to an 22-26 day of age. On most farms weaneding is done in age from 4 to 5 weeks, when body weight of piglets is about 6 to7kg (Costa et al., 2004). Limited activity and ability of piglets digestive tract in time of weaning requires maximum adjustment of diet structure. It is very important to care about the level and source of protein and also on the source and level of energy in diet (Tokach et al., 2003). Organic acid as feed additives in piglets diets gave a very good results due that fact, their introduction in piglets diet is necessary before weaning and immediately after weaning. In previous period the most used is fumaric, citric, lactic, propionic and formic acid, and of inorganic phosphorus acid. In time of piglets weaning in stomach there is no secreted HCl in adequate amount which is necessary for maintenance of optimal pH value of gastric juice, and efficiently welding feed proteins. It is also necessary that the amount of pepsin begins diff sting of protein, which altogether causes disorder in feed digestion and occurrence in diarrhea. Addition to lowering pH values and activation of pepsin, supplemented acid blocks uncontrolled development of microorganisms, especially E coli, which can not be developed in acid environment (Cromwell, 2001). One of opportunities to solve these problems is usage of high dose of micronutrients such as copper and zinc. Copper within the normal range has numerous features in organism and high dose of 100-250 ppm exhibit stimulatory effects. Zinc is integral part of enzyme and hormone insulin. In conditions when there is no sufficient quantity of zinc in feed or his reabsorption comes down, it led to a reduced appetite, reduced weigh gain, higher feed conversion, disorders in metabolism of carbohydrates, fats and proteins, as well as disorders in reproduction. Pigs need in zinc varies in wide interval and they are result are of many factors. Use of very high concentration of zinc oxide in prevention of phenomena and diarrhea through feed of weaned piglets started before two decades (Mavromichalis et al., 2000; Hill et al., 2001; Carlson et al., 2004; Davis et al., 2004; Buff et al., 2005). Aim of this work was to detect the effect of high dose of zinc in form of zinc oxide and copper in form of copper sulphate and citrus acid in nutrition of weaned piglets on growth dynamics, feed consumption and feed conversion, the health status and economic cost of weaned piglets.

Materials and methods

Experiment is derived under practical conditions on pigs farm "Stari Tamiš" in Pan evo. In experiment were involved 381 weaned piglets, which were according to body weight, gender, and age divided in two groups of 191 and 190 individuals. Every group is placed in 28 boxes in two-level cages. In each boxing is placed by 7 piglets of the same gender. Both groups of piglets are held in same farm chamber, under identical microclimatic condition. During the experiment piglets are measured after 16 days and on end experiment. After weaning and groups formation piglets were fed mixtures which composition is given in table 1. During the experiment, two nutritional mixture were used, starter and grover. Starter mixture was of different composition, while grover mixture was the same composition in both groups. In control group starter mixture was of standard quality, which is the used on farm, while in other group was used mixture which effect is examined. Used starter mixture was different. Weaned piglets in group with new starter were fed ad libitum, without feed restrictions. In control group piglets were fed starter mixture of standard composition with limitation in first 7 days, gradually increase feed quantity. After 16 days piglets of both group were fed with grover mixture of same composition that is used on farm.

Table 1. Composition and nutritional values of mixtures in experiment

Mixture	Starter		Grover
Group	I	II	Both groups
Corn	21.00	59.30	63.45
Wheat	20.00	0.00	0.00
Alfalfa	2.50	0.00	0.00
Soybean meal	8.00	15.00	16.00
Fullfat soy	14.00	10.00	13.00
Sunflower meal	0.00	0.00	4.00
Fish flour	6.00	4.00	0.00
Milk in powder	5.00	0.00	0.00
Whey	5.00	0.00	0.00
Yeast	2.00	0.00	0.00
Oil	4.00	0.00	0.00
Lysine	0.00	0.00	0.10
Sugar	10.00	0.00	0.00
Dicalcium phosphate	1.00	1.40	1.15
Chalk	0.00	0.30	1.00
Salt	0.50	0.00	0.30
Premix, 1%	1.00	0.00	1.00
Premix, 10%	0.00	10.00	0.00
In total	100.00	100.00	100.00
Feed prices, din/kg	59.34	42.73	24.67

* - In price are count only rates of individual feedstuffs: corn 17, wheat 19, 30 alfalfa 30, soybean meal 37, Fullfatsoy 40, sunflower meal 13, fish flour 135, powder milk 250, whey 137, yeast 60, oil 80, lysine 240, sugar 90, dicalcium phosphate 60, chalk 4, salt 10, 1% premix 108, premix 10% 167 dinars.

Gained results in experiment are processed as average value treatment and displayed in table form. Data on daily gain are processed with statistical method of variance analysis and tested with t - test. Statistical data processing was done in program software "Statistics 10".

Results and discussion

Of total piglets number involved in experiment, in first 16 days died 5 piglets, 2.62% in group I and 4 piglets or 2.15% in group II, which was on the treatment with the new premix in diet (Table 2). In second part of the experiment, mortality of piglets in the group I were higher, 9 piglets or 4.84%, while in group II died 4 piglets or 2.20%. During the whole experimental period in group I died 14 piglets or 7.33%, which is considerably more than in the second group, where died 8 piglets or 4.21%.

Table 2. Quantity of piglets and mortality in experiment

Group	Control		Experimental	
Protein level in mixture, %	20		18	
Premix	Premix 1%		Premix 10%	
	N	%	n	%
Number of piglets on beginning	191	100	190	100
Mortality in first 16 days	5	2.62	4	2.15
Mortality after 16 days	9	4.84	4	2,2 0
Mortality in total	14	7.33	8	4.21
Number of piglets at the end	177	92.67	182	95.79

Regardless of the total number of piglets in the group was small, it would be on the basis that it reliably appreciate the difference in the amount of mortality, the results do indicate a tendency to decrease, with the expanded use of new premix, which was used in the mixture which reduced the level of proteins involved citric acid and high levels of zinc and copper.

In first period piglets in I group are achieved average only about kilogram increment by indivi dual,   which is considerably lower of increment of this same piglets had in sucking   period. Another group of pigs, which is in a mixture with a new premix, during the first 16 days, increased the average body weight of 1.71 kg, an increase of about 70%. In the second part of the experiment, pigs in both groups were fed a grower with a mixture of the same composition, which significantly reduced the difference in weight gain per head which was 15.48 kg in group I and 15.66 kg in group II. Looking at the total duration of the experiment, weight gain in the first group of piglets was 16.51 and in II group 17.37 kg, which is 5.21% higher (Table 3).

Table 3. Body weight and daily gain of piglets

Group	Control		Experimental	
Protein level in mixture, %	20		18	
Premix	Premix 1%		Premix 10%	
Period of experiment	Body weight	Gain, kg	Body weight	Gain, kg
Body weight, kg				
- The beginning	5.74	0.00	5.79	0.00
- After 16 days	6.77	1.03	7.50	1.71
At the end of experiment	22.25	15.48	23.16	15.66
Total weight gain	0.00	16.51	0.00	17.37
Daily weight gain	g/day	Index, %	g/day	Index, %
- After 16 days	52.00	100.00	106.00 [**]	203.85
- 16 days to end of experiment	377.00	100.00	382.00 [ns]	101.33
Average	290.00	100.00	305.00 [ns]	105.17

** - Increase daily increment in Group II significantly on p <0.01, ns - not significantly

Daily weight gain of piglets in the first 16 days of the experiment, when piglets were fed diets of different composition and the group was very low and amounted to 52 g. By including a new premix in group II achieved yield was twice as high and amounted to 106 g, which is a very large increase of 203.85%. Statistical analysis shows that large differences in weight gain at this stage of the experiment statistically significant. In the second part of the experiment as well as the average performance differences between groups in weight gain were significantly smaller and not statistically significant.

Expanded use of premix at the same time changing the structure of the mixture in the first 16 days after weaning led to better feed utilization and significantly higher consumption per feeding day (Table 4).

Table 4. Conversion and feed consumption of piglets in first 16 days

Group	Control	Experiment
Protein level in mixture, %	20	18
Premix	Premix 1%	Premix 10%
Feed conversion, kg/kg	3.34	2.52
- Index, %	100.00	75.45
Feed consumption, kg/day	0.174	0.267
- Index, %	100.00	153.45

In I group piglets feed intake per kilogram of weight gain was very high and was 3.34 kg, which is about 25% more than in the II group, where the feed consumption was 2.52 kg. These tests in terms of the expanded use of new premix in a relatively inexpensive mixture of simple structure, led to a significant reduction in cost for feed (Table 5).

Table 5. Costs for feed in experiment

Group	Control	Experiment
Premix	Premix 1%	Premix 10%
Feed price, din/kg	59.34	42.73
Index,%	100.00	72.01
Feed consumption, kg/day	3.34	2.52
Index,%	100.00	75.45
Growth price, din/kg	198.20	107.70
Index,%	100.00	54.34

* - The price of food is calculated only price of feeds and premixes

In Group I, in which used a mixture with a higher protein level, which was included whey, milk powder, sugar and fish meal is more expensive than the mixture in the second group is composed by a simpler, and because of that, and with a much lower price. While the price of the mixture in the first group was 59.34 din/kg in group II, the price was 28% lower and amounted to 42.73 din/kg. Turning expensive and complex mixtures in the first group did not improve feed efficiency. As stated previously in this group of piglets is consumed by about 25% more feed when compared with group II, in which he used a mixture of simple and cheaper with the use of extended premix. Price for one kilogram of gain in the first group was 198.2 din/kg, and group II price increment was 107.7 din/kg. The difference in the cost of feed is a consequence of the increased mortality of piglets and much lower growth in group I, compared with group II piglets. Inclusion of high stimulus doses of zinc and copper in a number of studies led to a significant increase in daily gain and improved feed conversion. Summarized results of Hill et al. (2000, 2001), Case and Carlson (2002), Davis et al. (2004), Carlson et al. (2004), Hollis et al. (2005), Buff et al.(2005), Mavromichalis et al. (2000) show that the use of 2000 mg/kg of zinc leads to a daily weight gain of about 22%, which was confirmed in our tests, but in these studies the effect of zinc on the feed conversion ratio was significantly lower and the average reduction in feed consumption was only about 2 %. In contrast, in our studies, the reduction of feed consumption per kilogram of gain was very high at about 25%.

Conclusion

Based on the above it can be concluded that the use of the new premix with organic acids and stimulating dose of zinc and copper to reduce the level of protein in feed has led to significant increase in daily gain, better feed utilization and significantly reduce piglets mortality and reduction cost of diet.

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EFFECT SOYBEAN HEAT TREATMENT ON BROILER SLAUGHTER TRAITS

Dejan BEUKOVIC[*], Milos BEUKOVIC, Dragana LJUBOJEVIC, Vidica STANACEV,
Sinisa BJEDOV, Mirko IVKOVIC

Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia,
(Corresponding author: dejan.beukovic@stocarstvo.edu.rs)

Abstract

The aim of this study was to determine the influence of the effect soybean dependence of heat treatment on the broiler carcass conformation, hybrid Ross – 308, which were reared separately by sex. The first group was fed with a standard diets for chickens, in which the entire amount of soybean in the mixture was extruded, and the second group was fed with the same diets but the soybean was raw (not extruded). The measured the weight of broilers at slaughter and the yield was processed carcasses (conventional processing, ready to roast, ready to grill), the proportion of: pancreas (target tissue), body parts (wings, drumsticks, legs, thigh, chest and back), abdominal fat and edible offal. The testing results showed that heat treatment had a significant and better effect on body weight, the carcass yield, "conventional processing", "ready to grill" and "ready to roast". Also visible is the effect of extrusion on the internal organs of chickens. The group that had consumed raw soybeans was observed pancreatic hypertrophy, an enlarged liver, heart and spleen. The group that had consumed heat treated soybeans was significantly greater amount of abdominal fat.

Key words: *heat treatment, soybean, broiler chickens, broiler carcasses, carcass parts*

Introduction

Soybean is the most used nutrient in the diet of broiler chickens to meet the needs of protein and essential amino acids. Full use of high quality vegetable protein in soybeans is only possible with the previous heat treatment, which significantly increases production costs. Therefore, in order to reduce the cost of many tests conducted on the possibility of the use of raw soybeans in the diet of poultry, from which it came to the realization that the main carriers of inhibitory activity of raw soybeans protease inhibitors, primarily: Kunitz trypsin inhibitor (Kunitz, 1945) and Bowman-Birk trypsin inhibitor (Bowman, 1944; Birk, 1961; Tseng Yen et al., 1977). Other factors taken into account the hem agglutinin or lectins (Douglas et al., 1999), and antivitamin, goitrogene and indigestible olygo-saharide (Parsons et al., 2000). However the inclusion of raw grain in the food does not only have a negative effect on the growth of chickens, but also leads to an increase in relative weight of digestive organs, particularly the pancreas (Gertler et al., 1966; Arija et al., 2006, Brenes et al., 2008), which the target organ, and the size and activity changes depending on the level of trypsin inhibitors. Efforts to increase the use of legumes led to the development of a wide range of method processing, including extrusion. This technology has numerous advantages, including the possibility of wide application, high productivity, energy efficiency and high quality of the resulting product (Brenes at al., 2008).
The aim of this study was to compare the effects of raw soybeans and extruded soybean on broiler slaughter traits.

Material and method

One-day old broiler chicks' male hybrids Ross-308 were measured and arranged in 16 boxes, with each box were 60 chickens. The average initial weight of chicks was equal and it was 42.5 + / - 7 g. The experiment included two groups with four replicates. The holding system has been the floor type, with a straw mat, and food and water were available ad libitum, with a light regime of 24 hours. Temperature and air circulation are controlled and regulated in accordance with the technology for hybrid Ross 308th. Dead chickens are removed from pen daily and mortality was below 3%.

One-day old chicks hybrid Ross-308 are separated by gender method based on the length of cover and primary wing feathers.

Food and water were provided ad libitum, during the fattening period. At the end of the experiment, which lasted 42 days, were sacrificed by 32 individuals from each group. Before sacrificing chickens are starved twelve hours and weighed individually.

Table 1. Diet composition used in the experiment

Feedstuffs	Starter	Grower		Finisher	
Mixture type		Raw soybean	Heat treated soybean	Raw soybean	Heat treated soybean
Maize	51.77	53.65	53.35	56.56	55.36
Soybean meal	24.46	8.22	8.52	5.32	6.54
Raw soybean	-	30.00	-	30.00	-
Heat treated soybean	15.34	-	30.00	-	30.00
Yeast dry	4.00	4.00	4.00	4.00	4.00
Limestone	1.60	1.40	1.40	1.40	1.40
MCP	1.48	1.37	1.37	1.35	1.35
Salt	.35	.35	.36	.37	0.35
Premix	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.0	100.00

The chickens' diet was based on corn and soybeans. Starter mixture contained 23% CP and 12.65 MJ of metabolic energy and was used from 1st to 10th days. Starter mixture, where intake all chickens in the experiment and in it was included maize 51.77%, 24.46% full fat soybean meal, 15.34% soybean meal, 4% yeast, chalk, monocalcium phosphate, salt and premix. So this starter mixture contained 23% of crude protein and 12.60 MJ of metabolic energy. Experimental diet started from the tenth day, because raw soybean can't be successfully used in young chickens without heat treatment (Palacios et al., 2004). Experimental mixtures were grower and finisher, and differed in two groups. The mixtures used in the experiment were iso-energy and iso-protein. Chemical analysis of mixtures was made in Animal feed laboratory, Faculty of Agriculture in Novi Sad. Grower diet containing 22% of crude protein was used from 11th to 24th days, a paver with 21% of crude protein from 25th to 42th days. Mixtures consisting of maize, soybean meal, dried yeast, chalk, monocalcium phosphate, salt and premix. The experimental mixture included 30% soybean and to the treatments: 1) raw soybeans with 2) extruded. The levels of trypsin inhibitors in soybean are presented in Table 2.

Table 2. Levels of trypsin inhibitors in soybean

Group	Raw soybean	Heat treated soybean
TI (mg/g/min)	30.21	12.30

According to the Regulations on the quality of poultry meat ("Službeni list SFRJ", 1/81 and 51/88) yield was dressed carcasses (conventional tillage, ready to roast, grill ready), then cut the carcasses and the measurement of its parts: the head, neck, legs, wings, drumsticks, thighs, chest and back. Abdominal fat and edible offal were carefully separated and measured manually. Share of abdominal fat and edible offal is expressed as the ratio of their mass relative to weight prior to slaughter. The data were analyzed by statistical variation methods in the statistical package STATS 10th

Results and Discussion

Table 3 shows the final mass of chickens in the experiment, where it can be seen a significant difference p <0.001 in the final mass. Chickens who have consumed the mixture that contained untreated soybeans have lower final mass that averaged 1253.8 g, worse slaughtering yield (79.80) versus group who have consumed the mixture with heat treated soybeans where the average final weight was 2486.3 g, and slaughtering yield 82.53%. Experiments conducted on rats (Friedman et al., 1991), chickens (Anderson -Hafermann et al., 1992; Douglas et al., 1999; Palacios et al., 2004), laying hens (Zhang et al., 1991) and pigs (Palacios et al., 2004) have shown that the inclusion of thermally treated soy in the diet has a significant effect on the lower body weight in relation to consumption of heat treated soybeans.

Table 3 The values of the final mass slaughter and conventional carcass processing depending on the treatment of soybeans in the mixture

	Heat treated soybean		Raw soybean	
	Mean	St . Dev.	Mean	St. Dev.
Body mass, g	2486.3[a]	176.90	1253.8[b]	187.29
Conventional processing, g	2049.4[a]	15.80	1000.1[b]	154.08
Conventional processing, %	82.53[a]	2.50	79.80[b]	3.67
Ready to roast, g	1835.2[a]	113.90	878.3[b]	146.64
Ready to roast, %	73.87[a]	1.70	69.93[b]	2.76
Ready to grill, g	1681.3[a]	93.60	764.69[b]	163.58
Ready to grill, %	67.71[a]	1.80	61.16[b]	9.04

a-b different letters in each row indicate statistically significant differences at the level of p<0.01

When it comes carcasses "ready to roast" and "ready to grill" it can also be concluded that there is significant disparities p <0.001 between groups depending on whether the soybean was heat treated (73.87% ready to roast, and 67.71% ready to grill) or not (69.16% ready to roast, and 61.16% ready to grill).

Table 4. Shares of edible parts of carcass depending on the soy treatment in the mixture.

	Heat treated soybean		Raw soybean	
	Mean	St. Dev.	Avg.	Mean
Chest,%	31.71[a]	2.51	22.93[b]	1.99
Thighs, %	11.47[a]	0.73	12.76[b]	1.02
Drumstick, %	12.50[ns]	2.32	13.69[ns]	1.22
Wings, %	9.35[ns]	2.01	10.41[ns]	0.69
Back,%	19.28[ns]	1.93	19.26[ns]	1.34

a-b - different letters in each row indicate statistically significant differences at the level of $p < 0.01$
ns - statistically non significant differences

Table 4, shows the portions of edible parts of chickens carcass depending on heat treatment of soybeans in a mixture for chicken. Percentage of breast and thigh of chickens that consumed the mixture with heat processed soybeans was 31.71% respectively 11.47% which is statistically highly significant ($p < 0.01$) as compared to 22.93% respectively 12.76%, what was noted in the group whose mixture contained heat untreated soybean. Considering the drumsticks, there is evidence of a higher percentage in the group that consumed the heat untreated soybeans (13.69%). The same trend was also noted for the wings where the group who consumed raw soybeans, where the share of wings was 10.41%, as opposed to the group that consumed the heat-treated soybean where the share was 9.35% lower. Considering the back, there are almost no differences; the average share of the back of the chickens that consumed the mixture with heat treated soybeans was 19.28% and 19.26% for chicken with the mixture of heat untreated soybean. There is no significant difference between the groups in terms of drumsticks, wings and back.

A high percentage of the share breasts in the group that consumed the heat treated soybeans can be explained by a sufficient quantity of proteins that chickens adopted during the growth, what is not the case for the group where the heat treated soybeans were used. Where is due to the presence of anti-nutritive factors in the first place of the proteases, proteins adoption was difficult or impossible.

Considering the drumsticks, which, according to Table 4, have a larger share in the group on raw soybeans than in the group that has been on heat treated soybeans, the explanation lies in the fact that in terms of relative weight ratio (compared to conventional treatment), noting that the mass after conventional treatment of chickens was half less in the group that consumed a meal without heat treatment.

Table 5 shows the percentage share of the internal organs in relation to the final weight of chickens, where it can seen a significant difference in the percentage of pancreas between the groups of chickens who has used heat treated soybean (0.24%) respectively the group that has used a mixture of soybeans, without heat treatment (0.51%). If the relative weight of the pancreas of the chickens who have consumed raw soybeans reflect on the relative weight of the pancreas of chickens who have consumed heat treated soybeans, it comes to the value of more than 212% increase of the pancreas.

Table 5 Shares of edible parts of carcass depending on the soybeans treatment in the mixture.

	Heat treated soybean		Raw soybean	
	Mean	St. Dev.	Mean	St. Dev.
Pancreas,%	0.24 [a]	0.01	0.51 [b]	0.17
Liver,%	0.21 [a]	0.22	0.75 [b]	0.51
Spleen, %	0.12 [A]	0.03	0.15 [B]	0.04
Heart, %	0.51 [a]	0.05	0.61 [b]	0.08
Gizzard, %	1.38 [a]	0.17	0.95 [b]	0.44
Abdominal fat, %	1.04 [a]	0.33	0.76 [b]	0.28
Gizzard fat, %	0.36 [ns]	0.14	0.43 [ns]	0.12

a-b - different letters in each row indicate statistically significant differences at the level of $p < 0.01$
A-B - different letters in each row indicate statistically significant differences at the level of $p < 0.05$
ns – statistically non significant differences

The increase can be attributed to the pancreatic effects of trypsin inhibitors and lectins. Inactivation of free trypsin in the intestine stimulates the release of cholecystokinin from neuroendocrine cells in the intestine, thus leading to hyper-secretion of pancreatic digestive enzymes and subsequent enlarge of the pancreas (Lacourse at al., 1999). Cholecystokinin regulates the growth of pancreatic enzyme secretion and contraction of gall bladder (Rehfeld, 1998).
Changes in secretions affect the digestive structure and function, particularly disorders in the digestion and absorption, changes in the passages of content, increase microbial activity in the small intestine and the entire increase in the digestive tract and related organs (Hoerr, 1998). Hypertrophy of the pancreas was detected in chickens and rats in the food that added pure extract of soybean trypsin inhibitor (Gertler et al., 1966), chickens fed raw velvet beans (*Phaseolus vulgaris L.var. Pinto*) (Arija et al., 2006), raw chickpea (Cicero arietinum L.) (Brenes et al., 2008) and smooth beans (Mucuna pruriens) (Carew et al., 2003.; Tuleun and Igba, 2008). The effect of these raw legumes on the mass of the pancreas is probably the result of a well-known presence in the grain anti-trypsin factors that interfere with normal function pancreas enzymes, thus forcing the pancreas to enhanced work (Carew et al., 2003).
It is also evident and statistically significant $p < 0.001$ the enlargement of the liver, heart and gizzards of the chickens who have been fed with raw soybeans. Carew et al. (2003) have also observed a significantly higher relative heart weight of chickens and found that this increase may represent an additional burden that can lead to stress and disease. Observed increase in relative liver weight could be attributed to mobilization of body reserves in order to bear all expenses the need for rapid growth of certain organs which can lead to increase of the liver and cause hypertrophy and poor nutritional status of chickens who have been fed with raw soybeans (Arija et al., 2006; Carew et al., 2003).
In Table 3 it can be seen that there is significant increased $p < 0.005$ in relative spleen weight of chickens whose meal contained raw soybeans. In the study of (Arija et al., 2006; Brenes et al., 2008) extrusion caused the increase in relative spleen weight.
Considering the abdominal fat, it was significantly lower $p < 0.001$ the relative weight of chickens who have been fed with raw soybean. While in relative weight fat of the gizzards there is no significant differences in relative masses. This is explained with the lack of nutritional status chickens due to the presence of anti-nutritive factors (Arija et al., 2006).

Conclusion

Based on all the above facts, it can be concluded that the omission of heat treatment soybeans in the mixtures for chickens due to the presence of thermolabile anti-nutritional factors have a negative impact on the final weight and slaughter yield as well as in the conventional process of "ready to roast" or "ready to grill".

Reduction of the breast share, in the group where heat untreated soybeans have been used, is the consequence of the absence of the heat treatment.

Considering the internal organs and deposited fat, it can be concluded and it can be confirmed by many previous studies that heat untreated soybeans causes the hypertrophy of pancreatic due to presence of the trypsin inhibitor as well as some other anti-nutritive factors. It is evident the increase in the weight of liver, heart and gizzard as a result of nutritional status and stress of the chickens who have been fed with raw soybeans.

Significant reduction in abdominal fat in the group that have been fed with raw soybeans is also a direct result of poor nutritional status of the lack of heat treatment of soybeans.

Acknowledgement

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NUTRITIONAL VALUE OF TRITICALE (TRIJUMF) FOR BROILER DIETS

Vera DJEKIC[1*], Tatjana PANDUREVIC[2], Sreten MITROVIC[3], Vera RADOVIC[4], Jelena MILIVOJEVIC[1], Vladan DJERMANOVIC[3]

[1]Center for Small Grains, Kragujevac, Serbia
[2]Faculty of Agriculture, University in East Sarajevo, Bosnia and Herzegovina
[3]Faculty of Agriculture, University of Belgrade, Zemun, Serbia
[4]Faculty of Agronomy, University of Cacak, Serbia
(Corresponding author: verarajicic@yahoo.com)

Abstract

The aim of this study was to determine a way on how to investigate the effect of triticale on growth performance, production and slaughter characteristics of broiler chicks. The research was carried out on 200 broiler chickens, hybrid Ross 308. On that occasion, two groups of broiler chickens were formed with 100 broiler chicks in each group, namely control group (classic mixture fo broilers fattening) and experimental group (mixture with triticale genotype Trijumf). The experiment lasted 49 days. As criteria for utilization of triticale in the present study, production traits, and body weight and weight gain. The results showed that the experimental group of broiler chickens that were fed with a mixture of triticale (triticale genotype Trijumf), achieved better production results (P<0.05).
It can be concluded that triticale can be used as an untraditional source of energy in broiler diets to get best performance and as god source of income as the control.

Key words: *broiler, growth, feeding, triticale*

Introduction

Triticale, as a new type of highly successful small grains, deserves more attention. Thanks to intensive breeding program at the Center for Small Grains, in Kragujevac, two new domestic and commercial cultivars are to be found on the list of varieties.
When talking about grain yield, newer varieties of triticale mainly reached the level of leading wheat while having surpassed varieties of rye, barley and oats (eki et al., 2011.a).
Triticale is a convenient feed for all animals representing a high source of energy. Protein yield per unit area also represents an important indicator of the economic importance. The above characteristics are important for the biological value and product processing quality for both human nutrition and animal diets (eki et al., 2011.a). Nutritional value of grains depends on the protein content, and thus the products. Proteins with a higher content of indispensable amino acids have a higher nutritional value where the most important role has lysine content as the first deficit amino acid in grains.Triticale has a higher percentage of protein and lysine compared to the parental species and a lower energy value compared to corn and wheat (eki et al., 2012.a).
Triticale is already widely used for poultry feed (broilers, laying hens) worldwide. The quality of poultry products can be modified or enhanced by adding triticale as feed meal for animal feed. Therefore a considerable scientific interest in the use of triticale in animal feed has appeared in recent years, though the data on published research in the areas of productivity of poultry and quality of meat and eggs being scantier than those of the positive impact of this type of small grains to ruminants and pigs.Testsin broiler production include determination of the effects of diet mixtures with different amount of triticale on the

performance of both quantitative and qualitative traits of broiler meat. More studies appliedexamining of the nutritional value of triticale on product line features of heavy hybrids in the world (Ruiz et al., 1987;Vieira et al., 1995; De Brum et al., 2000; Camiruaga et al., 2001).

Barneveld and Cooper (2002), examined six varieties of triticale in forage mixtures for broiler fattening. Total feed consumption per kilogram of body weight of chickens ranged from 1.75 to 2.24 kg. Savage et al., (1987) point out that the use of triticale in the diet of chickens improve physical and sensory properties of cooked meat. When substituting wheat with triticale in mixtures for fattening broilers, no significant change in the production and carcass traits of chickens occurs (eki et al., 2011.b; 2012.b).The problem of adding commercial enzymes in the forage mixture had been solved with application of triticale for broilers fattening and mixtures for laying hens Vohra et al., (1991),what reduced overall feed production costs. Different formulations or participation of triticale and wheat in feed mixtures broilers fattening had been examined by Sarker et al., (2006). The same concluded that the highest body weight at the end of the experimental period had achieved chickens who were fed with the following formulations: W40T60 i W60T40. The lowest mortality was found in the group that was fed with mixture which did not include triticale. Korver et al., (2004) prefer triticale in relation to wheat due to higher average weekly weight gain of chickens upon the same amount of ingested food. Hermes and Johanson, (2004), claim that triticale in the diet of heavy line hybrids and who participated in various proportions in the mixture for broilers showed no adverse effects on performance traits of chickens.The biggest weight of tested chickens was achieved with 10% of triticale in fattening feed for broilers, while feed conversion was higher for formulations with 15% of triticale.

Numerous studies suggest that triticale successfully replace part of corn, wheat or barley in animal feed without negative consequences to the impact of domestic animals (De Brum et al., 2000;Hermes et Johanson, 2004; eki et al., 2011.a; 2012.a). Triticale is a convenient feed for all animals since represents a high source of energy.Because of favorable enzyme composition, triticale grains favorably effect the intestinal tract of monogastric animals (Barneveld et Cooper, 2002;Korver et al., 2004; Sarver et al., 2006).

The aim of of these studies, with respect to all above-mentioned, was to determine the effects of triticale on growth rate, feed consumption and feed conversion and performance traits of broiler chickens.

Materials and methods

The tests in this study were conducted on broiler chickens, hybrid Ross 308. Chickens were divided into two groups per 100 chickens. The first, control group received a mixture without the addition of triticale, and the second, experimental group received the same mixture supplemented with 7.5%, 12%, 15% and 18% of triticale (cv. Triumph) produced at the Center for Small Grain, Kragujevac. Four compounds were used in feeding: starter, grower I, grower II and finisher. The composition and quality of the mixture is shown in Table 1. Fattening lasted 49 days. Chickens were given food and water *ad libitum* during the experiment. Health state and mortality was observed with the groups examined during the fattening. Their body weight was measured once a week. After the final fattening and 12 hours of fasting, the chickens were slaughtered and the carcass weight measured.

The basic chemical composition (moisture, crude protein, crude fat and mineral matter) of complete mixture for chicken feed was determined by methods A.O.A.C. (1984). Calcium and phosphorus content was determined by the Regulations on sampling methods and methods of performing physical, chemical and microbiological analysis of animal feed (1987).

Table 1. Composition (%)and the quality of the mixtures used in the experiment

Feed (%)	Starter		Grower I		Grower II		Finišer	
	K	O	K	O	K	O	K	O
Wheat	40,0	31,2	42,0	28,8	43,6	27,1	48,8	28,6
Corn	21,0	21,0	20,0	20,0	20,0	20,0	20,0	20,0
Triticale		7,5		12,0		15,0		18,0
Soya bean meal	29,7	30,9	27,1	28,1	24,7	25,4	20,9	22,0
Sunflower seed pellets	2,5	2,5	3,0	3,0	3,5	4,0	3,5	4,0
Soya oil	3,15	3,25	4,55	4,7	5,05	5,25	4,15	4,7
Chalk	1,2	1,2	1,0	1,1	1,0	1,1	0,7	0,8
Monocalcium phospate	1,0	1,0	0,9	0,85	0,75	0,7	0,5	0,45
Premix	1,45	1,45	1,45	1,45	1,45	1,45	1,45	1,45
Total:	100	100	100	100	100	100	100	100
Chemical composition:								
Crude proteins, %	22,37	22,40	20,17	20,27	19,70	19,82	18,42	18,49
Fat, %	6,36	6,38	9,51	9,54	9,90	9,79	8,47	8,54
Crude fiber, %	3,17	3,18	3,43	3,43	3,58	3,58	3,23	3,27
Ash, %	6,88	6,40	5,89	5,87	5,99	5,95	5,64	5,65
Nitrogen (ekstrah.)%	45,61	46,26	46,78	46,43	46,40	46,22	48,79	49,22
Metabolic energy, MJ/kg	12,59	12,68	13,39	13,39	12,86	12,87	13,39	13,40
Ca, %	1,29	1,16	0,79	0,85	0,79	0,85	0,88	0,90
P (adoptable), %	0,53	0,34	0,42	0,42	0,42	0,42	0,64	0,66

*Premix composition (content of 1 kg of mixture): Vitamin A-9000 IU, Vitamin D3-3300 IU, Vitamin E-30, 0 IU, Vitamin K-2, 2 mg thiamine (B1) -2.2 mg; riboflomin (B2) -8.0 mg; pantothenic acid-12 mg niacin-66, 0 mg pyridoxine (B6) -4.4 mg, folic acid 1.0 mg-550 mg of choline, vitamin B12-0, 022 mg biotin -0.20 mg with 0-0.30-0, 45%, Mn-100 mg-75 mg Zn, W-0, 45 mg-8 mg Cu, Se-0, 10 mg-100 mg Fe.

Common indicators of variation in statistics were calculated on the basis of actual research results: average values error of arithmetic mean and standard deviation. Statistical data processing was done in the module Analyst Program SAS/STAT (SAS Institute, 2000).

Results and discussion

Performance results of both groups have been thoroughly monitored during the analysis of observed performance. Monitoring is done on a weekly basis. It is an extended fattening period of seven weeks. Table 2 shows the average body weight of broiler chickens, provenance Ross 308 per groups.

Based on the data obtained from Table 2, it can be concluded that in the first period, after the completion of fattening with starter mixture, control group achieved a higher body weight at the end of the second week of the experiment (398,265 g). In the second fattening period, at the end of the fourth week (after the grower diet and mixtures) control group had a slightly higher body weight of broiler chickens, by 24.544 g higher compared to the experimental group. On 49th day, (the end of feeding period) body weight of the broilers of the experimental group using triticale in mixtures was increased by 46,437 g compared to the control group where no triticale was used. The chickens of the experimental group also have statistically higher body weight compared to the control group (P<0.05). Our results are in agreement with results of Korver et al., (2004), Sarker et al., (2006) i   eki   et al. (2012.b).

Data obtained indicate that triticale has great potential as feed for chickens because it might replace wheat in diets for broilers fattening while would cause no significant changes in their production and carcass traits. Body weight of chickens fed with triticale is not different from the values obtained in feeding broilers with wheat (Vohra et al., 1991;Korver et al., 2004).

Table 2. Body weight of chickens tested by weeks of age (g)

Age (days)	Group	N	$\bar{x}$	S	$S\bar{x}$	C.V.	F_e	Relevance
1	K	100	41,250	3,852	0,385	9,337	0,632	NS
	O	100	40,881	3,930	0,277	9,613		
7	K	99	146,869	19,738	1,984	13,439	0,750	NS
	O	95	149,105	21,381	1,551	14,340		
14	K	98	398,265	57,397	5,798	14,412	0,182	NS
	O	95	395,000	63,413	4,600	16,054		
21	K	97	730,619	101,554	10,311	13,900	0,018	NS
	O	94	728,883	103,735	7,566	14,232		
28	K	97	987,629	96,031	9,750	9,723	4,583	*
	O	94	963,085	89,410	6,521	9,284		
35	K	96	1415,260	132,368	13,510	9,353	1,732	NS
	O	94	1395,585	111,903	8,161	8,018		
42	K	96	1896,875	207,462	21,174	10,937	0,217	NS
	O	94	1887,926	116,439	8,492	6,168		
49	K	96	2302,552	163,784	16,716	7,113	4,587	
	O	94	2348,989	177,271	12,929	7,547		*

NZ-P>0,05; *-P<0,05; **-P<0,01; ***-P<0,001

Since feeding has a different effect depending on the age of poultry this allows a better understanding of the overall effects of feed with triticale (Table 3).

Table 3. Daily and weekly weight gain of chicken groups examined, (g)

Group	Daily gains						
	I	II	III	IV	V	VI	VII
K	15,06	35,26	47,02	34,97	62,57	62,26	61,56
O	15,43	34,26	46,60	32,49	67,71	70,12	68,79
Group	Weekly gains (g)						
	I	II	III	IV	V	VI	VII
K	105,42	246,84	329,17	244,76	438,00	435,81	430,94
O	107,98	239,84	326,18	227,41	473,27	490,87	481,55

Analyzing data from table 3 it can be concluded that there were some differences between the two groups of chickens from the perspective of average daily gain. The chickens of the control group had the lowest daily gain of 15.06 g in the first week of fattening. Chickens of the experimental group had 34, 26 g in the second week, 46.60 g in the third week and 32.49 g in the fourth week. Chickens of the control group had 62.57 g in the fifth week, 62.26 g in the sixth week and 61.56 g in the seventh week).

Chickens of the control group had the lowest weekly gain: (105.42 g) in the first week, 438 g in the fifth, 435.81 g in the sixth and 430.94 g in the seventh week of fattening. The biggest weekly gain in the I, V, VI and VII week had the experimental group of chickens that were fed with triticale.In the case of feeding with forage mixtures in which no triticale was added (control group), a total of 4 broiler chickens died. If this value is put in relation with mortality upon dietary forage mixture with triticale (6 chickens) it is possible to draw the conclusion that triticale in mixtures for broiler chickens fattening has no negative effect on the health of poultry (Table 4). The results are better with the use of triticale varieties than those stated by Korver et al., (2004) and Hermes et al., (2004).

Table 4. Consumption and feed conversion during the study period (49 days)

Groups	Mortality, %	Production index	Feed consumption,kg	Feed conversion, kg/kg
K	4,0	182,784	5,682	2,468
O	6,0	185,518	5,703	2,429

The value of production index was higher in the group fed with triticale (185,518).

By the end of the experimental period (49 days) the highest feed consumption per chicken had the experimental group of chickens (5,703 kg).Feed conversion was somewhat better in the experimental group of chickens (2.429 kg / kg) than in the control group (2,468 kg/kg). The results obtained in terms of feed conversion and total feed consumption per kilogram of body weight of chickens were in accordance with the results obtained by Camiruaga et al., (2001), Cooper et Barneveld, (2002), and slightly worse than the results obtained by De Brum et al., (2000), Korver et al., (2004).Despite the reduced opportunities for comparisons with data from the literature available it can be concluded that the results of this study were in accordance with the results stated by Barneveld and Cooper (2002), Hermes and Johansson (2004), and eki et al. (2011.b; 2012.b).

Conclusion

Based on the obtained results it can be concluded that chickens fed with forage mixtures including triticale achieved slightly higher body weight and better feed conversion compared to the control group of chickens. Slightly higher mortality of broiler chickens had a group fed with a mixture where triticale was added.

Data obtained indicate that triticale has great potential as feed for chicken. Body weight of chickens fed with triticale did not significantly differ from those of chickens fed on wheat, as a feed component of the forage mixture, so triticale can successfully replace the wheat in diets for broilers fattening, which would cause no significant changes in the production and carcass traits.

Acknowledgments

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PHENOTYPE VARIABILITY OF BASIC COMPONENTS OF COW`S MILK IN CONVENTIONAL CONDITIONS OF PRODUCTION

Goran JEZ[1*], Tatjana PANDUREVIC[2], D. CVETANOVIC[3], J. JANKOVIC[1]

[1]University of Belgrade, Faculty of Agriculture, Serbia,
[2]University of East Sarajevo, Faculty of Agriculture, Bosnia and Herzegovina
[3]University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia
(Corresponding author: goranjez@agrif.bg.ac.rs)

Abstract

Aim of this research was to estimate the variability of basic components of cow`s raw milk (dry mater, proteins, milk fat, lactose and mineral maters) during four seasons (winter, spring, summer and autumn) and two milking terms (morning and evening milking). Total number of analyzed samples was 1568 (784 samples from morning and evening milking, and 196 samples for each season) from seven conventional farms that were uniform according to the breed, housing, diet and healthcare. By statistical data processing it has been established that season and milking time very significantly influenced the share of basic milk components, while interactive influence of mentioned factors was not same for all components. Milk collected in the evening was richer in dry mater without fat (8.61%), proteins (3.27%), milk fat (3.66%) and lactose (4.58%) compared to the milk collected in the morning which had 8.55%; 3.23%; 3.59%; 4.56% respectively for all components above mentioned. Based on what is quoted above we have concluded that quantitative variability of milk components is expressed during season and depends on milking term.

Keywords: *raw milk, season, morning, evening, milking*

Introduction

Milk as one of the basic products of cattle breeding belongs to nutritional products of high biological value which is used in human diet. Nutritional value of milk depends above all, on the content of its basic components, the proteins, milk fat, lactose, mineral maters. These compounds together represent the dry mater (DM) of the milk. Amount of DM of the milk decreases at spring and it touches its maximum during winter period (Ostoji , 2007). Similar state is with proteins and milk fat, while mineral maters are equally distributed throughout the year. Same author points out to relatively constant content of lactose in the milk throughout the year, with slight increase of the content during spring and summer. Ozrenk and Selcuk Inci, (2008). have established by chemical analysis that during winter period content of DM, proteins and milk fat is increased compared to summer content. Moreover they quote that amount of dry mater without fat (DMWF) and mineral matter content is increased in the milk produced during summer period. Jež *et al.* (2011) quote that seasonal variability of the chemical composition of the milk is the consequence of joint influence of several factors, especially diet, lactation phase and susceptibility to diseases, which vary throughout the year. Above mentioned authors researched the influence of the season to the milk quality and established that milk produced in autumn period has richest content of proteins, milk fat and dry mater without fat (DMWF), and that least amount of these components is in milk produced in warmer period of the year (spring/summer). Milk chemical composition is different also depending on milking time. According to research by Buenger *et al*. (2002),

milk drawn in the evening is richer in proteins and milk fat. Similar tendencies are present with goat milk, which has been partially proven in the research by Kastelic and Kompman (2006). These authors researched quality of goat milk taken in the morning and evening and found that milk that has been taken in the evening contains statistically very significantly higher amount of milk fat, proteins, lactose, DM and DMWF. Ostoji (2007) points out at the differences in milk chemical composition between morning and evening milking, with increase of milk fat by 0.5-0.8% and proteins by 0.2% in the evening milk, which is partially influenced by time interval between two milking. In agreement with this, Chládek *et al.* (2011)have concluded that when milking interval is 11 and 13h milk drawn in the evening is richer in chemical composition, but that with change of milking interval to 10 and 14h presence of milk fat in evening milk is insignificantly lower.

According to the literature review (Ostoji 2007, Ozrenk and Selcuk Inci 2008, Buenger *et al* 2002, Chládek *et al* 2011) it could be note that content of basic milk components and its chemical composition is changeable under influence of many factors. In this research we have examined the influence of season and milking timings (morning and evening milking) in the conditions which are present on conventional farms in Serbia. Another contribution of the conducted research lies in the fact that we have perceived the variability of the milk chemical composition from the point of interactive influence of researched factors.

Material and methods

In this assay result of the influence of the season and milking term on chemical composition of the milk and interaction of these two factors is shown. This analysis included samples of collected milk produced in spring (March 21st-June 22nd), summer (June 22nd –September 23th), autumn (September 23th – December 22nd) and winter (December 22nd- March 21st) period of the year, with equal sample amounts of morning and evening milking. From total number of 1568 samples 784 were taken after morning milking (196 samples per season) and same number after evening milking. Research was conducted on collected milk from seven big dairy farms (Mladost, Lepusnica, Pionir, P. prelaz, Kovilovo, Padinska skela and Dunavac, all from Serbia) where black and white cattle is being held with high intake of Holstein Frisian breed genes, they were uniform concerning conditions, diet and healthcare.

Milk chemical composition (proteins, milk fat, lactose and DMWF) was determined by spectrophotometric method in infra red area of radiation, and by instrumental method on Milkoscan S 50, amount of certain milk components is expressed in percents. Amount of mineral maters (ash) was calculated as difference between DMWF, lactose and proteins (% ashes = % DMWF - % laktose - % proteins).

Statistic data rendering was done by standard statistic methods *(Latinovi , 1996)* and software package STATISTICA 5.5, Stat.Soft,Inc was used.

Results and discussion

Average chemical composition of the researched milk and parameters of descriptive statistics for entire analyzed period and both milking terms are given in table1.

Table1. Average chemical composition and variability of milk components

Component	Statistic parameters					
	n	$\overline{x}$	SD	Cv (%)	min	max
M.fat (%)	1568	3.62	0.22	6.19	2.87	4.48
Proteins (%)	1568	3.25	0.14	4.40	2.73	3.72
Lactose (%)	1568	4.57	0.07	1.53	4.00	4.74
Minerals (%)	1568	0.76	0.03	3.94	0.66	0.86
DMWF (%)	1568	8.58	0.15	1.77	7.48	8.98

By analysis of average values of certain components it is evident that milk fulfills conditions given in the Rule book (Gazette of RS, No. 21/2009), special reference to the amount of milk fat, proteins and DMWF. Greatest variability is present in amount of milk fat (Cv=6.19%), which is in accordance with research by Ostoji (2007). This author cites that milk fat is the most variable component of the milk, so that is the reason why DMWF term was included, as its composition is more representative indicator of the milk quality. Value of the standard deviation (SD) for amount of milk fat and proteins in milk is significantly lower than what Bouloc *et al.* (2002) concluded in their research, which can be consequence of the cattle influence. The above mentioned authors researched the chemical composition of the milk from totally 27933 cattle and established SD for milk fat content of 0.74 and 0.38 for protein content, from which the conclusion that variability of milk composition is more expressed on single cattle level than on collected milk. Least variability was expressed for lactose contents. This component shows least oscillations concerning quantity, depending on the year, season and lactation period respectively (Ostoji , 2007).

Considering the season when milk was produced, it had different amount of certain components (table 2). Season as one of the analyzed factors had statistically very significant influence (*p<0.001*) on milk chemical composition.

Table 2. Average chemical composition of the milk per season

season⟍component	Winter			Spring			Summer			Autumn		
	N	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD
M.fat(%)	392	3.80	0.18	392	3.54	0.19	392	3.51	0.23	392	3.64	0.18
Proteins (%)	392	3.26	0.10	392	3.23	0.13	392	3.15	0.13	392	3.35	0.14
Lactose (%)	392	4.53	0.06	392	4.62	0.05	392	4.56	0.07	392	4.56	0.07
Minerals (%)	392	0.75	0.03	392	0.74	0.02	392	0.77	0.02	392	0.78	0.03
DMWF (%)	392	8.54	0.11	392	8.59	0.12	392	8.48	0.14	392	8.68	0.15

Influence of the season on the amount of milk fat was statistically very significant (*p<0.001*), to the similar conclusion *Botaro et al. (2008)* came to. Highest difference in amount of milk fat (0.29%) was noted between milk produced in winter and summer period (*p<0.001*), which is in accordance with research byOzrenk and Selcuk Inci (2008) and Jež *et al.*(2011). Moreover, significant differences in amount of milk fat were noted in dependence of the milking term (figure 1). Therefore, milk taken in the evening had higher amount of milk fat compared to milk taken in the morning (*p<0.001*). Similar tendencies, with little less variability (Cv 3.07-4.18%), was present for the protein amount, where greatest difference (0.20%) was noted between milk produced in autumn and summer period of the year (*p<0.001*). Congruence in changes of amounts of the milk fat and proteins during the season and in dependence of the milking term is consequence of very positive correlation of this two milk components (Ozrenk and Selcuk Inci, 2008), because the increase of the amount of milk fat contents was followed by the increase of the protein content in the milk. Interaction of the analyzed factors (season x milking term) have not expressed any influence (*p>0.05*) on the milk fat and protein contents in milk (figure 1).
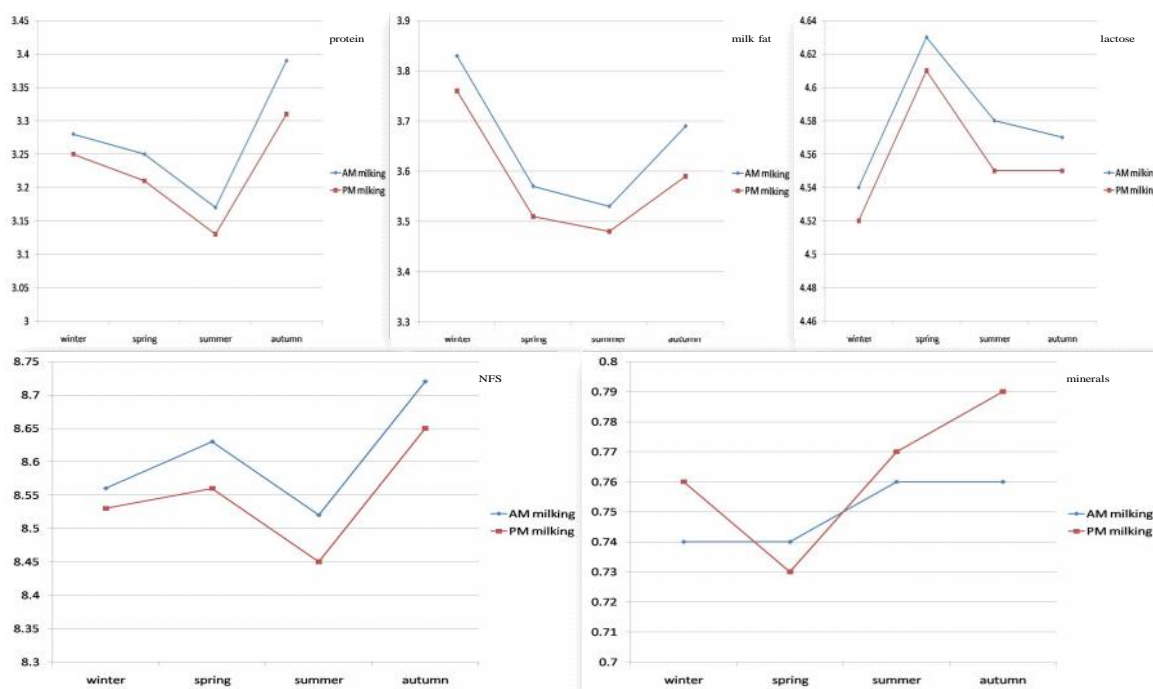
Figure 1 Variability of chemical composition of the milk depending on season and milking term

Lactose content was relatively constant throughout the year (table 2), with slight increase during spring season which is in accordance to research by Ostoji , 2007. Milk produced during the spring season had more lactose compared to other three seasons, and differences were significant at the 99% level. The milking term did not have any effect on the amount of lactose in the milk, even though the evening milk was richer with lactose. Difference of the evening and morning lactose level was not statistically significant ($p>0.05$). Milk produced in the autumn period is characterized by the highest amount of DMWF (table 2), and difference compared to other three seasons is statistically very highly significant ($p<0.001$). Moreover, milking term has expressed influence at the amount of DMWF, and milk collected in the evening had significantly higher ($p<0.01$) amount of above mentioned components, while interactive influence of the season and milking term was not significant (figure 1). The only milk component which was influenced by the interaction of these two factors is mineral maters. This result, however, should be accepted with reserve considering the ways of calculating the amount of mineral maters.

Conclusion

Analyzing the results given in this assay, it can be concluded that there is variability of the milk basic components depending on season and milking term, which is in accordance with data from literature. Season influence manifests by increase of proteins, milk fat and DMWF in autumn/winter period compared to spring/summer period. Evening milk is characterized with richer chemical composition, the increased amount of basic milk components compared to the morning milk, while interactive influence of the researched factors was not expressed on analyzed milk components.

Acknowledgement

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THE EFFECT OF THE BROILER PARENTS AGE AND THE PERIOD OF EGG STORAGE ON INCUBATION INDICATORS

Sreten MITROVIC[1], Tatjana PANDUREVIC[2], G. STANISIC[3], Vera DJEKI [4], V. DJERMANOVIC[1], Goran JEZ[1*]

[1]Faculty of Agriculture,University of Belgrade, Serbia
[2]Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
[3]Higher agriculture school of specialist studies, Sabac, Serbia
[4]Small Grains Research Center (SGRC), Kragujevac, Serbia
(Corresponding author: goranjez@agrif.bg.ac.rs)

Abstract

The basic objective of this study was examination of the effect of age of broiler parents (PA) of Cobb Hybrid 500 and the period of storage of eggs i.e. egg age (EA) on the fertility of eggs and chicken hatching, as well as the embryo mortality of chickens (early, middle and late) during the incubation period. By the method or a random sample, in the three phases of the production cycle, i.e. for different age of broiler parents (PA25weeks, PA41weeks, and PA58weeks) and in the case of eggs stored for up to 7 days, and over 7 days (EA <7 and EA> 7), 1050 eggs per phase (total of 6300 eggs) were selected, in order to determine these reproductive indicators.
The age of broiler parents affected the fertility of eggs because there were the most fertile eggs in the middle of the production cycle (PA41 = 97.05%), then at the beginning (PA25 = 96.09%) and the least in the final stage (PA58 = 93.00) of flock breeding. The egg storage period had no effect on the fertility of eggs, while the age of broiler parents and egg storage period significantly affected the percentage of chicken generating, and thus the embryo mortality during incubation. The lowest total embryo mortality (13.05%), regardless of the storage period, was found in eggs originating from PA41, much higher 15.87% in eggs originating from PA58 and the highest 16.93% in eggs originating from PA25. In addition, extending the period of storage of eggs i.e. egg age (EA < 7 and EA > 7) resulted in the increase of the total embryonic mortality in all three phases of the production cycle.

Key words: *storage, parents, eggs, embryo, mortality*.

Introduction

It is well known that the production technology of one-day old broiler chickens starts with breeding i.e. rearing of a certain heavy hybrid parent flock of hens and ends with artificial incubation of eggs produced for breeding (plantation). Observed as a whole, after oviposition (egg carrying), new-laid eggs are placed at the warehouse parent (mother) farm for a day or two, and then are transported by special vehicles with air conditioning to the chicken brooding house. They are re-stored and kept for a certain period of time before they are put in an incubator. Under optimal conditions, commercial hatcheries put in eggs after 3 to 5 days of storage by which the negative effects of egg storage are minimized to the hatching (feasibility) and the quality of day-old chickens. First of all, the highest percentage of chicken generating from a number of fertilized eggs (embryo mortality is reduced to a minimum) is achieved and quality and vital chickens are produced. However, the chicken breeding houses in some situations have to extend the duration of storage of eggs, because the duration of

storage of eggs in the chicken brooding house depends on the supply of hatching eggs, hatchery capacity, market demand and the price of day-old broiler chickens.

A remarkable number of researchers, such as Decuypere and Michels (1992), Reis and Soares (1993), Gustin (1994), Reis et al. (1997), Suarez et al. (1997), Elibol and Brake (2003), Altan et al. (2002), Tona et al. (2004), Miclea and Zahan (2006), Elibol and Brake (2006), Petek and Dikmen (2006), Schmidt et al. (2009), Reijrink (2010), Al-Bashan and Al-Harbi (2010) have found out that the age of broiler parents of different genotypes and age of eggs, i.e. the period of storage (keeping) eggs affect the incubation results, and therefore the fertility of eggs, i.e. the chickens' embryo mortality during incubation.

These authors, in a broader sense, submit that an extension of the period of storage of eggs, among other things, extends the incubation period, decreases the percentage of chicken hatching, reduces the quality of the chickens after hatching, which have negative impact on growth, feed conversion and mortality of broiler chickens during fattening. Although the negative effects of prolonged egg storage period are known to some extent, however, it is still not fully examined how age of eggs (storage period) affects the development of the embryo during the incubation period, and thus the number and percentage of high-quality day-old hatched out chickens.

According to this, the main objective of the study was to determine the effect of paragenetic factors on the results of incubation, particularly broiler parent age (PA) and the period of storage (keeping) of eggs i.e. egg age (EA). In fact, at different age of broiler parents of Cobb 500 hybrid (PA25weeks, PA41weeks, and PA58weeks) and at the eggs stored – old up to 7 (EA <7days) and more than 7 days (EA> 7), among other things, the number and percentage of fertility of eggs, chickens' hatching (out of the number of incubated and out of the number of fertilized eggs) as well as embryo mortality (early, middle and late mortality) during the incubation period have been determined.

Material and methods

The experimental part of the research was carried out on poultry farm (producing eggs for breeding) and chicken brooding house AGREKS Ltd. Lower Zabari, Republic of Srpska - BiH. This farm, among other things, deals with the rearing and breeding of broiler parents of Cobb 500 hybrid, i.e. the production of breeding eggs and day-old chickens.

In order to determine the effect of age of broiler parents in different stages of the production cycle (start, middle and end), i.e. at 25 weeks old flock (PA25), 41 (PA41) and 58 weeks (SR58), and stored eggs (older eggs) up to 7 (EA <7) and over seven days (EA> 7) on the fertility of eggs and embryonic mortality of chickens during incubation, studies were carried out on a total of 6300 eggs. This means that six groups (treatments) of eggs were selected by the method of a random sample, i.e. 1050 eggs aged up to 7 days and 1,050 eggs kept over 7 days per each phase were incubated (1,050 x 2 = 2100 x 3 = 6300 eggs).

All the eggs were kept in a storage room at the temperature of 15 ° C to 18 ° C and 75% to 85% relative humidity. All eggs are kept no longer than 14 days under the above mentioned microclimatic conditions.

A special attention is paid to the fertilized eggs and the eggs from which the chickens hatched out i.e. the eggs with dead embryo in the different stages of its development (early - to 7 days, intermediate from 8 to 17 days, and late from 18 to 21 days of incubation).

Due to limited space, the determined values of an average egg weight, i.e. day-old chickens are textually expressed in this paper, while the results on the fertilized eggs, chicken hatching out of the number of the eggs put in and the number of fertilized eggs, as well as embryo mortality presented in tables in absolute and relative values.

The results achieved are used to determine the effect of broiler parent age (PA), the time period of storage of eggs (egg age - EA) on the properties of the various categories of incubated eggs (fertile and unfertile eggs, the eggs from which chickens hatched, fertile eggs with dead embryo) and hatched day-old broiler chickens.
Statistic data rendering was done by standard statistic methods (Hadživukovi , 1973).

Results and discussion

In the middle of the production cycle (PA41), the average weight of the eggs stored up to 7 days (EA<7) was 63.11 g, weight of a day-old chickens was 44.01 g, the relative share of chicken in egg weight was 69.73%. Age of broiler parents statistically significantly (P <0.001) affected the increase of egg weight and a day-old chickens' weight, while the percentage of chicken in egg weight was decreasing. In addition, extending the period of storage of eggs for more than 7 days, in all three phases of the production cycle, has caused the egg weight and the chicken percentage reduction, i.e. the relative share of chicken in egg weight decreased with the extension of the period of egg storage, especially in the initial (PA25) and final stage (PA58) of the production cycle and the differences were confirmed at the level of P <0.001.
In addition to the effect of broiler parents' age and egg storage time on the egg weight, they had also a special effect on hatching of chickens, as it is evident from the data presented in Table 1.

Table 1. Fertilization of eggs and generating (hatchery) of chickens

Age of parent flock (PA)	Age of eggs (EA)	Total of incub. Eggs	Fertile eggs		Chickens hatched out	Chicken hatchery (%)	
			N	%		From inc. eggs	From fert. eggs
PA$_{25weeks.}$	<7	1050	1018	96,95	855	81,43	83,99
	>7	1050	1000	95,24	822	78,29	82,20
	Total	2100	2018	96,09	1677	79,90	83,10
PA$_{41weeks.}$	<7	1050	1023	97,43	920	87,62	89,93
	>7	1050	1015	96,67	852	81,14	83,94
	Total	2100	2038	97,05	1772	84,38	86,95
PA$_{58weeks.}$	<7	1050	977	93,05	834	79,43	85,36
	>7	1050	976	92,95	806	76,76	82,58
	Total	2100	1953	93,00	1640	78,09	83,97

The data from table 1 show that the age of broiler parents affected the fertility of eggs stored up to 7 and over 7 days. Highest fertility, out of the number of incubated eggs, was in the middle of the production cycle (PA41 = 97.05%), then in the initial phase (PA25 = 96.09%) and the lowest (93.00% PA58) in the final stage of the productive cycle of the breeding of the parental flock. However, the age of broiler parents and egg storage period had a significant effect on the percentage of chicken hatching, especially on embryonic mortality during incubation. The best hatching of chickens out of the number of incubated i.e. fertilized eggs was at PA41 (84.38% and 86.95%), then at PA25 (79.90% and 83.10%) and the worst at PA58 (78.09% and 83.97%). In addition to this, prolonging the period of egg storage negatively affected the percentage of hatching of chickens in all three phases of the production cycle.
From the above we can see that the age of broiler parents affected the fertility of eggs and chicken hatching, and the age of the egg (storage period) affected the percentage of the chicken generating (hatching) and their quality (vitality). Similar tests were carried out by Tona et al. (2004), Petek and Dikmen (2006) for broiler parents of different age and of different time periods of breeding egg storage. Tona et al. (2004) had a higher percentage of

generating for about 4% (88.36% - 84.65%) in case of seven-days old eggs originating from broiler parents of Cobb hybrid, which were 35 weeks old, compared to the parent flock, which was 45 weeks old. In both age groups of broiler parents, incubated fresh eggs had a statistically significantly lower percentage of chicken hatching from 7 days old eggs. Petek and Dikmen (2006) concluded that together with extending the storage period of eggs, at the same broiler parents' age (37 weeks), the percentage of the generating of chickens, out of the number of fertilized eggs, drastically decreases. Thus, chicken generating from the number of fertile eggs, kept for 5 days, was 97.78%, and from the eggs stored for 15 days only 61.82%. Reis and Soares (1993), Schmidt et al. (2009) came to the similar conclusion. These authors state that with the prolongation of the period of storage of eggs, no matter how old parent flock is, the percentage of chicken generating significantly reduces. Schmidt et al. (2009) found that the percentage of the number of hatching chickens out of the number of fertilized eggs reduces from 93.83% (2 days old eggs) to only 74.13% in case of eggs stored for 14 days.

The established embryo mortality (early - up to 7 days; middle - from 7 to 17 days and late - from 18 to 21 days of incubation) in different stages of the production cycle, i.e. the broiler parents' age (PA25, PA41 and PA58) is shown in Table 2.

Table 2. Early, middle and late embrio mortality during incubation

Parent age (PA)	Egg age (EA)	Embrio mortality							
		Early		Middle		Late		Total	
		n	%	n	%	n	%	n	%
PA25weeks.	<7	71	6,97	17	1,67	75	7,37	163	16,01
	>7	80	8,00	31	3,10	67	6,70	178	17,80
	Total	151	7,48	48	2,38	142	7,04	341	16,90
PA41weeks.	<7	44	4,30	24	2,35	35	3,42	103	10,07
	>7	58	5,71	33	3,25	72	7,09	163	16,06
	Total	102	5,00	57	2,80	107	5,25	266	13,05
PA58weeks.	<7	42	4,30	39	3,99	62	6,35	143	14,64
	>7	59	6,04	45	4,61	66	6,76	170	17,42
	Total	101	5,17	84	4,30	128	6,55	313	16,03

Observed as a whole, the data in Table 2 show that the embryonic mortality during incubation was affected by broiler parent age as well as by the length of egg storage (keeping). Namely, the lowest embryo mortality (13.05%), regardless of the period of storage of eggs, was found in eggs originating from 41 weeks old broiler parents (PA41), much higher 16.03% at the end of rearing of flock (PA58) and the highest 16.90% in the initial stage of the production cycle (PA25). In addition, in all three phases of production, the extension of egg storage for more than 7 days resulted in increased embryonic mortality during incubation. The biggest difference (5.99%) was found in the case of eggs originating from 41 weeks old broiler parents i.e. total embryonic mortality in eggs that were stored for up to 7 days, was 10.07%, and in the case of the eggs kept for longer than 7 days, it was 16.06%. In the case of eggs laid at the beginning and in the end of the production cycle, the storage period had a minor effect on embryo mortality (the differences were smaller), but in these production stages the total embryo mortality was higher.

Observed by the production cycle phases (broiler parent age - PA), from the data shown in Table 2, it could be further seen that the early embryo mortality ranged from 5.71% (PA41) and 7.52 (PA25), intermediate between 2,38% (PA25) and 4.20% (PA58), and late embryonic mortality between 5.25% (PA41) and 7.03% (PA25). At all stages of the production cycle, with extending the storage period of eggs, early, middle and late embryonic mortality increased, except for PA25 where the late embryonic mortality was lower in eggs stored for more than 7 days (6.70%) than in the incubated eggs kept to 7 days (7.36%).

These issues, i.e. determination of the effect of storage time of eggs originating from broiler parents of different age on the results of incubation, especially on embryonic mortality were dealt by Reis and Soares, 1993; Gustin, 1994; Reis et al., 1997, Suarez et al., 1997, Elibol and Brake, 2006; Miclea and Zahan, 2006, Schmidt et al, 2009; Al-Bashan and Al-Harbi, 2010.

Reis and Soares (1993) have also found that with the ageing of the broiler parents of hybrid Cobb 500 the embryo mortality increases, too, during incubation, but it was significantly lower than the embryonic mortality shown in our study. Thus, the total embryonic mortality in eggs originating from 33 weeks old parents was the lowest (2.46%), slightly higher (4.84%) at 43 weeks old flock, and the highest at the end of the production cycle - 7.19%. Similarly, Reis et al. (1997) found embryo mortality of 7.9% at the incubation of eggs originating from flock aged between 32 and 34 weeks, and at the flock aged between 48 and 50 weeks it was 8.5%. Suarez et al. (1997) found the highest embryo mortality at the youngest flock (29 weeks old) and it was 10.2%, then at the oldest flock (52 weeks) 8.8%, and the lowest (5.8%) at the eggs originating from 41 weeks old broiler parents. Compared to our results, these authors have found similar or lower total embryo mortality during incubation of eggs stored for up to seven days originating from parent flock of different age.

Similar to our studies, Elibol and Brake (2006) incubated eggs originating from broiler parents of different age (37, 41, 59 and 63 weeks) and determined early, middle and late, and therefore the total embryo mortality. Unlike our studies, these authors have found the lowest total embryo mortality (8.33%) at eggs originating from the youngest flock (37 weeks), then at 41 weeks old flock (9.50%), and significantly higher at 59 weeks old flock (12.28%), i.e. at 63 weeks old flock (12.64%). However, observed as a whole, total embryo mortality was quite similar to our results (Table 2). The same authors state that the early and middle embryonic mortality increases with the increase of broiler parents' age, while late mortality was lowest (3.85%) at 41 weeks old flock, slightly higher (4.06%) at 37 weeks old flock, the highest (5.26%) at 59 weeks old broiler parents. As a support to that observation Al-Bashan and Al-Harbi (2010) found, in their researches, the early and late embryonic mortality during incubation of eggs originating from broiler parents of different age (24, 30, 35, 40, 45, 50, 55, 60 and 65 weeks). The lowest embryo mortality (early - 2.7% and late - 2.9%), was determined with parents aged 45 weeks, and then it gradually increased, and at the end of the production cycle, the early embryonic mortality was 6.2% and the late one was 5.6%.

In fact, the results of these authors are similar to ours, i.e. the lowest embryo mortality (early, middle and late) was mainly established at the eggs that are produced in the middle of the production cycle during the rearing of broiler parents and increased with age. In fact, the early, middle and late embryonic mortality during incubation at eggs kept (stored) up to 7 days was somewhat higher in our study at the different age of broiler parents but it showed a similar trend of increase i.e. decrease.

