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THE INFLUENCE OF THE DIFFERENT TRAINING SYSTEMS ON YIELD QUANTITY AND QUALITY OF INTERSPECIFIC HYBRID S.V. 18-402, IN CLUJ-NAPOCA, ROMANIA

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Abstact. In this paper was studied the influence of training systems on grape quantity and quality of Seyve Villard 18-402, an interspecific grapevine variety, known also with biological resistance. The experience was placed in the Didactic Collection of UASVM Cluj-Napoca, Cluj County, Transylvania, Romania and was of the monofactorial type (V1 - classic system; V2 - Guyot with periodic replacement arms; V3 - Lenz-Moser bilateral cordon; V4 - Lenz-Moser unilateral cordon). The determinations included the calculation of the fertility and productivity elements and the analysis of the sugar concentration and the total acidity level. From the point of view of productivity, S.V. 18-402 showed the highest values of average weight of bunches, absolute and relative productivity indexes on Guyot with periodic replacement arms training system. The sugar concentration ranged between 156.65 g/l on Lens Moser bilateral cordon and 174.89 g/l on classic system. Acidity was between 4.14 g/l H_2SO_4 in Lenz Moser unilateral cordon and 5.81 g/l H_2SO_4 on classic system. The most suitable training system for S.V. 18-402 is Guyot with periodic replacement arms in Cluj-Napoca climatic conditions.

Keywords: grapes, S.V. 18-402, Lenz-Moser bilateral cordon, Lenz-Moser unilateral cordon, Guyot with replacement arms.

INTRODUCTION

Interspecific hybrids with disease-related resistance are varieties obtained by complex hybridizations between varieties of *Vitis vinifera* and varieties belonging to other species of the genus *Vitis* (Raddova et al., 2016). Interspecific hybrids of vines began to be cultivated due to resistence of diseases of fungal origin (powdery mildew, downy mildew and black rot) or of the grapevine root and leaf aphid *Phylloxera*, compared to the noble vine, which was largely destroyed with the introduction of those pests into Europe (Pop, 2010). Due to the low taste quality of wines prepared from the hybrids of the first generation, they were gradually restricted by legal regulations. In the first half of the 20th century, a new interest in breeding interspecific hybrid arises, on so-called French second-generation hybrids (Raddova et al. 2016). Kraus et al., 2005, states the second-generation hybrids are crosses native genotypes among themselves or with cultural European varieties. The breeder Seyve-Villard is mainly associated with these hybrids. Genetically, the first generation hybrids contained less than half of the genome of the European varieties and are characterized by low quality of wines (Raddova et al., 2016). Hybrids of the second generation contain 55-68% of the genome of European varieties, meaning an increasing in the quality of the wine (Kraus et al., 2005). The wines obtained from these varieties have lower malvidin content and can reach up to 10.5-11% volume alcohol. In France and in other European countries, a ban on the cultivation of interspecific varieties was declared and similar restrictions by setting penalties for their planting, enhanced by awarding bonuses for their grubbing (Jackson, 2008). Bavaresco, 1990 states that, in 1990, in Europe, the cultivated vine area with hybrids was greatly reduced to 0.04%, especially concentrated in Romania. Nowadays, the hybrid varieties are the most promising tool for low input, low cost and time-saving viticulture due to their tolerance to diseases and insects (Lisek, 2010). In many extra-European Union countries are in use a high percentage of interspecific varieties with good results in the wine industries and funding specific breeding programs (Fisher, 2000). In Canada, USA, Switzerland, Germany and Hungary several interspecific wines are commercialized (Daniela et al., 2013). In Romania, according to the legislation (Law on Vine and Wine 244/2002 and G.D. 769/2010) in the settlements outside the wine-growing areas, the planting of interspecific hybrids can be made on an area of no more than 0.1 ha of economic agent or family, only to ensure family consumption. Bucur, 2011 states that in Romania, most areas cultivated with interspecific hybrid varieties are found in family farms, where wine is largely produced for self-consumption. The wine resulting from the processing of interspecific hybrid grapes with resistance to disease is classified as table wine (alcoholic strength of at least 8.5% vol.) and are free to trade according to G.D. 769/2010 or they can be used to obtain distillates (Bunea et al., 2014). Training systems represent a physical manipulation of the canopy of the plant. There is evidence that training systems have been used in ancient vineyards in the Middle East, Greece and Rome (Reynolds and Vanden Heuvel, 2009). The first training systems were designed so that grapes do not reach the ground and facilitate harvesting.

Grapevine training systems are determined by natural environmental factors, cultivated varieties, the canopy management practiced, and the maintenance work that applies to plantations (Deloire, 2012, Nicolaescu, 2010).

