THE CHARACTERISTICS OF FRUITFULNESS OF SOME INTERSPECIES GRAPEVINE CULTIVARS

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ABSTRACT

The results of important agro-biological and technological characteristics of three grapevine interspecies cultivars (Medina, Gečej Zamatoš, and Kristala) are presented in this study. The following parameters were monitored: the total number of developed shoots, the number of fertile shoots, the number of bunch per vine, grape yield, fertility coefficient, the average bunch weight, yield per hectare, bunch and berry structural indicators and grape quality expressed through the content of sugar in must. Statistically significant differences were determined between the examined varieties regarding following characteristics: the number and yield of bunches per vine, structural indicators of berries and sugar content in must. The analysis of the obtained results related with the analyzed grape varieties in the agro-ecological conditions of Northern Bosnia showed that those varieties can successfully be cultivated in similar or identical agro-ecological conditions.

INTRODUCTION

The number of grapevine varieties present in the collection all over the world is estimated at around 6,000 to 10,000 varieties (McGowern, 2003). Crossbreeding within the Euro-Asian variety *Vitis vinifera* L. greatly contributed to a wide variety among cultivars. However, satisfactory level of resistance to various biotic and abiotic stress genetiic factors has not yet been reached. That is why crossbreeding of *Vitis vinifera* L. with other varieties from *Vitis* species is done (Nikolić, 2015).

Major development of grapevine breeding started in the 19th century when breeders tried to develop cultivars with improved resistance to diseases and pests through hybridization of *Vitis vinifera* L. variety and resistant wild varieties from North America, such as V. *aestivalis* Michx, *V. cinerea* (Engelm. ex A. Gray) Engelm. ex Millard, *V. labrusca* L., *V. riparia* Michx and *V. rupestris* Scheele (Jackson, 2014). New cultivars obtained by means of such breeding shall have positive adaptation characteristics, including resistance to diseases, pests and low temperatures (Myles et al., 2011; Myles, 2013; Reisch et al., 2012). Some authors think that such cultivars have grape structure and quality which is inadequate for obtaining good quality wine (Sun et al., 2011; Jackson, 2014). Even though vine cultivation conditions and the choice of appropriate enological procedures are very important for obtaining good qualities of the wine (Ugliano and Henschke, 2009; Mahanil et al., 2012; Bell and Henschke, 2015), variety is considered to be one of the crucial and decisive factors with respect to this (Young and Vivier, 2010; Reisch et al., 2012; Nikolić et al., 2015).

Ever since the first interspecies hybrids till present day, a huge number of these cultivars has been produced in many vine-growing countries. Despite positive results, most of the cultivars of interspecies hybrid type still have the status of available genetic material used for further crossbreeding. This, above all, refers to cultivars intended for wine production because good quality wine cannot be produced unless varieties which will give good grape quality necessary for producing good quality wine are selected.

When it comes to interspecies hybrid characteristics (especially those related with their resistance to low winter temperatures, fungal diseases), and taking into account the lack of tradition in Northern Bosnia region and climatic conditions there, Mijatović et al. (1987), point out that these varieties need to be introduced in experiments in this region as there are very favorable conditions for their successful cultivation there.

The main objective of this study was to obtain insight into fertility characteristics and grape quality of interspecies vine varieties Medina, Gečej zamatoš and Kristaly, cultivated in the region of Northern Bosnia and Kozara vineyards.

MATERIAL AND METHOD

Three interspecies of grapevine cultivars were analyzed: Medina, GečejZamatoš and Kristaly (Table 1).

The experimental part of the study was conducted in the experimental vineyard Sjeverovci near Kozarska Dubica (BIH). The experimental vineyard was established in 2008 with the row spacing of 3.0 x 1.0 m. The training system was Guyot single with 100 cm high trunk and mixed pruning. Vineyard soil is covered with grass and equipped with drip irrigation system. The slope inclination is 2-4%. The terrain faces South, Southeast and the rows are ordered in the North-South direction. Important ecological factors of the site were studied and analyzed in a longer period of time (2003-2013) and also examined in a two-year period (2012 and 2013).

Table 1

The origin and purpose of the examined Cultivars

Cultivar	Color of berry skin	Origin			Purpose
		Parental partners	Species	Country	
Medina	N	Eger 1 x Medoc Noir	I.C	Hungary	wine
Gečej Zamatoš	B	Eger 1 x Medoc Noir	I.C	Hungary	wine
Kristaly	B	Alfold 100 x SV 12-375	I.C	Hungary	wine

B – Blanc; N – Noir; I.C – Interspecies crossing

When it comes to fertility elements, the following parameters were experimentally monitored: the total number of developed shoots, the number of fertile shoots, number of bunches per vine, grape yield. Based on the planned load and fertility elements, the following parameters were calculated: fertility coefficient, the average bunch weight and yield per hectare.

