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THE ASSESSMENT OF ORGANIC FARMING SYSTEMS IN SOUTHERN PANNONIAN BASIN

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Abstract

This paper was intended to evaluate the systems of organic farming on the controlled and certified farms in the Southern Pannonian Basin during the two-year study. The key indicators were assessed in order to study the level of sustainability achieved on the organic farms and adaptation to new cropping technology. Chosen characteristics of farming systems were as follows: planting structure, crop rotation, crop structure, land cover over year, cover crops and others. Data were collected via questionnaires, documentation of farms and surveys. Based on these results we performed the evaluation process considering specific agro-ecological conditions of the farms. It was found that there are significant differences between the farms and farming systems related with production goals, adaptation to market demands, accessible machinery, whereas long-term production planning was not clearly determined. Most farms carry on similar production after conversion to organic. The average farm area covered with crops during the year is 70%. Improvement of organic farming with the proper crop rotation, leguminous plants or cover crops was not fully utilized.

Key words: organic farm, crop rotation, cropping technology, cover crops.

Introduction

Increasing demand for healthy food in Serbia led to the conversion of conventional farms to organic, which significantly contributed to increasing the overall sustainability of agricultural production (Lazić and Šeremešić, 2010). According to data from Willer and Lucas (2011) organic agriculture occupies 8661 hectares of total agricultural land in 2009 which indicate a stable growth in area and overall production compared with previous years (Willer and Yussefi, 2007). Nevertheless, recent data show a perspective in the utilization of agricultural areas with organic agriculture, although percentage of agricultural area with organic hectares is far less than EU average.

Organic plant production system involves the integration of nutrient management, plant protection and crop rotation, which must be judicious to increase the sustainability of the whole farm. Fertilization must be conducted in accordance with regulations (Official gazette of Serbia 48/2011), the soil preparation is based on crop requirement, while the planning and implementing the rotation derives from planned production. Crop rotation plays a central role in the basic design of organic farms (Wijnands, 1999), also pertaining to maintain and improve soil quality (Lampkin, 1994). In organic production systems design and planning of crop rotation is necessary for the establishment of appropriate relations between different

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groups of crops (e.g. legumes, cereals or row crops). In addition, the desired crop sequence in the framework of the planned crop management could develop agro-ecological favorable farm layout and significantly contribute to the sustainability of agricultural-ecosystems (Milošev and Šeremešić, 2008). For the preparation and evaluation of multifunctional developed crop rotation several methods and approaches were suggested (Vereijken, 1997; Dogliotti et al., 2003). Inappropriate selection of crops and crop rotation design can generate a problems with weeds (Barbieri, 2002), pests and diseases, leading to a reduction in product quality and thus reducing the yield (Porter et al., 2003). The potential disadvantages of a planned rotation, especially at the beginning of organic farming, may be a disproportionate number of rotation fields and their sizes, exaggerated diversification of species that are grown, reducing soil fertility, no consideration for mutual tolerance of crops (Šeremešić and Milošev, 2006; Čuvardić et al., 2006). In addition, accessing the organic farm should also take into account the relatively long period before rotation can be assessed in terms of its substantial effects on plant production and nutrient cycle on the farm (Watson et al., 1996).
The aim of this study was to evaluate the effectiveness of crop rotation on six organic farms in order to improve utilization of available resources and production technology.