In the review, Decuypere and Michels (1992) emphasize that apart from the age of parent flock, storage period affects the fertility of eggs i.e. chickens hatching, and thus the embryo mortality during incubation. Petek and Dikmen (2006), in their researches, found lower total embryo mortality - 9.52% (early - 5.10%, medium - 0.68% and late - 3,74%) at eggs stored for 5 days and significantly higher at eggs kept for 15 days, even 37.98% (early - 12.27%, medium - 8.11% and late - 17.60%). Similarly, Schmidt et al (2009) concluded that with extending the period of storage of eggs from 2 to 14 days the total embryo mortality increases from 7.05% to as much as 26.39% at broiler parents aged between 36 and 39 weeks. More specifically, total embryonic mortality at eggs kept up to 7 days (2, 4 and 6 days) was 9.52%, and at the eggs kept for longer than 7 days (8, 10, 12 and 14 days) it was 22.01%. The results of the above mentioned authors are substantially in agreement with our results i.e. that extending the period of storage of eggs increase the embryonic mortality of chickens.

The above mentioned indicates that at the optimal period of storage of eggs (2 - 6 days), no special procedures are needed, except for providing the proper temperature, relative humidity and ventilation of incubator. However, if the eggs are stored (kept) for a longer period of time, it is necessary to take appropriate actions, such as turning eggs during storage, pre-heating the eggs, placing the eggs in a plastic bag, installing nitrogen gas equipment i.e. providing quality air with optimal oxygen content and so on (Gustin, 1994; Altan et al., 2002; Reijrink, 2010).

Conclusion

The aim of this research was to determine the effect of age of broiler parents in different stages of the production cycle (beginning - PA25weeks, medium - PA41weeks and final - PA58weeks) and time of storage, i.e. age of eggs (EA <7days and EA> 7 days) on the embryonic development of chickens and the results of incubation. Based on the results achieved in terms of fertility of eggs and chickens' hatching i.e. embryo mortality, by the stages of the production cycle and the different time periods of storage of eggs, the following can be stated:

Egg storage period (EA) had no effect on their fertility, while the highest fertility of eggs, regardless of egg storage period, was established in middle of the production cycle (PA41 - 97.05%), then in the early phase (PA25-96.09%) and lowest at the end of breeding parent flock (SR58E - 93.00%). It was similar at the number of chickens' hatching out of the number of incubated i.e. fertilized eggs. In the case of PA41 chicken generating amounted to 84.38% (from the eggs put in) and 86.95% (from fertilized eggs), in the case of PA25 it was 79.90% and 83, 10%, and at PA58 it was 78,09% and 83.97%. In every age of the parent flock, the percentage of chicken hatching out of the number of put in and the number of fertilized eggs was higher in a shorter period of storage of eggs (EA <7). Depending on the stage of the production cycle (PA), the effect of egg storage period (EA < 7 and EA > 7) on the percentage of chicken generating was different. At PA41EA <7 and PA41EA> 7) the biggest difference was identified - 6.48% (of incubated eggs) i.e. - 5.99% (from fertilized eggs), and then at PA25EA<7 and PA25EA> 7 - 3.14% and 1.79%, and at PA58SEA<7 PA58EA > 7 - 2,64% and 3,02%.

The age of broiler parents and egg storage period affected the embryo mortality (early, middle and late) during the incubation period. Namely, the lowest total embryo mortality (13.05%), regardless of the storage period, was found in eggs originating from PA41, much higher 15.87% in PA58 and the highest 16.93% in PA25. In addition, extending the period of storage of eggs resulted in the increase of the total embryonic mortality in all three phases of the production cycle. Regarding the stages i.e. the age of broiler parents (PA), early embryonic mortality ranged from 5.71% (PA41) and 7.52% (PA25), intermediate between 2.38% (SR25) and 4.20% (SR58) and late mortality between 5.25% (PA41) and 7.03% (PA25). By extending the storage of eggs (SJ <7 and SJ> 7), at all stages of the production cycle, early, middle and late embryonic mortality increased, except for the PA25. So the late embryonic mortality at PA25EA> 7 was 6.70%, and PA25EA <7 was 7.36%.

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V

RURAL DEVELOPMENT AND AGROECONOMY

SUBSIDIES AS A FACTOR IN THE COMPETITIVENESS OF DOMESTIC AGRICULTURAL PRODUCTION

Vasko ZELJKO[*], Stevo MIRJANIC, Aleksandra FIGUREK

University of Banja Luka, Faculty of Agriculture, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: zeljko.vasko@agrofabl.org)

Abstract

There are often claims that one of the main causes of poor competitiveness of agricultural production of Bosnia and Herzegovina (BaH) is lower level of subsidies in relation to other countries. In addition, the problem stated is too big and too rapid liberalization of imports of agricultural and food products. Subsidies and custom duties increase competitiveness of domestic producers, which ultimately depends on the level of indirect subsidies and tariff protection enjoyed by their competitors in the domestic and international market.

Budgetary constraints in developing countries do not allow payment of the same subsidies to farmers as in developed countries. Because of the different systems of distribution of subsidies it is difficult to make direct comparison of the levels of Bosnia and Herzegovina (BaH)/The Republic of Srpska (RS) with other countries. Therefore, the level of subsidies in agriculture is measured by a single indicator, and one of the most common is the OECD's PSE (Producer Support Estimate) indicator. It expresses the average level of subsidies to agricultural producers at the level of the EU and amounted to 19.8% in 2010.

In the Republic of Srpska (RS), the level of agricultural subsidies (including incentives for long-term investment and rural development) in 2010 was 12.2% of its agriculture gross value added (GVA). In the last five years, livestock production is more subsidized (in average with 7.6% of agriculture GVA) with a tendency to increase subsidies to that group. Crop production is subsidized in average with 5.3% of agriculture GVA, with the tendency to decrease support to this group. The above suggests that the domestic producers are handicapped in free market competition because they are receiving lower level of subsidies, which combined with lower productivity, reduced their competitive position in relation to imported products, i.e. the imports are not charged by any or by very low customs.

The paper further elaborates on policies of subsidizing agriculture in RS and BaH and makes some comparison with the EU Common Agricultural Policy and the level of subsidies in the EU.

Key words: *Republic of Srpska, agricultural production, competitiveness, subsidies.*

Introduction

The term subsidy can be defined in very different ways, from any state support to accomplish certain goals, to only financial support. The World Trade Organization in The Agreement on Subsidies and Countervailing Measures defines subsidies. The definition contains three basic elements: (i) a financial contribution (ii) by a government or any public body within the territory of a Member (iii) which confers a benefit) (WTO, 2010). According to the IMF definition subsidies are current transfers that government units pay to enterprises either on the basis of the levels of their production activates or on the basis of the quantities or values of the goods or services that they produce, sell, or import (Paukovic, 2002). Therefore, it can be said that subsidies are the refund of the money, paid out of funds to certain categories of beneficiaries, provided they meet the requirements for it.

Subsidies are particularly widespread in agriculture as a particular kind of assistance or rewards to those who are engaged in agriculture. Previously, grants were paid for achieved volume of production or sales of specific agricultural products, and it is now generally paid mainly calculated per unit area (Single Area Payment Scheme) or farm (Single Payment Scheme), without their direct link to the achieved type and volume of production, with a greater emphasis on their environmental and social, rather than economic impact. The changed distribution method is a compromise between incentives objections that the subsidies to agricultural production place it in a privileged position in comparison to other productions as well as necessity for producers to deal with agricultural production, even when they do not have an economic interest. Subsidies are the cause of more or less (un)competitiveness because they directly affect the cost and the selling price of a product.

If the level of analysis focuses only on the domestic market, the question is how subsidies affect the competitiveness of domestic agricultural producers? Regardless of the numerous complaints of subsidizing agriculture (e.g., the World Bank has funded research on the subject with a series of working papers, among which it was interesting to read the views of Anderson (2009) or Anderson and Swinnen (2009), it is still prevalent in the world. One of the most subtle systems of agricultural subsidies that the European Union has for this purpose consumes 52 billion (OECD, 2011). Although figures are not comparable because of different sizes (e.g., the average arable land in the EU-27 in the period 2007-09 was 180 million hectares, with an annual value of agricultural production for the same period of 326 billion EUR) (OECDa, 2011) and the degree of development. BaH subsidized agriculture in 2011 with a total of 142 million BAM, a year earlier it allocated to agricultural subsidies 165 million BAM (Ministry of Foreign Trade and Economical Relations, 2011). By signing the Stabilization and Association Agreement, each candidate country is committed to adapt its system of incentives in agriculture to the EU *acquis* in this field, thus BaH will soon face with it. Subsidies that encourage higher production are limited by the World Trade Organization, whose rules are followed by 157 countries (Bosnia and Herzegovina is still not a member of this organization, but it will soon become), to a maximum of 5-10% of the value of production of subsidized products (so-called "de minimis" ceiling). The system of agricultural subsidies in BaH is anachronistic and is close to the one applied by the EU at the beginning of the eighties of the last century.

Materials and Methods

The starting point of the author is that there are no serious restrictions on international trade in agricultural products (which was a stronghold merchantilism's approach to international trade) and therefore a major component of a country competitive advantage in agricultural production is its relative price advantage. At the present level of agricultural development in BaH, a primary goal is to be competitive in the domestic market. In order to sell his product, a local farmer must offer it at the same price at which such imported product is sold, although those producers generally earn higher subsidies. This is only possible if the domestic producer has lower production costs (PC_1) which will compensate his lack of subsidies (s'), or if the profit (P_1) is reduced by as much as a foreign producer subsidy exceeds its subsidies.

$$PC_1 + s_1 + P_1 = PC_2 + s_2 + P_2$$
$$(PC_1 + P_1) + s_1 = (PC_2 + p_2) + s_2$$
$$s_2 > s_1 \qquad s_2 = s_1 + s'$$
$$P = const. \qquad PC_1 - s' = PC_2$$
$$PC = const. \qquad P_1 - s' = P_2$$

(Note: the suffix$_1$ denotes the conditions of the domestic producer and suffix$_2$ foreign producers).

The model is simplified because it did not include the transportation and other depending costs which are condition that of foreign products coming into the domestic market (which influences the reduction of the differences in subsidies). This model explains some of the causes of dissatisfaction of local farmers with the conditions in which they operate (there are more, but the problem of insufficient subsidies is mentioned very often). Conditions for agricultural production in BaH are such that they do not allow the high level of productivity per unit on the basis of which it would be possible to achieve lower production costs. Operating profit (profit) is something that motivates any producer, not just agricultural producer, to engage in some production, and if there is no profit or even if it is minimal, the motivation for such production is very low. In a situation where the productivity of agricultural production cannot significantly be changed in the short (or even medium) term, when the goal is to engage a part of the rural population in agricultural production and processing of as much agricultural land as possible, the source for improving the competitiveness of domestic agricultural production is inevitably required at the side of subsidies (which is applied by many other countries that have more favourable conditions for agricultural production than BaH). Due to the lack of such additional financial incentives, the number of those seeking work outside agriculture and the percentage of uncultivated areas is increasing (as it is evident in BaH). Of course, the solution to increase the competitiveness should be continuously looking on the side of reducing production costs through increased productivity and other measures.

Another way of dealing with the lack of competitiveness of domestic agricultural production is the protective custom tariff. It could be concluded that it is relatively late for the application of this solution in the case of BaH, given that Free Trade Agreements with CEFTA group and the Stabilisation and Association Agreement with the EU (major foreign trade partner) concluded and a commitment of BaH to join to the World Trade Organization. In the case of imports of agricultural and food products from CEFTA member countries no customs tariffs are applied, and in case of imports from the EU they are within the range 0-10% (BaH Customs tariff, 2011). After learning that, by accepting low levels of tariff protection, domestic agricultural production is too much and too fast exposed to the pressure and competition from abroad, tariff quotas and additional (temporary) duties were introduced for some key agricultural and food products. The World Bank in its recent study found that the nominal rate of protection in BaH for key products of plant origin (cereals, fruits and vegetables) is negative and for milk and lamb is positive (World Bank, 2010).

For the purpose of this research, systemizing and processing of data was done on the amount and structure of gross value added (GVA), *i.e.* gross domestic product (GDP) and subsidies paid to agriculture in the Republic of Srpska in the period 2007-11. Data are derived originally from the Ministry of Agriculture, Forestry and Water Management, and the authors have processed them for the purpose of analysis and designing the Republic of Srpska Agricultural Development Strategy for the period 2007-11 (RS Ministry of Agriculture, Forestry and Water Management, 2012). The methods of analysis, synthesis, modelling, comparison and tabulation of results of research were used. Moreover, the comparison of data was carried out on the amount and structure of subsidies in the Republic of Srpska and in the European Union, but it was limited because of methodological differences in the monitoring of the same data.

Subsidies for agriculture and rural areas in the EU and developing countries are paid according to a different model compared to the developing and underdeveloped countries. Almost all the researchers that investigated the same phenomenon in individual countries faced with the same problem of comparative analysis, including the authors of this paper. In

order to make agricultural subsidies comparable, the OECD[16] has established several standard indicators including the commonly used PSE (Producer Support Estimate) indicator that summarizes all kinds of subsidies, regardless of differences in the way they are, from a countryto another one, are paid. What exactly is summarized in the PSE indicator? Producer Support Estimate (PSE) isthe annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm-gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income(OECD, 2009). PSE is the ratio of agro political transfers compared to the total value of domestic production, measured in domestic prices (Franic and Kumric, 2008).

Results and Discussion

Gross value added of agriculture, hunting and related service activities in the Republic of Srpska (expressed in current prices) in 2011 is lower by 43.5 million compared to 2007, or 5.3%, despite the fact that this production in the same period was subsidized with 403 million BAM. In the same period GVA structure of agriculture has changed; the share of crop production increased, and the share of livestock production decreased. Although subsidies for crop production decreased, the value of crop production has increased, among other things, due to increase of the price of grains and other products of plant origin. In the period 2007-09, at the level of EU-27, crop production in agricultural output accounted for 52.9% and the livestock production for 39.9% (OECD, 2011), which confirms that the recognized tendency of changing the structure of Republic of Srpska agriculture GVA should not come as a surprise.

Table 1: GVA agriculture, plant and animal production and subsidies[17] (current prices)

million BAM

Specification	Indicator	2007	2008	2009	2010	2011	2007-2011
Plant production	GVA	286.1	401.2	383.4	381.5	409.0	1.861.3
	Subsidies	17.6	40.9	9.5	10.1	20.3	98.4
	Subsidies /GVA	6.1%	10.2%	2.5%	2.6%	5.0%	5.3%
Animal production	GVA	524.4	451.3	430.5	396.2	356.0	2.158.3
	Subsidies	30.4	45.8	31.0	27.4	28.8	163.4
	Subsidies /GVA	5.8%	10.1%	7.2%	6.9%	8.1%	7.6%
Agriculture, hunting and related services[18]	GVA	818.2	860.7	824.1	787.9	774.7	4.065.7
	Subsidies	64.1	107.8	55.5	95.8	80.2	403.4
	Subsidies /GVA	7.8%	12.5%	6.7%	12.2%	10.3%	9.9%

Source: Calculation of the authors based on dataof the analyses of the Republic ofSrpska Agricultural Development Strategyfor the period 2007-2011, supplemented withforecast dataof the Statistical Instituteof theRS on the size and structure of RSGDP in 2011.

In addition to the analysis of relations between subsidies paid and (gross) value added of agriculture, it is important to see to what extent subsidies are involved in the total GDP of the Republic of Srpska and the RS total budget (Table 2).

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[16]OECD - Organisation for Economic Cooperation and Development has today 34 members from Europe, North and South America, Asia and Oceania.

[17] These annual subsidy amounts represent the amount of funds approved for a particular calendar year, which include delegated duties paid from the budget for the coming year, that is why these annual amounts generally differ from the amount of agricultural budget for the same year.

[18] The difference between the total GVA of crop and livestock production and GVA of entire sector make hunting and related service activities, whose contribution to the creation of the total GVA is marginal and is not taken into account in this analysis.

Table 2: Gross domestic product, the RS budget and the RS agricultural subsidies (2007-11)

billion BAM

Specification	2007	2008	2009	2010	2011	2007-2011
RS Gross domestic product	7.351	8.489	8.223	8.308	8.670	41.041
GVA agriculture	0.818	0.861	0.824	0.788	0.775	4.066
RS Domestic budgetary revenue	1.190	1.436	1.375	1.227	1.383	6.610
Agricultural subsidies	64.1	107.8	55.5	95.8	80.2	403.4
GVA agriculture/RS GDP	11.13%	10.14%	10.02%	9.48%	8.93%	9.91%
Subsidies in RS GDP	0.87%	1.27%	0.68%	1.15%	0.93%	0.98%
Subsidies in the RS Budget	5.38%	7.51%	4.04%	7.81%	5.80%	6.10%

Source: Calculation of the author based on dataof the analyses of the Republic ofSrpska Agricultural Development Strategyfor the period 2007-2011, supplemented withforecast dataof the Statistical Instituteof theRS on the size and structure of RSGDP in 2011.

Following the principle that the subsidies for a given year are considered the ones paid on the basis of subsidy requests approved for that year, and not allocated funds from the budget for that year; spending on agricultural subsidies in the RS ranges between 0.68% and 1.27% of its total GDP with the five-year average of 0.98%. In relation to domestic budgetary revenue (total budget of the RS was higher due to the impact of grants and loans) agricultural subsidies were between 4% and 7.8%, with the five-year average of 6.1%. For example, still "unavailable" Croatia ten years earlier (2001) for the same purposes, allocated 2.2% of the state budget, which was 0.88% of its GDP, i.e. 13.6% of agriculture GVA (Gotovac, 2003). This comparison suggests that the Republic of Srpska allocates a much larger proportion of budgetary resources to agricultural subsidies, while the share of subsidies in total value of agricultural production is still lower than it was in Croatia a decade ago.

When the level of agricultural subsidies is seen as an absolute number (an average of 80 million BAM per year) it does not look very impressive, considering that ½ of the RS population lives in rural areas and are engaged, to a greater or lesser extent, in agriculture. If, for example, 80 million BAM is divided on 55 thousand registered farms, that were registered in the Farm Registry in late 2009 (Mirjanic *et al*., 2011) we get an average subsidy of 1,450 BAM per household per year (120 BAM/month). It is for most small farmers actually less because a significant part of the subsidies are paid to (big) corporate entities. If the amount of the annual subsidy is divided by 952,000 ha of agricultural land, it means that a subsidy is only 84 BAM per hectare. Since about 40% of agricultural land is not cultivated, then a real subsidy per hectare, is slightly higher than the above average.

A common objection is that subsidies for rural development cloud the picture of the actual level of incentives for agriculture and thus "stealing" some of the funds that were supposed to be used by the "real" farmers. On the other hand, Daugbjerg *et al*. (2005) state that consumers and taxpayers easier accept less visible forms of agricultural subsidies, because lobbies that support farmers often cover them through the various other forms of support. They recognize that farmers are more likely to understand the effects of individual measures with immediate effect than the various forms of social transfers whose effects on their economic situation is harder to recognize. The fact that the RS agricultural budget for 2012 was reduced by 20 million BAM in comparison with the previous year, supports the thesis that taxpayers and non-agricultural lobbies in the context of the economic crisis became less sensitive to the problems of farmers than in previous years the compensation period of loss of farmers based on introduction of 17% VAT to their inputs and outputs expired).

PSE indicator of the last 4 years had the following values (at the time of research, data were not completed for 2011) (OECDb, 2011).

Table 3: PSE indicator in some characteristic countries and economic groups (%).

State/Group	Indicator	2007	2008	2009	2010
Switzerland	PSE	48.65	54.40	59.52	53.86
Japan	PSE	46.12	48.47	47.88	50.01
Russia	PSE	18.19	21.89	22.11	21.37
EU	PSE	23.45	22.05	23.53	19.84
OECD	PSE	21.45	20.19	21.87	18.32
USA	PSE	10.01	8.76	10.07	7.04
The R. of Srpska	Subsidies/GVA agriculture	7.8	12.5	6.7	12.2

With all the reservations that the share of subsidies for agriculture (and rural development in the RS) in relation to agricultural GVA does not have the same meaning as the PSE, roughly these two numbers can, more or less, be compared. This comparison indicates that the level of agricultural subsidies in the RS is lower by 50% than in OECD countries and 60% lower than the EU average. If we go back to the formula given in the introduction of this work, it means that local farmers on average have to have lower production costs by 6-8% compared to the same product producers from the EU or the OECD, which are imported and sold in the domestic market or to be satisfied with a much lower profit margin in relation to its competitors from abroad. We should not forget that the entire analysis is based on the average farmer's level of subsidies. Historically confirmed rule is that those ones above the average, i.e. successful survive, and the ones below-average decline, which is a lesson that will have to be learnt and accepted by local farmers. There is no such a state and agricultural policy that will indefinitely help and rescue those who are permanently ineffective. The objectives of the Common Agricultural Policy of the EU in the forthcoming programming period 2014-20 will be significantly amended, and will insist on greater responsibility of farmers for their success or failure in the market and more subsidies will be related to the achieved results. EC plans in the next programming period (2014-2020) to increase funds for CAP only by 3.16% compared to the previous programming period (2007-13) (European Parliament, 2012). It should be noted that local farmers in this regard have some initial advantages over the European, because they, in the last ten years, have largely been left over to the actions of the market economy, and much less aided by various forms of subsidies (see *e.g.* Mirjanic and Vasko, 2008).

Conclusion

Subsidies are cash benefits from dedicated funds paid to certain categories of users, if they meet the requirements. They are particularly prevalent in agriculture as well as the kind of help and support those who are engaged in agriculture and living in rural areas. As a form of additional income or compensation of part of the costs, subsidies directly affect the level of competitiveness of agricultural producers, in the sense that producers who receive a higher level of subsidies are more competitive than those who have a lower level of subsidies.

In the Republic of Srpska, funds to subsidize the development of agriculture and rural areas during the period 2007-11 ranged between 55 and 108 million BAM per year, with significant variations from year to year. In this period, they ranged between 7-12% of the value of agricultural production of the Republic of Srpska, 4-7% of its budget expenditures and about 1% of its total GDP. Regardless of the trend of increased spending on agriculture subsidies, the RS is below the level of subsidies in the EU and other developed countries, which, combined with low levels of tariff protection of domestic agricultural producers puts it at a disadvantage in the domestic and international markets. Projections under the Common Agricultural Policy of the EU programming period 2014-2020, funding to subsidize

agriculture remain at the same level as in the previous period, with the intention to significantly reduce subsidies for market intervention. It should go in favour of the farmers in the RS and BaH due to budget constraints, and in the near future, it will not be able to implement more generous policy of subsidizing agricultural production.

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ECONOMIC DIVERSIFICATION OF RURAL AREAS IN ALBANIA - THE CASE OF KALLMET COMMUNE

Edlira KOLA[*], Sabri LAÇI, Esmeralda LAÇI

[1]Department of Geography, Faculty of History and Philology, University of Tirana, Albania
(Corresponding author: edlirakola@yahoo.com)

Abstract

Since the change of the political-economic system in the beginning of the '90ies, rural areas Albania are facing several challenges in terms of their economic profile. Traditional agriculture, although the main economic sector carrying most of the labor force and representing the main income source for most of the rural population, is facing a veritable crisis in different areas of the country due to several reasons: land fragmentation, persisting property problems, the presence of a family-based self-sufficient economy, lack of investments, weak infrastructure, rural exodus etc. The incomes derived by exerting agriculture *in strictu sensu* (production for consumption) are definitively insufficient for rural families. Therefore, efforts are made in order to diversify the production activity in two main ways: a) within the farm context by providing an extra-value to the agricultural production (commercialization of goods directly to the consumer, product transformation up to an embryonic agroturism); b) beyond the farm context by initiating nonfarm activities, mostly in the services sector, as well as by other sources of incomes such as employment, emigration etc. All this relatively large specter of activities, this diversified economy, is now part of most of the rural family strategies in Albania, but the researches and statistics in this domain still remain very limited. The highlighting, analysis and interpretation of these diversification tendencies embodies the aim of this study, based on the results of a questionnaire carried out in Kallmet commune (Lezha district).

Key words: *rural area, farm, economic diversification, agricultural activity.*

Diversification, a difficult concept to be defined

At first, based purely on the etymological aspect, the term 'diversification' seems easy to be interpreted associated to concepts such as change, transformation or process of transition from a certain subject to another. But this is only the narrow sense of the term. In several sciences, such as economiy, sociology or geography, especially when it comes to researches on territory, human practices, the developing dynamics etc, the term "diversification" is a relatively difficult concept to be understood.

Livelihood diversification is defined as the process by which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living (Ellis, 1998)[19].

Its implications, in accordance with a particular historical, economic, social and cultural context, are various, given the aspects of this concept depending on the type of the analyzed process.

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[19] Ellis, F. (1998), "Household strategies and rural livelihood diversification", Journal of Development Studies, Vol. 35(1):1-38.

Several authors associate diversification of economic activities and income sources of rural households to the low level of country's developpement, focusing their researches in developing regions or countries (REARDON, 1992[20]; REARDON et al, 1992[21]; BARRET. et al, 2001[22] etj.). However, as Ellis (2000)[23] says "… participation in multiple activities by farm families is, of course, not new, nor only confined to the rural sectors of developing countries. Livelihood diversification is widespread and is found in all locations, as well as across farm sizes and across ranges of income and wealth".

In this study, which is focused on a rural area with predominant agricultural activity and tries to maintain its geographical character, combined with other economic and psycho-social elements, the concept of "diversification" will be studied in terms of diversification of economic activities of farm families of the considered area. These activites will be classified in:

Activities based on the agricultural sector (beyond the basic function of agriculture – simple production), regardless of the area where it is exercised. These activities, such as: commercialisation of agricultural products directly in the hands of the consumer, industrial transformation of agricultural products, agritourism etc, although based on farm products, are indeed processes that do not represent an agricultural activity in its narrow concept[24].

Activities outside the agricultural sector, regardless of the domain they belong to.

Briefly on the studied area

The area taken into consideration is the commune[25] of Kallmet, part of Lezha district. Covering a surface of 18.1 km², with a population of approximatively 6800 inhabitants[26], the commune is composed of four villages: Kallmet i Madh, Kallmet i Vogël, Mërqi and Raboshtë, with an average distance of about 10km from the center of the district.

By the economic point of view, the commune has an accentued agricultural character, with ancient traditions in viniculture, oleiculture and processing of agricultural products, but in the same time there is a growing trend towards economic activities carried out outside of the agricultural sector.

Aim of research and methodology

T   his research respresents an attempt to analyze and interpret the current situation and the trend of farm families in rural areas, concretely in Kallmet commune, in terms of their involvment in the basic economic activites (agricultural production) and their orientation towards other activities, based or not on the farm resources. Considering this purpose, it is necessary to provide answers to some questions such as:

What is the degree of the involvement of farm families in agricultural activities and what are some of the characteristics of this activity?

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[20] Reardon, T. (1992), 'Income Diversification of Rural Households in the Sahel', Rural Development Studies, Vol. 24: 281-297.

[21] Reardon, T., C. Delgado and P. Matlon (1992), 'Determinants and Effects of Income Diversification amongst Farm Households in Burkina Faso', Journal of Development Studies, Vol. 32: 899-912.

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[23] Ellis, F. (2000), "The Determinants of Rural Livelihood Diversification in Developing Countries", Journal of Agricultural Economics, Vol. 51(2).: 289-302.

[24] Sales, processing, service provision etc.

[25] The commune is an administrative division, made of a certain number of villages.

[26] According to the commune's Civil State Office, September 2011.

What is the degree of the involvement of these families in other non-typically agricultural activities and what is the nature of these activities?

What is the tendency of these families in the future regarding their economic orientation?

Should the enlargement of the specter of economic activities be considered as a developing opportunitie for the area?

In order to answer to these questions and at same time to know and interpret the perceptions of farm families concerning their economic strategies, the most appropriated research method was considered the survey[27]. This process includes 70 families, chosen carefully in order to provide a satisfactory representation from all the villages of the commune and from several household categories. It is necessary to emphasize that the questions were asked only to the household heads, in order to understand if there is any relation between certain characteristics of the household head and the economic orientation of the household.

Main results of the survey and discussions

Below there are some of the main results of the survey carried out, with an emphasis on the cases where correlation between indicators is significant.

A. The data obtained from the survey show that all the involved households are owners of land they use. The sttructure of land property appears like this:

- inherited (46%);
- obtained from the implementation of the 7501 Law "On Land";
- partly inherited and partly obtained from the law.

As can be seen in the following table, agricultural land owned by households, despite its limited surface, appears multifunctional in terms of its agricultural use. All families are found to have possession of arable land and most of them also own vineyards and orchards. Despite the relativelty high interest for agricultural activity and the ancient and wellknowned agricultural traditions of the area, wasteland is considerably widespread phenomenon.

Table 1. Agricultural land use

Agricultural land use	The owning structure by the households (in %)	Average surface (m^2)
Arable land	100	6.7
Vineyard	86	2.2
Orchards	74	6.9
Pastures	26	1.5
Wasteland	26	2.3

Source: Survey results

B. Most of the households, about 66%, consider the owned agricultural land as insufficient, regardless of whether it comes to production destined entirely for self-consumption, partly for market or exclusively for the market. The remaining part (33%) explain that considering the agricultural land as sufficient does not always mean that it meets the household's needs, but it shows that a larger agricultural land would mean a greater commitment in agricultural works and, most of all, greater expenses, which could not be afforded by all the households.

C. All the surveyed households are simultaneously involved in land cultivation and animal husbandry. Planted crops are various, but the most common are grains, forages, grapes and some vegetables. Generally they keep two or three types of livestock: a typical household

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[27] The results obtained by applying this methodology aim to highlight the general tendencies of the population regarding the research's thematic, without pretending to perfectly represent the reality.

owns one cow, two pigs and ten chickens. Diversified structure of crop and livestock production, considering the limited area of agricultural land and farm as a whole, indicates that production firstly tends to meet household's needs and then to supply the agricultural markets.

D. Another important indicator of the weight that the agricultural activity carries is the engagement of the household members in agricultural works. As it can be observed in the following table, most of the households engage only one person in agricultural works, although the percentage of the households engaging more than one person is almos equal, tesfying the important role the agricultural activity plays in this commune in the cadre of the entire specter of economic activities, as well as the important time devoted to agriculture. However, the minmal percentage of households involving all their members in agricultural works indicates that this activity is not that omnipresent in terms of household's labor force, implying a possible involvement of the remaingin members in other activities outside the agricultural sector. On the other hand, it is found that almost all households (about 97%) cover themselves the agricultural works[28], which is related not only to the lack of need for external labor force, but to the limited financial possibilities of several households to afford the necessary expenses.

Table 2. The level of engagement of household members in agricultural works

Number of household members engaged in agricultural work	Households (in %)
Only one member	48
More than one member	46
All members	3
No one (hired persons)	3
Total	100

Source: Survey results

E. Despite the fact that about 94% of the households surveyed say they do trade a portion of their production (about 80% of families commercialise not more than 50% of production), mostly the product commercialisation is made indirectly, by a mediator. Only about 14% of the households trade their products (processed or not) directly into the consumer's hands, almost entirely in Lezha town. This way of production commercialization, which constitutes indeed a form of diversification of the activities carried out by farmers, generally provides them higher incomes[29], which, in the case of the surveyed households, represent about 30-40% of the total incomes of the households. The correlation between the indicators shows that in general households headed by persons of more than 50 years old are more suspectible to this form of trading.

To sum up, the households, despite the high degree of involvement in the trading process, appear less activie in the direct commercialization of agricultural products as one of the forms of diversification of activities within the agricultural sector. Moreover, the agricultural product commercialisation appears to be the only "extra-activitiy" within agriculture frame, since none of the surveyed households is not engaged in any other form of diversification[30].

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[28] It is about an everyday engagement and not about carrying out some specific agricultural processes.

[29] Except of the cases where the transport cost does not justifies the sending of the production at the market by the agricultural himself.

[30] The survey shows there is no household engaged in the industrial processing of agricultural products or offering toursist services based on farm resources.

F. With regard to the processing of crop and livestock production by households, almost 90% of them stated to process at least one product, but in each case it comes to an artisanal process, carried out by "primitive" means inside the house.

G. The survey shows that more than half of households (54%) also perform activities outside the agricultural sector, distributed by sector as follows:

Table 3. Engagement of households in activities outside the agricultural sector

Sector	Households engaged (in %)
Industrial	26
Construction	32
Services	42
Total	100

Source: Survey results

If in the industrial and construction sector it comes only to the engagement in the form of the employment of one of the household's members, more than ½ of the households in the service sector carry out an entrepreneurial activity, mainly modest trade.

Correlating analysis indicate the presence of a relation between the involvement in activites outside the agricultural sector and the age of the household head: on one hand, the households whose head is under 40 years old represent about 42% of households engaged in activities outside the agricultural sector, while making up only 26% of the total households surveyed; on the other hand the households whose head is over 64 represent only 5% of households engaged in activities outside the agricultural sector, while making up up to 26% of the total households surveyed.

H. The presence of at least one activity outside the agricultural sector in the cadre of the household's income sources helps in providing higher incomes. However, even in this case, as shown in the following table, there is a significant relation between the age of the heads of the households engaged in activities outside the agricultural sector and the quantity of provided incomes: in general, the more the household head is young, the more the incomes are higher (for the household heads of over 64 years old they are even lower than those of the corresponding households[31] engaged only in the agricultural sector).

Table 4. Incomes (in lek[32]) provided according to sectors and age of household head

Age of household head	Mean incomes of households engeded exclusively in the agricultural sector	Mean incomes of households engeded also outside the agricultural sector
Under 40	5200	9000
41-50	3200	6700
51-64	5600	8000
Over 64	6600	5000

Source: Survey results

I. Surveyed households show a low affinity towards expanding of the range of activities carried out withing the agricultural sector. Only 11% of them would be willing to engage in one the diversifying forms within this sector (mainly agricultural product processing and just a few in agritourism). The tendency to be orientated towards diversifying forms outside the agricultural sector is also low (only 20%, mainly in trade and construction). In fact, be, in

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[31] Households whose heads are more than 64 years old.
[32] Albanian currency

addition to the finding that activities outside the agricultural sector are more preferred compared to those within the sector (not just for financial reasons, but also for a better social position), the data obtained show not just a lack of interest towards the diversification of the specter of economic activities in general, but above all they reveal the difficulties (mainly financial) of the farm households for diversification.

J. The data gathered show that the engagement in a new activity, inside or outside the agricultural sector, is considered as an opportunity for the improvement of economic and social situation only by 11% of the surveyed households, while other options, such as: the increase of investments by the government or leaving the settlement or the country are considered more valuable.

K. The way inhabitans see their children's future is of particular interest for the research. Regardless of the pronounced agricultural character of the area, its agricultural traditions and the strong relation of the habitants with their settlement and especially their agricultural land, the agriculture is considered as the sector with less perspective, while the engagement in other sectors within the settlement and the alternative of emigration is seen as a better future for the young generation by most of the surveyed households.

Table 5. The children's future

The children's future in the eyes of the parents	Households (in %)
In the same area, in the agricultural sector	3
In the same area, outside the agricultural sector	40
In another area, inside the country	23
Outside the country	34
Total	100

Source: Survey results

Conclusions and recommendations

The conclusions of this research based on the interpretation of the results obtained by the survey in the commune of Kallmet are as follows:

The agricultural sector remains the most important in terms of the engagement of the households, but it results insufficient regarding the incomes it provides.

The basic function in the cadre of agricultural sector remains the simple agricultural production, mainly for self-consumption and less for trading purposes.

The range of diversifying activites within the agricultural sector is limited in the commercialization of agricultural products directly in the hands of the consumer.

Lead mainly by the aim of providing higher and complementary incomes besides the agricultural ones, but also by the aim of reaching a better social position, more than half of the surveyd farm households are found to be simultaneously engaged in economic activities outside the agricultural sector.

Most of the households exercing activities outside the agricultural sector are involved in the service sector (mainly in the form of entrepreneurial activity, mostly in trade), and less in construction and industrial sector (entirely in the form of employment).

The age of the household head has a considerable impact on diversification iniciatives: the most present in the forms of diversification within the agricultural cadre are found the households whose heads are older, while in activities outside the agricultural cadre, those who are younger.

The incomes of the households where agricultural activity is accompanied with the non agricultural one are generally higher compared to those livng exclusively of agricultural activity.

The tendency to orientate in the future towards activities outside the agricultural cadre is part of 1/5 of the surveyed households, while the one towards other non agricultural activites represents the will of only 1/10 of the households.

Almost all households see the future of the young generation outside the agricultural cadre, despite the wish to stay or leave the settlement.

Based on these conclusions, in the studied area, as well as in other similar rural areas it is important to encourage diversification in the cadre of agricultural sector, aiming the valorization of agricultural activity, in order to make it more flexible to the current demands and innovations and financially more efficient regarding. A diversified and multifunctional agriculture would lead to a multidimensional revitalization of rural areas. Also, the national, regional and local policies and strategies should extend their focus regarding the economic profile of the rural areas, taking into consideration not only the agricultural sector but also other non agricultural ones, as important components of the spectre of economic activities exerced by households.

Therefore, it is important to take all the necessary measures to provide a complete and updated database regarding the forms of engagement of households in economic activities and to constantly perform monitoring and studies for the inhabitans in general and for several targe-groups, in order to highlight the actual situation and to define the tendency of these familiar economic strategies in the future.

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STRATEGIES AND DIRECTIONS OF DEVELOPMENT OF POLISH AGRICULTURE

Małgorzata BUŁKOWSKA[*], Katarzyna CHMURZYŃSKA

Institute of Agricultural And Food Economics – National Research Institute, Poland
(Corresponding author: bulkowska@ierigz.waw.pl)

Abstract

Article presents some major changes that have occurred in Polish agriculture in the past ten years and the strategies and directions of development of Polish agriculture. In the years 1990-2004 the principles of market economy have been introduced in Poland, which led to a drastic reduction of Polish agricultural income parity. Rural development was impossible without the financial support for agriculture and structural policy. After 1989, a number of strategic documents which were the basis for the development of agriculture and rural development were prepared, but due to limited budget for implementation their influence was inconsiderable. Since 1990, a number of pre-accession programs (preparing Poland for joining the European Union), supporting the development of agriculture and rural development were implemented. Among them, the most important were PHARE and SAPARD. Since 2004, after the Polish accession to the European Union two EU co-financed programs aimed at rural development and agriculture were introduced: Rural Development Plan 2004-2006 and Sectoral Operational Programme "Restructuring and Modernisation of Food Sector and Rural Development 2004-2006". Since 2007 another Rural Development Programme (for years 2007-2013) is being implemented. All those programmes have consistent strategic objectives: improving the competitiveness of the agri-food sector and sustainable rural development. Achievement of these objectives will primarily depend on the improvement of macroeconomic situation and the degree of utilization of EU funds.
The article uses data of the Ministry of Agriculture and Rural Development, Central Statistical Office, the Agency for Restructuring and Modernisation of Agriculture and FAO.

Keywords: *CAP, strategies, food industry, foreign trade, EU financing.*

Introduction

The situation in Polish agriculture is highly dependent on socio-political circumstances, which have changed many times in the last decades. After the World War II agriculture in Poland underwent universal privatisation of property under the land reform, compulsory collectivization in the 1950s, and establishment of state agricultural farms in the 1970s towards the crisis in the 1980s and transformation into market-oriented economy in the 1990s. Transformation into market-oriented economy has resulted in a number of political decisions, *inter alia* the liquidation of state agricultural farms – the symbol of socialist agriculture. In 1989 they stopped being financed, and in 1991 their liquidation commenced. The last state agricultural farm was closed in 1994. Undoubtedly, liquidation of state agricultural farms was the right decision on the one hand, since as a creation of socialist economy they couldn't function in its current form. However, opponents criticised the methods of liquidation. Some of the farms were in good economic shape and, after the reform, could adjust to the new economic reality. A significant argument against the fast liquidation of state agricultural farms was the human factor, i.e. redundancy of thousands of people with no alternative livelihoods.

The cost of unemployment benefits, activation programmes for unemployed people, and the social impact exceeded the cost of additional payments for unprofitable farms. Until now, however, the high unemployment rate is one of the most serious problems of Polish agriculture and rural areas.

The worsening economic situation in agriculture is also reflected in the research of the Institute of Agricultural and Food Economics, which prove that at the end of the 1990s farms had worse performance results in comparison with the previous years (Wo 2000; Skar y ska, Augusty ska-Grzymek 2000). It was only after Poland's accession to the EU that some favourable symptoms appeared in agriculture.

Integration with the EU

Integration with the European Union created new conditions in Poland for the development of agriculture and rural areas. Poland received access to EU funds as well as to other instruments that are available for all member states. These include: financing from the Common Agricultural Policy measures, access to direct payments, which have an impact on the agricultural income and the opening of borders, which on the one hand allowed to enter Polish products to new markets on the other hand forced the Polish agricultural producers to adapt to rules and standards prevailing in the common European market.

The implementation of tasks in respect of support for agriculture and rural areas in Poland, in accordance with the EU system, commenced under the SAPARD Programme. The experience gained and skills acquired during the implementation of the programme were used for the purposes of the implementation of agricultural and structural policy after accession. The aim of this policy is to effectively and consequently raise the level and quality of living in the rural areas. In order to achieve these objectives, State policy for rural areas should concern both agriculture, and non-agricultural development of rural areas. Support for the development of rural areas needs to be complementary and should be in line with other national policies and strategies that define main development objectives and priorities under Cohesion Policy in Poland.

In the first years of membership (2004-2006), two programmes co-financed by the EU which focused on the development of agriculture and rural areas were implemented after the Polish accession to the EU: 1. Rural Development Plan 2004-2006 (RDP 2004-2006), and 2. Sectoral Operational Programme *Restructuring and modernisation of the food sector and the development of rural areas, 2004-2006* (SOP "Agriculture"). The new Rural Development Programme (RDP 2007-2013) has been implemented in Poland since 2007. The total amount of public resources – both EU, and national – allocated to rural development under SAPARD, RDP 2004-2006, SOP "Agriculture", and RDP 2007-2013 is EUR 23.7 billion (Figure 1). Financial resources under the programmes implemented in the previous programming periods were used almost in their entirety. RDP 2007-2013 attracts beneficiaries just like the previous programmes; therefore, it is assumed that funds under this programme will also be used in their entirety.
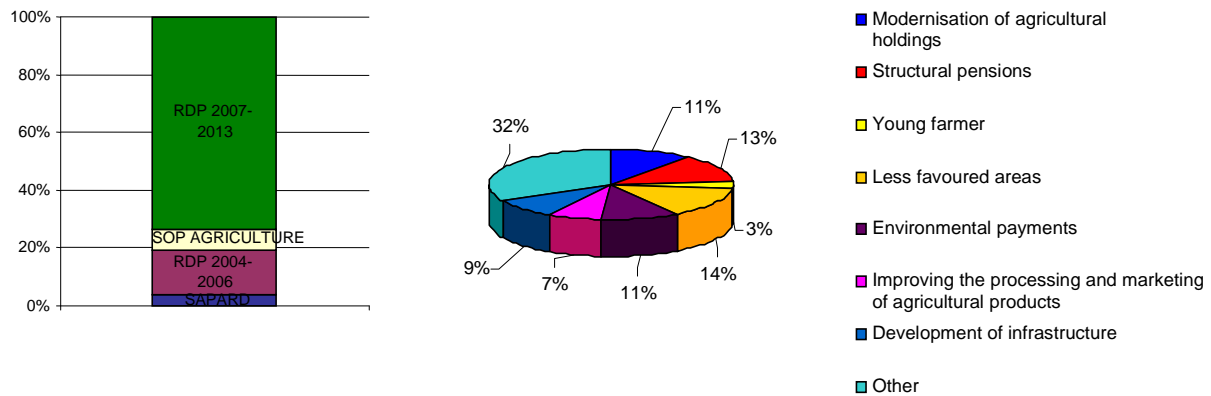
Figure 1. Budget of SAPARD, RDP 2004-2006, SOP "Agriculture" and RDP 2007-2013 in total and by measures.

Source: Allocation of available resources under the Annual Financing Agreements 2000, 2001, 2002 and 2003 to individual measures of SAPARD Programme; Information about the implementation and the results of the SAPARD Programme from www.minrol.gov.pl; Summary financial Plan table with EUR changed after reallocation of resources 4/2008, December 2008 - information from www.minrol.gov.pl, Resolution no. 45 of the Monitoring Committee for the Sectoral Operational Programme "Restructuring and modernisation of the food sector and the development of rural areas" of 5 July 2010. Table 3.1. Indicative allocation to certain rural areas measures (in EUR for the entire period), Rural Development Programme for 2007-2013, Ministry of Agriculture and Rural Development, Warsaw, March 2011.

Both the SAPARD pre-accession programme, and RDP 2004-2006, SOP "Agriculture" and RDP 2007-2013 have common strategic objectives, i.e.: 1. improving the competitiveness of the agricultural sector, and 2. sustainable rural development. These objectives are achieved by various complementary instruments (measures). Most of the measures implemented under RDP 2007-2013 are the continuation of measures implemented in the previous programming period, which determines the transparency of the policy towards agriculture and rural areas, and the consistency in achieving the EU programmes objectives. The most important rural development priorities are: (1) development of entrepreneurship and non-agricultural activity; (2) growth of competitiveness of farms; (3) development and improvement of technical and social infrastructure in rural areas; (4) improvement of the quality of human capital, and activation of rural population.

There is a great diversity of the measures under the programmes implemented in Poland – from strictly investment measures, social measures to those improving conditions and quality of living in rural areas. Such allocation of resources enables various restructuring and modernisation changes in agriculture and the food sector. However, too great dispersion of financing does not allow for focusing on the most important problems of Polish agriculture. At present, the next funding programme for the Common Agricultural Policy for 2014-2020 is being prepared. This will probably be the last period when the Member States will have access to considerable EU budget. It is therefore crucial to specify the type of measures to be supported, since that choice will probably shape the development of agriculture and industry for the next few years.

Impact of the CAP on Polish agriculture

Financing from the Common Agricultural Policy budget has had influence, *inter alia*, on the production aspect of Polish agriculture. Both area and structure of use of agricultural land changed. In comparison to 1997, the area of agricultural land increased by 2.5% and amounted to 18,934 thousand ha in 2010 (Table 1). Arable land in 2010 constituted the area of 13,969 thousand ha (14,059 thousand ha in 1997), orchards – 292.4 thousand ha (261.8 in 1997), meadows and pastures – 3,931 thousand ha (4,136.2 in 1997). This indicates that

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although the overall area of agricultural land increased, the area of arable land and meadows decreased in favour of orchards.

Table 1. Basic indicators of Polish economy and agriculture in 2010.

Specification	2010	Specification	2010
GDP per capita (EUR)	15 300	Share of agricultural import in import (%)	8,1
Population (million)	38	Net trade in agricultural products (EUR million)	2 593
Share of rural population (%)	39	Average area of a farm (ha)	10,36
Share of agriculture in GDP (%)	3,5	Arable land (ha million)	18,9
Share of agriculture in employment (%)	16	Arable land per capita (ha)	0,4
Share of agricultural export in export (%)	11,2	Plantations area (ha million)	10,4

Source: Data of CSO, Agency for Restructuring and Modernisation of Agriculture.

The total plantations area for harvest was 10.4 million ha in 2010. In comparison to the previous years, cereal (basic cereals with cereal blends, maize, buckwheat, millet and other) and forage crops cultivation area decreased. On the other hand, plantation area of oilseed rape and agrimony and field vegetables increased.

The structure of agricultural production in Poland has been changing over the years. Although livestock products (cow milk, pork and beef) are still at the forefront of production, there are significant changes in the structure of plant production. Livestock production accounts for over 50% of agricultural production in Poland. There has been strong growth in the production of poultry meat and eggs, particularly on farms producing on an industrial scale. Cereal production decreased (in comparison with 1995-1997), and the area of industrial crops increased (Table 2). This results from the demand on oilseed rape for energy purposes.

The change in the structure of agricultural production is the consequence of, *inter alia*, Poland's entry in the EU market, adjustment to its quality requirements, as well as demand for certain products that are exported, as presented in Table 2 herein.

Table 2. Average annual production of the most important products in Polish agriculture in 1995-1997 and 2008-2010 (in USD thousand and tonnes thousands).

Product	Value of production (USD thousand)		Quantity (thousand tonnes)	
	1995-1997	2008-2010	1995-1997	2008-2010
Cow milk, whole, fresh	3 449 782	3 739 656 /1/	11 820 500	12 383 733
Indigenous Pig meat	3 039 382	2 668 445 /2/	1 977 167	1 735 867
Potatoes	1 634 891	1 031 750 /5/	24 294 667	9 643 620
Indigenous Cattle meat	1 170 597	1 239 931 /4/	433 333	459 000
Apples	752 520	1 031 332 /6/	1 779 370	2 438 633
Sugar beet	674 477	421 354 /10/	15 680 400	9 795 740
Wheat	659 354	588 431 /8/	8 478 890	6 531 980
Indigenous Chicken meat	498 590	1 395 672 /3/	350 033	979 827
Hen eggs, in shell	322 346	498 250 /9/	389 655	601 743
Cabbages and other brassicas	272 723	186 306 /16/	1 822 503	1 245 007
Strawberries	251 094	260 768 /13/	184 998	192 126
Rye	215 663	263 194 /12/	5 746 543	3 477 250
Rapeseed	215 172	599 288 /7/	806 935	2 226 767
Carrots and turnips	200 254	211 680 /15/	802 622	848 420
Mushrooms and truffles	192 768	329 879 /11/	106 841	182 833

Notice: Figures in brackets in the "value of production" column – arranged according to the decreasing annual value in a given period.
Source: Author's own compilation based on FAOSTAT data.

Impact of the CAP on the income situation of farmers

Poland's accession to the European Union significantly changed the conditions of agriculture, food industry and the broader market environment of the Polish food sector. Such changes resulted from extending the Common Agricultural Policy to Polish agriculture, which through direct payments system guaranteed the increase of farmers' income and improvement of their living conditions, as well as provided access to financial resources under the pre-accession programmes and structural funds that enabled to accelerate modernisation processes in farms and their adjustment to the new market circumstances. The CAP also provided a set of instruments for the regulation of agricultural markets which limited the operation of market mechanisms. Following the lifting of the customs border between Poland and other EU Member States on 1 May 2004, Polish food producers were provided with free access to a large but demanding EU market.

The most important instrument of assistance for farmers are direct payments, which have been granted to 1.4 million farms (88%) since 2004. The share of payments in farmers' income amounts to ca. 40%, which means they have a considerable impact on the improvement of farmers' income situation. However, they impede land trade between farms and, thereby, structural changes in agriculture. The acceleration of structural changes is the key issue for the improvement of productivity and profitability of Polish agriculture. Admittedly, the number of farms in Poland has been decreasing steadily and the average area of a farm increases. However, these changes occur very slowly. In 2011, the average size of a farm in Poland was 10.4 ha of arable land (Table 1), while only farms of 16 and more ESU (the average area in Polish conditions is 56 ha of arable land) are able to generate income enabling beyond-parity payment for own labour and extended reproduction of fixed assets. The share of these farms in Poland does not exceed 6% of the total number of farms entitled to apply for payments.

The competitiveness of farms is to be enhanced by investment instruments that improve the technical supply of labour and lead to improved quality of production and to its modernisation. Payments for investments were available to Polish farmers already before Poland's accession to the EU under the pre-accession SAPARD 2000-2003 programme, and after 2004 – under EU programmes (Figure 1). Those instruments are targeted and addressed to beneficiaries who need to ensure their effective use, thus only a small number of farmers have had the opportunity to take advantage of them (a total of ca. 90 thousand). However, the opportunity to obtain even up to 50% reimbursement of incurred investment outlays is not always conducive to rational decisions made by farmers and the achievement of intended goals, as the calculation of efficient use of capital and the machinery is carried out in a "discount conditions.

Impact of the CAP on foreign trade in agri-food products

In the first years after accession to the European Union, the macroeconomic situation was favourable for Polish food economy, which accelerated Poland's economic growth. Foreign trade in agri-food products was the most dynamic and the fastest-developing sector of Polish food economy (Figure 2). After accession to the EU, sales in those goods nearly tripled, and since 2003 Poland has become a net exporter of food (a share of 4% in EU-27 exports in 2011). A great majority of Polish export (80%) goes to the EU market. Germany is the largest recipient of Polish food products among EU Member States, while outside the EU that role is played by Russia.

The competitive advantages of Polish food producers mostly stem from low costs and consequently the low price of products offered. In the long-term perspective, however, food

quality and safety as well as the ability to take pro-innovative action will play an increasingly important role.

The largest share in value of sold production of agri-food industry product as well as in the agri-food export have industries closely linked to agriculture, such as meat, fruit and vegetables and diary production. The value of exports of products from these three sectors in the years 2000-2011 in Poland amounted to approximately 50% of the total agri-food exports. This shows the great importance of these sectors in creating a positive balance of trade in the Polish agri-food products, as well as for the development of the food industry, including agriculture.
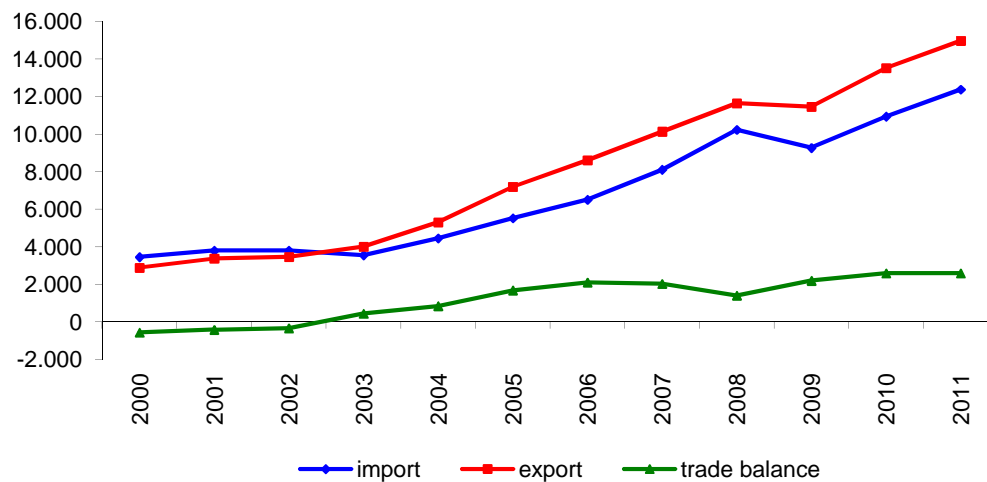
Figure 2. Foreign trade in agri-food products in EUR million.

Source: Own elaboration based on Eurostat data.

Between 1995 and 1997, Poland mostly exported products processed from fruit, the trade in which was almost unlimited, as well as skimmed milk. When Poland entered the European Union, barriers to trade with EU countries were lifted and EU customs tariff was adopted in trade with third countries, the structure of Polish exports changed considerably. Between 2008 and 2010, the greatest share in the value of Polish exports was attributed to cigarettes, but the production of cigarettes in Poland is based on imported raw material, so they were only re-exported. In the same years various types of food preparations and chocolate products were also important in Polish exports (Table 3).

Table 3. Poland's agri-food export (most important products) in 1995-1997 and 2007-2009.

Product	Exports value (USD million)		Quantity (thousand tonnes)	
	1995-1997	2007-2009	1995-1997	2007-2009
Fruit Prp Nes[*]	197 469	577 681	205 787	341 186
Milk Skimmed Dry	165 676	194 933	95 533	82 618
Sausages of Pig meat	148 111	130 419	96 410	37 090
Chocolate Prsnes[**]	145 622	738 114	43 811	133 844
Apple juice, concentrated	118 930	263 579	108 966	201 104
Sugar Confectionery	108 695	239 265	53 213	53 031
Pastry	75 838	703 103	43 843	215 392
Food Prep Nes[***]	75 429	886 613	43 371	265 785
Sugar Refined	54 963	204 787	172 252	313 646
Vegetable Frozen	54 655	264 894	103 406	349 268
Pig meat	50 548	345 093	36 037	157 431
Cheese of Whole Cow Milk	46 750	479 393	18 795	116 269
Cigarettes	30 790	1 225 705	5 801	88 101
Cattle meat	7 813	596 755	5 801	168 674
Chicken meat	34 823	478 357	10 482	217 944
Mushrooms and truffles	32 601	343 851	8 483	161 111
Turkey meat	2 168	290 619	575	80 969
Meat-Cattle Boneless (Beef & Veal)	10 249	268 344	2 270	63 015

*Fruit, nuts and peel, including frozen, prepared or preserved, jam, paste, marmalade, pure and cooked fruits, other than those listed separately.
**Includes sweetened cocoa powder, chocolate and other food preparations containing cocoa, as well as sugar confectionery containing cocoa in any amount. Excludes white chocolate.
***Including both crop and livestock products. Inter alia: homogenized composite food preparations; soups and broths; ketchup and other sauces; mixed condiments and seasonings; vinegar and substitutes; yeast and baking powders; stuffed pasta, whether or not cooked; couscous; and protein concentrates. Including turtle eggs and birds' nests.

Source: Author's own compilation based on the data from the FAOSTAT.

The growth of agri-food exports was possible thanks to Polish entrepreneurs being well-prepared to accession, and to the restructuring of enterprises and adjustment of production to EU requirements. The strong competitive position of Polish food industry in foreign markets is evidenced by the share of food industry products in agri-food exports, which amounts to 80-85% (one of the highest values in the EU)(Szczepaniak 2011). However, in the light of the ever greater liberalisation of global trade and the growing importance of developing countries such as Brazil and China in the international arena, the position of Poland as well as that of the entire European Union both in agri-food trade and in food production may diminish.

Conclusions

Upon Poland's entry to the EU, the transformation process in Polish agriculture and food industry became strongly dependent on the Common Agricultural Policy. Towards the end of the last century, CAP orientation shifted markedly – from a policy meant to support agricultural production towards a policy which supports the growth of competitiveness of European agriculture and the multi-faceted development of rural areas. Accession to the EU and inclusion of Polish agriculture in CAP instruments have contributed to making the changes in both agriculture and the entire food industry more dynamic. Those changes

followed for the most part from the strategy pursued towards agriculture and food industry, and supported by EU funds.

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HUMAN CAPITAL AND RELATIONAL CAPITAL AS SOURCES OF EFFECTIVE PARTICIPATION IN CROSSBORDER COOPERATION PROGRAMS

Francesco CONTÒ[1], Mariantonietta FIORE[1*], Pier Michele LA SALA[1], Umberto MEDICAMENTO[2]

[1]University of Foggia, Italy
[2]University of Bari, Italy
(Corresponding author: m.fiore@unifg.it)

Abstract

Cross border and transnational cooperation represents a source of knowledge and inputs for local development. Especially for less developed areas, these programs integrate the local and national public funding that, year by year, become lower. Meanwhile, the EU is setting new strategies that will probably take part in cooperation programs which are more difficult for organizations unable to build cooperative relationships strongly based on effective know-how, a larger territorial base (locally), well documented and motivated programs and projects. Future co-operators will need solid backgrounds, a fair amount of trained human capital, a strategic perspective and a good capacity to transfer the local operators' and SMEs' needs in transnational projects and vice-versa. Assets like updated information, experience, linkages with the social and economical tissues will be crucial in determining successful projects and follow-ups for both private and public agencies. Investments/stocks in both human capital and relational capital will increase their relevance compared to other forms of capital (financial and physical). We use statistics to make inference and to test this main hypothesis and several descending others, investigating the abilities of Local Action Groups (LAGs), in applying to cross-border and transnational cooperation programs, and in building project proposals. Our paper represent a proposal, a work in progress aiming at studying and verifying the existence of a correlation between social capital (SC), network and transnational cooperation programs. The selected territory is a region of a Southern Italy - the Apulia region - the Italian 'heel', whose 25 LAGs cover the whole region and include all Apulia provinces. Our work ends up with a set of insights about the behavior of these organizations useful to deepen the knowledge about the real role they can play in fostering and exploiting the corresponding territories.

Keywords: *Social Capital, Rural development, LEADER approach, Transnational cooperation, LAG*

Introduction

The integrated approach and the aggregation and cooperation among the different chain parties, countries or areas/territories are the main factors to increase the value added and the competitiveness of the rural sector thus helping to create social capital (Alfano *et al*., 2008). In fact, a crucial role is assigned to the local social capital to promote and to implement activities in local communities by planning processes aimed at increasing the value of resources (Helfat *et al*., 2007, 2010). The principle of territorialization of regional interventions can represent a relevant opportunity for the implementation of development strategies and to adopt transnational and interregional programs, which are essential in fostering the development of relationships and networks (Contò *et al*., 2012). Participating in a network means for the Social capital and for a firm, especially small or medium, to access

the know-how that alone would not be able to achieve, and improve, therefore, their competitive advantage. The phenomena of relocation of production, internationalization of enterprises, transnational business networks, have led to interpret the "space" not as a source of cost, but as a development factor, in a perspective of hierarchy and networks between areas (ibidem). The Leader approach (National Rural Network, 2010) is in particular characterized by the concept of multi-sector strategy, based on the interaction between parties and projects of different sectors of the local economy and on the implementation of innovative approaches, cooperation projects, networking of local partnerships. The cooperation among countries and commitment of all stakeholders from the early stages of preparation, implementation and support from both central and local government levels are fundamental for the realization and success of the Rural Agribusiness Development (RAD) programs objectives (Irianto, 2011). If the local social capital participates in a transnational and not only national network, it will be able to access the know-how that alone would not be able to achieve in special way when the rural sector, in particular, is going through a strong crisis; so, thanks to the 'relational capital', both new cognitive resources become available, such as information and trust, thus allowing the actors to achieve unattainable goals (Lippert and Spagnolo, 2006; Gintis and Khurana, 2007; Aoki, 2007). The role of social networks and social capital determining the success of locally rooted productive organizations, which adopt organic agriculture, has been also investigated showing a positive relationship (Casieri *et al.*, 2008; Kroma, 2006). To operate in an evolving market, as a source of many opportunities but also of new risks, we need tools such as training, counseling, community life and we should be member of a network (Contò *et al.*, 2011) and the social capital reflects the ability of community members to participate, cooperate, organize and interact (Kibbutz, 2005). Social capital is not only a set of norms and informal rules but networks that enable cooperation, trust, and collective action for the common good. Social capital does not arise in an instant. It is a product of social (multi-agent) interaction (Yiheyis *et al.*, 2007). Therefore, these social capital variables could act as important predicting factors thus determining the adoption and utilization of RDPs programs (Firouzjaie *et al.*, 2007) in an efficient way. Since the nineties, a new scenario in the field of local development has gradually affirmed based on finding a new form of competitiveness of the regions, especially the rural ones. In this context, the Leader Community Initiative, launched in 1991, was based on a partnership approach, multi-sectoral and integrated development of rural areas. The strategies start from the local (bottom-up approach) and are implemented by public-private territories: the Local Action Groups (LAG). Thus, the local actors become the main actors in their development (governance). Over several planning periods, LEADER has shown first, with the Leader I (1991-1993) an innovative model of local governance. With the Leader II (1994 - 1999) the Regional Leader Programs (FDP), transnational and national networks, in addition to the European Network for the promotion of innovative measures in rural areas, were introduced. With the Leader Plus (2000-2006), the Local Development Plans (LDP), by the GAL, have been introduced to improve and enhance the use of natural and cultural resources, to improve the quality of life in rural areas, to promote the value added of local products, to increase the competitiveness of products and services in rural areas and to promote cooperation between States.The LAGs are composed of both private and public partners, thus gathering a balanced and representative set of the different socio-economic local stakeholders. In Apulia region, their actions involve almost entirely, at least for inland areas, the regional territory. The added value of Leader ordinary policies of rural development derives from the set of challenges and opportunities that arise from the same rural areas. It aims to an economic growth in rural areas through the implementation of strategies aimed at encouraging and developing the ability to generate local production systems, to initiate cooperative relationships between local actors and development of territories. The Leader is the tool that aims to facilitate the aggregation, strengthen social

networks and institutional development, to facilitate the construction of an integrated regional development project, negotiated and shared. To this end, cooperation within the Leader was introduced to add value to local development actions through the exchange of know-how and joint actions on issues which are common to most rural areas. The need for cooperation arises in the Community context, the necessity of European regions to implement the cohesion between the territories (National Network for Rural Development, 2008, 2009, 2011; Zumpano, 2001), and to pool resources for achieving better results, thereby strengthening the impact and effectiveness of local development. Leader cooperation passes the condition of marginality and isolation of rural areas, facilitating the sharing of knowledge, experience, local knowledge and promoting socio-cultural enrichment of the rural population. Compared to Leader II, the Leader Plus interterritorial cooperation between rural territories belonging to the same Member State and the strengthening of transnational cooperation is introduced, providing the opportunity to cooperate with non-EU countries. In the framework of Axis IV of the Leader approach, in their regional rural development Programmes (PSR) 2007/2013, measure 421 was created with the objective to promote and support cooperation between local areas through the development and implementation of joint projects of transnational and interregional cooperation. Through the application of this measure it is possible to sustain its territories in terms of critical mass; also to support the introduction of innovation and diffusion of knowledge and skills developed and exploited in other places can find further enrichment by comparison and implementation of integrated projects on topics which are common at all territories.

Materials and methods

Our dataset includes data by the Local Development Plans (LDP) of the 25 LAGs of Apulia Region that cover the whole region. The study was developed over 4 months of work to capture all data relative to social capital, to transnational projects, financial assets and main characteristics of area of influence. The dataset was structured in several sections; the first section includes 2.237 observation about LAGs' social capital, and it was divided into 13 categories. As shown in the diagram below, the 13 groups are grouped by analogy in 6 general sectors (graphs 1-2):

Public Institutions (PI) formed by 3 groups: Municipalities, Provinces and other Institutional public subjects – like Park Authorities, Mountain Communities, Chambers of Commerce and so on).

Firms (FI) formed by Farms, Consortiums and Productive cooperatives categories.

Associations (AS) formed by trade associations, cultural and social promotion associations, cooperatives in the tertiary sector.

Training (TR) formed by Universities, Departments and Research centres.

Banks and financial Institutions (BF).

Others (OT) that include e.g. Foundations, nature reserves, Management Committee, individuals, agro-technician provincial colleges and so on.
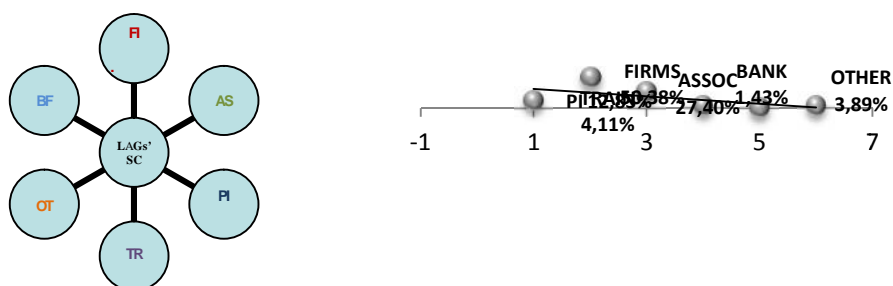
Figures 1-2: The SC of LAGs (structure and percentage)
Source: our processing of data from PSL of LAGs (2009/10).

The figure highlights the sectors and their respective percentages: firms represent the 50% of the SC, followed by AS (27.40%) and PI (12.83%). The second part describe and develop the data concerning the topic of investigation that is the transnational projects individuated at preliminary level in the RDP of LAGs. The transnational projects of all 25 LAGs are in total 68 that is 2.72 projects for every LAG on average. Those ones at local and inter-territorial level are 39 so the average value is only 1.56.

The financial assets of the 25 LAGs are quite unevenly distributed with a small percentage of LAGs owing more that 200,000.00 Euros and the larger share with around 120,000.00 Euros. We could then expect that assets cover a role in determining successful acceptance, so that it would be better to consider the influence of other variables (as SC) separately for these two subgroups. High variability can be observed also in the bureaucratic area of influence of each LAG, as well as for the number of firms that appear in the list of the LAGs' memberships. Variation occurs, anyhow, in most of the different types of members, thus suggesting quite a variation in the composition of each LAG's membership. This information covers for us a great deal of interest since it makes it reasonable to expect that exploring how different memberships works out an organizational framework, would stem different SC (relationally based) assets that, in turn, could be useful to explain different output levels.

