Field Crop Studies (2019) XII(1): 17-26
http://fcs.dai-gt.org/bg/

ISSN: 2535-1133 (Online)
ISSN: 1312-3882 (Print)

ORIGINAL PAPER

Statistical assessment of the influence of Fercal rootstock on some agrobiological and growth traits of Misket Rusenski and Super Ran Bolgar table vine cultivars (*Vitis vinifera* L.)

Galina Dyakova[1] • Krasimira Uzunova[2] • Ralitsa Mincheva[1] • Iliana Ivanova[1] • Svetlana Stojanova[1] • Gergana Kovacheva[1]

[1]Institute of Agriculture and seed science „Obraztsov chiflik", 7007 Rousse, 1, Prof. Ivan Ivanov Str., Bulgaria

[2]Agricultural University, 4000 Plovdiv, 12, Mendellev bulv., Department Genetics and plant breeding, Bulgaria

Corresponding Author: Galina Dyakova; E-mail: DjakovaRousse@abv.bg

Received: October 2018 / Accepted: February 2019 /

Published: March 2019

Abstract

Dyakova, G., Uzunova, K., Mincheva, R., Ivanova, I., Stojanova, S. & Kovacheva, G. (2019). Statistical assessment of the influence of Fercal rootstock on some agrobiological and growth traits of Misket Rusenski and Super Ran Bolgar table vine cultivars (Vitis vinifera L.). Field Crops Studies, XII(1), 17-26.

The influence of the rootstock is of a significant importance in terms of the growth power and agrobiological traits of the vine cultivar. The study included two dessert vine varieties - Misket rusenski and Super ran Bolgar, grafted on two rootstocks - SO4 (widely used in the practice and accepted as control in the researches) and Fercal. The study took place at the experimental vineyards of IASS "Obraztsov chiflik" – Rouse in four replications, 11 plants each, as first class vines, equal in vegetation development were used. In both cultivars, during the vegetation, the values of 15 agro-biological and growth traits were registered. Data obtained were statistically analyzed using the evaluation criteria F – Fisher and t – Student, in order the influence of Fercal rootstock on the agrobiological and growth traits of both cultivars to be more precisely estimated.

Using t — Student criterion significant differences were found in 13,3% of all the traits, where Fercal rootstock was used. In Super ran Bolgar cultivar the traits were "number of shoots" and "length of internode", and in Misket Rusenski — "number of shoots", "including fruiting shoots". By applying Fisher's criterion in order the influence of the rootstock to be evaluated, significant differences were found in double more traits. Expressed as a per-

centage — 26,7% for Super ran Bolgar (number of developed shoots of a vine, yield, girth of the rootstock and length of the berry) and 33,3% for Misket rusenski cultivar (number of developed shoots, number of clusters, fruit-bering coefficient, girth of the graft and length of the berry). The coincidence of some of the traits proved the universal influence of the rootstock on the growth and yield in both cultivars.

In such studies it is recommended the both criteria for statistical analysis to be used, because of the different level of variability of the traits. Thus a fuller adequate assessment of the influence of the different rootstocks on the development and productive qualities of the vines is being achieved.

Key words: Rootstocks, Statistical assessment, Table vine cultivars

Introduction

In the wide diversity of rootstocks and varieties in viticulture, a problem arises, caused by the fact that some important agro-biological traits modify positively under the influence of one of the rootstocks and negatively – by other traits onto the same rootstock.

In planting, between both components creates an artificial symbiosis, in which the variety with its individual genetic characteristics combined with the rootstock and environmental factors, forms its biological and economic qualities (Deidda, 1986; Gorodea et al., 1986; Todorov, 1987; Koblet et al., 1994; Hristov et al., 1998; Arestova and S'yan 1999; Reynolds and Wardle, 2001; Agut et al., 2003; Bettiga, 2003; Boso et al., 2008).

The choice of rootstock is important in terms of the force that it induces to the grafted variety. Vine rootstocks induce different growth of the grafted vine varieties. Researchers have essentially different views of the relation between the force of growth and fruit-bearing of the grafted varieties (Parejo et al., 1995; Nuzzo and Matthews, 2006). In this respect, experiments with a wide range of varieties, combinations, and areas are conducted in traditional wine countries, such as France, Spain, Argentina, etc.

The value of data received from field experiments is expressed by their degree of precision. Therefore, an important requirement of these experiments is to ensure the receipt of data with the highest possible accuracy, respectively the smallest possible differences between the tested variants to be identified as statistically proven (Shanin, 1977).

