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PRINCIPLES OF ORGANIC VITICULTURE APPLIED IN MURFATLAR VINEYARD, ROMANIA

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Abstract

The paper describes the particularities of the organic viticulture technology applied in Murfatlar vineyard. The research was conducted during 2011 and 2012, for two romanian varieties: Columna, for white wines and Feteasca Neagra, for red wines. The main climatic indexes were determined: the real heliotermic index (IHr), the bioclimatic index (I.B.V.), the oenoclimatic aptitude index (IAOe) and the aridity index (Martonne), as well as the soil hydric regime and the dynamics of some physiological processes (stomatal conductance and clorophylle index).

Due to the climate warming and water deficit, the phytosanitary status of plant were good but the timing of full maturity was advanced by 5 - 6 days in 2012 compared to 2011.

After evaluating the harvest quality, it was found that during the studied years the conditions were favorable for obtaining quality wines - DOC (about 200 g/l sugar and 6-7 g/l tartaric acid in grape must).

Keywords: Murfatlar vineyard, organic viticulture, addapted technology, harvest quality

Introduction

At the Research Station for Viticulture and Oenology Murfatlar vines are grown organically since 2007. The purpose of organic viticulture is to offer consumers a quality wine, typical for the region of origin. Organic Viticulture provides customers healthy products, without using chemical fertilizers, synthetized insecticides, fungicides and herbicides. One of the main goals of ecological agriculture is respecting the environment and therefore avoid the pollution of soil, air and water.

Currently, there are 45 ha of registered organically grown vineyards, of which 15 ha are certified and 30 ha under conversion. The varieties selected and cultivated under this system are Columna and Chardonnay for white wines and Fetească Neagra, Cabernet Sauvignon and Pinot Noir for red wines.

Organic viticulture principles applied at Murfatlar is based on maximum use of local resources, in parallel to minimizing the economic and environmental risks (Bernaz, Dejeu, 1999). It aims mainly: maintaining the biodiversity, preserving the biological activity of the soil, preventive crop protection and obtaining quality productions.

Material and methods

The study was conducted at the Research Station for Viticulture and Oenology Murfatlar during the viticultural years 2011 and 2012. The observations targeted two organically cultivated vine varieties, Columna and Fetească Neagră, focusing on the adaptability to organic cultivation in Murfatlar area conditions. The varieties under study were grafted the rootstock Berlandieri X

Riparia Teleki 4 - Oppenheim selection 4-4 and the training system used is Guyot with bilateral cordons.

Climatic data were provided by the weather station Weather Master 2000 and include daily observations regarding maximum and minimum temperature, insolation and precipitations, based on which were calculated a range of climate indicators frequently used in viticulture: heliotermic index, bioclimatic index, oenoclimatic aptitude index and aridity index (Martonne). In order to study the hydric regime of the soil, samples were collected for the depths of 0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm and 80-100 cm for each of the 2 parcels under study. Sampling was performed using a agrochemical auger and the samples were processed by the gravimetric method (Blaga et al., 2005).

Weekley, between the phenological phases of blooming and ripening of the grapes measurements were performed directly in the field in order to determine stomatal conductance and chlorophyll index by using the SC-1 leaf porometer and SPAD-502DL chlorophyll meter.

Only phytosanitary treatments permitted by the legislation were used, namely: sprayings with copper sulphate - KOCIDE 2000 at a dose of 1.5 kg/ha and 80% sulfur - Kumulus DF, at a dose of 3 kg/ha. In order to monitor the moth populations (Lobesia botrana) were used sex pheromone traps.

In order to determine the production quality the grape ripening process was monitored, namely: the weight of 100 grains - by weighing with a technical balance, the must sugar content - refractometrically and the total acidity - by titration with 0.1 N NaOH with phenolphthalein as indicator.

The derived wines were analyzed by standardized physicochemical methods: the alcohol concentration - by the pycnometric method, the reducing sugars - by the Schrol method, the total acidity - by titration with 0.1 N NaOH in the presence of fenolroth as indicator, the volatile acidity - by distillation and titration with NaOH 0. 1N in the presence of phenolphthalein and the unreduced extract - by the Tabarie method.

Description of applied technologies

For the varieties under observation, before the vegetation period starting, were applied the following works: winter pruning, crop sanitizing and the revision of the sustaining system.