Social Capital is here assumed to positively influence planning strategies and acceptance in transnational cooperation partnerships, when resulting from a process rooted on networking activities. The LAGs, in their formal nature of private corporation as well as in their mission of enhancing local development, should build the social capital of the local communities they belong to. Reading the National Strategic Plan in fact, the guideline for each regional Rural Development Plan, the LEADER Approach results have been strengthened, especially in its role of enhancing the local governance and boosting endogenous development. The LAGs, thus, play a determinant role both in managing, planning and fostering efficient resource allocation and bottom-up development. The constitution of a local partnership, representative of both the stakeholders and the civil society, is the bet that each LAG need to win. Nonetheless, the LAGs need to be contemporary rooted in their respective territory and to be networked at a larger scale with a variegated set of actors, primarily LAGs in the same region, but also peer organizations out of the regional boundaries.

Networking activities for a developing agency should be considered as one of the main daily task able to amplify the chances to intercept and relocate resources, opportunities and planning. Also, networking is becoming crucial for two main reasons: (1) larger public funding requires larger partnership built up taking into account both territorial representativeness and competencies complementarities; (2) the emphasis on the bottom up approach poses the relevant topic of acceptance of any project proposal, mainly for those with higher environmental, economic and social impact. Successful LAGs should be able to create consensus among local stakeholders and population and, on the other hand, to interface with several larger scale actors, both locally, nationally and in the abroad, such as regional governments, external entrepreneurs, experts and professionals, research and educational institutes, development agencies, policy makers, lobbyists, etc. and, last but not least, other LAGs. Cooperation, then, becomes crucial. The spread of information, experiences and know-how among rural territories belonging to national or EU contexts is a positive principle that has been kept and enforced by the latest programming season, and the innovations introduced relate mainly the experience exchange procedures, so to ameliorate effectiveness and efficacy of cooperation (Franceschetti *et al.*, 2009).

We here propose an analytical tool to map out and evaluate the LAGs ability in cooperation and building consensus, and to investigate which features affects such intangible efforts. In our case study, consensus relates to the inclusion in transnational cooperation partnerships that, although potentially one of the best available solutions for sustainable local development,

present several issues when coming at the point. We propose here to explain (or better, regress) any measure of acceptance (*e.g.* share of approved projects that did not provoke a negative reaction from the local population) with the presence of SC in the corresponding local communities. To solve for the role of other variables that may have influence on successful projects, and to isolate the role of SC, we propose a wider idea of Capital to be measured for each territory, that comprehends human capital (HC), financial capital (FC), infrastructures and facilities capital (IC, that also includes natural heritage), social capital (SC):

$$C_{tot} = HC + FC + IC + SC$$

While it is easy to get a measure of FC and of the non-natural components of IC, it is more difficult to grasp a valid value of the other components. Also, there is the issue related to how adding up such different measures. One solution, may reside in asking to assign a score related to the relevance of each component within the LAG activity, taking into account that all the scores have to sum up to 100. Otherwise, the researcher may assign the score after surveying each of the components. Anyhow, a great effort should be paid to solve for this scoring procedure to avoid subjectivity. As for the measure of SC, we suggest to use several kinds of variables. The first is a completeness score (table 1), that refer to the idea that the set of members of each LAG should represent the same composition of the civic society it belongs to. Given the previously listed 13 member categories the score is then calculated as the complement to 100 of the percentage of missing categories in it membership's composition. To have a more precise measure, the score should be somehow normalized for the real composition in the 13 categories of the territory each LAG belongs to. Secondly, we propose the calculation of a set of indexes using social network analysis applied to the network of co-memberships in local public financed projects, as proxies of the ability of networking of each LAG. The indexes here proposed are mainly those that refer to centrality and brokerage, although many other network measures can be used to trace out a qualitative picture of the LAGs' networking activities and effectiveness. We performed this analysis over the 25 aforementioned LAGs.

In order to understand if there is a variation in social capital among LAGs, so to make it reasonable to look for any cause-effect relationship when exploring the role of SC in determining successful acceptance in transnational cooperation partnerships, we firstly observed the 25 LAGs' *egonetworks*, recalling that an *egonetwork* is the net of *alters* to which an *ego* is connected with one-step relationships.

Table 1: LAGs' completeness scores.

LAGs	Completeness score	LAGs	Completeness score
Luoghi del Mito	100.00	Ponte Lama	81.82
Meridaunia	100.00	Sud Est Barese	81.82
Colline Joniche	100.00	Terra dei Messapi	81.82
Piana del Tavoliere	100.00	Terra dei Trulli e di Barsento	81.82
Terre di Murgia	100.00	Terre del Primitivo	81.82
Valle d'Itria	100.00	Valle della Cupa	81.82
Terra d'Arneo	90.91	Daunia Rurale	81.82
Serre Salentine	90.91	Fior d'Olivi	81.82
Terra d'Otranto	90.91	Daunofantino	63.64
Alto Salento	90.91	Murgia Più	63.64
Gargano	90.91	Capo Santa Maria di Leuca	54.55
Le città di Castel Monte	90.91	Isola Salento	54.55
Conca Barese	90.91		

Source: our processing of data from PSL of LAGs (2009/10).

Summary statistics tell us that the larger variation is observed in the number of pairs and ties and in the brokerage index, while *egonetwork* size, density and two-steps- reachability are

quite evenly distributed. Thus, acting as a broker within the individual network of co-membership relationships may cover some interest in determining successful LAGs. Looking at the whole co-membership network, there's a total of 600 observations, with a mean of 0.94 (that is a really small density).

We then compared different measures of centrality, starting from the most simple, and going through *betweenness centrality* including in their normalized form. Results show low variation paired with somewhat moderate network centralization indexes (NCIs), thus suggesting a quite hierarchical structure that can be observed when analyzing the clique-co-memberships and the relative dendrogram. Indeed, the NCI is really small when calculating *betweenness*. All the LAGs collaborate with each other but looking at the single observations some do it less. These information will be useful when looking at the network composition.

Looking at the whole network picture, in fact (fig. 1), we can immediately recognize a more dense and strongly connected core of few actors and a set of peripherical LAGs and even 3 isolates (in blue). This conformation seems to explain the results showed by the centrality indexes formerly presented. By performing a clique-by-clique co-membership analysis and representing the results as a dendrogram (fig. 2 see also table 2 for more details), the network conformation immediately appears, clearly showing a clear hierarchy of small subgroups of 3 LAGs (on average) and few influential nodes ("Fior d'Olivi" and "Sud Est Barese", for example) summing up to 13 out of 25 LAGs.

Figure 1: Project affiliation network of the Apulian LAGs

Figure 2: Clique-by-clique co-membership dendogram of the Apulian LAGs..

Table 2: Clique-by-Clique Actor Co-membership matrix

```
      1 2 3 4 5 6 7              HIERARCHICAL CLUSTERING
                                 OF OVERLAP MATRIX
      -- -- -- -- -- -- --
                                  Level  1 2 3 4 5 6 7
   1  17 12 11  9  9 10  4
                                 ------  - - - - - - -
   2  12 13  9 10  7  7  3
                                 12.000  XXX . . . . .
   3  11  9 12 10 10  9  3
                                 10.000  XXXXX . XXX .
   4   9 10 10 12  8  7  3
                                  9.667  XXXXXXX XXX .
   5   9  7 10  8 11 10  4
                                  8.375  XXXXXXXXXXX .
   6  10  7  9  7 10 11  5
                                  3.667  XXXXXXXXXXXXX
   7   4  3  3  3  4  5  6
```

Source: our processing on data by PSL of LAGs(2009/10).

Results and discussion

Finally, we tested our main hypothesis, exploring the relationships between the network indexes and the number of successful participation in transnational cooperation partnerships. All the above mentioned indexes were tested, excluding those that made no sense for our hypothesis, and we mainly focused on centrality (mainly betweenness) and brokerage, following the Ronald Burt's theory of structural holes. The indexes were tested against some variables that we considered as well influential over our dependent variable (*TotProgTrans)*, namely amount of start-up financial capital (*capsoc*) and the completeness score (*compl*), and against the number of successful local project partnerships (*TotProgNotTrans)*. Future researches should consider any measure of human capital at least. We then looked at Simple pair-wise correlations (tab. 3). As shown in the table the number of local projects is strongly, significantly and – moreover – negatively correlated to the independent variable, as well as by brokerage (*broker*), egobetweenness (*egobet)*. This set of variables presents also some inner correlations, thus inducing to fear multicollinearity. No more correlations are noticed. Running the aforementioned model, the overall result is fairly satisfactory as it explains the 60 of the variance and it is statistically significant (tab. 4). Nonetheless, the observation of results in terms of coefficients is quite weak, since only financial capital and the complementarily score show some statistical significance.

Table 3: Simple pair-wise correlations.

	TotProgNot~s	TotProgTrans	broker	nbroke	egobet	negobet	betweenness	nbetweenness	compl	capsoc
TotProgNotTrans	1									
TotProgTrans	-0.6090*	1								
Broker	0.8502*	-0.5196*	1							
Nbroke	0.8116*	-0.4639*	0.9561*	1						
Egobet	0.7881*	-0.4382*	0.9603*	0.9205*	1					
Negobe	0.7330*	-0.34	0.8897*	0.9409*	0.9462*	1				
betweenness	-0.12	0.13	-0.07	-0.06	-0.02	0	1			
nbetweenness	-0.12	0.13	-0.07	-0.06	-0.02	0	1.0*	1		
Compl	0.09	-0.21	0.04	0.04	0.06	0.06	-0.17	-0.17	1	
Capsoc	0.3	0.12	0.33	0.28	0.32	0.24	-0.05	-0.05	0.38	1

Note: * indicate 95% significance level.

Table 4: Econometric Results.

TotProgTrans	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
TotProgNot~s	-0.4	0.23	-1.72	0.1	-0.89	0.09
Capsoc	0	5.24E-006	2.86	0.01	3.99E-006	0
Compl	-2.63	1.19	-2.22	0.04	-5.13	-0.14
broker	-0.06	0.04	-1.46	0.16	-0.15	0.03
egobet	0.34	0.26	1.32	0.21	-0.2	0.88
betweenness	-0.01	0.07	-0.13	0.89	-0.16	0.14
_cons	4.13	1.04	3.96	0	1.94	6.32

Source of Variance	SS	df	MS
Model	13.98	6	2.33
Residual	9.06	18	0.5
Total	23.04	24	0.96
Number of obs = 25		F(6, 18) = 4.63	
R-squared = 0.61		Prob > F = 0.01	
Adj R-squared = 0.48		Root MSE = 0.71	

Conclusions

As results of our analysis, we can clearly state that variation in the LAGs' membership composition and completeness index suggest a variation in the LAGs' SC level. Selecting one network that could work as proxy for relational-based SC, as the co-membership in public founded projects, variation occurs at individual level mainly in the brokerage index calculated within each singular egonetwork. Network level analysis, also, suggests that the Apulian LAGs work locally forming small groups, neatly distinguished and hierarchically clustered, and that it is more worth to consider this level of analysis, other than individual network features.

Nonetheless, there is no functional relationship between ability in local project development (as expressed by centrality or brokerage in the network of co-membership in local projects) and the number of transnational projects implemented. This results may depend on several reasons:

successful participation in the two different kind of projects requires to activate different relationships and networks;

if the above is true, it could lead to think that:

the key players (as well the game rules) that facilitate transnational partnerships are different depending on the local partnerships;

the LAGs "bowl alone" – as Putnam would say - when targeting larger scale projects, instead of sharing a common view or plan;

successful participation in transnational projects depends on other assets, such as human capital, financial capital or both;

issues related to the available data: time stacked data may lead to different results;

two or more of the above reasons.

Finally, a further analysis that may help to deepen the details of relational dynamics as opposed to commonly used inference models, may reside in regressing the network of project cooperation over the network of formal and informal relationships that each LAG builds during its lifelong activities, in a time series fashion, so to better grasp the dynamics. The formal and informal relationships can be surveyed combining desk analysis (*e.g.* analysis of board of directors, list of associates, etc.) with direct survey using a dedicated questionnaire.

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RECORDING OF ACCOUNTANCY DATA AT THE FAMILY FARMS IN SERBIA

Zorica VASILJEVIC[1*], Vlade ZARIC[1], Ivana IVKOV[2]

[1]Faculty of Agriculture, University of Belgrade, Serbia
[2]Ministry of Agriculture, Forestry and Water Management, Serbia
(Corresponding author: vazor@agrif.bg.ac.rs)

Abstract

There was no systematic and continuous monitoring of accounting data on agricultural family holdings in Serbia by 2011. At the end of 2011 it was started with the *Project of establishing a network of accounting data on family farms in Serbia*. The system of recording accounting data on family farms in Serbia is based on the so-called the FADN (Farm Accountancy Data Network) methodology, which applies in EU countries.

Given the importance that agriculture plays for Serbia, and within that, particularly family farms, as well as involvement in the process of international integration, the establishment of recording and monitoring of a number of accounting data in selected commercial family farms is of great importance for Serbian agriculture.

The paper presents the basic characteristics of establishing a network of accounting data on family farms in the Republic of Serbia, the results and problems that arise in the realization of such action, and the significance of the obtained data and records for business analysis of commercial family farms, agriculture and rural areas of Serbia.

Key words: *family farms, agriculture, accountancy data network, FADN methodology*

Introduction

Sector of family farms is of great importance for the agriculture of Serbia due to the number of these farms as well as in terms of resources in their possession and share in the total production of certain agricultural products. According to the 2002 Census, there are 778,891 holdings in Serbia. The estimates show that today, after ten years, the number of farms decreased significantly and that it now dropped to about 650,000.[33]

However, data on the ownership structure of Serbian family farms show that the small farms are dominant ones. Data from the 2002 Census indicate that 77.4% of all family farms in Serbia have a property of up to 5ha. The analysis of ownership structure of the registered family farms (RFF) in Serbia done in 2008, points out to similar results: 62.9% RFF has a property of up to 5ha, there are 25.5% of medium-sized holdings (5-10 ha), while large holdings according to our conditions (over 10 ha) participate by only 11.6% of the total RFF number (*Vasiljevi et al., 2008*). Based on these data, it is estimated that 250,000 – 300,000 family farms are economically active, i.e. they could be regarded as so-called commercial farms.

Since they have no legal status, family farms have no obligation to have recording of accountancy data. For this reason, in the past period there was no systematic and continuous monitoring of accounting data on the Serbian family farms. There were certain attempts in this domain, but they have mostly been done on a smaller scale and discontinuously. In late 2011,

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[33] A new Census of Serbian agriculture, which should be carried out in the period of October-December 2012, will provide the latest information on the number of family farms, agricultural resources at their disposal, and their share in production of agricultural products.

it has been started in Serbia with establishing a network for the collection of accountancy data from the selected representative sample of family farms, thanks to which the most important production and economic data generated by commercial family farms will be systematically and continuously monitored in the future.

Establishing a network of accounting data on the family farms based on FADN methodology is a condition for Serbia's accession to the European Union, which gives a high priority to this activity in the Republic of Serbia. In October 2011, the project *Establishment of the Serbian Farm Accountancy Data Network - FADN* was officially launched within the IPA 2010 program cycle.[34] The objectives of the project are the following:

Preparation of the National Plan for introduction of FADN system in the Republic of Serbia;

Implementation of the pilot project aiming at testing of FADN methodology and establishing the structure of the system;

Synchronizing the domestic legislative with the EU ones;

Institutional capacity building in the context of education and training of the appropriate national officers and farmers in order to enable the application of appropriate sampling methodology, collection, processing and analyzing of obtained data;

Establishment of the appropriate information system for data processing, storing and analyzing.

Material and Method

The EU member states have established a system of data recording on the farms so-called **FADN** (***F**arm **A**ccountancy **D**ata **N**etwork).* This system was established in order to allow both microeconomic analyses and determination of the financial status of the farms at the macroeconomic level, and it was supported by EUROSTAT. The concept of FADN was established in 1965. It is based on the annual (accounting) collection of production, economic and financial data out of the farm sample, classified into groups according to 3 criteria: the economic size of holdings, the type of agricultural production and the regional status. Conducting of the annual research about the farm income level using the FADN methodology is the obligation of all EU member states and it represents an instrument of European Commission (EC) for evaluating the farmers' income, as well as for determining the impact of the EU Common Agricultural Policy (CAP) on their operation.

In accordance with the EU legislation and methodology, the Liaison Agencies are responsible for data collection through annual FADN research in the member countries, for the purpose of determining the income status of the farms and the efficiency of agricultural production.

The representativeness of the data is ensured by the choice of farms' sample within FADN system which covers 90% of the total utilized agricultural area (UAA), 90% of the total livestock units and more than 90% of the agricultural production value of the EU member states.

The FADN network is consisted of annual surveys conducted by the EU member states. Every year, the departments of the EU responsible for the FADN activities collect the accountancy data from the farms selected for the sample, which has been derived from the national farm samples. In this way FADN represents unique, harmonized source of microeconomic data, i.e. a source of data collected according to the accounting principles which are unique for all

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[34]It is planned that the Project of establishing FADN network in Serbia lasts for two years, with a budget of €2 million grant, fully funded by the EU. The project is being implemented by the consortium led by NIRAS Group within which are, among others, the consulting institutions from Denmark. France, Hungary, Poland and Estonia.

countries in this network. FADN is basically engaged in agriculture. However, this survey also serves for collecting the data on non-agricultural activities on the farm, e.g. tourism, forestry etc.

The collected information, for each farm in the sample, includes some 1,000 variables and they are being delivered by the national Liaison Agencies in charge. These variables refer to the following two sets of data:

Physical and structural data, such as location, area under crops, number of livestock, labor, etc. and

Economic and financial data, such as the value of production of various crops and production lines, stocks, sales and purchasing, operating costs, fixed assets and financial resources, production quotas and subsidies including those related to the application of the CAP measures.

Based on the data collected, three FADN reports are being made for the different categories of users, namely: The Report for the farms, The National report, (so-called Standard Report) and The Report for EC (*Farm Returns*) for the purposes of creating the EU CAP agrarian policy.

All data related to the particular family farms, which have been submitted to the EC, have to be treated with the utmost confidentiality. Consequently, it is not allowed that the data for particular farms go outside the boundaries of the *General Directorate for Agriculture* which is located within the EC. Only the aggregated data for the groups of farms within a region or the member states are being published at appropriate level of aggregation whereby all the data for the particular farms can not be recognized.

In order to be ensured that the sample for the recording of accounting data according to the FADN methodology reflects the heterogeneity of agriculture in a country, before sampling of the farms, the Liaison Agency stratifies the focus field according to the three main criteria (region, economic size and type of agricultural production). The farms are being selected in the sample in accordance with the selection plan that guarantees the representativeness.

Given the fact that participation in FADN network causes the expenses of each national Liaison Agency (sampling, surveys, etc.), the EC approves the payment for each successfully completed farm questionnaire that is being submitted.

Since the time period for the accounting is a calendar year, the procedure of collecting farm data has been adapted to that. At the beginning of the year, the farm owners together with extension assistants are filling out the inventory lists on farm potentials. Inventory lists are the forms with the directions for filling out the appropriate data.

The data are being collected on a selected number of farms, having appropriate economic size. An economic size is not expressed in hectares or livestock numbers, but in the money amount (in €). The farms that keep records using this system are registered in the Farm Register. The boundaries of economic size are determined by each country itself and according to the general standard and the state of agriculture. In the Register, there are usually the farms that have market relevance (the commercial ones) and those ones where more emphasis is put onto the basic agricultural production, but not to the supplementary activities, e.g. forestry or rural tourism. At the end of the calendar year, the changes that have occurred compared to the beginning of the accounting period are being introduced into the inventory lists. The final inventory is at the same time the initial inventory for the next calendar year.

Results and Discussion

FADN network for collecting the farm accountancy data in the Republic of Serbia is being managed and coordinated by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (MAFW). Several institutions are involved in the implementation of the operations concerning collecting and processing of the accountancy data on the family farms. The Institute for Science Application in Agriculture (ISAA) with its regional extension offices (34) is engaged in activities of data collecting and verifying. The Directorate for Agrarian Payments performs the role of Liaison Agency and it maintains the database network on the farm accountancy. The Statistical Office of the Republic of Serbia coordinates the activities on Agricultural Census (October 2012), as well as on the Structural Farm Survey considering the future FADN activities, particularly in the domain of the stratified sampling plan development which should be based on a statistical farm register (with a particular focus on the calculation of economic size and typology). The Steering Committee, which is supposed to supervise the work of the national Liaison Agency and, in a certain way, to control the implementation of the whole project, in addition to the representatives of the above mentioned institutions, also includes the representatives of the two agricultural universities (Belgrade and Novi Sad), which will also represent an expert support in the case of various data analysis according to the FADN methodology. After completion of the project of establishing the network and starting with its regular functioning, the Steering Committee should evolve into the Governing Board.

By the project for establishing FADN network it has been planned that definitive sample for monitoring and recording the accountancy data on the family farms in Serbia amounts between 1,500 and 2,000 farms. However, it takes time for establishment of a network based on this size sample. It is estimated that the full scaled FADN network will be established and "will come to life" in the next 5-9 years. Predictions for Serbia are that it is going to happen until 2018. Until then, it is planned for the sample to be successively increased. In the first stage, starting from February 2012, the sample for data recording includes the first 40 pilot farms. Along with the formation of sample, it is carrying out the training of the staff which will be engaged in the activities of the FADN network establishment in Serbia as well as in the surveying of the selected farms. For the initial number of farms in the sample, 20 extension advisors have been trained and they all belong to the Serbian agricultural extension services that are organized at The Institute for Science Application in Agriculture (ISAA). The first group of interviewers consists of advisors employed in 16 regional agricultural extension services and their selection was made by MAFW.

Participation of farmers in the sample is voluntary, as it is the case in all EU countries. The benefits of participation in the selected sample the commercial farms should recognize in an improvement of production and economic results on their own farm, i.e. in achievement of higher profitability in agricultural production as well as in the linked complementary activities, due to the fact that the voluntary participation in the sample is not being paid.

In the second stage (early 2013) it is planned that the number of farms on which the accountancy data will be recorded will be increased onto 190 (while the number of trained interviewers will be increased onto 48). At the end of the two-year lasting project of FADN network establishment (October 2013), the number of surveyed farms should be increased onto 270 (and number of the trained interviewers onto 68). It is planned that the sample increases by about 40% each year until it reaches the projected size of about 1,500-2,000 farms. Each interviewer will have the task to visit four times each farm in the sample that he is responsible for and where he/she records the accountancy data. During the period of full development of the FADN network, each trained interviewer will record the accountancy data at 15-35 farms, depending on the needs and availability of certain interviewers due to the

other advisory activities, given the fact that the survey work will be carried out by the employees in the national agricultural extension services (ISAA).[35]

During the two-year lasting project, the Department in MAFW responsible for FADN network, ISAA and the new established Liaison Agency should fully overmaster all the activities concerning establishment, expansion and utilization of the FADN network, as well as the collection and processing of the obtained from the farms, which will be comparable with the data collected in all EU member states, but also in the candidate countries (e.g. Croatia). For those needs, it is provided and it is being established the appropriate IT support.

Certainly, there are a number of problems facing an implementation of the FADN project in our country. One of them is that the accounting data recording considers only registered family farms (RFF) and only the commercial ones. In addition, it should be noted that legislation that enables the smooth functioning of FADN network is not yet completed, while the elaboration of the five-year National plan for introduction of FADN system in the Republic of Serbia has been still under construction. Finally, Serbian farmers are proverbially distrustful for new initiatives, especially when it is an introduction of the regular recording of what they produce, then of the costs and revenues generated from production, because they are being afraid that it will have an impact on an increase of the taxes that they have to pay to the state. Due to this fact, the institutions that are responsible for establishing of the FADN network, first of all the interviewers who collect the accounting data at the farms, should particularly take into account the manner in which they present the project of introducing the farm accountancy data recording to the farmers, in order to find collaborators in the farm owners, as the whole action will produce results equally useful for both, for the farms and for the state.

Conclusion

Taking in an account the importance of agriculture in the economy of Serbia and within that particularly an importance of the family farms, as well as the process of accession into the international integrations, there is a need of establishing a system of a permanent monitoring and recording the actual production and economic results on the family farms. In 2011, with a help of the EU funding, Serbia initiated the process of establishing the network for the collection of accountancy data on selected family farms using the FADN methodology which is being applied by the EU member States and the candidate countries as well, taking into account that it is one of the preconditions for the EU accession in domain of agriculture.

In October 2011, it started the realization of the project under title "*Establishment of the Serbian Farm Accountancy Data Network - FADN*" within the IPA 2010 program. The project will last for 2 years and the establishment of a complete network for 5-8 years.

The definite sample for permanent data collection will be between 1,500 and 2,000 farms, which represents a representative size that will be able to provide the adequate data about the physical, structural, economic and financial information for commercial family farms' sector in Serbia. Those data will be comparable to data which are being collected in other European countries applying FADN methodology and they will serve both to increase the production efficiency and profitability of the family farms in Serbia, but also for more successful agrarian policy and designing the supporting measures for family farms.

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[35] Based on past experiences with the FADN network in the EU countries, it is estimated that the annual costs of recording the accounting data within the FADN network will amount to 400 and 500 € per each farm, which means that for the total number of maximum 2,000 farms, the costs will amount to 800,000-1,000,000 €

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ACCESS TO CREDIT OF FARM HOUSEHOLDS IN HAI DUONG PROVINCE, VIETNAM

LE Thi Minh Chau[1*], Philippe LEBAILLY[2], Tuan SonNGUYEN[1]

[1]Hanoi University of Agriculture, Vietnam
[2]Gembloux Ago-Bio Tech, University of Liege, Belgium
(Corresponding author: chaulehanoi@yahoo.com)

Abstract

Using data from the household survey in Hai Duong province, this paper aims to examine the current access to credit of farm households, factors affecting to credit accessibility from the formal sector and then draw some policy implications. It is found that, credit supply of the formal sector did not meet the credit need of famers. In the farmer's side, dependency ratio, area of crop land, area of fish pond, and number of pigs were main factors influencing the credit accessibility of farmers. Besides that age, educational level of household head and area of fish pond were key determinants of the loan amount approved by the banks.

Keywords*: Vietnam rural credit, Access to credit.*

Introduction

Hai Duong locates in the Red River Delta region, Vietnam. Its poverty rate considerably reduced from 23% in 2003 to 11% in 2010, but still higher than that of the whole region. Agriculture occupied 64.2% of total labour in 2010. In addition, the agricultural land area has been significantly reduced due to the industrial process, 7.6% in the period 2006-2010 (HDSO, 2010). The local authority has used credit as a powerful tool for poverty reduction and promoting of agricultural production. There exist three major formal lenders providing credit to the rural area in Hai Duong, namely Vietnam Bank for Agricultural Development (VBARD), Vietnam Bank for Social Policies (VBSP) and People Credit Funds (PCFs). The outstanding loans of formal sources increased sharply. In the period 2005-2010, average growth rates of outstanding loans of VBARD, VBSP and PCFs were 24.5%, 33% and 30%, respectively (HDSB, 2010)[36]. These figures indicate considerable achievements in the supply side of the formal credit sector. At the household level, however, the credit accessibility of farm households has been in questions. The purposes of the paper are to analyze the current access to credit, identify the factors affecting credit accessibility of farm households from the formal credit sector, and finally draw some policy implications for a better credit access of farm households in Hai Duong.

Material and methods

Data collection
The primary data were collected, using a semi-structured questionnaire for household survey. Selection of households was made using both stratified and random selection. Firstly, four districts with some differences in social and economic characteristics were selected as representative districts of Hai Duong. Secondly, in each district, one representative commune was chosen. Finally, 145 farm households engaged in animal production and participated in

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[36] Inflation rates in Vietnam were 8.5 % in 2005, 22.1 % in 2008 and 9.2% in 2010 (GSO, 2010).

the Sustainable Development of Household Economic project[37] were randomly selected for data collection.

Group discussion: It was organized to investigate the strengths and weaknesses of credits providing from formal credit sources based on farmers' assessment.

Data analysis and classification

SPSS software was used for data processing using descriptive statistics and analysis of variance (ANOVA). Most of farm households engaged in integrated animal production, including poultry, pig, pig and fish breeding, and differed in terms of scale production. The proportion of annual income from animal production to total household income was selected as a criterion to classify the surveyed farm households into two groups, namely the animal-based group and the non animal-based group. The purpose of this classification is to explore differences in credit accessibility between two groups.

Results and discussions

Farm household's demand for credit and their participation in the rural credit market

As detected from the survey, there was a high demand for credit from farm households in both groups. The animal-based group needed credit to buy feeds, upgrade fish ponds and payback old loans. The farm households in the non animal-based group, who were un-skilled labourers, did not find stable off-farm jobs and earned low income from non-farm activities. Therefore, they desired to borrow money for their animal production. Famers borrowed money from the formal sector or the informal sector. It was also possible for them to borrow from both sources at the same time. 77.2 % of borrowers in the animal-based group obtained credit from the formal sector, while this figure in the non animal-based group was 51.4 %. With respect to each formal credit source, the proportion of borrowers in the non animal-based group that obtained credit from VBSP (52.5%) was higher than that of the animal-based group (20.8%). As detected from the field survey, many borrowers in the non animal-based group were the poor, targeted clients of VBSP, so they borrowed money easily from this source. For VBARD, 60.4% of borrowers in the animal-based group got loan from this source, while this figure in the non animal-based group was only (32.5%). This tendency was also similar for PCFs. Two main reasons led to this situation: (i) VBARD and PCFs are commercial banks. The lending interest rates of both banks are determined by the same level of other commercial banks but higher than that of VBSP ;(ii) Physical collateral is required for a borrower. However, the non animal-based group, including many of the poor, often lacks the physical collateral. As results, they had less access to credit of VBARD and PCFs. With regard to the informal sector, both groups borrowed money from this sector. The non animal-based group depended on the informal credit more than the animal-based group. This implies that the credit provided by the formal sector did not fulfil the credit need of farm households. The surveyed data also pointed out that 41 surveyed households did not get any credit in 2010 even they had credit needs. Some farmers indicated that their families were ranked as the non-poor households in the village. Thus, they were excluded from the VBSP's beneficiaries. Some others also reported that they did not get any loan from VBSP due to limited fund for lending. The remaining farmers did not borrow money from VBARD and PCFs due to various reasons; that are mentioned later on. On average, the number of borrowers from VBARD was the highest. The average amount of loan provided by VBARD was also the highest among the credit sources. The number of borrowers of PCFs was lower than those of VBARD and VBSP

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[37] The project funded by Walloon region of Belgium. The project main's activity was to transfer some techniques for animal production to farmers, partly contributing to improve on animal production and farm income.

but loan amount of PCFs was ranked the second among three formal lenders. VBSP provided smaller loans.

Table 1: Financing sources of surveyed households in 2010.

Indicator	Total		Animal-based group		Non animal-based group	
	No.	%	No.	%	No.	%
I. Surveyed households	**145**		**58**		**87**	
II. Borrowers						
1. Formal sector	**81**	**62.8**	**44**	**77.2**	**37**	**51.4**
-VBARD	*45*	*48.4*	*32*	*60.4*	*13*	*32.5*
-VBSP	*32*	*34.4*	*11*	*20.8*	*21*	*52.5*
-PCFs	*16*	*17.2*	*10*	*18.8*	*6*	*15.0*
2. Informal sector	**48**	**37.2**	**13**	**22.8**	**35**	**48.6**
-Friend and relatives	*33*	*67.3*	*7*	*53.8*	*26*	*72.2*
-Village moneylender	*16*	*32.7*	*6*	*46.2*	*10*	*27.8*
3. Both sectors	**25**		**11**		**14**	
III. Household without loan	**41**		**12**		**29**	

Source: Household survey, 2011; Total number of borrower of formal sector is lower compared to the total number borrowers from all lenders (VBARD, VBSP, PCFs) because one household can borrow money from different lenders in the same year. It is similar for the total number of borrowers from the informal sector.

For all credit sources, the average loan amount of the animal-based group was considerably higher than that of the non animal-based group. Furthermore, number of borrowers from the formal sector in the animal-based group was also higher than that in the non animal-based group. It partly reflects a higher demand for credit and a better credit accessibility of the animal-based group compared to the other group as both groups need loans to finance for their production and consumption.

Table 2: Average loan amount by credit sources in 2010 (Unit: Million VND/per household)[38]

	Total		Animal-based group		Non animal-based group		F value
	Mean	Range	Mean	Range	Mean	Range	
I. Formal sector[39]							
1. VBARD	28.2	5.0-50	31.9	15-50	18.8	5-30	16.6[***]
2. VBSP	8.4	4-17.2	8.5	4-17.2	8.3	4.3-8.6	0.01
3. PCFs	25.3	10-35	25.5	20-35	24.5	10-30	0.1
II. Informal sector[40]							
1. Friend and relatives	5.6	1-20	10.2	2-20	4.3	1-13	13[***]
2. Village money lender	10	2.5-25	14.6	10-20	7.3	2.5-25	4.7[*]

Source: Household survey, 2011; (Note: ***, **, * significant at 1%, 5% and 10 % level, respectively.)

Determinants from household side for their borrowing amount from the formal sector

In the transaction of credit, there are many factors that simultaneously determine the terms of contracts such as the amount, the interest rate, the purpose, the collateral and the repayment schedule. These are determined by agreement between borrower and lender in the rural market. It was observed that the loan amount received from a credit source is based on both credit demand and credit supply. The implication is that the demand and supply curves of credit cannot be identified separately (Duong and Izumida, 2002). Based on the range of loan amount, borrowers were classified in several groups to compare how differences in characteristic of borrowers and its relation with their borrowing amount.

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[38] In 2010, on average 19100 VND = 1 USD.

[39],[7] In 2010, lending interest rates per month were: VBARD: 1.16-1.3%; PCFs: 1.25-1.5%); VBSP: 0.5%-0.8%; informal moneylenders: 3%, estimated; and friend & relatives: 0%, normally. Loan terms were 2 years for VBARD, 1 year for PCFs and 2-3 years for VBSP.

Table 3: Characteristics of household borrowers (presented by Mean value) of the formal credit sector by range of loan amount.

Indicator	Unit	Range of loan amount (million VND)				F value
		Up to 10 n=20	11-20 n=18	21-30 n=27	31-50 n=16	
Age of household head	Years old	48.2	46.8	48.5	45.0	0.84
Education of household head	School year	6.8	7.3	7.2	7.5	1.6
Family size	People	4.7	4.5	4.8	4.3	0.75
Number of workers	People	2.3	2.5	2.6	2.4	0.47
Dependency ratio		0.53	0.45	0.41	0.43	1.3**
Area of crop land	1000 m²	2.1	3.0	2.3	2.8	2.4*
Area of fish pond	1000 m²	1.2	3.1	3.5	4.2	2.3*
Number of poultry	Head	185	198	200	242	1.2
Number of pigs	Head	10	15	17	25	4.2***

Source: Household survey, 2011. (Note: ***, **, * significant at 1%, 5% and 10 % level, respectively).

It was found that the household heads with higher levels of education had a better skill of production. They also had better understanding of lending procedure of formal credit sources. Therefore, they wish to borrow a large amount of money for the expansion of production. Findings from the survey show that there were small differences in family size and number of workers among surveyed households. However, the dependency ratios were quite different between them. The households with higher dependency ratios borrowed lower amounts of money from formal sources than households with lower dependency ratios. It can be explained that they usually need credit for their urgent consumption, while the formal sector mainly provide credit for production in the rural area of Vietnam. Households with big fish ponds, higher number of poultry and pigs had a higher demand for credit for the purchasing of production inputs. They prefer to borrow money from formal credit sources because lending interest rates were quite lower as compared to those of village money lenders. It was found that farmers did not use their loan from formal sources for crop production. They used their own money to invest in crop production, thus they lacked money for animal production. For this reason, households with larger area of crop land were likely to borrow a large amount of money from the formal sector. In the demand side, the positive determinants of borrowing amount from the formal sector were educational level of household head, dependency ratio, area of crop land, area of fish pond, number of poultry and pigs. Result of F-test showed that dependency ratio, area of crop land, area of fish pond and number of pigs were statistically significant. It means that they were dominant determinants.

Formal lender's behaviours in responding to credit demand of farm households

Of total surveyed households, about one third was poor. The VBSP's credit has been targeted to the poor. However, availability of funds for lending is limited. Most of the non-poor realized that they were excluded from VBSP's beneficiaries. Consequently, they did not propose to borrow money from this source. For this reason, this paper only focused to on analyzing behaviour of the other two sources *i.e.*, VBARD and PCFs in responding to credit demand of farm households. Both VBARD and PCFs are formal lenders and provide credit on collateral. They provided a larger loan size. In order to obtain credit from banks, households have to submit their loan application form to the banks. Of 145 surveyed households, 76 households applied for credit to VBARD or PCFs whereas 69 remaining households had demand for credit but did not apply. The reasons leading to this situation were that they were afraid of not being able to repay their loans, afraid of being refused, lack of collateral and high lending interest rate. Among the households that have applied for loans, 61 were provided loans while 15 were refused. 41 borrowers fully obtained their required loan amount and 20 households were partly provided with their requested loan amount. For those who were not provided with loans, staff of the banks responded that it was due to unavailability of lending funds at the time they applied for borrowing money. The farmers also stated that in the last

four months of the year they were in needs of credit to invest in animal production. However, it is more difficult to obtain loan from banks. VBARD and PCFs are lending on physical collateral[41]. Currently, the land use certificate[42] is considered as unique physical collateral accepted by VBARD and PCFs. Generally, the farm households who hold large land area and have the land use certificate have better credit accessibility. The housing, production equipments and livestock are not accepted as physical collateral. However, these things also partly influenced lending decision of bank's staff. Because, staff of VBARD and PCFs visit the farmers' houses and take a look on their assets to estimate their asset value before deciding to provide loan. The farm households that have high value of assets and large scale of livestock may have better capability of loan repayment. Therefore, they are likely to have a better credit accessibility. VBARD and PCFs provided a full required loan amount for the households who proposed a medium loan amount, and had a larger land area, higher value of assets and large scale of poultry and pigs. Despite owning land use certificates, the households applying for higher amounts but having smaller land area, lower value of asset and lower number of pigs and poultry were provided lower loans as required or refused to provide loan. It seems that the higher demand for loan amount of borrowers leads to the more lending limitation from the banks.

Table 4: Indicators reflected the influence of farm household characteristics on lending decision of VBARD & PCFs.

Indicator	Unit	Approved a full required loan amount (n=41)		Approved part of the required loan amount or Refused to provide a loan (n=35)		F-value
		Mean	S.D	Mean	S.D	
Amount of required loan	Mill. VND	24.5	9.8	58.5	21.5	71***
Amount of approved loan by VBARD&PCFs	Mill. VND	24.5	9.8	33.5	7.9	12***
Age of household head	Years old	48.2	7.7	44.5	7.8	4.1**
Education of household head	School year	7.2	1.2	7.8	1.3	5.1**
Family size	People	4.5	0.7	4.8	1.3	1.2
Dependency ratio		0.42	0.14	0.45	0.13	0.8
Area of crop land	1000 m^2	2.7	1.2	2.6	1.2	0.04
Area of fish pond	1000 m^2	39.3	2.5	30.6	2.2	1.9*
Total value of assets	Mill. VND	132.1	96.6	120.7	73.7	0.3
Number of poultry	Head	226	101	195	87	1.9
Number of pigs	Head	20.9	14.3	17.7	9.3	1.0
Non-farm income	Mill. VND	24.3	16.7	22.6	13.3	0.2

Source: Household survey, 2011. (Note: ***, **, * significant at 1%, 5% and 10 % level, respectively).

In the rural area of Vietnam, information on credit supply is very important for the borrowers to obtain a loan. At the commune level, information on credit usually comes from the staff of mass organizations and PCFs. It was found that, the older household heads had a better credit accessibility, compared to the younger. Because, the older household heads had wider and stronger relationships with the staff in commune than the young ones. As a result, they had better ability to gather credit-relevant information. It implies that social relationships also affected credit accessibility of farmers. Furthermore, younger household heads with higher level of education and lower non-farm household income wish to borrow higher amounts of money for the expansion of livestock production. However, they were provided a part of

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[41] VBARD does not require physical collateral for loan amount less than 10 million VND (based on Decision67/1999/QD-TTg, credit policyforagricultureand rural development, dated May 30th,1999).
[42] In 1993, the government of Vietnam promulgated the land law with issuance of land use certificate for farmers and the introduction to a new law. Although land still remains the property of the state, under the new law usage rights could legally be transferred, sold, leased, bequeathed and used as collateral for loans. The duration of tenure rights was extended to 20 years for agricultural land and to 50 years for forest land.

required amount of loan. On the contrary, the household heads with older age and lower level of education had lower demand for credit but they were approved full required loan amounts. It was also found that in response to the strong demand for credit of young farmers, the formal sector limited their desired amount of loan. In summary, age, educational level, social relationship of household heads, land area, number of pigs and poultry were determinants of lending decision of VBARD and PCFs. Result of F-test showed that age, educational level and area of fish pond were key determinants.

Conclusions

In Hai Duong, credit supply of the formal sector did not meet the credit need of famers. Farm households still depend on the informal sector. The farm households in the animal-based group need more loan for their production than the other group. They borrowed larger amount of money from the formal credit sector than the farm households in the non-animal based group. The farm households in the non animal-based group also need credit, but they depend more on the informal lenders. Credit accessibility of farmers determined by both demand side and supply side. With regard to demand side, dependency ratio, area of crop land, area of fish pond, and number of pigs are main factors influencing the accessibility of farmers to credits from the formal sector. VBSP mainly provided credit for paying education fee. Therefore, credits provided by VBARD and PCFs were significantly important for animal production. Besides that age, educational level of household head, area of fish pond were key determinants of loan amount approved by VBARD and PCFs. Social relationships also influenced credit accessibility of farmers. The stronger credit needs of farmers were more limited by VBARD and PCFs. The study indicates that a large demand for credit exists in Hai Duong. Some policy implications for the formal sector to improve credit supply and credit accessibility of farm households consist of *(i)* For VBARD, information on credit program without collateral requirement should effectively inform to farmers. The lending network between VBARD and mass organizations should be strengthened. In the coming period, it is more important for VBARD to effectively implement the Decree No.41/2010/ND-CP, dated on August 12, 2010, which allows VBARD to provide non-collateral loan with a maximum of 50 million VND to farm households. Furthermore, VBARD also needs to improve their role in rural lending and increase the availability of lending fund to meet credit needs of famers; *(ii)*With transaction offices located in commune, PCFs should have more competitive strategies to increase their outreach to the rural area; *(iii)* For VBSP, the credit supply for agricultural production should also be expanded.

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MARKET ASPECTS OF A TYPICAL HERZEGOVINIAN PRODUCT CHEESE IN A SUCK

Slavica SAMARDZIC[1*], Sabahudin BAJRAMOVIC[2], Marko IVANKOVIC[3], Aleksandar OSTOJIC[4]

[1]Ministry of Agriculture, Forestry and Water Management of Republic of Srpska, Bosnia and Herzegovina
[2]Faculty of Agriculture and Food Sciences, University of Sarajevo, Bosnia and Herzegovina
[3]Federal Agro-Mediterannean Institute, Mostar, Bosnia and Herzegovina
[4]Faculty of Agriculture, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author:slavica92000@yahoo.com)

Abstract

Cheese in a suck, unique and characteristic product of Dinaride range which encompasses Herzegovina, to the characteristics it possess, in next period could become relevant initiator of rural development of this region.

Aim of this research was estimation of market aspects of the Cheese in a suck from the perspective of producers, consumers and distributors, as well as analyses of productive, selling, distributive and purchasing prices. Primary data have gained by questionnaire on the sample of 35 producers and 1182 consumers, 17 restaurants, 5 bridal restaurants and 2 retailers. Method applied for data collection wasquestionare composed of relevant questions for each interviewed subject, and method of data presentation was descriptive statistics. Research was carried out in Herzegovina, Banja Luka and Sarajevo in the period from 2005 to 2011 with the exception of research consumers in Sarajevo that is carried out in 2009.

Research results have shown that productive price of cheese is relatively high, 9,67 KM, for cheese made of cow's milk, while selling prices are frequently lower that productive ones. Relatively low percentage of consumers, 24,11%, consider purchasing price for a high. Majority of producers, 25,71%, cheese sell by combining different ways of selling. The highest percentage of consumers, 31,30% cheese buy directly from producers on farm. Research results of distributors, especially restaurants, don't give enough reason for optimism regarding Cheese market. On the territory of the production of Cheese in a suck, it is almost impossible find on menu.

Keywords: Cheese in a suck, cheese market, cheese prices.

Introduction

The last couple of decades, one of leading trumps of the development of rural areas stand out products whose presence in a given area has centurylasting history. Such a products are became part of identity and cultural heritage of the territory from which they derive.Their uniqueness entails specific target group of consumers.Thus, most consumers are familiar with the typical products,likelocal population is.Apart from them, the target group of consumers could be: curious ones – tourists, nostalgic ones - immigrants and socially vulnerable ones - those who are willing to purchase products to support the maintenance of the production system.Cheese production area mainly includes terrain of Upper Herzegovina, municipalities Nevesinje, Konjic, Prozor/Rama,Posušje,Bileca and Berkovici (31 producer), while in the area of Lower Herzegovina are identified only 4 producer.

Area of consumption of Cheese in a suck, except sporadic exceptions, such as Sarajevo, Banja Luka, Dalmatia, Zagreb and Vojvodina, where live large number of immigrants from Herzegovina, mostly coinciding with the geographic boundaries of Herzegovina.

Research subjects of this work were market aspects of Cheese in a suck, like are sale, distribution and supply of cheese, as well as analysis of production, sales and purchasing prices of the cheese.

Material and method

The main methods of data collection were questionnaire and structural interview. Results were analyzed by descriptive statistics and statistical inference based on the X^2 test. All surveys were conducted in the period from February to July 2011, except consumer survey inSarajevo, which was carried out in 2009 year.

This survey was carried out in 35 producer's households from 8 Herzegovinian municipalities (Berkovi i-8, Bileca-1, Konjic-4, Ljubinje-3, Ljubuški-1, Posušje-1, Prozor/Rama-5 and Nevesinje-13). Selection of the surveyed households has been made according to the registry obtained from the Association of Producers ofHerzegovinan Cheese in a Suck, while the producer of Posusjeand producer of Bileca, were selected based on prior knowledge to deal with the cheese production. The association has a total of 42 members, of whom 33 were interviewed. Two producers, members of the Association, who have been engaged in the production of cheese in the past years, left the production and started selling milk to local dairies (one Nevesinje and one of Konjic), while one respondent, member of the Association of Berkovi i who has a farm of 60 cows, never has been producer, but he became a member of the Association, as he says, "to be present in Association if ever could be organized purchase of cheese."

During the study surveyed a total of 1182 customers and potential customers, of which 1102 were from the area of 16 municipalities in Herzegovina (Berkovi i-12, Bileca-43, Capljina-58, itluk-49, Gacko-34, Grude-49, Konjic -90, Ljubuški-66,Mostar -315, Neum-14, Nevesinje-54, Posušje-48, Prozor/Rama-51, Stolac-30, ŠirokiBrijeg-90, Trebinje-108), 50 from Sarajevo and 30 from Banja Luka. The sample size for the Herzegovinian municipalities is determined in proportion to the population. The survey sample was made in Sarajevo during Wine Fest maintained at Europe in October 2009 year, while a survey in the Banja Luka is done with casual clients who buy cheese, all of whom were employed. Since the survey sample of Sarajevo and Banja Luka has been taken unsystematically and the results for the two municipalities are only indicative. Subjects were grouped by age into three categories: up to 25 years, 25 to 65 years and more than 65 years. In relation to the overall size of the survey sample, 18.53% were in the category of less than 25 years, 67.85% were between 25 and 65 years old, and 13.62% were older than 65 years.

Distribution survey was conducted through interviews. All distributors were classified into groups: retailers, restaurants, bridal shops, small stores and large retail chains, and then made up a list of questions relevant to each of them. All interviews were conducted face to face, except conversations with marketing departments of big retail chains such as Maxi, Robot and Interex with whom interview was carried out by telephone. In the course of this research two interviews were conducted with dealers who buy cheese from producers and resell it in the market, one in Trebinje and one in Mostar, then 17 interviews in the catering facilities in all municipalities in which the survey was conducted of consumers, except in Sarajevo and Banja Luka, 5 wedding salon (Nevesinje, Široki, Gruda, Ljubuski, Posušje), 5 retail and 3wholesales.

Results and discussion

Placement of cheese

This research has identified these ways of cheese placement:

Sall ,,on farm" meanssaleof cheese tothe fixed and known direct consumers. They order in advance certain quantity of the cheese. This type of sale is registeredat the producers who produce small amounts of cheese and those ones who during the summer months driving out the cattle to the mountain. Bigger producers also have this kind of demand, but because of the already established way of placement, frequently even avoid this type of sale. Anther this kind of sale there must mention retailers who in periods of decreased demand of the cheese (e.g. summer period),buy cheese of smaller producersin smaller quantities.

Sell at the market means the sale of cheese during market day (one day a week) in the municipality in which it is produced. Small number of producers sells cheese in this way. Basically, this type of placement is characteristic for producers who have small quantity of production and have regular customers "on farm". It also happens that producerswho stay on mountain during summer period produce large quantities of cheese and failure to place it in a relatively short period of time, due to the inadequacy of storage space for a long time, and yet unsettling habit of storage cheese in the central storage, part of the production sold out at the market.

Sell to Herzegovinian emigrants and occasional clients in Sarajevo and Banja Luka means sale to the consumers mainly originating from Herzegovina, mostly Zagreb, Belgrade, Novi Sad and Sarajevo. This type of sale is identified at a small number of producers from Posusje, Prozor/Rama and Ljubinje. In the case of Banja Luka there is a word of the clients that do not necessarily originate from Herzegovina, but order cheese through acquaintances.

Giving cheese like a present. As many producers have close relatives living in the city, one of identified ways of placement of the cheese is giving it like a present. Also, the consumer research has shown that in the case of payment services to third parties (e.g. mechanics), producers give cheese instead of money (a kind of barter).

Sell toresellers means selling of all produced quantities of cheese "in a suck", who further continue pack cheese in smaller quantities and resellit at the market, restaurants or to the direct customers. This method of selling is foundat the producerswho achieve higher production quantities, and have known buyers for many years. Producers who sell cheese in this way tend to have smaller problems with the placement. Resellers mainly place cheese on the market in economic centers of Herzegovina, Mostar and Trebinje.

Sell to the restaurants and other catering facilities isa form of selling that has less importance from the producers' perspective. Only one producer fromLjubuski all produced quantity sells throughout restaurants, while some producersstate that a certain quantity of production sells through bridal facilities. However, this form of selling has no constants in its character, as the demand of wedding salons is usually associated with eating habits of clients who make wedding party. Also, according to the results of this research,restaurants almost have no offer Cheese in a suck.

Sall through retail and wholesale facilities is one of the identified form of selling, but of less importance for producers for a momentdue to the lack of legislation for legal sale of cheese. However, producer fromPosusje,who makescheese from pasteurized milk, has mentioned this way of selling as the most important one. Research has found that the Cheese in a suck made of pasteurized milk by dairies from Bileca,Nevesinje and Posusje, can be found on sale in retail and wholesale facilities, both in Herzegovina and elsewhere of Herzegovina (Banja Luka, Sarajevo).

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As the largest number of interviewed producers, 9 of them,which make 25.71%, combine several above mention methods of selling, it is difficult to give a precise overview in measurable parameters on quantities sold individually in some of these ways (Table 1). Also, a significant percentage of respondents, 20%, produce only for their own use. Only 7 manufacturers, which make 20%, have constant customers for all produced quantity, most of them are from Nevesinje, 6 of them, or sell to the restaurants, which indicates that a small percentage of respondents have preferred method of placement. Due to the difficult preservation of cheese after opening suck (change in taste, easy perishability) producers generally don't likeretail sale and all other ways of selling characterizelike difficult placement.

Table 1. Identified ways of selling cheese

Way of placement/selling	Number of producers	%
1. Combining more ways	9	25,71
2. Production only for selfconsumption	7	20,00
3. Selling to the resellers	6	17,14
4. On farm selling	5	14,29
5. No production for sale	4	11,43
6. Selling on the market	3	8,57
7. Sell to the restaurants and other catering facilities	1	2,86
8. Sallthrough retail and wholesale facilities	0	0,00
9. Sell to Herzegovinian emigrants and occasional clients in Sarajevo and Banja Luka	0	0,00
10. Giving cheese like a present	0	0,00
TOTAL	35	100,00

Purchasingofcheese

The highestpercentageinterviewed, 51.18%, cheese buy directly from producers, weather on farm, or on market.It is mainly a long lasting established way of buying cheese and in the same time the most preferred one by consumers. However, not everyone has opportunity to purchase cheese directly from producers. Thus, 15.48% of total interviewed buy cheese from resellers. Only 7.53% interviewed cheese buy in wholesale and retail trade (Table 2).

Table 2. Identified ways of purchasing cheese

Responses	Number of respondents	% (compared to the total number of responses)	% (compared to the total number of respondants)
1. Directly from producers on farm	370	34,68	31,30
2. From producers on the market	235	22,02	19,88
3. From resellers	183	17,15	15,48
4. Obtained from relatives from village	152	14,25	12,86
5. In retail shops	64	6,00	5,41
6. Through acquaintance	34	3,19	2,88
7. In wholesale shops	25	2,34	2,12
8. On fairs	4	0,37	0,34
TOTAL	1067	100,00	90,27

Distribution of cheese

With respect to the manner of sale cheese, there are two identified forms: (1) direct sale to consumers and (2) sale to distributors. As the Cheese in a suck is "illegal" product on market (due to unregulated legislation on the selling of products made from unpasteurized milk), fear of inspection and payment of fines is determining obstacle for distributors to trade with cheese.

Resellers. Interview with themhas been conducted at markets in Trebinje and Mostar. Both retailers had on offer a full range of dairy products:Cheese in a suck - fat, Cheese in a suck - Torotan, kajmak, "Cheese in blocks" (just curdled cheese made from skim milk), Urda (product obtained by curdling of whey), whey and milk. Cheese in a suck - fat made from cow's milk is sold at a price of 15 to 20 KM in Mostar, and 13 to 18 KM in Trebinje. Purchasing price they didn't want to disclose, but they said that is worthwhile to work with fatty cheese. Cheese in a suck - Torotanat the market in Mostaris sold at a price of 8 to 10 KM, while the purchase price of it is 3 to 4 KM. Interviewed reseller in Mostar said that there is no "major" problem with inspection, while the reseller from Trebinje said "that inspection is a big problem."

Catering services. Interviews with representatives of catering services were conducted in 12 municipalities in BiH, in 17 restaurants. Only 5 restaurants in its regular offer hadCheese in a suck, 1 in Nevesinje, 2 in Mostar, 1 in Citlukand 1 Ljubuski. Reasons why they have not Cheese in a suck in everyday are shown in Table 3.

Table 3. Reasons of catering servicies for not having Cheese in a suck in regular menu

Answers	Number of answers	% (compared to the total number of responses)	% (compared to the total number of respondants)
1. Fear of inspection	12	46,15	70,59
2. Easy perishable goods	6	23,08	35,29
3. Lack of demand	4	15,38	23,53
4. Expensive product for average customer	2	7,69	11,76
5. Brucellosis decreased demand	2	7,69	11,76
TOTAL	26	100,00	

As it is visible from the table, "illegality" of cheese on market is a key problem for the lack of cheese on the menu for catering services. Even those who have cheese in regular offer have responded that they do it "at high risk" and "do not know till when."
Furthermore, all were asked under what circumstances they would have cheese in regular offer. All 12 were reported that they would have cheese on offer if it would be legally permissible. Otherwise they are unwilling in times of severe economic situation "take the risk".
Interview conducted with 5 ownersof**_wedding salons_**has shown almost the same results as interviewmade in restaurants. The difference is that menu of wedding salons is fully formed according to the wishes of clients who makewedding, and there are clients who request menu with Cheese in a suck. However, fear of inspection is always present and risk is solely a burden on restaurant owners. Cheese sell through catering servicereaches the price up to 50 KM per kg.
Retail and wholesale stores. In research were interviewed 5 owners of retail stores: 2 in Mostar, 1 inLjubuski, 1 in Posusje, and 1 in Nevesinje. They sell cheese at a price from 12 to 15 KM. All answered they were satisfied by demand, but due to the problem of the legislative they are not willing to sell cheese produced by producers.

During the research interview was done with representatives of marketing department big supermarket in Mostar and Banja Luka. All they had in offer Cheese in suckmade by dairiesfrom Nevesinje, Posusje and Bileca. The cheese is sold in vacuum packs of 0.5 to 1 kg at a price of 14 to 16 KM per kg. They expressed satisfaction with present demand, but from the same reasons mentioned by small shops they are not willing to sell cheese produced by producers.

Prices

Productive prices

On the basis of quantity of materialused for cheese production acquired during research conducted amongcheese producersin 2009 (Samardzic, 2009), and according to the current prices in 2011has made calculation of cost price for cheese made of pure cow's milk, and it is 9.67 KM per 1 kg of cheese. Quantities of wood used for maintain temperature during phase of curdling, the amount of water for maintain hygiene of materials and space for curdling, consumed electric energy and fuel costs for transportation of the cheese to the final customer, are calculated on subjective producersestimation. More detailed in Table 4.

Tabela 4. Calculated producing price of Cheese in a suck made of cow s milk per 100 kg

Type of cost	Measure unit	Quantity	Price per measure unit	Sum (KM)
Material				
Milk (cows)	Liter	800	0,80	640,00
Rennet*	Liter	0,24	5,00	1,20
Salt**	Kg	3	0,50	1,50
Suck***	Piece	2,22	18,00	39,96
Other costs				
Wood	m^3	0,2	40,00	8,00
Water****	m^3	1,6	10,00	16,00
Electricity	KW	300	0,125	37,50
Labour*****	Working hour	45	4,50	202,50
Fuel	Liter	10	2,00	20,00
TOTAL				966,66
Per 1 kg				9,67

* At 100 liters of milk it goes 30 ml of rennet
** At 100 kg of cheese it goes 3 kg of salt
*** In one suckin average goes 45 kg of cheese
**** It is assumed that the average per liter of raw milk goes 2 liter of water (water price of 10.00 KM/m^{3}ishigher due to transport costs)
***** This includes work on curdling of 1.5 to 2 hours every morning and evening and work of 2 hours every 5 day forbraking cheese blocks and inserting in suck

Selling prices

Research results have shownextremely high variation ofprices within the same cheese category.Depending on milk category used for cheese production it is only possible to display range of priceswithin same cheese category and they are:
cows' milk cheese 8 to 15 KM,
cheese made of mix of sheep' and cows' milk 10 to 18 KM,
sheep' milk cheese 15 to 25 KM.
It has found that cheese price depends on category of milk (cows' or sheep') used for making cheese, the territory in which it is sold, and to some extent on the degree of ripeness and dryness (long standing in suck). Thus, producersfromKonjic achieve the lowest sale prices,

while producers from Prozor/Rama andLjubuski achieve the highest sale prices for particular category of cheese.

However, as producers are reluctant to give the answer to this question, the impression is that data on sales prices are increased compared to actual sales prices achieved in the market. Therefore, these data should be taken with reserve and obtained price ranges should be reduced about 10 - 20%.

Of 25 producers who have a certain amount of cheese for sale, 4 producers responded that they were not satisfied with the sales price of cheese, 14 have answered that they are satisfied with the sales price, while 7 responded that they are satisfied when there is no other choice.

Purchasing prices

When respondents have been declaring purchasing price of cheese, there was observed disagreement with sale price quoted by the producers. Price quoted by customers range from 7 to 25 KM. Surveyed producers, perhaps out of fear of competition, or of keeping prices as secrets from other producers, have provide answers on increased selling prices, and consumers of reduced purchasing prices.

In relation to the total number of respondents, only 24.11% said that price of cheeseis high.

Testing respondent's attitude toward price of cheese is made by applying X^2test in relation to the individual municipalities and found that the attitude of the respondents ofpurchasing price is not depending on the municipality in which survey has been conducted.

Conclusion

From researchresults is visible that most consumers cheese purchase from known and constant suppliers:directly from producerson farm 31.30%,from producers in market 19.88% and 12.86% obtained from relatives of village (Table 2). Knowing each otherrepresent a sort of unwritten guarantee for cheese quality and hygienic safety, even in absence of a legal certificate that could confirmthis information. Mutual trust amongproducers and consumersis a reason, despite illegal presence of cheese in market, why producers still manage to sell all produced quantities.Reason for giving up some producers of this production probably lies in the difficult attainment of consumer confidence due to lack of confidence in the quality and hygiene of cheese. This explains the phenomenon that someproducers have regular customers for years, while others have no demand and give up of production. Cheese in a suck, besides the lack of guarantees for its quality, has nomajor fluctuations in relation supply - demand. Cheese in a suck is an excellent example how short chain of distribution and mutual trust among producers and consumers, has stronger power than official certificate.

Research results have shown that producers sell cheese in range of prices from8 KM (Konjic) to 25 KM (Ljubuški). Such a big disparity of prices causes serious harm to producers,on one hand due to the realization of small profits, and on the other hand due to the reduction of cheese reputation among consumers. The cause of this phenomenon is often ininadequacyof keeping cheese for longer period. In order to protect producers and consumers it is elaborate and adopt a clear pricing policy for certain categories of cheese.

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DEMOGRAPHIC PROBLEMS OF RURAL DEVELOPMENT OF THE REGION OF FRUSKA GORA

Radovan PEJANOVIC[*], Sanja DJUKIC, Zoran NJEGOVAN, Danica GLAVAS-TRBIC

University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia
(Corresponding author: pejanovic@polj.uns.ac.rs)

Abstract

In this paper the authors analyzed the demographic aspects of the region of Fruška gora. Region Fruška gora is one out of two mountains in the Autonomus Province of Vojvodina (Republic of Serbia). Two zones are present on the surface of 139.430,01 hectares. The central zone is the highest part of mountain, which is owned by the National Park „Fruška gora". In a wider zone of Fruška gora are located settlements and agricultural land, with extensive and intensive use. Most of the region of Fruška gora has characteristics of rural areas, agriculture is a traditional economic activity in this area, with dominantly small farms. However, the authors indicate that the current demographic trends are limiting factor for the development of this region. The depopulation and senilization of Fruška gora's settlements are the dominant demographic trends. Therefore, the authors propose a model to overcome these limitations. In this model, the authors suggest that it is necessary to ensure economic empowerment of the region through the development of agriculture and tourism, which would be accompanied by an appropriate measures of population policy.

Keywords: *Fruška gora, rural development, demographic aspects.*

Introduction

Region of Fruška gora is the unique geographical location in the Autonomous Province of Vojvodina (Republic of Serbia) and covers an area of approximately 139,430.01 hectares. In the midle of Fruška gora on the surface of about 25,525 km^2 is located National Park "Fruška gora", while in the broader scope are settlements and agricultural areas.Administrative-territorial units which are the parts of this region are municipalities: Sremski Karlovci Beo in, Irig In ija, Šid, Ba ka Palanka, Ruma, and the cities: Novi Sad (Petrovaradin) and Sremska Mitrovica. Natural resources and cultural values are protected on whole area, On entire area the protection of natural resources and cultural values is performing, in accordance with the predetermined protection regimes. Management in this region should be guided by the principles of sustainable development. Also, the main economic activity in the region is agriculture, and to a lesser extent - tourism.

Materials and methods

Sources of data are taken from the project of the "Master Plan of Sustainable Development of Fruška gora 2012-2022.", as well as documentation from his base, and the most important is: "Spatial plan of special purpose of Fruška gora". In the paper is used an empirical method to identify specific demographic characteristics and rural development in the region of Fruška gora. Processing of the data was performed by statistical analysis.

Results and discussion

Demographic aspects in the region of Fruška gora

The total population of the region of Fruška gora has increased in the period 1991-2002. year by 15.5%. Increase of population was recorded in 42 settlements, while in the remaining 15 settlements the total population has decreased. This population growth was a result of migrations over the past two decades. However, observed municipalities and cities of Fruška gora in the period 2007-2010. year had a reduction in the number of inhabitants in most settlements, and only in Novi Sad and Sremski Karlovci had an increase in population (table 1).

Table 1. The population of the cities and municipalities of the region of Fruška gora in the period 2007-2010. year

	2007.	2008.	2009.	2010.	Increase / decrease (2010-2007.)
Backa Palanka	58.110	57.538	57.000	56.438	-1.672
Novi Sad	319.259	323.708	327.175	330.527	11.268
Indjija	48.944	48.624	48.376	48.075	-869
Irig	11.595	11.434	11.319	11.205	-390
Ruma	57.713	56.963	56.409	55.890	-1.823
Sremska Mitrovica	83.205	82.373	81.613	80.881	-2.324
Sid	36.423	35.845	35.390	34.957	-1.466
Sremski Karlovci	8.782	8.834	8.845	8.819	37
Beocin	15.704	15.672	15.682	15.633	-71

Source: author's calculations based on data from the Statistical Office of the Republic of Serbia

During the period since 1991. to 2002. year demographic trends of Fruška gora's population were marked by negative natural increase (up to 85% of the village), and in some areas (e. g. Mala Remeta) population growth was zero. This negative trend continued after 2002. year, so in most Fruška gora's settlements population growth was negative and expressed values (table 2).

Table 2. Population growth of the cities and municipalities of the region of Fruška gora in the period 2007-2010. year

	2007.	2008.	2009.	2010.
Ba ka Palanka	-339	-282	-332	-352
Novi Sad	138	368	441	427
In ija	-182	-188	-230	-227
Irig	-88	-110	-100	-114
Ruma	-377	-345	-366	-408
Sremska Mitrovica	-439	-478	-385	-461
Šid	-297	-252	-247	-237
Sremski Karlovci	-18	-14	-42	-25
Beo in	-68	-37	-68	-68

Source: Statistical Office of the Republic of Serbia

The migration was the only source of population growth in the region of Fruška gora in period from 1991. to 2002. year. These migrations have occurred as a result of exile from the former Yugoslav republics (during the 90-ies in the last century). Their participation in Fruška gora's area was 23,7% (according to Census of population, 2002.), which means that the area of Vojvodina settled over 30 thousand people.[43] Making analysis by settlements, the largest number of refugees settled in Šid (about three thousand), and over two thousand settled in Petrovaradin, Sremska Kamenica, Sremski Karlovci, Novi Slankamen and Kukujevci. But even in this contingent of the population regressive trends (low reproduction) are expressed. In this region isn't possible to stop the intense process of depopulation.

Reduction of population growth has caused the intensification of population aging (senilization). The average age of the population in Fruška gora's area in 2002 was 41,6 years. Some settlements had got for the same period higher values of this ratio, e. g. Velika Remeta – 52,1 years and Slankamena ki Vinogradi – 45,4 years. Observed by settlement, in 2002. in only sixteen settlements an average age was below 40 years, while in the remaining forty settlements average age exceeded this value. Parallel to this, the number of young and working-age population is decreasing, so the population of Fruška gora's area has caracteristics of regressive type of population (table 3).

Table 3. Proportion (%) of different age groups in the total population, by municipalities and cities of the region of Fruska gora in 2002.

	different age groups in relation to the total population (%)		
	< 20 years	20-39 years	> 40 years
Backa Palanka	22	27	51
Novi Sad	22	29	49
Indjija	23	27	50
Irig	22	25	53
Ruma	23	27	50
Sremska Mitrovica	23	27	50
Sid	23	26	51
Sremski Karlovci	23	20	57
Beocin	24	20	56

Source: author's calculations based on data from the Statistical Office of the Republic of Serbia

Due senilisation and depopulation in the present, degradation in quality of the population could be expected in future. In this case, one of possibilities to slow down this process is the population growth by fertility increas in the region of Fruška gora. Another possibility is increasing the number of persons who immigrated in order to improve the "quality" of the population in the region of Fruška gora (younger age groups in the fertile period of his life). Also, in order to increase efficiency, it is necessary to separate the social from demographic measures, for the purpose of easier access to financial resources. According to this, the funds from the provincial budget (AP Vojvodina) should be directed every year in an appropriate amount (about 3% according to France) to encourage procreation.