Materials and methods

The following farms were analyzed: Kelebija, Tavankut, Ljutovo, Bajmok, Kisac and Orom. Selected farms were recommended after discussion with certification organisation in Serbia and therefore we consider them eligible for investigation according to national organic legislation. Among them there were no common treatments. The information about cropping practice was obtained from questionnaires, farm documents (prepared for the certification), and by interviewing the farmers in investigation conducted 2005/06. Numerical data were presented as average values for two production year after statistical analyses, whereas indicators of crop rotation were expressed by proper mark. Soil chemical analyses indicated that the certified organic sites were either as fertile as the adjacent conventional fields or marginally less fertile but not significantly so (Cuvardic et al., 2006). Soil fertility was maintained, primarily, with different amounts of an organic fertilizer (i.e. manure, compost) applied at four-year intervals on each field and microbiological fertilizers (i.e. Bactofil A and B etc.). Selected farmers utilized on-farms resources for additional nutrient input such as N-fixing crops (i.e. soybean, pea) and green manures (*Trifolium sp*., *Medicago sativa*, Phacelia *tanacetifolia* etc.). Primary tillage was conducted with shallow moldboard plowing or disc harrowing in autumn, and seedbed preparation was carried out with harrow, disk harrow and field cultivators. To suppress weeds mechanically measure were used.

Results and discussion

Organic farming at the analyzed sites was characterized by a great diversity which derives from the specific agricultural conditions on the farm and planting structure that dominated during the conventional production. The crop structure selection depends on the size of farms and land use as well as demand for crops that direct the farmers to produce those crops that will be competitive in the market (Table 1). Although each farm could be observed as an independent production unit, a similar pattern of crop structure is observed in the neighboring areas that are in conventional production. Number of crops that are grown on organic farms was significantly different (Table 1, Table 2). As good preceding crop, small grains cover approximately 21.4 to 25.8% of the total arable land in farms (except Tavankut). A high proportion of cereals and pulses, which was found at Ljutovo and Orom may represent a good

basis for building up a balanced crop rotation. However, organic producers at the Kelebija and Bajmok that cultivate > 50% row crops in the structure of planting may have difficulty in achieving optimal rotation for organic farm. Kisac was oriented to the production of vegetables, with more than 30 different varieties and with 60% of arable land covered with vegetables indicate high level of specialization and market oriented production with high production costs. At the farm Tavankut there were only two plant species in certified organic production (alfalfa and oil pumpkin) with the preceding crops soybean and wheat.

Table 1. Crop structure at the investigated sites

Indicators	Organic Farms											
	Kelebija		Tavankut		Ljutovo		Bajmok		Kisač		Orom	
Total area	**11.7**		**5**		**15,5**		**11.9**		**14**		**6.5**	
Crop structure	*Crop (%)*	*Area (ha)*	*Crop (%)*	*Area (ha)*	*Crop (%)*	*Area (ha)*	*Crop (%)*	*Area (ha)*	*Crop (%)*	*Area (ha)*	*Crop (%)*	*Area (ha)*
Legumes	11.1	1.3	40	2	37.4	5.8	13.4	1.6	7.1	1	53.8	3.5
Small grain winter/spring	24.8	2.9	-	-	25.8	4	25.2	3	21.4	3	23.1	1.5
Tuber crops	1.7	0.2	-	-	1.9	0.3	-	-	14.2	2	-	-
Vegetables	11.1	1.3	-	-	15.5	2,4	-	-	64.3	9	-	-
Row crops	51.3	6.0	60	3	19.4	3	61.4	7.3	-	-	23.1	1.5

Analysis of organic producers showed that they continue to grow crops similar to the period before conversion to organic production. Organic producers showed the tendency of development in two directions. The first is the growing of legumes and tends to improve soil fertility with the crops structure that is with less economic value. On the other hand there is a tendency to grow several intensive row and intensive vegetable that have higher economic value and high demands on nitrogen. When analyzing the total number of crop that are grown (except Tavankut) and the distribution of fields (Table 1) there are sufficient potential for various crop rotations, especially those made from row crops, grains, vegetables and forage crops. According to this study organic production is based on the rotation of 3-5 crops including a regular alternation of different groups of crops (legumes / grains / row crops / vegetables). Production based on pre-defined crop rotations was limited to one year in advance. The choice of crops variety on farms is defined only for the following year in accordance with the crop rotation and with respect of the environmental conditions (Table 2). Within the planned crop rotations there is a possibility that some crop become dominant on the farm which could intensify organic production, and subordinate other crops in rotation (Wijnands, 1999).

