PRODUCTIVE AND TECHNOLOGICAL CHARACTERISTICS OF TABLE VARIETIES GROWE IN THE CONDITIONS OF OPLENAC VINEYARDS

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ABSTRACT

Investigations were carried out in vineyard of King Petar I Karadjordjevic Foundation of at Oplenac. In experiment were tested four table grapes varieties: Black Magic, Victoria, Michel palieri and Muscat Hamburg. Training system is characterized with height of 90 cm on which Guyot pruning is used. In research is studied vegetative potential, fertility, mechanical composition of grape and berries and sugar content and acidity. In red varieties is determined anthocyanins concentration. Michel palieri was with the largest vegetative potential expressed through shoot mass (0,590 kg/vine). The highest values of fertility parameters (number productive shoots, number of inflorescences on spur and arc, coefficients of fertility) had a variety Muscat Hamburg. The highest sugar content was determined in Muscat Hamburg must, a total acid in Victoria variety must. According to anthocyanins Mikele palieri content variety is dissociate (0.179 mg/g fresh weight).

INTRODUCTION

First of all, from the nutritional aspect grapes is one of the most complete fruit due to very complex chemical composition of the grape juice-must, berry skin and seeds. In chemical grape composition were dominated sugar, organic acids, minerals, vitamins, tannins, oils, etc., which are in addition to nutritional and human health importance (Zivkovic et al., 2016; Pržić, 2014; Marković, 2012).

According to the last agriculture count under table grape varieties in Serbia is 4600 ha. Since this is a small area current production mainly satisfy needs of Serbia markets (Markovic and Pržić, 2016). In the current assortment are dominant very early ripening period varieties Kardinal, of varieties from middle ripening period is dominated Muscat Hambourg, and since from late ripening period Afuz ali and Muscat italy (Korac, 1997).

In the last decade was started with introduction of attractive table varieties, initially in experimental plantations where was analysed their economic and technological characteristics, and later in larger production plantings throughout Serbia. Firstly was introduced cultivars Prima, Ora, Lival, Danlas, Michel palieri, Black Magic and others. (Marković, 2003).

MATERIAL AND METHOD

Research was carried out in vineyard of King Peter I Karadjordjevic-Royal Winery at Oplenac-Topola municipality. In vineyard were planted four table varieties: Black Magic, Victoria, Michel palieri and Muscat Hambourg. Vineyard is an altitude of 300 m and covers area of 3.7 ha. Row spacing is 2.70 m and 1.0 m spacing between vines in row. It is geographically positioned at GPS coordinates N 44° 14' 4" and E 20° 41' 03". Training system is characterized with height of 90 cm on which Guyot pruning is used. All experimental vines were uniformly pruned where one arc was left with eight buds and spur with two buds.

Vegetative potential was determined by measuring of shoot mass during pruning. Inflorescences counting on spur and arc was done at flowering time, after which are determined coefficients of potential, relative and absolute fertility.

For purposes of testing mechanical composition of berries and clusters were selected five vines from which was harvested five representative clusters which are subjected. After clusters selecting it was measured their individual weight, length and width after which was carefully separate each berry from cluster stem without meat rest. With measuring on analytical balance was determined cluster mass, mass of all beres on cluster and cluster stem weight. Berries number was determined by counting. After that was selected 100 berries from which was separated epidermis and seeds. The seeds and epidermis mass was measured on an analytical balance. Seeds number was determined by counting. Other parameters were obtained by computation.

The grapes quality was expressed through sugar content in grape which was examined by Oeshle mostwage and values were determined using Dujardin-Salleron tables. Total acid content was determined by titration method with n/4 NaOH. Results shown are average of three-year research. For data analysis (ANOVA and LSD test) software IBM SPSS Statistics 2.0, Chicago, IL, USA was used.

RESULTS AND DISCUSSIONS

Vegetative potential was determined based on shoot weight which was cuted during regular pruning. It was found that the highest value of shoot mass was recorded for variety Michel palieri (0,590 kg/vine), after that for Black Magic and Muscat Hamburg varieties (0.470 and 0.408 kg/vine) and at the end for Victoria variety (0.260 kg/vine).

Table 1.

Shoot weight (kg/vine)

Vine	Black Magic	Victoria	Michel palieri	Muscat Hamburg
1	0,355	0,105	0,645	0,330
2	0,535	0,245	0,335	0,890
3	0,485	0,305	0,795	0,170
4	0,355	0,215	0,386	0,305
5	0,620	0,440	0,785	0,345
Average	**0,470**	**0,260**	**0,590**	**0,408**

With the highest percent of productive shoots was characterized Muscat Hamburg and Victoria variety, while the lower percentage was determined for Black Magic and Michel palieri variety. The same trend of variation is identified for developed and inflorescences number per spur and arc.

