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RELIMINARY RESEARCH ON THE GRAFTING AFFINITY OF SOME NEW GRAPEVINE CULTIVARS CREATED AT RDSVO ODOBESTI ON DROUGHT-RESISTANT ROOTSTOKCS

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Abstract

The global warming of the climate, a phenomenon that has significantly characterized the last decades, has considerably influenced the evolution of the thermal and water regime annually and during the growing season in the viticultural ecosystem of the Odobeşti vineyard, the atmospheric and pedological drought characterizing the last four years of viticulture. In this context, the use of drought-resistant rootstocks for grafting is one of the solutions to counteract this extreme phenomenon that is increasingly present in the wine-growing areas of southern Moldova. In the present paper, preliminary results are presented regarding the grafting affinity of three new vine varieties created at RDSVO Odobeşti ('Putna', 'Măgura' and 'Vrancea'), on three rootstocks with drought tolerance obtained by Romanian viticultural research ('Drăgăşani 70 M.', 'Crăciunel 71 Bl.', 'Ruggeri 140 Vl.'). For comparison, the rootstock 'Berlandieri x Riparia Sel.Oppenheim 4 –4 Bl.' was used, with the widest use for grafting in the Odobeşti wine-growing area. The preliminary results obtained show a good and very good grafting affinity on 'Ruggeri 140 Vl.' rootstock. for all three varieties studied.

Key words: *rootstock, grafting affinity, drought.*

INTRODUCTION

One of the basic conditions that must be taken into account when choosing rootstock varieties is their affinity with *Vitis vinifera* cultivars. A good affinity between grafts and rootstocks can guarantee obtaining grafted vines with complete concretion, long life and increased yield.

The broad spectrum of influence under which the affinity between grafts and rootstocks is manifested has led to its subdivision into morphological affinity and physiological affinity (Dalmasso, 1950), grafting affinity and production affinity (Zimmerman, 1959). Grafting affinity is an essential condition in the production of good quality viticultural planting material, while production affinity is the basic requirement for the establishment of new vine plantations, with superior technological potential. Scientific research carried out over time has demonstrated once again that in the case of grapevine grafting, there is a mutual influence of the grafted partners (Southey, 1992; Tița, 1998; Stoian et al., 2004; Vršič et al., 2004; Hamdan et al., 2010; Korkutal et al., 2011; Köse et al., 2014; Grigolo et al., 2021; Ungureanu et al., 2021). Thus, the rootstock exerts a strong influence on growth (Constantinescu et al., 1966; Grecu, 1980), fertility (Huglin, 1958), resistance to drought, at minimum temperatures, productivity (Martin et al., 1973; Ţardea and Rotaru, 2003), as well as the oenological potential (Taran et al., 2017).

The errors committed as a result of the incorrect choice of rootstock varieties for grafting vinifera varieties cannot be corrected and as a result, productivity decreases, the resistance of the stumps to chlorosis, drought and frost is reduced, which later causes the appearance of voids and the premature disappearance of wine

plantations (Ungureanu et al., 2021). In the context of current climate changes that have led to the significant manifestation of the drought phenomenon in many wine-growing areas (Cichi, 2006; Gladstones, 2011; Roehrdanz and Hannah, 2016; Van Leeuwen and Darriet, 2016; Santos et al., 2020; Pușcalău et al., 2021), the use of rootstocks with drought resistance is increasingly required (Mărculescu et al., 2006; Bekar, 2019). Establishing the most appropriate varieties of rootstock for grafting the newly created vinifera cultivars is one of the main objectives for the establishment of new wine plantations, justifying the current research on establishing the affinity of grafting and the affinity of production of these cultivars on different cultivars of rootstock.

