



Technological Investigations for Improvement of Grapevine Propagation Material Production in Bulgaria. Part I. Results of Affinity Study and Comparative Testing of Paraffins in the Production of Grafted Rooted Vines

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Abstract

The investigations were carried out at the Institute of Viticulture and Enology – Pleven, Bulgaria, in the period 2011-2013. To study the biological affinity of the newly-selected red wine variety Storgozia at IVE-Pleven cuttings from that variety were grafted to rootstocks widely used in viticultural practice - Berlandieri x Rupestris 110 Rihter (110R); Riparia x Rupestris Kordifolia 44-53 Malegue (44-53M), Berlandieri x Riparia SO4 - control. The best callus formation at the site of grafting during stratification was found in the case of grafting of Storgozia variety to rootstock 44-53 M - 85.8%. The strongest growth was also induced by the rootstock 44-53 M. The yield of first-class vines with 44-53 M (50.4%) was almost identical to that obtained with SO4 - 50.9%.

Comparative study of paraffins Aktigref, Rebvaks VF and Proaktigref for applying after cuttings transplantation was carried out for determining the stimulation of callus induction at the site of grafting and prevention of tissue dehydration. The best results (percentage of first-class vines) were obtained using Rebvaks VF - 44.4%.

Key words: vine propagation material, technology, nursery, affinity, paraffins

Introduction

Bulgaria is a country with traditional viticulture and production of grapevine propagation material. During the period 1960-1970, about 80-100 million grafted rooted vines, were produced, half of them for export (Marinov, 1990). Nowadays, our membership in the European Union and the participation in the European single market require constant search for solutions to improve the quality of vine propagation material. That issue, in addition to the biological potential of the source material for grafting is also related to improvement of the technology for the production of vine propagation material. Therefore, in recent years active researches in biological and technological aspects had been carried out in the country. Some of them were directed towards studying the affinity in the nursery and fruit-bearing plantation to determine the optimal rootstock combinations depending on the genotype of the grafted components and conditions of cultivation (Pondev et al., 2003; Trifonova, D., 2003,

Dimitrova V et al., 2004; Trifonova, D., A. Iliev, 2006, Dyakova G., 2007; Pondev K., V. Kovachev, 2007; Hristov, X., K. Popov, 2007; Dyakova G. et al., 2012). Simultaneously at the Institute of Viticulture and Enology - Pleven, paraffins were being tested for stimulation of callus induction at the site of grafting and prevention of tissue dehydration (Dimitrova V. et al., 2007, 2008, 2009).

Objective – to study the biological affinity of Storgozia variety to vine rootstocks 110R, 44-53M, SO4 and optimization of the technology through comparative study of paraffins, applied after grafting of the cuttings.

Material and Methods

The investigations were carried out with red wine vine variety Storgozia, selected in IVE-Pleven obtained through the method of interspecies hybridization. The variety is suitable for organic production and it was distinguished for its high resistance to some fungal diseases and low winter temperatures.

For studying the affinity, cuttings of Storgozia variety were grafted to rootstocks of the following varieties:

- Storgozia/SO4 (control);
- Storgozia/110 R ;
- Storgozia/44-53 M.

Berlandieri X Riparia SO4 rootstock was used for control as the most widely used in Bulgaria for vine propagation material production.

For the comparative testing of types of paraffins and their impact on the vitality indicators of the grafted cuttings from Storgozia/SO4 variety in the nursery, the following paraffins were applied after grafting of the cuttings:

- Aktigref;
- Rebvaks VF;
- Proaktigref.

Grafting was performed by machine, "omega" type of connection. The stratification of the waxed cuttings was done by the classical technology - in boxes of sawdust while maintaining the required temperature, humidity and light in the premise.

After the stratification the grafted cuttings were waxed again with paraffin Sirka for all variants. Rooting was performed by the technology of Radulov L., 1979, improved at IVE Pleven.

The following indicators were followed up: callus induction at the site of grafting - full circular callus (%); buds germination at

stratification (%); shoots development in the nursery (%) - in dynamics; yield of first-class vines (%); biometric measurements of the grafted rooted vines - length of the main shoot and lateral shoots (cm); number of internodes.

Results

1. Studying the affinity of Storgozia variety to vine rootstocks 110 R, 44-53 M and SO4

**Degree of callus induction at stratification of the grafted cuttings*

The regeneration processes during stratification are of great significance for the proper functioning of the new plant, constituted of two components – a rootstock and a cutting. Callus induction at the site of grafting is of premium importance as it determines the connection of the grafted parts.

