Development of grafted grape seedlings depending on the length and variety of rootstock

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Abstract. The grafted grape culture is highly demanded in industrial production due to a number of advantages in comparison with its own rooted culture. The high cost of production of grafted seedlings and climate change necessitate a change in the planting depth of grape plantations for the Rostov region by reducing the length of the rootstock and the selection of optimal scion-rootstock combinations. In this regard, in 2019-2020, I was on the experimental field of the ARRI&W – Branch of FRARC, an experiment was laid in order to study the effect of length (from 30 to 45 cm) and varieties (Kober 5BB and Riparia Rupestris 101-14) stock on agro biological indicators of grafted grape seedlings of the Denisovskiy variety. According to the research results, it was found that, depending on the length of the rootstock, with a length of 30 cm, there is an increase in the yield of grafts from the chamber to 82.65%, the survival rate to 82.5% and the final yield of seedlings to 52.4 cm. The greatest influence on the quality of seedlings was rootstock variety. The stock-rootstock combination Denisovskiy × Kober 5 BB has a low seedling yield from 15.5 to 24.6%, which is lower than the Denisovskiy × Riparia Rupestris 101-14 combination with a seedling yield from 36.4 to 52.4%. It can be concluded that, according to the results of the experiment, a positive dependence was revealed in the yield of grafted seedlings of the Denisovskiy variety with a rootstock Riparia Rupestris 101-14 and a rootstock length of 30 cm, in comparison with the widespread rootstock variety Kober 5 BB and a length of 45 cm.

1. Introduction
The transition to a grafted grape culture, the emergence of rootstock and scion varieties resistant to low temperatures, a change in climatic conditions, suggests the possibility of changing the planting depth of grape seedlings, laying plantings with seedlings with a shorter underground stem [1-3]. Changing the planting depth of grape seedlings has a significant impact on technological processes: they will significantly reduce the cost of producing grafted seedlings, laying and operating grape plantations [4-5]. An important role in the production of grafted grape seedlings is played by the selection of scion-rootstock combinations. According to a number of authors, before the introduction of grafted seedlings into industrial production, scientific justification and careful selection of scion-rootstock combinations for grape varieties planned for the production of seedlings is necessary [6-10].

In this regard, it became necessary to theoretically substantiate the change in the planting depth of grafted seedlings and to set up field experiments for conducting long-term studies that allow assessing
the prospects for changing the planting depth of grafted grape seedlings in the central part of the Rostov region.

The length of the underground trunk - the depth of planting seedlings directly depends on the climatic conditions of the region where the grape plantations were laid.

The climatic conditions of the Lower Don are characterized by thermal resources sufficient for the industrial culture of grapes and the production of wine [2; 6-7; 11-12]. According to Tolokov N.R. the value of Brans heliothermal index (the product of the sum of active temperatures above 10 °C and the sum of the duration of sunshine for the same period) in the Rostov-on-Don region ranges from 3.2 to 7.2, the average value is 5.4. For France, this indicator varies from 3.0 to 6.7 [13].

Since the 70s of the XX century, an increase in temperatures has been observed in European Russia. Warming has generated interest in assessing the prospects for changes in the bioclimatic potential of regions, predicting the response of crops to climate change [14-15]. Changes in climatic conditions on a global scale have also affected our region. Analysis of weather and climatic conditions, carried out by Novikova and Naumova L.G. for the period 1981-2017 showed that the increase in heat supply observed in recent decades, accompanied by a decrease in precipitation, led to earlier flowering and ripening of all studied groups of grapes. Climate changes were generally favorable for grapes: there was an increase in the percentage of blossoming eyes, the number of normally developed shoots, yield, average bunch weight, sugar content in varieties of different origins and directions of use [16-18].

Finally, the XX beginning of the XXI century, and especially in the abnormally hot summer of 2010, there are many temperature highs, while the temperature lows have hardly been observed recently. Months with heavy rainfall have also become more frequent. Due to global climate change on Earth, the conditions of the central part of the Rostov region acquire the characteristics of a typical Mediterranean climate, with rainy winters and hot, dry summers.

Thus, an analysis of the literature on the optimization of the planting depth of grape seedlings and changes in climatic conditions indicates the need for research work related to determining the planting depth of grape plantations in the central part of the Rostov region.

2. Materials and methods

The studies were carried out in the areas of the experimental field of the FSBSI Institution ARRIV&W – Branch of FRARC in 2019-2020, located on the steppe near Don plateau, the relief is wavy. Soil - ordinary chernozem, calcareous, medium-thick, slightly humus, heavy loamy, on loess-like loams. Ground waters lie deep, on the border between the parent and underlying rocks and do not affect the development of the root system of the grape bush. The climate is continental. The sum of the average daily positive temperatures from the third decade of April to the frost is 3300-3400 °C. The area belongs to the zone of insufficient moisture.

The aim of the research is to study the influence of the length and variety of rootstock on the agro biological indicators of grafted grape seedlings. The experiment was carried out in three repetitions of 50 plants, on the following scion variety Denisovskiy and rootstocks Kober 5BB and Riparia Rupestris 101-14, according to the experiment scheme:

- Option 1. - stock 30 cm long;
- Option 2. - stock 35 cm long;
- Option 3. - stock with a length of 40 cm;
- Option 4. - stock 45 cm long (control).

The grafting was carried out according to the technology generally accepted in the production of table grafting with a one-eyed scion cuttings according to the variants of the experiment, the nursing work was standard for an irrigated school. The research technique included the determination of the regenerative activity of grafted grape cuttings according to the method of L.M. Maltabar, N.I. Melnik (2004) and callus formation in the average sample of inoculations by the method of L.V. Kolesnikov.
(1968), and after stratification in the chamber, the nature of survival, growth and development of
seedlings in a school, the development of the root system according to the method of L.V. Kolesnik
(1968) and the output of first-class grape seedlings from the school according to the generally
accepted method (in accordance with GOST 31783-2012).