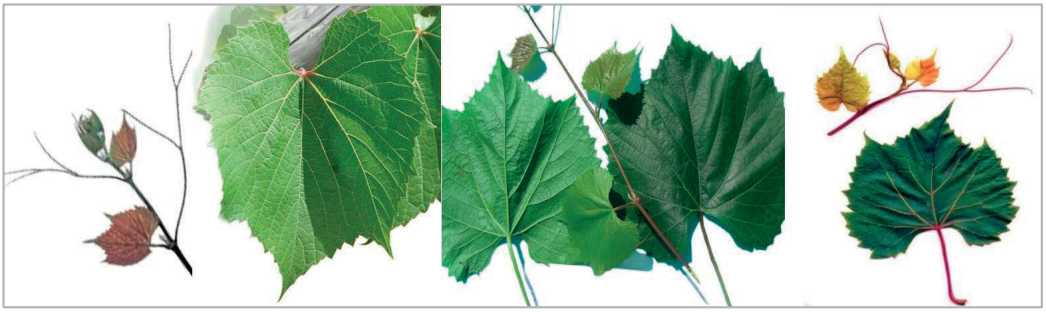
MATERIALS AND METHODS

The research took place at RDSVO Odobești in the period 2022-2023 and included the organization of experimental variants in which two main factors were taken into account: grafted *V. vinifera* cultivars and rootstock cultivars. For this purpose, three new vinifera cultivars created at RDSVO Odobești were used: 'Vrancea' - a cultivar for white wines, obtained from crossing the hybrid combination ('Traminer' x 'Armaș') with the 'Fetească regală' cultivar, approved in 2018, 'Măgura' - a tinctorial cultivar for red wines, obtained from the crossing of the cultivars 'Băbească neagră' x ('Merlot' x 'Alicante Bouschet'), approved in 2014 and 'Putna' - a cultivar for table grapes, obtained from the crossing of the cultivar 'Ceauș' with the cultivar 'Muscat de Alexandria', approved in 2014 (Figure 1).

The vine cultivars mentioned were grafted on three rootstock clones with drought resistance obtained in Romania: 'Berlandieri x Riparia - Sel. Drăgășani 70 M.' supplied by RDSVO Drăgășani, 'Teleki 8 B - Sel. Crăciunel 71 Bl.' supplied by RDSVO Blaj and 'Ruggeri 140 - Sel. 59 Vl.' provided by RDIVO Valea Călugărească (Figure 2). The rootstock 'Berlandieri x Riparia Sel.Oppenheim 4 - clone 4 Bl' was used as a control.

a) b) c)

Figure 1. The *V. vinifera* cultivars studied: a) 'Putna'; b) 'Măgura'; c) 'Vrancea'



a) b) c)

Figure 2. Rootstock cultivars studied: a) 'Sel. Drăgășani 70 M'; b) 'Sel. Crăciunel 71 Bl.'; c) 'Ruggeri 140 - Sel. 59 Vl.'

From the combination of the three *Vitis vinifera* graft cultivars with the three rootstock cultivars, 12 experimental graft/rootstock variants resulted, each with three repetitions.
The forcing of the grafted cuttings was carried out by the method with total stratification with sawdust and external heating. The planting of cuttings in the vine nursery was done in linear beds of soil made in the spring, on which a drip irrigation hose was placed.
To determine the grafting affinity, after forcing and hardening the grafted cuttings, the formation of the circular callus at the grafting point, the growth of the shoots from the grafts and the formation of roots at the base of the rootstock were observed in particular. After harvesting the vines from the vine nursery, the yield and quality of the planting material was monitored for each variant of the experiment.
The obtained data were statistically processed for analysis of variance using the FoxPro/LAN 2.0 statistical analysis program.

RESULTS AND DISCUSSIONS

Through the determinations made after forcing and tempering the grafted cuttings, the experimental data presented in Table 1 (Figure 3) were obtained. They show the fact that the percentage of grafted cuttings with circular callus at the grafting point, in all the vinifera cultivars studied, was higher in the case of their grafting on rootstocks ′Sel. Drăgășani 70 M.′ (95.6%) and ′Ruggeri 140 - Sel. 59 Vl.′ (93.3%).