Figure 1 presents the data on callus induction during stratification of Storgozia variety grafted on the tested rootstocks 110R, 44-53M and the control (Storgozia/SO4). The difference between the variety-rootstock combination Storgozia/44-53M and the control was insignificant – cuttings with full circular callus were 2.5% more in favor of the tested rootstock. For Storgozia/110R, the control exceeded by 4.1% the number of grafted cuttings with full circular callus.

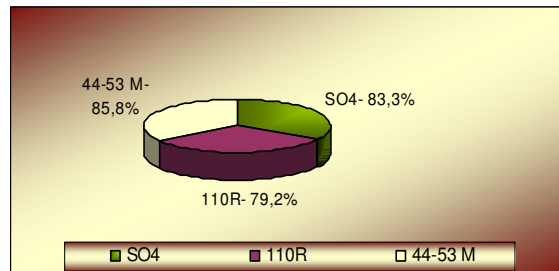


Figure 1. Full circular callus induction at the site of grafting (% cuttings) in stratification of Storgozia variety grafted on SO4 (K), 110R and 44-53M rootstock

The ratio of developed buds was also one of the main indicators of the physiological processes activity during stratification. The studies of Mamarov, 1989 had proven that the developed buds had a stimulating effect on the complex processes in the grafted components under the conditions of the material stratification. In this study, the ratio of developed buds was very high

for all three variety/rootstock combinations. The average ratio per years ranged from 90.0% for SO4 (K) rootstock to 93.8% for 44-53 M rootstock, indicative of the vital processes activation in the grafted areas as well as of the good quality (physiological and health status) of the cuttings for grafting.

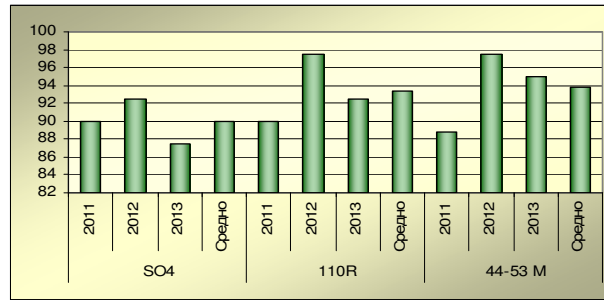


Figure 2. Developed buds (% cuttings) in stratification of Storgozia variety, grafted to SO4(K), 110R and 44-53M rootstocks

**Impact level of rootstocks on vine vegetative processes in nursery*

Shoots germinating in nursery is another important biological indicator. The average data for the 3-year study (2011-2013) revealed the best rate of germination - 84.2% in SO4 rootstock variant, followed by a narrow difference by Richter 110 - 81.2% (Figure 3). More significant difference was observed between the variants per years. The

highest rates of germinating in all variety/rootstock combinations were recorded in 2011. It was supposed that the differentiation per years was primarily a result of the growing conditions impact. In this regard, strongly influencing factor on germination, growth and development of rooted cuttings were the high temperatures and inadequate humidity.

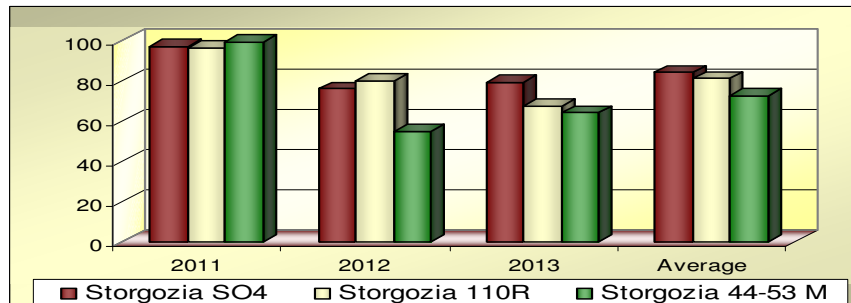


Figure 3. Developed shoots (%) of the planted in the nursery waxed cuttings of Storgozia variety, grafted on SO4(K), 110R and 44-53M rootstocks ** Impact of vine rootstocks on the yield of standard vines*

The ratio of first-class grafted rooted vines was the most important indicator in the production of vine propagation material and simultaneously an indicator of the best affinity. Data on first-class vines yield were in correlation with the results of developed shoots in the nursery. The best yield was obtained in 2011. Due

to the dependence on soil and climatic conditions in the next two years the ratio of first-class vines was significantly lower. The highest first-class vines yield on the average for the three years of the study was obtained by grafting Storgozia to SO4 rootstock - 50.9%, almost equal with the combination with 44-53 M - 50.4%.