The objective of the study was the character and degree of influence, caused by Fercal and Berlandieri x Riparia S04 to be determined, in regard to a range of economically important, morphological and agrobiological traits and characteristics of both table vine varieties (Super ran Bolgar and Misket rusenski) grafted thereon. Two criteria – t and F (Student and Fisher) were applied in the statistical analysis of the results in order that objective to be achieved.

ISSN: 2535-1133 (Online)
ISSN: 1312-3882 (Print)

Material and methods

Two early ripening seed table vine varieties – Misket Rusenski and Super ran Bolgar were the object of the study.

Brief characteristics of the table vine varieties studied:

Super ran Bolgar variety was created at the Institute of viticulture and wine production in Pleven in 1961 via crossing of Italia and Yantur varieties (Todorov, 2005; Pandeliev et al., 2006). The cluster is semi-large to large (18,8 x 13,2 cm), conical, sometimes with one brunch, half-compact to loose. The berry is very large (24,9 x 17,2 mm), oblong, slightly acute on both sides (at the base and at the top). The skin is yellow-green to amber, thin and elastic. The consistence is fleshy crispy, gentle, and the taste – harmoneous.

The vines are mid-growing. Grape yield in half standard Guyot training system is about 1 400 kg/da. The mass of the cluster is 250-300 g, and the mass of the berry – 4,8-5,0 g. Grapes ripen in early August and contain 15-20% sugars and 5,5-5,9 g/l titric acids.

Misket rusenski variety was created at IASS „Obraztsov chiflik" via crossing of Misket hamburgski and Kardinal (Todorov, 2005; Pandeliev et al., 2006). The berry is large (19,4 x 17,3 mm), ovate. The skin is medium thick, dark violet, with a thick waxy cuticle. The consistence is crispy and the taste – muskat. The vines are fast-growing. Grape yield in half standard Guyot training system is about 1 300 kg/da. The mass of the cluster is 300 g, and the mass of the berry – 4,8 g. Grapes ripen in late July-early August and contain 16% sugars and 4,24 g/l titric acids.

Both cultivars were grafted on Fercal and SO4 rootstocks.

Brief characteristics of the rootstocks, involved in the study:

Fercal rootstock is medium ripening and medium growing. The drought resistance is higher than that of Chasselas 41B. It is considered highly resistant to carbonates in the soil (up to 45%) and the rootstock - the most resistant to physiological chlorosis. It gives medium power of growth to grafts. The vines, grafted onto Fercal enter a little earlier in fruit-bearing, and have a better fertility, than the grafted on Chasselas 41B.

Berlandieri x Riparia SO4 **rootstock** is mid to fast-growing. It is resistant to drought and to active carbonates in soil up to 17%. It has a good affinity with most of the table and wine vine varieties. The plants grafted onto it distinguished with longevity, abundant fruitfulness and qualitative grapes. It is believed that it improves the maturation of the wood of grafts and makes them more resistant to

winter frosts.

The study was conducted at the Experimental vineyard of IASS „Obraztsov chiflik" - Rousse in four replications, 11 plants in every replication. The vine planting was conducted at the distance of 2,0 m/1,4 m on hilly areas, facing South, about 1 km from Danube river. Soil type was carbonate chernozem on deep loess. The formation was half standard Guyot, stem height being 0,60 m and vine loads 19 winter buds, by average, realized in 5 spurs of 2 buds each and 1 fruiting cane of 9 buds. Loads were equal in both cultivars, because they were high yielding.

For each variety grafted onto the two rootstocks — Fercal and *Berlandieri x Riparia SO4* (SO4) the values of 15 agro-biological and growth traits were registered. In comparisons, the variant, grafted onto SO4 rootstock was accepted as control.

The following agro-biological and growth traits were studied: number of developed shoots of a vine (a), including fruiting shoots (b); percentage of fruiting shoots, according to the formula $c = b/a \times 100$; the number of clusters per a vine, developed on shoots grown from winter eyes; fruit-bearing coefficient; grapes yield per a vine, kg; length of annual ripened growth of the vines, cm; length of internode of mature shoot, cm; girth of the rootstock, cm; girth of the graft, cm; length of the cluster, cm; width of the cluster, cm; length of the berry, mm; width of the berry, mm; and mass of the annual ripened growth of one vine, kg.