Figure 3. Aspects of the process of grafting and forcing grafted vines

The cuttings grafted on the rootstock ′Sel. Crăciunel 71 Bl.′, showed a lower callus index (83.5%), a value close to the control rootstock ′Berlandieri x Riparia Sel.Oppenheim 4 - 4 Bl.′ (78.8%). After tempering, before planting in the school of vines, for all the vinifera varieties studied, the average percentage of cuttings with shoots from grafts was higher in the case of using the rootstock ′Ruggeri 140 - Sel. 59 Vl.′ (84.7%), followed by ′Sel. Drăgășani 70 M.′ (81.9%), and smaller on the rootstock ′Sel. Crăciunel 71 Bl.′ (73.4%), closer to the value recorded by the control rootstock (68.6%).
In terms of root formation at the base of the grafted cuttings after hardening before planting in the vine nursery, the obtained data demonstrate that the type of rootstock influences both the duration of the root formation period and the number of rooted cuttings.

Table 1. Data obtained from forging and hardening grafted cuttings

Grape cultivar	Rootstock cultivar			
	Sel. Drăgășani 70 M.	Sel. Crăciunel 71 Bl.	Sel. Ruggeri 140 - 59 Vl	Sel.Opp. 4 - 4 Bl. (control)
Cuttings with circular callus at grafting point (%)				
′Putna′	95.65	92.27	97.22	85.02
′Vrancea′	97.10	76.98	91.66	67.64
′Măgura′	94.06	81.45	91.16	83.84
Average	95.60	83.56	93.34	78.83
Cuttings with shoots from grafts started to grow (%)				
′Putna′	83.85	78.49	91.66	80.34
′Vrancea′	91.30	76.98	91.66	59.80
′Măgura′	70.55	64.72	70.71	65.66
Average	81.90	73.40	84.67	68.60
Cuttings with roots at the base of the rootstock, after hardening (%)				
′Putna′	64.62	47.69	68.68	44.84
′Vrancea′	57.97	45.45	62.87	32.35
′Măgura′	60.29	41.41	64.71	39.39
Average	60.96	44.85	65.42	38.86

For all the *vinifera* cultivars studied, the number of cuttings with roots varied depending on the cultivar of rootstock used for grafting.
The percentage of grafted cuttings with roots at the base, before planting in the vine nursery, in the three vinifera cultivars studied, was higher at the variants in which the rootstock ′Ruggeri 140 - Sel 59 Vl.′ was used for grafting (average value 65.42%) and rootstock ′Sel. Drăgășani 70 M.′ (average value 60.96). If the was used for grafting the rootstock ′Sel. Crăciunel 71 Bl.′, 44.85% of cuttings with roots were registered. The lowest number of cuttings with roots, in all the vinifera cultivars studied, was recorded in the cuttings grafted on the control rootstock ′Sel. Oppenheim. 4 - 4 Bl.′ (38.86%).

Figure 4. Aspects after forcing and hardening of grafted vines and planting in the vine nursery

Statistical interpretation of the experimental data obtained after forcing and hardening the grafted cuttings, shows distinctly significant differences regarding cuttings with circular callus at the grafting point for the ′Vrancea′ grape cultivar grafted on ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel. 59 Vl.′ rootstocks, compared to the control rootstock (Table 2).

Table 2. Cuttings with circular callus for ′Vrancea′ grape cultivar

Variant	Cuttings with circular callus at grafting point (%)			
	% vines with circular callus	%	Difference (%)	Significant
′Vrancea′ x ′Sel. Drăgășani 70 M.′	97.10	143.53	29.45	**
′Vrancea′ x ′Sel. Crăciunel 71 Bl.′	76.98	113.79	9.33	
′Vrancea′ x ′Ruggeri 140 - Sel. 59 Vl.′	91.66	135.49	24.01	**
′Vrancea′ x ′Sel. Oppenheim 4-4 Bl.′ (control)	67.65	100.00	0.00	-
DL (P 5%)			14.5977	
DL (P 1%)			22.1051	
DL (P 0.1%)			35.5112	