In the contingent of total population in the region of Fruška gora many municipaliities have a significant participation of agricultural population (except In ija, Beo in, Sremski Karlovci, Novi Sad). The largest percentage of the agricultural population in the total population have two municipalities, Irig with about 19% and Šid with 17%. The participation of active

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agricultural population in cities and municipalities in the region of Fruška gora is in the range from 54% to 64%, indicating that the population is predominantly oriented towards agriculture as an major economic activity (table 4. and table 5).

Table 4. The patrciipation of the agricultural population in the total population in the municipalities and cities in the region of Fruška gora for 2002. year

	In total	Agricultural	Agricultural in total (%)
Ba ka Palanka	60.966	6.461	10,60
Novi Sad	299.294	5.760	1,92
In ija	49.609	4.413	8,90
Irig	12.329	2.411	19,56
Ruma	60.006	6.992	11,65
Sremska Mitrovica	85.902	11.939	13,90
Šid	38.973	6.683	17,15
Sremski Karlovci	8.839	217	2,46
Beo in	16.086	1.065	6,62

Source: author's calculations based on data from the Statistical Office of the Republic of Serbia

Table 5. The participation of active and supported agricultural population in the total agricultural population in the municipalities and cities in the region of Fruška gora for 2002. year

	In total agriculture population (%)	
	Active	Supported
Ba ka Palanka	59,82	40,18
Novi Sad	57,53	42,47
In ija	54,70	45,30
Irig	56,86	43,14
Ruma	55,69	44,31
Sremska Mitrovica	57,61	42,39
Šid	58,16	41,84
Sremski Karlovci	58,06	41,94
Beo in	64,41	35,59

Source: author's calculations based on data from the Statistical Office of the Republic of Serbia

Aspects of rural development and multifunctional agriculture in the region of Fruška gora

Region of Fruška gora is a dominantly rural area. But some municipalities like Sremski Karlovci, In ija, and the city Novi Sad have the characteristics of urban municipalities. Other municipalities/cities (Sremska Mitrovica, Beo in, Ruma, Ba ka Palanka, Šid and Irig) are a group of settlements with rural type.[44] Taking in mind the position of Irig in the area of Fruška gora, it can be concluded that it is predominantly rural settlement. Agriculture is the most important economic activity in the region of Fruška gora. The potential for crop production in the region of Fruška gora is concentrated in Sremska Mitrovica, Novi Sad, Ba ka Palanka, In ija and Irig. Spaces for efficient livestock production are concentrated in Sremska Mitrovica and Novi Sad. In addition to the unfavorable demographic development, as the second limiting factor in the development of the region of Fruška gora is the lack of built and maintained infrastructure.[45]

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[44]Njegovan, Z., Pejanovi , R., (2009). Ruralna regionalizacija AP Vojvodine, Poljoprivredni fakultet, Novi Sad, 2009.

[45]Pejanovi , R., Njegovan, Z., (2011). Ruralni i lokalni ekonomski razvoj AP Vojvodine, monografija, Poljoprivredni fakultet, Novi Sad.

Region of Fruška gora has specific geographic, climatic and agro-ecological conditions and a suitable land for the diverse agricultural production (crop and livestock production). In the present circumstances, multifunctional agriculture is performed mostly on private land (the dominant small and medium family farms). According to this, multifunctional agriculture of Fruška gora is characterized by[46]:

favorable growing conditions and the existence of the good traditions in the production of fruits, grapes, vegetables and livestock;

the presence of reservoirs which are important for irrigation, fishery development and sport-fishing tourism;

proximity of major consumption centers and tourist destinations, which is an important factor of demand of agricultural products;

favorable conditions for the production of honey plants and development of beekeeping;

the presence of significant forest complexes and favorable conditions for the development of hunting;

favorable conditions for the production and collection of medicinal and aromatic plants.

Despite these advantages the region has insufficient use of agricultural potential. For example, the areas of orchards and vineyards are insufficiet and with unfavorable age structure. Vegetable production (as fruticulture and viticulture) despite of significant free land for increase of production isn't enough developed. Livestock production of Fruška gora has a good tradition, but in recent decades this branch of agriculture had a drastic decline in the development, both within the Republic of Serbia and the region of Fruška gora. Namely, agricultural enterprises and farms in the region of Fruška gora were together with plant production, and the forage base was provided from its own resources, ensuring organic fertilizers for crop production. Also, in the region of Fruška gora there aren't enough processing and storage capacities even for the current needs of agricultural production. Bearing in mind that the current trends in food production turned more towards to the aspect of health-safety food, the region has a significant preconditions for organic food production. Nevertheless, this model of agricultural production hasn't developed significantly because of: insufficient education and information of producers and qualified staff on environmental production systems, and inadequate level of incentives and subsidies for organic farming, etc.

Tourism, besides agriculture, is another important branch of the economy in rural areas of Fruška gora. These potentials are not used enough, and with their development it could be achieved several important goals, such as increase in quality of life of local population, increase of investment, job creation and so on. Namely, in this region there is a considerable number of tourist attractions that could be base of the following types of tourism: ecotourism, geotourism, rural tourism, camping tourism, wine tourism, manifestation tourism, fishing tourism, hunting tourism, ethno-tourism, health-recreation tourism and spa tourism.[47]

Conclusion

Region of Fruška gora has a significant development potential, but they are not used enough. It is a rural area, where agriculture is the main economic activity and tourism is the second most important branch of the economy. But, the demographic aspect of the development of the region of Fruška gora is unfavorable. In fact, this region is characterized by two negative

[46]"Master plan održivog razvoja Fruške gore 2012-2022.", (2011). Nau no stru na studija, (koordinatori: Pejanovi , R., Orlovi , S., Lazi , L., Panjkovi , B.), Univerzitet u Novom Sadu, Novi Sad.

[47]Prostorni plan podru ja posebne namene Fruške gore do 2022. godine (2004). „Službeni list AP Vojvodine", broj 18/04, Novi Sad.

demographic phenomena: population decline and increase of senilization. These processes are dominant in those municipalities that are predominantly rural type. According to this, a considerable budgetary resources are necessry, which would be in the function of the population policy, with the aim of fixing the negative demographic "images" of Fruška gora.

At the same time with these measures, it is necessary to ensure the economic strengthening of the region in order to create a favorable environment for the life and work, especially for young people. Besides the improvement of primary agricultural production (fruticulture, viticulture, cultivation of vegetables and livestock production) it is necessary to invest in other development resources (hunting, fishing, water management, beekeeping, farming of medicinal, aromatic herbs and honey, etc.). Aslo, it is necessary to invest in the infarstructure in the region of Fruška gora. Development of the primary sector and infrastructure in the region of Fruška gora opens a new opportunities in the processing of agricultural products, tourism (ethno village, wine, religious and other forms of tourism), as well as the development of the service system, which ultimately provides the basis for greater diversification of economic activities in rural areas of Fruška gora.

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OFFERING MECHANISATION SERVICES AS A WAY FOR INCREASING EMPLOYMENT OF LABOUR FORCE ON FAMILY FARMS DIRECTED AT CROP PRODUCTION

Sasa TODOROVIC[*], Sanjin IVANOVIC

University of Belgrade, Faculty of Agriculture, Zemun, Serbia
(Corresponding author: sasat@agrif.bg.ac.rs)

Abstract

Hidden unemployment on family farms directed at crop production represents a favourable environment for the emergence and growth of rural poverty. Bearing that in mind, this research aims at investigating the possibilities that the labour force on the farms dealing exclusively with crop production can be better employed by providing other family farms with mechanisation services. Thus, an appropriate model of family farm is formed so as to serve for considering organisational and economic effects of offering mechanisation services to other farms.

The results of the conducted research show that in this way the family farms directed exclusively at crop production could additionally employ available resources, which in some months leads to increasing the employment of labour force on the farm by 58.72% and reducing the time available for doing other activities by 14.96%. Better use of labour force and mechanisation contributes to obtaining better results of farm operations, which can be seen from the growth of gross margin of the farm, as well as from gross margin per worker of 22.17%.

Key words: *labour force, employment, mechanisation, offering services, family farms, crop production.*

Introduction

The engagement of labour force on the agricultural family farms is one of the issues which has a very great importance, not only for the development of agriculture, but also for the whole rural development of the Republic of Serbia. Hidden unemployment on family farms represents a favourable environment for the emergence and growth of rural poverty. Although dealing with this issue has not received sufficient attention in the previous researches, however, some main features of engagement of labour force on family farms are well known.

When speaking of purely field crop operations, it can be stated that the utilisation of available labour force to a large extent varies during the year. Considering temporal distribution of expenditure of labour per some months Mun an et al. (2008) arrive at conclusion that work peaks on family farms directed at crop production (located in the lowland region of the Republic of Serbia) occur in April and October (since these are the periods of intensive works in crop growing). Nevertheless, available manpower is completely exploited only on the farms of the size exceeding 45 ha for the month of October and for those of the size exceeding 70 ha for the month of April.

Here, we come to the issue of small land areas which family farms usually own. On the basis of the data of the Treasury of the Ministry of Finance and Economy of the Republic of Serbia for 2008, which refer to the registered family farms in the region of AP Vojvodina, one can see that small family farms dominate - the farms that have less than 5 ha of land make 56% of

the total number of registered farms, whereas the participation of the farms with the land area exceeding 10 ha amounts to only 18.5% (Todorovi et al., 2009).

Similarly, researches of other authors point to the issue of extremely small land areas as one of the limiting factors for the development of agriculture of the Republic of Serbia. Hence, Bogdanov and Boži (2005) emphasise that on the area of the whole Republic only 5.6% of farms possess more than 10 ha of land[48].

On the farms owning small land areas, the exploitation of available labour is at a very low level. If one takes into account that these small farms dominate in the structure of land tenure of family farms of the Republic of Serbia, then it is obvious that there is an issue of large unexploited potentials of the labour force on the agricultural family farms, even in the months of intensive works in crop production (sowing and harvesting). Therefore, there are indeed most possibilities that labour force on the small farms dealing only with crop production can be more engaged, and proportionally to that, higher incomes can be generated on the farm. Thus, the farms must be directed at some additional activities, such as, for example, livestock production. Accordingly, Todorovi et al. (2011) analysed the effects of the introduction of cattle fattening on purely field crop operations, which had very favourable impacts on the engagement of labour force even during the months when there is no work in crop production (December, January and February). However, it should be taken into account that this kind of extension of activities requires already existing facilities which can be used for cattle production or some investments are necessary for their construction.

For this reason, as a particularly interesting issue emerges the research of the possibilities that the labour force on the farms dealing exclusively with crop production might be better engaged by offering mechanisation services to other family farms and in that way more favourable effects of operations will be produced due to generating additional revenues from provided services. Bearing in mind that this change leads to an alteration in functioning of the farm, it is necessary to test economic justification of such business decision.

Material and method

As a source of data, interviews with the holders of family farms dealing exclusively with crop production from the regions of AP Vojvodina were used. In addition, a modern literature on the organisation of crop production was used. A detailed analysis of natural, organisational and economic conditions in which these farms operate was previously carried out so as to successfully accomplish the given aim, then the analysis of all available resources which are at their disposal as well as the analysis of production results.

The starting assumption of the research is that the family farm is planning to commence offering mechanisation services (services of sowing and harvesting) to other family farms in the nearby environment, so as to enhance the engagement of available labour force and the degree of mechanisation exploitation, and thus more favourable economic effects of business operations will be exerted. Mechanisation services would be carried out for the activities of sowing and harvesting of crops (that is, during April, July, September and October) since there is the greatest need for using mechanisation services for the aforementioned working operations (during the given months). The total scope of the aforementioned services which the farm (model) would provide is based on the evaluation received on the basis of a surveying of the family farms. For the other months during the year it is realistically difficult to predict the scope and the kind of services which can be delivered using mechanisation (and during some months these services cannot be delivered), thus, in this research the remaining part of the year is not taken into consideration.

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[48]According to 2002. Census the number of agicultural holdings in the Republic of Serbia was 778,891.

Offering mechanisation services is chosen because compared with some other possible activities it does not require the acquisition of new mechanisation (that is, it does not require any additional investments), which corresponds to the realistic situation on the surveyed farms. Therefore, it will lead only to the income rise due to offered services on the farm and to the rise of variable costs.

For the purpose of considering economic effects of offering mechanisation services to other family farms the model of field crop operations with the following characteristics is made:

the farm is situated in lowland region;

it has 22.94 ha of arable area of uniform quality and optimum plot size;

deals with intensive crop production;

2 family members are constantly engaged on the farm;

arable area is exclusively used for growing cereals (maize and winter wheat) and industrial crops (sunflower and soya bean);

the whole arable crop production is market-oriented, that is, there is not any form of internal realisation of the obtained crop products;

it is equipped with all needed mechanisation (both driving and towing units) so it has mechanisation which can be used for providing other farms with mechanisation services (universal combine harvester, grain drill and row-crop planter).

In the research, the analysis of economic effects of offering mechanisation services is conducted on the basis of gross margin, as a difference between production value and variable costs of production, since offering mechanisation services will not result in altering fixed costs on the farm. According to Gogi (2005) the fixed costs do not vary when changing the degree of utilisation of capacity, i.e. their total amount remains the same regardless of the amount of produced products or provided services.

Results and discussion

The results of the conducted research show more significant engagement of labour force in the analysed months on the farms which offer mechanisation services compared to the farms not dealing with the services (Table 1).

Table 1. The change of labour expenditure on the farm due to offering mechanisation services (per months)

Month	Spent time on the farm exclusively directed at crop production	Spent time on the farm directed at crop production and offering mechanisation services	Change (hours)	Change (%)
IV	58.29	88.81	30.53	52.37%
VII	48.03	73.54	25.51	53.11%
IX	51.78	102.80	51.02	98.53%
X	100.01	144.52	44.50	44.50%
TOTAL	258.11	409.67	151.56	58.72%

Source: Authors` calculation

In the observed months, the spent working time on the farm exclusively directed at crop production is 258.11 s, and regarding the farms directed at crop production and offering mechanisation services it amounts to 409.67 hours, so that the change of spent working hours, as a consequence of offering mechanisation services amounts to 151.56 hour, that is 58.72%. Observed per months, the highest rise of engagement was recorded in September (98.53%) which is twice higher rise than the rise recorded in the remaining three months in which it came to the change (April 52.37%, July 53.11% and October 44.5%).

Bearing in mind that the months in which it came to the rise of the engagement of labour force are simultaneously the months of intensive works in crop production on the farm which offers

services, it is necessary to determine the time available for doing other activities (total and per months) before and after offering mechanisation services.

Since the time is better spent on the farms offering mechanisation services, it resulted in the decrease of time available for performing other activities (Table 2).

Table 2. Available time for doing other activities on field crop operations (per months)

Month	Available time for doing other activities on exclusively field crop operations (per months)	Available time for doing other activities on field crop operations also offering mechanisation services	Change (hours)	Change (%)
IV	220.34	189.81	-30.53	-13.85%
VII	281.13	255.62	-25.51	-9.07%
IX	266.84	215.82	-51.02	-19.12%
X	245.05	200.55	-44.50	-18.16%
TOTAL	1,013.36	861.80	-151.56	-14.96%

Source: Authors` calculation

The total working time which is available during the observed months to the members of the household for doing other activities (different activities outside the farm or some other agricultural or non-agricultural activities on the farm) is reduced by 151.56 hours, i.e. by 14.96% as a consequence of offering mechanisation services. Observed per months, the highest reducing is recorded in September (19.12%), slightly less in October (18.16%) significantly less in April (13.85%), and the lowest in July (9.07%).

It is obvious that on the farm offering mechanisation services there is still significantly available time for performing other activities even in the months of simultaneous conducting of intensive works in crop production on one`s own farm and offering mechanisation services to other family farms.

Very important conclusions, regarding the economic effects of offering mechanisation services, can be drawn by calculating different indicators based on gross margin (Table 3).

Table 3. Economic effects of offering mechanisation services

Indicator	The farm exclusively directed at crop production (RSD)	The farm directed at crop production and offering mechanisation services (RSD)	Change (RSD)	Change (%)
Gross margin (total)	2,527,939.87	3,088,466.07	560,526.20	22.17%
Gross margin per worker	1,263,969.93	1,544,233.03	280,263.10	22.17%
Gross margin per working hour	5,624.25	5,138.61	-485.63	-8.63%

Source: Authors` calculation

The determined amount of gross margin at the farm level to a large extent influences the total business results, because all fixed costs are subtracted from this amount so as to calculate the profit. Taking into account that the fixed costs are constant, every change of gross margin at the level of agricultural farm is in the short term directly reflected in the amount of profit. The positive gross margin contributes to a covering of the fixed costs, thus, as stated by Ivana Ivkov et al. (2008), the maximising gross margin is equivalent to maximising the profit or minimising the losses.

Increasing the total gross margin of the farm, as well as gross margin per worker, amounting to 22.17% (as a consequence of delivering mechanisation services) shows that not only will the total farm profit increase, but that the effects of work of constantly engaged workers on the farm will improve as well. In consequence, even apart from the evident decrease of gross margin per working hour by 8.63%, the decision on offering mechanisation services is economically acceptable.

Conclusion

The results of this research should be regarded as a tendency for examining development models which would activate the resources of rural environments for the purpose of the rise of the employment and creation of additional income. Thus, it was found that along with more rational way of organisation of operations, which comprises the expansion of business direction towards offering mechanisation services to other family farms, the family farms directed exclusively at crop production could additionally exploit available resources.

It is confirmed by rising the engagement of labour force on the farm in the observed months by 58.72% and reducing the time available for doing other activities by 14.96%. Better utilisation of available resources, first of all, labour force and mechanisation, contributes to improving the results of operations which can be seen from gross margin of the farm amounting to 22.17%, and by the same percentage, gross margin per worker is increased. At this point, it is necessary to pay attention to the fact that regarding the analysed model of the farm (which has approximately 23 ha of arable land, which is the area significantly higher than the average at the national level) there is still much available working time which is not used. Therefore, these family farms, apart from offering mechanisation services, have to find additional ways in order to engage labour force (on the farm or outside it), or it is necessary to consider increasing of land areas which will be cultivated.

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GENERAL TRENDS ON AGRICULTURAL – FOOD PRODUCTS MARKET IN SERBIA

Drago CVIJANOVIC[1*], Branko MIHAJLOVIC[1], Gorica CVIJANOVIC[2]

[1]Institute of Agricultural Economics, Belgrade, Serbia
[2]Faculty of Biofarming Backa Topola, Megatrend University, Beograd, Serbia
(Corresponding author: drago_c@iep.bg.ac.rs)

Abstract

According to population income trends and supply and demand trends, on the world market of agricultural-food products in next ten-years-lasting period is expected increase of agricultural products consumption. Owing to expected income growth, the consumption of agricultural products for human nutrition will increase faster in those countries which are not members of the OECD. At the same time, in developing countries will come to changes in consumption habits, where will increase the share of animal origin products, meat and dairy products, as well as the consumption of sugar and vegetable oils. These all will cause a growth of derived demand for fodder, like cereals, except wheat, soybean meal and sunflower meal. In such conditions, agriculture represents one of the economic development pillars of the Republic of Serbia, and its significance for the national economy, besides economic, also has both social and ecological component. However, beside great potential in the sector of agricultural production, which has been a result of favourable climatic conditions, natural land characteristics and available water resources, it has not been optimally used. Exactly due to such potential, the agriculture in Serbia does not represent a common economic branch, considering that, in all municipal or regional strategies; it has been defined as one of the strategic development directions.

Key words: *agriculture, market, agrarian policy, food industry.*

Introduction

The agriculture in Serbia does not consider a common economic branch, as due to peculiarities of this production and tradition tied to it, as well as owing to great expectations. The most important elements of reform processes in Serbian agrarian sector since 2000 have been: market liberalization, privatization of processing industry, activation of agrarian financial market, as well as forming new institutional forms at all levels.

In the following period, Serbia should become a member of the WTO and to apply absolutely the adopted rules, which means significant decrease of import protection, cancelling export incentives and change of internal support structure to domestic agricultural production. There will also cancel or significantly diminish the import protection for products from the EU countries, in accordance with the Stabilization and Association Agreement (except for small number of delicate products, which will keep certain level of tariff protection after 6 years of transitional period, too).

The transitional period until the full application of the Stabilization and Association Agreement (until 2014) is important for structural changes in domestic agriculture, in regard to that, after this period, the measures will be modified and synchronized with the common

EU policy (*CAP*)[49]and rules and principles of the WTO. Accordingly, of Serbian agriculture is expected properties enlargement, increase of general productivity level (especially technical-technological production level) and competitiveness in regard to quality and prices, along with simultaneous adjustment of production, processing and placement with international standards. However, it is important to emphasize that agriculture cannot keep the existing employment level and to be, at the same time, competitive in surroundings, and especially in the EU. A conflict of agriculture role in economic development and its social component constantly characterizes Serbian economic structure, while precise restrictions of development-oriented agricultural husbandries and those husbandries which fall into a domain of social and rural state policy – are necessary for defining clear directives of competitive agricultural-food sector establishment in the future.

The next restrictions for faster agriculture development must take into consideration:

Small property is in ownership of individual agricultural producers; there is great number of semi-natural husbandries of small economic and financial potentials, with aggravated possibilities of capital accumulation from agriculture,

Insufficiently successful privatization of enterprises in the sector of primary agriculture, and at the same time, insufficiently strong competition among privatized companies in food industry;

Unbuilt vertical and horizontal market chains, insufficiently organized flows of repurchase and turnover of agricultural products, and underdeveloped all forms of farmers associations (including also agricultural cooperatives),

Underdevelopment of financial market, high capital price, lack of entrepreneurial capital (in English venture capital), foreign investments, joint ventures are significant limitations for greater investments,

Unfavourable general business climate, high investment risk and insufficient protection of proprietary rights (insufficient legal protection of an investor) – also limit new investments of domestic entrepreneurs regarding inventions in agricultural production and investments in primary processing sector,

Possibilities for higher state incentives are limited by low agrarian budget,

High requirements regarding quality standards and regulations which domestic producers must fulfil if they desire to enter the foreign markets (EU, Russia, USA and similar), and, at the same time, is slow adjustment of domestic producers and processors to safety food standards[50].

Material and methods

In realization of the research task were used desk researches of data which relate on the agricultural-food products market in Serbia. Such research implies using the data from the official sources: data of the Statistical Office of the Republic of Serbia, materials of the Serbian Chamber of Commerce etc; using the data from domestic and foreign literature; using the internal data. There were also used quantitative methods, first of all - time series analysis. With combination of stated methods can get more reliable answer to key questions which impose within the analysis of the general trends on the agricultural-food products market in Serbia.

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[49] See more detailed: Cvijanovi , D., Simonovi , Z., Mihailovi , B. (2011): „The focus and goals of new reforms of agrarian and regional support to the EU", Economic of Agriculture journal, Year 58, no.3 (359-527) 2011, Belgrade. UDK: 338.431:339.1; UDC 338.43:63; ISSN 0352-3462; pp.359-370.

[50]Passing the Law on Food Safety („Official Gazette of RS", no. 41/09) and series of follow-up laws are the initial steps for introduction of standardization procedure in production of food products and respect of food safety principles.

Results and discussion

On trends in world trade of agricultural-food products have an effect the global geo-political and economic situation, vacillating of supply and demand for the products on big markets, as well as trade negotiations and multilateral agreements. Although Serbian market is small and relatively closed (Serbia is not sufficiently integrated in the world courses), the mentioned trends will affect also on domestic market of agricultural products and foreign trade exchange of Serbia with the world. In such conditions, Serbian agriculture has extraordinary place and role in the total economic development of the country, especially in the process of adjusting economic mechanisms for certain social goals realization, on conduction of reforms and transition, and primarily on alleviation of the world economic and financial crisis impact[51], which seriously jeopardize revival and development of the economy.[52]

Yugoslav model of agriculture was based on cooperation, as a bond between individual husbandries and big state/public enterprises. The vertical integration system has been structured the most often at the local/regional level, and had comprising inputs market, primary agricultural production, processing, finishing, sale and services. The big agro-industrial systems had a strong impact on the local economy, monopoly position at the local market and had been supported by the republic and state funds. Parallel with the big agro-industrial systems had existed also a network of other participant in turnover (middlemen), whose business had been verged on black economy. During 90's, after a decline of big agro-industrial factory-farms (combines) had appeared ten-years-lasting vacuum or elemental force in institutional and organizational functioning of agricultural inputs market and repurchase of agricultural products. A precondition for revitalization of the agricultural products market was created primarily by privatization of processing capacities (especially in the field of industrial plants and milk processing), and then also by strengthening of food wholesale and retail chains. However, while the industrial plants and milk market is characterized by strong domination and negotiating power of several purchasers in regard to the primary agricultural producers[53], lack of secure agreements with purchasers and domination of black economy are especially present in production of fruits, vegetables, turnover of livestock, maize etc.

The agriculture is, together with industry, an undeniable developmental chance of Serbia, and its role and significance in the national economy will not decrease. Nevertheless, in order for agriculture to really use its chances and qualify its self for intensive production and higher export, two essential and structural problems on the agricultural-food products market search for a constructive solution and coordinated role of all government institutions:

Strengthening the competition on repurchase and agricultural products market and sanctioning an abuse of dominant position by small number of companies (in present moment, the market characterizes the oligopsons' market structure, i.e. strong negotiating power of small number of companies in repurchase),

Transforming the repurchase courses from the "black" economy into the regular channels; the black economy leads to unequal conditions of competition of firms which do business legally

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[51]See more detailed: Vojnovi , B., Cvijanovi , D., Veselinovi , P. (2011): „Researching the crisis impact on domestic enterprises' business", Economic of Agriculture journal, Year 58, no.4 (529-804) 2011, Belgrade. UDK: 338.124.4; UDC 338.43:63; ISSN 0352-3462; pp. 749-760

[52]*Agriculture in 2011 with expectations for 2012 – Assessments, evaluations and proposals*, SCC, Association for Agriculture, Food and Tobacco Industry and Water Management, Belgrade, February, 2012, p.2

[53]For example, in production of oleaginous plants single out four factories, of which two are within the same business system, in milk production a dominant market share has only one business system, within which structure are 5 big dairies, 8 privatized sugar refineries are in hands of 3 owners etc.

and those who avoid law, and the domination of blackeconomy is noticeable not only in products' sale, but also in business/registering of the firms, employment of workers etc[54].

Thereby must point out that, no matter how good were, the isolated activities of the MAFWM of the RS in this segment were not enough for changes and engagement of all institutions, especially judicial and legislature authority – can lead to solution of evident problems in functioning the market of agricultural products.

According to data of the Statistical Office of the Republic of Serbia (*table 1*), the costs of food, beverages and tobacco, besides continuous decrease of share, are further more highly represented in family budget costs in Serbia. In 2000, this share was amounted 54,0%, and in 2008 45,8%. Such state points out to still low population standard and thereby insufficient life quality, regarding that insufficiently assets stay for satisfying the other needs, of non-existential character. It is a consequence of insufficiently liberalized market and monopoly orientation of processors and tradesmen.

Table 1. Macro-economic indicators of Serbian agriculture

	Jed.	2000	2001	2002	2003	2004	2005	2006	2007	2008
Share of agriculture, forestry and fishery in GDP:										
	%	18,7	18,0	13,3	11,4	11,9	10,3	9,6	8,7	
in employment (ARS)	%					23,9	23,2	20,5	20,8	21,4
Share of food industry, beverage and tobacco in GDP		6,2	5,7	5,3	4,9	4,7	4,4	4,7	4,4	
Total		87	119	97	93	120	95	100	92	108
Plant production		73	150	96	83	144	94	97	82	123
Livestock breeding		95	99	102	98	100	101	97	100	97
Share of food, beverage and tobacco i family budget costs	%	54,0	58,4	49,0	47,7	45,0	41,7	43,4	45,1	45,8
Trade with agricultural-food products	mil. €	631,0	854,1	1.133,3	1.086,2	1.316,2	1.353,7	1.713,1	2.035,5	2.327,1
Export	mil. €	319,7	347,4	554,9	509,4	628,7	731,7	991,9	1.217,9	1.327,3
Import	mil. €	311,3	506,8	578,3	576,7	687,5	622,0	721,1	817,6	999,8
Foreign trade balance	mil. €	8,3	-159,4	-23,4	-67,3	-58,8	109,7	270,8	400,2	327,5
Share of agricultural-food products in:										
Total export	%	19,0	18,3	25,3	20,9	22,2	20,3	19,4	18,9	31,3
Total import	%	8,6	10,7	9,8	8,8	8,0	7,4	6,9	6,1	6,4

Source: Statistical Office of the Republic of Serbia – different publications

That is to say, the basic characteristics of the agricultural-food products market in Serbia reflect in the following trends:[55]

Some processors, i.e. buyers of agricultural products (oligopson) who have significant market share and market power, dominate on most of primary agricultural products market: market of wheat, sunflower, soy, sugar beat, milk, tobacco; business ambience in this field are characterized by: small domestic market, aggravated sale possibilities, especially export, high technological requirements of agricultural production, standards in safety and food quality system and the EU requirements;

Placement in hyper-markets is possible only for small number of agricultural producers who have great production opportunities, then for organized and successful cooperatives and

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[54]According to the research of the Serbian Association of Employers, on black market is the least of tobacco, and the most of seasonal fruits, vegetables and poultry. The black economy is, according to the same source, dominant for two reasons: 1) great tax burdens and 2) extremely long payment terms. Source: Conditions and burdens of business and collective negotiations, Serbian Association of Employers, 2010, pp.4-6

[55]Internal files of the Institute of Agricultural Economics Belgrade, i.e. the results of numerous focus groups and survey research of primary agricultural producers in the period 2007-2008

associations; besides all conveniences of hyper-market has been noticeable the great negotiating power ofwholesale and retail chains in regard to agricultural producers, which reflects in stipulation ofproducers by payment terms, quality, price, imposed packaging standards, etc;

Market of livestock, fruits, vegetables and eggs could represent the markets of complete or at least high competition; although, the basic imperfection of these markets reflects through a significant share of „black" economy, but also the absence of organized repurchase and long-term connection of primary agricultural producers and processors; on the mentioned markets small number of purchasers have the HACCP certificate;

from the supply side register numerous of small agricultural producers, infavourable age-educational structures and poor economic powers; they are characterized by natural and semi-natural production, small possibility for investments in cold storage plants, dryers, silos, increase of production and its standardization;

insufficient organization of agricultural producers through associations and cooperatives, and therefore results that numerous producers who do not have own productions for the needs of, so called big buyers, and, at the same time, have great supply and aggravated sale on the local market;

In irregular courses of repurchase and payments is high percentage of the primary agricultural products markets, which leads to disloyal competition; this condition can improve through better law enforcement and efficient work of inspection authorities;

Warehouse receipts market and term market of commodity products is insufficiently developed; there are also missing repurchase-distributive centres and agricultural cooperatives which role would be to take over the sale function and distribution from agricultural producers, in a most efficient way;

Farmers from peri-urban zones of the cities (Belgrade, Novi Sad, Nis), in regard to the farmers in rural areas, have better opportunities of market sale, primarily due to vicinity of big consumer centres, where do the significant turnover of the agricultural products on the markets.

Conclusion

The agriculture is one of the Republic of Serbia economic development's pillars, and its significance for the national economy, beside an economic, also has a social and an ecological component. However, besides great potential in the sector of agricultural production, which has been a result of favourable climatic conditions, natural land characteristics and available water resources, it has not been enough utilized. Exactly owing to such potential, the agriculture in Serbia does not represent an ordinary economic branch, considering that in all municipal and regional strategies has been defined as one of the strategic developmental courses. Nevertheless, successful inclusion onto the international market limits insufficient assortment of food products in regard to current supply in developed world, where has been neglected the research on better exploitation of existing capacities, through introduction of new lines and products. As limiting factor points out an oscillation of market products quality, as regarding non-existence of standards, as well as regarding disrespect and insufficient control of the existing standards. There is also slow adjustment to the market business criteria, which base on introduction of modern management and marketing systems. Insufficient predictability in business of food industry has been caused by non-existence of long-term contractual relations between the food industry and raw materials processors, as well as by non-existence of market integration, primary agricultural production and industry which, as its input, uses exactly agricultural products.

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INTERNATIONAL AID TO BOSNIAN AGRICULTURE, FORESTRY AND RURAL DEVELOPMENT IN THE POST-WAR PERIOD

Hamid EL BILALI[1*], Sinisa BERJAN[2], Jasmina SIMIC[3], Aleksandra DESPOTOVIC[4], Sabrija CADRO[5], Ljubomir STOJKOVIC[6]

[1]Department of Sustainable Agriculture and Rural Development, Mediterranean Agronomic Institute of Bari (CIHEAM-MAIB), Italy
[2]Faculty of Agriculture, University of East Sarajevo, Republic of Srpska, Bosnia and Herzegovina
[3]Cooperative Union of the Republic of Srpska, Bosnia and Herzegovina
[4]Biotechnical Faculty, University of Podgorica, Montenegro
[5]Faculty of Agriculture and Food Science, University of Sarajevo, Bosnia and Herzegovina
[6]Faculty of Organizational Sciences, University of Belgrade, Serbia
(Corresponding author: elbilali@iamb.it)

Abstract

Damage related to the 1990s war in Bosnia and Herzegovina (BiH) to the agricultural sector totalled approximately US$ 4.54 billion. About 70% of the business infrastructure and 60% of livestock were destroyed.The paper aims at providing an overview of foreign aid and assistance to BiH in the post-war period with a special focus on agriculture, forestry and rural development.

The work is based on an extended review of secondary data especially from the Donor Coordination Forum in BiH. The paper (i) lists the main policies and institutions dealing with agricultural and rural development; (ii) analyses international aid history especially principal sectors and areas to which were dedicated approximately US$12 billion after 1995; (iii) investigates current situation of international assistance focusing on donor agencies, aid sectors (*e.g.* governance; economic development; agriculture and forestry; environmental protection) and financial allocations by sector and by donor in 2009-10 period; (iv) focuses on agriculture and forestry sector especially main donors (*e.g.* USAID, European Commission, World Bank, JICA, FAO, SIDA, DFID, JICA, EBRD, UNDP), government implementing organisations, financial allocations, projects and donor coordination; (v) devotes a special attention to international aid perspective evolution in the transition from the "era of Dayton" to the "era of Brussels"; and (vi) analyses aid effectiveness and impacts using many socio-economic indicators. Despite the huge efforts made by dozens of international organisations Bosnian rural areas still lag behind in terms of socio-economic development, which puts in question rural and agricultural development policies and strategies appropriateness but also international support effectiveness.

Keywords: *International aid; Bosnia; agriculture; effectiveness.*

Introduction

Current Bosnia and Herzegovina (BiH) consists of two governing entities, namely the Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS), and one self-governing administrative unit *i.e.* Br ko District (BD) under the State sovereignty. According to the Labour Force Survey for 2010, the agricultural sector employs 166,000 persons *i.e.* 19.7%. of the total labour force (ASBiH, 2010). Rural areas represent 81% of the territory of BiH where lives around 61% of the total population. Agricultural land covers 50% of the total area of BiH. The average size of farms is 2.6 ha (MoFTER, 2009).

The 1990s war in BiH left the country in economic ruins. By the end of 1995, BiH's output had fallen to just 10-30% of the pre-war level. GDP had collapsed to less than US$500 per capita, about 20% of its pre-war level. Most of the basic infrastructure was shattered and more than 80% of the population received some food aid. The destruction costs in Sarajevo alone amounted to €14 billion (IDA, 2009). War-related damage to the agricultural sector totalled approximately US$4.54 billion. Seventy percent of the business infrastructure and 60% of livestock were destroyed (Christoplos, 2007). In 2001, 10% of farmland was mined (Gärke, 2001).

The most enduring legacy of the war in the rural sector may not be in terms of physical destruction, but the institutional weaknesses and delayed reforms due to a complex and polarised political system. BiH is certainly not a 'collapsed state', but due to the legacy of war it still lacks many of the institutions that would seem self-evident in a 'normal state' (Christoplos, 2007).

The paper aims at providing an overview of foreign aid and assistance to BiH in the post-Dayton Peace accords period especially in terms of financial allocation, main donors and implementing institutions, sectors, effectiveness and approaches with a special focus on the sectors of agriculture, food, forestry and rural development.

Material and methods

The work is based on an extended review of secondary data especially from the Donor Coordination Forum in BiH. A considerable amount of reliable secondary data has been consulted, analysed and cross-checked. The paper (i) lists the main policies and institutions dealing with agricultural and rural development (ARD); (ii) analyses international aid history especially principal sectors and areas; (iii) investigates current situation of international assistance focusing on donor agencies, aid sectors and financial allocations in 2009-10 period; (iv) focuses on agriculture and forestry sector especially main donors, financial allocations, projects and donor coordination; (v) devotes a special attention to international aid perspective evolution in the transition from the "era of Dayton" to the "era of Brussels"; and (vi) analyses aid effectiveness and impacts. Inconsistency of secondary data from different sources was the main problem faced during the preparation of this paper.

Results and discussion

The design and implementation of ARD policies involve different international, national and sub-national actors (regional; intermediate or sub-regional; and local) (OECD, 2006). In BiH, intermediate levels, Entities of RS and FBiH, have a crucial role in ARD design and delivery. In BiH, all levels of governance are involved in the agricultural sector management and rural areas development. International organisations and development agencies have implemented different rural development projects and programmes during the post-war period. There is no ministry of agriculture at the level of central government. The two entities of the FBiH and RS, and Brcko District, each retain their own quasi-ministerial structures. This institutional architecture is not recognised as appropriate for developing the statutory and regulatory functions and the overall administrative tasks that are essential for wider integration into EU and international markets. Each entity has its own systems for phytosanitary control, veterinary services, etc. and provides different subsidies types and levels. The roles of cantons and municipalities are different in each entity and unclear in many respects (Christoplos, 2007).

The main agriculture and forestry strategies are BiH Harmonisation Strategy and Operational Programme for Agriculture; FBiH Strategy for Agriculture and Rural Development; RS

Strategy for Agricultural Development; and RS Strategic Plan for Rural Development. Notable progress was made in the Forestry sub-sector with the introduction of Corporative Governance in RS. The new FBiH revised Law on Forestry was drafted in February 2010 (MoFT, 2010).

International aid poured into BiH after the Dayton Peace Accords, signed in 1995, targeted primarily cities and villages in the Federation. RS claims to have received only about $1.9 billion of the approximately $12 billion given (International Crisis Group, 2011). From 1996 to 1999, $3.7 billion were allocated by 48 countries and 14 international organizations (Pasic, 2011). From 1996 to 2002, Bosnia's annual aid amounted to $730 million, or, $1,400 per person. At $1,400 per head, assistance in the first two post-war years in Bosnia was higher than any other international state-building project since the Second World War (Huliaras, 2010). It has been calculated that BiH has received more per capita aid than any European country under the Marshall Plan. Since 2000 international aid to Bosnia has been decreasing (Pasic, 2011).

As BiH moves from the era of Dayton onto the road to Brussels, the EU itself has assumed a leading position in BiH's international engagement (Christoplos, 2007). In total, throughout the last twenty years the European Union (European Commission and the member-states) provided about 66% of the assistance for the reconstruction of Western Balkans and the United States about 15%. With regard to the relevant burden of the European Community and its member states, Community contributions were higher to much higher than all EU member states bilateral efforts taken together (Huliaras, 2010).

The EU invested EUR 91.280 million in Bosnia under the 2011 budget of the Instrument for Pre-accession Assistance (IPA) which represents 9.1% of budget for all countries wishing to join the EU. The funding focuses on Public administration reform, justice and home affairs, private sector development, transport, environment and climate change, and social development (EC, 2011a). Aid under IPA is expected to increase to 110.2 million Euro in 2012 (EC, 2008).

The United States provided large amounts of aid to Bosnia. According to the USAID "Greenbook", the US provided over $2 billion in aid to Bosnia between 1993 and 2009 (Woehrel, 2011). Moreover, since 1996, the World Bank has committed over $1.1 billion, while other World Bank agencies had sent $500 million by 2010 (Bardos, 2010).

In the immediate post-war period the main reconstruction priority was housing (Christoplos, 2007). Two main aid programs were food aid and cash handouts (Andersson, 1997). Direct food assistance in the form of food aid has been given in BiH as far back as 1992 (World Bank, 1997). As far as agricultural and rural development is concerned, there was a transition from modalities reminiscent of the agricultural rehabilitation programming supported in the past through the Consolidated Appeals Process (CAP1 phase), 'era of Dayton', to now preparing for future EU membership and increasing integration into markets steered by the EU Common Agricultural Policy (CAP2 phase), 'era of Brussels' (Christoplos, 2007).

Over time, agricultural programming in BiH has become increasingly marketing oriented in the sense that great attention is being paid to ensuring that producers can sell their crops. Development processes are combining the tools of poverty reduction strategies applied in 'developing countries' with the mechanisms of pre-accession that have been used in 'transitional countries' (Christoplos, 2007). The goals of post-conflict reconstruction and stabilization are no longer adequate for dealing with the current problems (Huliaras, 2010). Nowadays, most agricultural programmes in BiH are primarily directed toward promotion of commercial production (Christoplos, 2007).

During the period 2009-10 donor agencies and international financial institutions had development activities within the sectors of education; health; good governance and institution building; conflict prevention and resolution, peace and security; infrastructure;

economic development and social protection; local governance; agriculture and forestry; environmental protection without forgetting cross-cutting programmes and projects (MoFT, 2010).

In 2009, total allocations of the DCF (Donor Coordination Forum) members amounted to €727.75 million out of which €195.73 million was in the form of grants. These figures represent an overall decrease of €33.90 million in total ODA (Official Development Assistance) allocations. In comparison with 2008, there was a €23.70 million increase in grants but a €57.60 million decrease in loans. In 2010 total allocations by the DCF members to all ten sectors was €726.93 million, out of which €507.36 million was in the form of loans (MoFT, 2010). The EC, USA/USAID, Sweden/Sida, and the Netherlands provided the largest amount of grant aid in 2009 followed by UNDP, Norway, Germany, Italy/IC and Switzerland/SDC/SECO. The three largest international financial institutions, the EIB, EBRD and the World Bank, as well as bilateral donor, Germany, provided loans in 2009-2010 (MoFT, 2010).

The agricultural, forestry and rural development sector is characterized by the presence of a number of international donors and financial institutions, such as the USA/USAID, Sweden/SIDA, Italy/IC, UK/DFID, Japan/JICA, Spain/AECID, Switzerland/SDC/SECO, Czech Republic/CzDA, the European Commission (EC), the World Bank, European Bank for Reconstruction and Development (EBRD), UNDP, FAO, etc. However from 2009, due to the world economic crisis, the investments of donors in BiH have decreased (MoFT, 2010). Key governmental partners of donors in the agriculture and forestry sector are the Sector for Agriculture, Food, Forestry and Rural Development (SAFFRD) at the Ministry of Foreign Trade and Economic Relations (MoFTER); RS Ministry of Agriculture, Forestry and Water Management; FBiH Ministry of Agriculture, Water Management and Forestry; State Veterinary Office; BiH Food Safety Agency and BiH Plant Health Protection Agency (MoFT, 2010).

The agricultural and forestry sector received 6% of total ODA allocations in 2009 and 2% of total ODA allocations in 2010 (MoFT, 2010). The total allocation to the agriculture and forestry sector by DCF members was €46.61 million in 2009, which includes €32.15 million in loans (including commercial loans from EBRD in the amount of €28.7 million and the World Bank loan tranche of €3.45 million) and €14.46 million in grants. For 2010, donors have contributed €13.10 million including EC Pipeline projects for 2010 in the value of €1.3 million and the World Bank loan tranche of €4.26 million (MoFT, 2010).

The distribution of aid in the agriculture and forestry sector recorded a steady increase from 2007 to 2008 and a significant increase in 2009. However, is should be noted that 2009 figures include commercial loans provided to private enterprises working in this sector (MoFT, 2010).

According to the Donor Coordination Forum in BIH, total allocation to aid in Bosnia in 2011 was about €1.503 billion of which €34.200 million were dedicated to agriculture and forestry sector (2.28%). Data of the DCF-BiH, show a sharp decrease of official development assistance to BiH from 2011. The delayed impact of the economic crisis on financial allocations to cooperation for development is due to the long programming periods adopted by donors. Assistance to agriculture and forestry sector as well as its share in total assistance decreased in a dramatic way from 2010 showing an increased focus of bilateral and multilateral donors on crisis response projects and supporting the financial sector (Tab. 1).

Tab. 1. Share of agriculture and forestry sector in total official development assistance to Bosnia in 2005-2012 period.

Year	2005	2006	2007	2008	2009	2010	2011	2012
Foreign assistance total budget (€)	692,836,667	1,050,366,016	1,564,286,725	1,889,549,159	1,917,426,361	1,981,415,749	1,571,850,127	824,363,623
Agriculture and forestry (AF) sector (€)	47,004,376	53,862,045	74,239,583	59,321,956	126,572,392	64,531,297	39,142,542	34,137,461
Share of AF in total budget (%)	6.78	5.13	4.75	3.14	6.60	3.26	2.49	4.14

Source: Authors' elaboration of data from the Donor Coordination Forum in BiH).

Regarding the agricultural sector, some projects cover the entire country but many specific activities target vulnerable groups such as returnees and socially excluded people in the Srebrenica and north-western regions. Other projects are created with the purpose of revitalising traditional farming methods in agriculture in areas such as the Herzegovina region. The forestry sub-sector is one of the least funded sectors with only a few donors implementing programmes and projects in this area (MoFT, 2010). According to the Donor Coordination Forum in BiH, as of December 2011, the ongoing projects in the sectors of agriculture, food and forestry are listed in table 2.

Table 2. Main projects dealing with agriculture and forestry in 2011 in BiH.

Project Title	Donor	Implementing Agency	Start Date	End Date	Amount (€)
REGA - Rural Employment Generation Activity	USAID	USAID/MKO Partner	19.12. 2008	30.9. 2013	468,195
Capacity Building of Agricultural Business in Drought Adaptation in BiH	USAID	USAID/ Association Centre for Development and Support	23.9. 2010	22.3. 2012	230,876
FARMA - Fostering Agriculture Market Activity	SIDA, USAID	Sida, USAID/Chemonics International Inc.	1.9. 2009	1.9. 2013	8,653,695
Food Safety	SIDA	SWEDAC	1.9. 2008	1.6. 2012	1,503,000
Fostering Entrepreneurship in Rural Areas by Improving Competitiveness and Market Potential Project in BiH	USAID	USAID/Fruit Grower Association-Integralna proizvodnja voca	1.4. 2011	31.3. 2014	1,043,514
Increasing Quality and Market Production of Milk North-East Bosnia and Herzegovina	Czech Republic	CRP Tuzla, PRUNUS Zvornik, Bijeljina cooperative	1.12. 2010	1.12. 2013	712,000
Sectoral analysis for IPARD	EC	EC	23.12. 2010	23.12. 2011	500,000
SUPPLY-Strengthening and harmonisation of BiH agriculture and rural sectors	EC	EC	1.10. 2010	1.4. 2012	130,980
Supply of Satellite Imagery for Agriculture and Rural Sectors in BiH	EC	EC	23.11. 2010	23.3. 2011	126,000
Support to BiH plant health administration	EC	EC	3.11. 2010	12.1. 2013	790,451
Women Empowerment through Organic Farming in Bosnia and Herzegovina	USAID	USAID/ MOZAIK Community Development Foundation	8.9. 2010	9.9. 2013	1,062,525

Donor coordination meetings, as a platform for information exchange between all stakeholders in the agriculture sector, are organised and chaired by MoFTER. The improved, focused collaboration of international assistance has prevented overlapping of activities. Project ideas compiled by MoFTER are presented to the donor community at international donor conferences. Harmonisation with international standards and further strengthening of

state and entity-level capacities are essential for further progress. MoFTER organises regular donor meetings to present the agricultural sector priorities. There is no formal coordination mechanism in the Forestry sector at the state level. Donor agencies emphasise the need for further enhancement of state–level and entity capacities for better aid coordination (MoFT, 2010).

Despite the massive destruction, reconstruction and rehabilitation in general in the country have been rapid. However, it is important to compare the relatively lacklustre recovery in agriculture with the much more dynamic performance in other sectors (Christoplos, 2007). In spite of the efforts made by international organisations, Bosnian rural areas still lag behind in terms of socio-economic development, which puts in question also international aid and support effectiveness. The effectiveness of a donor's assistance in a partner country is affected by the nature of the institutional framework for its relations with the partner government and with other donors, and by its own internal rules and culture. Different objectives and interests between donors and partner governments can impair aid effectiveness (OECD, 2003).

The five core principles on which are founded the Paris Declaration on Aid Effectiveness (2005) and Accra Agenda for Action (2008) (*i.e.* ownership, alignment, harmonisation, results, and mutual accountability) are guiding principles for providing more co-ordinated and effective development assistance as well as specific good practices donors may adopt for developing the overall framework for donor-partner government relations (OECD, 2003). In December 2009, the Council of Ministers of BiH signed the Paris Declaration on Aid Effectiveness, which committed the state to work with donors on the five areas of aid effectiveness. These principles oblige both BiH's institutions and donor community to strengthen their mutual partnership for implementing of aid initiatives in line with the new Country Development Strategy (MoFT, 2010).

For many observers, foreign aid to the Balkans has a mixed record. A 2005 Report by the International Commission on the Balkans, reached a rather damning indictment stating that despite ploughing billions of aid and Europe dispatching to the region, the medium-term returns have been meagre. Other studies that focused more specifically on the economic effectiveness of assistance have also reached dull conclusions, arguing that external aid has had a very weak positive impact on the economic performance of the Balkan countries. However, from another point of view aid to the Balkans can be considered as particularly successful in alleviating poverty, in providing food and shelter to refugees and in establishing a secure environment for resettlement. Moreover foreign aid helped preserving peace (Huliaras, 2010).

In recent years, many analysts have expressed concern that the international community's efforts over the past 15 years to stabilize Bosnia are failing (Woehrel, 2011). In fact, there are still many socio-economic issues which need to be addressed. Youth unemployment in BiH is among the highest in the region. According to the recent State commission's study on Youth Issues, BiH unemployment rate is about 4 times EU average. According to Eurostat data (2011), in 2010 the welfare of BiH citizens was the second-lowest among all EU member states and candidate/potential candidate countries (Pasic, 2011).

Although in aggregate human development terms BiH is progressing well, social exclusion and poverty are pressing problems, with increasing inequalities. 2007 data suggests a poverty rate of 18.6%, with 22.9% at risk of poverty. The National Human Development Report 2007 suggests that over 50% of the population is socially excluded. Registered unemployment reached 43.1% in June 2011. It was particularly high among the young population (57.9% for people aged between 15 and 24) (EC, 2011). In 2004, almost 20% of the population lived below the poverty line, while another 30% were close to the poverty line, reported the IMF in 2005. According to the UNDP's Human Development Report 2011, BiH ranked

74[th]worldwide (UNDP, 2011). Just over half (53%) of the total population of BiH and close to 80% of the poor reside in rural areas (IFAD, 2011).

Another concern, is that BiH is still suffering from high levels of corruption. According to the Corruption Perceptions Index 2011 (Transparency International, 2011), BiH ranked 91 out of 183 countries, lagging behind all its neighbours. In 2006, Germany's Spiegel reported that more than €2 billion have been lost in Bosnia; the destiny of these funds being not known (Pasic, 2011).

Conclusions

For the average citizen of BiH, the billions of Euros of foreign aid have not brought much progress. The average Bosnian has not seen any – or a vey meagre share - of the $1,400 per capita of international assistance given to the country. As Bosnia's international assistance keeps on decreasing, finding a comprehensive development strategy is becoming a higher priority. If the issues of unemployment, socio-economic inequality and corruption are not addressed, Bosnia will continue to lag further behind its neighbours. The hope is that aid will gradually become less significant for the stability and economic development of BiH.

If BiH's agriculture and forestry is to develop in the face of the increased competition, international aid assistance as well as investments are needed to create the institutions required for the government, civil society and the private sector to work together to achieve longterm sustainable development of the sector.

Evidence shows that for increasing aid effectiveness there is a need to have a greater sharing of objectives between donors, and Bosnian State and Entity governments, clearer expectations of each other and more predictable and transparent aid flows. In particular, donors should coordinate in a way that would be transparent and minimise unnecessary transaction costs. Moreover, legal and legislative frameworks at State and entity levels should be harmonised and horizontal and vertical coordination between the competent and involved institutions and organisations should be improved. Improving targeting accuracy in the aid delivery process can yield improved coverage and reduced leakage and can have a sizable impact in terms of poverty reduction and sustainable agricultural and rural development.

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MACROECONOMIC FACTORS OF DEVELOPMENT (AGRO) INDUSTRY REPUBLIC OF SRPSKA

Adriana RADOSAVAC[1*], Radovan PEJANOVIC[2]

[1]Eko Hemija, Brod, Republic of Srpska, Bosnia and Herzegovina
[2]Faculty of Agriculture, University of Novi Sad, Serbia
(Corresponding author: adrianaradosavac@gmail.com)

Abstract

The possibilities Republic of Srpska agricultural development based on natural and human resources (agricultural land for organic food production, forests, electrical energy potential, climatic conditions, employed in agricultural production). Analysis of macroeconomic trends shows that the Republic of Srpska in the period 2005 - 2011 year achieved significant growth in economic activity with high gross domestic product growth (in the area of agriculture, trade, manufacturing industry). The pace of economic growth is dependent on the successful mastery of developmental constraints (insufficient level of investment, low productivity, technological obsolescence and low competition). The functioning and operation of the economy in 2011 was influenced by the negative effects of economic crisis and this trend continued in 2012. In foreign trade in 2011. the export is recorded, a higher rate than imports, and there was an increase of import coverage by exports, which shows a smaller deficit in foreign trade. Countries that participate the most in the export structure of Republic of Srpska are: Italy (16.3%), Serbia (16.1%), Croatia (13.8%), while the structure of imports leads Russia (23.1%), Serbian (17%) countries that belong to the category of other (10%). During the research the authors came to the conclusion that in order to maintain macroeconomic stability and economic growth, economic policy will be aimed at reducing the deficit by slowing the growth of domestic demand for imported goods, and increase the competitiveness of exports, investment promotion and enterprise development and opening of Small and Medium Enterprises.

Keywords:macroeconomic factors, gross domestic product, foreign trade of goods, deficit.

Introduction

Republic of Srpska is economically designed as a region with strong industry and export-oriented economy. Finished goods of heavy indusrty were exported (electrical assemblies, military program), energy sources, raw materials of (metal ores nad non-metallic ores). Textile industry was developed but even though agriculture sector was lagged behind, it was signigicant to overall development. However, agriculture sector is facing with high limited factors on the market with raw materials and finished products(low prices of finished products, limited degree of financing with acceptable prices) witch leeds to the reducing poductivity degree and competitiveness. Republic of Srpska have resources for food manufacturing that are not used enough, so food must be imported to satisfy the needs of the population. Yearly import of agriculture and food products is estemated over 2 bilion KM and export about 400 milion KM.

Analysis and scope of foreign trade of Republic of Srpska

When analysing the trends in trade exchange, it is possbile to see global trends where the most of the ravenue from international trade goes to highly developed countries that have products and srevices that are competetive on world market. Global trade exchange has become a very important factor for worlds gross domestic product, so that today the trade exchange is 1/4 gross domestic product.

The highest growth rate have countries with highest export growth. Economic and technologic globalazation force countries to stimulate creation of international competetive products or companies and create good conditions that will atract international competetive subejcts and industrial branches with purpose to increase economic growth and development.

One of the biggest problem of Republic of Srpska is very high foreign trade deficit, because of the low economy competitiveness on international market, bad protection and stimulation of domestic production, high dependency of export-import, discrepancies in Customs Tariff (customs duties on intermidiate goods and row materials that are not manufacturing in Bosnia and Hercegovina and Republic of Srpska).

Majority of countries in transition like Republic of Srpska have highlighted foreign trade deficit and low level of international competitiveness, hence foreign trade deficit is unavoidable sindrom that doesn't bypasses neither country in transition like Repuiblic of Srpska. Institution in Republic of Srpska have an obligation to cope for better company position on foreign trade exchange and apropiate use of funds and mesures on the BiH level as making institution aprochable for users in Republic of Srpska.

Economy uncompetitiveness complicates macroeconomic stability of Republic of Srpska, which is quite distinct, and high foreign trade deficit negatively impacts on payment balance of Republic of Srpska and like BiH they are facing with numerous custom and non-custom barriers in the countries where they are exporting, so they need help with that. Market of Republic of Srpska and BiH is small and doesn't provide enough space for development of economic subjects. Foreign investment is necessary for economy growth, which will encourage export and direct foreign investments for solving foreing trade deficit and economy development. It is also necesseary to encourage export i the region through free trade agreement CEFTA. Initative has to be started for suspension of custom on raw materials that are not manufacturing in the country, direct influence on export coompanies, help in development and adjusting products to international standards, support for market development, promotion of export offer, stronger support of various of institution (Government of Republic of Srpska) to the export companies.

It is very important to increase exports, becuase that is a prerequisite for macroeconomic stability and economy gorwth. High growth of economy activity in Republic of Srpska in year 2005 has been influence on total growth of foreign trade for 19,8%, which contributed import growth for 11%. In year 2004 total value of the export was 50% bigger than in the year 2003 but it was still on very low level. In the year 2005 value of the export was significantly increased which allows Republic of Srpska to leave the group of countries with smallest export per capita, whose overall participation was 39,5%. Foreign trade growth in the year 2005 was made with successful market restructuring and with products with higher competitiveness for some economic subjects on european market. Negative trend of foreing trade exchange is reduced a little so that the coverage rate of import with export at the end of the year 2005 was increased for 9.6% but it was still at very low level with 39,1%.

Total volume of products exchange of Republic of Srpska in relation to the world, was in the growing trend so that in the year 2007 was about 5 bilion KM, and represent and increase for 14% compared to the last year(3,35 bilion KM is relate to the import products and 1.67% on the export products).
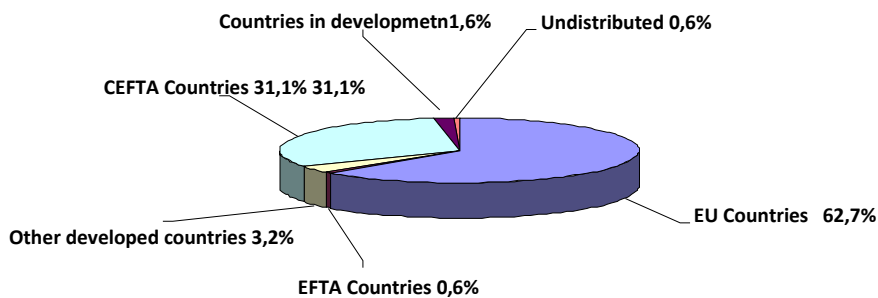
Table 1. Foreign trade exchange RS and BIH (in milion KM)

Year	Export		Import		Balance		Coverage import with export			
	RS	B&H	RS	B&H	RS	B&H	RS	B&H	RS	B&H
2003	611	2428	2278	8365	2888	10793	-1667	-5937	26,80%	29%
2004	843	3013	2703	9423	3546	12436	-1860	-6410	31,20%	32%
2005	1131	3783	2953	11180	4084	14963	-18230	-7397	38,30%	34%
2006	1540	5164	2760	11389	4300	16553	-1220	-6225	55,80%	45%
2007	1672	5937	3348	13899	5020	19836	-1676	-7962	49,90%	43%

Source: Republic institute of Republic of Srpska

Further growth of a foreign trade exchange volume is to be expected due to increased activity of domestic economy subject, increased demand for equipment and half products and increased offer of domestic products.

CEFTA is contributing to the increasing of foreign trade exchange volume, supplementing existing agreement of free trade with some countries from the region. Goals of CEFTA agreement are synchronization for development of the economic relationship between countries with CEFTA agreement, increase productivity, achieving financial stability in relationship with acts of General agreement for tariffs and trade (GATT, 1994) and contract of foundation of World trade organization (WTO).

The structureof exports bygroups of countries

Countries in developmetn1,6% Undistributed 0,6%
CEFTA Countries 31,1% 31,1%
Other developed countries 3,2%
EFTA Countries 0,6%
EU Countries 62,7%

Export was in the constant high growth rate, while in the year 2007 growth was at 8,5% rate. Value of the import was also increasing until the year 2005, in the year 2006 import was reduced, while in the year 2007 was increased for 21.3%. What is noticable is that the foreing trade deficit was growing at most and it was at 37,4%, which was reduced in the year 2006, but again reached a value of 1,6 bilion KM. Volume of foreign trade exchange of Republic of Srpska and foreign countries in the period from 2006-2010 was at avarage growth rate at 9,6%.

Low level of coverage import with export brings to the high foreign trade deficit. Reasons for deficit are low competitiveness of domestic products that are related with quality and price and low proteciton for domestic productions. Macroeconomic flow in Republic of Srpska in a first half of 2011 year, was in a moderate recovery, trend of economy growth in year 2010 was in the first and the seocnd half of the same year. Economy growth was in a various economic activity, due to the increase of foreign demand. In a second half of the year 2011, growth was in the slowing rate, which have negative impact on foreign trade exchange. Unfavorable trend were continued through the year 2012.
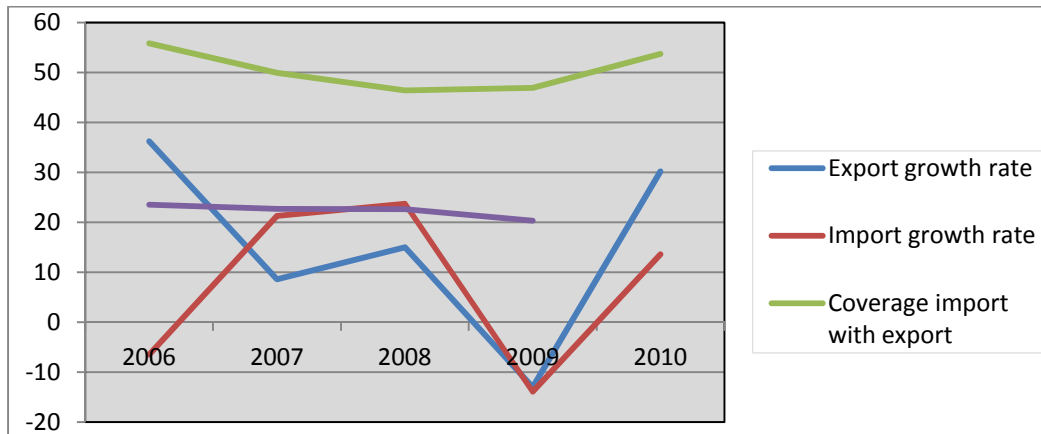
Graph 1. Growt rate of foreing traded exchange of RS

Acording to the statistic data, total volume of products exchange of Republic of Srpska with foreign countries for period from january-may 2012, was 2,72 bilion KM, which means that was higher for 2,5%, then in the same period of the year 2011. Realized export was in the value of 965,856 bilion KM which was lower then in the same period of the year 2011 for 3,5%. Foreign trade deficit is 769,75 milion KM and it is higher for 20% compared to the same period in the year 2011. Coverage import with export is 54,8% compared to the same period of last year which was 60,3%.

Table 2. Foreign trade exchange of RS in the year 2012.

Month	2012. year			
	Export in 000	Import in 000	Balance in 000	Coverage export with import in %
January	158.330	290.628	-132.297	54,5
February	161.327	242.652	-81.325	66,5
March	214.153	474.051	-259.898	45,2
April	204.803	372.405	-167.602	55,0
y	227.243	382.867	-155.624	59,4
Total (I - V)	**965.856**	**1.762.603**	**-796.747**	**54,8**

Source: Republic institute of Republic of Srpska

Export structure should be from the products with appropiate standards that will satisfy the needs of costumers in other countries. Because the size of the market, Republic of Srpska and BiH will be force to take liberal foreign trade policy. Prerequisite for further development would their openness to the world.

The highest value of achived export from Republic of Srpska is in sector of base metals (iron ore and their products, with participation of 20% in total export), wood and wood products, half-products of low degree treatment (alumina, paper confetcion), electric energy and products from metals, leather and footwear. Republic of Srpska competes on the world market with export goods with low treatment level and low added value. In food production Republic of Srpska is on a very high place on the regional market and broader, because of the low competitiveness in this sector. The structure of imported goods is much wider, from energy sources, through high-tech products to the consumer goods and food products, often with quality that doesnt satisfy the standards in regulated market.

Three most imported foreign trade partners of Republic of Srpska are EU, Serbia and Croatia. Serbia is the country that participate the most in total export of Republic of Srpska with 20,4%, then comes Italy with 18,2%, Croatia 13,0%, Germany 8,6%, Slovenia 6,9%, Austria 6,2%.

Serbia is also a conutry that participate the most in import with 22,3% then comes Russia with, 17,8%, Italy 10,3%, Germany 7,0%, Croatia 6,5%, Slovenia 4,7%, China 4,2%, Austria 3,6% and Hungary 2,5%.

Leading partners of Republic of Sprska according to the goods exchange for the year 2010
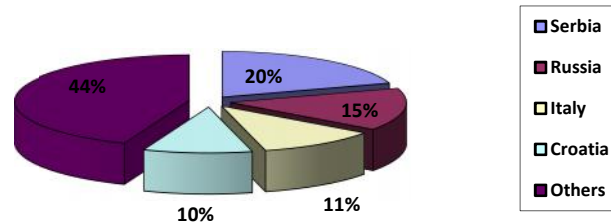
Electric energy participate the most in export structure of industrial products with 12,9%, then processed wood 5,4%, petrol oil 5,1%. White sugar is the highest exported goods for agriculture products with 0,59%, then comes milk and sour cream with 0,44%.

Petrol and oil are the highest participants in import structure with 17%, then drugs 3,7% (sugar, cofee, natural gaas, fruits, vegetables)..

In the year 2010, the highest deficit in goods exchange for agriculture products were: drinks, alcohol and vinegar 13,74%, grains 9,01%, remains of the food industry and litter 6,99%, sugar and sugar products 6,87%, grains based products and milk 6,11%, meat and meat products 4,94%, feed 4,71%.

Conclusion

For sustainable development of Republic of Srpska it must be activated faster and efficient progress of agriculture, improved enviroment menagment, development of infrasctucture, potential energy source, updated infrasturcture and telecommunications. Macro stability is sustainable with stronger export activity, participation in regional and global integration which will lead to the higher income in relation to the public expenditure. Increased competitiveness will be achived with stronger research and development activities with educated work force, support and infrastructure development, strengthening export function. Coverage import with export is increasing every year, which indicates to the lesser deficit in foreign trade exchange Republic of Srpska with the world.

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COMPARATIVE ANALYSIS OF VEGETABLES PRODUCTION IN SERBIA AND REPUBLIC OF SRPSKA

Nebojsa NOVKOVIC[1*], Beba MUTAVDZIC[2], Dragan IVANISEVIC[1], Zarko ILIN[1]

[1]Faculty of Agriculture, University of Novi Sad, Serbia
[2]European University, Belgrade, Serbia
(Corresponding author:nesann@polj.uns.ac.rs)

Abstract

The subject of this research is comparative analysis of changes of production characteristics, the most important sorts of vegetables in Serbia and Republic of Srpska.

Changes and tendency of sowing areas, yields, and total production are analyzed, and compared during 2001-2010. Subject of analyzing were the most important sorts of vegetables, namely: potato, tomato, pea, cabbage & kale, onion, pepper, beans, carrot, cucumber and garlic. The each sort and vegetables in whole are analyzed.