During the vegetation period were applied 4 hand hoeings, weeding sprouts on the stem, directing and tying the shoots, works that increased the efficiency of the applied treatments.

Soil tillage focused on preservation and raising fertility, water retentionand accumulation, air penetration to the roots, the release of carbonic acid in the soil and facilitating the microflora activity. Five mechanical hoeings were performed for weed control. To protect vines against extreme temperatures and removing pests, autumn plowing was performed at a depth of 20-28 cm and spring plowing at a depth of 18-20 cm. It was taken into consideration the prevention of artificial soil compaction.

In order to optimize the ripening and maturation processes were aplied the thinning-out, the shoot top and leaf removal, favoring production quality by increasing the concentration of sugars in wine.

Results and discussion

Climatic indexes

The real heliotermic index (IHr), proposed by J. Branas et al. (1946), emphasizes the interaction between light and temperature. The values obtained for 2011 and 2012 falls within the specific range for the Murfatlar vineyard, exceeding the value of 2.6, wich indicates that the region is very suitable for vine cultivation, both for white and red varieties.

The bioclimatic index (I.B.V.) refers to the interaction of temperature, light and humidity (Constantinescu et al.,1964); the values recorded for the years under study are specific for this area (10-15), even higher, being beneficial for this culture.

The oenoclimatic aptitude index (IAOe) formulated by St. Teodorescu (1978) is being used for establishing the degree of climatic favorability that a region dispose for grape anthocyanins synthesis - for the production of red wines (Pop, 2003). The values of IAOe 2011-2012, as ilustrated in table 1, confirm that the area is suitable for obtaining semi-dry and semisweet red wines (values beyond 4600 are indicated), with controlled denomination of origin.

The de Martonne aridity index allows estimating the degree of aridity of an area for a limited period (one year or one month). The average value calculated for 20 years classifies the viticultural center on the border between semi-humid and semi-arid climate, the years under study (2011 and 2012) being caracterized by droughts alternating with rainy periods (table 1).

Table 1. Synthetic ecological indexes values compared to the multiannual average

Synthetic ecological indexes	Values		
	Multiannual average 1991-2010	2011	2012
IHr	3.02	3.2	4.1
I.B.V.	13.2	15	15.6
IAOe	5093	5351	5840
Aridity Index (de Martonne)	23	13	22

Soil hydric regime

In terms of soil moisture, in 2011 the initial water reserve value is situated well above the average, favoring the entry into vegetation, but since June, when the plant needs for water is still high, there is an aggravation of water deficit, with repercussions on the development of shoots and grapes (Fig. 1), having though a beneficial effect on sugar accumulation.

In 2012 the initial water reserve recorded a moderate deficit, approaching the normal in May and then registeres a strong deficit, with negative effects on vines. The deficit recorded during the summer months is though normal for this time of the year for this area and favours sugars and polyphenols accumulation.

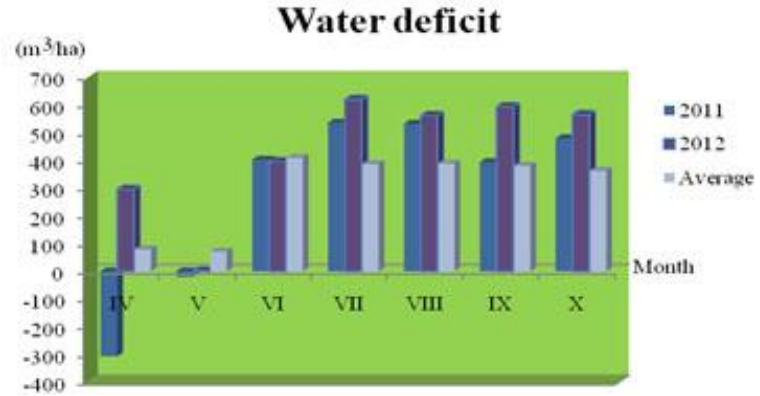

Fig. 1. Water deficit (m^3/ha) during the vegetation period

Dynamics of the main physiological processes

In 2011, the stomatal conductance for the two varieties under study recorded higher values at the beginning of the flowering phenophase, in comparation to the values obtained in 2012 for the same period. For Columna variety in 2012 the values were higher at the beginning of the veraison phenophase (259,8 mmolH_2O/m^2s), due to temperatures over 37 °C compared to the optimal transpiration intensity at 25-30 °C, indicating the intensification of transpiration process and stomatal closure. The values decreased significantly during grape maturation due to the slowing of vegetative growth processes.