In the case of grafting on the rootstock ′Berlandieri x Riparia - Sel. Drăgășani 70 M.′, the Vrancea variety did not show significant differences.
In contrast, the ′Putna′ and ′Măgura′ grape cultivars did not show significant differences compared to the control regarding the cuttings with circular callus at the grafting point. Regarding cuttings with shoots from grafts started to grow, the ′Vrancea′ grape cultivar showed distinctly significant differences compared to the control rootstock in the case of grafting on ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel 59 Vl.′ rootstocks, and significant differences in the case of grafting on rootstock ′Sel. Crăciunel 71 Bl.′ (Table 3).
′Putna′ and ′Măgura′ *vinifera* cultivars did not show significant differences compared to the control rootstock in terms of the percentage of cuttings with shoots from grafts started to grow.

Table 3. Cuttings with shoots from grafts started to grow for ′Vrancea′ grape cultivar

Variant	Cuttings with shoots from grafts started to grow (%)			
	% vines with shoots	%	Diference (± %)	Significant
′Vrancea′ x ′Sel. Drăgășani 70 M.′	91.30	152.68	31.50	**
′Vrancea′ x ′Sel. Crăciunel 71 Bl.′	76.98	128.73	17.18	*
′Vrancea′ x ′Ruggeri 140-Sel. 59 Vl.′ Vl.′	91.66	153.28	31.86	**
′Vrancea′ x ′Sel. Oppenheim 4-4 Bl.′ (control)	59.80	100.00	0.00	-
DL (P 5%)	14.0157			
DL (P 1%)	21.2238			
DL (P 0.1%)	34.0953			

The variance analysis regarding the percentage of cuttings with roots at the base of the rootstock established very significant differences for the ′Vrancea′ grape cultivar in the case of grafting on ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel 59 Vl.′ rootstocks, and significant differences in the case of grafting on ′Sel. Crăciunel 71 Bl.′ compared to control rootstock ′Sel. Oppenheim 4 - 4 Bl.′ (Table 4).

Table 4. Cuttings with roots at the base of the rootstock, after hardening for ′Vrancea′ grape cultivar

Variant	Cuttings with roots at the base of the rootstock, after hardening (%)			
	% vine with roots	%	Diference (± %)	Significant
′Vrancea′ x ′Sel. Drăgășani 70 M.′	57.97	179.20	25.62	***
′Vrancea′ x ′Sel. Crăciunel 71 Bl.′	45.45	140.49	13.10	*
′Vrancea′ x ′Ruggeri 140 - Sel. 59 Vl.′ Vl.′	62.87	194.34	30.52	***
′Vrancea′ x ′Sel. Oppenheim 4 - 4 Bl.′ (control)	32.35	100.00	0.00	-
DL (P 5%)	9.9608			
DL (P 1%)	15.0835			
DL (P 0.1%)	24.2312			

For the ′Măgura′ grape cultivar, the analysis of variance established very significant differences for cuttings with roots at the base of the rootstock in the case of grafting on the rootstocks ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel. 59 Vl.′, compared to the control rootstock Sel. Oppenheim 4 - 4 Bl.′ (Table 4). The grape cultivar ′Putna′ did not show significant differences compared to the control rootstock in terms of the percentage of cuttings with roots at the base of the rootstock.