Research of comparative analysis shows that Republic of Srpska, comprising with Serbia has: Higher share in participation of total sowing area (about 11%, compare with 8%); Higher average yields of tomato, peas, pepper, beans, cucumber and garlic. Yields are higher between 4% (cucumber) and 25% (pepper); Higher increasing rates of all analyzed sorts of vegetables; Total year production on the level of between 7.7 % (carrot) and 20 % (potato, beans, cucumber), of total year production in Serbia.

Key words: *vegetables, comparative analysis, Serbia, Republic of Srpska*

Introduction

Vegetables production is very important branch of plant production for the agriculture of Republic of Serbia, and Republic of Srpska. Characteristics of vegetables production are: Relatively short time of production, what give possibilities for two or more sowing in the same year, and much better usage of land; Intensive production - large investment in the irrigation and production technology, and in the same time, getting a high yields;

The subject of research in this paper is the comparative analysis of movement in production characteristics of the most important kind of vegetables in Republic of Serbia and Republic of Srpska. The sowing areas, yields, and total year production of: potato, tomato, pea, cabbage & kale, onion, pepper, beans, carrot, cucumber and garlic, are analyzed. Included period of research is 2001-10 year.

The goal of research was to compare yields, areas and quantity of production and tendency of changing specific kind of vegetables in Serbia and Srpska. On the base of results of comparative analysis it is possible to get conclusion about importance, positive and negative tendencies of specific kind of vegetables and this causes. It is one of the bases of making agrarian policy and strategy in the vegetables production development in both case – Serbia and Republic of Srpska. Mutavdzic et.al. (2011) analyzed production results in vegetables production in Republic of Serbia in the period of 2001-10. Novkovic et. al. (2011) was analyzed changing of sowing areas, yields, and total production of important kind of vegetables in Vojvodina region in the period 2000-09. Novkovic et. al. (2012) gets the similar results about vegetables production tendency in the case of Republic of Srpska.

Method of Research and Data Source

In this paper, the quantitative methods of research are implemented. The quantitative analysis included areas, yields and total year productions of ten important sorts of vegetables in Republic of Serbia and Republic of Srpska in the ten-year period, 2001-10. Data are processed by standard statistic measures: average of value ($\overline{X}$) of characteristics in observed period and change rate (r). For research was used official published data of Reublic Institution of Statistics of Republic of Serbia and Republic of Srpska. After separate analysis fo the each kind of vegetable, the comparative analysis between Srebia and Srepska was done. The index method has been used for the comparation. For comparishment of movement for vegetables characteristics whic had an oposite direction, indx coeficient is not accounting. In that cases the qualitative analisis has been implemented.

Results of Research with Dissccusion

The comparative analysis of production characteristics in vegetables production between Republic of Serbia and Republic of Srpska has been implemented for the each kind of vegetables. In Table 1 are presented results of comparative analysis in potato production. Sowing area under the potato was in average five times bigger in Serbia than in Republic of Srpska. Decreasing rate of sowing area was for 40 % higher in Srpska, than in Serbia.

The yield of potato was the same in the both Republics, but in Republic of Srpska it has five times more increasing rate than in Serbia. Results of movements of sowing areas and yields were that total production of potato in Serbia had high tendency of decreasing, while in Srpska it showed tendency of slow increasing. In the same proportion of sowing area was and total production of potato.

Table 1. Potato indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	84,880	16,639	19.6	-2.19	-3.07	140
Yield (t/ha)	10.5	10.5	100.0	0.72	3.81	529
Production (t)	885,933	173,113	19.5	-1.48	0.64	-

In Table 2 are showed results of comparative analysis in tomato production. Sowing area under tomato was almost ten times more in Serbia than in Srpska. In the both case sowing areas had negative tendencies in observed period 2001-10. Negative tendency is four times much higher in Republic of Srpska. Average yield of tomato was higher for the 13 index point in Republic of Srpska, than in Serbia. Also, opposite of sowing area average yield has more than four times higher increase rate than tomato yield in Serbia. Total year production of tomato in Serbia was les than 35 thousand ton. In Republic of Srpska it was 3 thousand ton. Result of positive tendencies of sowing area and yield was much more positive tendency on total production of tomato in Republic of Srpska.

In Table 3 are presented results of comparative analysis in pea production. Sowing area under the pea was much more in Republic of Serbia than in Republic of Srpska. In Srpska sowing area was les than 8 % sowing area of pea in Serbia. Low tendencies were present in the both case. The difference was that in Serbia was present low decreasing rate while in Srpska was present low increasing rate. Average yield of pea in observing twenty years period was higher in Republic of Srpska for the 12 % and showed twice more tendency

of increasing than the same in Serbia. The result of tendencies in sowing are and yield, total year production of pea showed two and half higher increase rate in Republic of Srpska.

Table 2. Tomato indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	20,647	2,047	9.9	-0.36	-1.47	408
Yield (t/ha)	8.7	9.8	113.0	1.24	5.28	426
Production (t)	178,823	20,029	11.2	0.87	3.82	439

Table 3. Pea indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	13,197	1,016	7.7	-0.08	0.62	-
Yield (t/ha)	2.6	2.9	112.0	2.46	5.03	204
Production (t)	34,628	3,024	8.7	2.37	6.10	257

Table 4 shows comparative relations and movements of indicators in production of cabbage & kale in Serbia and Srpska in the period of 2001/10. Average sowing area of cabbage & kale in Republic of Srpska was about 12 % of average sowing area of cabbage & kale in Republic of Serbia. In the both case the negative changing rate are presents. Decreasing rate of sowing area of cabbage & kale is three times more intensive in Srpska. Average yield of cabbage & kale was higher in Serbia for almost 15 %. While, in Serbia was present tendency of slow increasing of yield, in Srpska yield of cabbage & kale showed hard tendency of increasing. Total year production of cabbage & kale in average in Republic of Srpska was on the level of 10 % from the same in Serbia. Because negative rate of changing sowing area and yield in Serbia, rate change of total production of cabbage & kale cabbage & kale was also negative. In the Republic of Srpska increase rate of yield was much higher than decreasing rate of sowing area, so total production of cabbage & kale showed high increasing rate. The results of comparative analysis in production of onion are presented in the Table 5.

Table 4. Cabbage & kale indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	21,439	2,587	12.1	-0.74	-2.25	304
Yield (t/ha)	14.1	12.3	87,0	-0.62	6.85	-
Production (t)	311,643	31,708	10.2	-0.17	4.50	-

Area under the onion in Srpska was 10 % of areas under the onion in Serbia, in average. In the both Republics were present slow decreasing rate. In Serbia it was much intensive. The same as in the case of cabbage & kale average yield of onion in Serbia was higher for 15 %. Both yields, in the Serbia, and in the Srpska showed tendency of increasing. The increasing rate in Srpska is almost twice higher than in Serbia.The total year production of onion, in average in Srpska was les than 9 % from that one in Serbia. While in Serbia was present rate of slow increasing, in Republic of Srpska it is much more intensive. Change rate of total production of onion in Srpska is almost eight times higher than in Serbia.

Table 5. Onion indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	19,583	1,968	10.1	-1.67	-0.15	9
Yield (t/ha)	6.7	5.8	87.0	2.27	4.41	194
Production (t)	130,560	11,447	8.8	0.56	4.44	793

In the Table 6 are presented the results of comparative analysis in pepper production in the Republic of Serbia and Republic of Srpska. Average sowing area of pepper in Republic of Srpska was more than 12 % of sowing land of onion in Serbia. In the both case there were present almost the same rates of slow decreasing of areas under the onion. Average yield of pepper in Republic of Srpska was higher for 25 %, than in Republic of Serbia. This is the most higher different in yield fro the all vegetables kind for Srpska. It is positive that in both cases the increasing rate of yield is showed. In Srpska increasing rate is thee and half times higher than in Serbia. The total year production of pepper in Srpska in average was on the level of 15 % from production of pepper in Serbia. Even decreasing the sowing areas of pepper in both cases it were present tendency of increasing the total production. The change rate was four times higher in Srpska than one in Serbia.

Table 6. Pepper indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	19,234	2,334	12.1	-0.55	-0.52	95
Yield (t/ha)	7.9	9.9	125.0	2.32	7.90	341
Production (t)	151,946	23,222	15.3	1.76	7.41	421

In Table 7 is given data about production of bean in Serbia and Srpska. The sowing area under the bean in Republic of Srpska was almost one fifth from that one in Republic of Serbia. With potato and cucumber, bean showed the highest percent of sowing area (When compare sowing area of some vegetable in Srpska and Serbia). Tendencies of changing the sowing areas under the bean were in the both case negative. In Serbia, the negative tendency was higher for 36 index point than in Srpska. Average yield of bean of 1.4 tons per hectare in Republic of Srpska was higher for 17 % or for two hundred kilo then that one in Serbia. While in Serbia was present insignificant tendency of increasing the yield of bean, in Republic of Srpska was present intensive tendency of growth for average rate of increase of 5 % per year. Total production of bean in Republic of Srpska was more than 20 % that bean production in Serbia, in average. In a both case were presents positive tendencies of changing. Little more higher rate of increase was in Serbia.

Results of comparative analysis are presented in Table 8. Sowing area of carrot in Republic of Srpska was 11 % from sowing area of carrot in Serbia. While in Serbia area under the carrot showed tendency of slow increase, in Srpska area under the carrot showed tendency of medium decrease. Average yield of carrot was more than 40 % higher in Serbia than in Republic of Srpska, and that is the biggest difference in yield of some vegetable. The yields in a both cases showed almost the same positive rate of increase. Total production of carrot in Srpska was les than 8 % of the same in Serbia. Positive change rates were present in a both cases, but in Serbia it was higher.

Table 7. Bean indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	22,970	4,389	19.1	-2.29	-1.68	73
Yield (t/ha)	1.2	1.4	117.0	-0.40	5.03	-
Production (t)	28,600	5,857	20.5	3.79	2.95	78

Table 8. Carrot indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	7,716	852	11.0	0.79	-1.93	-
Yield (t/ha)	8.5	6.0	70.0	4.48	4.61	103
Production (t)	66,030	5,096	7.7	5.30	2.52	47

In the Table 9 are showed results of comparative analysis in cucumber productions. The average area under the cucumber in Republic of Srpska was almost 19 % from the average sowing area of cucumber in Serbia. In a both case the positive change rates were present, but that one in Republic of Srpska is much higher. The yield of cucumber in Republic of Srpska was insignificant higher (4 %) than that in Serbia. In a both case the positive change rate of yield were present. In Srpska, change rate was 8.3 % per year, what was 4.6 times higher than in Serbia. Total year production of cucumber is Srpska was les than 20 % than production of cucumber in Serbia. The same as in the case of yield, in total production of cucumber the positive tendencies were present. The increasing rate of production in Srpska was five times higher.

Table 9. Cucumber indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	8,760	1,629	18.6	0.32	1.54	481
Yield (t/ha)	7.1	7.4	104.0	1.80	8.30	461
Production (t)	62,259	12,120	19.5	2.13	10.03	471

The results of comparative analysis of garlic production are presented in Table 10. Areas under the garlic in Srpska was about 11 % of sowing are of garlic in Serbia. In the case of Srpska and in the case of Serbia there were present the negative change rate of sowing areas movement. The negative tendencies was twice more intensive in Serbia. The average yield of garlic of 3.3 tons per hectare was for 18 % or five hundred kilo per hectare higher in Republic of Srpska than in Republic of Serbia. Yield had an opposite tendency in observed period. In Serbia yield had a very slow tendency of increasing, while in Srpska yield of garlic had tendency of grow. The average year production of garlic in Republic of Srpska was les than one thousand tons. It was on the level of 13 % of average year production of garlic in Republic of Serbia. Also, total production of garlic had opposite tendency of movement in Serbia and Srpska. In Serbia was significant tendency of decreasing the total production of garlic, by negative rate of changing of -2.6 % per year, in average. In Srpska production of garlic showed positive change rate of 1.25 % per year in average.

Table 10. Garlic indicators in Serbia & Republic of Srpska (2001-10)

Indicator	Average $\overline{X}$		Index Serbia =100%	Change rate r (%)		Index Serbia =100%
	Serbia	Republic of Srpska		Serbia	Republic of Srpska	
Area (ha)	8,795	980	11.1	-2.35	-1.34	57
Yield (t/ha)	2.8	3.3	118.0	-0.22	2.59	-
Production (t)	24,902	3,239	13.0	-2.57	1.25	149

Conclusion

The results of comparative analysis of production of ten the most important kind of vegetables in Republic of Serbia and Republic of Srpska in the period 2001-10 showed next:

- It is higher participation of vegetables in total sowing lend in Srpska (11%), than in Serbia (8 %); Sowing areas of some kind of vegetables in Srpska were in the interval between 7.7 % (pea) and almost 20 % (potato, bean), from areas of the same kind of vegetables in Serbia; In the Republic of Srpska higher decreasing rate of sowing area have: potato, tomato and cabbage & kale. Lower decreasing rate have: onion, pepper, bean and garlic. Higher increasing rate of sowing area has cucumber, while other kinds of vegetables (pea and carrot) have the opposite tendency;
- The average yields of tomato, pea, pepper, bean, cucumber and garlic are higher in Republic of Srpska. The difference in yield is interval of 4 % (pepper) to 25 % (pepper). Republic of Serbia have higher yields of cabbage & kale, onion, and carrot, while the yield of potato is the same in both countries. The highest difference in yield has carrot (40 %); In the Republic of Srpska are higher increasing rate of yields of the all observed kind of vegetables. In the case of Serbia, some kind of vegetables even have a negative changing rates (cabbage & kale, bean and garlic);
- The level of total year production of vegetables in Republic of Srpska is in interval between 7,7% (carrot) and 20% (potato, bean and cucumber) from the same in Serbia; The all observed kinds of vegetables have higher increasing rates of total production in Republic of Srpska. Some kinds of vegetables (potato, cabbage & kale and garlic) have even negative change rates of total production in Serbia.

Acknowledgement

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TENDENCY OF VEGETABLES DEVELOPMENT IN REPUBLIC OF SRPSKA

Nebojsa NOVKOVIC[1*], Beba MUTAVDZIC[2], Ljiljana DRINIC[3], Aleksandar STOJIC[3],Gordana ROKVIC[3]

1Faculty of Agriculture, University of Novi Sad, Serbia
2European University, Beograd, Serbia
3Faculty of Agriculture, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author:nesann@polj.uns.ac.rs)

Abstract

Vegetables production is one of the most intensive branches of plant production. It generates high yields and therefore economics effects per unit of land. According to importance of vegetable production (in economics sense) for producers and for agriculture in all, the basic direction in a future development of this branch, are optimal using of disposal capacity, increasing production and changing the structure of production.

The subject of this research paper is a volatility analysis of production characteristics of the most important vegetable varieties, cultivated in the Republic of Srpska. That means analyzing of changes and tendency of sowing areas, yields, and total production of: potato, tomato, pea, cabbage & kale, onion, pepper, beans, carrot, cucumber and garlic.

Analyzed period is 2001-10. Methods of descriptive statistics are applied in analyzing vegetables characteristics. That means basic statistical indicators, as: average value, extreme value (minimum & maximum), coefficient of variation, and change rate.

Research shows, that absolute area (in hectares) under the vegetables is decreasing, while, relatively, it is the same, about 11% of total sowing land in Republic of Srpska. Yields are showing tendency of increasing, and total production of all analyzed important sorts of vegetables are increasing, too.

Results of quantitative analysis makes base for the qualitative analysis of production and development of vegetables in Republic of Srpska. Both of them, are useful for creating of agrarian policy for development of production, consumption, processing, and export of different sorts of vegetables.

Key words: vegetables, production, quantitative analysis, *Republic of Srpska*

Introduction

Vegetables production is one of the most intensive branches of plant production, what proves high yields and high economic results. Taking in account importance of that branch of agriculture, in economic sense, for agricultural producers, and for agriculture in whole, basic directions for the future development are optimal usage of production capacity, increasing volume of production, and changes of production structure.

Subject of this research is analysis of changes of production characteristics of important varajaty of vegetables in Republic of Srpska, and that is: tendency of sowing areas, yields, and total production. Analisis include: potato, tomato, pea, cabbage & kale, onion, pepper, beans, carrot, cucumber and garlic. Included period of research is the first decade of XXI Century, years 2001-10. Research in this paper has objective to improve importance of vegetables production, as for coventional development of agriculture, as for for organic and sustainable and multy functional rural development.

Novkovic et. al. (2008) analysed vegatables production in Srebia and Vojvodina region, in the period: 1981-2007. Results are that vegetables production area in Serbia is 300.000 hectares in average. From that area, about 80.000 hectares is in Vojvodina region. Vegetables production in Vojvodina region is about 5% in the production structure of plough land, what is fare from Serbia, where is that share 8, 5%. Area under vegetables is very stable. Tendency of low increasing is present in Serbia, and low decreasing is present in Vojvodina.

Mutavdzic et.al. (2010), using regression models observe influence of yield and total production of some important sorts of vegetables in actual year,on sowing area in the next year. In general, in vegetables production, yield and total production don't have influence on sowing are in next year, as it is case of crops and industrial plants. The most, relatively important influence of yield, on sowing area in next year show melon & water melon, than paper, tomato and pea.

Mutavdzic et.al. (2011) analyzed natural results in vegetables production in Serbia in period 2001-10 year. Results of analysis are compared with adequate for the period from previous decade, 1992-2000. For last ten years, vegetables production in Serbia increase in all observed sorts of vegetables. Growth was from 2% in the case of onion, though 26% of paper, to 56% in the case of pea.

Method of Research and Data Source

In this paper, the quantitative methods of research are implemented. The quantitative analysis included areas, yields and total year productions of ten important sorts of vegetables in Republic of Srpska in the ten-year period, 2001-10.

Data are processed by standard statistic measures: average of value ($\overline{X}$), minimal (min), and maximal value of characteristics in observed period (max), coefficient of variation (Cv), and change rate (r).

For research was used official published data of Reublic Institution of Statistics of Republic of Srpska.

Results of Research with Dissccusion

Analysis of Vegetables Area

In Table 1 was given the basic data about areas of important sort of vegetables in Republic of Srpska, in the period 2001-10 year. Potato is (with about 17 thousand hectares) the most represent vegetables sort in Republic of Srpska. Fore times more than second sort of vegetables, bean. In observed period, areas under the potato had fail in average year rate of minus 3 %, and they move in interval from 14.5 to 19 thousand hectares.

Area under the tomato was 2 thousand hectares, in average. The area is very stable; the coefficient of variation was only 4%, what was a minimal, after onion and pepper. Sowing area under the tomato was in interval of 1.8 to 2.1 thousand hectares. Tomato area shows low decrease rate of -1.47 % per year, in observed period.

In Republic of Srpska, the pea was sowed in last ten years on one thousand hectare, in average. Pea was only vegetables sort (with cucumber) which shows a tendency of increasing, in observed period. The rate of increasing of sowing area under the pea was symbolic 0.62 %, per year. Pea was produced on area from 900 to 1,100 hectares, with highly expressed variability, what show high coefficient of variation, more than 10%.

Table 1 Indicators of analyzed vegetables area in Republic of Srpska (2001-10)

Vegetables	Average $\overline{X}$ (h)	Interval of variation		Coefficient of variation Cv (%)	Change rate r (%)
		Minimum	Maximum		
Potato	16.639	14,539	19,247	8.15	-3.07
Tomato	2.047	1,872	2,138	4.00	-1.47
Pea	1.016	876	1,147	10.24	0.62
Cabbage & kale	2.587	2,297	2,818	6.08	-2.25
Onion	1.968	1,852	2,086	4.00	-0,15
Pepper	2.334	2,170	2,464	4.00	-0.52
Bean	4.389	4,006	4,668	4.92	-1.68
Carrot	852	710	988	8.64	-1.93
Cucumber	1.629	1,393	1,811	8.96	1.54
Garlic	980	862	1,045	5.57	-1.34

Cabbage & kale were produced on 2.6 thousand hectares, in average. Area was relatively stable (coefficient of variation 6 %), and it was moving in interval of 2.3 to 2.8 thousand hectares. In observed period, cabbage & kale have highly expressed rate of decreasing. Onion posses about 1.9 thousand hectares, in average. It changes from year to year, in the interval of 1.8 to 2.1 thousand hectares in observed period.

Area under pepper was 2.3 thousand hectares. It was moving in interval of 2.1 to 2.5 thousand hectares. The area was stable (low coefficient of variation 4 %). Tendency of low decreasing of sowing area under the pepper was also present.

Bean was, after potato, the most sowed sort of vegetables in Republic of Srpska. It was cultivated on 4.4 thousand hectares, in average. Area under the bean was changing in the interval of 4 to 4.7 thousand hectares, depending of year, and possessed relatively low coefficient of variation, 4.92 %. Bean had high rate of decreasing of hectares.

Carrot was produced on les than one thousand hectare (852 ha), and it is the minimum of the all observed kind of vegetables. Area under the carrot shows high variability (Cv = 8.6), and tendency of decreasing in 1.93 % per year.

Cucumber possessed 1.6 thousand hectare, in average. Cucumber, also, shows unstable sowing area. The coefficient of variation was 9 %. The tendency of increasing was present, too. Increase rate was 1.54 %, per year.

Garlic was produced on 980 hectares, in average. It was changing in interval from 860, to 1,050 hectares per year, in observed period. Area under the garlic showed tendency of increasing. Decreasing rate was -1.35 %, per year.

Analyzed sorts of vegetables are possessed more than 92.4 % of total area under the vegetables in Republic of Srpska. The most present were: potato with 44.6%, bean with 11.8 %, cabbage & kale with 6.9 %, and pepper, with 6.3 %. In last ten years (2001-10) area under the vegetables in Republic of Srpska was decreased from 40,867 hectares in 2001, on 33,935 hectares in 2010. Decreasing was constant, from year to year. Total deceasing of vegetables area was 6,932 hectares, or 17 %.

It is interesting, that rate of vegetables in total sowed area in Republic of Spike was not practically changed. It was insignificantly increasing from 10.7 % on 10.8 %. The reason for this is that total sowing area in Republic of Srpska is decrease for 69 thousand hectares, or more than 18 %, in period 2001-10.

Analysis of Vegetables Yield

Statistical data about yields of observed vegetable plants are presented at Table 2. Average Yield of potato in the period 2001-10 was 10.5 t/ha, and it was changing between 7.3 t/ha, and 12.3 t/ha. Yield of potato had medium variability, with coefficient of variation of 16.1 %. In the first decade of XXI century poatato yield shows increasing, by average rate of 3.8 % per year.

Tomato had average yield of 9.8 t/ha. Tomato yield had very wide interval of variation, from 5.6   13.6 t/ha, what shows extremely high coefficient of variation, 24.6%. Even high variability, tendency of increasing of yield was present.

Table 2 Indicators of analyzed vegetables yield in Republic of Srpska (2001-10)

Vegetables	Average $\overline{X}$ (t/h)	Interval of variation		Coefficient of variation Cv (%)	Change rate r (%)
		Minimum	Maximum		
Potato	10.5	7.3	12.3	16.15	3.81
Tomato	9.8	5.6	13.6	24.57	5.28
Pea	2.9	1.8	4.3	22.87	5.03
Cabbage & kale	12.3	7.6	16.0	18.83	6.85
Onion	5.8	4.0	7.7	20.39	4.41
Pepper	9.9	5.8	12.2	21.07	7.90
Bean	1.4	0.9	1.7	21.28	5.03
Carrot	6.0	4.0	7.7	19.70	4.61
Cucumber	7.4	4.1	9.1	21.59	8.30
Garlic	3.3	2.5	3.9	13.68	2.59

Pea, with average yield of 2.9 tons per hectare had significant variability (v = 22.9 %). Yield of pea was changing in the interval between 1.8 and 4.3 tons per hectare. In the observed period, yield of pea shows growth by average year rate of 5 %.

Average yield of cabbage & kale was 12.3 tons per hectare, and also shows high variability of 18.8 %. Cabbage & kale have tendency of increasing of yield, by average increase rate of 6.85 % per year.

Onion had average yield of 5.8 tons per hectare. It had also a high variability. The coefficient of variation was 20.4 %. Yield of onion was moving in the interval of 4 and 7.7 tons per hectare.

Average yield of pepper was 9.9 t/ha. It had variation in interval of 5.8 and 12.2 tons per hectare. Yield of pepper shows tendency of increasing in observed period, by average rate of 7.9 % per year.

Average yield of bean in Republic of Srpska in observed ten-year period was 1.4 tons per hectare. It was moving in the interval of variation of 0.9 to 1.7 t/ha, and it shows the same rate of increasing as pea, 5 % per year.

Carrot had average yield of 6 tons per hectare. The yield was in the interval of 4 to 7.7 t/ha. Increase rate of yield of carrot was 4.6% per year in observed period.

Yield of cucumber was 7.4 tons per hectare in average. It shows the biggest rate of increase, comparing with all observed sorts of vegetables. The average rate of increase of yield of cucumber was 8.3 % per year.

Average yield of garlic was 3.3 t/ha. The variation of yield was in the interval of 2.5 to 3.9 tons per hectare. Garlic has tendency of increasing the yield, by average rate of 2.6 % per year. It is the minimal increase rate, comparing with all observed kind of vegetables.

The all vegetables plant, in observed decade (2001-10) had positive rate of grow. The highest grow rate had cucumber (8.3%), pepper (7.9) and the all cabbage & kale, while, garlic had the lowest grow.

Analysis of Total Vegetables production

Total vegetables production is result of sowing (harvesting) area and yield. Quantity of each vegetable kind depends of participation in sowing structure, and level of intensity of production. Table 3 presents changing of total production of important kind of vegetables in Republic of Srpska, in the period 2001-10.

Table 3 Indicators of vegetables production in Republic of Srpska (2001-10)

Vegetables	Average $\overline{X}$ (t)	Interval of variation		Coefficient of variation Cv (%)	Change rate r (%)
		Minimum	Maximum		
Potato	173,113	122,933	208,447	14.40	0.64
Tomato	20,029	12,012	26,620	24.32	3.82
Pea	3,024	1,536	4,836	30.36	6.10
Cabbage & kale	31,708	21,401	40,551	16.70	4.50
Onion	11,447	7,523	15,552	20.86	4.44
Pepper	23,222	13,071	28,806	21.27	7.41
Bean	5,857	4,026	7,755	20.93	2.95
Carrot	5,096	3,421	7,188	23.22	2.52
Cucumber	12,120	5,684	16,406	25.09	10.03
Garlic	3,239	2,443	3,919	15.78	1.25

Average year production of potato in Republic of Srpska in the last ten years was about 173 thousand ton. Year production was relatively stable, and shows the minimal coefficient of variation among the all observed kind of vegetables (Cv = 14.4 %), and tendency of insignificant increasing (0.64 %).

Total year production of tomato was about 20 thousand ton, in average. It shows tendency of low increasing, by the rate of 3.8 % per year. Year production of tomato was in interval of 12 and 26 thousand ton.

Extremely increasing of production of pea was present in observed period. Average rate of increasing of total production was more than 6 % per year. Average year production of pea was 3 thousand ton, and it was changing in the interval between 1.5 and 4.8 thousand ton, depends of year.

Average production of cabbage & kale in the observed period was 32 thousand ton per year. Production shows tendency of increasing, by change rate of 4.5 % per year.

Total year production of onion was in interval of 7.5 to 15.5 thousand ton. In average it was 11 thousand ton per year. Onion shows the similar tendency as cabbage & kale.

Year production of pepper in Republic of Srpska in the period 2001-10 was between 13 and 29 thousand ton. In average it was 23 thousand ton per year. Pepper also shows tendency of high grow, by change rate of 7.4 & per year. Bean was produced in quantity between 4 and 7.8 thousand ton per year. Average year production of bean was 5.8 thousand ton. Bean shows lower increase rate of nearly 3 % per year.

Carrot was produced in quantity of 5 thousand ton per year, in average. Variation of production was in interval of 3 and 7 thousand ton. Similar as bean, carrot shows lower rate of increasing of production (under the 3 %).

Production of cucumber in Republic of Srpska was changing in the interval of 5 to 16 thousand ton per year, during observed period. In average it was 12 thousand ton. Cucumber shows the highest increasing rate, more than 10 % per year.

Garlic year production was more than 3 thousand ton in average. It was changing between 2.5 and 4 thousand ton. Year production of garlic shows tendency of low grows, by rate of 1.25% per year.

Conclusion

The characteristic of vegetables production in Republic of Srpska, in the period 2001-10 in generally was:

- It is present process of decreasing of sowing area in the greater part of vegetables. Yearly rates of decrease were: potato - 3, cabbage & kale - 2.2, carrot – 1.9, bean -1.7, tomato – 1.4 and garlic – 1.3 percent. Positive moving shows only pea (0.6 %) and cucumber (1.5 %).
- Average yields of the all observed kinds of vegetables were increased. The yearly increasing rate was: cucumber 8.3, pepper 7.9, cabbage & kale 6.8, tomato 5.3, pea 5, bean 5, carrot 4.6, onion 4.4, potato 3.8 and garlic 2.6 percent.
- Increasing of yields were more intensive than decreasing the sowing area, what results by increasing of total year production to all observed kind of vegetables in Republic of Srpska. Year rate of increasing of total vegetables production were: cucumber 10, pepper 7.4, pea 6.1, cabbage & kale 4.5, onion 4.4, tomato 3.8, bean 2.9, carrot 2.5, garlic 1.2 and potato 0.6 percent.
- Tendency in vegetables production are: 1. Increasing of intensity of production; 2.Absolutely, but not relatively increasing of sowing area; 3. Increasing of total production of vegetables.

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IMPACT OF THE EUROPEN UNION REGULATION ON THE SUGAR SECTOR IN POLAND

Agnieszka JUDZIŃSKA[*]

[1]Food Industry Economics Department, The Institute of Agricultural and Food Economics - National Research Institute, Warsaw, Poland
(Corresponding author: judzinska@ierigz.waw.pl)

Abstract

The main objective of the paper was an assessemen of the influence of the EU sugar market reform on the condition of Polish sugar sector. The research were based on statistical data concerning sugar market in respect of output, trade and financial performance. The the legal framework concerning the sugar sector regulations were also considered in the analysis.

Period from 2006 to 2010 is a time of implementation of sugar reform in the EU. Its main target was to cut production of sugar and market opening for world's poorest countries. In the article there has been presented consequences of new regulations for Polish sugar beets planters, sugar idustry, as well as exporters and importers of this product. Poland as third sugar producer in the EU (in connection with implementation of the reform) has incured high social / public and financial costs. It is particularly noticeable in smaller field's surfaces, decreasing of profitability for farmers and closures of many sugar factories. Sugar producers cannot meet the demand fully as a result of restricting the production limitto the Shortages are filled in with import, what is bad for Polish trade balance.

The CAP reform had both a negative and a positive impact on Polish sugar sector. The positive impact was observed through modernisation and concentration of the sector and improved efficiency while the negative outcomes concerned market regulations, in particular insufficien t production quota, which caused a reduction in the capacity of the sector and a deterioration of competitiveness on foreign markets.

Keywords: *sugar, suger market, CAP reform, market regulation*

Introduction

Polish accession to the European Union coincided with the reform of the existing EU regulations in the sugar market. Transformation of the common agricultural policy had a decisive influence on the economic and financial condition of the sector, what is more it significantly changed the market conditions. The need for reform, implemented by the European Commission in 2006, resulted from a number of causes: the willingness to improve the competitiveness of the sector, efforts to stabilise the market and the need to ensure favourable conditions for operation to all participants. The introduction of the reform was also influenced by unfavourable approach of the World Trade Organisation (WTO), which contested the compatibility of the EU's system of export subsidies in sugar industry with the rules of international trade[56].

The main changes in market regulations concerned the reduction of production limit, reduction of the minimum sugar beet price and the reference price of sugar, reducing sugar

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[56] Subsidised export caused lowering of global sugar prices, which in turn negatively affected the situation of developing countries.

export without subsidies and the introduction of direct payments to growers and financial assistance aimed at the restructuring of the sugar industry. As a result, there have been significant changes in the yield of sugar beet cultivation, production and financial situation of the sugar industry and its effectiveness, as well as in the trade balance.

Materials and methods

The study made use of the literature on the subject, the secondary data of the Institute of Agricultural and Food Economics, data of the Central Statistical Office and the data of the Association of Sugar Producers in Poland. Statistical data used for the analysis cover the 2003-2011 period and concern the sugar industry in the scope of production, financial and commercial results and taking into account market framework conditions. The collected data were analysed with the use of the descriptive method and time series analysis. The results are presented in tabular form and depicted by graphs.

Results and discussion

Supply and profitability of growing sugar beet cultivation
Immediately prior to accession to the European Union, Polish growers received an average of Polish Zloty (PLN) 124.40 for a ton of sugar beet. In the first two years after the integration the sugar beet prices increased significantly to PLN 187/ton in 2004 and PLN 175.30/ton in 2005, i.e. respectively by 51% and 41%. In the subsequent years, according to the new regulations of the CAP, the beet procurement prices in Poland declined steadily to PLN 104/ton in 2008. Compensation in the form of the so-called sugar payments covered only 60% of losses (decrease in purchase price) associated with the reduction in prices of sugar beet in 2006 and 2007, and about 64% in subsequent marketing years.
Reduction in prices led to a decline in the profitability of sugar beet production. In 2004-2007, the rate of profitability of sugar beet production was approximately 40%, thus it was nearly 13 percentage points lower than in 2003. In 2008, due to a significant reduction in crop the profitability of growing sugar beet fell below 13%. The depreciation of the zloty against the euro and the economic recovery in the global market meant that in 2009-2011 the average price of sugar beet in purchase rose to PLN 123/t. However, it was still lower than the prices quoted immediately after accession.

Table 1. Sugar beet production in Poland.

Specification	2003	2005	2008	2011
Cultivated area (thousand ha)	286	262	187	190
Yield (q/ha)	410	416	465	611
Number of growers (thousands)	85	71	41	36
Beet harvest (thousands of tons)	11,739	11,912	8,715	11,605

Source: Authors' own compilation based on the data of the entral Statistical Office, ,Internatioanl Confederation of European Beet Growers and Institute of Agricultural and Food Economics.

The decline in profitability and the progressive concentration of the sugar industry made the Polish growers less and less interested in growing sugar beet. This resulted in a systematic reduction in the number of growers, which in 2011 amounted to 36 thousand and was less than half compared to the average in 2003-2004. Resignation from the production of sugar beet was reflected in the reduction of crop acreage. In addition, the decline in the sown area was affected by the progressive reduction of sugar production quotas. In 2003, sugar beets were grown on nearly 300 thousand ha, while until 2011 the area of cultivation decreased by

more than 1/3 to 190 thousand ha. At the same time, the average plantation area increased from 3.85 ha in 2003-2004 to 5.30 ha in 2011, i.e. by more than 37%.

The decline in sugar beet cultivation area was accompanied by a significant increase in performance. The yield level increased from 428 q/ha in 2004 to 611 q/ha in 2011 (Table 1.). Such a large increase in yield was due to favourable weather conditions and the ongoing restructuring of plantation areas. At present, sugar beets are grown by relatively large farms in the regions with the best soils. The quality of raw material measured by sugar content also improved (from 12% in 2004 to 16.2% in 2011), which had a positive impact on the technical and economic viability of sugar production [Chudoba, 2004].rices competitiveness

The increase in the price competitiveness of the sector was one of the main objectives of the reform of the sugar market regulation. The intervention price for white sugar, amounting to EUR 631.9/ton, was replaced by a reference price, whose value from 2009/10 season amounts to EUR 404.4/ton, thus it is lower by 36%. Since 2004, the selling prices of sugar in Poland are characterised by high volatility. In the period before the reform, i.e. until 2006, there was a sharp increase in prices (on average 11% per year), and after that their levels decreased slightly.

The systematic reduction in supply and an increase in raw material prices on the world market meant that the price of the EU sugar instead of the announced decline showed a strong upward trend. Since mid-2010 there was another rise in prices noted in Poland. The increased demand for sugar from the consumers (purchase of sugar stocks) and an increase in export demand for food (including that containing sugar) constituted additional factors stimulating the growth of prices. In 2011, the average selling price in the domestic market was PLN 2.96/kg, which was by 37% higher than last year. The retail prices also showed high growth rate. Their average level increased by nearly half from PLN 2.75 to 4.07/kg [The sugar market, 2011]. Thus, it was nearly 50% higher than the level recorded noted immediately after accession.

Changes in foreign trade

Poland for many years was a net exporter of sugar. Since the introduction of the market system to the economy the negative balance was experienced only in 1995 which was due to unfavourable weather conditions and the excess of demand over supply. Both before accession, and in the first years of membership, the domestic demand for sugar remained relatively stable at around 1,600-1,630 thousand tons. Sugar production amounting to an average of 1,900 thousand tons was higher than consumption, and the surplus was intended for export. In 2003-2006 Polish foreign trade in sugar was characterised by a high positive balance. During this period, the average level of exports was 566 thousand tons, the import, which is only a supplement of the supply did not exceed 75 thousand tons, and a positive balance ranged from 350-630 thousand tons.

Export has a significant impact on the economic and financial health of the sector. The IAFE-NRI research shows that from the accession to the EU until 2006 the exports accounted for 15-21% of the sales revenue. Simultaneously the import penetration rate remained at a low level of 2-4%. After the reform, the share of exports in sales value decreased to 13%, while the value of imports increased to over 20%, which contributed to the weakening of the domestic industry's competitiveness on external markets [Szczepaniak, 2011]
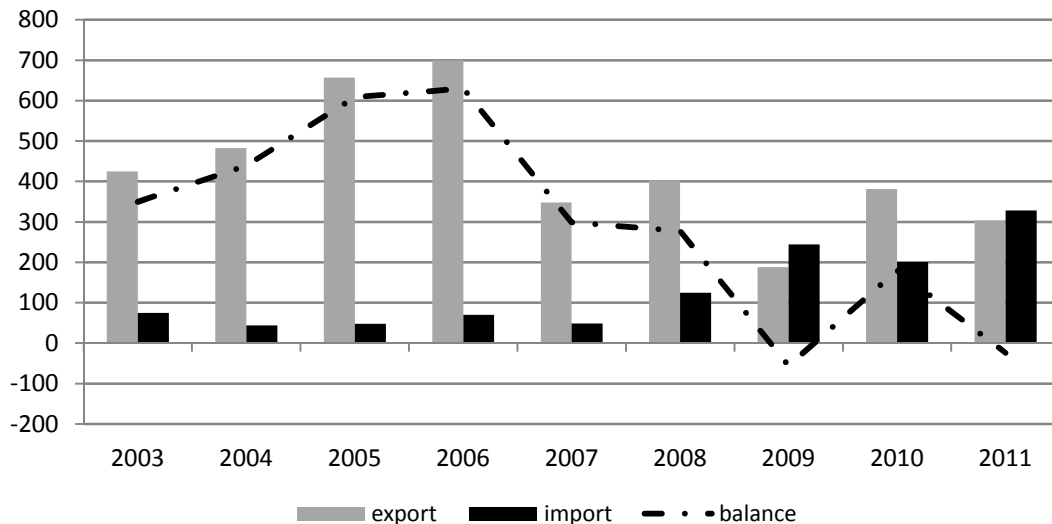
Figure 1. Foreign trade in sugar (thousand tons).

Source: The IAFE-NRI calculations based on data from the Analytical Centre of Customs Administration.

With the entry into force of the new market regulations, Polish sugar producers, despite the fact that they have a high potential for production, were forced to reduce supply to the amount of the allocated production quota. The surplus must be exported outside the EU, or used for non-food purposes in other sectors of the economy. The production quota negotiated by Poland was reduced from 1,630 to 1,405 thousand tons in 2009/2010 (and subsequent seasons), i.e. to a level about 13% lower than the average national consumption. This translated into a dependence of national supply on imported raw materials. As a result, in 2007-2011 period exports of sugar dropped from 700 to 304 thousand tons, with an increase in imports from 70 to 328 thousand tons. In 2009, for the first time Poland has become a net importer of sugar, when the negative balance amounted to 56 thousand tons (Figure 1.). Unfavourable balance of trade was also recorded in 2011, but compared to 2009 it was reduced by nearly a half. In the light of the applicable legal regulations, regardless of the level of production, Poland is forced to import an average of 200-250 thousand tons of sugar per year.

Economic and financial situation of Polish sugar industry
In the European Union sugar production is dependent on the limits per individual Member States. Immediately prior to joining the EU, Poland had two sugar production quotas: A (destined for the domestic market) amounting to 1,520 thousand tons and B (for export with subsidies) amounting to 102.2 thousand tons. In the first year of integration we had a limit (total of A and B quotas) totalling 1,671 thousand tons, while in 2005 it was reduced to 1,582 thousand tons. Under the reform of the sugar market the A and B quotas have been replaced by a single quota, whose principal value was 1,498 thousand tons. In the following season, after further reduction of the basic quota and the purchase of additional quota (in the amount of 100.6 thousand tons) Polish producers could market 1,533 thousand tons of sugar. As a result of increasing financial incentives by the European Commission, which aim at giving up production quotas, the limit of sugar production in Poland was reduced to 1,405.6 thousand tons in the campaign of 2008/2009, thus it was 16% lower than the one obtained in the accession negotiations and on average 200 thousand tons less than the national requirements. The same production quota is also in force in the subsequent economic years.
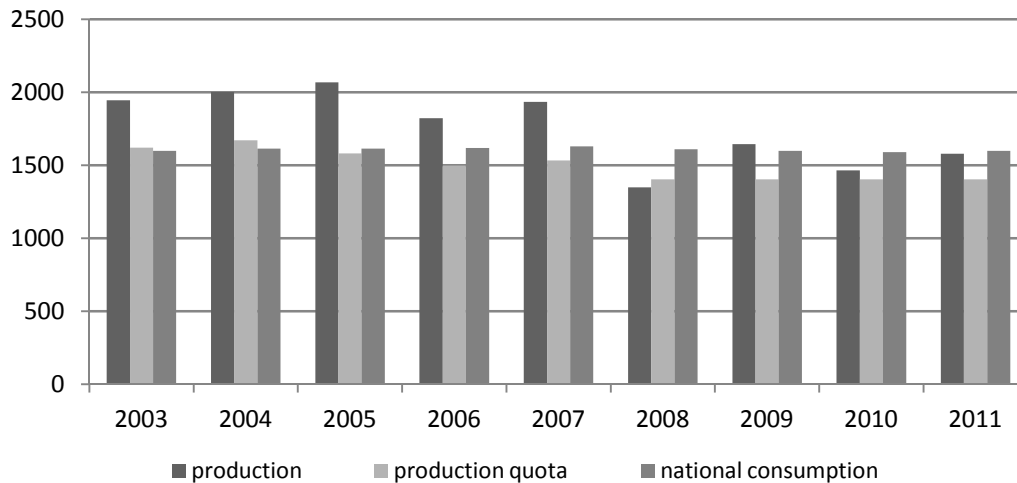
Figure 2. Sugar production in Poland (thousand tons).

Source: [The sugar market 2004 and subsequent].

In fact, in the analysed period, the actual sugar production in Poland was higher than the allocated limits. In 2003-2005 (i.e. immediately before the reform) the average sugar production amounted to 2005 thousand tons. Following the reforms of the market in 2006-2011, production decreased by approximately 16% in relation to the average of the previous seasons. Particularly strong decline in production was recorded in 2008, when it fell to 1,350 thousand tons to a level that was significantly lower than the quota as well as domestic consumption. This was caused by the reduction of cultivated area, as well as reduction in crops. In 2009-2011, due to the favourable economic situation, production was again higher than the allocated limit and slightly higher than the national demand (Figure 2.). According to forecasts, in the current season production will be reduced to 1,580 thousand tons.

Reduction of production was conducive to accelerating the concentration of the sugar industry and the elimination of less profitable plants. During this period, the number of active sugar factories decreased by nearly 70% from 57 in 2003 to 18 in 2011. Liquidation of factories was accompanied with a substantial decline in employment, which decreased from 15 to 3.5 thousand people, with more than double increase in labour productivity. The average level of sugar production per sugar factories also increased - from 34 to 104 thousand tons. The increase in the scale of processing is certainly a welcome phenomenon, which has a positive impact on improving the efficiency of processing [Szajner, 2006]. In the course of the reform there was further concentration of the ownership structure in the sugar industry. As a result of privatization there are now four sugar companies in the domestic market, three of which are owned by foreign capital.

The sugar industry in Poland is characterised by a large variability in financial performance over the years. This is the result of significant fluctuations in supply that affect the level of sugar prices, as well as changes resulting from the reform of the EU regulatory system of the market. In 2003-2011 the sugar industry recorded negative financial results on three occasions. Negative values were also recorded in gross and net profitability rates of the sector and the rate of return on equity (ROE). In 2008, net income in current prices amounted to PLN 4,127 million and was about 5% lower than in 2003 and about 35% lower than in 2004-2005.

Table 2. Selected economic and financial indicators of the sugar sector.

Specification	2003	2005	2008	2011
Net income in current prices (PLN million)	4,344.4	5,296.7	4,127.2	4,586.8
Measures of profitability, expressed as a % of net revenues				
Profit (loss) gross	-11.2	0.38	-6.99	23.4
Profit (loss) net	-11.39	0.33	-7.52	19.4
Liquidity	1.07	1.42	2.6	3.01

Source: The IAFE-NRI calculations based on CSO data.

As of 2009, the economic and financial situation of the Polish sugar industry has improved significantly. This is due to the improvement in market conditions, a significant increase in sugar prices in the domestic and external markets, as well as the positive consequences of restructuring (cost reduction). These factors partly offset the negative effects of the reform. As a result, financial results currently achieved by the domestic sugar industry are significantly higher than the average values of the financial indicators in the food industry. In 2011, net profit of the sugar industry achieved a record level of PLN 1.3 billion, compared to 765 in 2009. Sugar production was very highly profitable. Net profit margin increased from 16.4 to nearly 20%, while gross margin increased from 18.8% to 24% (Table 2.). In comparison, the average value of these margins in the food industry as a whole was respectively 3.4% and 4.2%. Also the liquidity of the industry and the value of the ROE equity ratio improved. Financial results show clear evidence of a large increase in the technical efficiency of production in the sector, which is reflected in reduced costs and increased productivity of production factors [Szajner, 2011]

Conclusions

The year 2010 witnessed the end of the most important part of the EU regulatory reform in the sugar market that has had both positive and negative consequences for the Polish sugar industry. Positive aspects include speeding up the process of restructuring and modernisation of the sugar industry, improvement of the technological competitiveness of the industry, greater concentration of production and improvement of processing efficiency. Positive changes also affected the increase in the quality and efficiency of the resource base. In addition, reduction of production costs (especially energy costs) provides a good basis for building sustainable competitive advantages relative to the Community market, as well as global market.

The main negative effect of changes in regulations on the EU sugar market was a significant reduction in sugar and sugar beet production, which was accompanied by the decrease in profitability due to price declines. Reduction in production quotas resulted in reduction of the production potential and strengthening the competitiveness of the sector within the oligopoly. The possibilities for entering new entities to the industry were limited, and the market was clearly depending on supplies from imports and substitute products. These factors contributed to the deterioration in the sector's competitiveness in the international arena.

Reduction of production capacity and production quotas led to adverse changes in foreign trade in sugar. The profitability of exports clearly decreased, and the forced increase in import led to a conversion of the sector into net importer. Reducing the number of sugar factories translated into a significant decline in employment, which was only partially offset by restructuring charges. Retail prices of sugar have not been reduced, although it was one of the most important arguments for changing market regulations. Stabilisation of the market has not been achieved due to the lower sugar supply in relation to consumption. The current system

results in stiffness of the production potential and also affects the development of the market and further increase in efficiency of both producers and growers.

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AGRICULTURAL AND RURAL DEVELOPMENT GOVERNANCE IN MOROCCO

Hamid EL BILALI[1*], Sinisa BERJAN[2], Noureddin DRIOUECH[1], Lahcen AHOUATE[3],
Aziz ABOUABDILLAH[4], Ahmed NAJID[5], Imadeddine ROUINI[6], Khalid AZIM[7]

[1]Mediterranean Agronomic Institute of Bari (CIHEAM-MAIB), Bari, Italy
[2]Faculty of Agriculture, University of East Sarajevo, East Sarajevo, Bosnia and Herzegovina
[3]Directorate of Agriculture of Rabat Salé Zemmour Zaer, Ministry of Agriculture and Fisheries, Rabat, Morocco
[4]National School of Agriculture, Meknes, Morocco
[5]Provincial Directorate of Agriculture, Essaouira, Morocco
[6]Domaine de Douiet, Les Domaines Agricoles, Fes, Morocco
[7]National Institute of Agronomic Research (INRA), Agadir, Morocco
(Corresponding author: elbilali@iamb.it)

Abstract

Morocco is divided into 16 regions and 62 provinces. Agriculture share in the gross domestic product (GDP) is 15%. Agriculture represents 40.5% of total employment and 80% in rural areas. Governance analysis focuses on institutions and structures dealing with decisions making and implementation. The paper provides an overview of Moroccan agricultural and rural development (ARD) governance especially in terms of actors and policies with a special focus on the Green Morocco Plan (GMP). The work - based on an extended secondary data review - (i) describes the main ARD policies and the roles of the key national (Ministry of Agriculture; Agricultural Development Fund), regional (Regional Departments; Regional Offices; Agriculture Chambers) and local (Provincial Directorates; Agricultural Development Centres) public institutions; (ii) enumerates the main ARD projects implemented by international donors (European Commission, IFAD, FAO, Millennium Challenge Corporation, World Bank, UNDP, USAID); (iii) analyses ARD budget; and (iv) provides some recommendations for improving ARD governance and coordination. The GMP - a multi-billion Euro programme launched in 2008 by the Ministry of Agriculture - aims at making agriculture a lever for growth. It introduces new models of agricultural value chains governance such as aggregation and public-private contract programmes. The implementation of the GMP implied the restructuring of the Ministry of Agriculture; the delegation of some functions to the private sector; and, the establishment of new entities (*e.g.* Agricultural Development Agency). Improving ARD governance in Morocco requires increasing inclusiveness and fostering participation of farmers, the private sector and the civil society in policy design, implementation and evaluation.

Keywords: *agriculture; rural development; Morocco; governance*.

Introduction

Morocco is divided into 16 regions and 62 provinces. The agricultural sector represents 15% of Morocco's gross domestic product (GDP). It is a major source of employment as about 4 million people work in the agricultural and agro-industrial sectors. Agricultural exports totalled €1.4 billion in 2010, mainly to the European union (EU) (Oxford Business Group, 2012). In 2009, agricultural GDP (agriculture and fisheries) had a value of about 107.2 billion dirhams (1€= 10.9907 Moroccan Dirham – MAD) (MAPM, 2011). Agriculture sector plays an important socio-economic role as 80% of the 14 million rural inhabitants depend on agricultural revenues (ADA, 2009). Agriculture, forestry and fisheries

sector represents 40.5% of total employment; more than three-quarters in rural areas (MAPM, 2011). Apart from its strategic role in domestic food security, agriculture plays an essential role in rural development and reduction of regional disparities. About 70% of the poor live in rural areas. The reform of the agricultural sector is unavoidable because of the liberalisation of agricultural trade with the EU (EC, 2007). The Moroccan government's cornerstone initiative to develop the agricultural sector is the Green Morocco Plan (Plan Maroc Vert), a multi-billion Euro agricultural development programme. Launched in 2008, the Green Morocco Plan (GMP) aims to increase the sector's profitability and spur rural development by seeking out private investment in regions with a high agricultural potential. It also provides for the modernisation of farming methods in arid regions and increases environmental protection standards (Oxford Business Group, 2012; MAPM, 2011).

The concept of governance is built around notions such as transparency, participation, consensus orientation, accountability, responsibility, efficacy and the rule of law (FAO, 2012). Governance comprises mechanisms, institutions and processes of decisions making and implementation through which persons and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences (Cheema, 2005). According to UNESCAP (2009) governance is '*the process of decision-making and the process(es) by which decisions are implemented*'. Governance analysis focuses on the formal and informal actors involved in decision-making and implementing the decisions made (Sheng *et al.*, 2007).

The paper aims at providing an overview of Moroccan agricultural and rural development (ARD) governance especially in terms of actors and policies.

Material and methods

The work is based on an extended review of secondary data from different sources: the Ministry of Agriculture and Maritime Fisheries; the Agricultural Development Agency (ADA); the European Commission (EC); the International Fund for Agricultural Development (IFAD); the Millennium Challenge Corporation (MCC); etc. Available secondary data have been collected, analysed, cross-checked and validated. The paper (i) describes the main ARD policies and the roles of the key national, regional and local public institutions; (ii) enumerates the main ARD projects implemented by international donors and financial institutions; (iii) analyses ARD budget; and (iv) provides some recommendations for improving ARD governance and coordination in Morocco. The lack of and/or difficult access to reliable and updated secondary data has been the main constraint faced during this work.

Results and discussion

The budget allocated to the Ministry of Agriculture in 2009 amounted to 4.041 billion dirhams in payments credits. In 2009, which is the first year of the GMP implementation, there was a 153% investment budget increase with respect to 2008. The field of agricultural development, training and research had 50.1% of the budget and that of agricultural spatial planning received 45.6%. The allocation for the general administration accounted for 4.2% (MAPM, 2011).

The design and implementation of ARD policies involves several different supra-national or international, national and sub-national (regional and local) actors (OECD, 2006). The main public institutions dealing with ARD policies in Morocco include: Ministry of Agriculture and Maritime Fisheries and its decentralised structures; research and training institutions; etc. Other ministries involved in rural development comprise the Ministry of Equipment (National Program of Rural Roads), the Ministry of Education (literacy programs),

the Ministry of Health, etc. Entities of the Ministry of Agriculture that operate in the entire country are (MAPM, 2011):

• Central level: the Ministry of Agriculture is responsible for overall coordination of the national agricultural sector. It also deals with rural development. The divisions of Irrigation and Spatial Planning and Development of Production Chains provide technical support.

• Regional level: the Regional Departments of Agriculture (RDA) and the Regional Offices for Agricultural Development (ROAD).

• Provincial level: Provincial Agriculture Directorates (PAD).

• Local level: 122 Work Centres (for non-irrigated areas) and 170 Agricultural Development Centres (ADC) (for irrigated areas) are the closest structures to farmers.

Other key actors include the Agricultural Development Agency (ADA), the Agricultural Development Fund (ADF), the National Office for Food Safety as well as international donors. The research-training-education system is composed of key organizations such as (MAPM, 2011): Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II), Meknes National School for Agriculture (ENAM); the National School for Forestry Engineering (ENFI); the National Institute of Agronomic Research (INRA); and many agricultural institutes. Moreover, other public and private actors play an important role in agricultural and rural development (MAPM, 2011): Chambers of Agriculture; inter-professional and economic interest groups; private enterprises such as suppliers of agricultural inputs (fertilizers, pesticides, seeds); etc. Morocco has more than 250 producer associations and groups and 6,000 cooperatives. Moroccan agricultural cooperatives are grouped in the National Union of Moroccan Farming Cooperatives (UNCAM). Other important civil society organisations dealing with agriculture include: the Moroccan Association for Seeds and Seedlings; the Association of Producers and Exporters of Horticultural Products (ASPEM); the Moroccan Association of Producers and Exporters of Fruits and Vegetables (APEFEL); etc.

The main building blocks of the Green Morocco Plan (GMP) are (ADA, 2009):

1. Adopting aggregation as an organization model for agriculture: creation of win-win partnerships between producers, processors and marketers. Aggregation is a voluntary partnership with an actor (aggregator) who has management, financial and technical expertise aimed at implementing agricultural investment projects *i.e.* aggregation projects.

2. Insuring the global development of Moroccan agriculture: modern agriculture and traditional agriculture. The 1st pillar focuses on projects that depend on private financing and develop highly productive or value added modern agriculture (milk, vegetables, meat, etc.). The 2nd pillar deals with traditional agriculture and aims at improving farmers' income in unfavourable and marginal areas (non-irrigated areas, mountains and oases). Overall, pillar II will undertake 545 projects, with a budget of 20 billion MAD targeting 855,000 farms.

3. Promoting private investment in the agricultural sector.

4. Adopting a contractual approach: mobilization of the government and its decentralised representatives, professionals and associations through partnerships with clear responsibilities.

5. Promoting Moroccan agriculture sustainability: climate change, water, etc.

6. Dismantling segmentation: addressing cross-sector issues such as land tenure and water.

Through the analysis of the current situation, 16 Regional Agricultural Plans (RAP) have been prepared. Each RAP represents a roadmap for the agricultural development of a region, supported by the central administration and the public institutions (ADA, 2009).

The implementation of the GMP necessitated the restructuring of the Ministry of Agriculture and the creation of new entities: the Agricultural Development Agency (ADA), the National Office for Food Safety (ONSSA) (ADA, 2009), the Agricultural Development

Fund (ADF), and the National Agricultural Advisory Office (ONCA) is to be established by 2013.

The Agriculture Development Agency (ADA) participates in the implementation of the GMP by proposing action plans for supporting high value added agricultural sectors with the objective of improving productivity as well as traditional agriculture through the implementation of economically viable projects in view of improving farmer income (ADA, 2009a).

To encourage private investments in agriculture, the state grants, under the Agricultural Development Fund (ADF), financial assistance through grants and incentives. In order to make funding from the State timely and simpler, the ADF created a cell at each Provincial Department of Agriculture (PDA) and each Regional Office of Agricultural Development (ORMVA), which serves as one stop shop and contact with farmers, in granting financial aid. The main types of aid granted under the ADF in 2009 (MAPM, 2011) regarded: hydro-agricultural planning and development; crop production (farm equipment and products valorization), and livestock production. Subsidies are higher in the case of cooperatives with respect to individual farmers in an attempt to foster aggregation and a better organisation of agricultural producers. Expenditures have increased by almost 11% between 2007 and 2009 (2.9 billion DH) and their structure has undergone a significant change (MAPM, 2011).

Through the GMP Morocco is determined to create a million jobs and double agricultural GDP. Between 2008 and 2010, the annual income of participating smallholders has tripled to US$ 3,000, and agricultural GDP has increased by 30% (WEF, 2011). Since 2007, fertiliser use has increased by 7%, the mechanisation of farming techniques has risen by 27%, and the use of irrigation systems has gone up by 127% (Oxford Business Group, 2012).

The EU seeks to develop a particular close relationship with Morocco and to support Morocco's reforms. The current agenda of EU-Morocco relations is spelled out in an Action Plan under the European Neighbourhood Policy. It replaces the EU-Morocco Association Agreement signed in 1996 and the 1976 Co-operation Agreement. Support of the EC to reforms in the Moroccan agriculture sector aims at ensuring the introduction of a coherent agricultural and rural development policy with the aim of convergence towards the necessary conditions for establishment of a Morocco-EU free trade area. It aims specifically to (EC, 2005): improve agricultural structures and marketing chains; develop rural infrastructure; diversify rural economic activities; develop and promote quality products; foster private-sector investment; support the introduction of sectoral agricultural policy reforms; and support land tenure reform.

Since 1979, IFAD has financed eleven rural development projects in Morocco, for a total of US$194.1 million. Projects have focused on increasing agricultural production in mountainous zones, rangelands with poor productivity, and rainfed agricultural zones. Ongoing IFAD projects in Morocco include: Agricultural Value Chain Development Project in the Mountain Zones of Al-Haouz Province; Agricultural Value Chain Development Programme in the Mountain Zones of Taza Province; Rural Development Project in the Mountain Zones of Errachidia Province; and Rural Development Project in the Eastern Middle Atlas Mountains (IFAD, 2012). In August 2007, the Millennium Challenge Corporation signed a five-year $697.5 million compact with Morocco to reduce poverty and stimulate economic growth. It aims to increase productivity and improve employment in high potential sectors such as fruit tree productivity and small-scale fisheries. The compact entered into force in September 2008 (Millennium Challenge Corporation, 2012).

The main international financial institutions operating in Morocco include the World Bank (WB), the Islamic Development Bank (IDB), the African Development Bank (ADB), the European Investment Bank (EIB), the European Bank for Reconstruction and Development, Belgian Cooperation Agency (BTC), etc. The WB's strategy for Morocco

covers rural poverty reduction, basic social services development and good governance promotion. It also supports agricultural policy reforms. Various UN agencies are active in Morocco: UNICEF, the UNDP, the WFP, the United Nations Fund for Population Activities (UNFPA), the FAO and the WHO. There are two levels of coordination between donors in Morocco: that of the Commission and the Member States and that of the Donor Group (EC, 2007). Meetings of heads of mission and first advisers take place monthly. Each group is headed by a representative of the rotating EU Presidency. Thematic groups (environment, housing, water, education, gender, health and NHDI) have also been set up to study a particular field in greater detail. The first step was to produce common strategy papers, which were transmitted by the Presidency to the Moroccan authorities. The National Human Development Initiative (NHDI), is a political framework - launched on May 18, 2005 - which aims at promoting social development in particular reducing social deficits and poverty and assisting the extremely vulnerable. The NHDI puts poverty alleviation and marginalisation at the heart of political debate in Morocco. It is a powerful tool for improving local governance in the country, in particular as regards local development and management of basic social services (EC, 2007). The Donor Group is an initiative launched in 2002, which by 2003 had representatives from most of the donors active in Morocco: the World Bank, the International Finance corporation (IFC), the UNDP, USAID, the ADB, the IDB, the EC, EU Member States, Canada and Japan. The Moroccan government was officially notified and involved in the work of the groups (EC, 2007).

Governance and coordination of agricultural and rural development in Morocco should be improved if the GMP is to achieve its expected outcomes. A basic action to strengthen coordination would be to encourage dialogue between the involved institutions. That is critical especially regarding the participation of rural people, farmers and their organizations. According to OECD (2006) developing strong partnership through vertical governance arrangements and public-civil society partnering agreements can make governance institutions more responsible regarding the design and implementation of rural development policies. Human capital has also a strategic relevance in order to achieve a good coordination between the involved institutions. It is critical to strengthen staff capacities particularly the analytical and communication skills. According to OECD (2006), since rural policy is strongly knowledge-based and involves multiple actors, coordination and communication mechanisms play a key role in the design and implementation of place-based rural development policies. Communication should be developed horizontally as well as vertically across different government tiers (OECD, 2006). Motivation and incentives to public institutions' staff can help in achieving this objective.

Recommendations for improving ARD governance include as well: reforming ARD policy design, implementation, and evaluation; strengthening governance for service provision and policy implementation; addressing cross-cutting governance issues (*e.g.* natural resources management, climate change, rural innovation systems, etc.); decentralisation and community empowerment and public administration institutions reforms; control of corruption; etc.

Conclusions

Agriculture still plays a very important role in the socio-economic development of Moroccan rural areas especially resource-poor, remote and marginalised ones. The Green Morocco Plan and the innovative governance arrangements that it brought about offer a unique opportunity to develop both modern and traditional models of agriculture in Morocco thus contributing to the improvement of rural people's incomes and livelihoods. However, for achieving that it is important to improve agricultural and rural development governance and coordination between the national, regional, local and international actors that are involved in the design and implementation of the agricultural and rural development policy in Morocco. A

basic action to strengthen coordination between the involved actors in the policy cycle would be to encourage dialogue between these institutions. Communication should be developed horizontally as well as vertically. Participation of civil society organizations and the private sector in RD policy design and evaluation should be encouraged. Decentralization should go hand in hand with deconcentration. Building the capacity of human resources dealing with ARD policy is a priority. Raising the awareness of rural population is also crucial. That's why it is important to improve the performance of Moroccan advisory and extension services. All that is necessary to increase the policy impacts and its contribution to the sustainable development of Moroccan rural areas.

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ANALYSIS OF COMPARATIVE ADVANTAGES OF AGRO-INDUSTRY SECTOR OF REPUBLIC SRPSKA

Aleksandar OSTOJIC, Vesna MRDALJ[*]

Faculty of Agriculture, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
(Corresponding author: vesna.mrdalj@agrofabl.org)

One of the key macroeconomic indicators for determining the contribution of agriculture to overall economic development of country is foreign trade in agricultural products. The aim of this paper consists in analyzing the position of the agro-industry of Republic Srpska in international trade for the period 2004-2011. The analysis of the position of the agro-industry of the Republic of Srpska in the international market is made on the basis of comparative advantages in relation to the CEFTA countries. The comparative advantages of the agro-industry are analyzed through the use of RCA indicators. The research results show a significant loss of comparative advantage of the agro-industry of the Republic of Srpska.

Keywords: *Agro-industry, RCA indicator, comparative advantage, CEFTA, Republic of Srpska.*

Introduction

Bosnia and Herzegovina, and thus the Republic of Srpska, among others, through the adoption and implementation of the Central European Free Trade Agreement (CEFTA), committed itself to the active involvement of the agro-industrial sector in the European integration process. CEFTA is a free trade agreement signed between the countries of South-Eastern Europe: Albania, Bosnia and Herzegovina, Bulgaria[1], Romania[57], Croatia, Macedonia, Yugoslavia (Serbia and Montenegro), Moldova and UNMIK of Kosovo. By the entry into force of this unique multilateral agreement, 32 free trade agreements entered into force by then are terminated. Like other sectors of the economy of the Republic of Srpska, agro-industry sector, first under the influence of bilateral free trade agreements, and the CEFTA agreement, enters the regime of liberalization of trade flows. For the Republic of Srpska, agro-industry sector is one of the most important levers of its entire economy development. The liberalization of trade flows imposed accepting new challenges to the agro industry sector in order to promote its development and improvement of its competitive position in the market. Thus, this work should answer the question whether the openness of the Republic of Srpska, as a result of acceptance of the above agreement, caused positive change in the structure of international trade of agro-industrial products. Positive change in the structure of international trade implies a change of comparative advantages by the production of higher value-added (Buturac, 2007: 5). In order to define this, an analysis of the comparative advantages of the agro-industrial sector of the republic of Srpska in relation to the CEFTA region has been done.

This paper analyzes the agro-industry sector of the Republic of Srpska (RS) in international trade.

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[57]Until 2007,Romania and Bulgaria had been members of CEFTA Agreement, and after that they become members of theEU and this Agreement does not apply to them anymore.

Material and methods

The analysis of the comparative advantages of the agro-industrial sector of the Republic of Srpska in relation to the CEFTA region was carried out using RCA indicator or *Balassa index*. It was originally developed in 1965 by *Balass*. It is calculated as follows:

$$RCA = \ln \left(\frac{X_i}{M_i} \right) \times \left(\frac{\sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} M_i} \right) \times 100$$

where **X** is export, and **M** import. ***i*** is production group. Interpretation of this indicator is as follows: *positive values of RCA indicator advantages show that a state has significant comparative advantages in production and exchange of a group of products. Vice-versa, negative values indicate the lack of comparative advantages*. In this paper, RCA indicator has been calculated for the groups of agro industry products of the RS, classified according to custom tariffs of Bosnia and Herzegovina.

Results and discussion

CEFTA countries of the region, in terms of trade in agro-food products, are important foreign trade partners of the Republic of Srpska. Generally, the Republic of Srpska agro-industrial sector, on average, for the period compared to the total foreign trade takes about 26% of shares. The Republic of Srpska agro-industry notified deficit with the most important trading partners of CEFTA countries, in the observed period (Figure 1).
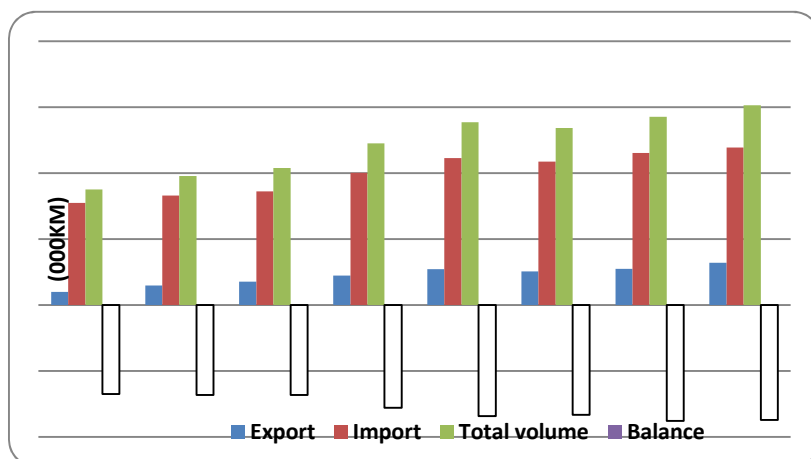
Figure 1. The total foreign trade of the Republic of Srpska agro-industrial sector with CEFTA countries in the period 2004 - 2011.