A lower fertility rate determined on Michel palieri variety was connected with a strong vigor of this variety. In fact, with very expressed vigor (table 1) degree of inflorescence differentiation in bud is lower, and thus fertility parameters that were examined of these variety. The results of tested fertility parameters is shown in table 2.

Table 2.

Number and % of productive shoots per vine

Number of productive shoots per vine							
Black Magic		Victoria		Michel palieri		Muscat Hamburg	
6,1		6,3		5,5		9	
% of productive and non-productive shoots per vine							
62,8	37,2	74,3	25,7	46,6	53,4	78,6	21,4
Inflorescences number per spur and arc							
Spur	Arc	Spur	Arc	Spur	Arc	Spur	Arc
2,1	6,1	2,5	6,9	2,2	5,1	2,3	11,7

Using two-factorial ANOVA was founded statistically highly significant difference between varieties for number of productive shoots. By LSD test (least significant difference test) was determined individual differences between all varieties except for Black Magic and Victoria varieties, where statistical significance was not found. The results are shown in table 3.

Table 3.

ANOVA test for number of productive shoots

LSD	Average	Black Magic	Victoria	Michel palieri	Muscat Hamburg
		6,067	6,267	5,533	9,000
Black Magic	6,067		0,2ns	0,533*	2,933**
Victoria	6,267			0,733**	2,733**
Michel palieri	5,533				3,466**
Muscat Hamburg	9,000				

LSD=0,413557 LSD=0,550485

After inflorescence counting was determined values for coefficient of potential, relative and absolute fertility. The highest values for coefficient of potential fertility is determined for Muscat Hamburg variety (1.40), while other cultivars had significantly lower values (table 4).

Table 4.

Fertility coefficient

Coefficient of potential fertility			
Black Magic	Victoria	Michel palieri	Muscat Hamburg
1,21	1,37	0,81	1,40
Coefficient of relative fertility			
1,30	1,49	0,98	1,59
Coefficient of absolute fertility			
1,69	1,74	1,41	1,75

Using two-factorial ANOVA for coefficient of potential fertility was founded statistically very significant difference between Black Magic and Victoria and Victoria and Muscat Hamburg varieties. Results is shown in table 5.

Table 5.

ANOVA test for coefficient of potential fertility

LSD	Average	Black Magic	Victoria	Michel palieri	Muscat Hamburg
		1,197	1,359	0,799	1,430
Black Magic	1,197		0,162ns	0,398**	0,232*
Victoria	1,359			0,560**	0,070ns
Michel palieri	0,799				0,631**
Muscat Hamburg	1,430				

LSD=0,175748 LSD=0,233938

Values for coefficient of potential fertility ranged from 0.98 for Michel palieri variety to 1.59 for Muscat Hamburg variety. High values of coefficient of potential fertility for Muskat hamburg variety indicate that this variety formed large inflorescences number per bud. Using two-factorial ANOVA was founded statistically significant difference between all varieties except for Muscat Hamburg and Victoria varieties (table 6).

Table 6.

ANOVA test for coefficient of relative fertility

LSD	Average	Black Magic	Victoria	Michel palieri	Muscat Hamburg
		1,305	1,488	0,976	1,588
Black Magic	1,305		0,183*	0,3286**	0,283**
Victoria	1,488			0,512**	0,1ns
Michel palieri	0,976				0,612**
Muscat Hamburg	1,588				

LSD=0,164327 LSD=0,218736

Coefficient of absolute fertility had a high value whereby was almost identical values for Muscat Hamburg and Victoria variety. A significant statistical difference was founded between varieties Black Magic and Michel palieri, then Victoria and Michel Palieri and finally between Mikel Palieri and Muscat Hamburg.

Statistical significance was not determined for varieties Black Magic and Victoria, Black Magic and Muscat Hamburg and Victoria and Muscat Hamburg. Results are shown in table 7. Popescu (2012) stated that on his research on the Victoria varieties coefficient of relative fertility varied from 0.78 to 1.1, while coefficient of absolute fertility was 1.2.

Table 7.

ANOVA test for coefficient of absolute fertility

LSD	Average	Black Magic	Victoria	Michel palieri	Muscat Hamburg
		1,747	1,737	1,411	1,694
Black Magic	1,747		0,01ns	0,336**	0,052ns
Victoria	1,737			0,326**	0,042ns
Michel palieri	1,411				0,283**
Muscat Hamburg	1,694				