3. Results and Discussion
Stratification of grafts on a nutrient substrate stimulates the development and growth of shoots, which
creates unfavorable conditions for airing grafts and significantly increases the degree of damage to
seedlings by fungal diseases.

After stratification, the lowest yield of grafts with circular callus was observed on the rootstock
variety Kober 5 BB with a length of 30 cm, which was 60%. On the rootstock Riparia Rupestris 101-
14 with a length of 30 cm, the responsiveness of the scion variety Denisovskiy was noted in
comparison with the rootstock Kober 5 BB, in which the yield of grafts with circular callus was 76%.
With a length of 40 and 35 cm of the Riparia Rupestris 101-14 rootstock, moderate activity of the
grafted components is observed in comparison with the length of 45 (control) and 30 cm of this
rootstock variety, and with the Kober 5 BB rootstock of 35 to 45 length (control).

![Figure 1. Regeneration activity of grafts of the Denisovsky variety depending on the length and
variety of rootstock cuttings (average for 2019-2020).](image)

Vaccinations with a fully developed circular eye and callus were planted in the school. According
to Figure 2, it can be seen that with different lengths of the Kober 5 BB rootstock, the number of
planted plants varied slightly (69.7-77%). The number of grafts of the Denisovskiy variety on the
Riparia Rupestris 101-14 rootstock in the variant with the rootstock length of 30 cm exceeded the
control variant by 9%, and in comparison with the Kober 5 BB rootstock the excess varied from 5.65
to 12.95%.
Figure 2. The adaptive ability of grafted seedlings of the Denisovskiy variety, depending on the length and variety of rootstock cuttings when grown on a school (average for 2019-2020).

The survival rate of plants on the school and the final yield were calculated for seedlings relative to the number of planted plants. Figure 2 shows that on the rootstock variety Kober 5 BB with a decrease in the length of the rootstock, there is an increase in plant survival on the school from 45.85 to 82.5%. However, the high temperature of the summer period and drought negatively affected the safety of the grafted seedlings of the Denisovskiy variety on the Kober 5 BB rootstock, where after digging; the number of first-class seedlings was 15.5-24.6%. The rootstock variety Riparia Rupestris 101-14 showed more successful test results. So, the survival rate varied from 56.65 to 77.1%, and the yield of seedlings from 36.4 (rootstock length 40 cm) to 52.4 (rootstock length 30 cm). A significant difference between the analyzed rootstock varieties can be explained by the individual characteristics of each rootstock variety, which are manifested during their approbation when choosing the optimal combinations of grafting components and under the influence of unfavorable environmental factors.

Figure 3. First-class grafted grape seedlings of Denisovskiy variety after digging, depending on the length and variety (2020).

Figure 3 visually shows that a more powerful root system of grafted seedlings was developed on the Kober 5 BB rootstock, which is directly related to the low plant survival rate on the school. The
sparseness of the plants on the school allowed the remaining seedlings on the Kober 5 BB rootstock to absorb more nutrients and moisture, and the lack of shading allowed the development of a more powerful leaf apparatus (table 1).

Table 1. Indicators of the development of annual shoots of grafted grape seedlings of the Denisovskiy variety depending on the length and variety of rootstock (average for 2019-2020).

| Rootstock variety | Stock length, cm | Shoot length, cm | The ripening of the shoot, cm | Shoot diameter, mm | Sheet surface area, cm² |
|-------------------|-----------------|-----------------|-------------------------------|-------------------|------------------------|
| Riparia Rupestris 101-14 | 40 | 101 | 56 | 4.5 | 1366.5 |
| | 35 | 95 | 56 | 5.0 | 1391.3 |
| | 30 | 94 | 52 | 4.8 | 1217.5 |

Analyzing the data in table 1, it can be seen that the grafted seedlings of the Denisovskiy variety on the Kober 5 BB rootstock developed the largest annual growth (from 73 to 108 cm) and leaf area (from 1092.8 to 1863.7 cm²). However, when analyzing the quality of the obtained seedlings, the indicators of ripening and the diameter of annual shoots are important, which directly affect the storage quality and further development of seedlings in a permanent place. When analyzing the influence of the stock on the development indices of one-year seedlings, the responsiveness of the Denisovskiy scion variety to the Riparia Rupestris 101-14 stock is seen. The seedlings of this variant, with the analyzed rootstock length from 30 to 45 cm, had the best ripening of shoots from 47 to 56% and the diameter of an annual shoot from 4.1 to 5.0 mm. Considering the influence of the length of the rootstock on the quality indicators of one-year shoots, it can be seen that the best development of the shoots was noted on both rootstock varieties (Kober 5 BB and Riparia Rupestris) with a length of 35 cm, in which maturation was 64 and 56 cm, diameter 4.8 and 5.0 mm respectively.

4. Conclusion

Based on the results of the studies, it can be concluded that reducing the length of the rootstock to reduce the cost of production and the underground stem can be widely used in industrial production, and a preliminary search for the optimal scion-rootstock combination of the variety planned for growing will minimize production costs for grafting seedlings and repair vine plantations.

According to the research results 2019-2020 it was found that the survival rate and yield of first-class seedlings of the Dekabrskiy variety depend significantly on the length and variety of the rootstock. With a rootstock length of 30 cm, the Riparia Rupestris 101-14 rootstock has the highest seedling yield of 56.65%, which is 21.25% more than the control version of the Riparia Rupestris 101-14 rootstock variety and 32.9% more than the control version of the Kober rootstock variety 5 BB.

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