The total number of developed shoots, the number of fertile shoots, and the number of bunches per vine was determined when counted during grape harvest. The fertility coefficient was obtained from the ratio of the number of bunches and the total number of developed shoots. Grape yield per vine was determined by means of weighing grape mass from vines during harvest. The average bunch weight was calculated based on grape yield per vine and the number of bunch per vine. Grape yield per hectare was calculated based on grape yield per vine and the number of vines per hectare.

Bunch and berry indicators were determined in the laboratory by means of the method of Prostoserdov (1946). Grape quality was determined through sugar content in must (%) by means of a manual refractometer.

Statistical analysis was performed in SPSS 23 (IBM, 2013), by means of implementing standard statistical methods, whereas the t test for probability P = 0.05 and 0.01 was used for analyzing the correlation and dependence of parameters. A Coefficient of Variation was calculated for analyzed characteristics and expressed in percentages.

RESULTS AND DISCUSSIONS

Climatic factors strongly influence geographical distribution of vine variety cultivation, grape production and wine quality and characteristics (Bois et al., 2012).
The information regarding mean values of monthly air temperatures in 2012 and 2013 and mean values of the eleven-year period (2003-2013) for the region where the experiment was carried out are presented in Table 2. It has been observed that average annual and average monthly vegetation temperatures in the years in question were higher than those of the perennial average. The obtained results are in accordance with the results obtained by Jones et al. (2005) in their study with climatic models.

Table 2

Average monthly, vegetation and annual air temperatures in the years when the study was conducted and perennial average (2003-2013)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	IV-X
2012	1.7	-2.9	9.3	12.3	16.2	22.4	24.5	24.4	18.4	12.1	9.0	1.0	12.4	18.6
2013	2.4	2.1	6.1	13.5	16.7	20.4	23.1	23.1	16.4	13.0	7.0	1.8	12.1	18.0
Mean value	0.6	1.6	6.8	12.5	16.9	20.9	22.8	22.1	16.7	11.6	6.8	2.2	11.8	17.7

Table 2 shows that it is possible to cultivate grapevine under these conditions, with some caution, because the average annual temperature is above 12^{o}C. For normal grapevine cultivation, the average annual temperature should be between 9 and 21^{o}C. The average vegetation temperature is around 18^{o}C, which satisfies grapevine cultivation criteria in one region. The minimum value of the average vegetation temperature suitable for grapevine cultivation is 16^{o}C.

Table 3

The amount of precipitation in the years when the experiment was conducted and the mean values in the longer period of time analyzed (2012-2013)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	IV-X
2012	42.5	45.6	12.8	86.6	115.8	63.9	35.1	1.0	63.8	96.6	70.4	106.0	740.1	462.8
2013	87.0	107.8	87.5	71.6	73.3	53.6	18.4	63.6	63.2	47.3	168.8	2.0	844.1	391.0
Mean value	61.5	50.5	60.8	71.2	77.8	86.1	64.3	61.7	87.6	74.8	81.1	80.3	857.7	523.5

The amount and disposition of precipitation in certain region influence not only grape quality, but they also indirectly influence wine quality (Van Leeuwen et al., 2004). The average annual amount of precipitation for a longer period of time (2003-2013) was 857.7 mm, and 523.5 mm in the period of vegetation. In the years when the experiment was conducted, lower amount of precipitation was determined when compared to the longer period of time analyzed (Table 3).

Table 4

The results of the chemical composition of soil on the examined location

Depth	pH		*Organic C %*	P_2O_5 mg/100g	K_2O mg/100g
	H_2O	KCl			
0-20	5.1	4.0	2.6	5.9	24.3
20-40	5.2	4.0	2.3	3.5	22.3
40-60	5.2	3.7	0.4	0.4	13.7

The results of the chemical composition of soil show that this is a highly acid soil (pH 3.7 – 4.0) (Table 4). Vertisol – clay soil dominates in the experimental perennial where the analyses were conducted. Clay soil contains fine clay particles and up to 40-cm- deep humus horizon. It is black and it has unfavorable hydro-physical properties which is why this type of soil is also called "minute soil" due to its very short cultivation time. It is classified as fertile soil and it dominates on hilly terrains of Northern Bosnia combined with marl and magnetite. It is used a lot in agriculture due to its properties.