Traits were determined after the methods adopted in scientific-research practice. The length of internode of mature shoot, the size of cluster and berry were determined after Katerov et al. (Katerov et al., 1990), and the form of berry – after Lazarevskiy (Lazarevskiy, 1959). Girths of the graft and the rootstock were measured 5 cm above and below the place of the grafting.

Two criteria - Student (t - test) and Fisher (F) were used in the statistical processing, as for the purpose SPSS 19 was used for analysis of the data obtained. Standart formulas were used for calculating the criteria (Zapryanov and Dimova, 1995; Mencher and Zemshman, 1986).

Results and discussion

The results of the study for both table vine cultivars were presented in Tables 1 and 2. Agrobiological and growth characteristics of the cultivar are in direct dependence on the growth power, resistance or susceptibility of the rootstock to one or another environmental factors.

With the help of two criteria – Student (t) and Fisher (F) the influence of Fercal rootstock was statistically evaluated on 15 growth and agro-biological traits, compared to SO4, the control accepted. Both rootstocks have different growth force - SO4 is mid to fast-growing, while Fercal is mid growing.

ISSN: 2535-1133 (Online)
ISSN: 1312-3882 (Print)

Table 1. Comparative evaluation of cv Misket Rusenski by agrobiological and growth traits via criteria of Student (t) and Fisher (F) at levels of significance $\alpha<0.05$; 0.01 and 0.001, respectively.

Traits	Misket Rusenski							
	SO4 rootstock - control		Fercal rootstock		t exp.	Confi dence	F exp.	Confi dence
	$\bar{x}$	S	$\bar{x}$	S				
1. Number of developed shoots of a vine	16,1	2,21	19,33	1,37	**6,57**	+++	**2,61**	++
2. Including fruiting shoots	11,58	2,62	14,28	2,60	**3,87**	+++	1,02	ns
3. % of fruiting shoots	71,22	7,99	73,46	9,42	0,96	ns	1,39	ns
4. Number of clusters per vine	13,7	3,7	16,88	7,4	1,96	ns	**3,31**	++
5. Fruit-bearing coefficient	0,85	0,25	0,88	0,37	0,41	ns	**2,17**	+
6. Yield per a vine, kg	4,771	2,05	4,72	1,82	0,09	ns	1,27	ns
7. Length of annual ripened growth shoot, cm	150,89	25,23	145	26,07	0,86	ns	1,07	ns
8. Length of internode of mature shoot, cm	7,4	0,79	6,1	0,62	6,83	- - -	1,59	ns
9. Girth of the rootstock, cm	22,12	0,51	22,71	1,36	1,61	ns	1,15	ns
10. Girth of the graft, cm	19,52	2,9	20,7	1,74	1,26	ns	**2,83**	+
11. Length of the cluster, cm	19,42	2,77	18,0	3,28	1,717	ns	1,4	ns
12. Width of the cluster, cm	11,38	1,84	10,46	1,9	1,79	ns	1, 07	ns
13. Length of the berry, mm	19,49	1,31	19,6	1,79	0,24	ns	**1,9**	+
14. Width of the berry, mm	19,17	1,52	18,3	1,61	**2,05**	–	1,13	ns
15. Weight of the annual ripened growth of one vine, kg	0,52	0,15	0,61	0,21	1,56	ns	2,0	ns

In critical values of the criterion: $t\,P_{5\%} = 2{,}005$ $F\,p_{5\%} = 1.93$
$t\,P_{1\%} = 2{,}670$ $F\,p_{1\%} = 2.47$
$t\,P_{0.1\%} = 3{,}480$ $F\,p_{0.1\%} = 3.41$

Table 2. Comparative evaluation of cv Super ran Bolgar by agrobiological and growth traits via criteria of Student (t) and Fisher (F) at levels of significance $\alpha<0.05$; 0.01 and 0.001, respectively