Source: Authors' processing based on data of VTKBiH and RZRS.

Export-import ratio ranged from 13% in 2004 to 27% in 2011, when it recorded the highest value of the indicator. On average, for the observed period, import ratio was 22%. The maximum value of exports and imports was in 2011, the export valued at 128.5 mil. KM and imports at 477.1 million KM. The main export trade partners of the Republic of Srpska agricultural industry and the CEFTA countries for the analysed period were Serbia and Montenegro, Croatia, Macedonia and Albania. After 2007, when Serbia and Montenegro got

their independence, Serbia took a significant place in terms of volume of trade exchange of agricultural - food products. In terms of exports, the Republic of Srpska agro-industrial sector in the observed period exported mainly to Croatia. The maximum value of exports to this country, was in 2011 when it valued at 66,9 million KM. The second most important partner in terms of exports was Serbia, and the largest export value was in 2011 when it valued at 42.8 million KM. Similar to exports, the import dominant partners in foreign trade of agro-industrial products for the period were Serbia and Montenegro, Croatia, and after falling apart of Serbia and Montenegro, it was Serbia. The maximum value of imports of agro-food products with major partners of CEFTA countries, the Republic of Srpska had in 2011 with Serbia in the amount of 377.6 million KM and Croatia 73.4 mil. KM. While Serbia and Montenegro were together, the largest value of imports was in 2006 when it valued at 300.7 mil. KM (Figure 2).
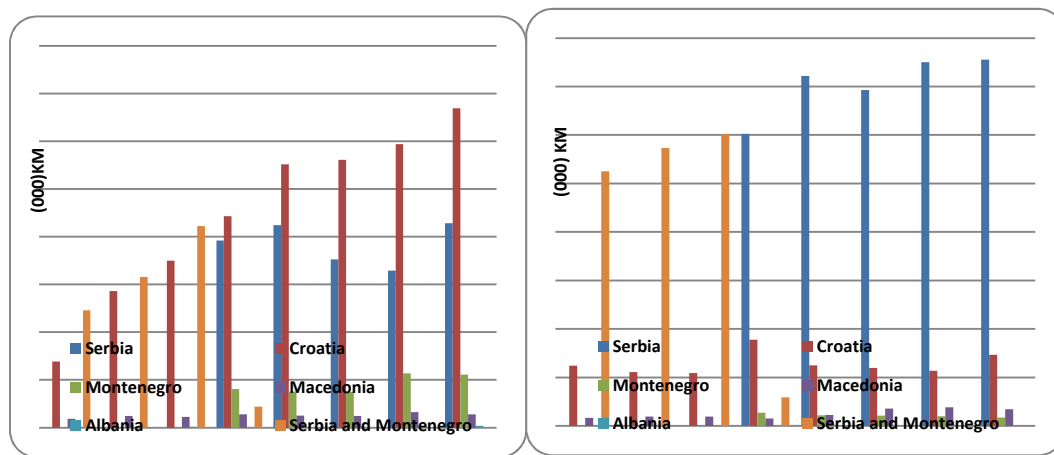
Figure 2. Export and import of the Republic of Srpska's agricultural industry with its major trading partners of CEFTA countries in the period 2004 -2011.

Source: Authors' processing based on data of VTKBiH and RZRS.

Empirical analysis of comparative advantages of the agricultural industry sectors of the Republic of Srpska shows that, in relation to key foreign partners of CEFTA countries, most product groups reported negative values of RCA indicators (table 1). The comparative advantages analysis was performed for the production group of 01-24 against major foreign trade partners of CEFTA; Serbia and Montenegro, Croatia, Macedonia and Serbia for the period 2004 - 2011. For the first four years of the observed period, the Republic of Srpska agro-industry in relation to Serbia and Montenegro, for nearly all product groups, showed negative values of RCA indicators, except for a group of customs tariffs 03 (*fish, crustaceans, molluscs and other*) in 2004, and in 2005 when its value was positive and $RCA_{2004}=+0.3$ and $RCA_{2005}=+0.4$. By analyzing the comparative advantages of certain product groups of the Republic of Srpska agricultural industry in relation to Croatia, the positive values of RCA indicators were noted in the Customs Tariff Group 04 (*milk and dairy products*) in $RCA_{2004}=+0.2$; $RCA_{2005}=+1.6$; $RCA_{2006}= +1.2$; $RCA_{2007} = +1.5$; $RCA_{2008}=3.9$; $RCA_{2009}=2.9$; $RCA_{2010,}$ $RCA_{2011}=+5.0$ and +5.1. In this case, the positive value of RCA indicators for the group of customs tariff 04 confirms restructuring of the Republic of Srpska dairy sector. Parallel with the process of structural reform, there are changes in comparative advantages in international trade (*Teodorovic and Buturac, 2007*). For this group of products, a continuous growth RCA indicator value is evident, with the highest value reported in 2011. In addition to milk and dairy products, groups of products of customs tariff 07 (*vegetables, roots and tubers*), 08 (*table fruits: citrus fruit or melons*), 19 (*cereals and flour products*) and 20 (*vegetables, fruit, etc.*) also recorded positive values of RCA indicators. Customs tariff 07 and

08, except in the initial period of 2004, mainly noted positive values of RCA indicators. In relation to Serbia, product groups of the Republic of Srpska agro-industrial sector, except product group of the customs tariff 03 (*fish, crustaceans, molluscs and other*), generally reported a lack of comparative advantages. Insufficient comparative advantages in certain periods were shown by the following groups of products - 08 (*table fruit*), 13 (*shellac, gums, resins, etc.*), 14 (*vegetable planting material*) and 17 (*sugar and sugar products*). The Republic of Srpska in foreign trade of agro-food products in relation to Macedonia, recorded comparative advantages in the following groups of products: 11 (*products of milling industry*) for the periods of $RCA_{2004}=+1.1$; $RCA_{2005}=+1.3$; $RCA_{2007}=+0.2$, $RCA_{2009}=+0.2$ and $RCA_{2011}=+0.7$, 12 (*oil seeds*) in 2004 and 2009 - $RCA_{2004}=+0.3$; $RCA_{2009}=+0.1$, 19 (*products made of cereals, and flour*) for almost the entire observed period. Looking at the RCA indicator values in Table 1 for the period 2004 - 2011, negative values for the group 10 (*cereals)* were noted, especially bearing in mind the growing conditions for the production of this product group, and the fact that the overall structure of the grains take a dominant position with an average of 272,645 ha. Negative values of RCA indicators for the group 10 (*cereals*) show the lack of comparative advantages in the production and trade of this group of products of the Republic of Srpska.

Conclusion

Agro-industry sector in the Republic of Srpska foreign trade with CEFTA countries, regardless of the increased volume of trade in the period 2004-2011, consistently had a negative balance. From the standpoint of comparative advantages of the Republic of Srpska agro-industrial sector in relation to the CEFTA region, showed that the liberalization of trade flows, as well as increased volume of trade in agro-industrial products between the Republic of Srpska and major trade partners of CEFTA countries, has not adopted, or made positive changes of expected trade structure. Compared to individual trading partners of CEFTA countries, from a total of 24 agro-industry product groups analyzed, the comparative advantages in relation to Croatia was expressed in the customs tariffs product group 04 (*milk and dairy products*), with the continuous increase of RCA indicator in the observed period. Positive values of RCA indicators for this product group show that there were structural changes in the dairy industry in the Republic of Srpska, i.e. it was restructured. In relation to Serbia, the comparative advantages of the agro-industry sector were showed in the product groups 03 (*fish, crustaceans, molluscs and other*), and 08 (*table fruits*), 13 (*shellac, gums, resins, etc.*), 14 (*plant material for planting*) and 17 (*sugar and sugar products*), and in relation to Macedonia it was the highest in milling industry as well as products based on cereals and flour. In relation to Serbia and Montenegro, the positive values of the RCA indicator were recorded in the production group of the customs tariff 03 (*fish, crustaceans, molluscs and other*) in 2004 and 2005. A lack of comparative advantages in the production and exchange of other observed groups with all CEFTA countries was recorded in the period 2004-2011.

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Table 1. RCA index of product groups of agro industry of the Republic of Srpska in comparison with the main foreign trade partners of CEFTA region, 2004 - 2011.

CT	Name	RCA2004			RCA2005			RCA2006			RCA2007				RCA2008			RCA2009			RCA2010			RCA2011		
		SCG	HR	MK	SCG	HR	MK	SCG	HR	MK	SCG	SR	HR	MK	SR	HR	MK	SR	HR	MK	SR	HR	MK	SR	HR	MK
01	Live animals	-0,4	0	0	0	0	0	-0,2	0	0	0	-0,3	0	0	-0,3	0	0	-0,3	0	0	-0,2	-4,3	0	-0,2	0	0
02	Meat and other products	-0,4	0	0	0	0	0	-0,7	0	0	0	-0,3	0	0,4	-0,3	0	0	-0,1	-2,0	0	-0,1	-3,4	0	0	-2,9	-0,2
03	Fish, crustaceans, molluscs and other	0,3	-0,4	0	0,4	-1,5	0	-0,5	-0,9	0	0	0,3	-0,8	0	0,2	0,3	0	0,2	1	0	0,2	1,1	0	0,3	0,3	0
04	Milk and dairy products	-0,4	0,2	0	-0,4	1,6	0	-0,3	1,2	0,7	-0,3	-0,3	1,5	1,1	-0,2	3,9	0,5	-0,1	2,9	0,1	-0,1	5,0	0	0	5,1	0
05	Products of animal origin	-0,05	0	0	-0,3	0	0	0	0	0	0	-0,4	0	0	0	0	0	-0,1	0	0	0	0	0	0	0,2	0
06	Trees, plants…	-0,3	-0,2	0	-0,4	-0,03	0	-0,4	-0,1	-0,3	-0,5	-0,5	0,2	0	-0,4	-0,1	0	-0,3	-0,4	0	-0,2	-0,7	0	-0,4	-2,3	0
07	Vegetables, roots…	-0,1	-0,1	- 1,2	-0,1	0,2	-1,3	-0,2	0,1	-0,9	-0,04	-0,2	0	-1,0	-0,1	2,1	-0,8	-0,1	2,2	0,7	-0,1	1,8	-0,6	0	1,3	0
08	Fruits; citrus and melons	-0,2	-0,2	0	-0,1	-0,1	-2,5	-0,2	0,2	0	0	-0,1	-0,1	0	0	0	0	0	0,3	0	0,1	1,1	0	0,1	0,7	-0,3
09	Coffee, tea, and spices	-0,4	-1,1	0	-0,4	-0,04	-0,4	-0,6	-0,9	0,7	-0,1	-0,8	-3,8	-0,3	-0,3	-5,3	0,3	-0,4	-4,7	0,4	-0,3	-4,9	0	-0,3	-4,0	0
10	Crops	-0,4	-1,4	0	-0,5	-1,7	0	-0,6	-2,1	0	0	-0,5	-2,0	0	-0,5	-1,7	0	-0,3	-2,2	0	-0,2	-3,2	0	-0,4	-2,3	0
11	Milling industry products	-0,4	-0,5	1,1	-0,6	-1,1	1,3	-0,7	-2,3	0	-0,8	-0,9	-3,2	0,2	-0,8	-7,4	0	0	-6,1	0,2	0	0	-0,1	-0,7	0	0,7
12	Oils seeds and products…...	-0,1	-0,4	0,3	-0,2	-0,5	-0,3	-0,2	-1,4	0	-0,7	-0,1	-0,9	0	-0,1	-2,0	0	-0,1	-2,4	0,1	-0,2	-2,4	0	-0,1	-0,6	0
13	Lac, gums, resins and other....	-0,01	-0,4	0	0	0	0	0	0	0	0	0	0	0	0	0,9	0	0,2	0	0	0	0	0	0	0	0
14	Plants for plaiting	-0,1	0	0	-0,2	0	0	0	0	0	0	0	0	0	0,1	0	0	0	0	0	-0,1	0	0	0,1	0	0
15	Fats and oils of animal and plant origin	-0,5	-0,5	0,5	-0,6	0	0	-0,8	0	0	0	-0,8	-5,1	0	-0,9	0	0	0	0	0	-0,5	0	0	-0,9	-3	-1,3
16	Meet, meet products, fish,…	-0,3	0	0	-0,4	0	0	-0,3	0	0	-0,6	-0,5	0	0	-0,7	-3,6	0	-0,3	-4,5	-0,8	-0,3	0	-0,8	-0,4	-1,9	0
17	Sugar and sugar products	-0,2	-1,0	-1,2	0,03	-2,7	-0,3	-0,01	-3,4	-0,3	-0,1	0,1	-2,8	-1,7	0,1	0,3	0	0	-0,3	-0,6	-0,6	-2,7	-0,7	-0,2	0,9	-0,7
18	Cocoa and cocoa products	-0,3	0,2	-0,3	-0,3	0,1	-0,6	-0,4	1,1	-0,6	-0,3	-0,4	1,3	-1,0	-0,6	2,2	-0,8	-0,6	0,9	0	-0,2	-0,2	0,3	-0,3	0,4	0,3
19	Crops, fluor…	-0,2	0,6	0,3	-0,3	1,4	0,5	-0,4	1,8	0,1	-0,3	-0,3	1,4	0,1	-0,3	2,2	0,1	-0,3	2,7	0,2	-0,3	2,3	-0,3	-0,4	2,6	-0,3
20	Vegetable, fruits and other...	-0,2	0,5	-0,1	-0,2	0,7	-0,5	-0,01	2,0	-0,6	-0,2	-0,1	0,9	-0,4	-0,1	2,5	-0,4	-0,2	2,9	-0,1	-0,2	3,5	-0,3	-0,1	3,2	0
21	Food stuffs	-0,1	-0,7	0,3	-0,2	-0,2	-0,2	-0,2	-0,6	-0,4	-0,3	-0,2	-0,4	-0,7	-0,2	-0,1	-0,3	-0,2	-0,3	-0,2	-0,2	-0,1	-0,4	-0,2	0,3	-0,4
22	Alcohol and beverages	-0,4	-0,7	0	-0,6	-0,4	0	-0,6	-0,1	0	-9,5	-0,5	-0,2	0	-0,4	-0,1	0	-0,4	0,3	0	-0,3	0,2	0	-0,4	0,2	0
23	Residues and food residues	-0,6	-0,9	0	-0,5	-2,3	0	-0,7	-3,1	0	0	-0,8	-2,2	0	0	-4,5	0	0	-4,8	0	-0,5	-3,5	0	0	-3,8	0
24	Tobacco and replacements	-0,2	0	0	-0,1	0	0	-0,1	-3,4	0	-0,2	-0,6	0	0	-0,6	-12,9	0,1	-0,1	0	0,01	-0,2	-3,4	0,01	-0,7	0	0,02

SERBIAN AGRIBUSINESS AWAITING THE EU INTEGRATIONS AND AGRARIAN POLICY

Branislav GULAN[*], Vojislav STANKOVIC

Chamber of Commerce and Industry of Serbia, Belgrade, Serbia
(Corresponding author: gulan@nscable.net)

Abstract

The production of food, raw materials (for other sectors), the trade exchange with the world, social , demographic and other aspects determine, among other things, multifunctional importance of the agribusiness for social and economic development of the Republic of Serbia. The agribusiness activity, according to the important natural and human resources and the level of production and processing achieved, is one of the most significant economic activities in Serbia. The participation of the primary agribusiness in the realisation of the gross domestic product of the Republic of Serbia in the period 2002 – 2013 was between 15.5 and 11.8 percent, however, if the total contribution of the agribusiness to other sectors is observed, this participation goes beyond 40 percent of total GD. It also near 44 percent of the population in Serbia lives in the rural areas (the population density below 150 inhabitants per square meter). It indicates on particular importance of the agribusiness for the stability of total economic and social development, the permanent food stability as well as social and political stability.

Keywords: *agribusiness, food, stability, country, exchange*

How and where to go further

In the last two centuries the agribusiness of Serbia had gone through two main periods ranging from the agricultural overpopulated to deagrarianization which started upon the Second World War and lasting up to date. At the beginning of this century the agribusiness entered the transition phase meaning the privatization and the lack of measures of the development agricultural policy. However, regardless of the phase the agribusiness found itself, it had bad economic position and insufficient financial support of the state. On the other side, its main task was to feed the nation and thus provide the social peace in the country.

Today in Serbia the agribusiness participates with 12 percent of the GDP and according to the census conducted in 2002 the agrarians make up near 11 percent of total inhabitants. The role and importance of the agribusiness particularly was revealed during the sanctions in the 1990's when the agribusiness turned out to be the most vital economic sector. Today the agribusiness in Serbia, its potentials and limits show the same trend which is that the investing in the agribusiness is lower than it is necessary (the agricultural budget amounts to 2.2 – 2.6 percent). The small households of three hectares the most are the dominant. While in the 1990's the agribusiness recorded the constant deficit, lately a substantial surplus in the agribusiness was recorded which in 2011 was 1,4 billion dollars. The agribusiness 8the production and processing of the agricultural produce) is the most important economic sector in Serbia, which in the creation of the gross domestic product (GDP) participates with over 20 percent, and with the following activities with more than 40 percent!

The production of food, raw materials (for other sectors), the trade exchange with the world, social , demographic and other aspects determine, among other things, multifunctional

importance of the agribusiness for social and economic development of the Republic of Serbia. The agribusiness activity, according to the important natural and human resources and the level of production and processing achieved, is one of the most significant economic activities in Serbia. The participation of the primary agribusiness in the realisation of the gross domestic product of the Republic of Serbia in the period 2002 – 2013 was between 15.5 and 11.8 percent, however, if the total contribution of the agribusiness to other sectors is observed, this participation goes beyond 40 percent of total GD. It also near 44 percent of the population in Serbia lives in the rural areas (the population density below 150 inhabitants per square meter). It indicates on particular importance of the agribusiness for the stability of total economic and social development, the permanent food stability as well as social and political stability. The primary agricultural production in Serbia, since the former SFRY secession, functions in instable and extremely unfavourable conditions, with the unchanged production structure, first and foremost, the capital intensive production (the livestock breeding), because of the frequent lack of efficient measures of the agricultural policy.

The livestock fund in Serbia is lower by 50 percent in relation to the data from the 1980's. Its reduction will be felt after the drought in 2012. In the structure of the realized value of the agricultural production, only 31 percent of the value comes from the livestock breeding, while the number of the livestock heads is reduced to 0,30 per hectare of the arable land, which indicates an extreme extension of the domestic agribusiness. The optimal share of the livestock industry in the agriculture is at least 60 percent for Serbia, with the number of heads per hectare of the arable land.

The inherited and yet unsolved problems from the previous period influence the agricultural production for years, realises slower growth if compared to its objective production capacities and the importance in the economic structure of the country. A drop in the physical volume of the production is particularly exposed in the existing extensive way of production where unfavourable climate conditions are extreme.

The physical volume of the agricultural production realized in the period of transition recorded huge oscillations: extreme growth in 2001 of 18.6 percent, in 2004 of 19 percent and in 2008 of 9.1 percent, then the growth in 2009 of 0.8 percent, then a drop in 2010 of 0.4 percent and in 2011 a growth of 0.8 percent. The varied cycles and ups and downs are features of the extensive production. However, while writing this paper there are no official data on the drought caused damages in the agribusiness of Serbia in 2012, the first estimates say that they amount to over three billion dollars. The drought took away a part of the crop production, influenced the slaughtering of livestock, and thus the total agricultural production will be lower. An growth of near two percent was expected, but the Economic institute estimates a drop of 10 percent.

The following unfavourable influences are characteristic for the extensive primary agricultural production:
Long-lasting unfavourable position in the primary and secondary division due to the depreciated prices of the agricultural produce and disparity of the prices of industrial inputs and agricultural produce:

The prices of inputs record an growth up to 30 percent annually, which raises the prices of harvest and low the productivity;

Very low accumulative and reproductive capability of commercial and family-owned households, collective crafts and other agricultural producers

Over 50 percent of the turnover of the agricultural and food industry is in the grey zone. The VAT payment evasion make the damage to producers and the state. At the same time, in the big trade chains the payment system of 180 days substantially reduces the working assets to the agriculture and makes the outflow of the finances from the agriculture to other economic sectors;

Disinvestment, as a consequence of inadequate financing system and credit policy unadjusted to specific features of the agricultural production;

As of 1994 the dominant investment resource was the agricultural budget. Lately the amount of assets in the agricultural budget records the tendency of relative and absolute reduction. The share of the agricultural budget in the national budget is reduced in the period 2004 – 2012 from 5.3 percent to 2.2 percent;

The shortage of reproduction materials needed, first and foremost, of mineral fertilizers and means for the crop protections;

The consumption of complex fertilizers is reduced by 50 percent, and the nitrogen fertilizers by 35 percent observed in comparison to the mid of the 1980's.

The decrease of technical and technological level and extension of crop and livestock production, with the falling of the production per capacity unit;

The agribusiness of Serbia is specific for its big diversity of agricultural households (an average size of a household is below three hectares), insufficient equipped with agricultural mechanization, which is technologically too old (an average age 25 years), the low usage of mineral fertilizers and extremely low productivity in all fields of production (an average yield of crop production amounts to 1.5 – 2.5 percent lower, while the productivity of livestock industry is lower by three to five times if compared to the certain EU states);

The reduction of the consumption of basic agricultural products in the country as the result of low purchasing power of the population contributes to the stagnation of agricultural production;

In Serbia in 2010 an average consumption of meat and meat products per capita amounted to about 60,3 kilograms(total meat 39,6 kilograms out of which beef four kilograms, pork meat 16,9 kilograms, mutton meat 1,1 kilograms and poultry meat 16,6 kilograms), which is a minor quantity if compared with the certain EU countries. An annual consumption of meat per capita in the European Union amounts to 74,9 kilograms (Germany - 86,7 kilograms, France – 69,9 kilograms, Italy – 67 kilograms, Greece – 68,1 kilograms). The most dominant kinds of meat are pork with an average annual consumption of 41,3 kilograms. The consumption of milk (milk products excluded) of 60,3 litters per capita is lower than an average consumption in the EU where an average 82,5 litters (Germany – 64,1 litters, France – 70,2 litters, Greece – 65 litters). However, if the consumption of milk and milk products will

be compared, the differences are huge. In Serbia an average annual consumption of milk and milk products is 83,6 litters, which is a minor quantity in comparison to the consumption in the EU (245 litters) and Germany (308 litters). In the consumption of fruit and vegetable (59,3 kilograms and 145,9 kilograms respectively) per capita, Serbia is legging behind by two to three times in relation to an average consumption in the EU.

The limitations of goods funds and modest export growth of agricultural and food products (observed in comparison to real possibilities);

Transition of agribusiness to the market business conditions is followed by certain development of foreign trade exchange. In 2008 the value of the agricultural and food products reached to the value of two billion dollars, the import value of 1,5 billion dollars and the trade surplus in the amount of 500 million dollars was achieved. In 2010 the export of the agricultural products was 2,24 billion dollars, the import 1,036 billion dollars and the surplus 1,205 billion dollars. In 2011 the export of the agricultural products from Serbia amounted to 2,7 billion dollars and the import was 1,4 billion dollars and the surplus was 1,3 billion dollars;

Development directions and expected results

The main direction of the future development of agribusiness and food industry is optimal usage and keeping of available production capacities, the increase of the volume of agricultural production, the change of agricultural production structure, the production of high-final and high quality products. The goal of such development direction is to meet the domestic demand and to increase the export of high quality agricultural and food products. In that view the Government should adopt the concept of increase of production and export of agricultural and food products within the long-term National plan for agricultural production. The agricultural development in Serbia should be directed to the modernization and change of production structure towards higher market orientation and the improvement of total efficiency of agribusiness. The import of GMOs should be clearly defined on the packaging of a product with a view to inform a consumer. The commercial production of GMOs products in Serbia is prohibited in accordance to the Law.

Instead of the current 778.000 small agricultural households in Serbia, by 2020 there will be near 450.000 commercial households with an average size of around 20 hectares. The rest of them would be small households which will be organized in the forms of collective crafts. This production will be important too both for natural consumption and the market. In particular, it is necessary to define the programme of specific production of flower, young plants, vegetable, the poultry production (eggs and broilers), certain sorts of fruit, mushrooms and others. In the agricultural production structure the livestock breeding should play a dominant role, while the crop production should be based on the usage of genetic potential of newly created sorts of hybrids. In the rural areas it should be located near 35 – 40 percent of industrial activities relating to agribusiness, which would recruit a higher number of available labour force in those areas. The export-oriented production of high value food, beef meat, remedial plants, the breeding of vegetable, the rural tourism are the activities which could be carried out by 200.000 inhabitants by 2015.

Export capacity in agribusiness

According to the available capacity and possibilities of better usage of the results achieved by scientific and technological processes, the global market of agricultural and food products it is possible to produce enough quantities of good products for the food stability of the population, the strategic reserves and the export. The faster improvement of the export-oriented agricultural and food industry of Serbia requires the application of the concept of sustainable development of agribusiness, technical and technological modernization, the improvement of labour management and total organization of these activities, including the long-term and favourable measures of the agricultural policy. According to the results of the global researches, the achieved level of production and foreign trade exchange of agriculture and food industry as well as the projections of growth of the production of these products, the following products and potential markets could be determined:

Wheat – 500.000 tons with the orientation to the markets of Macedonia, Bosnia and Herzegovina, Iran, Algeria, Morocco and Egypt

Maize– near 1,5 – 2 million tons of mercantile and near 25.000 tons of seed maize. The possible markets are the EU countries, the Russian Federation, Ukraine, Bosnia and Herzegovina and Macedonia

Sugar – 250.000 tons with the orientation to the markets of the EU (preferential quota 180.000 tons), Macedonia, Bosnia and Herzegovina and Russian Federation

Sunflower oil – 100.000 tons. The market of the former YugoslavianRepublics, the EU countries and the Russian Federation

Tobacco and tobacco products – near 3 000 tons. The tobacco to the EU market, cigarettes to the Russian Federation

Calves and beef meat – near 20.000 tons to the EU market (preferential quotas 8.750 tons), Italy, greece, Bosnia and Herzegovina, Macedonia, Russian Federation and Middle East countries.

Sheep – 3000 tons. Orientation to the markets of the Arabian countries and near African countries.

Mutton meat – 3000 tons. Orientation to the markets of Italy, Greece, Switzerland and Middle East countries.

Canned meat – near 30 000 tons with the orientation to the USA, the EU, Russian Federation and Ukraine

Fruit, vegetable and products – in the value of 700 million dollars with the orientation to the EU market (Germany, Austria, Italy, Great Britain) and Russian Federation

Wine – 30 000 tons with the orientation to the markets of Germany, the USA, Japan and Canada

Remedial plants and forest fruit – near 60 million dollars to the markets of the USA, Austria, Italy and Germany

By 2015 the increase of the volume and the change of the production structure of the agribusiness along with the adoption of the agricultural policy measures, particularly in the field of financing the foreign trade exchange could completely meet the domestic demand and realise more than three billion dollars of the foreign currency inflow thanks to the export. By 2020 the agribusiness in Serbia should meet the domestic demand on higher level and provide the foreign currency inflow of near six billion dollars, and by 2030 the inflow of ten billion dollars.

Agricultural production financing

The financing of the agricultural production is the most important issue of the agricultural policy, starting from the fact that none of the economic activities could have good performances if the issue of finances is not solved. Up to now the state has turned to be a decisive factor in the creation of monetary and credit measures and in the financing policy of the agribusiness. In addition to the budget assets allocated to the agribusiness, the agriculture should participate in total production investments with at the least 20 percent. The collective crafts have to established in accordance with the principle saying that apart from an share invested there should be a guarantee for better security when it comes to the credit lines. It is necessary to pas the law on collective crafts.

The National programme of agricultural production should define the type of production, its volume, structure and quality taking into consideration the agricultural and production potentials on the regional level depending on the size of a household as well as the estimates of the demands on both domestic and international market. Since the amount of the assets in the agricultural budget records a relative and absolute decrease (participation of the agricultural budget in the national budget was reduced in the period 2004 – 2012 from 5.3 percent to 2.2 percent), it is suggested that in 2013 the share of the agricultural budget should be five percent of total value of the national budget, and this share should reach ten percent in the years to come. The assets for this purpose should be earmarked from the budget of the Republic of Serbia. With a view to increase total volume and quality of the primary agricultural production, the change of the structure of total agricultural production, being defined by the National programme, it is needed to provide the premiums in money to producers for produced and supplied quantities of products.

The concept of the agricultural policy for 2013 should be based on the recovery of agribusiness defined by the National programme for agribusiness, its financial consolidation and affirmation of intensive production structure which should be realised through the support of the agricultural budget which in 2012 amounted to near 32 billion RSD and is only 2.4 percent of total budget of the republic of Serbia for 2012. The revision of the budget for 2012 envisages its increase of 10 billion RSD – to 42 billion RSD. In 2013 it is necessary to focus on the elaboration of the strategy for agribusiness and rural development by which of means the status of agribusiness need to be defined in a way which make it economically profitable, market-oriented and interesting to farmers and agricultural enterprises to deal with this activity for economic reasons, and let the authorities to deal with the social policy for the period of up to 10 years. The application of SAA, the access to the WTO, the realisation of the CEFTA and EFTA as well as the realisation of the National programme for the EU integration are priority aims of the Republic of Serbia. In addition, one of the main goals in 2013 must be a growth of agricultural production of at the least two percent.

Conclusion

The agricultural production is being carried out under the pressure of climate and other global changes followed with a dramatic increase of prices of food and petrol, in other words, the inflation in the development Western states. The hunger threatens to almost one billion people. It is obvious that the world does not have the strategy to fight these problems. On the other hand, Serbia should pass the strategy for development of agribusiness and prevent the increase of the prices, the inflation and import of food. The development of the agribusiness in Serbia should be directed to the modernization and change of the production structure leading to the market-orientated exportation and improvement of total efficiency of agribusiness. The production and technological pre-structuring and a growth of productivity as well as higher

competitiveness on the domestic and global market must be based on ecological, energy and economic criteria. Serbia should become the area of traditional and conventional agricultural production. At the same time, the development of the scientific research and application of new knowledge and technology will enable a substantial increase of volume of the agricultural production. Therefore, the elaboration of the strategy for development of agribusiness and rural development of the Republic of Serbia by 2020 appears to be the main priority.

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THE CASE STUDY OF THE TERRITORIAL AND URBAN DEVELOPMENT & RURAL AREAS PARK (T.U.De.R.Park) OF THE HILL OF TODI CITY.

Adriano CIANI[*], Antonio BOGGIA

Department of Agricultural Economics, Farm Appraisal and Food Sciences , Agricultural Faculty, University of Perugia, PERUGIA-ITALIA
(Corresponding author: ciani@unipg.it)

Abstract

The Perugia University's, recently, in September 2011, has promoted an International Summer School-SIS entitled "The Sustainable Management and Promotion of the Territory" – SMPT (www.gpst-smpt.com) whose partners include the a Local Municipality of Todi City. The SIS is part of a more extended project called *A.M.A.R.- Associazione Mondiale di Amicizia delle Aree Rurali (World Friendship Association of Rural Areas)* . In line with the path of the A.M.A.R. Project, the first step of the SIS- SMPT meeting (held in Todi from September 4th to 11th, 2011) was the drafting of the *Charter of TODI.* The keyword of Charter of TODI is TRADI-OVATION: a combination of the words TRADITION-INNOVATION. The city of Todi (Tuder = border, from Etruscan) of Etruscan origin (1000 B.C.) is placed at the top of the Hill of Todi. Different technical and management aspects have caused the beginning of an inexorable problem of instability in major portions of the slopes. The Municipality had to run the expropriation of 900 hectares of land. The same Municipality is working in recent years to give these lands located between the urban area (historic and recent) and the purely rural area a new feature. The authors have conceived within the broader Plan of Development of the idea of Hill of Todi-T.U.De.R-Park-Territorial and Urban Development and Rural Areas-Park. Multifunctional approach and vision as common goods are two basic principles of the Park. This is to obtain an overall improvement of the image of the city that can be characterized by advanced example of sustainable land management and promotion, modern governance of territory to improve the relationship between urban and rural areas.

Keywords: *Territorial Planning, Urban Development, Sustainable Management, Rural Areas, Multifunctionality*

Introduction

The theory of welfare economy, since its very beginning, has always promoted the reflection on the growth and development models (Solow, 1956; Hirschman, 1958). The principles of sustainable development have been remarked through several stages, and thanks to that, it is currently a widespread heritage among the most important international institutions. It is worth to mention some of the main contributions on the topic. Albert Hirschman in 1958, Rachel Carson in 1962, the Club of Rome in 1972, United Nations in 1972, the WCED in 1987, the 1st WSSD(World Summit on Sustainable Development) in 1992 with the Agenda 21 proposal, the Millennium Goals in 2000, the WSSD of Johannesburg in 2002, the promotion of the Decade of Sustainable Development by UNESCO (2015-2014) UNESCO World Conference on Sustainable Development in Bonn (March 2009), G8 University Summit in Turin (May 2009), UNGASS Resolution for Rio+20 (December 2009),the "Future We Want" (June 2012). Are in motion in recent years two other concrete options represented by the

Green Economy and the *Bio-Economy.* Inside these contributions the role of Common Goods and the Urbanizing Agriculture is growing. New prospects of the relationship between the urban and rural areas are, step by step, set-up and analyzed. This framework support a news paradigm about the content of value of the goods :not only use value but also no use value as *existence value* and *value of inheritance*. For some natural resources or areas or entire sectors we should speak of the civil service of the goods in that capacity from private goods only become common property. The Rural Development Program of the European Union for 2014-2020 speaks, e.g., of the Civil Service should take agriculture. In this framework the new approach for the planning is to overtake the simple land vision toward the Territory Sustainable Management and Promotion. Following this vision and operative approach as were stimulate to preparing a proposal about the future of the Hill of Todi City we achieved several kind of positive results.

Material and methods

Perugia University is located in Umbria, a region in central Italy. Its historical traditions concerning the natural resources management are retrievable in several famous ancient historical and literary works such as "*Bucoliche*" by Virgilio, "*Rerum Natura*" by Plinio il Vecchio, "*Cantico delle Creature*" by S. Francesco. The socio-economic context has always been strongly related to the territorial development processes and to the valorization of natural resources. Umbria was a leading region, also after the II World War's most important industrialization period, with its conservation of the land peculiarities and the rural agricultural reality. In 1955 this context was analyzed in a noteworthy study by Henry Desplanques, "*Campagne Umbre*"; it is a significant research, with a penetrating interpretative capacity, concerning the *sui generis* value of the regional area, whose sustainable management is deeply rooted in the awareness of the economical subjects and policy makers .It is not a case that this region is known worldwide as *"the Green Heart of Italy and Europe".* Recently, in September 2011, the University of Perugia promoted an International Summer School-SIS entitled *"Sustainable Management and Promotion of the Territory" –SMPT* (www.gpst-smpt.com) in collaboration with Todi's Agricultural Technical Institute "A. Ciuffelli ", the Alumni Association, and the Local Municipality. Thanks to their typical specificity, they may-if properly guided-*turn their elements of weakness* in *strengths*, providentiallyinvolvedin their socio-economic modernization process.A more endogenous rather than exogenous development, a bottom-up rather than a top-down approach. We would like to strengthen the *Sustainable development vision from output of political strategy toward the culture of all people and nations.* In this sense, science must facilitate the removal of barriers, which often imprisoned and overshadowed the ancestral values of the ancient societies, *not to be approached as if they belonged to a museum, but with the revival and rediscovery spirit:* a kind of science that *awards property but also humanity.* The growth of universities research centers will characterize them, *even more, as a window of consciousness* together with their spirit of analysis, and the skills brought by all the autonomous self-decision-making people of the world society.

Results

International Summer School-SIS entitled "The Sustainable Management and Promotion of the Territory" –SMPT (www.gpst-smpt.com)
The above mentioned International Summer School-SIS about " *Sustainable Management and Promotion of Territory"* tooke place in Todi in two editions : 2011 and 2012.The SIS was born, first of all, with the objective of giving a solution to the different management

necessities of Perugia University area. Even though it is a naturalistically rich area, it is subject to frequent phenomena of hydrogeological instability, and also to fire hazard in summertime, because of the large amount of woods. In order to limit these risks, the trend is to promote prevention through the learning of GPS and GIS use. The aim is to improve a management method able to safeguard – through the constant monitoring– the development, the good quality of life, and the protection of environmental resources, especially landscape and biodiversity.

There is the will to start and consolidate a mechanism that can make "the country talk", by means of the use of the new ICT. For example, the contextual use of websites, webcams, e-commerce, can turn the local firm (handicraft, agricultural, and services) into a globalized entity which is detectable and reachable by any potential client from any place in the world. This procedure leads to a loyalty effect with a high surplus value, since it is linked to the "face" of every operator, and to the image of specificity of the country. In other words working to concretize "Smart Cities" and " Smart Communities". This is the direction of the processes of growth and innovation, aimed at safeguarding an internal sustainable development which is replicable and transferable. From these two attributes it is possible to originate additional opportunities. On the one side, the opportunity of strengthening the sustainable development culture for the needs of the regional reality where Perugia University and SIS operate; on the other side, through the involvement of foreign students, the opportunity of promoting SIS with a cognitive system of training and learning. In the light of the already mentioned "tradi-ovation activity" about the Territory's Sustainable Management and Promotion, was conceived one of the professional trainings and demand component, supplying the best skills for the technicians who work in the area: agronomists, architects, engineers, surveyors, and land surveyors. During the workshop week, full immersion activity projects were carried out, involving enhancement and intervention on some subjects, included in the Todi's district: the Castles of Monte Nero and the village of Petroro, the Widespread Hotel of Massa Martana's territory, the Arboreal Archaeology Company. All this was done with the addition of a 2 days Visiting Tour.

The Charter of TODI

Following the careful preparation of the SIS on its educational contents and the training within the territory, an extensive discussion during the final session in the 2011 Edition, was held, since the majority of the group shared the same basic ideas. It has been assumed that the nature of Todi's town was declared as the most sustainable in the World by the Kentucky University Professor Richard S. Levine. This could be the possible national and international benchmark to strengthen, in order to improve the effective action of guardianship, enhancing and promoting any rural area in the world. The Members of the core group decided to draw up this Charter, and agreed in promoting this initiative in their home countries, and those of the foreign partners. They also undertook to establishing a Local Action Group-LAC, which will help bring this mission all over the world. The Charter it's strong linked with the keyword **"TRADI-OVATION"** ,for short, the acronym of "**T**erritory, **R**ural **A**reas, through **D**evelopment, **I**nnovation, **O**rganization, **V**alorization, friendly user, **T**echnology, **I**CT sharing, **O**nline **N**etworking. This is the main component with which this innovative process can be structured to give effective credibility. It contribute to erase the increasing disillusion that usually follows the main international meetings. The authors think that it is necessary to turn the words into practical actions, towards the foundation of the new model of territories management and promotion. The Charter invites everyone to take into account that the *Charter of TODI* and the town's initials: **T.O.D.I.,** are emblematic and of great significance to capture attention, according to the logic shown by the *words quadrangle* in **Table 1.**

Table 1. The meaning of TODI "quadrangle of words"

Territory	**HO**listic	**D**ematerialization	**I**nvent
Tradition	**O**bservation	**D**igitalization	**I**nnovation
Training	**O**rientation	**D**emonstration	**I**CT
Tutoring	**O**rganization	**D**evelopment	**I**nternationalization

The A.M.A.R. Project

The Summer School is part of a more extended project called **A.M.A.R.-Associazione Mondiale di Amicizia delle Aree Rurali (***World Friendship Association of Rural Areas)*** whose the partnership would like to set up in Todi during 2014, when **the State Technical Agricultural College "A. Ciuffelli" 150th Anniversary** will be celebrated. The project intends to build up the A.M.A.R. association as a possible international government, with the will and duty of looking after the Rural Areas Sustainable Development all over the world. Many of the most remarkable current "voices" (such as that of Mr. Bill Gates) - each one within his own working and acting field – already declared few years ago their agreement about the A.M.A.R. aims. The same Project, if well guided in the development of a sustainable management and promotion, can represent the main base to support the *eradication of poverty, to reach a fairer and happier life in the world* (UNCSD, 2012).

T.U.De.R.Park-(Territorial and Urban Development & Rural Areas Park) of the Hill of TODI City.

The city of Todi (Tuder = border, from Etruscan language) of Etruscan origin (1000 B.C.) is placed at the top of the Hill of Todi.

The slopes of the hill until the middle of the 18 century 18 were characterized by the presence of mainly woodland plants or trees (olives, grapes, etc..). From this period the hill began to be cleared so wildly for the production of firewood and to expand arable land. Since ancient times (it has been verified at least since Roman times) the pass was run with a rational control engineering geological soil with a series of underground drains and wells that have provided stability to the middle of last century. Different technical and management aspects have caused the beginning of an inexorable problem of instability in major portions of the slopes. Following the intervention of a special national law, the Municipality had to run the expropriation of 900 hectares of land owned by privates. The same Municipality is working in recent years to give these lands located between the urban area (historic and recent) and the purely rural area, a new feature. The authors have conceived within the broader Plan of Development of the idea of **Hill of Todi T.U.De.R-Park-**Territorial and Urban Development and Rural Areas Park. Multifunctional approach and vision as common goods are two basic principles of the Park. This is to obtain an overall improvement of the image of the city that can be characterized by advanced example of sustainable land management and promotion and really *Smart Cy and Smart Community..*

Conclusions

The planning of the A.M.A.R. Project, the activation of the International Summer School on Sustainable Management and Promotion of Territory, and the drafting of the Charter of TODI too, showed that the international and local levels responses were significantly good. This is a way to support the assertion of the Strategy of Sustainable Development, even if probably weak in terms of Cartesian analysis and predictive power, but with a concrete fruitful will to promote the culture of the territory sustainability. One of the future perspectives is to improve

the formative issues, specifically with the local and international cases of study. The elaboration and analysis (first of all, the Charter of TODI, which has the logo of "tradi-ovation" by SIS will be gradually transferred through seminars and conferences in the formative local institutes. For that the executive staff of SIS received by the town of Todi the proposal to prepare the Project of the Park of T.U.De.R. (acronym and also old name of Todi City (Urban Territory and Rural Area Park). At present, a preparation phase for an appropriate operative General Agreement between the University and Todi's Municipality is going on. *The pillar of the proposal of a virtuous learning circuit about the sustainable development is based on an adaptive and visionary testing method.*
It's not possible to achieve happiness, (which is considered lawfully indispensible in most of the Countries Constitutions, and one of the most important targets of the next RIO +20), *without big dreams to imagine and to reach.*

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CLUSTERS - BASIS OF TOURISM COMPETITIVENESS IN SERBIA

Jelena PREMOVIC[*], Ljiljana ARSIC, Zoran MILICEVIC

[1]Faculty of Economics in Kosovska Mitrovica, Serbia
(Corresponding author: jelena.premovic@gmail.com)

Abstract

The aim of this paper is to emphasis the importance of clusters as a key factor to enhance the competitiveness of tourism in Serbia. The formation of tourism clusters in order to improve positioning Serbia as relevant destinations on the international tourism market is the basis of tourism development strategy. The Strategy of tourism development highlights the importance of clusters in increasing the competitiveness of the tourist offer of Serbia. The strategy is designed layout of clusters in Republic of Serbia, which is not based on current administrative boundaries that exist within the country, but on a rational basis in the various forms of economic experience, which in some parts of the country can develop. At that way four clusters are defined: Vojvodina, Belgrade, Serbia Southwest, and Southeast Serbia. Institutional infrastructure for the development of these clusters does not exist today. It will be gradually formed, as the existing Tourist Organization of Belgrade and Vojvodina, and the Western Regional Tourism Organization of Serbia and the emerging Regional Tourism Organization of Eastern Serbia. Cluster development should be aligned with the further progress in the process of regionalization of Serbia. Positioning of individual clusters should point out the following elements: geographical location, products that can be placed on the international market, a clear link with Europe, and points out the connection to the cultural, spiritual and emotional values of the climate and the people who create entertainment.
The paper will give benchmark analysis of clusters in Serbia in the field of tourism in order to emphasis their necessity in the process of utilization existing tourist potentials of our country.

Key words: *clusters, tourism, regional development, benchmark analysis.*

Introduction

Connection into a cluster involves cooperation and innovation of active partners, companies of all sizes in various fields, citing on education, training, development and introduction of new technologies into business processes. Clustering is offensive involvement in international developments flows; that is the process of creating new opportunities, not just following existing. The key clusters advantage lies in multidimensional proximity of all stakeholders - not only geographical but also cultural and institutional proximity and alignment. Proximity allows sharing power and resources, joint activities require a shared vision and goals, and personal and social relationships and strengthen the confidence and allow faster flow of information. The effects of connecting the clusters are well-reflected only in a sufficiently large number of interconnections. Cluster development in Serbia is at an early stage, although knowledge of all the advantages and disadvantages of clustering are known. Since each concept, an idea, policy, etc. has its good and bad sides, either cluster is no exception. Clusters in today's business world enable companies to certain benefits that they would not have if they work as separate legal entities. In contrast, there are exemptions to certain limitations, especially if the cluster concept is understood as a "panacea" or as the solution to all problems. Benefits subjects business association in clusters are: the increase in production and

employment, increase innovation, strengthening the expertise and know-how, improve quality and productivity, increased exports, better use of resources through cooperation, reduce costs, increase flexibility, access to new technologies, successful change management and better access to global financial markets. While the disadvantages of mergers in clusters subjects business are: government's attempts to develop clusters, although businesses are not interested, small coincidence structure and corporate culture of partner companies, the lack of legal or financial opportunities, lack of entrepreneurial spirit, the low level of trust within the cluster, lacking knowledge partners, insufficient inclusion in the network of collaborators, lack of informal connections, unclear or unrealistic expectations of members who enter the cluster tourism as a highly dynamic industry, naturally attractive than other areas for the introduction of flexible regional development policy. Economics, form that enables the achievement of regional development through innovation, increased productivity, competitiveness and export orientation of the economy are the clusters.[58] To achieve such results is a complementary grouping charge of economic and non-economic entities and institutions associated with the same interest. Therefore, the model of clustering in tourism accepted worldwide as a powerful framework for sustainable destination development with economic, social and environmental point of view. The ability of providing greater values through the cluster model, allowing the region to be more competitive and expect better results to through numerous activities in the tourism value chain[59].

Conditions of tourism in Republic of Serbia

On the threshold of a new stage of tourism development, Serbia is faced with the need for rapid revitalization of the inherited structure and the wise use of many untouched attractions and design of new products. Certainly the rehabilitation of structures inherited a priority not only for the economically more efficient solution is to return to the international market, but the fact that he inherited and around the destination in the easiest possible way to raise the capacity supply and the level of competition, and thus create a stronger base for marketing activities.

The Strategy of tourism development of Republic of Serbia points out to opportunities for tourism development in relation to trends in world tourism, the tourism strategic positioning, selection of priority Serbian tourism products and competitiveness plan, investment strategy, plan the necessary investment and marketing plan. The expected results of applying the strategy to achieve increased competitiveness of Serbian tourism, increase foreign exchange earnings, growth in domestic tourist traffic, as well as job growth through tourism in order to transform Republic of Serbia in the competitive tourist destination. Republic of Serbia is the crossroads where the place intense adaptation to European integration and where to show a strong growth in the competitive capacity of institutions, companies and individuals. Tourism in this context, there is such an essential complex with increasing potential untapped. Serbian coach potentials are far underutilized, because tourism has never been a serious subject of development policy of Serbia. On the other hand, many states with similar or even lower potential in recent years have made efforts that brought them to the world tourist map of important countries. Examples of Republic of Hungary, Czech Republic, Bulgaria, Romania and Poland confirm it the best. Republic of Serbia today has only comparative advantage in tourism, because it has a variety of tourist structures, located near the traditional and emerging

[58]Barilovic, Z., Funda, D., Clusters asthe possibilityof economic development, http://www.famns.edu.rs/skup1/radovi_pdf/barilovic_funda.pdf, downloaded , 5.09.2012.
[59]Djurasevic, S., (2009), Clusters as abasis forregional developmentin tourism, theMontenegrinJournalof Economics,No.9,p.101-109.

tourism markets, has a long history and a general recognition, preserved natural resources, and the proportion of good communication has great human potential. The transformation process of comparative into competitive advantage in the tourism industry of Republic of Serbia is a part of the reform process, as well as the political attitude towards tourism as an important creator of national prosperity.

According to the study of the World Economic Forum (The Travel & Tourism Competitiveness Report 2011) among 134 countries, Serbia on 85th place ranking is worse than Slovenia (which is 32), Croatia (33), Montenegro (36), Macedonia (76) and better in respect of BiH (97), when be considered in relation to the countries from the former Yugoslavian region[60]. So, in addition to numerous tourism potentials, the Serbian tourist products are not adequately developed or commercialized in the global tourism market. From the current approximately 87.000 accommodation facilities in old buildings, Serbia does not achieve business results not nearly as competitive countries. Because of the closed market delayed the process of restructuring and privatization, there were no significant investment from home and abroad, so there was no development of new forms of tourism. Due to the high centralization there were no investments in infrastructure maintenance inherited tourist destination because communities are not financially able to meet the requirements of their particular maintenance and new development. The value chain of tourism of Republic of Serbia, in Belgrade, except to some extent, is not built. This raises the question of standards, quality of service and loyalty to Republic of Serbia as a tourist destination. Tourism development goals and interests of Republic of Serbia in tourism are as follows[61]:

promote economic growth, employment and quality of life of residents through the development of foreign tourism;

ensure the development of their own positive international image;

ensuring long-term protection and integrated management of natural and cultural resources in the interest of sustainable tourism development;

ensuring international quality standards of tourists protection according to contemporary European practice.

Popular tourist positioning of Republic of Serbia must be based on the professional insight into factors that have a crucial impact on the overall success of Republic of Serbia as a tourist destination. It is a minimum of three key factors:

an objective interpretation of the central elements of the offer in the field of resources and attractions, and defined strategic potential for success in the tourism industry;

analyzing and assessing the value of current and expected trends in the global tourism and realistic assessment of opportunities for market penetration and development of Serbia;

analysis of the competition, which includes structural and procedural knowledge in the real state of the competitive circuit.

Tourist structuring of Republic of Serbia

Schedule of characteristic tourism clusters in Republic of Serbia is based on administrative boundaries that currently exist within the country, but primarily rational strongholds in various forms of experience economy, which in some parts of the country can be developed.

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[60] The Travel & Tourism Competitiveness Report 2011, World Economic Forum
http://www.weforum.org/issues/travel-and-tourism-competitiveness, accessed5.09.2012.
[61] The Strategy of Tourism Development of Republic of Serbia,p. 8., orwww.srbija.gov.rs, accessed5.09.2012.

One of the ways to achieve drivers of innovation and competitiveness in the modern business environment is the association and cooperation of enterprises in the cluster. Clusters through horizontal and vertical integration of enterprises and strengthening the links and relationships between these companies, strengthen the competitive advantage of companies and institutions involved in clusters[62]. Based on the concentration of different types of resources in some parts of the country it is possible to offer a principal theme for differentiated positioning of individual clusters, namely[63]:

Vojvodina;

Belgrade;

Western Serbia with Kosovo;

Eastern Serbia.

The proposed framework tourist structuring of Serbia contains all the essential elements:
point out commonly known geographical term for which the binding of Republic of Serbia is relatively fast and at low cost travel could identify with foreign tourists;

indicate that the products would initially be placed on the international market;

recommend a clear relationship with Europe;

recommend a link with the cultural, spiritual and emotional values of the area and the people, making the tourist offer in the broadest sense of the word.

Projections of the basic parameters of the tourism sector of Serbia and their regional (cluster) distribution based on the following assumptions:
socio-economic development of Republic of Serbia, which will take place towards the inclusion of Serbia into the European integration;

the development of tourism in Republic of Serbia is responsible centralized state agency or other form of organization to support the development of entrepreneurship in the tourism industry of Republic of Serbia;

to immediately take the necessary action to be as soon as possible and commercialize products that are internationally "and MICE Business Tourism", "city breaks", "Events", "touring", "special interests" and "cruising "where should i start an international campaign building awareness of the country as a tourist destination;

taking the necessary actions to begin with the removal of the identified "bottlenecks" and open development processes identified product "Marine", "Health tourism", "Mountains and Lakes" or the "Rural Tourism", which due to high initial investment in hardware and software can not be immediately commercialized in the international market.

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[62]Pejanovic, R., Njegovan, Z., (2009), Current problemsofagriculture and rural areas Serbia, Industry, Institute of Economics, br.1/2009, p. 87-99.
[63] The Strategy of tourism development of Republic of Serbia,p.17., orwww.srbija.gov.rs, accessed5.09.2012.

Today's Serbian tourist destinations/clusters and national tourism policies are in limbo, primarily due to the fact that the tourism policy of Serbia does not have the instruments to influence the development, growth and competitiveness in tourism. If she wants to build international competitiveness in tourism, Serbia must accept the fact that the very business mission of national tourism policy must be subordinated to this, at least until the establishment of the mature stage of development. Therefore, there is a direct correlation strategy to create a competitive tourism sector and the current capacity of tourism policy of Serbia. Realization of these and other activities and tasks that are detailed in the plans of competitiveness, investment and marketing, building a vision, strategic positioning and development of the national tourism policy. Emphasizes the issue of commitment required for the construction of tourism policy of Republic of Serbia. Only in this way it can be moved toward the realization of pre-defined and ambitious development goals.

Establishing institutional infrastructure for tourism development of Serbia

Although tourism policy until recently was not considered important, today is the starting point of the thought process in the tourism industry. It is focused on the tourism development at all levels and as such needs to create a long-term development perspective. The traditional state policies on tourism are gone. Government of some countries or support already built a competitive framework for the actors in the tourism process (for example, Austria and Switzerland) or are actively involved in entrepreneurial and competitive environment for the construction of tourism (Greece and Turkey at the start of his tour of ascent, Egypt and even today). At the level of state policy, it is recognized that the tourism competitiveness creating on the level of tourism clusters and products, rather than on the national level. In this regard, the government should support the competitiveness of clusters tourism development variety of investment in infrastructure, as it is now no longer speaks about tourism competitive states than the states with more or less competitive tourism clusters/destinations. Been classified on the Serbian tourism clusters is performed based on the strong needs of the individual clusters Serbia/destinations regulate our own position, so to achieve competitive advantage on its own. In this way will be the most successful and distinguished oppose competition. Key competitive tourism product portfolio strategies by clusters have been set up with the goal and the way to open the way for the establishment of their international competitiveness. This practically means that Serbian tourist clusters should do the same, better or different than competitors. In essence, the meaning of competitive activity is to Serbian tourism clusters marketing experience, which they cannot be experienced with the least possible effort for the guests. Competitive clusters activities, their operational efficiency, or "diamond competitiveness" which stimulates them, represents three instruments that define the concept of competitiveness. They can be successfully developed only with the cooperation and partnership between the private and public sectors. This partnership must, however, be based on mutual interest and maximum transparency. No one can strengthen the competitiveness clusters instead of actors who appear in it. State authorities in Serbia still only privatization can affect the structure of private actors in the cluster, which can only take responsibility for building competitiveness. The only way to effectively influence the long-term competitiveness of the cluster (considering the options, reach agreements and make available their intellectual, technical and financial resources) is to establish cooperation and partnership between stakeholders of the public and private sectors.

Conclusion

We can conclude that if she wants to revitalize inherited offer protection and planning and use their own potentials quickly, Serbia must decide what kind of interventionist development model competitive tourism products and tourism clusters she needs. Creating and operating a professional enterprise concerned, not only as the initiator and public sector partners at the destination, but also to all domestic and international investors and fund a possible solution to an increasingly competent subjects deficit on the local market. Otherwise, Republic of Serbia in the near future will be difficult to quickly improve their operational efficiency and competitiveness of the tourism industry. In fact, without the development of tourism in their own expertise and competent cannot be sustained in the long term.

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EVENT TOURISM AS A POTENTIAL GENERATOR OF DEVELOPMENT OF THE RURAL TOURISM IN THE REPUBLIC OF SERBIA

Gordana RADOVIC[1*], Radovan PEJANOVIC[1], Zoran NJEGOVAN[1], Kristina KOSIC[2]

[1]Faculty of Agriculture, University of Novi Sad, Serbia
[2]Faculty of Sciences, University of Novi Sad, Serbia
(Corresponding author: finpoljo@eunet.rs)

Abstract

Events certainly have their social role and are significant for preserving tradition and cultural heritage, but they could also have an economic effect if integrated into the tourist offer and promoted on both the domestic and international tourism market. According to the current data in the Republic of Serbia, there are around 1.000 registered events of various sorts, although the actual number is estimated to be even higher. The objective of this paper is to present ethnographic and gastronomic events held in the Republic of Serbia, and by identifying them and their most frequent destinations, point to the opportunity of the rural tourism development. If the events are chronologically and territorially integrated in the tourism product, there is a possibility to transform the comparative advantages into the competitive ones and valorize them on the tourism market.

Key words: *rural tourism, ethnographic and gastronomic events, Republic of Serbia.*

Introduction

Tourism is nowadays a leading service industry in the world. It makes 13% of the world's overall service industries, and it demonstrated quite vitality in the conditions of economic crisis. According to the data of the World Tourism Organization, tourism growth in 2011 was 5%, while in the first six months of 2012 it was 4%. As far as the financial ability is concerned, prevailing are the tourists who are on a lower to average financial ability scale, while when it comes to age structure, majority of them belong to the young and elderly age groups. It is estimated that in future tourists would be more oriented towards the continental tourism, while the seaside tourism will be neglected (Unkovic, 2012).

When it comes to development of continental tourism, we believe that in the Republic of Serbia advantage should be given to rural tourism development, taking into account that even 85% of the territory is rural and inhabited by 55% of the total population of Serbia. It should not be forgotten that rural tourism is given a priority in the Tourism Development Strategyof the Republic ofSerbia[64] among other types of tourism related to special interests of the tourists. Rural tourism[65] is a type of tourism comprising all the tourist activities taking place in rural regions, which can be considered a tourist offer of the particular region in question. Most of the rural regions in the Republic of Serbia kept their traditional architecture, still possess valuable ethnic features, clean environment, rich cultural heritage and diverse gastronomic offer, while the people living in these areas are well-known for their hospitality. According to the statistics of the tourist association's archives, rural tourism began to live in the Republic of Serbia during the 70s of the 20th century, when 50 villages i.e. 800 households

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[64]*Tourism Development Strategy of the Republic of Serbia*, Official Gazette, RS No. 91/2006
[65]*Ruralni turizam*; Eng. Rural tourism; Ger.Ferien auf dem Land; Fr. Tourisme rural; Ital. Turismo rurale.

offered the capacity of around 3000 beds (Muhi, 2009). According to the official statistics from 2009, a total of 145.354 overnight stays were registered specifically in rural tourism, while 2.556,128 overnight stays could fall under the category of rural tourism, which altogether makes 2.700,000 or 27% of the number of registered stays on the territory of Serbia in all of the tourism sectors. There are no official data on number of registered agricultural households dealing with village tourism but according to the estimation of local tourist organizations, Serbia possess the capacity of 10.567 beds in village households, and it is assumed that 32.747 more could be employed in rural tourism. In addition, according to the estimates, 10 billion dinars of income was generated from rural tourism in 2010, which makes 16% of the total of 62 billion dinars as the overall direct tourism gross domestic product for Serbia in 2010.[66]

According to the previously stated, it can be concluded that the Republic of Serbia does possess the comparative advantages, but they are insufficiently exploited for the purpose of rural tourism development. This is backed up by the fact that the average occupancy is only 4%, as well that it varies significantly throughout the year. In order to achieve the continuity of the tourist flow, it is necessary to connect the rural tourism offer with numerous various events that are held in the Republic of Serbia during the year. Ethnographic and gastronomic events are certainly considered the most important for the rural tourism offer, and therefore are the subject of study in this paper.

Meaning and significance of the events

Event (Lat. manifestatio) stands for a public performance or event (Klajn and Sipka, 2006). Tourism events mean public performance or displaying something in public, as for example exhibitions, celebrations, or various performances of human achievements. They are special for its uniqueness and ability to reach goals and effects of tourism, and are organized in places where there exists a special interest (Bjeljac, 2006).

Tourism values that are not of a monumental nature but represent people's spiritual heritage, are presented in the form of events. Numerous phenomena and objects can be called tourism values only when presented through the events. In addition, the value of each particular event is determined by its location and timing. This confirms that good traffic connection of the populated areas, together with other tourist attractions and event timing, directly influence successful organization of the event. Well-thought-out organization and strong logistics contribute to achieving any of the desired goals, be it a presentation of achievements, enrichment of the seasonal offer, keeping the residents together in the place of origin, or raising interest among the accidental visitors. The most common form of presentation and tourism offers is through commercial tourism events, folklore events, and business-oriented ethnographic events. Such events advertise their commercial products through entertainment, tradition, folklore, customs, and usually have the aim of selling products (Kosic, 2009).

Events are integrated in tourism and represent an undeniable part of human civilization from its beginnings. Moreover, they stand for a global phenomenon of growing importance through the means of the event industry. They are: (a) of social (cultural) importance, which is seen through preservation and promotion of tradition and cultural heritage; (b) income generators; (c) efficient means of attracting both foreign and domestic tourists; (d) an opportunity to mobilize local resources, contractors and entrepreneurs; (e) excellent means of promoting the destination, local culture and community values but also the country where the event takes place. Serbia is the only European country recording a 2% growth in foreign tourists' visits in 2009, in comparison to 2008, and the reasons can be found in the following events:

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[66]*Master plan održivog razvoja turizma Srbije*, www.merr.gov.rs, (11.09.2011.)

Universiade in Belgrade, traditional annual festivals like Gu a, Exit, Belgrade Beer Fest, which altogether drew in around one million visitors, 10% of whom were from abroad(Delic, 2012).

Ministry of Finance and Economy of the Republic of Serbia recognized the importance of the events for tourism development and tends to continually raise investments in this type of tourism product. In 2007, the share of subsidies allocated to the events, in the overall budget for subsidizing the non-profit sector, was 33%, and in 2011, this share grew to 58% (Pindzo, 2012).

Events have social importance when it comes to preserving tradition and cultural heritage, but they can also have commercial value if integrated in a single tourism offer and purposefully promoted on domestic and foreign tourism markets. According to the data available in the Republic of Serbia, there are around 1.000 registered events of various sorts, although the actual number is estimated to be even higher. Considering this, Serbia can be rightfully called an event country. The best known ones record visits of 50.000 to even 150.000 tourists. We believe that in order to fully exploit the event tourism potential, it is necessary to connect (integrate) this type of tourism with another tourism product and create a unique offer for both the local and foreign tourism market, which would in turn have a favourable effect on balance of payments and reducing unemployment in Serbia. To be precise, if the event tourism is integrated with the rural tourism, which is further proposed in this paper, the result would be reducing unemployment in rural regions, ensuring survival of our villages, which would have a beneficial effect on the demographic picture, bearing in mind the fact that every fourth village in Serbia is simply dying out. On the other hand, rural tourism would increase tourists' spending on non-accommodation services. "Most revenues in tourism are generated through the accommodation services, serving food and beverages, while the accompanying services generate almost negligible income (Boskovic and Njegovan, 2012)

Table 1 shows results of the latest research on characteristics of the events in the Republic of Serbia, presented at the 45th Fair of Tourism in Novi Sad.

Table 1. SWOT analysis of tourism product/events in Serbia

STRENGTHS	WEAKNESSES
* Human resources (educated staff, enthusiasm, voluntary work, willingness to work in teams); * Collaboration with other stakeholders on local level (educational and cultural institutions, local media, food manufacturers, etc.); * Opportunity to create interactive activities depending on the programme of events.	* Inadequate staff expertise (planning, organization, management, monitoring, marketing); * Lack of motivation of staff employed in tourism; * Professionalism; * Lack of awareness among the local people of the importance of tourism events and cultural heritage; * Standardization of the programme and activities to match the type of event; * Inadequate product branding and profiling; * Unrealistic budget and financial analysis; * Lack of originality (tendency towards kitsch); * Unsustainability of events.
OPPORTUNITIES	**THREATS**
* Multiethnicity and multiculturality; * Wealth of natural and cultural heritage; * Increased number of tourists in Serbia; * Tendency of growth in number of tourists from abroad; * Growth in accommodating capacities; * Public-private partnership; *Existence of strategic paper regarding the development of this product on national level; *Networking, integration and clustering of	*Cumbersome procedures for getting various permits and slow local administration; *Danger of losing the local cultural identity due to inadequate programmes of the events; *Political changes; *Inadequate souvenir offer; * Inadequate product branding and profiling in the Law on Tourism; * Limited capacities of particular areas; *Devastation of environment;

700

events; *Educating the organizers of events and local tourism organizations; *Availability of EU funding; *Revitalization of areas for agricultural production; *Revitalizing the tangible and intangible cultural heritage.	*Insufficient exploitation of existing funds; *Inability to perceive tourism as important economic activity on a local level; *Having many different events at the same time; *Small-scale, poorly organized events damage the image of big and recognizable events, which are held in the same place but at different times.

Source: Research results: Improving the quality of tourism product/event, overall result of the workshops, which were conducted between December 2011 and September 2012 by the Ministry of Finance and Economy of the Republic of Serbia, Sector for Tourism, Chamber of Commerce of the Republic of Serbia, regional chamber of commerce and Tourist Organizations of the City of Novi Sad and Vršac, whose results were presented at the 45th Fair of Tourism in Novi Sad on September 27, 2012.

Importance of the events for rural tourism development

The appearance of rural tourism on the world tourism market is related to specific demands of the tourists, who regardless of the experience potentially acquired through the mass tourism, still wish to use this type of tourism to meet different cultures, customs, habits, food and way of life. The mentioned differences can best be seen in rural environments of particular states, having in mind that such environments are the guardians of tradition since they managed to preserve, despite the mass culture, all of the unique characteristics of certain peoples and nationalities. Ethnographic and gastronomic events, which are common in rural areas, are exactly the right guardians of tradition and perfectly reflect typical food and way of life of certain peoples. Therefore, they are invaluable in keeping the traditional agriculture, old crafts, richness of folklore, national costumes and folk celebrations.[67]

According to Dr. Demonja, in order to develop rural tourism, it is not only enough to have tourism economies but also the catering infrastructure together with well organized rural tourism destinations.[68] On the other hand, according to the analysis done by Dr. Kušen, and under the assumption that tourists spend at least three days at the rural tourism household, after satisfying the basic subsistence needs, they have on average ten to fourteen spare hours a day for activities proposed by the host i.e. tourism product designer, to make their stay more pleasant and interesting.[69] It is necessary to develop an integrated rural tourism product in the Republic of Serbia that would be based on comparative advantages that the country has for the development of rural tourism, but also on numerous ethnographic and gastronomic events held mostly in rural regions. Ethnographic[70] events preserve the customs, culture and tradition of peoples, while gastronomic[71] ones tend to keep the tricks of trade in preparing food. In order to highlight the originality of a certain locality, it is necessary to avoid having similar events in different places, but enhance exactly the event that is authentic for a certain region instead. It is recommended to territorially and chronologically connect several events, create an

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[67] Radovi G., Pejanovi R., Njegovan Z., (2012), *Etnografske i gastronomske manifestacije kao indikatori razvoja ruralnog tuirzma u Vojvodini,* Tematski zbornik radova, Sedmi nau ni skup sa me unarodnim u eš em, Turizam: izazovi i mogu nosti, Trebinje, str.482.