The theme of this paper is to try to establish an optimal method of training of interspecific hybrid cultivation (S.V. 18-402), which is consistent with the climatic changes that have occurred over the last years. Due to those facts, in the last years it is possible to grown black grapes in the northern areas of Romania, including the Transylvanian region.

The purpose of the research was to determine the influences of the various training systems on the quantity (100 berries weight, average bunch weight, yield) and quality (sugar content and acidity expressed in g/l of H_2SO_4 at harvest) of interspecific hybrid S.V. 18-402 under the same climatic conditions of the year 2016 in Cluj-Napoca, Cluj County.

MATERIALS AND METHODS

Seyve-Villard 18-402 (S.V. 18-402) is a interspecific hybrid, of second generation, being a cross between Plantet (Seibel 5455) and Seyve-Villard blanc (S.V. 12-375), created after 1930 (Bunea et al., 2013b). In Romania, those interspecific hybrids are also called improved hybrids or hybrids with biologic resistance. The bunch grape has cylindro-conical shape, often winged, with an average weight of 175-205 g. S.V. 18-402 is a grape with late ripening, reaching a sugar content at harvest around 161 g/l and an acidity of 5.9 g/l H_2SO_4, producing an intensely colored and perfumed wine. The insured yields are quite high reaching 14-15 to/ha (Baniță et al., 1979). The grape berries are oval, medium in size, black-purple, and more lean in bunch. It has good resistance to frost in winter, powdery mildew and downy mildew, and a medium resistance in *botrytis*. In most years it can be grown without the application of anti-cryptogrammic treatments. It is also tolerant to the phylloxera attack - the radicular form, so it can also be cultivated on own roots (without grafting) on any soil type (Grecu, 2010).

The experimental field was located in the Didactic collection of UASVM Cluj-Napoca Cluj County, Transylvania, Romania. The vines were planted on 1.2 x 1.8 m distance between vines and between rows. The vineyards was established in 2013 on grafted on SO-4 with a planting density of 4629 vines/ha. The trellis system is monoplan with a three-row wires (1-simple, 2-double, 3-double). The same trellis system was used for all training systems in the experiment field.

The experiment was organized on 4 training system (variants) with 3 replicates each (10 vines/repetition).

V1 - Classic system - mixt pruning system (spurs and canes) - 2 spurs of 2-3 buds and 3 canes of

6-7 buds placed on a lower truck (25 cm height)

V2 - Guyot with replacement arms - mixt pruning system - 2 replacement spurs and 2 canes of 10-11 buds (this training system is particular for Transylvanian vineyards, after pruning the canes were conducted on double wire in semicircle)

V3 - Lenz-Moser bilateral cordon - spur pruning - spurs with 2-3 buds, 4-5 spurs/cordon.

V4 - Lenz-Moser unilateral cordon - spur pruning - spurs with 2-3 buds, 8-10 spurs/cordon.

Fertility elements were determined by calculations of the absolute (A.F.C.) and relative (R.F.C.) fertility coefficients. The bunches average weight was determined by successive weighing of 50 grapes/repetition using the analytical balance. The absolute (A.P.I.) and relative (R. P.I.) productivity indices were obtained from the product of A.F.C. and R.F.C., respectively, and the bunches average weight (g). The 100 berries weight resulted from the analytical balance. The yield (to/ha) was calculated on the basis of the number of bunches on a vine, the average weight of a bunch and the number of vines on 1 ha. The sugar content at harvest was determined by the refractometric method. The acidity level in grapes at full maturity was measured by the titrimetric method (Mureșan, 2008).

Statistical analysis. The data were expressed as mean ± standard deviation (SD) from three replicates for each variant. The statistical interpretation of the data was performed using the Duncan test, SPSS Version 23 (SPSS Inc., Chicago, IL., USA). The analysis of variance (ANOVA) was used to interpreted data and calculate de F (Fisher) factor. The average separation was performed with the DUNCAN test at $p \leq 0.05$.

RESULTS AND DISCUTIONS

The town of Cluj-Napoca, have an area of 179.5 km², and is located in central Transylvania in the Someş Mic Corridor, situated within three major geographical units: the Transylvanian Plain, the Someş Plateau and the Apuseni Mountains, which influence the climatic conditions throughout the year (Boancă et al., 2018). The climate in Cluj-Napoca is temperate-continental, with slight oceanic influences. Being a hilly town, located on several altitudes, temperatures and precipitation may vary from one neighborhood to another. The average annual temperature in Cluj-Napoca is 9.3°C, and the average precipitation of 551 mm (Lung, 2012). During the year 2016, at Didactic collection of UASVM Cluj-Napoca were recorded a precipitation level of 764 mm (rainy year for Cluj-Napoca area), with a 191 day precipitation and an average temperature of 10.1°C. In experimental plot the soil type is typical preluvosoil, with a clay-sandy texture, which ensures a good supply of plants with water (Lung, 2012).

