RJH Vol. III, 2022: 193-198
10.51258/RJH.2022.23

Rootstock influence on the young grafted vine development

C. Burlacu[1] and S.P. Barbu[1]*

[1] Research and Development Institute for Viticulture and Oenology, Valea Calugareasca, Romania

*Corresponding author email: stelianap.barbu@gmail.com

ABSTRACT

The importance of the technology in vine planting material production, the efficiency in the grafting process, and the quality of the resulted material are becoming interesting objectives in the field of viticultural research in Romania. The modern technologies are trying to be based more on mechanical grafting and less on human manual labor due to aspects regarding the cost and time pressure. In the current study was approached the importance of the biological compatibility between rootstock and scion in the grafting process. The grafting technique used was mechanical grafting in the omega section. Four well known grapevine cultivars, 'Afuz Ali', 'Italia', 'Merlot', and 'Fetească albă' and three from the most utilized rootstocks in the Valea Calugareasca viticultural center were selected for the grafting process. Various aspects such as the efficiency of the grafting process and the development of the grafted vine shoots and roots were evaluated. The study revealed better compatibility of the grafting process between 'Afuz Ali', 'Merlot', and 'Fetească albă' with the 'Berlandieri' x 'Riparia Kober 5BB' rootstock and between 'Italia' with 'Berlandieri' x 'Riparia Teleki 8B', 'Crăciunel 71' selection. Regarding the vine grafted development, the results did not highlight the influence of a particular rootstock, so the 'Berlandieri' x 'Riparia Kober 5BB' had the most significative influence on the 'Fetească albă' development, but 'Berlandieri x Riparia Teleky 4B SO4-4' rootstock was the most reliable in all the four combinations.

Keywords*:* grapevine, grafting process, compatibility, grafting rate

INTRODUCTION

The grafting of vines, which represents the most effective way to reduce phylloxera, has also a special influence on the yield and quality of grapes (Reynolds and Wardle, 2001; Terra *et al*., 2003; Keller *et al*., 2012). Studies have pointed out the interactions between rootstocks and grapevine scions which have an impact on vine vigour and therefore vine balance (Bates *et al*., 2001), sugar accumulation in berries (Reynolds and Wardle, 2001) chemical properties of the berries (pH, acidity, content of soluble solids), biologically active compounds content, and the antioxidant activity (Klimek *et al*., 2022). The degree of compatibility between rootstock and scion is one of the most important factors which determines the quality of grafting vines and the grafting rate (Ion *et al*., 2004; Petkou *et al.,* 2004). Graft quality is also influenced by the characteristics of rootstock and scion cuttings, especially by the content of carbohydrates and the conditions of preservation prior to grafting and during the callusing process, as well as the grafting technique (Gramaje and Armengol, 2011; Waite *et al.*, 2015).

The aim of this study was to assess the impact of different rootstocks on the vegetative growth parameters of the grafted vines in the nursery and to verify the rate in obtaining compliant grafted vines.

MATERIALS AND METHODS

Four grapevine cultivars, 'Afuz Ali', 'Italia', 'Merlot', and 'Fetească albă', were used in grafting as scions and the 'Berlandieri' x 'Riparia Teleki 8B', selection 'Crăciunel 71 (C71)', 'Berlandieri' x 'Riparia Kober 5BB (K 5BB)' and 'Berlandieri' x 'Riparia Teleky 4B SO4-4 (SO4-4)' were selected to be used as rootstocks.
The scions were harvested in December 2020, treated with an antibotrytic product (Switch 62,5 WG) by immersion for 4 hours and conserved in plastic material bags in controlled conditions in protected spaces with a temperature of 2°C ±1°C in the wintertime. The rootstock harvesting and shaping were done in February of 2021, before grafting.
Both scion and rootstock cuttings were analysed for carbohydrate content using the anthrone method as described by Scott and Melvin (1953).
Before the grafting, wetting was carried out for 36 hours for scion cuttings and for 48 hours for rootstock cuttings, along with their disinfection by using Switch 62,5 WG, 1g/L. Grafting was performed by applying mechanical grafting in omega section (https://www.vignevin-occitanie.com/fiches-pratiques/la-production-de-plants-de-vigne-en-pepinieres/). After the forcing stage, the first classification of vines was made, in which the quality of callus formed at the grafting point was noted. The forcing lasted 17 days at 30°C and a humidity of 90%. After two days of acclimatization under the same conditions, the vines were classified and planted in nursery on billons covered with black plastic film in order to avoid as much as possible the shock due to low temperature in the soil and for weeds control. The billons were made at a distance of 140 cm, in two rows with a density of 24 vines per meter. The vines were irrigated using a drip system, with a weekly rate of 250 - 300 m^3 water/ha.
In order to stimulate the development of shoots, foliar fertilization was carried out, along with phytosanitary treatments, three times, at 14 days intervals, the last application being applied in July.
In the nursery the following observations were performed:

- the grafting productivity in the nursery;
- primary and auxiliary roots number, length, and diameter;
- shoot length and diameter;

Statistical analyses were performed for the shoots and roots results by using the Tukey test, which is a single-step multiple comparison procedure, and which can be used to find means that are significantly different from each other (Tukey, 1949).
Distribution graphs were realized for better visualization of the studied characteristics, in different situations in which each rootstock has been used. The Tukey tests and distribution graphs were performed with the JMP 16 statistical software (https://www.jmp.com/).

RESULTS AND DISCUSSIONS

The carbohydrate content was registered in the normal range for all the samples, with values between 11.05% and 12.47% for the rootstocks and 12.03% and 13.05% for the scions (Table 1).

Table 1. Carbohydrate content of the studied material

Material code/name[a]	Cane	Carbohydrate content (%)		
		Sugar	Starch	Total
'C71'	Rootstock	10.68	1.79	12.47
'K 5BB'		9.62	1.43	11.05
'SO4-4'		10.53	1.36	11.89
'Afuz ali'	Scion	9.99	2.04	12.03
'Italia'		9.82	2.92	12.74
'Fetească albă'		10.57	2.48	13.05
'Merlot'		9.99	2.17	12.16

[a]C71 - Berlandieri x Riparia Teleki 8B, selection Crãciunel 71; K 5BB - Berlandieri x Riparia Kober 5BB; SO4-4 - Berlandieri x Riparia Teleky 4B SO4-4;

The vine cultivars taken into the study showed different productivity regarding the compatibility with the three rootstocks. Thus, the 'Italia' cultivar presented the best productivity on the C71 (79.80%) and the 'Afuz Ali', 'Fetească albă' and 'Merlot' cultivars had the highest productivity on the 'K 5BB' rootstock, with 65.66%, 62.63, respectively 72.73 % (Table 2).

Table 2. Grafting productivity for the analysed material

Vine variety	Rootstock[a]	Grafted quantity (pcs)	Resulted quantity (pcs)	From which		Resulted vine productivity (%)
				With ripened shoot < 10 cm (pcs)	With ripened shoot > 10 cm (pcs)	
Afuz ali	C 71	99	55	0	55	55.56
	K 5BB	99	65	0	65	65.66
	SO 4-4	99	60	1	59	60.61
Italia	C 71	99	79	2	77	79.8
	K 5BB	99	69	0	69	69.7
	SO 4-4	99	58	0	58	58.59
Fetească albă	C 71	99	61	0	61	61.62
	K 5BB	99	62	0	62	62.63
	SO 4-4	99	50	0	50	50.51
Merlot	C 71	99	60	1	59	60.61
	K 5BB	99	72	0	72	72.73
	SO 4-4	99	56	0	56	56.57

[a]C71 - Berlandieri x Riparia Teleki 8B, selection Crãciunel 71;
K 5BB - Berlandieri x Riparia Kober 5BB;
SO4-4 - Berlandieri x Riparia Teleky 4B SO4-4;

The data was analysed using Tukey test for identifying the influence of the studied rootstocks on different characters of the four cultivars, respectively the development of the shoots and the primary and auxiliary roots.
Significative and distinct significative differences were observed in the results (Table 3).