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[71] Klajn I., Šipka M.,(2006), *Veliki re nik stranih re i i izraza* ; Prometej, Novi Sad, str. 280, "Gastronomija: poznavanje veštine pripremanja jela, kult ukusne hrane, uživanje u hrani, sladokustvo."

integrated rural tourism product, which will rely on accommodating the guests in village households placed near the event localities.[72]

Table 2. Municipalities/cities possessing the greatest potential for development of the integrated rural tourism product

Ba ka Palanka
Etno šor; „Ala volem kolo da igram", Štrudla fest; Dunavski bal
Bostanijada

NoviSad
Festivalmeda; Danimladogvina-portugizer; Festivalfolklora; Interfest-festivalvina; Šunkafest; Futoškakupusijada; Siriškoprelo; Rumena kapihtijada; Koviljskarakijada „Parastosdudu"

Titel
Tradicionalna izložba ru nih radova; Etno manif. „Pokaži da ti ja pokažem"
Kotli pod titelskim bregom

Subotica
„Ukusitradicije"; „Svinjokoljskidani"; Takmi enje žetelacauru nomkošenju žita „Ris"; Dužijanca; „Interetno"; „Berbanskidani"; „Butkicijada"; „Pali kevinskesve ansoti"; „Danimladogvina"; Festivalkulturesveta"; „Etnofest"; „Prvomajskiuranak"; „BerbanskidaninaHajdukovu"; Festivalbeloglukau Šupljaku; PasuljijadauDonjemTavankutu; Festivalbunjeva kihprelauBajmoku

Sombor
Festivalvinaihrane „RavangradWineFest"; Somborskikotli ; „Bodrogfest" uBa komMonoštoru; IzložbastarihzanatauSonti

Kikinda
„Daniludaje"; FestivalgulašauRuskomselu; „Gusanijada" uMokrinu; Danivinaivinograda, Saborfrulaša „Škripi eram" uI ošu; Danijeseniukorpi; Severnobanatske žetvenesve anosti; PitijadakrompirušauNovimKozarcima

Žagubica
SaborvrelaHomolja; Saborfrulaša; Danizdravehrane „Priveg"; Danibiljaigljiva; Spasovdaskidani

Žitište
„Pilefest"; „Pasuljijada" uRavnomTopolovcu; BanatskatestijadauSrpskomItebeju; „Kara or evskaprela" uBanatskomKara or evu

Zrenjanin
„Banatskevredneruke"; Me unarodnifestivalfolklora „Lala", Daniparadajza; Festivalljubaviivina; Svetskoprvenstvoukuvanju obanskogpaprikaša

Deliblato
Etnomanif. „Opuštenoodsrca"; Pihtijada; Etnobazar „Nelomitemibagrenje", Berbagrož a; „Slaninijada" uKa arevu; „Gulašijada" i ŠunkafestuOmoljici; Žetela kidaniuVojlovici; „Paprikijada" uBanatskomBrestovcu

Pan evo
Zlatnikotli , Takmi enjeukuvanjuriblje orbe; „Štrudlijada"; Dolova kisajamvina; VinarijadaDolovo

In ija
Pudarskidani; Danimeda; Sajamvojvo anskihkihvina; Etnofestival; „Sremskipeškir"; Etnomanif.„Tradicionalnograditeljstvokaosrpskiproizvod"; „Najboljavinapodjednimkrovom" uKr edinu; Zlatnikotli uBeški; Etnomanif.„Maradi kajesen"

Irig
Pudarskidani; „Guš evijada"; Etnomanif.„Jesenidedunjomoja,kukuruzive suzreli"; Danivina; „Bostanijada" uRivici

ajetina-Zlatibor
Sabortruba aismotranarodnogstvaralaštva; „Pršutijada"; Šljivova kisajamdoma erakije „Rakijada"; Etnomanif.„Seoskivišeboj" uJablanici

Valjevo
Etnomanif.„Zlatniopanak", Festivalduvan varaka; DanimalineuBrnkovini; „Prelaiposela" uDonjojToplici; DanigljivauMedvedniku; DanikupineuStavama

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[72] Radovi G., Pejanovi R., Njegovan Z., (2012), *Etnografske i gastronomske manifestacije kao indikatori razvoja ruralnog tuirzma u Vojvodini,* Tematski zbornik radova, Sedmi nau ni skup sa me unarodnim u eš em, Turizam: izazovi i mogu nosti, Trebinje, str.488.

Krupanj		
DanikrompirauRa evini;	DanigljivauRa evini,	„Krkušijada“;
Etnomanif.“Nadigravanjezadukat“uDobromPotoku; Danime ašauMa kovomkamenu		

Loznica
„Lazarice“; „Pekmezijada“
Me unarodnaizložbagljivaigljivarijada“; Smortanarodnogstvaralaštva „Dodole“
„Miholjskidaniseoskogturizma“; Etnomanif. „Moba“; „Savinsko prelo“
Sajam vina i starih zanata

Topola		
„ ur evdanskidanivinairakije“;	Sabornarodnogstvaralaštva	„Oplena kaberbagrož a“;
PrvomajskiuranaknaBukulji; „Šumadijskidani Šljive“ uStragarima		

Beograd		
FestivalfolkloraSrbasazapadnestraneDrine;	„Vinogastrofest“;	Beogradskisalonvina;
Beogradskirakijafestival; Festivalslavaipravoslavlja „Slavagastro“; „Fishfest“; „Vinofest“-		
Sajamgastronomijeivinskogturizma		

Kraljevo		
„Pasuljijada“;	Danimeda;	Smotrade ijegfolkloraiansabalaSrbije; „Projada“
iSmotranarodnogstvaralaštvadeceSrbijeuRatini; „Daniborovnice“ naKopaoniku		

Niš
Etnosajam; Danibureka; Rakijabrend,;Danivinaimeraka; Salonvinai okolade „Dol eVita“; „Pihtijada“
uNiškojBanji

Source: Resultsoftheresearchconductedwithin the paper called "Rural Tourism as Factor of Rural Economy Diversification in the Republic of Serbia" (see the list of references)

Table 2 shows municipalities and cities in the Republic of Serbia with the greatest number of registered ethnographic and gastronomic events throughout the year, according to the data from Tourism Organization of Serbia .[73]These are at the same time the areas showing greatest potential for development of the integrated rural tourism product. According to the definition we proposed, IRTP[74] stands for the synergy of event tourism, based on ethnographic and gastronomic events, and rural tourism. It is therefore both justified and necessary to invest in the rural tourism offer development on the territories of municipalities and cities listed in Table 2. The process of identifying the events and creating the integrated rural tourism product should be conducted by the local economies together with local tourist organizations, and with strategic and financial support from governmental and provincial institutions, taking into account that the state "ought to create desirable ambience for promoting a certain concept of development (Pejanovic and Njegovan, 2012).

Conclusion

The Republic of Serbia possesses comparative advantages for rural tourism development, which are insufficiently exploited. Average occupancy of the accommodation facilities in the Republic of Serbia is only 4% in rural tourism, which suggests that in order to ensure a continuous flow of tourists and raise occupancy during the year, it is necessary to integrate rural tourism offer with numerous ethnographic and gastronomic events, i.e. create an integrated rural tourism product. Such product means to chronologically and territorially relate several events, which will rely on accommodating guests in rural households situated around the event localities. With the aim of highlighting the originality of a certain locality, it is necessary to avoid having similar events in different places, but instead, boost development of exactly those events that are authentic for a certain region. The greatest potential for integrated rural tourism product development are seen in Ba ka Palanka, Titel, Subotica,

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[73] Radovi G., Pejanovi R., (2012), *"Rural Tourism as Factor of Rural Economy Diversification in the Republic of Serbia" (see the list of references)*
[74] IRTP=Integrated Rural Tourism Product

Sombor, Kikinda, Žagubica, Žitište, Zrenjanin, Deliblato, Pan evo, In ija, Irig, ajetina-Zlatibor, Valjevo, Krupanj, Loznica, Topola, Kraljevo, Niš, as well as in areas surrounding the cities of Belgrade and Novi Sad.

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IMAPCT OF FOREST PREAMENAGMENT WORKS ON FOREST FORMATIONS: THE CASE OF FENOUANE FOREST (DHAYA-SAIDA MOUNTAINS, ALGERIA).

Kerrache GHAOUTI[1*], Labani ABDELRRAHMANE[1], Benabdeli KELOUFI[2]

[1]Department of Biology, University of Saïda, Algeria
[2]Department of Biology, University of Mascara, Algeria.
(Corresponding author:kerrache_g20@yahoo.fr)

Abstract

After the independence of Algeria, a first attempt to forests orthogonal premanagment took place in 1968 in the Mountains of Ouled Nail (The Centre of Algeria) and was resumed in 1973 in the Dhaya-Saida Mountains (Western Algeria) over an area of 20,000 ha, this attempts was completed experimentally in 1984.

This project was applied to overcome the difficulties that have faced forest managers and his specifically aim was to create conditions to the development and the forest managment also the following objectives was cited :

- Prepare an optimal forest timber production both in terms of quality than on quantity and facilitate the managment operations in the phase of silvicultural management.

- The prevention of the wooded area and facilitate the fight against fires, land clearing, tree felling, grazing and erosion.

- The optimal mobilization of wood at the opening of thepartitions.

- Improving the forests water balance by increasing infiltration at the expense of the torrential flow.

During 1986, the Minister has decided to extend these operations on the massive forest of the western Algeria ; an area of 200,000 ha. Unfortunately since the abundance of the project in 1989, no studies or evaluations were performed on the results of his work while he is one of the hotly contested issue in the national forest sector.

In this work, we studied the impact of this project on forest formations of Fenouane (Dhaya-Saida Mountains) with an evaluation of the results compared to the objectives assigned to this project.

This study allowed us to estimate the dynamics of forest formations.

As a result of this study, we can say that despite the multiple benefits afforded by this project, this work has unfortunately caused much damage to the forest ecosystem with a disturbance of the water balance of the massif with extensive erosion of access lines (transect, road platform) opened uniformly in a low mountain region.

Keywords: *Premanagment*, *Impact*, *Erosion*, *Forest formations*, *Mountains*.

Introduction

The forest Premanagment, according to Grim (1989), is all operations with the objective of cutting the forest estate, its compartmentalization and its mapping to a

computerized planning favoring the production function but also taking into account the functions of protection and recreation, or on a forest and without any preliminary study, three types of openings are made uniformly (see Photo 1) with the following order:

- Firstly, the forest is compartmentalized by transects of 4 meters (Layon) wide open with bulldozer to limite the forest plots and used also in some cases as a forest access, the spacing is 300 meters in an east-west and 350 meters in the direction north-south. The data lines cross either the plains, hills, plateaus or mountains (see Photo 1). This architecture will result in the creation of quadrilaterals plot with an area of 10.5 ha.

- Then, a fraction of the primary openings are extended to 8 meters to constitute the forest roads.

- In the end, we proceed to the opening partitions within the plot, of 3 meters opened with bulldozer and distanced with 25 meters (see Photo 1) the concept admits a mandatory partitioning of at least 50% of the forest area and has as objectif to facilite the timber evacuation and hauling.
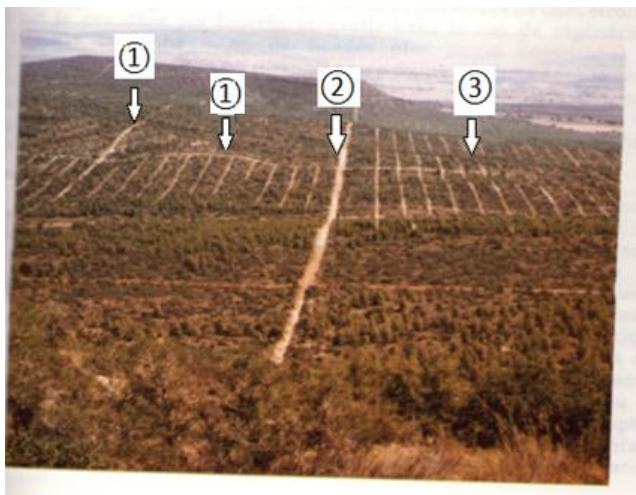
Photo 1.The openings ofthe orthogonal premanagment (PhotoGrim, 1989modified).

Materials and methods :

This impact study was carried out on the forest of Fenouane which lies about 20 km to the west of the capital of the province of Saida (western Algeria), administratively it belongs to the town of Ain El Hajar (See Map 1) and Geographically, the forest of Fenouane lies on a mountainous region (Dhaya-Saida Mountains) with a very rugged terrain where the dominant slope class is 7 to 12.5% where the average altitude is 850 meters.

The forest soils are dependent on the topographic morphology with five types divided into 3 classes with a dominance of modal brown calcareous soils.
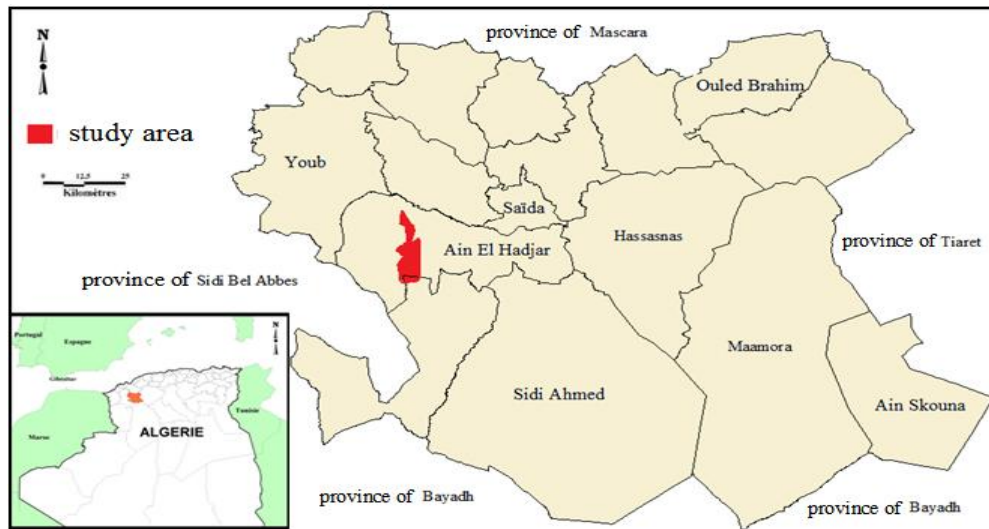
Map 01: Location of the forest of Fenouane (province of Saida, Western Algeria).

The region's climate is the Mediterranean semi-arid climate where the average annual rainfall, with 436 mm during the period 1913-1938 (Seltzer, 1946) and only 339 mm between 1980 and 2009, confirm a climate fluctuation with a clear trend towards aridity reported by several authors (ITGC, 1998; Benabdeli, 1996b; Mederbal, 1995 ; Kerrache, 2011). This trend to aridity should be considered in all development program and operation in the productive spaces (Labani and al, 2006).

Covering an area of 3598 ha, Fenouane forest is very representative of Mediterranean thermophilic vegetal groups, dominated by Aleppo pine and Barbary cedar but with a remarkable bushy undergrowth (Benabdeli, 19966a).

On Fenouane forest, operations of opening transects were conducted during the period 1974-1976 with the realization of 229 km and a fraction of 67 km has been extanded to forest roads ; the result of this operation is her subdivision on 374 forest plots. Partitioning operations were conducted during the period 1982-1984 with the opening of 825893 meters partitions (Grim, 1989).

Impact of pre-development work on forest formations

The openings of the orthogonal premanagment generate a very large bare area, it is 13,2% in the forest Fenouane (Kerrache, 2011) which affect the forest formations. The assessment and understanding of these effects by phytoecological diagnosis is a component for better management of forest ecosystems, to understand those impacts we process the following steps:

1/- The phytoecological bearings: we identify changes caused by openings made during the orthogonal premanagment works, where in the three forest formations of the forest Fenouane (dense forest, woodland and scrub), we taken several plots where homogeneous bearings of 100 m2 are installed to the description of the vegetation were a bearings conducted within the plot (the witness statement) and other bearings (1, 2, 3 or 4 bearings) are placed near the openings (transect and forest road). Throughout this forest, we performed in total, 51 phytoecological bearings (see Map 2).

2/- dendrometric analysis: We saw in the description of the orthogonal premanagment that the openingd are highly concentrated in the forest area where each forest plot with 350 meters long , a total of 16 openings are made (see Photo 1) accentuating the effects of edge by an excess to light near these openings (Balandier and al, 2002) which has as resulted more growth in height and diameter for the openings adjacent trees creating a gap between the

annual growth of the trees of the same forest crop (Collet and al, 2001). In order to estimate this growth surplus, a dendrometric analysis is required where we took the classic tree measurements (height and diameter) of the trees found along a direct line (15 lines in total (see Map 2)) which is connected within the forest crop (no edge effect) until the opening (transect, forest roads or partition) which is the point with the most enlightened with the following precautions:

- The forest crop sampled must be dense for the phenomenon of increasing growth in the edge is really significant.

- The forest crop sampled must had the same tree measurements in the beginning (same age and height), site selection is done by using the forest crop maps developed by the BNEF (1990) with a field verification.

- The morpho-pedological parameters (soil type and moisture) must be homogeneous along this line.
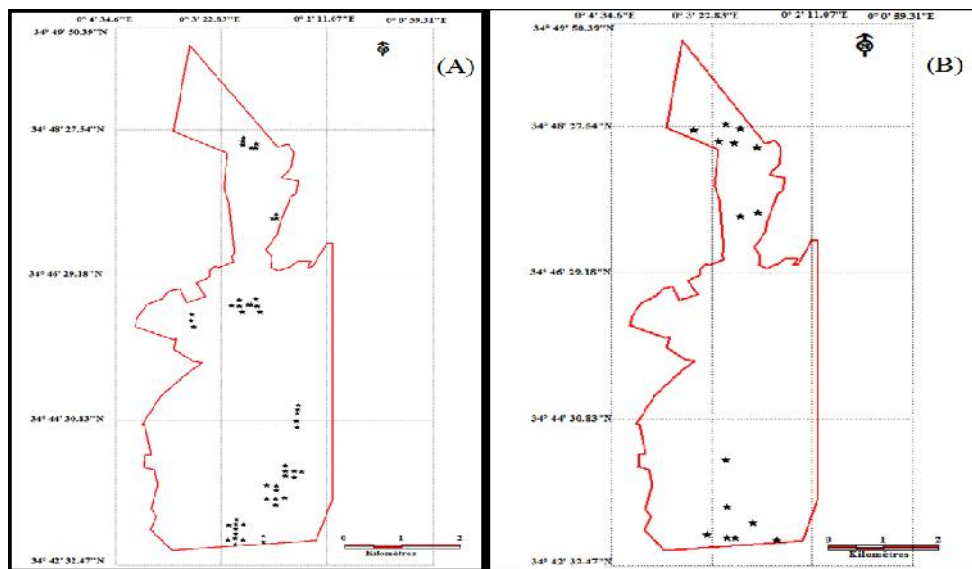
Map 2. Location of phytoecological bearings (A) and the starting points of dendrometric bearings (B).

Results and discussion

Vegetation is an indicative of environmental conditions and can be used to identify the consequences of past practices on the environment (Koerner and al, 1999), the phytoecological study allowed us to estimate the impact of the orthogonal premanagmentworks on vegetation with the following observations:

- The behavior of the colonizer cistus (*Cistus villosus*) in the dense part where it has spread dramatically near the openings that his presence within the plot is very small.

- In the scrub, a very large shrub species composed of species whit reproduction through sprouts as oleaster (*Olea europea* var europea), the phyllaire (*Phillyrea angustifolia*), mastic (*Pistacia lentiscus*) and kermes oak (*Quercus coccifera*) spread dramatically near the openings. According to the bearings made within transects and partitions, we note that almost all species recolonize the opening by stump or sprouts (oleaster, mastic, oak kermes, etc..) or

with seed like the Aleppo pine, closure rate partitions usually exceed 40 % of the shrub and 15% shrub stratum, the rate is often less important in the transects, generally less than 20 % but more than the shrub 40 % for shrub stratum.

The exploitation of mensuration data confirms the growth surplus on trees behind the edge of the openings created by the orthogonal premanagmentworks where the situation is as follows:

- In the non-partitioned plots, trees behind forest road (8 meters) have an average surplus of 25 Cm in diameter and 72 Inches high, those adjacent the transects (4 meters) have an average surplus of 11,5 Inches in diameter and 50 Inches high (Kerrache, 2011).

- In the partitioned plots, trees behind forest road have an average surplus of 10 Cm in diameter and 60 Inches high, those adjacent the transects have an average surplus of 12,5 Inches in diameter and 75 cm in height and feet adjacent partitions have an average surplus of 9,9 Inches in diameter and 72 Inches high (Kerrache, 2011).

After these very significant results, we can say that the openings in the orthogonal premanagmentworks are highly concentrated in the forested estate where the forest of Fenouane, an area of 3598,8 ha saw the opening of 1055,42 km divided between forest roads, transects and partition with respectively 8, 4 and 3 meters wide causing the denudation from vegetation of 13,2% of this forest. After this diagnosis, we can deduce that these openings have increased edge phenomena within the forest ecosystem with an observable phenomena in different forest formations such as the proliferation of plant species in the shrubs whith stump or sprouts and the proliferation of cistus (*Cistus villosus*) this species is highly flammable, located on the edge of the forest plot can create fire eclosion.

In addition, the dense forest stands are affected by the intensity of openings generated by the premanagment where the growth of trees located near the openings is influenced by a surplus of solar radiation. This creates disparities in the even-aged stands, which translates to the language by the destruction of the structure of these populations; mensuration analysis has allowed us to estimate thegrowth surplus that is very remarkable views height and diameter in non-partitioned plots and remarkable view height in the plot due to the light competition in trees adjacent openings. Also, following the removal of trees nearby leads to a rapid change in the architecture of the tree (Aussenac, 1977), something we have seen on the ground where trees have the branches very bases found near the openings caused by the absence of natural delimbing, which will promote the spread of fire and provide poor quality of wood.

Finally, the application of a geometric plotting on a mountainous region admit the opening of transects onsteep slope (see photo 2) where on a forest area of 665 ha saw the opening of 56,000 meters between transects, forest roads and partitions, about 34,68% are open on slopes between 6 and 12 % and nearly 10 % open on slopes between 12 and 25% (Kerrache, 2011), thus, these are affected by linear erosion (see photo 2) which causes a loss of water, carries soil and plant debris affecting the productivity of the forest stands and then prevents any movement of forester vehicle, currently the majority of these transects are inaccessible and impractical . In addition, beyond these gullies has generally within plots seriously disrupt forest stands with windthrow and roots denudation.
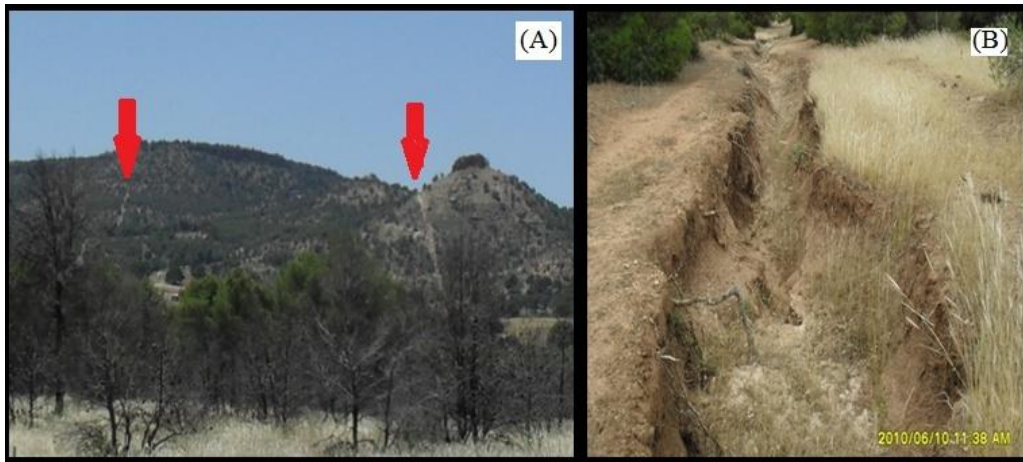
Photo 2:(A) Opening of transectsonsteep slope. (B) Erosion on atransect.

Conclusion

This impact study of orthogonal premanagment works on forest formations has identified shortcomings in the concept and addressing the damage done in this very fragile ecosystem to disturbance, among these shortcomings include the following points:

- The application of the concept of large forest tracts without any preliminary study.

- A very important area is exposed by the openings, it is about 13,2 ha bare for every 100 ha forest stands, which generates many negative effects (windthrow, forest bioclimate modification, erosion, etc.).

- The loss of access to almost all infrastructure opened (transects, forest roads and partitions) by a recolonization of vegetation or erosion.

- Disruption of hydrological regime of the forest by widespread erosion.

- Openings in the premanagment have caused the proliferation of species of shrub, as well as the proliferation of opportunistic species such the Cistus.

- The total forest opening provides easy access to the forest causing a surplus of overgrazing, cutting crime, thus generating a windfall of generalized degradation of plant cover.

- The creation of numerous sites of penetration and exit in the forests making the forest massive control very difficult especially.

- The structure destruction of the even-aged dense stands population etc.

We tried in this study to answer a palpable controversial topics of national forest sector but what is essential to raise is the necessary consideration of ecological characteristics in all processes in Mediterranean areas, according to Barbero (1981), these characters and their ecological characteristics are very important and must be taken into account in particular on the development and treatment of Mediterranean forests.

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TABLETING: ALTERNATE WAY OF VALORIZATION OF AGRO-RESOURCES

Benamara SALEM[*], Aksil TOUNSIA, Boukhiar AISSA, Megdoud DJEMAA, Iguergaziz NADIA, Babouri SARA, Galouz MOHAND SALAH, Nakib WAHIBA, Rahal SOFIANE

Department of Food Technology (FSI), Laboratory of Soft Technologies and Biodiversity (LTDVPMB/F S), University M'hamed Bougara of Boumerdès (Algeria)
(Corresponding author: sbenamara2001@yahoo.fr)

Abstract

In this work we attempt to investigate the possibility of use tableting as alternate way for valorization of some agro-resource species, including, certain date (Phoenix dactylifera L.) fruit varieties as ordinary edible fruit, strawberry tree (*Arbutus* unedo) berries and numerous medicinal plants. The preliminary results obtained are conclusive. In all cases, the date fruit powder is used as base matrix because of its capacity to undergo tableting. The combination of various plant species with date fruits allowed to obtain tablets with convenient physical proprieties in terms of hardness, disintegration time, erosion…Also, the final product acquired an appetizing flavor which is of a particular interest when the initial non-food matrix has a disagreeable taste. Thus, the formulation of such tablets from medicinal plants hides the bitterness, making the product more acceptable to consumers, especially those suffering from various diseases. Also, the fast dissolution of the date powder, thanks to the presence of natural simple sugars, make the obtained tablets very convenient for some patients. The physical-chemical proprieties of powder and then tablets from lyophilized strawberry berries are also investigated. Taking into account its high content in vitamin C, this powder can be employed as other natural ingredient enhancing the nutritional value of tablets, as well as their stability. Finally, the effervescent ability of date powder is studied, varying the proportions of some chemical reactants like tartaric acid, citric acid, sodium carbonate and bicarbonate.

Keywords: *tableting, valorization, agro – resources species*

Introduction

Tablets are obtained from various powder ingredients which can be classified into two main active and inactive (excipient) components. There are three main methods of developing powders for tablet making (Document Techceuticals, 2011): direct compression, wet granulating and dry granulating.

Among the different habitually used processes the food powders undergo, among others, compaction with view to obtain products with some functional characteristics (Dhanalakshmi et al., 2011).

Many food and non-food materials are subjected to tabletting: seaweeds (*Eucheuma cottonii*) (Abidin et al., 2011), bitter melon (*Momordica charantia*) (Hasan & Khatoon, 2012), pitaya powder (Yusof et al., 2011).

It is already underlined that date fruits may be considered as a more or less perfect food, providing potential health benefits (Al-Shahib & Marshall, 2003). Recently, we have reported about the possibility to produce tablets from certain date varieties of low commercial value (Adiba et al., 2011), whereas Ngwuluka et al. (2010) have investigated date fruit powder for its binding properties in comparison with acacia and tragacanth.

In the present work, tableting ability of powders from Algerian agro-resources, including date (Phoenix dactylifera L.) fruits, strawberry tree (*Arbutus* unedo) berries and olive (*Olea europaea L.*) leaves are investigated.

Material and methods

The powders used for tableting are prepared in laboratory using either thermal vacuum (200 mbar)-drying at 75°C (laboratory oven of type Heraeus) (for date fruits) or freeze- drying (for strawberry tree berries and olive leaves). The different tablets obtained are evaluated for their different properties: modeling of adsorption isotherms at different conditions and effervescent ability (date powder tablets), sensory and physical properties (date powder tablets added with olive leaf extract) and release properties (tablets from arbutus berries). Concerning adsorption isotherms, the different curves are obtained following the procedure described by Labuza et al. (1985). Also, the Brunauer Emmet Teller (BET) and Guggenheim Anderson Boer (GAB) models are tested to describe experimental data, using Statistica 8.0 software.

Compaction can be described as a large irrecoverable deformation during which the powder is changed into a dense compact (Sinka, 2007). Presently, two types of presses are used: single-station presse of type Herzog (in case of natural date powder and date powder added with olive leave extract) and laboratoryhydraulic pellet presse initiallyintended for IR analysis (in case of powder from arbutus berries).

The method followed to study the feasibility of effervescent date tablet formulation is adapted from that described by Nguyen and Pham (2011).

Results and discussion

Figures 1 and 2 present the examples of the shapes of the adsorption isotherms related to tablets obtained from date powder with different sizes and compacted with different forces.
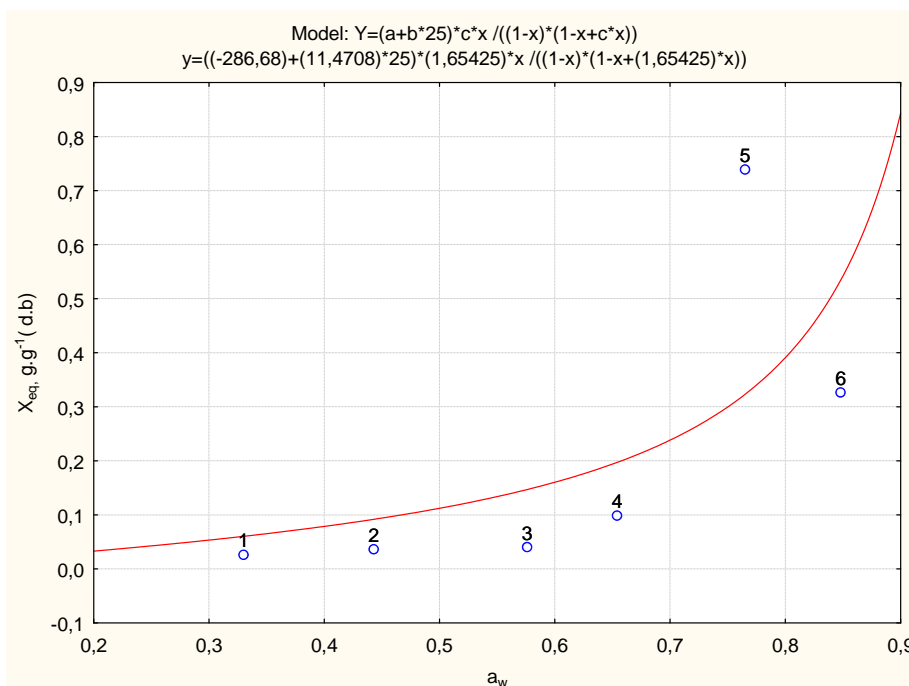

Model: Y=(a+b*25)*c*x /((1-x)*(1-x+c*x))
y=((-286,68)+(11,4708)*25)*(1,65425)*x /((1-x)*(1-x+(1,65425)*x))

Figure 1: Adsorption isotherm related to tablets from date powder obtained by vacuum drying), applying BET model (powder size= 200-250 μm; compression force = 10 kN; Temperature = 25°C)
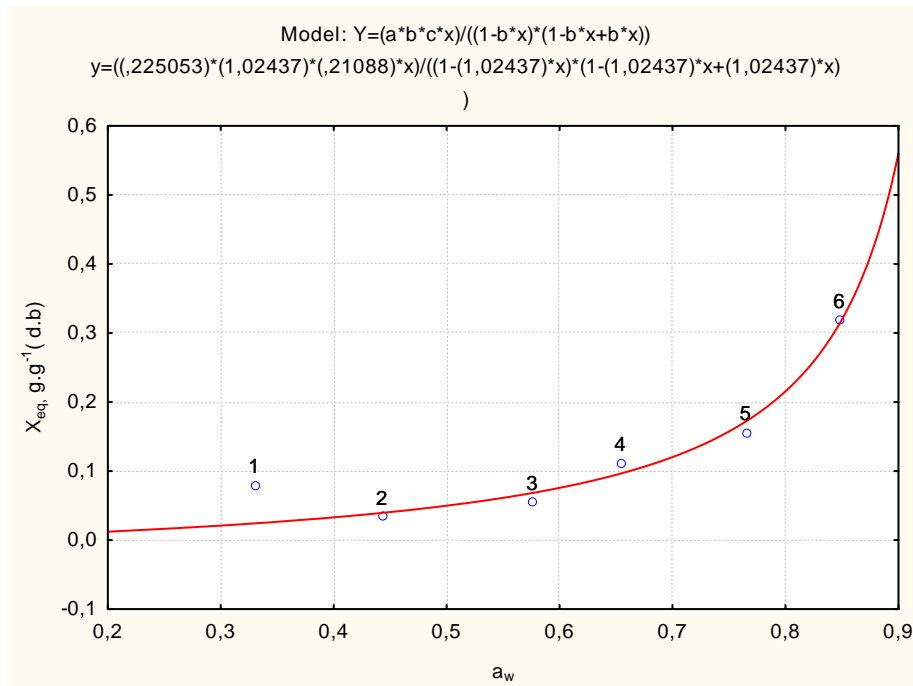
Figure 2: Adsorption isotherm related to tablets from date powder obtained by vacuum drying), applying GAB model (powder size= 200-250 μm; compression force = 5 kN ; Temperature = 25°C).

Moreover, the table 1 indicates the adequacy of models applied to describe the adsorption isotherms.

Table 1: Parameters of the two models (BET and GAB) and determination coefficient related to adsorption isotherms. Case of tablets obtained from date powder with 200-250 μm size.

	a	B	c	R^2
BET (5 kN)	252.22	10.09	0.94	**0.96**
BET (10 kN)	286. 68	11.47	1.65	0.62
GAB (5 kN)	0.22	1.02	0.21	**0.96**
GAB (10 kN)	0.42	0.86	0.41	0.66

As it can be seen, the both models describe correctly the adsorption isotherms of date tablets obtained under compression force of 5 kN. These findings are in concordance with those communicated by Fadini et al. (2006) who demonstrated that for tablets from macadamia nuts (at 25 °C) the GAB model was the most suitable, followed by the BET and Oswin models. It must be underlined that, the cited reference is the unique scientific work found to be devoted to adsorption isotherms of tablets.

On the other hand, the effect of environmental relative humidity on color stability of the tablets is clearly demonstrated (Figure 3) which thus highlights the importance of water activity as an essential parameter of the storage conditions of the formulated product.

	44,3	84,8
a_W (%)	44,3	84,8
Size (µm)	250-315	200-250
Compaction force (KN)	5	5
Results		

Figure 3: Effect of water activity on color stability of tablets (left: original color).

Some physical properties of tablets from combination of date powders with 3% (w/w) freeze-dried olive leaf extract are summarized in Table 2.

Table 2: Some physical properties of tablets obtained from combination of powders from date fruit and olive leaves

Parameter	Value
Weight (g)	0.48±0.04
Diameter (mm)	12.20±0.07
Thickness (mm)	3.48±0.19
Hardness (KP)	10
Friability (%)	<1
Disintegration time (min)	15

The obtained hardness is compared with that of tablets from pure date powder (not presented here). In opposite, the general acceptability of tablets by consumers (results also not showed in this paper) is positively influenced by this fortification.

Concerning tablets from arbutus berries, their release ability, expressed by means of conductivity is illustrated by the figure 4.

It can be easily noticed that the tablets show a good ability to release various nutrients (especially electrolytes: minerals, organic acids…). In addition, the temperature seems to influence considerably the release kinetics.

Regarding effervescent ability of date powder tablets, the effervescent time of about 1 min was reached when the ratio of effervescent agent (sodium bicarbonate and citric and tartaric acids) was 50%. We think that, apart from added chemical agents, the high sugar content of
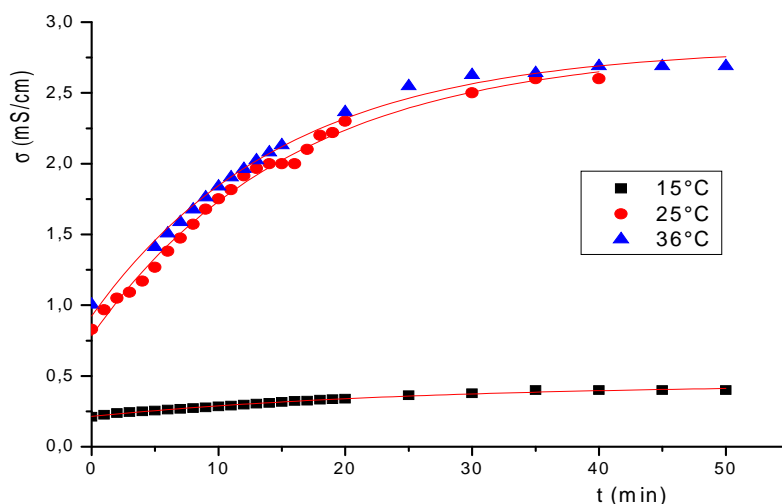
Figure 4: Conductivity versus time. Case of dissolution liquid medium (distilled water) of tablets obtained from powder of arbutus berries (compaction force=1000 Pascal).

Date powder may contribute to disintegration mechanism of tablets.

Conclusion

The possibility of formulation tablets from various local agro-resources is highlighted by the results presently displayed. Nevertheless, further investigations are needed to enhance the quality of the obtained final products.

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AGRICULTURE AND THE ROLE OF COOPERATIVES IN RURAL TOURISM DEVELOPMENT IN THE REPUBLIC OF SRPSKA

Vesna MRDALJ[1*], Drago TODIC[2]

[1]Faculty of Agriculture, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[2]Faculty of Sciences, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina
(Coresponding author: vesna.mrdalj@agrofabl.org)

Abstract

The importance of agriculture in a country is determined primarily through food production and ensuring food security. From the standpoint of tourism development of the country, first and foremost requirement is the production of food. Tourism is a direct consumer of agricultural products, thereby encouraging the development of agriculture, while agricultural production is influenced by trends in tourism spending adjusted by changing the existing structure. Cooperatives in rural areas in terms of improving the competitiveness of agriculture production, but also providing other necessary forms and contents for life and work of the rural population are very important. Generally, cooperatives are considered one of the main instruments of implementation of rural development policy measures, including measures that are specifically related to the development of tourist activities in rural areas. The goal of this work consists in determining the connection between agriculture and tourism, the place and role of cooperatives in the development of tourist activities in rural areas of the Republic of Srpskathrough the presentation of good practices.

Keywords: *Agriculture, cooperatives, rural tourism, Republic of Srpska*

Introduction

Tourism is now one of the world leading industries, which is an important economic, social and ecological factor. In the beginning of its development, it had characteristics of elite tourism for only wealthy members of society, and then transformed into a mass tourism, and today in specific forms of tourism. There are new forms of tourism, adapted to wishes and needs of each individual. According to estimates of the World Tourism Organization, tourism will experience progress by 2020, which will, among other changes, the tourism demand will go towards eco-tourism, cultural tourism, thematic tourism, and cruise and adventure tourism. According to these estimates, tourism will be based on the use of various natural and anthropogenic resources. This specifically includes rural areas, whose main activity agriculture is unavoidable as the main supplier of food, raw materials and labour, as well as responsible for the development of rural tourism and travel motive of movement of people. Rural areas represent the opposite of urban space. This is a space that originally served as a living work area of farmers and as whole cultivated, uncultivated and populated areas outside the cities.

This work aims at determining the connection between agriculture and tourism, the place and role of cooperatives in the development of tourist activities in rural areas of the Republic of Srpska.

Results and discussion

Very often village and rural tourism equalized, and the largest number of authors make no terminological and fundamental difference. The village tourism in Serbia today is marked by three different offers:

- On farm tourism,

- All kinds of tourism, which occur within the area of the village, and

- All kinds of tourism, which occur in the overall rural area, *i.e.* outside cities.

The main reason of terminological dilemma lies in the fact that in the Serbian language, there is no corresponding word for a common overall area outside the cities, which would set aside part of the village, namely the populated area and other space outside of city ."Rural" adjective was formed from the noun of village, and cannot be extended to the whole rural area, and in this sense, the use of the term rural becomes more adequate (although it is a foreign word), which refers to the total area outside cities and phenomena taking place in it (Todorovic and Šteti , 2009). There are several definitions of rural tourism, such as the definition of the Council of Europe (1986): "*Rural tourism is tourism, which includes all activities in the rural areas; the most important characteristics of this kind of tourism are quiet environment, protected environment, and the absence of noise, communication with hosts, domestic food and becoming familiar with village jobs*". However, more adequate definition for us is the one made by local authors that rural tourism is meeting the needs of local and foreign tourists in rural areas, with local and regional attractiveness. Developers of rural tourism must be aware of the fact that tourists in rural areas buy experience, and carries the memory of the house and some souvenirs. The best example of the development of rural tourism is Austria from 50s of the twentieth century to the present. The first phase of development of this form of tourism was self initiative of alpine villages of Austria. It was selected area, almost cut off from the world in winter, with agricultural production, which could no longer compete with the commercial and industrial agriculture of other developed countries. This was followed by depopulation and slowing down the development. After the analyzes, as part of a national strategy for the development of depopulated areas, rural areas of the Alps begins to revive, in which the rural tourism was leading activity with its complementary activities. New activities have allowed additional income, which compensated the lack of income from agriculture. The construction of municipal infrastructure, kept the population, and the contact with leads to reviving the economy and cultural life, and the symbiosis of old and new, traditional and modern. The life returned to Alps (Lukic, 2000). Tourism in rural areas of Europe today is an important element of the overall tourism offer and the development of rural areas. Rapidly, spatial planning developed and evaluation of natural resources, new development of agriculture and forestry, environmental protection, and cultural - historical heritage. Rural tourism has become an important link in the chain of development of rural areas.

Generally, tourism and agriculture are very closely related. Food production, food security production of raw materials for the processing industry; foreign trade of agro food products; and social, demographic, and other aspects determine the multiple significance of agriculture in a country. The first and basic requirement for the development of tourism in a country is the production of food. The Republic of Srpska in terms of meeting the needs of the local population in food, with the exception of some products (fruit and potatoes), is

characterized by a low level of self-sufficiency, and is forced to import substantial quantities of agro - food products. By providing enough food for their own purposes, for strategic reserves and exports, one can think more seriously about the development of tourism in a country. Between industry and agriculture there is a close relationship, which is reflected in (Mirjanic and associates, 2011):

- Production and consumption of agricultural and food products;

- Promotion of typical agricultural products (products with protected geographical indications of origin);

- Maintaining of rural landscapes;

- Organizing of agro-tourism;

- Enrichment and expansion of tourism facilities;

- Providing an additional source of revenue and jobs for the agricultural population.

Through direct consumption of agricultural products, tourism encourages the development of agricultural production. Under the influence of consumer trends in tourism, agricultural production is changing its existing structure. Tourism has a great importance and role in the development of rural areas. Effects of its development are of social, economic, and cohesive nature. Sociological effects are manifested through the creation of new jobs and increased employment. Specifically the inclusion of women and youth in addressing this activity is emphasized. Another very important sociological impact of tourism development in rural areas is to stop depopulation and migration patterns between rural - urban areas. In the Republic of Srpska there are highly expressed processes of migration, mainly incurred as a result of the influence of economic factors. Studies at the level of rural households showed an average of 0.35 family members, moved from rural areas (Mirjanic and associates, 2011). In terms of achieving the economic effects of tourism development in rural areas, it primarily refers to the increase in the total income of rural households through the sale of farm products, handicrafts, accommodation services on small farms. With the economic development of an area, including rural, infrastructure development is essential. In other words, with no developed public and tourist infrastructure there would be no tourism development in rural areas.

Cohesive effect of the development of rural tourism includes tourism as a mechanism for developing a balanced regional development. Under the planned regional organization of the Republic of Srpska, uneven economic development different regions is evident, and thus, the development of tourism activities would be significantly affect equal economic development of them (Rural development of Republic Srpska 2010). In addition to the above effects, the development of rural tourism significantly affects the preservation of local identity, traditions and customs, and other ambient values in rural areas.

Activities of cooperatives in rural areas in terms of improving the competitiveness of agriculture take an important place. The development and strengthening of business associations of farmers into cooperatives significantly influences the increased market activity of farmers. In the context of the development of rural areas, cooperatives are one of the key instruments of rural development. Specifically, they are the best organizational form of business connections and improved the position of farmers in rural areas. Agricultural producers through joining the cooperatives achieve their economic, social and other interests.

Furthermore, the nature of the organization and activities provided, enhance economic and social status of the rural population. Uniqueness of cooperatives in the context of rural areas is reflected in the fact that better efficiency in the implementation of rural development measures, is achieved if it goes through one organization instead of various users in relation to the implementation of measures to individual users. Key areas within which the results of activity of cooperatives in rural areas are manifested are: education and raising awareness of rural population, agriculture, improving the quality of life in the rural area by infrastructure development and introduction of complementary activities in order to increase sources of income for rural households and employment. Therefore, the activities of cooperatives in rural areas of the Republic of Srpska, on the basis of which the concept of long-term development of this form of tourism would be based upon, are:

- Continuing education of rural population and developing an entrepreneurial approach to developing tourism activities in rural areas;

- Definition of tourist attractions and facilities, according to which a certain area, the region was distinctive in relation to the other (image formation);

- Defining strategy, or certain forms of tourism, which could be developed based on existing natural and human resources;

- The identification and registration of rural households to engage in this activity;

- Enabling rural households to provide tourist services - investment in the construction and equipping facilities for agro-tourism activity;

- Marketing and promotion.

One of the best practical examples, reflecting the role and importance of cooperatives in the development of tourism in rural areas of the Republic of Srpska, is an agricultural cooperative "Agrojapra" Donji Agici, in Novi Grad municipality.

Administrative - territorial area of the municipality of Novi Grad encompasses 48 villages and cadastral municipality, where 47 villages with their domains make rural areas, while one area and cadastral municipality – Novi Grad is urban. Overall ratio of the rural and urban geographic space is 94.36: 5.64%, and as far as population is concerned (in 2008) 64.84: 35.16%. Generally, rural areas throughout the former Yugoslavia, and thus Novi Grad have been experiencing economic, social, functional and physiognomic transformation. This process had the most impact to the rural population, which has been steadily falling since 1961 from 27,590 inhabitants to 25,758 inhabitants in 2003, i.e. 6.65%. This decrease was flowing unevenly both spatially and temporally. Agricultural cooperative "Agrojapra" from Donji Agici near Novi Grad was founded in 2000 and operates on a large Podgrme area in the river valley of Japra. The cooperative activity included 255 households in the area of 23 villages. In addition to primary agricultural production, the cooperative established production facilities for the production of cold-pressed pumpkin and sunflower oil, a mini-dryer, a mini-refrigerator, a bakery, a mill on Japra river, etc. Moreover, the Cooperative has built a new village hall in which there is the library with a reading room, where is located the centre for education of its members, an ethno-museum that testifies the former life in the valley of Japra.

As part of the Cooperative project, rural tourism has become the educational and scientific basis for a large number of students in primary and secondary education, as well as students of Agricultural and Mathematics Science of the University of Banja Luka. As far as tourism infrastructure is concerned, the Cooperative plans to build hiking trails and a

sightseeing viewpoint on Hozi stone, summer stage with stands, accommodation of 50 beds for the school in nature, which could last for five full months during the year, as well as adaptation of accommodation for domestic and foreign tourists in rural households. Along with these, the Cooperative is working on the introduction of education programs for family farmers, who plan to get engaged in the provision of services in rural tourism.

Finally, to get all the benefits of the development of cooperatives in rural areas, or in this case, the start of tourist activities, it is essential to have material support of the local entity government, which would stimulate its development. Synergy andinvolvement of thekey stakeholders inorder tosignificantlyaccelerate the developmentof rural areas,whereby it would fully satisfy the principal activities of the rural development policy, based on the application of the principle of *"bottom-up"* and *"top-down"*.

Conclusion

Today, rural tourism as one of the specific forms of tourism is an important link in the chain of development of rural areas. It includes all activities in the rural area, and the main features of quiet and protected environment, absence of noise, communication with hosts, local food and exploring rural affairs. In the functionof the development of rural areas, rural tourism accounts for a number of positive effects from economic, social and cohesion standpoints. As an industry, tourism is closely linked to agriculture. Thanks to the direct consumption of agricultural products, tourism encourages the development of agriculture. The revitalization of rural areas focuses on cooperatives.

Generally, in terms of improving agricultural production cooperatives have an important place. In the context of the development of rural areas, cooperatives are considered one of the most important instruments for the implementation of rural development policy. Due to the nature of its organization and activities provided by the improvement of the economic and social status of the rural population.In the development ofruraltourism ,cooperativesactivities go from theeducation and informationof rural population, identification and trainingof ruralhouseholdsto provide servicestotourists, to marketing andpromotion.Supportof relevant local andentity institutionsisan unavoidable factorin the realization ofrural development measures,includingmeasuresrelating to thedevelopment of tourism activities.

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EVALUATION OF ACCOUNTING ACQUISITION OF BIOLOGICAL ASSETS AND PROPERTY

Nikola VUKMIROVIC[1], Djojo ARSENOVIC[2], Srdjan LALIC[3*], Dragan MILOVANOVIC[1]

[1]Faculty of Economics, University of Banja Luka, Bosnia and Herzegovina
[2] Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina
[3] Faculty of Business economics Bijeljina, University of East Sarajevo, Bosnia and Herzegovina,
(Corresponding author: srdjan.lalic@fpe.unssa.rs.ba)

Abstract

The mission and purpose of agricultural enterprises' accounting is to collect data about condition and behavior of all the elements of the agricultural business system, and turning them into information. Accounting business events in enterprises involved in agricultural activities are more specific compared to classic industrial, service and other companies, which is partly the result of specific agricultural production in general, but also caused by character of the individual, primary property position (balance sheet assets) in agricultural companies that requires specific accounting treatment. The agricultural sector is a key sector in the economic development of many countries, particularly less developed countries and countries in transition. Agricultural sector has its own specifics that requires special and accounting information framework for monitoring the impact of incentives for more efficient use of agricultural resources. Accounting information framework in the agricultural sector should be based on the provisions of International Accounting Standard - 41 (Agriculture) in order to be able to compare the results achieved in various countries.

Keywords:accounting and information models, the efficiency of resource use, the agricultural sector, agrarian entrepreneurship, financial incentives, tax breaks, accounting standards.

Introduction

Agriculture is a very complex system, which derives from its highly complex, heterogeneous structure of production flows functioning, even when one considers its main activities (crop production, agriculture, viticulture, horticulture, animal production, feeding, breeding, production of separate products such as milk, eggs, wool, etc.). Agriculture is an open system, as it operates on the principles of the social environment, and not the laws of nature. Agricultural products, due to its importance for the level of prices for living standard, are in this respect under the strict supervision of the company. Therefore, the position of agriculture in the primary distribution of the economy is more unfavorable than average. Economic disadvantages due to the position of agriculture lower its accumulative and reproductive ability, which limits the rapid and balanced development of agriculture. In this paper, we want to point out the necessity of special accounting and information systems to monitor and measure the efficiency of resources' use in agriculture, which shows a significant development opportunity for Bosnia and Herzegovina as a whole. Agricultural production has a biological-genetic character. Therefore, its scope, pace and character are ongoing, and the role of certain elements of technology is to ensure the primary productive funds: soil fertility, traits of seeds and planting material, and the potential variety or race. In strategic development documents BiH has particularly emphasized the importance of increasing the efficiency of

resources' use in agriculture, because this entity has more than 2/3 of the BiH agricultural resources. Therefore, the focus of the research will be placed on defining the key characteristics of the agricultural sector, the modeling of entrepreneurship according to established specificities of the sector, monitoring and measuring the effects of encouraging innovation and entrepreneurship in the agricultural sector. Accounting for monitoring and measuring the effects of stimulating the development of agro-entrepreneurship will be critically and separately analyzed in terms of adjusting to the orientations of the International Accounting Standard-41 (Agriculture) conditions in BiH. IAS 41 - Agriculture provides so-called accounting treatment of biological assets (biological assets) during a period of growth and declining birth (conception), as well as the initial evaluation of agricultural products at the point of harvest, ie. collection.

1. Issues subsequent measurement of biological assets

Behavior of agricultural enterprises, as well as the influence of different environmental factors, determines the connection and operation of the elements that make up the structure of the company. These elements are in different proportions of interconnections and interactions with different behavior. Therefore, the connection should have a system of feedback, which means that the agricultural enterprise is dynamic system, the system of self-regulation. Calculation of the subsequent measurement of biological assets is presented on the following example.

Example 1: The subsequent measurement of biological assets

Company from Example 1 Orchard is activated due to gender. The estimated fair value of Orchard minus estimated costs of selling at the moment of activation were identical to the value of capitalized costs of raising Orchard: 55,000. The company estimated useful life of the Orchard for a period of 25 years. Linear method was adopted for the calculation of the estimated annual depreciation and amortization costs: 2.200KM (55.000KM/25god = 2.200KM). After 5 years, the fair value of the Orchard minus any selling cost is estimated at 42,000. After the fifth year, account balance of Orchards-0250 is 55,000 and the 0259-IV of perennial plants 11,000 (5 years h 2,200).

Table 1. Calculation of the effects of subsequent measurement at fair value

Ord. num.	Description	Amount	The amount to be posted
1	The fair value at the time of activation	55.000	
2	Written-off value	11.000	
3	Do not write off the value of	44.000	
4	Subsequent fair value	42.000	
5	**The difference (4-3)**	2.000	
6	*Reduction coefficient (4/3)*	0,95455	
7	*Diminution in value of biological assets in the account (1h6)*	52.500	2.500[75]
8	*Reduction in the allowance account (2h6)*	10.500	500[76]

Source: Izmjene u me unarodnim ra unovodstvenim standardima, Savez ra unovo a i revizora RS, april - may 2005. year, p. 150.

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[75]Such amount represents the amount to be posted. Was obtained as the difference between the gross value of property increased the cost of a given facility (55000-52500 = 2500).

[76]The obtained amount represents the amount to be posted. Was obtained as the difference between the gross value of the increased allowance account and the value of biological assets that account before subsequent measurement (11000-10500 = 500).

Table 4. Turnover of livestock

Ord. num.	Description	Cows		Calves		Heifers	
		pieces	kg	pieces	kg	pieces	kg
1	**Initial state**	**115**	**80.000**	**20**	**1.500**	**50**	**25.000**
2	Fertilized			15	400		
3	Translated from the second category	40	25.000			15	2.500
4	Bought	5	3.750				
5	Excess	-	-				
6	Growth in weight		3.750		4.600		5.750
7	**All inputs (2 -6)**	**45**	**32.500**	**15**	**5.000**	**15**	**8.250**
8	Sold	15	11.400	-	-	-	-
9	Translated into the second category	-	-	15	2.500	40	2.500
10	Translated to fattening	30	15.000	-	-	-	-
11	Died	1	700				
12	Emergency slaughtered	1	650			1	250
13	Shortage	-	-	-	-	-	-
14	**All output (8 to 13)**	**47**	**27.750**	**15**	**2.500**	**51**	**2.750**
15	**Balance at end of period (1 +7-14)**	**113**	**84.750**	**20**	**4.000**	**4**	**30.500**

He then compiles the calculation of gain in weight of an asset based on table puerperium, which in our example is as follows:

Table 5. The calculation of second Growth flock in kilograms

Ord. num.	Description	Cows	Calves	Heifers
1	Balance at end of period(Ord. num.15)	84.750	4.000	30.500
2	Output in the period (no.. 14)	27.750	2.500	2.750
3	Initial state (Ord. num. 1)	80.000	1.500	25.000
4	Entrance to increase during the period except	28.750	400	2.500
5	**Growth in weight (1 +2-3-4)**	**3.750**	**4.600**	**5.750**

Increment value of livestock is calculated at a price that is lower cost and increase the market price if it is lower as in our example looks like this:

Table 6. Calculation of increment

Categories of livestock	kg	The average price	Total
Growth Cows	3.750	**2**	**7.500**
Growth Calves	4.600	4	18.400
Growth Heifers	5.750	3	17.250
Total gain			**43.150**

Example 3. Evidence of growth of livestock
Based on data from the previously displayed tables puerperium, billing increments flock in kilograms and value, it is necessary in accounting eveidenciju agricultural enterprises.

Table 7. The accounting records of growth of livestock

Ord. num.	Date	Description	Account	Owes	Claims
1)		**Cows**	02600	7.500	
		Calves	02601	18.400	
		Heifers	02602	17.250	
		Income from activities and product demand for fixed assets	6210		43.150
		entry growth of livestock			

Conclusion

Agricultural resources in the Republic Srpska and Bosnia and Herzegovina as a whole in relation to the developed countries of the European Union and the United States, are used in an extensive way with very low efficiency. Through various calculations, cost accounting and bookkeeping and other methods, we find that this is a more specific type of posting and some accounts that are not present in other areas of the human economy have been basically used. Agriculture is a specific economic activity because the method in the manufacturing sector still remains at a lower level, when we compare it with other industrial companies. Entrepreneurship development which involves the use of different agricultural resources based on the application of innovation, new technologies, new production organization is in its infancy. Hence, it is necessary to improve the system of business enterprises in the agricultural sector by increasing the productivity of all production factors. Parallel to this process, it is necessary to improve accounting and tax regulations in order to be able to adequately measure the increasing efficiency of agricultural resources. Quality of accounting information enables improvement of financial and tax incentives system for the development of entrepreneurship in the agro Serbian. Due to the limited scope of this paper, some of the issues and problems could be investigated and processed and may be the subject of the further research. This applies particularly to the new forms of incentives for agricultural entrepreneurship and new complementary methods of reporting.

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CONSIDERING SERVICING POTENTIALITY OF STATE FOCAL POINTS: CASE STUDY OF SARDASHT IN SOUTH OF IRAN

Rasoul FARJAM, Hassan AFRAKHTEH

[1]Kharazmi University, Tehran, Iran
(Corresponding author: goudi.up@gmail.com)

Abstract

Sardasht village was upgraded to a city through a political declaration in 2010. The declaration was made to create service centers, enhance development trends and to promote growth in the area. It also created centralization of essential services thereby facilitating the delivery of basic services to the people in the region. In this article, the existing practices in the delivery of services in the region were analyzed to determine: (a) the role Sardasht market and (b) the factors affecting the delivery of services as viewed by the inhabitants of rural hinterlands. The two major questions raised in the surveys to address the objectives are: (a) capability of the Sardasht city to deliver basic services to the people and (b) the facilities needed to be established in the town to regulate the delivery of services from the city to the surrounding areas. Data collection was done by field survey using questionnaire in selected 248 rural households. The households were selected using Cochran formula from 51 sample villages and after pre-evaluation of some documents of the villages. Collected data were analyzed using descriptive statistics, Chi-square and logistic regression. Results showed that SardashtCity is the main destination of rural population to obtain different services, but it faces with serious problems in providing basic services and in making urban – rural relationship.

Keywords: *Market town, Rural hinterland, Urban Service Potentiality, Rural – Urban Relationship, Sardasht, Bashagard*

Introduction

Provision of quality and locally accessible services within rural areas is inherently difficult, increased commuting and in-migration and raised consumer expectations (service and quality) between settlements of a region (Findaly *et al*., 2001). This, have pressures to reap economies of scale in a settlements hierarchy system and also contributed to the decline in the availability of rural services within small settlements (Shaw & Powe, 2004).

In 2010 apolitical decision has led to the conversion of the Sardasht village to a city center of Bashagard township. The aim of the decision was to establish central areas with efficient and centralized delivery of essential services to the people in the region. But, it is unclear what form this takes and upon which factors the role depends. There is also likely to be a mutual dependence, where the viability of the services themselves are dependent upon trade from hinterland residents and where many of these residents, particularly the less mobile, may also rely on such services within or from their nearest town. The future prospects for market town services will depend on the continuation of such a relationship.

Upgrading Sardashat village from a small settlement to the political centrality of Bashagard region is very controversial. This controversy has coupled with other issues and made bases of the essential questions of this research. The major questions of this study are(1) is Sardasht city capable of providing services essential needs of rural hinterlands at present

time? (2) which services will Sardasht need to continue that role based on urban-rural relations? According to these questions, the current system in providing services in the region was analyzed. This was done by examining the current role of Sardasht market town and the factors affecting perspective services as viewed by inhabitants of rural hinterlands. So, the following topics will be discussed in this paper:

a) level of bilateral affiliation between current services in Sardasht market-town and the inhabitants in the surrounding rural hinterlands.

b) current role of Sardasht market- town and the factors which provide that role.

c) Future of the perspective of Sardasht market- town in delivering basic services to its region.

Although adopting the establishment of Sardasht city as the center of township could provide a solution for rendering desirable services to rural hinterlands, shouldn't be ignored that the current and future function of it for delivering services depend on some special factors. These factors will be explained in this paper.

Materials and methods

Following figure shows the situation of Bashagard district and Sardasht city in Iran. The Bashagard region has 248 villages and 32,424 inhabitants (Iran's Central Statistics Office, 2006; NPSP, 2011: 68). The Sardasht village is located in the region of Bashagard in Hormozgan province, south of Iran (Figure 1).
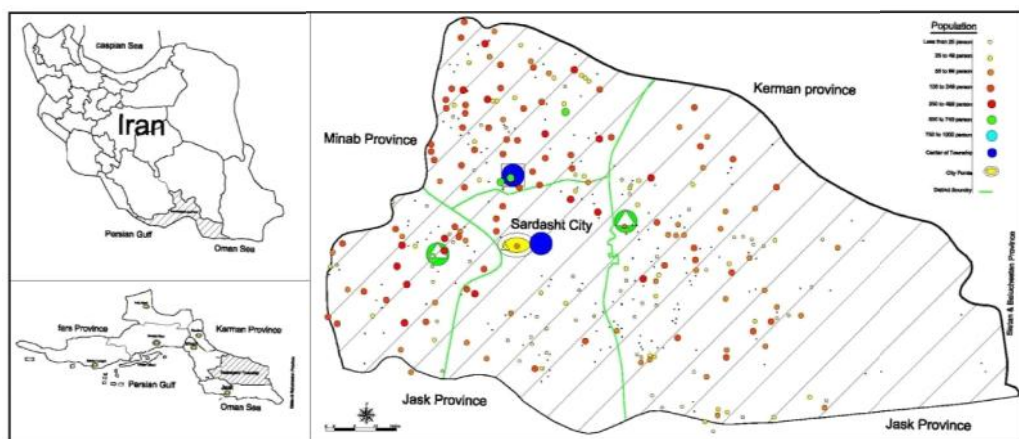

Figure 1: The distribution of small and average cities in Hormozgan province and Bashagard region.

Quantitative data collection was done in two ways: librarian study and questionnaire research. The data provided essential index for determining the importance of relationships between Sardasht market-town and its rural hinterland residents. In order to determine the essential statistical population sample among all villagers, development levels and different levels of services have been mentioned. Based on these, villages were divided into three categories as having weak, average and high level of services. Cochran formula was used to determine the number of statistical population sample. In this case, the safety of distant is 95% and the quantities of **q** and **p** are considered 10 and 90 percent in order. The results showed that 248 samples were needed for the study. The collected data were analyzed by following statistical techniques:

a) Chi-square was used to determine the rate of dependency and independency of variables in order to specify the effective factors in the development of Sardasht.

b) Logistic regression model[77]was used to specify the effective factors that affect the future services that the market-town of Sardasht can provide.

In order to show future perspective of Sardasht market-town, it is necessary to specify the effective factors in its role fulfillment. Those variables that were used in this part of analysis were consisted of current services in market-town, the distance from villages to Sardasht, their population, age, gender, and respondents' jobs. The variables from the questionnaire were consisted of (1) "the rate of respondent's tendency to refer to market-town of Sardasht for gaining services in future", and (2) the levels which have 2 parts. e.g., 1=yes, 2=No.

Since the results of logistic regression model varied, only three parameters were used. These were 2log (likelihood), B logit, and exp (B) logit, and table of variables in equation.

In order to recognize the effective factors on future role of market-town of Sardasht, the above mentioned model was applied on two groups of explanatory repressors. At first, economic and social variables like place of living, the distance from place of living to Sardasht city, settlements population and their types of occupations were used and then other variables consisting all of services were incorporated.

Theoretical Literature

There exist various opinions of known or experts on regarding the roles of small towns in rural regional development. For example Tisdel (1997) believes that to prevent the centralization of population in some parts, attention should be paid to the growth of small and medium towns. These are solutions stipulated in the policy of settlement system (Rezvani *et al.*, 2009; Amchakei, 2004). Hensen (1960) considers the role of small towns in national development as a factor for growth in developing countries (Rezvani *et al*., 2009; Bagheri, 1996:85). Rondinelli (1983) states the role of small towns in urban function on rural development (UFRD) theory in rural development. The theory was discussed focusing on the aim of adding spatial dimensions to the regional planning. This approach assumes that if developing countries tend to reach extension, growth, and expansion in region, they should follow the dispersed geographical pattern in investing and presenting fundamental services (Zebardast, 2006). Presence of some of difficulties like absence of easy access to basic services and concentration of under populated areas make the presentation of qualitative and quantitative services in some rural areas difficult (Shaw & Powe, 2004). These difficulties can be resolved by creating and strengthening the role of market-town for some of settlements. Market-town is regarded as a place to live, for job and business for inhabitants of city and rural hinterlands (Rogbourne and Hammond, 1998). These market-town centers provide essential needs for periphery rural settlements. As a result market-towns are places that have general demanded capacity for fulfillments of their roles as central places in rural districts (DETRA, 2000R ; DEFRA, 2004; Swain, 1997).

There is a bilateral relationship between current quantitative and qualitative services in market-towns and the trend of population increase in rural hinterlands. It means that the improvement of the quality and quantity of current services in market-town will cause the improvement in the longevity of rural population. On the other hand, the changes in population will strengthen the commercial and role of market-town. As Shaw (2004) stated

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[77] - In this model if variable of answering part be shown by 1 & 2, their changes can be written as the conditional probability: $p^1|i_2 - i_m = p$. And if they have been written based on a multi sentences model, it can be expressed in this way: $p^1|i_2 - i_m = \dfrac{p^1|i_2 - i_m}{p^1|i_2 - i_n + p^2|i_2 - i_n}$.(Bayazidi *et al.*, 2009: 147)

lessening the pulling role of regional and national metropolitans in an area is a direct and manifested result of strengthening the role of market-town in spatial planning.

In analyzing the role of small cities in providing services to the hinterlands, essential services of rural hinterlands in market-town as well as three other features should be taken into account. These features are the effective delivery of services to market-town (Moseley, 1979; Shaw & Powe, 2004). These factors consist of accessibility, the quality of services and the resident characteristics. Those studies which are directly related to the roles of market-towns in providing services to rural hinterlands are much more restricted than those studies which are related to the roles of small cities in regional development.

The study done in this field by Chiang Tang's research in Wenzhou, China, showed that development is dependent on government's plan. This is based on restoration of small towns in official hierarchy in strengthening their rural market (Akbarian, 2006:10; Fanni, 2003:18). Regbourne and Hammond (1998) showed in their study that the market of Ludlow strived to recognize the internal relationships between a market-town and regional economy of periphery. Their study showed that through referrals by the residents, big supermarkets played a significant role in the social and economic development of Ludlow.