Traits	Super ran Bolgar							
	SO4 rootstock – control		Fercal rootstock		t exp.	Confi dence	F exp.	Confi dence
	$\bar{x}$	S	$\bar{x}$	S				
1. Number of developed shoots of a vine	14,11	3,4	17,6	2,32	**4.5**	+++	**2,12**	+
2. Including fruiting shoots	8,13	3,14	8,6	2,72	0,6	ns	1,34	ns
3. % of fruiting shoots	55,92	9,64	47,9	9,6	**3,114**	- -	1,02	ns
4. Number of clusters per vine	12,16	6,3	13,55	5,7	0,82	ns	1,22	ns
5. Fruit-bearing coefficient	0,86	0,46	0,76	0,33	0,85	ns	**1,96**	_
6. Yield per a vine, kg	4,582	2,57	4,69	1,54	0,17	ns	**2,8**	+ +
7. Length of annual ripened growth shoot, cm	166,07	28,66	165,9	24,55	0,01	ns	1,33	ns
8. Length of internode of mature shoot, cm	7,13	1,79	8,6	1,6	**3,24**	++	1,28	ns
9. Girth of the rootstock, cm	22,14	1,75	22,5	2,8	0,41	ns	**2,5**	+
10. Girth of the graft, cm	19,88	1,59	20,4	2,05	0,75	ns	1,68	ns
11. Length of the cluster, cm	16,4	1,61	15,5	2,11	1,77	ns	1,16	ns
12. Width of the cluster, cm	10,9	1,65	9,8	1,7	**2,2**	-	1, 2	ns
13. Length of the berry, mm	25,45	2,09	25,7	1,2	0,56	ns	**3,14**	+ +
14. Width of the berry, mm	16,7	1,77	17,5	1,54	1,77	ns	1,32	ns
15. Weight of the annual ripened growth of one vine, kg	1,12	0,37	0,53	0,38	**4,13**	---	1,14	ns

In critical values of the criterion: $t\,P_{5\%} = 2{,}005$ $t\,P_{1\%} = 2{,}670$ $t\,P_{0.1\%} = 3{,}480$ $F\,p_{5\%} = 2.1$ $F\,p_{1\%} = 2.62$ $F\,p_{0.1\%} = 3.41$

Statistical assessment via Student's criteria is based on the average arithmetical values, and when using the criterion of Fisher – the comparison is based on variability. Very often in conducting experiments with different influencing factors, the central (typical) trends of excerpts are retained, but the degree of variation significantly changes (Lidanski, 1988). For this reason, we have carried out parallel biometric analysis.

Applying Student's criterion to the both cultivars, significant differences were reported at equal positive rate in two growth traits, which was 13,3% of all traits observed. For all the other traits, the influence of Fercal rootstock was statistically equalized (insignificant) or in a negative trend to that of SO4 in terms of growth traits.

In Misket rusenski cultivar, for the trait "number of developed shoots of a vine" and "including fruiting shoots", at level of significance $\alpha < 0.001$ a positive influence of Fercal rootstock was reported, compared to SO4 rootstock (Table 1).

For Super ran Bolgar cultivar - for the traits: "number of shoots" and "length of internode", at levels of significance $\alpha < 0.05$ and 0.001 (table 2).

The results of the biometric analysis via the criteria of Fisher (F) showed in total 4 traits for Super ran Bolgar (number of developed shoots, yield, girth of the rootstock, and length of the berry) and 5 traits for Misket rusenski (number of developed shoots, number of clusters, frui-bearing coefficient, girth of the graft, and length of the berry) with positive significant differences, using Fercal rootstock. Expressed as percentages, that influence was 33,3% for Misket rusenski and 26,7% for Super ran Bolgar, respectively, of all growth traits in total (Tables 1 and 2).

The strongest was the influence of Fercal rootstock reported for the traits: "number of developed shoots" and "number of clusters" at a level of significance $\alpha < 0.01$ for Misket rusenski cultivar and for "yield" and "length of the berry" for Super ran Bolgar, at the same level of significance. Fruit-bearing coefficient did not influence positively when Fercal was rootstock of Super ran Bolgar.

The twice larger number of traits with significant differences when using Fercal rootstock, compared to SO4, for both cultivars, showed that when the criterion of Fisher was applied, the assessment was more complete and accurate of the changes occurred in the growth and productive characteristics of the table vine cultivars.

In such a kind of parallel biometric comparisons with two criteria of identical data, a more competent and adequate determination of the positive influences is allowed, in case of two rootstocks, widely used in practice in growing of table vine varieties. In order the recommendations to be with greater practical application and all the essential differences of using of both rootstocks to be found, it is recommended both statistical criteria to be used as an evaluation element.