Table 3. Analyzed parameters results for the vine grafted plants

Character		Afuz Ali			Italia			Merlot			Fetească albă		
		SO 4-4	*C71*	*K 5BB*	*SO 4-4*	*C71*	*K 5BB*	*SO 4-4*	*C71*	*K 5BB*	*SO 4-4*	*C71*	*K 5BB*
Shoot	Length (cm)	55.2	60.44	63.01	52.6	49.8	*58.9	56.5	51.6	54.97	50	46.2	**59.7
	Diameter (mm)	2.56	2.6	2.49	2.25	2.25	2.35	*2.41	2.34	2.22	2.28	2.24	*2.36
Primary root	Number	5.3	5.13	5.22	*5.21	4.82	4.47	4.68	4.75	4.54	4.86	4.9	4.85
	Length (cm)	33.7	**38.0	36.4	34.2	33.7	32.3	33.4	35	34.96	*36.6	32.3	33.21
	Diameter (mm)	3.83	3.95	3.99	3.97	3.92	3.96	3.82	3.87	3.65	3.91	3.98	3.98
Auxiliary root	Number	4.17	4.56	4.43	4.16	*4.63	4.22	4.91	4.92	4.71	3.12	3.23	*3.56
	Length (cm)	19.5	18.2	18.62	18.5	17.7	18.13	18.1	17.6	17.33	13.96	13.7	13.84
	Diameter (mm)	1.19	1.23	1.21	*1.28	1.24	1.17	1.22	1.27	1.21	1.24	1.21	1.22

*** distinct significative according with Tukey test;*
** significative according with Tukey test;*
[a]C71 - Berlandieri x Riparia Teleki 8B, selection Crãciunel 71; K 5BB - Berlandieri x Riparia Kober 5BB; SO4-4 - Berlandieri x Riparia Teleky 4B SO4-4;

The rootstock C71 had a distinct significate influence on the primary root length and on the number of auxiliary roots in case of 'Afuz Ali' (Figure 1) and Italia cultivars.

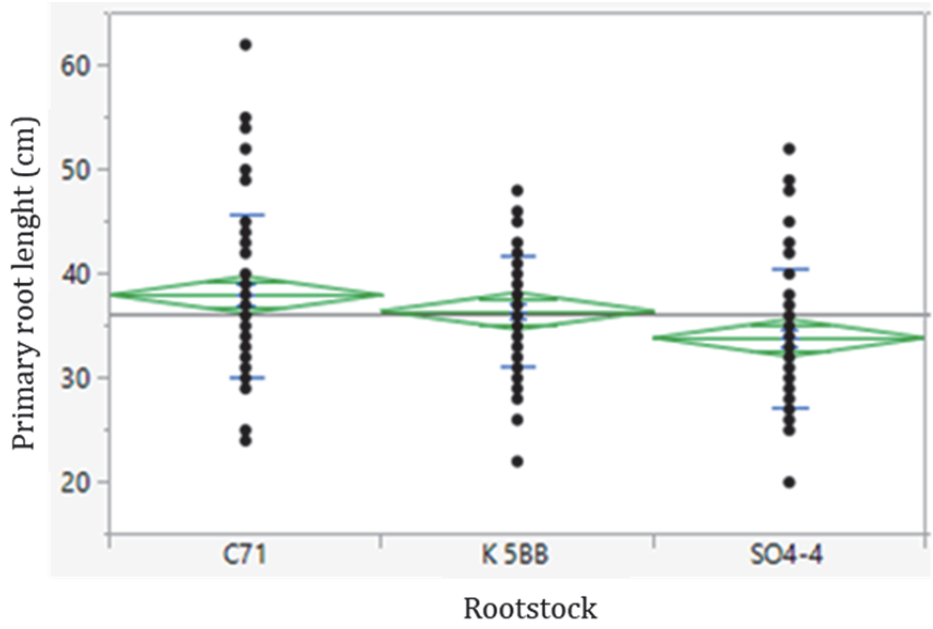

Figure 1. Distribution of the primary root length for 'Afuz Ali' cultivar grafted on the three studied rootstocks

The rootstock SO4-4 was highlighted for its influence on the number and length of primary roots, and on the shoot diameter in case of 'Fetească albă' (Figure 2), 'Italia', and 'Merlot' cultivars.