The intensity of gas exchange measured by stomatal conductance indicates high values (212, 4 and respectively 243,8 mmolH_2O/m^2s) for both varieties starting with the veraison phenophase in 2012, due to the high temperatures in July and August (Fig.2).

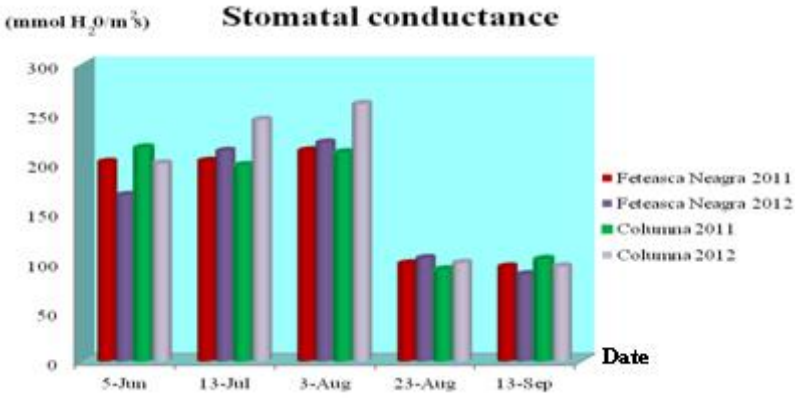

Fig. 2. Stomatal conductance (mmolH_2O/m^2s) for Fetească Neagră and Columna varieties during 2011-2012, starting with the flowering phenophase until full maturity

The values recorded for the chlorophyll index increase (43,3 and 44,2 µg/cm^2 for Fetească Neagră and repectively 42,2 and 44,6 µg/cm^2 for Columna variety) starting with the berries growth period and sugars accumulation, reaching a maximum in early August (the chlorophyll content in leaves doubles - 45,7 µg/cm^2 on average) due to the intensification of photosynthetic activity, and then decrease during the ripening process (Fig. 3).

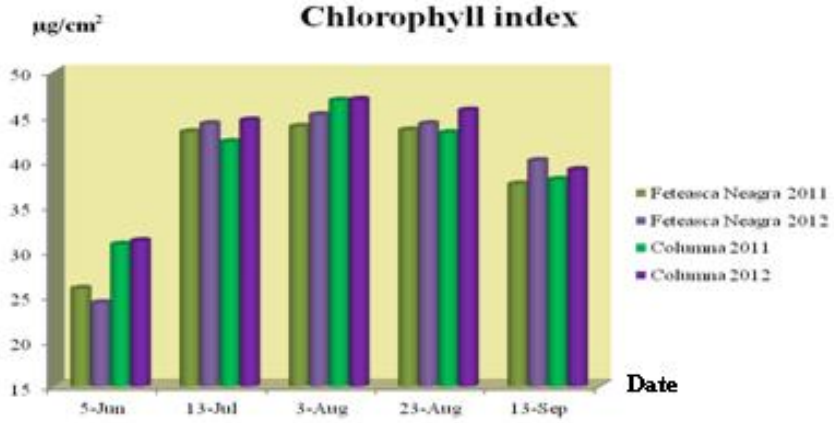

Fig. 3. The chlorophyll index (µg/cm^2) for Fetească Neagră and Columna during 2011-2012, starting with the flowering phenophase until full maturity

The values obtained for the concentration of chlorophyll pigments in 2012 (43,5 µg/cm^2 on average), were higher comparative to the previous year (37,5 µg/cm^2 on average), favoring the superior accumulation of sugars for both varieties under study, as will be observed in Fig. 5. During grapes ripening, regardless of the variety particularities, the concentration of chlorophyll diminishes, a process related to the depression of growth processes.

Phytosanitary status of plantations

The evolution of the characters regarding the emergence and development of mildew, powdery mildew, gray mold and grape moth *Lobesia botrana* were monitorized.