LSD=0,11758 LSD=0,15651

Mechanical composition of cluster and berry represents varietal characteristics. Based on knowledge of mechanical composition of grape and berry can gets assessment of grapes quality, which have a special scientific and practical significance. In tables are presented components of mechanical composition and structure of tested grape and berry. Average bunch and berry weight of tested varieties ranged from 350.0 g (Black Magic) to 505.0 g (Muscat Hamburg). Variety Victoria had in average bunch weight of 361.0 g, and Michel palieri 273.0 g. Average berries number for varieties was: Black Magic 22.0, Michel palieri 36.6, Victoria 60.0, while the highest recorded berries number was determined for Muskat hamburg variety 117.2. The average berries number was conected with berries size. With biger size berries number decreases. Matthews and Nuzzo (2005) in their studies confirm that high yield and berries size are negatively correlated with most qualitative parameters. Smaller berries and vines with low yields have higher sugar content, well-balanced acidity, tannins and anthocyanins content. According to the maximum berries number on variety Muscat Hamburg had the largest berries mass in cluster of 490.1 g, followed by Black Magic and Victoria varieties with same beries mass and at the end Michel palieri with the smallest determined berries weight 239.0 g (table 8). Dimovska et al. (2013) reported that average berry weight at Black Magic was 5.46 g, while average length of berries was 22.8 mm and width 18.8 mm.

Table 8.

Mechanical composition of cluster and berry

Parameter	Black Magic	Victoria	Michel palieri	Muscat Hamburg
Cluster mass (g)	350,0	361,0	273,0	505,0
Berries number in cluster	22	60,0	36,6	117,2
Berries mass (g)	340,4	329,0	239,0	490,1
Cluster stem mass	9,59	32	15	12
Indicator of cluster weight composition	35,5	12,3	17,2	41,1

The percentage of epidermis in cluster was done on average sample of 100 berries. The largest percentage was recorded for Black Magic varieties 8.31%, followed by Muscat Hamburg variety 5.8%, then Victoria 5.0% and at the end Michel palieri variety 2.7%. By berries meat percentage varieties are taken following trail: Michel palieri 91.0%, Muskat hamburg 90.2%, Black Magic 87.9% and Victoria 85.2%. Seed number was determined on

sample of 100 berry which was fir variety Black Magic i200, Victoria 152, Michel palieri 160 and Muscat Hamburg 210.

Value of structure indicator varied in the range of 5.1-10.1 (Black Magic 5.1, Victoria 5.8, Michel palieri 10.1, Muscat Hamburg 9.2). The largest percentage of cluster stem was founded Victoria variety (8.9%), with the largest berries and seeds percentage in a cluster is characterized Muscat Hamburg variety (97.6%). Results is shown in table 9, 10, and 11.

Table 9.

Structure berries indicator

Parameter	Black Magic	Victoria	Michel palieri	Muscat Hamburg
100 berries mass (g)	860,1	750,0	725,0	530
Epidermis mass of 100 berries (g)	58,2	29,9	20,1	25,0
Seed mass of 100 berries (g)	7,6	5,64	6,4	6,9
Berries meet mass of 100 berries (g)	794,3	307,6	689,5	455,7
Seed number in 100 berries	200,0	152,0	160,0	210,0

Table 10.

Structure cluster indicator

Parameter	Black Magic	Victoria	Michel palieri	Muscat Hamburg
% of stem in cluster	2,74	8,9	5,5	2,4
% of berries in cluster	97,26	91,1	94,5	97,6
% of epidermis in cluster	8,31	5,0	2,7	5,8
% of seed in cluster	1,1	0,9	0,9	1,6
% of meat in cluster	87,9	85,2	91,0	90,2
% of solid residue	5,1	14,78	9,0	9,8
Structure indicator	5,1	5,8	10,1	9,2

Table 11.

Structure berries indicator

| Parameter	Black Magic	Victoria	Michel palieri	Muscat Hamburg
% of epidermis in berries	6,8	4,0	2,8	4,7
% of seed in berries	23,5	20,3	22,1	39,6
% of meat in beries	69,7	75,7	74,4	55,7
Berries indicator	14,3	16,6	13,4	23,2
Weight berries composition indicator	17,6	23,8	34,8	19,3

In Muscat Hamburg must was founded the highest sugar content (22.6%), followed by Black Magic variety 21.4% for Viktorija 18.8%, and the minimum sugar content was determined in must of Michel palieri (16.7 %). For Victoria variety was recorded the highest content of total acid (11.4 g/l), followed by Michel Paliere with 10.6 g/l, after total acid that Muscat Hamburg (10.4 g/l), and finally the lowest total acid content was founded in must of Black Magic variety (9.0 g/l).