Table 5. Cuttings with roots at the base of the rootstock, after hardening for ′Măgura′ grape cultivar

Variant	Cuttings with roots at the base of the rootstock, after hardening (%)			
	% vine with roots	%	Diference (±%)	Significant
′Măgura′ x ′Sel. Drăgășani 70 M.′	60.21	152.86	20.82	***
′Măgura′ x ′Sel. Crăciunel 71 Bl.′	41.41	105.13	2.02	ns
′Măgura′ x ′Ruggeri 140-Sel. 59 Vl.′	64.90	164.76	25.51	***
′Măgura′ x ′Sel. Oppenheim 4-4 Bl.′ (control)	39.39	100.00	0.00	-
DL (P 5%)	6.2634			
DL (P 1%)	9.4846			
DL (P 0.1%)	15.2368			

The basic criterion that determines the establishment of grafting affinity is the yield and quality of the grafted vines (Figure 5). The data presented in Table 6 confirm the fact that in the combined graft/rootstock interaction, the best results for all the *vinifera* cultivars studied were obtained in the case of grafting on the rootstock ′Ruggeri 140 - Sel. 59 Vl.′: ′Putna′ (69.1%); ′Vrancea′ (62.4%); ′Măgura′ (61.9%), followed by the rootstock ′Sel. Drăgășani 70 M.′:

′Măgura′ (48.5%); ′Putna′ (48.3%); ′Vrancea′ (43.5%). The lowest yields were recorded in the case of the ′Vrancea′ and ′Putna′ cultivars grafted on the control rootstock ′Sel. Oppenheim 4 - 4 Bl.′ (21.5% and 30.8%, respectively), and the ′Măgura′ cultivar recorded the lowest yield in the case of grafting on the rootstock ′Sel. Crăciunel 71 Bl.′ (23.9%). The table grape cultivar ′Putna′ recorded the highest average value of yield in standard vines (45.9%).

Figure 5. Aspects after forcing and hardening of grafted vines and planting in the vine nursery

Table 6. The yield in standard vines following the classification of vines from native *Vitis vinifera* cultivars grafted on rootstock cultivars with drought resistance (%)

The grape cultivar	The rootstock cultivars				Average/ cultivar
	′Sel. Drăgășani 70 M.′	′Sel. Crăciunel 71 Bl.′	′Ruggeri 140 - 59 Vl.′	′Sel. Oppenheim 4 - 4′ (control)	
′Putna′	48.35	35.35	69.08	30.82	45.90
′Vrancea′	43.48	24.68	62.37	21.53	38.02
′Măgura′	48.55	23.94	61.87	33.33	41.92
Average/rootstock	46.79	27.99	64.44	28.56	41.94

The synthesis of experimental data regarding the influence of rootstock varieties with drought tolerance on the yield results of the grafted planting material for the ′Putna′ table grape cultivar are presented in Table 7.

Table 7. The yield of planting material obtained after classification the vines for the ′Putna′ cultivar

Variant	Yield obtained in the vine nursery %	%	Diference (± %)	Significant
′Putna′ x ′Sel. Drăgășani 70 M.′	48.35	156.88	17.53	*
′Putna′ x ′Sel. Crăciunel 71 Bl.′	35.35	114.70	4.53	ns
′Putna′ x ′Ruggeri 140 - Sel. 59 Vl.′ Vl.′	69.08	224.14	38.26	***
′Putna′ x ′Sel. Oppenheim 4 - 4 Bl.′	30.82	100.00	0.00	-
DL (P 5%)			14.4687	
DL (P 1%)			21.9097	
DL (P 0.1%)			35.1972	

Thus, the statistical interpretation of the experimental data obtained after classification the grafted vines, shows that the rootstock ′Ruggeri 140 - Sel. 59 Vl.′ exerted a positive influence in the case of the ′Putna′ cultivar, in the form of a 38.3% increase in grafted planting material, compared to the control. A positive influence on the ′Putna′ cultivar was also exerted by the rootstock ′Sel. Drăgășani 70 M.′, with a

17.5% increase in grafted planting material, compared to control ′Sel. Oppenheim 4 - 4 Bl.′.
In the case of the ′Vrancea′ white wine cultivar, distinctly significant differences were recorded for the rootstock ′Ruggeri 140 - Sel. 59 Vl.′, with an increase of grafted planting material of 40.8%, compared to the control rootstock (′Sel. Oppenheim 4 - 4 Bl.′). Significant differences were also recorded for the rootstock ′Sel. Drăgășani 70 M.′, with an increase of grafted planting material of 17.5%, compared to the control rootstock. (Table 8).