Cartwright and Swain (1997) did a research for the Center of Eastern Europe Studies on "finding farmers in eastern Europe". Their studies were based on Friedmann's supposition that "*if rural households access to land, labor and market products can be provided by small cities and if these points were reproduced by political and official decision, barter interchanges of cities and villages will be decreased. Instead, their capabilities in production would be increased*". By examining aforesaid studies which were done in the Czech Republic, Poland, Romania, Hungary and Slovakia, it was concluded that market-towns have high capacity in providing services to rural hinterlands as well as commercial exchanges with them (Swain and Cartwright, 1997). This conclusion is verified by England rural development documents (DETR, 2000).

In a study on "rural-urban marketing linkages" by White (2005) the role of market-cities and small average city centers in facilitating the relation of town village as an important factor was considered. He believed that the number of population in rural areas depends on current services and facilities in market-town as well as the ways of their access to markets (White, 2005:4). In this study both current models and field assessment of the relation between market-towns and rural hinterlands and the directions followed for these assessments are presented. The current and future role of market towns in providing services to their hinterlands was perfectly shown by the study of the city of Alnwick in the northeast of England (Shaw & Powe, 2004). The main purpose of this study was to provide quantitative and qualitative assessment of essential services of rural hinterlands in market-towns.

Most of Iranian studies are in the form of thesis for universities which generally examine developing small towns by advancement of rural parts. Studies on the advancement of villages to towns and their influence in developing rural areas have already been done (Hasel, 1999; IzadiKharameh, 2001; Rostami, 2001; Sheikhi, 2003; Fanni, 1996; Ghadermazi, 2004). Many researches focus on the role of small cities in spatial planning and national development plans (Fanni, 2003; Nazarian, 1996). Their findings referred to the regional view that small towns play roles in marketing and presentation of services and agricultural products or examined either the roles of small towns in regional development and urban network or the functions of one or some cities in a period of time (before or after becoming a city) in regional rural development. However, in current study is examined a region which did not have any city or regional market-town in the past to manage and to provide services to its rural hinterlands. Hence, this research focused on Sardasht services in order to recognize the effective factors in the development of market-town and determine the criterion to achieve an efficient delivery of services.

Results and discussion

A. The importance of current services in the market-town of Sardasht

The research was distributed among three rural groups with weak-average-high levels of services. The result showed that 88.7% of respondents go to Sardasht to avail of the services. The rest (31.3%) obtain the services from Goharan, Khomeini Shahr and Jackan cities. 38.9% of inhabitants come to the market town daily, 37.4% weakly and 23.7 % monthly. Moreover 38.2 % of respondents generally go to Sardasht to obtain better services. 48.9% of inhabitants stated that they go to Sardasht because of the proximity of their place of living to Sardasht and 13 percent consider other factors like public transportation going to Sardasht city.The respondents were asked to choose which among the following 19 services do they vail in Sardasht market: doctor, sanitation house, health center, dentistry, drugstore, guidance school, high school, pre-university, library, post office and telecommunication, transportation, selling and buying agricultural products, agricultural tools and instruments store, agricultural tools repairmen, veterinary, bank, building material store, electrical equipment store, foodstuffs store, stationery store and official and disciplinary services. The results are shown in table 1.

Table 1: The goals of inhabitants' referrals to market-city of Sardasht (percent).

Services / Calculations	Sanitation & health Services	Educational & Cultural Services	Foodstuffs stores	Non- Food stuffs stores	Agricultural Services	Official and disciplinary services	Commercial services	Post office and telecommunication	Transportation Services
Mean	71.74	76.36	72.50	75.56	69.85	95.40	78.60	86.30	55.70
Min	45.80	75.60		74.00	51.90				
Max	88.50	77.90		77.90	80.90				

Except from dentistry and transport services, the majority of the basic services needed by the people were obtained from Sardasht city. Using Chi-square test showed that 68.7% of respondents always go to Sardasht city to obtain other services. Moreover, 97.7% of them prefer to go to this place to get their essential services. The results are shown in tables 2 and 3.

Table 2: How do you agree this sentence "I would rather refer to Sardasht to supply the essential services for me and my family"?

Responses	Frequency	Percent	Valid Percent	Cumulative Percent
Totally agree	26	19.8	20.3	20.3
Agree	99	75.6	77.3	97.7
Disagree	3	2.3	2.3	
Totally disagree Total	3 128	2.3 97.7	100.0	100.0

Table 3: Do you always go to Sardasht city to get services?

Responses	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	90	68.7	68.7	68.7
No	41	31.3	31.3	100
Total	131	100	100	

Since the respondents were selected from three rural groups with weak- average- high levels of services, social and economic features, their points of view and their ways of utilizing services were different and these differences generated goals and stimulants to go to

the market-town. Consequently, there was dependency between social and economic variables and current /future roles of Sardasht market – town that was specified.

The dependency was assessed using Chi-square test. The results of Chi-square test indicated significant dependency of services with each other's with a P-value <0.05. Since the achieved P-values were smaller than 0.05, it can be concluded that the rate and kind of services they used in the market – town of Sardasht depend on three rural servicing groups (*i.e.* weak, average, high services). Although access to drugstores & repair shop for agricultural instruments, which was included in this category, have different values from other quantities. These quantities related to veterinary and medical services were totally different. Their P-values equal to 0.622 and 0.365, respectively. This means that there is no dependency between these variables and the variables on the level of services in rural hinterlands. In other words, the current role of market-town of Sardasht in providing services to inhabitants of rural hinterlands is affected by medical and veterinary services.

This point cannot be ignored since some parts of rural population will not come to Sardasht city to avail of the services. The results show 28.26% for medical remedial services, 23.64% for educational services, 27.5% for providing foodstuffs, 24.5% for providing non-foodstuffs, 31.15% for agricultural services, 22.4% for commercial and financial services, 44.3% for transportation are provided by the periphery of Sardasht market-city. In the results, it is indicated that 17% % refer to Jakdan, 3% to Khomeinishahr, 13.7% go to Goharan city.

A.   **The effective factors on future role of Sardasht market-town**

As explained above all services are effective in current role fulfillment of market-town of Sardasht except medical services, veterinary and, to some extent, repairs for agricultural tools. In order to show future perspective of Sardasht market-town, it is necessary to specify the effective factors in its role fulfillment. The results in tables 3&6 showed the effect of economic – social variables on different ways of referring to Sardasht market-town to access future services.

Table 3: Interaction history of economic –social variables

Iteration	-2 Log likelihood	Coefficients						
		Constant	Agricultural jobs	Living in a weak level servicing village	Living in average level servicing village	Living in a village with distance less than 50 km to market-town	Living in a village with distance less than 20 km to market-town	Living in a village with distance between 20 to 50 km to market-town
1	216.843	-5.898	.740	2.307	1.818	.572	-.588	-1.101
2	216.630	-6.783	.845	2.547	2.047	.655	-.620	-1.153
3	216.629	-6.827	.848	2.559	2.060	.658	-.620	-1.153
4	216.629	-6.828	.848	2.559	2.060	.658	-.620	-1.153

a   Method: Enter. b   Constant is included in the model. c   Initial -2 Log Likelihood: 238.070 .   d. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Table 4: Variables in equation for socio –economic variables.

	B	S.E.	Wald	df	Sig.	Exp(B)
Agricultural jobs	.848	.939	.816	1	.366	2.335
Living in a weak level servicing village	2.559	.799	10.259	1	.001	12.923
Living in an average level servicing village	2.060	.651	10.000	1	.002	7.843
Living in a village with distance less than 50 km to market-town	.658	.454	2.103	1	.147	1.931
Living in a village with distance less than 20 km to market-town	-.620	.708	.769	1	.381	.538
Living in a village with distance between 20 to 50 km to market-town	-1.153	.481	5.757	1	.016	.316
Constant	-6.828	2.750	6.166	1	.013	.001

a Variable(s) entered on step 1: Agr.Job, Living in W.L.S, Living in A.L.S, Living in less than 50 km, Living in less than 20 km Living between 20 to 50 km

Results indicated that among economic and social factors, "rural inhabitants with weak services" variable with $EXP^B or (e^{2.559}) = 12.923$ quantity undertake the impression on future perspective of Sardasht market-city (Tables 5 and 6). The second effective factor will be "rural inhabitants with average services" with $EXP^B or (e^{2.060}) = 7.843$. In this order "agricultural jobs" with 2.335, "living in settlements with 50 kilometers less distant from Sardasht" with 1.931 Exp(B) are the subsequent effective levels.
Among aforesaid factors, two variables have the least effect on rural inhabitants' referrals to market-town of Sardasht. These are "villages with less than 1000 population" and "setting in villages with 100-250 population".

The same approach was done for all effective services (variables) on the role of Sardasht market-town. In order to have desirable analysis of the above variable effects, and because of soft –ware limitation, they were classified into six groups of health & remedial, educational, official and disciplinary, transportation & accessibility to foodstuffs and non-foodstuffs sores. Variables on the probable indexes for future referrals to Sardasht city for accessibility to services of high school, pre-university, library will be 9.809, 1.693 and 120.0, respectively. Among the mentioned variables, referring to library is more than others.

Next results would be exciting, -2log likelihood for transportation variables, official and disciplinary, accessibility to foodstuffs and non-foodstuffs stores equal to 169.070. The 69 units of differences with initial -2 log likelihood with 238.070 indicate the correspondence the model with date. The logit index showed weak, average, high levels of variables in future referring to Sardasht market-town. The variables of referring to "building material store", "referring to bank" and "foodstuffs stores intensely" affect the future referrals. The variables of "referring to light agricultural repairmen store", "official & disciplinary center", "referring to the post office and telecommunication" for adopting services, "referring to dentistry" and "accessibility to selling & buying agricultural stores" have the average effect. Finally, those two variables with weak influence are "referring to transportation services" and "stationery stores". The results were indicated in tables 5 and 6.

Table 5: Interaction history of transportation, official and disciplinary and accessibility to foodstuffs & non-foodstuffs stores.

Iteration	-2 Log likelihood	Constant	post office and telecommunication	transportation services	accessibility to selling & buying agricultural stores	accessibility to agricultural tools store	accessibility to light agricultural repairmen store	referring to veterinarian	referring to bank	referring to building material store	referring to scribal store	referring to glossary shops	referring to official & disciplinary center
1	173.45	-4.701	-.172	.026	.038	.275	.795	.190	.750	1.219	-1.135	.746	.740
2	168.37	-6.325	.281	-.111	.194	.494	.910	.207	1.09	1.496	-1.547	1.048	.796
3	167.85	-6.915	.493	-.201	.314	.594	.944	.186	1.27	1.564	-1.765	1.195	.799
4	167.84	-6.983	.510	-.215	.336	.601	.952	.186	1.30	1.569	-1.801	1.219	.794
5	167.84	-6.984	.510	-.216	.336	.601	.953	.186	1.30	1.569	-1.801	1.220	.793

a Method: Enter   b Constant is included in the model. c Initial -2 Log Likelihood: 238.070 .   d Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 6: Logit indexes for variables of communication, official and disciplinary and accessibility to foodstuffs & non-foodstuffs stores.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
post office and telecommunication	.510	.660	.598	1	.439	1.666
transportation services	-.216	.462	.218	1	.641	.806
accessibility to selling & buying agricultural stores	.336	.622	.292	1	.589	1.400
accessibility to agricultural tools store	.601	.843	.508	1	.476	1.824
accessibility to light agricultural repairment store	.953	.413	5.328	1	.021	2.593
referring to veterinarian	.186	.653	.081	1	.775	1.205
referring to bank	1.306	.724	3.252	1	.071	3.690
referring to building material store	1.569	.502	9.785	1	.002	4.804
referring to scribal store	-1.801	.793	5.159	1	.023	.165
referring to glossary shops	1.220	.740	2.718	1	.099	3.386
referring to official & disciplinary center	.793	1.406	.318	1	.573	2.210
Constant	-6.984	1.810	14.889	1	.000	.001

In determining the effective factors in role fulfillment and future perspective of Sardasht market-town services, logistic regression was used. The results showed that current services in Sardasht has the rang of effects of, so much, much, mediocre, a little, little in future referrals to market town indicated in table 7.

Table 7: classifying the effective variables on future referrals to Sardasht market-town.

services	B	S.E.	Wald	df	Sig.	Exp(B)	Effectiveness
Library	4.787	0.757	39.966	1	0	120	Very high
Referring to drugstore	3.724	1.181	9.943	1	0.002	41.409	High
Referring to high school	2.283	0.709	10.373	1	0.001	9.809	High
Referring to building material store	1.569	0.502	9.785	1	0.002	4.804	High
Referring to bank	1.306	0.724	3.252	1	0.071	3.69	Normal
Referring to glossary shops	1.22	0.74	2.718	1	0.099	3.386	Normal
Accessibility to light agricultural repairment store	0.953	0.413	5.328	1	0.021	2.593	Normal
Visit Doctor	0.793	0.57	1.938	1	0.164	2.21	Normal
Referring to official & disciplinary center	0.793	1.406	0.318	1	0.573	2.21	Normal
Referring to dentistry	0.717	0.407	3.098	1	0.078	2.049	Normal
Accessibility to agricultural tools store	0.601	0.843	0.508	1	0.476	1.824	Low
Post office and telecommunication	0.51	0.66	0.598	1	0.439	1.666	Low
Referring to pre-university school	0.494	0.738	0.448	1	0.503	1.639	Low
Accessibility to selling & buying agricultural stores	0.336	0.622	0.292	1	0.589	1.4	Low
Referring to veterinarian	0.186	0.653	0.081	1	0.775	1.205	Low
Referring to sanitation house	0.055	0.413	0.018	1	0.895	1.056	Low
Transportation services	-0.216	0.462	0.218	1	0.641	0.806	Very low
Referring to sanitation Centers	-1.451	0.659	4.85	1	0.028	0.234	Very low
Referring to scribal store	-1.801	0.793	5.159	1	0.023	0.165	Very low

Conclusion

A rural region which lacks essential services facility, city points as a higher central place for delivering services to rural hinterlands especially in southeast of Iran with non-asphalt roads can be crucial. Establishing a market-city in this region to lessen the lacks of services facility can be the most effective solution.

Based on a novel approach which is supported by England government (Shaw & Powe, 2004) the research was done on Sardasht city as a market-town. This research showed that despite the lack of suitable place in settlement hierarchical system, Sardasht city's inhabitants' aim to get services. It can be concluded that about 78% of respondents have daily, weekly and monthly referrals to Sardasht market-town. Averagely, rural hinterlands inhabitants for getting services to Sardasht market–town equal to 71.1% for remedial health services, 76.36% for educational services, 72.5% for foodstuffs store, 75.56% for non-foodstuffs stores, 64.85% for agricultural services, 95.4% for official and disciplinary services, 78.6% financial & commercial services, 86.3% for post office & telecommunication and 55.7% goes to transportation services.

 In other words, those services which are more important in role fulfillment of Sardasht market-town include: sanitation house, health, remedial centers, drugstore, dentistry, high school, pre-university, library, transportation, selling & buying agricultural instrument, referring to the banks, foodstuff & non-foodstuffs stores, post office & telecommunication , referring to official & disciplinary centers, medical services and veterinary. And to some extent farming instruments repairs do not affect role fulfillment so it should be focused by those locals in charge.

The results showed that three settlements, Khomeinishahr, Jakdan and Goharan are going to continue the role fulfillment of Sardasht market-town. In total, 32% of the regional referrals were allocated to those settlements. By considering the level of the delivery of services and the location of settlements these results were predictable. Each settlement has direct influence to attract Sardasht referrals to themselves. Another point that should be regarded is that location of Sardasht at a distance of 19&20 kilometers between Gharanand Jakdan will result in 13.7 and 17% of town referrals attraction. Consequently, any negative changes in qualification and quantification of services in Sardasht will be to its rival profits. This shows that, although the role of Sardasht market-town is so desirable in providing services, it can be threatened severely.

In determining the effective factors in current role fulfillment of Sardsht market-town in the delivery of services to rural hinterlands, some points were used. The variables were those which show economic – social features of respondents and those variables which show current services in Sardasht city. The results indicated that the rate and kind of current services depend on 3 rural groups namely: weak- average and its services. However these results were totally different for medical and veterinary services.

In determining the effective factors in role fulfillment and future perspective of Sardasht market-town services, logistic regression was used. The results showed that current services in Sardasht has the rang of effects of, so much, much, mediocre, a little, little in future referrals to market town.

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ACTIVITIES IN THE MAP SECTOR IN RURAL AREAS OF SERBIA

Svetlana TURUDIJA-ZIVANOVIC[1*], Tomislav ZIVANOVIC[2]

[1]Institute for Medical Plants »Dr Josif Pancic«, Belgrade, Serbia
[2]Faculty of Agriculture, University of Belgrade, Serbia
(Corresponding author: sturudija@mocbilja.rs)

Abstract

Natural resources are an important component in the economic development of the state and society. The resources of Serbian rural areas can be of far greater significance than they are today for business operations of the MAP sector and economic development of these areas. The main opportunities involve organized buy-back of these plants, expansion of MAP plantation production to hilly-mountainous areas, value added processing of the collected MAP, improved marketing strategy in the sector, accompanying certifications (organic, ISO, KIA, HACCP). Strengthening of the MAP sector's market connections in the country and abroad would bring about better utilization of the existing resources, while better horizontal and vertical association of all participants in the value chain would lead to increasing demand for herbal raw materials and expansion of the production and processing facilities. Better integration of the MAP sector in the economy of rural areas would result in increased employment level of a part of the labor force.

Key words:*resources, medicinal and aromatic plants (MAP), sector, rural areas.*

Inroduction

Serbia, being a part of the Balkan Peninsula, is rich in biological resources, both natural (autochthonous flora and fauna) and anthropogenic (determined by effects of diverse factors). Extensive biodiversity of the region is associated with the geographical position, orographic and edaphic factors, climate, as well as historic factors of the wildlife development. A general characteristic of biodiversity in Serbia is genetic, species and ecosystem diversity. The foundation of agricultural activities consists of natural resources utilization. Extensive use of agricultural areas (meadows, pastures, arable land enclosed by hedges) generates positive effects on agricultural development. Due to above mentioned, Serbian rural areas possess comparable advantages of medicinal and aromatic plants (MAP) collecting, production and processing. The advantages mirror themselves in a rich raw material base with respect to diversity and amounts, the existence of agricultural land, tradition of MAP growing and collecting, building structures that can be adapted to the needs for herbal product processing and production. Besides that, it is possible to provide financial resources, plant product market development is under way in Serbia, and production and processing equipment and technology is well known and available.

Resources of rural areas in the MAP sector

From the viewpoint of topography and resources exploitation in agriculture, the territory of Serbia can be divided into the flat area of the Pannonian Plain (Vojvodina region), characterized by intensive agricultural production, and the hilly-mountainous region with dominating extensive agricultural production. The prerequisite of economic activities at the

level of rural communities and regions is based on resources evaluation: natural, human, infrastructure and current facilities. Rural areas resources represent a significant potential that local community can make use of to promote a broad spectrum of agricultural products: medicinal plants, forest fruits, handicrafts, tourism services and the like. Plant resources potential is of critical importance for the economy of rural areas (woods, pastures, meadows). In order to improve these resources utilization, it is necessary to view them from a number of angles: biodiversity (quality and quantity), soil types, climate, water resources, infrastructure, human resources etc. A prerequisite for plant resources exploitation is their optimal utilization (sustainable exploitation).

Serbian rural areas cover 85% of its territory with 55% of population living in these areas. The economic structure of rural areas is still based on natural resources exploitation and primary sector business operations. A majority of natural resources (arable land, woods, water etc.) are located in rural areas abounding in ecosystems and biodiversity. An important component of rural areas is natural, cultural and historical heritage.[78]Small family-owned holding is present to a significant extent in the socio-economic structure of Serbian rural households.

The area covered by the Republic of Serbia has outstandingly favorable conditions for agricultural production (climate, soil, water resources). The Republic of Serbia manages soil area of about 5 093 000 ha[79]of agricultural land accounting for 3 602 000 ha of arable land, of which fields and gardens cover 64.8%, orchards 4.7%, vineyards 1.1%, meadows 12.2% and pastures 16.4%. Geographical position of Serbia is specific for its geomorphological, geological and pedological diversity, influences of diverse climates that have resulted in abundant genetic, species and ecosystem diversity. Therefore, Serbia can be considered one of the most significant biodiversity centers in the Balkans. Medicinal plants are among the most important economic plants in Serbian flora.

The activities of the MAP sector are partly based on agricultural production (plant growing and collecting) that is largely going on in rural areas (collecting in hilly-mountainous areas and growing in flat areas). This way of raw material supply provides revenue acquisition for a part of rural population, for both households involved in plant production and seasonal workers hired for the job. Considering the fact that buy-back is organized in the areas of MAP picking (examples are enterprises *Betula* in the village of Zitkovac and *Sanicula* in Gornja Mutnica)[80]where, apart from pickers, a certain number of people are employed in processing plants (permanent and seasonal workers), the development of rural areas is thus supported. There are much more examples of such enterprises because the majority of them are located in rural areas.

The low level of farm mechanization equipment is a limiting factor in agricultural production, so that many producers turn to the production that does not require specialized mechanization. In Serbia, a small number of households possess specialized machinery and equipment for the production of MAP. However, this is not a limiting factor for the MAP plantation production because the production of most species does not require any additional equipment. Besides, small-sized holdings and adverse sowing structure in Serbian agricultural production aggravate and reduce economic utilization of the existing farm machinery. Such small-sized areas characteristic of family holdings are acceptable for medicinal plant production. Medicinal plants can be grown in most regions of Serbia, provided that irrigation is practiced, a very important prerequisite for steady and high yields and production of quality raw material.

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[78]www.minpolj.gov.rs/download/ruralnirazvoj-strategija.
[79]Statistical Annual Report, (2009.), RZS, Belgrade.
[80] Turudija Ž. S., (2009): Market development and marketing channels for MAP, Master's thesis, University of Belgrade, Faculty of Economics Belgrade.

In Serbian rural areas (as defined by OECD methodology) there are 1 365 million households, which accounts for 54% of the total number of households in Serbia. There are 328 thousand households of up to 3 ha in size, or 56% of the total number of households in rural areas of Serbia. Labor force, with human capital objectified in it, represents one of the resources essential to every community as well as one of the key factors of agricultural economy development, and overall national economy. After the 1991 Land Reform land supply of some households was increased, so a large number of households were interested in changing the structure of traditionally grown cultures in their fields, i.e. they wanted to start a new business. Also, a large number of unemployed rural people saw a chance for their household survival and revitalization in the MAP sector related jobs. However, it is evident that organized agricultural products buy-back is missing, because farmers are traditionally used to farm cooperatives as a synonym for organized sale and secured market, therefore there is a strong need for this type of organizational structure of the present cooperatives. Usually, there is no contractual MAP production with buyers and processors. In addition, trading participants (buyers) do not view small-sized rural households as reliable suppliers. The absence of organized marketing channels in agricultural products trade is one of the limiting factors in production specialization. MAP collecting and growing as primary processing of herbal raw materials would assist in establishing economic security and stability of rural households that own scarce agricultural resources. The level of extra knowledge and skills of the family members in rural areas is rather low and most often it can not be used to diversify farm activities. Therefore, households can not identify the possibility of engaging their family members in activities other than traditional agricultural ones in both their household and the environment. Tradition is also a limiting factor of agricultural production diversification. It is difficult for many households to determine to change agricultural production structure on their household, especially to introduce new crops, such as medicinal plants, or to start a new job (additional value to the raw material produced on a holding).

Activities in the MAP sector

Positive effects of various plant products have been confirmed by their long-term use throughout history, but many new active principles were discovered as well as their effects in treating a multitude of health disorders. Such a trend in investigations and application to population healthcare has contributed to commercializing of medicinal plants. A return to natural resources in nutrition and healing along with growing material well-being and humanity cultural level has contributed to paying greater attention to the improvement of MAP production and exploitation, which is supported by the EU planning to have 30% of plant-origin medication by the year 2025.[81]

Plant collecting is a dominant way of herbal raw material supply in the world and with us. Collecting of wild plants, forest fruits and mushrooms is the activity practiced by many members of rural families (especially in hilly-mountainous areas of southeast Serbia). This activity can be seasonal, done in parallel with other household jobs, and all generations can be involved. Most commonly, medicinal plants pickers belong to rural population: shepherds, peasants, pensioners, children and women, earning extra money in this way. They are mainly contractual pickers working for dealers, but not infrequently they do not have an end buyer at all. If there is a contract, in that case a list of plants is defined as well as price and amounts. Also, a long-term tradition of treating diseases with medicinal plants and knowledge of medicinal plants species has transformed many pickers of plants for one's own needs into

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[81] USAID Agribusiness project in Serbia (2008): Herbs, mushrooms and forest fruit (medicinal and aromatic plants) value chain assessment, 33,*ww.agrobiznis.net/.../Herbs_Mushrooms_and_Forest_Fruits_Value_Chain_*.

contractual pickers doing this job to improve their income. Medicinal plants are most often sold when dry. However, some enterprises organize plant picking in the field. The reason is to ensure picking of the amount needed and to obtain better quality raw material.

MAP growing is by far a more secure method of herbal raw material supply. In Serbia, more intensive growing of medicinal plants started around the mid-20th century, when herbal raw materials were produced applying the well-known technology of growing (chamomile, mint, balm, fennel, cumin etc.). In order to meet the demands for plant products, medicinal plants-based industry is developed worldwide. To achieve the validation of use, i.e. efficiency, safety and quality of these products, basic and applied researches should be performed that would help to rank these products as patented pharmaceutical products. Such standards can be met only by organized, controlled and targeted production on agricultural land. These requirements can be fulfilled by introducing medicinal plants into plantation production. Today, this production is organized in the world in compliance with the GAP, HACCP, KIA standards, and organic production is increasingly expanding. From the viewpoint of ecology, Serbian rural areas, especially in hilly-mountainous regions, fulfill most prerequisites for certification of organic production and MAP collecting. This could be an opportunity for some enterprises in this sector as well as for family households willing to change the structure of production on their holdings.

The areas under medicinal plants and their distribution have not changed significantly over the past years. The largest areas are under mint, followed by chamomile, fennel, parsley etc. Some plant species steadily demanded at the market are grown only on a few hectares of land (marigold, mallow, common valerian). Due to limited needs for herbal raw materials and balanced demand and supply, increase of growing areas and structure of medicinal plant species should be planned and agreed, respectively. According to some independent estimates, the areas under MAP cover approx. 5 000 ha and have never exceeded 10 000 ha.[82]The maximum growing areas should cover about 15 000 ha, so that surplus does not emerge at the market.

Data on areas under medicinal plants are rather varying, depending on data source, however, it is estimated that medicinal plants are grown on approx. $1^0/_{00}$ of arable land (graph No 1-based estimate), which is minor compared to other traditionally cultivated crops with us. Production of some cultures requires engagement of much labor force, which increases the price of production itself. On the other hand, this is advantageous for family households that employ labor force in this way. Intensive plant species can employ family members and provide income for small households in the primary production process as well as for bigger specialized enterprises in the processing and export activities.[83]

However, MAP plantation production has a series of limitations. In some countries (USA) there is increased demand for wild plants in particular, because it is considered they are of better quality. It is evident that all species can be easily cultivated; it takes several years for some plants to achieve technological maturity (e.g. Gentian). In such cultivated plants the return on investment is postponed, which is discouraging for producers. Despite this fact, efforts should be made to promote MAP growing, especially of endangered species. Data on areas under MAP in Serbia differ, as above mentioned, and estimates for the period 2001-2010 are presented in graph 1.

Pickers and producers most commonly do not possess processing facilities, so it is impossible to realize added value to thus produced and picked herbs, respectively. Consequently, MAP raw materials are sold at prices as dictated by the market. Higher prices could be obtained by procurement of equipment for primary processing (drying, chopping,

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[82]Data provided by the Institute for Medicinal Herbs Research "Dr. Josif Pancic", Belgrade.
[83] Kišgeci J. (2008): Farmer's Agricultural calendar, Dnevnik, Novi Sad, 286-287.

grinding, sorting, packaging, transport). Such a way of organizing could be achieved by pickers and producers when associating into cooperatives or some other form of societies. Bulgarian model for MAP trade management is highly praised[84]and their experience could be applied to the development of the MAP sector in Serbia.
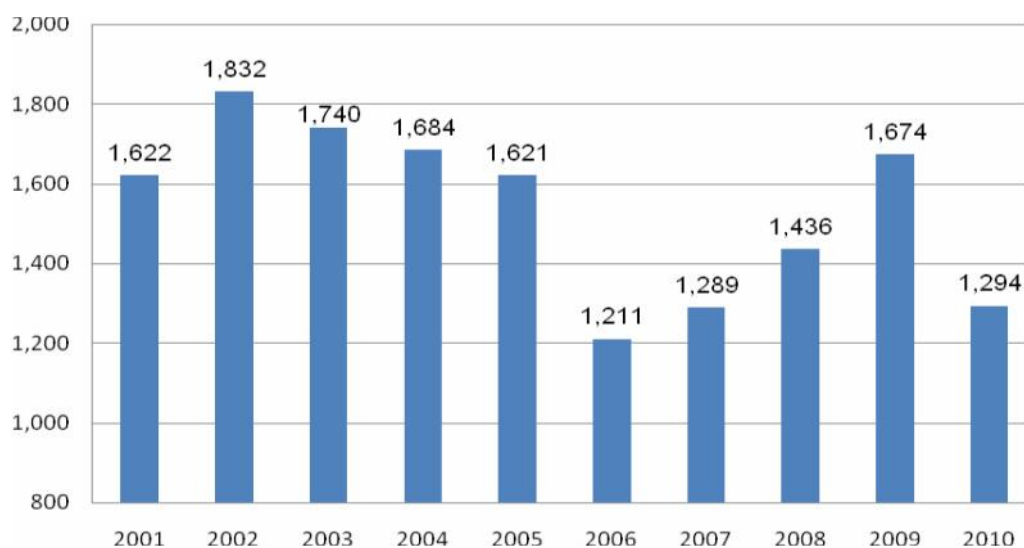

Fig.1. Area under cultivated medicinal plants in Serbia (data obtained thanks to Chamber of Commerce of Serbia)

Enterprises operating business in Serbian rural areas deal with buy-back and primary processing, but they possess facilities for drying, cutting, sorting and packaging that are technologically obsolete and mainly insufficient. This reduces the amounts and quality of MAP, which can not meet the demands posed by domestic and foreign market. A majority of enterprises from this sector are facing the problem of financial resources needed for financing raw materials, processing and storage. It is impossible for many enterprises to use favorable bank loans to invest into processing facilities and end products. Also, MAP export is not stimulated at all as is the case in some countries in the Region. In Serbia, there is no national association to take care of this sector's interests, except for the association within Serbian Chamber of Commerce. For the time being, it is only USAID that assists the MAP sector in Serbia, and the 'Srboflora' association has been founded under its sponsorship. The aim of 'Srboflora' is to support the MAP sector development, primarily to increase export of medicinal herbs.

Serbia possesses comparable advantage for organizing MAP primary production and processing. The advantages are its rich raw material base, abounding in diversity and amounts, building structures that can be adapted to the needs of proposed production, sufficient quality soil for MAP plantation growing, possibility to provide financial resources for the production, developed market for all end products, technology has been conquered and is available to all future producers etc.[85]

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[84] Lange D. i Mladenova M. (1997): Bulgarian model for regulating the trade in plant material for medicinal and other purposes. U: Bodeker,G., Bhat,K.K.S., Burley,J. and Vantomme,P. (eds) Medicinal plants for Forest Conservation and Healthcare. Non-wood Forest Products 11: 135-146. FAO, Rome.

[85] Kišgeci J., S. Jela i D. Beatovi (2009): Medicinal and aromatic plants, 9-13, University of Belgrade, Faculty of Agriculture, Belgrade.

Serbian state's activities in the MAP sector

In Serbia, there is no development strategy for the MAP sector at the state level. To improve business operations of the sector, business climate should be created, where it is possible to play the role of an 'honest' mediator in establishing straight trade arrangements founded on precisely defined profit distribution relationships. Therefore, permanent cooperation should be established within the value chain, continuous market monitoring, transparency of prices, testing of potentials for developing local brand, and placement of products at the local and foreign market.

To eliminate the risks and utilize the advantages of MAP plantation production, the following measures should be undertaken: to initiate the establishment of agricultural cooperatives and other forms of interest societies and associations of producers and collectors, to establish the Agency or Directorate for Development, with the help of state institutions, which would provide services for interested producers and investors, ranging from project preparation to finding financial resources and project promotion, to solve infrastructure problems by reconstructing the roads and building new ones, because primary production and buy-back are organized in rural areas, to develop, in cooperation with consulting firms and professional services, the educational program for producers and pickers to get familiarized with and apply standards relevant to the MAP sector.

In order to increase the amounts of cultivated herbs, the structure of production on agricultural holdings should be changed in favor of MAP, taking into account the psychology of producers and their attachment to a certain type and method of production, its stereotype nature and total involvement in traditional method of agricultural production. This phase implies a larger number of activities aimed at improving the present production levels, with lesser investment in infrastructure, mechanization and the other. All this can be achieved by establishing a professional service to assist the producers (education, information, field demonstrations etc.), by founding associations or cooperatives or by activating the existing ones, by promotion of agricultural production (irrigation, protection, preservation technology, intensification etc.), by introducing new plant species in current plant production and the other. Producers are highly aware of the need for market-oriented production and for production structure change and increase by education level increase, whereby costs reduction and profit rise is achieved. The role of education is prominent because it raises awareness that introducing new plant species in agricultural production (and novel technologies too) is one of essential prerequisites for conquering the market and survival at it.

Conclusion

The existing rural areas resources, such as soil, climate, biodiversity, labor force, tradition of plant growing and collecting, current market, as well as increasing demands for herbal raw materials can contribute to the MAP sector development and economy of rural areas of the Republic of Serbia. Viewed long-term, there is a problem of financing in the sector, unorganized buy-back, absence of cooperatives or enterprises to organize MAP buy-back and production in a broader area of Serbia, inadequate marketing activities, and lack of organized program of local economic promotion in Serbia. Today's enterprises and rural population need a more efficient support. This type of support should be oriented to strengthening of entrepreneurship through active assistance in administration issues at business setup, training for business plan development, financial management and marketing knowledge, support for rural households in production and services diversification. Production diversification should be stimulated towards introducing new production lines, standards application and products value increase (processing, packaging). Easier access to

the market of goods and services should be ensured for small-sized rural households, through various forms of association. Improvement of living standard for people living in mountainous areas can be achieved by stimulating the creation of sustainable market, as well as social and environment sustainability. Improvement of institutional capacities is required at the local, regional and national level, and support for programs focusing on participants' needs.

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POSSIBLE ANSWERS TO THE NEW CHALLENGES OF THE AGRICULTURAL PRODUCTION TOWARD RURAL DEVELOPMENT AND AGRO-ECONOMIC EFFICIENCY

Vilmos KOVAC[*], Hajnalka KOVAC-SARKANJ, Branislav RAKETIC

Corvinus University of Budapest, Faculty of horticultural science Consultation centre in Senta, doo "Quality consulting", Serbia
(Corresponding author: haccp1@gmail.com)

Abstract

Agricultural producers primarily have to respect the principles of the safety of food and traceability of the product, considering purpose and place of consumption of the agricultural products. They also have to pay attention on the regulations according to the marking and packaging the products. To demonstrate the product compliance it has to be used a principle of a production system, like GLOBALG.A.P, organic production, integrated production, marking the products with mark on geographic origin etc.

Keywords: *standards, regulations, rural development*

Introduction

Information technology development and more efficient transportation are lead to the world globalization. This makes impact to the primary agricultural production too. In this changed environment the food market becomes more and more concurrent, but the agricultural actors who have not got huge surfaces of agricultural lands but they are in the rural environment must to be found their place. The productions on these small parcels have to be specific and recognizable.

In order to be the production economically justified and by that reason to be attractive for younger generations too, agricultural producers have to be chosen new methods and techniques of production. The new generation of farmers has to be well educated, to be familiar with the newest law regulations, standards, and methods of production as well as to be prepared for the most up to date marketing techniques in order to recognize the newest requirements of the customers.

Basically, all agricultural actors must to be respected the law defined requirements.

They are obliged to respect the requirements of the agricultural and food production, among others, it is primarily refers to the environment protection, animal welfare as well as careful usage of the pesticides and veterinary medicines.

Besides these basic requirements, food producers have to use additional knowledge and imagination in order to provide value-added products, like products with geographical indication geographic origin mark, to be provided food by the method organic production, integrated production, as well as they harmonize their products with the certain standards like GlobalGAP or with the other requirements of the huge department store chains, to provide products with individual quality which would be appreciated both by consumers and by customers (distributors, wholesale and retailers).

Material and method

When it comes to agricultural production there is a basic requirement that the agricultural products must to be health safe. Health safety means that the food (product) does not harm the consumers' health, so "the food is not safe, if it is harmful for the human health and if it is not suitable for human consumption."(Zakon o bezbednosti hrane)

In the European regulations num. 178/2002/EC which have been accepted in January 28th 2002 from the side of the European Parliament and Council defined the general principles and terms of law concerning to the food, the procedures which are arranged the domain of food safety and founded by the European organ for food safety.

 "Regulation on the basic principles of foodstuff safety stated the followings:

- Comprehensive, unified approach,
- Responsibility for food safety,
- Traceability,
- Consistency, efficiency, dynamism and transparency,
- Risk analysis ,
- Principle precautions (SOMOGYI Á. et al., 2003)

Besides this it would regulate obligations prior to its import into the territory of European Union, that is the imported food for the sake of sale in the territory of European Union, must to meet the requirements of the food safety (except some defined exceptions) because in that way is possible the free movement of products.

Food and feed imported into the Community for placing on the market within the Community shall comply with the relevant requirements of food law or conditions recognized by the Community to be at least equivalent there to or, where a specific agreement exists between the Community and the exporting country, with requirements contained therein.

Although "the state is responsible for the public health of its citizens, but this responsibility in the given situation does not manifest in the creation and maintenance of regulations concerning to the food safety, neither in the controlling of the compliance (and sometimes in forceful implementation) of these regulations (NAGY A. et al, 2003)

To that end on the state level, and from the customers side "increasingly focuses on the united, integrated approach of chain feeding from the fields to the table. (BÁNÁTI D. et al, 2003)

Concerning to the creation of the more effective consumer protection against diseases and to connect work of inspections in the European Community members, regulation num. 178/2002/EC founded a rapid alert system (RASFF, Rapid Alert System for Food and Feed) which can be displayed the danger that could come from food or feed and which could be directly or indirectly threaten the human health condition. There is an opportunity for not European Community members to engage to this rapid alert system.

To enable it to perform its task of monitoring the health and nutritional risks of foods as effectively as possible, the Authority shall be the recipient of any messages forwarded via the rapid alert system. It shall analyze the content of such messages with a view to providing the Commission and the Member States with any information required for the purposes of risk analysis.

Owing to this system and the notification of the consumers concerning to the problems related to food safety, consumers and customers pay more attention on food safety. Because of that in the production of the agricultural products, farmers in all cases have to pay attention that their products can be used:

- For animal feeding (entering in food chain)
- Directly (without any processing, directly consumed food), or like
- Raw material for food industry

It can be sold in domestic or foreign markets. Producers prior to export their products have to be informed and pay attention on the law regulations of that country where they are going to sale their products. Pay special attention on the regulations related to the marking and packaging the products.

Besides excellent knowledge of the agricultural products, they have to be so-called "managers" in order to recognize and react on requirements of consumers and customers, to produce quality products in accordance with the Good Agricultural practice.

In the dependence of the purpose of the product, requirements of consumers or customers agricultural producers voluntary or on the account of customers implement a system, standard or produce method.

The most basic requirement is when the customer looking for from the agricultural producer plant treatment diary. The products with the purpose to serve as animal food the most common is that the customers require only the completed plant treatment diary.

If the fruits or vegetables directly, without processing in the fresh state comes to the consumers some of them request from customers that the production let to be provided by the methods of integrated production or they can be requested for GLOBALG.A.P. certificate.

Certificate of GLOBALG.A.P. standard might be carrying out from January 1st 2012 by the new 4th version. Every producer has to be registered in the– da GLOBALG.A.P. database. At this registration every agricultural producer get an unique so-called GGN number (GLOBALG.A.P. number). "This digit number is unique and remains valid and attached to the legal entity as long as it exists. It serves as search key on the GLOBAL.A.P. website to validate certificates.

For the sake of that the customers and consumers could be verified whether the producer possess valid GLOBALGAP certificate on the base of GGN number, the producer must to mark the unique GGN number on the packaging. They can mark that number on products which are produced under the conditions of the GLOBALG.A.P. regulations.

Before the procedure GLOBALG.A.P. certification the agricultural producers must to state according to whether they provide so-called parallel producing – whether they have got agricultural producing of products of the other domain which are not covered by the GLOBALG.A.P. regulations.

This is a cardinal importance, because the products which are derived also have to be marked at handling and storage, in order to not to be in some way mixed with the products produced by the GLOBALG.A.P. principles.

By the possessing of the GLOBALG.A.P. standard the agricultural producers can be demonstrated for the customers and consumers product compatibility from the aspect of food safety, that the production is carrying out in that way, which would pay attention on the health protection of the employees as well as on environment protection.

GLOBALG.A.P. certification might be completed separately, this is so-called Option 1 or in groups, this is so-called Option 2. The GLOBALG.A.P. certificates issue for a year period with that the certification body which have issued the certificates at Option 2 have the rights on extraordinary control, which would be reported 48 hours earlier to the arrival on site in the organization as well as at producer.

If the fruits, vegetables or cereal purposed for processing, when entering (or maybe before it) into the manufacturing plant it should be undergone through detailed control.

Processing industries by the implementation of HACCP (Hazard analysis critical control point) system perform entering control of the incoming raw materials, in order to "built-in" safety into the products and in order to established procedures, analyzing of the completed products serve "just" as for affirmation of the validated established (working) procedures.

Often requests additionally from the agricultural producers besides soil analyzing the completed plant treatment diary. They control the list of applied means for plant protection and the waiting period focusing on that in which soil would be sold the finished product which occurs from the current plant in the plant treatment diary.

In the case of any deviation from the granted values they stop reception and reject the product take over. Besides this many apply techniques of producer evaluation and ranking. If any of producers does not meet the granted criteria it would be excluded from the circle of approved suppliers. It is of fundamental importance to them, due to if the raw material contains remains of treatment/protection means for plants or other dangerous chemicals in more quantity then allowed, there impossible to produce health safety product.

By the conditions for product acceptance, by the qualitative criteria and by (in some organizations) the evaluation of suppliers, employees undergo through internal (in some cases also through external) trainings. Because "Significant percent of poisoning and infection caused by food origin from the lack of knowledge of food safety", so they prevent this by training of employees (NAGY A. et al., 2003)

Especially important segment is the enforcement of good hygienic practice during the production, picking and packing for the sake of avoidance of microbiological dangers at those fruits which are often consumed by the consumers without washing (for example raspberry) in fresh or in frozen state.

In that case it is appropriate to apply GLOBALG.A.P. principles during the production, because it is more precisely contains criteria of HACCP system (Hazard analysis critical control point). The trend on the food market is the consumers' desire for authenticity with traditions and food safety. In that struggle for competitiveness the authenticated products become more and more valuable, that is products with special quality. These characteristics of food arising from its composition values, the producing method and processing as well as climate from which it comes from. Owing to this system it would provided exclusive product, where just traditional Europe most serve with marking the geographical origin.

Two type of geographic origin mark exists:

"Appellation of origin shall be geographical name of a region, locality, or country used to designate a product originating therein, the quality and specific characteristics of which are due exclusively or essentially to the geographical environment, including natural and human factors, and such product is produced, processed and prepared entirely within a specific geographical area.

Geographical indications shall be indications which identify particular goods as goods originating from the territory of specific country, region or locality within such territory, where a given quality, reputation or other characteristics of such goods can be essentially attributed to their geographical origin, and such goods are produced and/or processed and/or prepared within a definite geographical area (Zakon o oznakama geografskog porekla)

These marks are easily recognizable. These marks could be placed by only producers whose possess status authorized users for that marks, and whose are certificated from the side of certifying house which have been previously authorized by the Ministry of agriculture.

Depending on the type of certificate scheme, certificate of the agricultural products and food products aim to:

- Decrease transaction costs and to increase efficiency in the chain of vertical supplying

- Decrease risk and in that way protect the insight of the subject of food management, especially traders.
- Insure respect concerning to the production processes with law regulations and with the requirements of consumers and inhabitants.
- Highlighted characteristics of certain products or processes in order to distinguish them on the market.
- Support the maintenance of product diversity and production methods in that way contribute to the realization of rural development.
- Decrease duplications and overlaps of the requirements between schemes or between schemes and official requirements.

Organic production has got significant role in the rural area development, because enables economic development, diversification activities, attracting financial resources, but also constitutes integral part of strategy for rural and agricultural development. Significance of the organic production is origin from following aspects which involve, like:

- Protection of natural resources from pollution.
- Soundness of biological diversity
- Long-term maintenance and increasing the soil fertility.
- Production through recognized production methods.
- Consumer protection.
- Possibility of sustainable socioeconomic development of rural areas.

Logo for organic products as in private so in national use as addition for food and drinks marking with which are draws attention of the consumers to the products making by special methods. Therefore, consumers who buy products with "Organic" logo could be sure that:

- At least a 95% ingredient of the agricultural product is produced by organic methods.
- The product is in accordance with the regulations of the national control schemes.
- Product is directly coming from producer or it is packaging for final consumption.
- Product carries the name of producer, processor or seller.

In all cases, all the ways or principles which would be used by the agricultural producer, must to be respect principles system traceability.

"Traceability is possibility for food monitoring, animal food, animals which serve for food production, raw material or substances intended to or which would be expected to embedded into the food or into animal food, through all the phases of production, processing and trade" (Zakon o bezbednosti hrane)

Traceability of the products must not be lost during its transportation, processing, trade and sale, for the sake of every packaging of finished product, participants in the chain of board must to have such a documentary system, which could be on that base found (group) primary producer, from where (from which parcel) the product origin.

Results and discussion

One of the basic aims of agricultural and food industries development in Serbia is to increase the competitiveness of our products both on domestic and on foreign markets. For the sake of competitiveness of the Serbian products in Europe and in other countries, we must bear in mind that the production processes, processing and distribution must to be tailored to

the procedures, which have been embedded in the standards according to the quality and safety of food.

Requirements of the consumers and the market on the beginning of the 21 centaury have been imposed such a conditions for all of the members of the board chain (agricultural production, processing of the agricultural products and food industry, commerce) that there is impossible to survive and to be successful on the market, unless exclusively to be oriented toward quality and by responsible attitude to the food safety. Agricultural production in order to be economically justified, like a basic goal for the farm survival, must to create confidence toward products in consumers and customers. To achieve this, they have to demonstrate product compliance in order to satisfy high criteria of standards and regulations.

Conclusion

In the main part, all farmers have to be legally obliged to respect regulations according to the agricultural and food production, among others; primarily it is related to the environment protection, animal welfare, and careful usage of pesticides as well as veterinary medicines. Beyond these "basic" requirements, farmers and food producers have to be used their knowledge and imagination in order to provide products with "special" quality, which might be reputable by the side of consumers. Agro-food sector will have to be advanced by those approaches in the following years in order to hold competitiveness and profitability. For the farmers and food producers, that means two things: as first, to provide quality products which are desired by consumers, and as second, clearly inform consumers according to its product quality.

Agricultural producers primarily should be respected the principles of food safety and product traceability, considering the purpose and place of the agricultural product usage. In order to demonstrate product compliance appropriate to applies some principles of production system, like GLOBALG.A.P., organic production, integrated production, marking the products with their name of origin, etc.

In order to be the implementation and certificate system of food safety and traceability would be more favorable, there is an advice for the producers to aggregate into societies, and in that way would be contribute to the rural development. Besides, by association there is a possibility for joint actions toward major customers of commercial chains.

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RURAL REGIONS AND TOURISM IN MONTENEGRO

Miroslav DODEROVIC[*], Dragomir KICOVIC

Philosophy Faculty, Niksic, University of Montenegro
(Corresponding author: dodemir@t-com.me)

Abstract

Although the rural heritage of Montenegro is the best way to reflect its exceptional value areas, and although it is very important and diverse, it unfortunately has not been adequately treated. This heritage is at high risk: on the one hand, the decay of a large number of abandoned villages, and on the other hand, due to the extremely rapid and uncontrolled urbanization that destroys much of the valuable heritage and rural landscape. Value and potential of rural heritage and authentic cultural landscape in Montenegro is still not recognized, partly due to insufficiently developed awareness of the heritage of this segment, by both citizens and decision makers, and, unfortunately, architects and planners. The transition from planned economy to market economy was characterized by a number of contradictions and inefficiencies, both at the structural and political level. Such a situation does not help development and modernization. The main strategic objectives of tourism in rural areas in Montenegro are: competitiveness in international markets, balanced regional development, motivating young people to stay in the countryside, permanent protection, implementation and adherence to high environmental standards and sustainable long-term evaluation of tourism resources. Also, development of a comprehensive offer of tourist destinations, raising the quality of accommodation, catering and tourism services, encouraging organic food and local products and their placement in tourism infrastructure, training of employees in tourism and inland tourism increase in the proportion of the total tourist traffic are important objectives.

Keywords: *Montenegro, tourism, landscapes, development, goals.*

Introduction

Agriculture, along with tourism and services, are the top priorities of economic development in Montenegro. Agriculture accounts for about 15% in total GDP, while it constantly employs about 9% of the active workforce. Many households are engaged in agriculture on small holding (about 5 ha on average), so it is a primary or supplemental source of income for over 60,000 households. Agricultural land and waters of Montenegro are well preserved from industrial pollution and allow the production of healthy and organic food, particularly meat (poultry, lamb, goat, beef and veal), dairy products, honey, fish, vegetables (tomatoes, peppers, cucumber, etc.), fruits (plums, apples, grapes, citrus, olives) and high-quality wines (Vranac, Krstac and others.). Natural pure water is of high quality (measured by strict international standards). There are also specific plants such as forest fruits (blueberries, mushrooms) and wild herbs, especially sage, whose outstanding features are known almost everywhere.

Natural and other conditions influenced by the fact that in agriculture is quite clearly differentiate production orientation by major regions. The coastal region is dominated by navigation activities and agriculture focused on the production of citrus, early vegetables, olives, herbs, seedlings and subtropical crops. In the Central region there is production of

fruits and vegetables, seedling material, flowers, greenhouse production and collecting medicinal herbs and berries. In the Northern region there is production of milk, meat, potatoes, wool, fish farming and gathering berries. Commercial and other logic dictate that the use of comparative advantages in the future, which means that in this particular region dominates existing or slightly modified production orientation. Wherever possible, especially in the Northern region is to stimulate the production of the so-called healthy food and organic agriculture, and in the coastal region especially the production and processing of Mediterranean cultures.

Objectives

Tourist valorization, as the process of evaluation and assessment of natural and anthropogenic values important for tourism, take into account, among other things, mountains that have the status of National Parks. Valuation is a very important step because it has the significance of application and is able to use those elements in space for a range of other activities and does not constitute a higher value. Complexity valorization of the strengths when it comes to mountains because they are independent and complementary tourist values, which takes up more features: picnic and recreational, sports and manifestation, hunting, health and wellness, natural reserves, national parks and other features.

Materials and methods

The importance of valorization of mountain and rural areas is reflected in the fact that it contributes to the distinctiveness and individuality, shows the characteristics of the mountains that make them different from other natural objects. In doing so, one must take into account the specific knowledge of the evolutionary space (depending on the time of observation) and the one on which the emphasis during this procedure. The only correct approach is the one that is based on the study of several aspects of the use of comparative results of several scientific disciplines.

Montenegrin agriculture, despite the limited agricultural land 518,000 hectares, is very diverse.(1) Comparative advantage is the fact that the land, generally speaking, is not worn out and that Montenegro still uses low amount of fertilizers (over 10 times less than the EU average) and plant protection products. The low level of use of fertilizers and pesticides is a great base for the development of organic agriculture. However, there is loss of agricultural land (primarily using it for other purposes). Montenegro is divided into five agricultural regions: coastal, Zeta bjelopavlicki, mountain-valley slope, and the karst mountain area. This zoning is based solely on the environmental conditions and does not coincide with any other territorial divisions.

Constraints for agricultural development are numerous and include, inter alia: a) fragmented holdings and production in harsh natural conditions, b) agriculture is to a large extent just additional occupation, which slows down the modernization of farms and market orientation, and c) a low level of education and professional manufacturer for farming as a business, d) lack of built infrastructure in rural areas, lack of a strong financial sector lending for agriculture and the reluctance of banks to lend to small food producers, and e) an undeveloped market infrastructure and lack of vertical integration of agriculture and manufacturing. The scope of incentives is not satisfactory, since the overall state support for the development of agriculture in GDP participates with about 0.65%.

As a result of these and other constraints, the competitiveness of food producers is relatively low, and there an import dependency of Montenegro in the food sector. In 2010 the trade deficit on imports of food close to 150 million Euros, and the degree of coverage of

imports by exports, although significantly higher than in previous years, was 28%. EU (and the WTO) agriculture integration processes are the major challenges, since the experience of other countries shows that this is the area with the most extensive obligations in the EU accession process. Requirements are related to food safety, the common organization of the market for certain agricultural products and rural development - a component of agricultural policy to which the EU attaches greaterimportance.

Regarding the future development of the model, Montenegro will develop a concept of sustainable agriculture, which places agriculture in much broader context of its importance in terms of contribution to the GDP. A basic point of departure is the multiple roles of agriculture which has the function of sustainable rural development, environmental protection and long-term sustainable resource management function, economic function, the function of supporting the development of tourism, social, nutritional and national-cultural function (through the tradition and cultural heritage of the country). It is necessary to ensure that the agricultural policy of rural households in Montenegro enter the system of protection of the environment and nature. Given the fact that the star CORINE virtually shows that all of Montenegro belongs to the sensitive nature area, it is necessary to adjust the agricultural policy to that fact. Therefore, the state should provide a clear legislative practice and Agricultural Policy which will provide farmers compensation for losses due to the limitations of applied measures of protection and conservation of the environment and conservation of traditional agricultural production if farmers and farms (farms, cooperatives) adhere to specific care practices. It is necessary to define the appropriate fiscal policies and subsidies.

Priority tasks in the development of agriculture and fisheries are: a) providing a stable and high-quality food supply by raising the competitiveness of local producers and sustainable management of resources, and b) rural development and providing adequate standard of living for the rural population. Measures to be undertaken to achieve these objectives relate primarily to the improvement of the legal framework (in line with EU requirements) as well as providing substantial support to the development of agriculture and fisheries from the budget and from the private sector (the availability of credit and the like).(5)

Results and discussions

The elements to be taken into account in the mountains - the national parks, and so is Lov en, are some of following. Geographic position (position of Lov en near the Adriatic Sea in the background of the Bay of Kotor) travel position (ratio of contractive zone of Lov en and dispersion zones of major cities and the position of the competing values of tourism) and transport position (in the direction much as possible to come to Lov en, what is the functional significance of roads, etc). Therefore, validation of the mountains shall supplement their functions, both present and future. Recognize and define locations for various types of tourism as priorities in the further development, which tells us all we need to valuation complex access. While many of the circumstances related to changes in the organization and economics of livestock production are changed, areas in national parks may be subject to far greater attention primarily because of their deliberate and systematic improvement of natural conditions adjusted with one hand and for the possibility of organizing the production of biologically highly valuable and healthy Food as another trend that is accepted by us with many improvisations, misunderstandings, which is our traditional superficiality or voluntarism.(3)

Generally speaking, the main feature of land in national parks belongs to the mountain types. So, they are usually light texture, the shallow surface that often occurs on the surface, the plant assimilative poor and mostly sour to very sour. When a heavier textures then the most crowded, with bad air regime which requires the development of specific vegetation.

Terms of erosion are very favorable, and its intensity is increased. Although a variety of flora and production of all types of turf is common to have more or less degraded. This raises the fundamental question of how to improve and enrich the basic constraints arising from laws and regional plans of national parks. We believe that it is important to emphasize that it is difficult to expect a spontaneous improvement of just banning grazing is often pointed out, because degradation of grassland in these areas is not only the result of a single factor. The most common characteristics of the soil are the poverty of the nutrient elements. Often, however, rich in organic matter is important for food because of climate and soil conditions of its mineralization process is slowed down. Production on arable land and the preservation of the environment and its improvement in these conditions can be done in two ways. First, the maximum should be replaced by the introduction of foreign grain travnleguminose mixture thus providing higher quality forage colic, and to the greater involvement leluminoza reduces the need for fertilizer on the one hand, and effectively protect the land from erosion on the other. Second, be sure to run a contour tillage. It is our opinion that the improvement in fruit production should strive to increase the size.

Primarily significant changes to the structure of long-term plantings go in the direction of expansion of plum, raspberry and hazelnut. At this orientation, the fact that the decisive influence of the species does not require a strong protection against diseases and pests which meets the requirement of the elimination or substantial obstacles in the use of chemicals. He starts from the assumption that the biology of these species correspond to areas of ecological conditions.

Animal husbandry in the area of national parks bears all the hallmarks of the environment in which it takes place. Mostly elevation has caused predominantly a place of natural meadows and pastures, and they domination of sheep and cattle production. Framework setting out spatial plans on the number and structure of livestock are generally acceptable. So load pitch is to be in the range of 1 - 6 sheep or 0.25 to 1.3 cows per hectare and the relationship between them in range 4-10: 1. It should be noted that the Pasha range above 1,000 meters height can be 100 - 120 days. For any improvement of livestock, particularly in these areas, it is important to start with race reorientation, especially in sheep herding. There is the choice of the type of livestock facility, location, type of material and the multiple ways fertilization important safety constraints, space and water protection, technology and rationality. The principles are the same as that for the choice of location for a settlement. They should be located in a protected area out of the wind "hot" material, provided with water, but not close to the source or water courses.(4)

The rapid development of chemistry and the pharmaceutical industry have pushed the importance of early collection of aromatic and medicinal plants. However, in recent times, fears that occur in people from unnecessary removal of nature, which is reflected in the reputation of return of alternative medicine, reaffirms this activity. The flora of Montenegro has a large number of decorative, plant species that give special aesthetic impression, as water, and terrestrial ecosystems. Early spring and high mountainous flora is characterized by large and highly colored flowers. The vegetation consists of all plant communities that cover its territory. In this area there are 37 vegetation classes, 53 ranks, 97 parcels and 267 associations.(7)

Apart from all the stresses and circumstances to tourism (fun, entertainment, learning, patriotism and internationalism) occupies a special position and profit or economic effects that the objects. As an important form of consumption occurs consumption of food and beverages in places of tourist needs resolution. Questionnaire surveys in different countries of the world shows that 1/3 of the respondents prefer to travel for reasons of proper eating dishes of the national cuisine. Tourism market has a number of advantages when it comes to the marketing of agricultural products. Tourists buy on the spot and avoid transportation costs, customs,

waiting, etc.. Also, agricultural products sold in the final processing are considered to be the most profitable, while some products are sold up to 10 times more expensive. The tourist industry should count that they are particularly prized products that represent the best and stand out locally and nationally, that both quality and appearance. This requires national and regional increasingly emphasize and highlight the tourist industry and its promotion.(6) Development plans should emphasize the concept of healthy food and its products that reflect local climate, a special way of processing and preparation. The concept of healthy food often has a number of similarities with the concept of active protection of nature. In order to have the greatest effects were more and more in the field of nutrition; they point the geographical origin of products and the highest quality, and avoid imitations. It is important to emphasize the local, traditional and national, as opposed to the global import and leading globalization and uniformity. This can be achieved only by a deliberate policy of linking leading manufacturer of food packaging and on one side, and the tourism and hospitality industry on the other. Only in this way can expect the greatest effects of cooperation and prolific food production and tourism market.(8)

Adequate development of agriculture realizes many benefits, and its successful development, provides:

- agricultural production must be based on ecological principles;
- further increase agricultural production and therefore contribute to the overall growth of the economy, to ensure meeting the needs of the population and ensuring stability;
- optimal use of agricultural land,
- a tighter integration of the agricultural economy in other economic flows;
- agriculture to alleviate disparities between regions, social groups and individuals
- agriculture should provide adequate nutrition and contributes to the preservation and improvement of health population, protection of cultural patterns and cultural heritage, and a way of life;
- Balanced distribution of income.

For achieving the goal of Montenegro - an ecological state, agriculture special significance in the agricultural production of organic food has a special place. However, except for declaratory commitment to this production, the Montenegrin science and profession have not dealt with seriously. Hence, this is an attempt to highlight the most important constraints, that is, what steps should be to create conditions and what if it wants to enter into the production of healthy food but in the strict sense of the word because it is expensive and available only to a small circle of high-income consumers. Production should be carried out under strictly defined conditions and with controlled processes.(2)

Tourism generates a number of positive and negative impacts on the environment. Positive impacts of tourism on the environment shall be determined as follows:

a) Tourism is many regions is the main or additional source of income. Great positive significance of tourism is its characteristic multiplication since creeping into your core business a number of other activities,

b) Tourism enriches the environment and the elements of its new facilities.

c) has a positive effect on raising awareness of both individuals and society as a whole

d) Tourism contributes to the aesthetic improvement of geographical area, its beauty and humanizing, and the formation of a qualitatively new content,

e) Positive impact on a number of facilities and institutions (national parks, nature reserves, museums, galleries and the like.), although they are not only meant for tourism just get through it real and importance,

f) And, finally, it has a positive effect on the actions of protection, restoration, renovation and restoration of various cultural and historical monuments and their involvement in tourism.

Negative impacts of tourism on the environment are the following:

*   the adverse impacts arising oversized and unplanned tourist traffic, which in turn negatively affects the change in the physiognomy of the landscape and the disruption of the ecological balance,
*   Tourism affects the degradation of the landscape and the building of mismatched and oversized objects.(2).

Conclusion

Agriculture, along with tourism and services are the top priorities of economic development in Montenegro. Agriculture accounts for about 15% in total GDP, while it constantly employs about 9% of the active workforce. Many households are engaged in agriculture on small holdings (about 5 ha on average), so it is a primary or supplemental source of income for over 60,000 households. The main strategic objectives in rural tourism in Montenegro are: competitiveness on the international market, balanced regional development, self-employment and motivation of young people to stay in rural areas, long-term protection, implementation and adherence to high environmental standards and sustainable long-term evaluation of tourism resources, development of full range of tourist destinations, raising the quality of accommodation, catering and tourism services, stimulating the production of organic food and local products and their placement in tourism infrastructure, training of employees in tourism and increasing our mainland tourism in the overall tourism economy. Because space, especially geographically (geospace) is for many activities, especially tourism, an indispensable component of development, before the appearance of conflict and processes in the environment are undesirable. Tourism involves a healthy environment with stable ecological relationships because of their role in the market on a variety of stresses and isotropic environment. Tourism is seen as a space consumer since it uses the "revived" those surfaces, objects and phenomena that are not of interest to a number of other activities.

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BENEFICIARIES AND BENEFITS

- **Institutions** supporting innovation in the food sector and beyond (National Technology Platforms, networks and clusters) will be encouraged to promote and use the project results.
- **Policy makers** in fostering innovation and competitiveness will be encouraged to use and apply the project results on local/national/regional/international level.
- **SMEs**, their suppliers and customers as well as ICT solution providers will be encouraged to enjoy benefits of the project.
- **Research organisations/researchers** will be asked to contribute to project activities.
- **General public** will be addressed to recognize the role of the food sector and innovation in increasing living standards and quality of life.
- **Young people** looking for a carrier in the food sector will be addressed using modern tools in order to grab their interest.

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Project Partners

Lead Partner:
HUNGARY
Hungarian Science and Technology Foundation (TETALAP)
Contact: Dóra Groó capinfood@tetalap.hu

HUNGARY
Campden BRI Hungary Ltd. (CBHU)
Contact: András Sebők a.sebok@camodenkht.com

HUNGARY
Computer and Automation Research Institute,
Hungarian Academy of Sciences (MTA SZTAKI)
Contact: Géza Haidegger haidegger@sztaki.hu

GREECE
Federation of Hellenic Food Industries (SEVT)
Contact: Vasso Papadimitriou vasap@sevt.gr, Fotini Salta fotsal@sevt.gr

ITALY
University of Milan, Department of Economics,
Management and Quantitative Methods (UMI)
Contact: Alessandro Banterle a.essandro.banterle@unimi.it

ROMANIA
National Institute of Research & Development
for Food Bioresources (RA)
Contact: Adriana Macri acriana.macri@bioresursa.ro

SLOVENIA
Chamber of Commerce and Industry of Slovenia-
Chamber of Agricultural and Food Enterprises (CCIS-CAFE)
Contact: Petra Medved Djurasinovic petra.medved@gzs.si

BULGARIA
University of Provdiv (UP)
Contact: Ivan N. Minkov minkov@uni-plovdiv.bg

BELGIUM
Ghent University (UGENT)
Contact: Xavier Gellynck xavier.gellynck@ugent.be

SERBIA
Faculty of Agriculture, University of Belgrade (UB)
Contact: Victor Nedovic viktor.nedovic@nauka.gov.rs

BOSNIA and HERZEGOVINA
University of East Sarajevo, Faculty of Technology (UES)
Contact: Radoslav Grujic grujic@blic.net

MONTENEGRO
Capital City Podgorica - Secretariat for entrepreneurship
development (SED)
Contact: Vladimir Pavićević vpavicevic@pggrad.co.me

UKRAINE
Uzhhorod National University (UZH)
Contact: Nadiya Boyko nadiya.boyko@gmail.com

CAPINFOOD project

Improving the enabling environment and public awareness for innovation in the South-East-European food sector through transnational collaboration

Jointly for our common future

MAIN DATA OF THE PROJECT

Project title
Improving the enabling environment and public awareness for innovation in the South East European food sector through transnational collaboration

Program
South East Europe Transnational Cooperation Programme
(SEE Programme)

Priority axis
Facilitation of innovation and entrepreneurship

Area of intervention
Enhance the framework conditions and the pave the way for innovation

Duration
01/03/2011 - 28/02/2014

MAIN OBJECTIVES

To improve the enabling environment for food innovation:
- by capacity building of the supporting institutional framework
- by reducing the barriers of innovation
- by promotion of public awareness on benefits of innovation in the food sector
- through transnational collaboration

SPECIFIC OBJECTIVES

- to develop **national innovation strategies** for the food sector
- to improve the **coordination** of the related institutional framework at both national and SEE regional level
- to **develop skills** of innovation promotion institutions in SEE in order to use comprehensive tools in supporting SMEs
- to promote the use of **ICT based tools** for fostering innovation in the food sector
- to develop **pilot systems** for institutions for provision of collective innovation support services for food SMEs
- to improve the social **appreciation of food innovation** and entrepreneurship
- to **disseminate food research results** to a wider community – especially to young people - and also beyond the food sector
- to **integrate non EU countries** into the development of South East Europe
- to concert efforts and share successful approaches related to food innovation by the establishment of a **regional forum** in the South East Europe area

MAIN EXPECTED RESULTS

- a **South East European (SEE)** forum for exchanging experiences and successful practices of the National Food Technology Platforms (NFTPs) and other voluntary initiatives of stakeholders to enhance innovation
- **best practice guides** on using industry panels for collective innovation generating and supporting services and on ICT solutions for enhancing innovation in the food sector
- a **service** manual for innovation supporting services
- a **pilot model** for providing innovation support services.
- a **campaign** to increase the public appreciation of food innovation in 9 countries
- an **intelligent knowledge management tool** to improve access to young people.
- **inventory of ICT based solutions** for the food industry
- **recommendations** to improve the enabling environment for food innovation for regional, national, EU policy makers, institutions, civil organisations and SMEs for 9 SEE countries and for the whole SEE area