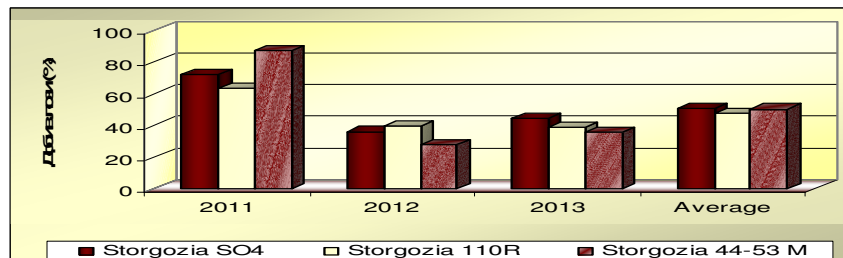


Figure 4. Yield of first-class vines per variants (2011-2013)

**Biometrical measurements*

The results of the biometric measurements provided additional information about the biological potential of the grafted rooted

vines ready for permanent planting. Simultaneously, they were an indicator of the rootstock varieties on the physiological processes of growth and development of the variety-rootstock combinations in the nursery.

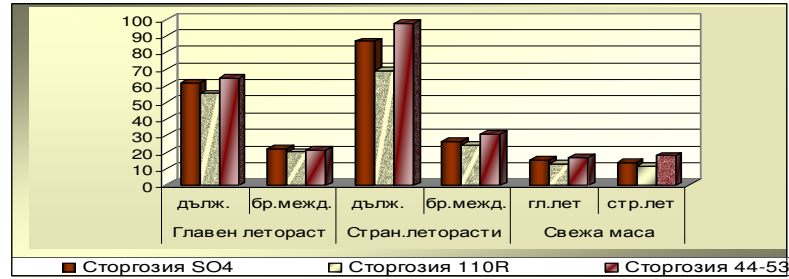


Figure 5. Biometrical measurements of vines of Storgozia variety grafted to SO4(K), 110R and 44-53M, after taken away from the nursery

Data analysis of growth processes in the vine nursery showed that 44-53 M rootstock induced the strongest growth of the main shoot – 64.3 cm in length and 21.1 internodes. Second was the control – 61.6 cm in length and 21.7 internodes. The weakest growth of the main shoot was induced by 110R rootstock. Data on the length and number of internodes of the lateral shoots were equal as those for the main shoot. The mass of the main and the lateral shoots confirmed the observed dependences of the impact of the rootstock varieties on the growth indicators of the grafted variety. Again, the highest values of the mass had Storgozia/44-53 M, respectively 16.8 g of the main shoot and 17.9 g of the lateral shoots. The results obtained from the biometrical measurements of the grafted rooted vines proved

undoubtedly that according to the analyzed indicators 44-53 M rootstock had the greatest impact on the growth processes of the grafted vine variety.

2. Comparative testing of paraffins and their effect on the vital indicators of the grafted cuttings of Storgozia/SO4 variety in the vine nursery

Application of wax technology in vine propagation material production through open growing of the grafted vine cuttings in the vine nursery raised the issue for better coating at the site of grafting to stimulate the callus induction processes while protecting the extremely soft callus tissue from dehydration.

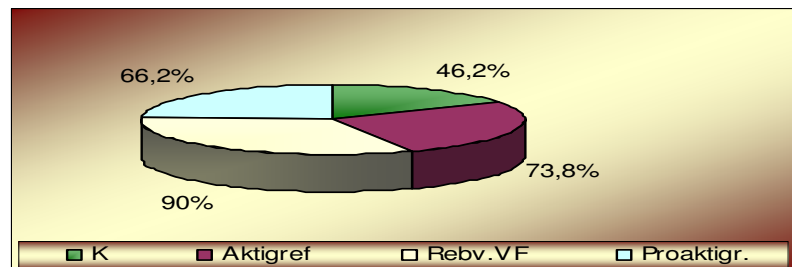


Figure 6. Induced full circular callus at the site of grafting (% cuttings) after stratification of Storgozia/SO4 - control (unwaxed cuttings) and applied paraffins – Aktigref, Rebvaks VF and Proaktigref

Data presented in Fig. 6 on callus inducing of Storgozia/SO4 variety demonstrated the positive impact of paraffins. The ratio of cuttings with a full circular callus without applying wax was 46.2%, i.e. approximately two times lower compared to those waxed with Rebvaks VF. It is known that wax coatings contain growth substances having a

stimulating effect on callus tissue inducing between the grafted components. In the comparative testing of Aktigref, Rebvaks VF and Proaktigref, the best results were obtained using the paraffin Rebvaks VF - 90% of the cuttings had a full circular callus at the site of grafting.