The results are shown in the graph 1. Boškov et al. (2012) conducted research which included growing of Viktoria variety on two different training systems like VSP and pergolas. Sugar content on pergola was 14.8%, while on VSP was 18.8%.
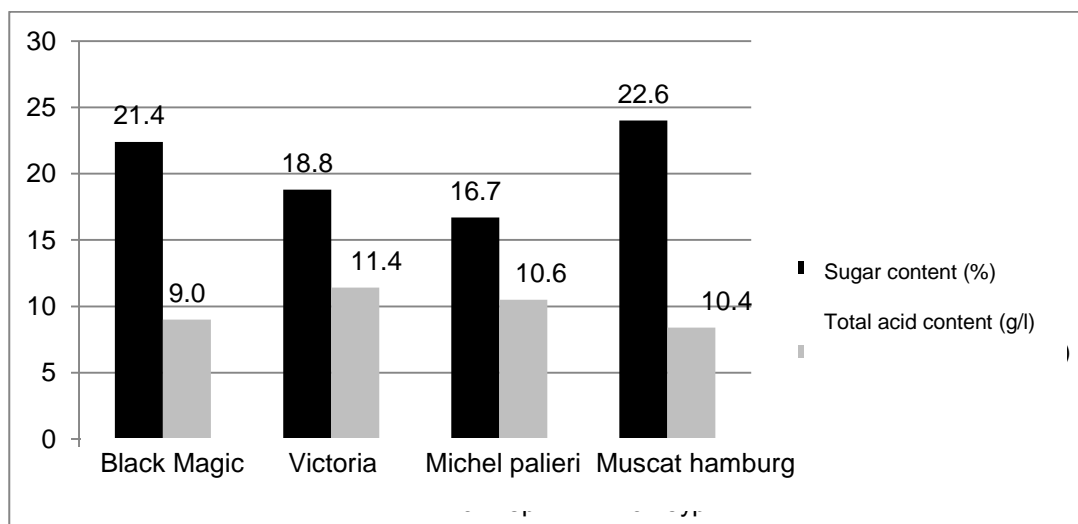
Graph 1. Sugar and total acid content

Qualitative analysis included determination of anthocyanins concentration in berri epidermis of red varieties. Concentration of total anthocyanins is expressed in mg/g of fresh weight (graph 2). With the highest concentration of anthocyanins was characterized Michel palieri variety (0.179 mg/g of fresh weight), the lowest content of anthocyanins was founded for Black Magic variety (0.128 mg/g of fresh weight). The results are according to Kennedy et al. (2001).
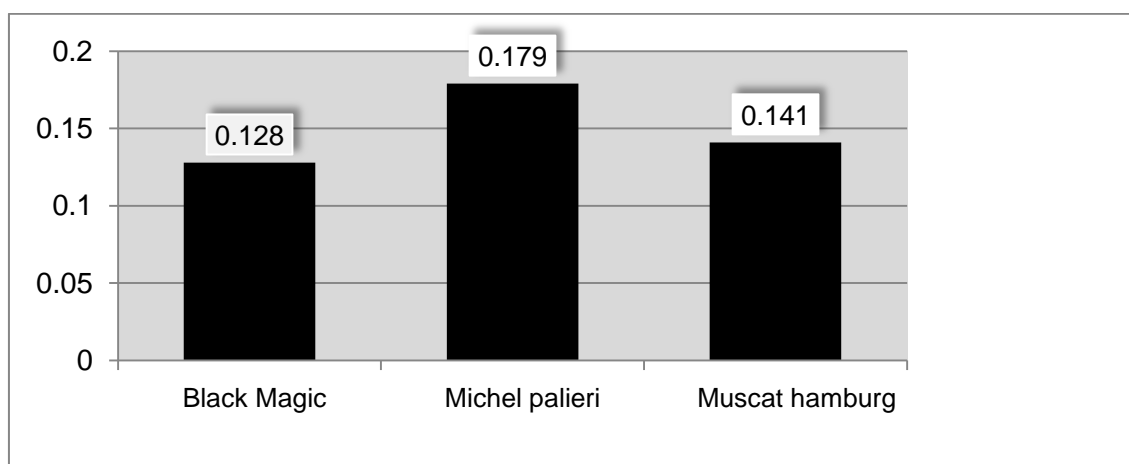
Graph 2. Anthocyanins concentration (mg/g of fresh weight)

CONCLUSIONS

Based on research can be carried out following conclusions:

- Muscat Hamburg is characterized with a large number of productive shoots and the largest number of inflorescence on spur and arc. Coefficients of potential, relative and absolute fertility was with the highest values for this cultivar. Also, it is characterized with large clusters mass and berries number, low percent of berry flesh and high sugar content in must.
- Black Magic variety is characterized with large shoot mass during pruning which indicating strong vigor, with the highest meat mass of 100 berries, large seeds mass and the largest percent of epidermis in a cluster.
- Victoria was with the lowest average shoot mass, the lowest seeds number in a berry but with the largest percentage of stem cluster and structure indicator.

- Michel Palieri has large total anthocyanins concentration. The value of percent of meat in berry, structural indicators and weight composition indicator of berries were highest for this variety.

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