Table 2. Crop structure at the investigated sites

Indicators	Organic Farms					
	Kelebija	Tavankut	Ljutovo	Bajmok	Kisač	Orom
Legumes annual/peranuual	2	1	3	2	1	1
Small grain winter/spring	2	-	4	2	1	1
Tuber crops	1	-	2	-	1	-
Vegetables	5	-	1	-	11	-
Row crops	3	1	3	2	-	1
Total number of crops	**13**	**2**	**13**	**6**	**14**	**3**
Type of rotation[1]	V/FCV	L	FCV	FCV	V	FCV
Intercropping	Yes	No	Yes	No	No	No
Winter cover crops	No	No	Yes	No	Yes	No
Numb. of crops in rotation	4-5	3	3-4	4	4	3-4
SCI[2](%)	70%	75%	65%	65%	90%	55%

[1]Types of crops that were the subject of planned rotation (other crops were grown in other fields on the farm); **V**- vegetable crops, **FC**- field crops, **L**-legumes; [2]**S**oil **C**over **I**ndex-period of year during which the soil is covered with plants (% of 12 month) - estimated by farmers; [3]Number of years of planned crop rotation in the future.

Desired level of coverage of land with crops - Soil cover index (SCI), according to Helander and Delin (2004) during the year is 80%. In our study, the average index of land cover with crops was less than 70% (8 ½ months). The obtained values for individual farms show a very low usage of winter crops crops and stubble crops. Only two out of the six farmers regularly include inter-seasonal winter crops and apply intercroping in major crop in order to improve the effects of crop rotation, maintain fertility and to increase biodiversity.
On the basis of various resources that exist on farms and production targets different crop rotations may be proposed to for the studied agro-ecological conditions of the northern part of Serbia. It is recommended that rotation contain up to 40% legumes, to ensure that the animal feed and maintained soil fertility. In preparing the vegetable crop rotation in organic production N balance can be significant altered with a significant crop demand for nitrogen and small input. Vegetable crop rotations are mainly intended for the production of fresh fruit and share in specific vegetable rotation should be in the range 70 - 80%. Forage crop rotations should be allocated outside the main complex crop rotation, with the share of fodder crops 60 to 80%.

Conclusions

Investigated farms are different in terms of organic production systems and management approaches with available resources present on the farm. The results show that the production is based on 3-4-crop rotations, with the proper selection of crops. Organic farming systems can be improved by introducing inter-season crops winter crops, and greater percentage of legume crop in combination with recommended doses of organic fertilizers.

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ЕВАЛУАЦИЈА СИСТЕМА РАТАРЕЊА НА ОРГАНСКИМ ФАРМАМА ВОЈВОДИНЕ

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Резиме

Циљ истраживања система ратарења у органској пољопривреди је да се укаже на користи које произилазе из одрживог приступа пољопривредној производњи. У раду је дат приказ система ратарења на фармама органских произвођача у систему контроле и сертификације на подручју Војводине током две године истраживања. Анализирани су кључни индикатори који указују на ниво постигнуте одрживости и то: структура сетве, плодоредне ротације, однос између различитих група усева, покривеност земљишта усевима и др. Подаци су прикупљени преко упитника, из документације о вођењу газдинства, односно кроз разговор са власницима фарми. На основу добијених резултата извршили смо евалуацију фарми имајући узимајући у обзир специфичности услова производње. Утврђено је да постоје значајне разлике посматраних газдинства, системи ратарења се прилагођавају захтевима тржишта, поштујући принципе плодосмене са 3-4 годишњом ротацијом, док дугорочно планирање производње није присутно. Просечна покривеност земљишта усевим током године износи 70%. Потенцијали коришћења плодореда, легуминозних биљака или покровних усева нису довољно искоришћени.

Кључне речи: Системи ратарења, органкска пољопривреда, плодоред