The quality of grapes is primarily influenced by climatic conditions of the year (Bora et al., 2014) and secondly by the microclimate created around clusters influenced by the training system. Reynolds and Vanden Heuvel, 2009, states that the training system has a significant influence on quantity, rather than on the quality of yield.

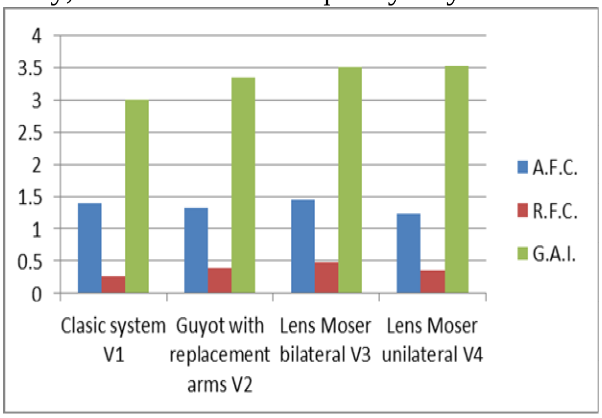

Figure 1. *Absolute fertility coefficient (A.F.C), relative fertility coefficient (R.F.C.) and gluco-acidimetric index (G.A.I.) of S.V. 18-402, in four training systems*

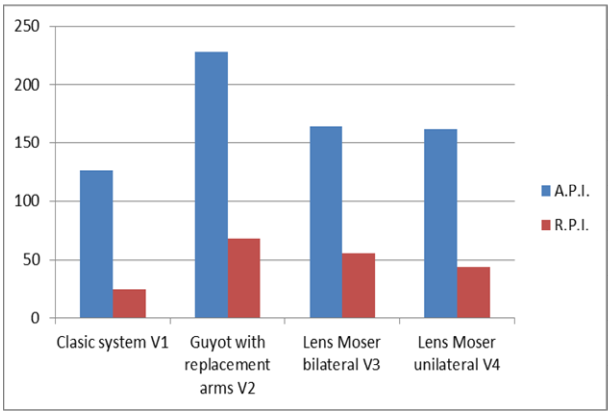

Figure 2. *The absolute productivity index(A.P.I.) and the relative productivity index (R.P.I.) of S.V. 18-402, in four training systems*

Al-Joumayly, 2003, reported that fertility coefficients are genetically determined and only slightly conditioned according to season. The absolute fertility coefficient showed the highest value at V1 (1.40) and V3 (1.45), while V4 (1.23) had the lowest value. The relative fertility coefficient showed the highest value at V3 (0.49) followed by V2 (0.39), V4 (0.36) and V1 (0.27) (Figure 1). Our result are in according with Daniela et al., 2013, which show that some interspecific hybrids such as Seibel 7052, G.M. 7743-8 and S.V. 39639 exhibited high fruitfulness potential, frequently presenting three bunches per shoot, recording a better performances than the *Vitis vinifera* cultivar (Pinot Gris), while others such as S.V. 12390 and GA 52-42 exhibited the worst performance.

Fisher et al., 1996 highlight the importance of knowing the fruitfulness of the first basal buds when consider the manual and mechanical spur pruning. In our study, S.V. 18-402 recorded for all variants (mixt and spur pruning) a good fruitfulness, revealed by the values of fertility coefficients. Daniela et al. (2013) states that interspecific hybrids such as Seibel 7052, S.V. 39639 and GA 52-42 were unsuitable for spur pruning due to their low fruitfulness in the first 4 buds.

The absolute productivity index was the highest for V2 (227.37), and the lowest in V1 (164.6). The relative productivity index ranged between 24.69 (V1) and 67.63 (V2) (Figure 2). The results in this study are lower than those obtain by Vișan et al., 2015, for others interspecific hybrids Valeria and Muscat de Pölöskei (table varieties) and Seyval, Valérien and Purpuriu (wine varieties), in Southern Romania, may be due to more favorable climatic conditions for grapes varieties in that area. Gluco-acidimetric index values ranged between 3.01 (V1) and 3.52 (V4) (Figure 1).