Table 5

Agro-biological and technological characteristics of the examined cultivars

Fertility elements	Cultivar								
	Medina			Gečej Zamatoš			Kristaly		
	X	Sx	Vk	X	Sx	Vk	X	Sx	Vk
Total number of developed shoots	5.60	0.66	26.72	6.60	0.72	24.61	6.60	0.45	15.45
Number of fertile shoots	5.60	0.45	15.45	6.20	0.76	27.74	6.60	0.46	15.45
Number of bunch per vine	6.20	0.76	20.74	10.20*	1.27	28.00	11.60**	1.34	23.91
Fertility coefficient	1.23	0.26	47.87	1.55	0.12	17.53	1.75	0.15	19.35
Grape yield per vine (kg)	0.87	016	42.44	1.38	0.22	35.10	1.74**	0.19	23.83
Average bunch weight (g)	134.79	10.55	17.50	132.00	10.26	17.39	151.82	3.72	5.40
Grape yield (kg ha^{-1})	2899.71			4599.54			4779.42		

**p<0.01; *p<0.05

X – Mean value; Sx – Mean value error; Vk – Coefficient of variation

Based on the data presented in Table 5 it can be concluded that there were statistically significant and important differences among cultivars in terms of the number of bunches and grape yield per vine. Kristaly had the highest number of bunches per vine (11.60), whereas Medina had the lowest number of bunches per vine (6.20). There is also a significant difference in the number of bunches pre vine between Medina and Gečej Zamatoš cultivars, and also a highly significant one between Medina and Kristaly cultivars. Kristaly had the highest grape yield value (1.74 kg), whereas Medina had the lowest one (0.87 kg).

Table 6

Structural indicators of bunches and berries and elements of grape quality in analyzed cultivars

Indicator	Cultivar								
	Medina			Gečej Zamatoš			Kristaly		
Bunch characteristics	X	Sx	Vk	X	Sx	Vk	X	Sx	Vk
Stem percentage in bunch structure (%)	5.02	0.47	21.27	5.18	0.27	10.9 4	5.23	1.26	53.83
Berry percentage in bunch structure (%)	94.98	0.47	1.12	94.82	0.25	0.59	94.77	1.26	2.97
Berry characteristics									
Skin percentage in berry structure (%)	26.84	0.65	5.49	26.84	0.66	5.49	15.96**	0.97	13.66
Flash percentage in berry structure (%)	68.91	0.47	1.54	82.39**	0.83	2.27	79.68**	0.97	2.72
Seed percentage in berry structure (%)	4.25	0.22	12.04	3.11**	0.08	6.02	4.36	1.30	15.68
Grape quality									
Sugar content in must (%)	21.01	0.65	6.93	19.51	0.80	9.23	15.83**	0.13	1.87

**p<0.01; *p<0.05

X – Mean value; Sx – Mean value error; Vk – Coefficient of variation

Table 6 shows the elements of bunch and berry structure of analyzed varieties. It can be concluded that there is no significant difference among the analyzed cultivars in terms of grape structure elements.

Grape berry consists of three elements: skin, flash and seed. These elements vary significantly thus contributing differently to the overall composition of wine (Kennedy, 2002). During the flowering period, ecological conditions of the region and nutrients influence fertilization which results in the higher or lower number of seeds in a grape berry (Ebadi et al., 1995).

Medina and Gečej Zamatoš varieties have the same share of skin in the structure of the berry (26.84%), whereas the presence of skin in the structure of the berry is significantly smaller in Kristaly variety (15.96%). Gečej Zamatoš variety has the highest percentage of flash (82.39%) and the lowest share of seeds in the structure of its berry (3.11%).

The content of sugar in grape berries plays one of the most important roles when it comes to wine quality. Sugar content in grape berries varies during the ripening process and it depends on a number of factors, such as, cultivar, climatic and ecological characteristics of the region and location, training system and ampelotechnical measures (Jordão et al., 2015). Table 6 shows that there is significant difference in the content of sugar in must between Medina and Kristaly cultivars and Gečej Zamatoš and Kristaly cultivars. Medina cultivar has the highest content of sugar in must (21.01%), whereas Kristaly variety has the lowest content of sugar in must (15.83%).

CONCLUSIONS

The analyses of the obtained fertility and grape quality indicators of the examined grape cultivars in the agro-ecological conditions of Northern Bosnia showed that, Medina, Gečej Zamatoš and Kristaly varieties can successfully be cultivated in similar or identical conditions. Genotypic specific traits of monitored characteristics were determined in analyzed cultivars. Kristaly variety had the biggest bunches, whereas Gečej Zamatoš variety had the highest percentage of flash and at the same time the lowest percentage of seeds in its berries. Medina and Gečej Zamatoš cultivars have the highest level of sugar content.

Further research should be conducted with the aim of determining the quality of the wine obtained from these varieties so that it can be decided whether it would be economical to cultivate them in this region or not.

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