Vine mildew and gray mold manifested with greater intensity in 2012 compared to the previous year, due to climatic conditions favorable for the development of these pathogens (Heavy precipitation in May - 145 mm). The symptoms of this diseases manifested in both of the studied plots, the average infestation being between 2 and 7, from moderately resistant to resistant. Pest control was carried out by a complex of technological and ecological measures, with the mention that the treatments play a preventive role, and therefore have been applied during the incubation period of the pathogens (*Plasmopara viticola* and *Botrytis cinerea*).

The attack of the powdery mildew (Uncinula necato) recorded a higher intensity in 2011, the average infestation ranging between 7 and 13, from moderately resistant to moderately susceptible, and manifested on the young bunches in both varieties under study, Columna variety being affected in a higher proportion.

Manual works: correct tying of the shoots, thinning and partial defoliation created optimal conditions for good hub ventilation and effectiveness of the applied treatments.

Preventive combating of grape moth was achieved by applying green works and by placing pheromone traps (fig. no.4), which helped establishing the population density. The number of moths captured weekly ranged between 2-7 individuals/trap, the economic damage threshold of 100 butterflies/trap/week was not reached in neither of the two years under study. Under these conditions the application of a treatment is not necessary.

Fig. 4. AtraBot pheromone traps placed in the experimental plots

Production quality

The quality of the grapes, appreciated by the sugar content, total acidity and grain weight, is presented as it was monitored over the ripening process, from the 6th of August to harvest time; from the obtained graphics (Fig. 5) the date on which the varieties reached full maturity, the grain weight is maximum and the sugar content optimal for starting the harvest can be easily observed.

The differences in therms of grape quality were not significant during the two years under study: the sugar content increased slightly - by 7-10 g/l, the grain weight - by 4-14g and the total acidity decreased by 0,4 - 0,6 g / l; it is worth mentioning the advance of full maturity and harvest time by 5-6 days in 2012, phenomenon driven by the global warming process and water shortage.