Table 1. The analysis of the main grapes quality parameters obtained in Didactic Collection of UASMV Cluj-Napoca in 2016

Variant parameter	Classic system V1	Guyot with replacement arms V2	Lens Moser bilateral V3	Lens Moser unilateral V4	Fisher Factor	Significance
100 berries weight (g)	262.54 **c** ±7.32	310.22 **b** ±11.37	262.96 **c** ±4.00	335.74 **a** ±2.16	77.133	p≤0.000
Sugar (g/l)	174.87 **a** ±2.55	167.23 **b** ± 4.85	156.65 **c** ±3.93	166.37 **b** ± 3.97	11.409	p≤0.000
Acidity (g/l H_2SO_4)	5.76 **a** ±0.28	4.95 **b** ±0.36	4.13 **c** ±0.19	4.72 **b** ± 0.21	19.636	p≤0.000
Average bunch weight (g)	90.72 **d** ±2.54	170.68 **a** ±3.58	114.01 **c** ±3.77	136.24 **b** ±2.83	507.561	p≤0.000
Yield (to/ha)	10.33 **c** ±0.96	15.13 **a** ±0.84	13.17 **b** ±1.07	12.08 **bc** ±0.99	12.983	p<0.000

Average values, ± standard deviation (n=3).
*The difference between two values in the same row, followed by a common letter is insignificant (Duncan test p<0.5)

The 100 berries weight (Table 1) showed a variability of the data, confirmed by the factor F = 77.133, p≤0.000. V4 had the highest value (335.74 g) of 100 berries weight, the difference being significant from the following V2 (310.22 g). The values observed in V1 (262.54 g) and V3 (262.96 g) did not show statistical differences. Our results have much higher values for this parameter compared with those obtained by Bunea et al., 2013b (165.0 - 211.3 g), for the same interspecific hybrid (S.V. 18-402), in the same area (Cluj-Napoca). Those differences may be explained by the aged of vineyard, the training system, canopy management, the type of planting material (ungrafted/grafted) and the climatic conditions in experimental field.

The annual climate conditions and the cultivar have a strong effect on yield quality Pavloušek and Kumšta, 2011. The sugar content in grapes was similar for V2 (167.23 g/l) and V4 (166.37 g/l), with no statistical differences between them. It was observed that for V3 the sugar content had the lowest value (156.65 g/l), with the highest sugar content being recorded for V1 with 174.87 g/l of sugar being statistically different of all the other analyzed variants. Our values are much lower compared with Bunea et al., 2013b (193.5 g/l - 237.6 g/l) for S.V. 18-402 and Bunea et al., 2013a (161.6 - 208.8 g/l) for Chambourchin in the same area (Cluj-Napoca), those differences are due to climatic conditions of experimental years and vineyard management.

Pavloušek and Kumšta, 2011, revealed that, also the year and the cultivar have a powerful effect on titratable acid contents. The highest acidity level was determined at V1 (5.81 g/l H_2SO_4), the value obtained being statistically different from the other studied variants. The lowest acidity level was recorded for V3 (4.14 g/l H_2SO_4). Similar results were recorded by Bunea et al., 2013b (for S.V. 18-402) and Bunea et al., 2013a (for Chambourchin), but lower than Daniela et al, 2013 for some interspecific hybrids in Italy (6-7 g/l H_2SO_4).

The cluster weight had the highest variability between the four training systems, also confirmed by the high value of the factor F = 507.561, $p \leq 0.000$. The clusters had the highest weight at V2 (170.68 g) and the smallest at V1 (90.72 g), the training system had a great influence on this parameter. The results are comparable with those revealed by Daniela et al., 2013, for several interspecific hybrids in Italy, where the S.V. 12390 and Villard Blanc showed the cluster weight of 217 g and 181 g, respectively, but other hybrids such as Seibel 5178, Phoenix, GF 138-3, GA 52-42 and S.V. 39639 recorded values at nearly 100 g.

Grape production was the highest in V2 (15.10 to/ha), and the lowest in V1 (10.08 to / ha). The yield obtained for V3 (13.17 to / ha) was higher than that obtained for V4 (12.07 to / ha). The small clusters on V1 determine low yield for classic system. The results are comparable with those obtained by Daniela et al., 2013, when testing 19 interspecific hybrids found a great variability on yields. The authors recorded significantly high yields, with over 20 to/h obtained for the most productive hybrids and also 4 - 5 to/ha obtained for the least productive varieties. The vine spacing was 3 × 1.7 m (1960 vines/ha), and the vines were trained using the Sylvoz system, with 3 canes of 10 - 12 buds each.

The values obtained in this study are comparable to other authors, who noted significant differences between the quantitative and qualitative parameters of the grapes harvested from the vines cultivated in different training systems, within the same climatic year (Reynolds and Vanden Heuvel, 2009; Peterlunger et al., 2002).

CONCLUSIONS

The training system had an important influence on quantity and quality of production for S.V. 18-402 in climatic conditions of Cluj-Napoca. Each analyzed parameter has variability through the training systems. The largest amount of sugar in grapes was determined the classic system, may be due to the low cluster weight and the low yield. Also, the ratio between sugar content and acidity level in grapes was well balanced in classic system. Under the climatic conditions of Cluj-Napoca, it can be recommended to use the classic system to obtain a quality yield. Instead, in order to obtain a large production, the most suitable training system that can be used in this area is Guyot with periodic replacement arms.

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