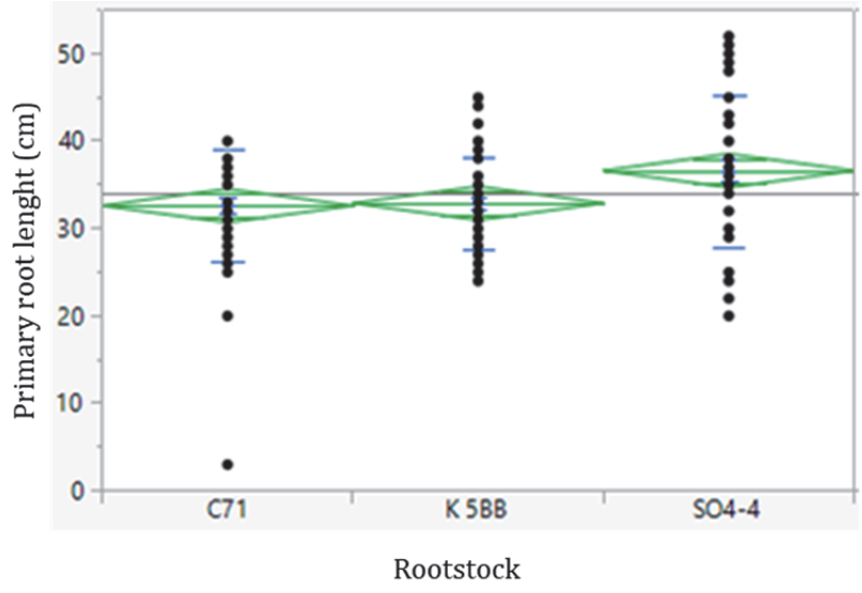

Figure 2. Distribution of the primary root length for 'Fetească albă' cultivars grafted on the three studied rootstocks

For the rootstock 'K 5BB', the results revealed an important influence on the shoot length and diameter of 'Fetească albă' (Figure 3) and Italia cultivars.

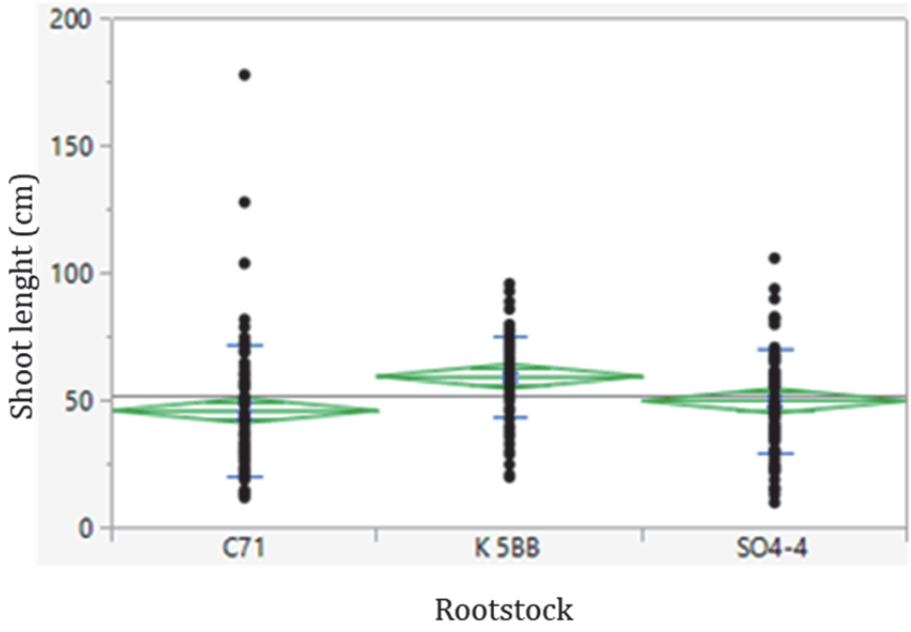

Figure 3. Distribution of the shoot length for 'Fetească albă' cultivar grafted on the three studied rootstocks

CONCLUSIONS

The results regarding the scions and rootstocks compatibility in the grafting process revealed a better interaction between 'Afuz Ali', 'Merlot' and 'Fetească albă' with the 'Berlandieri' x 'Riparia Kober 5BB' rootstock, respectively between Italia with the 'Berlandieri' x 'Riparia Teleki 8B', 'Crăciunel 71' selection rootstock.
Regarding the development of the grafted vines, the results did not highlight the influence of a particular rootstock, so that the 'K 5BB' had the most significative influence on the 'Fetească albă' development after grafting, but the 'SO 4-4' rootstock was the most reliable in all of the four combinations.

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