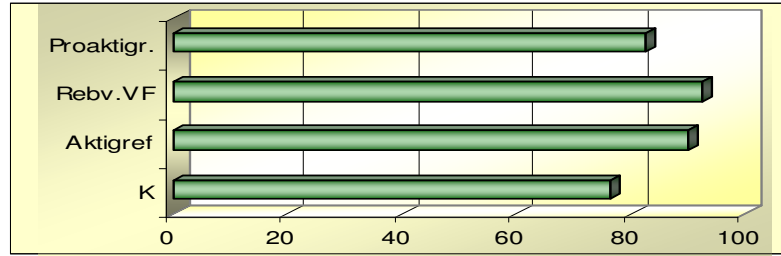


Figure 7. Ratio of germinated buds on the grafted cuttings after stratification of Storgozia/SO4 - control (unwaxed cuttings) and applied paraffins – Antigref, Rebvaks VF and Proaktigref

Fig. 7 revealed the correlation between the ratio of cuttings with full circular callus at the site of grafting and the ratio of cuttings with germinated buds during stratification. The best bud germination was found when paraffin Rebvaks VF was applied - 92.5%. Similar results were obtained for the control in which the ratio, like callus formation, had the lowest rates - 76.3%. The other two variants took an intermediate position.

The follow-up results of the shoots germinating of the waxed cuttings of Storgozia/SO4 revealed a difference of 30% between paraffin Aktigref (38%) and Proaktigref (8%) in the first recording on 29 May (Figure 8). Later that ratio was changed and during the last recording on 12 July 2013 – the best shoots development was found in waxing with Rebvaks VF - 78.8%. The rate of germination of cuttings waxed with Aktigref decreased over time and during the last recording it had the worst results (59%).

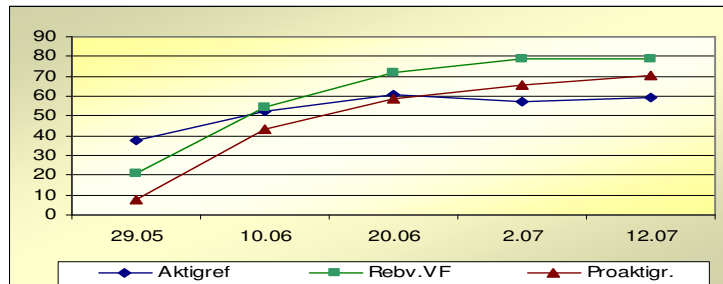


Figure 8. Shoots germination of Storgozia/SO4 shoots in the nursery when waxed with Aktigref, Rebvaks VF and Proaktigref

The ratio of first-class vines was in the range of 30.5% to 44.4% (fig. 9) as it was in correlation with the shoots germination in the nursery during the last recording. From the

comparative testing of the three paraffins the highest yield was obtained when Rebvaks VF was used.

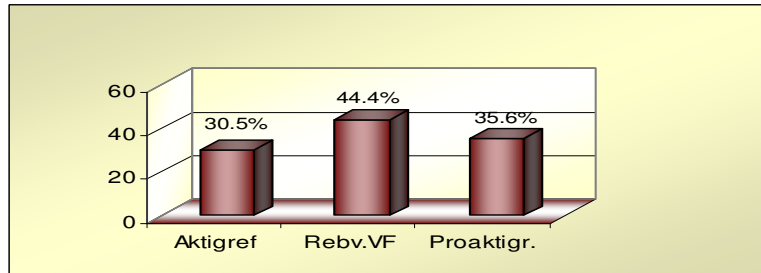


Figure 9. Yield of vines in the comparative testing of paraffins used after grafting of Storgozia/SO4

Conclusion

In the affinity study of Storgozia variety to 110R and 44-53 M rootstocks it was found that in

the combination variety/rootstock Storgozia/44-53 M the ratio of grafted cuttings with full circular callus after stratification was 85.8% and exceeded the control and Storgozia/110R. The strongest growth was also induced by the rootstock 44-53 M.

The yield of first-class vines with 44-53 M (50.4%) was almost identical to that obtained with SO4 - 50.9%.

In the comparative testing of Aktigref, Rebvaks VF and Proaktigref for Storgozia/SO4 variety, the ratio of cuttings with full circular callus

and developed shoots during the stratification was the highest when Rebvaks VF was used, respectively 90% and 92.5%. Shoots germination in the nursery and grafted rooted vines yield (44.4%) had also the highest rates when waxing with Rebvaks VF was performed.

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