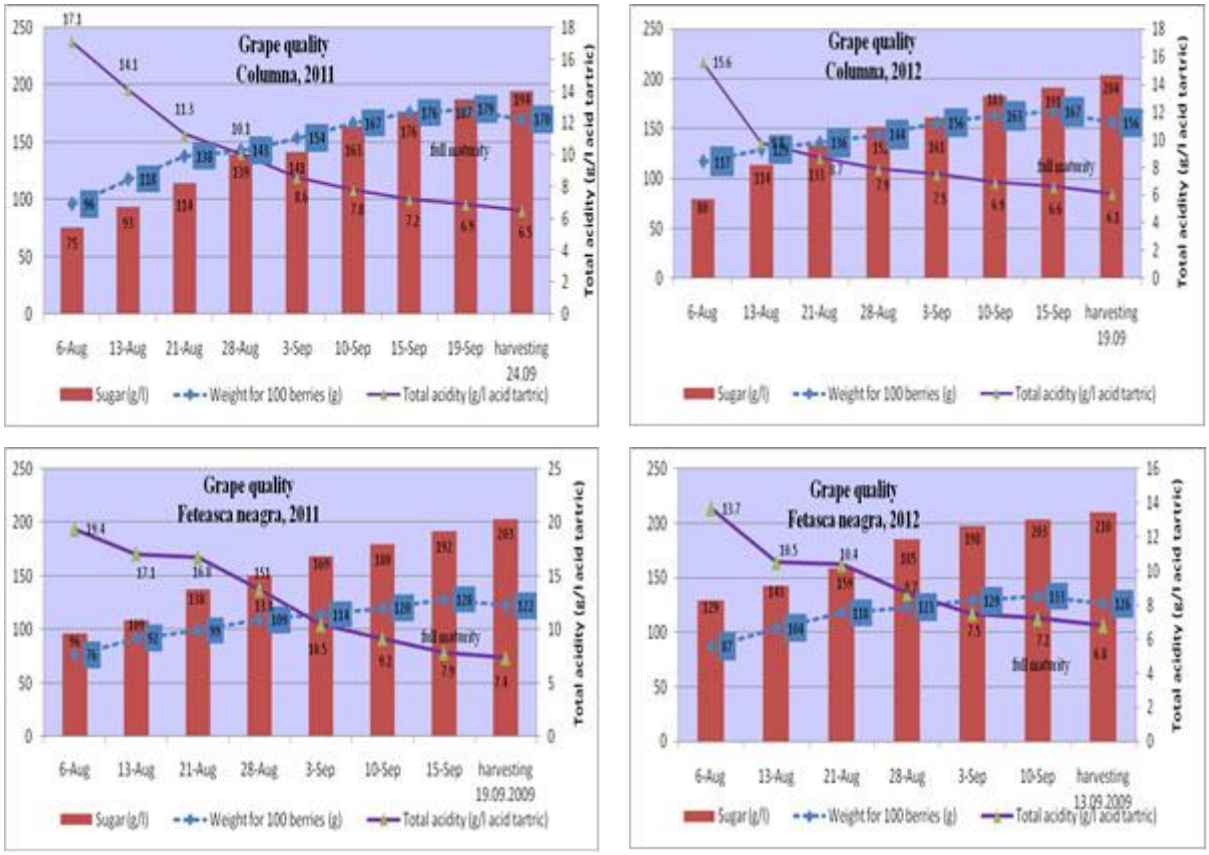

Fig. 5. Maturation dynamics of organically grown grapes

Physico-chemical composition of wines was evaluated based on the overall composition parameters (alcohol concentration, total acidity, volatile acidity, reducing sugar, non-reducing extract), by standardized physico-chemical methods. The analysis results are presented in Table 2. The resulting organic wines were extractive (19,5-26,8 g/l), with a normal alcoholic content (11,2 - 12,2% vol), balanced in terms of total acidity, qualitative wines classified in the controlled denomination of origin category (DOC).

Table 2. Physico-chemical parameters obtained for the organic wines obtained at the Murfatlar Viticultural Center

Year	Variety	Alcoholic content (% vol)	Reducing sugars (g/l)	Nonreducing sugars (g/l)	Total acidity (g/l tartric acid)	Volatile acidity (g/l acetic acid)
2011	Columna	11,2	3,6	19,5	6,61	0,49
	Fetească Neagră	11,8	2,5	26,7	6,18	0,55
2012	Columna	11,8	1,8	21,9	5,73	0,32
	Fetească Neagră	12,2	3,2	26,8	5,35	0,56

Conclusions

Murfatlar viticultural center climate, characterized by the climatic indexes values, is favorable for the ecological cultivation system of the varieties Fetească Neagră and Columna.

The observations regarding the values of the stomatal conductance and chlorophyll content showed a good correlation between the intensity of transpiration and stomatal opening relative to the vine vegetation stage.

The cultivation technology has been adapted to the Murfatlar vineyard climate and was applied so that organic viticulture principles to be followed strictly, minimizing the intake of allowed plant protection substances, and the removal of those forbidden. Mechanical and manual work had the aim of optimizing treatment effects and minimizing the risk of pest and disease attack.

Sugar accumulation was slightly stimulated by climate warming and the titratable acidity at harvest time recorded low values, due to due to the frontloading of grapes maturation phenophase, the combustion of the organic acids being increased at higher temperature values. The obtained organic wines were classified in the category of controlled denomination of origin wines.

The climate conditions changing in the recent years and the tendency to maintain it as favourable for all grape varieties can be considered prospective for cultivation of the land in the ecological system.

Bibliography

Bernaz G., Dejeu L., 1999, Fertilizarea viilor si intretinerea solului in conceptie ecologica, Ed. Ceres, Bucuresti, p. 35

Blaga Ghe., Filipov F., Rusu I., Udrescu S., Vasile D., 2005, Pedologie, Ed. Academic Pres, ClujNapoca, p. 72

BRANAS, J., BeaNON, G., LEVnooux, L., 1946, Elements de Viticulture Generale, Ecole Nat. Agric., Montpellier, p. 79

Constantinescu, Gh. şi colab., 1970 - Ampelografia R.S.R., vol. I. Ed. Academiei R.S.R., Bucureşti, p. 255

Mirica I., Mirica A., 1986, Protectia vitei de vie impotriva bolilor si daunatorilor, Ed. Ceres, Bucuresti, p. 25

Pop, N., 2003, Viticultură, Ed. Academic Press, p. 89

Teodorescu, Şt., Popa, A., Sandu, Gh.,1987, Oenoclimatul României, Ed. Ştiinţifică şi Enciclopedică, Bucureşti, p.113