Table 8. The yield of planting material obtained after classification the vines for the ′Vrancea′ cultivar

Variant	Yield obtained in the vine nursery %	%	Diference (± %)	Significant
′Vrancea′ x ′Sel. Drăgășani 70 M.′	43.48	201.95	21.95	*
′Vrancea′ x ′Sel. Crăciunel 71 Bl.′	24.68	114.63	3.15	ns
′Vrancea′ x ′Ruggeri 140 - Sel. 59 Vl.′	62.37	289.69	40.84	**
′Vrancea′ x ′Sel. Oppenheim 4 - 4 Bl.′ (control)	21.53	100.00	0.00	-
DL (P 5%)			17.1550	
DL (P 1%)			25.9776	
DL (P 0.1%)			41.7322	

The statistical interpretation of the experimental data regarding the influence of rootstock varieties with drought tolerance on the yield results of the grafted planting material for the ′Măgura′ tinctorial red wine cultivar are presented in Table 9.

Table 9. The yield of planting material obtained after classification the vines for the ′Măgura′ cultivar

Variant	Yield obtained in the vine nursery %	%	Diference (± %)	Significant
′Măgura′ x ′Sel. Drăgășani 70 M.′	48.55	145.66	15.22	*
′Măgura′ x ′Sel. Crăciunel 71 Bl.′	23.94	71.83	-9.39	ns
′Măgura′ x ′Ruggeri 140 - Sel. 59 Vl.′	61.87	185.63	28.54	***
′Măgura′ x ′Sel. Oppenheim 4 - 4 Bl.′ (control)	33.33	100.00	0.00	-
DL (P 5%)			10.2755	
DL (P 1%)			15.5601	
DL (P 0.1%)			24.9968	

And for the ′Măgura′ cultivar, the data obtained show that the rootstock Ruggeri 140 - Sel 59 Vl. exerted a very significant positive influence, in the form of a 28.5% increase in grafted planting material, compared to the control.
The ′Sel. Drăgășani 70 M.′ rootstock also exerted a positive influence on the ′Măgura′ cultivar, with an increase of grafted planting material of 17.5%, compared to the control ′Berlandierii x Riparia Sel. Oppenheim 4 - 4 Bl.′

CONCLUSIONS

Preliminary research on establishing the grafting affinity of the three vinifera cultivars in interaction with the three rootstocks with drought resistance demonstrated the existence of significant differences compared to the control rootstock.

The ′Vrancea′ cultivar showed distinctly significant differences regarding the percentage of grafted cuttings with circular callus at the grafting point and the percentage of shoots starting to grow from the graft, in the case of grafting on ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel. 59 Vl.′ rootstocks.
The cultivars ′Vrancea′ and ′Măgura′ registered very significant differences compared to the control rootstock for the percentage of cuttings with roots at the base of the rootstock in the case of grafting on ′Sel. Drăgășani 70 M.′ and ′Ruggeri 140 - Sel. 59 Vl.′ rootstocks.
The highest yield of standard planting material for all the studied cultivars was recorded in the case of their grafting on ′Ruggeri 140 - Sel. 59 Vl.′ rootstock (average value 64.4%).
The cultivar for table vines ′Putna′ and the cultivar for tinctorial red wines ′Măgura′

recorded very significant and significant differences regarding the yield of standard vines in the case of grafting on the rootstock ′Ruggeri 140 - Sel. 59 Vl.′, respectively on the rootstock ′Sel. Drăgășani 70 M.′

The cultivar for white wines ′Vrancea′ showed distinctly significant and significant differences in the case of grafting on the rootstock ′Ruggeri 140 - Sel 59 Vl.′, respectively on the rootstock ′Sel. Drăgășani 70 M.′.

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