Conclusions

Based on the results we made the following conclusions:

1. With the help of the criterion of Student significant differences were found in 13,3% of all the traits when Fercal rootstock was used in both observed cultivars.
2. With the implementation of the second criterion (of Fisher) for the assessment the influence of the rootstock, significant differences were found in twice larger number of traits. Expressed in percentage – 26,7% for Super ran Bolgar cultivar, and 33,3% for Misket rusenski cultivar.
3. The twice larger number of traits with significant differences, when using Fercal rootstock compared to SO4, for both cultivars, showed that with the implementation of the criterion of Fisher the assessment was more complete and accurate of the changes occurred in growth and productive characteristics of the table vine cultivars.

In order the recommendations to be with better practical application and all the significant differences to be found out of the use of both rootstocks, it is recommended both statistical criteria to be used as evaluation elements.

References

Agut, C., Rodriguez-Lovelle, B. & Fabre, F. (2003). Effect of rootstock on Syrah behavior. http://www.institut-rhodanien.com/Institutweb/publications/pdf/rhoneenvo/ReVOart03.pdf

Arestova, N. & S'yan, I. (1999). Influence of the anatomical properties of the rootstocks on the grapes yield and the longevity of the vines. Grapes and wine in Russia, 1, 18-19 (Ru).

Bettiga, L. (2003). Wine grape varieties in California: Rootstock Selection. ANR publications. B., 188, 12-15.

Boso, S., Santiago, J. L. & Martínez, M. (2008). The influence of 110-Ritcher and SO4 rootstocks on the performance of scions of Vitis vinifera L. cv. Albariño clones. Spanish Journal of Agricultural Research, 6(1), 96-104.

Deidda, P. (1986). Vine rootstocks, used in Sardinia: current status, problems and prospects. Journal of Viticulture and Enology, 39 (5-6), 193-199.

Gorodea, G., Costache, M., Panea, E., Nenciu, I., Marin, V. & Chirculescu, N. (1986) Study on the behavior of the world assortment of rootstocks varieties, in terms of Greek wine center. Problems of Theoretical and Applied Genetics , 18 (3), 171-182 (Ro).

Hristov, Hr., Popov, K. & Chanev, Ch. (1998). Growth and fruit bearing of different vine varieties grafted on 41B and Ferkal rootstocks. Viticulture and Enology, 4, 10-12 (Bg).

Katerov, K., Donchev, A. & Kondarev, M. (1990). Methodology for study and description of vine varieties and rootstocks. Bulgarian ampelography, vol. I. BAS, Sofia (Bg).

Koblet, W., Candolfi-Vasconcelos, M.C., Zweifel, W. & Howell, G.S. (1994). Influence of Leaf Removal, Rootstock, and Training System on Yield and Fruit Composition of Pinot noir Grapevines. Am. J. Enol. Vitic, 45:2, 181-187.

Lazarevskiy, M. (1959). Grapes varieties. In M., State publ. house. Agricultural literature, 420, 35-39 (Ru).

Lidanski, Tr. (1988). Statistical methods in biology and agriculture. Zemizdat, Sofia (Bg).

Mencher, E. & Zemshman, A. (1986). Basis of design of elements of mathematical statistics in studies on viticulture. Shtiintsa, Kishinev, 238, 12-20 (Ru).

Nuzzo, V. & Matthews, M. A. (2006). Response of Fruit Growth and Ripening to Crop Level in Dry-Farmed Cabernet Sauvignon on Four Rootstocks. Am. J. Enol. Vitic., 57:3, 314-324.

Pandeliev, S., Katerov, K., Lazarov, I., Kovachev, V. & Ivanov, M. (2006). Dessert vine varieties in Bulgaria. Plovdiv, 120 (Bg).

Parejo, J., Minguez, S., Sella, J. & Espinas, E. (1995). Sixteen years of monitoring the cultivar Xarello (Vitis vinifera L.) on several rootstocks. Acta Hort., 388, 123-128.

Reynolds, A. & Wardle, D. (2001). Rootstocks Impact Vine Performance and Fruit Composition of Grapes in British Columbia. HortTechnology, July-September, 11 (3), 419-427.

Shanin, J. (1977). Methodology of the field experiment. Publication of BAS, Sofia (Bg).

Todorov, I. (1987). Bolgar variety in vine breeding (V.vinifera L.). Publishing House of BAS, Sofia (Bg).

Todorov, I. (2005). Production of vine planting material. Publ. House “Dionysus”, Sofia (Bg)

Zapryanov, Z. & Dimova, D. (1995). Guide exercises in experimental work with biometrics. Zemizdat, Sofia (Bg).