Improvement of technological methods of production and cultivation of grafted grape seedlings

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Abstract. At present time, there is a steady trend of expanding the area of grape plantations in the Russian Federation. The revival of the industry is caused by a number of problems, one of which is the lack of grape high-quality planting material. The purchase of imported seedlings is not a universal way of satisfying vineyards in seedlings, due to the inability of imported clone varieties to the soil and climatic conditions of grape growing regions in the Russian Federation. That is why it is necessary to increase the yield of grape seedlings of local table and technical varieties. The paper presents the results of studying the duration of growing of grape seedlings and the substrate used for them. It was found that the optimal composition of the substrate for grafted vegetative seedlings growing is a combination of sawdust + glauconite sand + bentonite clay (in a ratio of 1:1:1) with a growing time of 60 days. With this method of cultivation, the yield of first-class grafted seedlings was 51.2%. The duration of grafted vegetative seedlings cultivation, generally accepted in the production of 40-45 days, provides the yield of seedlings at the level of 35.4-39.6%, which is lower than the best variant of the experiment by 11.6-15.8%.

1 Introduction

The development of viticulture in modern market conditions should be based on highly efficient, energy-saving technological methods for the production of grape planting material [1].

The cultivation of grafted vegetative seedlings is of the greatest interest and importance for production. Vegetative grape plants, both grafted and root seedlings, are in a vegetative state, intended for planting on a plantation (permanent place) without prior planting in nursery garden. Such seedlings are widely used to accelerate the propagation of new promising technical and table grape varieties [2, 3, 4].

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Viticulture is one of the most important branches of agriculture. Further development of this branch in our country is of great importance in the agricultural industry [5]. However, the grape growing industry is in a difficult situation [6, 7]. One of the reasons is the low yield of seedlings. This is due to a number of negative factors, one of which is the use of unpromising and ineffective artificial substrates in the cultivation of vegetative grape seedlings [8, 9].

When growing grafted planting material, special attention is paid to the selection of optimal nutrient substrates and the timing of grape plants growing on them. The main task of the artificial substrate is to provide good aeration, have sufficient water capacity for development and supply of plants with enough nutrients.

Today, the main method of grape seedlings growing is to plant cuttings in an open ground of nursery garden, so a large number of the most fertile lands are used annually for nurseries [10, 11]. This method cannot be considered rational at the present stage, since the cultivation of seedlings in the nursery garden is associated with large labor costs during the most stressful period of the field season. Nevertheless, the yield of seedlings from the nursery garden and with high agricultural technology is small [12].

In modern grape breeding, a new technology for planting material growing on artificial substrates in greenhouses is being actively introduced. Over the past decade, there has been an intensive growth of protected ground areas in many countries. Currently, they exceed 190 thousand hectares. Especially high rates of protected ground development are typical for the USA [13, 14].

The success of greenhouse cultivation technology depends on many components. Special attention should be paid to the selection of substrates when growing planting material in greenhouses that provide the optimal mode of plants growing [15].

The substrate is a variety of natural components and their analogues, which are used as a highly productive medium in which the root system of plants is located. Depending on the crop grown and the method of cultivation, various types of substrates are used in industrial production, namely: organic (sawdust, sod, sphagnum moss, and others) and inorganic (mineral wool, sand, perlite, hydrogel, and others) [16].

The complex of measures for the creation of highly productive grape plantings should be based on the correct choice of technology for seedlings growing, which directly affects the level of seedlings survival in permanent place, the period of entry into fruiting and the yield of grape plantations. Also, the economic efficiency of grape seedlings growing and reduction of their cost depend primarily on the quantitative and qualitative indicators of plants per unit area and the cost of their production [17].

From the above, we can conclude that the search for new substrates and the correct selection of its composition, working out energy-saving technologies for planting material growing on them are currently relevant.

2 Materials and methods

In the experiment, the influence of planting periods and substrates on the quality and yield of vegetating seedlings was studied. The object of research was standard grafted seedlings (graft - Crystal variety, rootstock – Kober 5BB). The experiments were laid on the plots of the experimental field of the VNIIViV n.a. Ya.I. Potapenko in 2016-2018, located on the steppe bottom plateau, the terrain is hummock-and-hollow. The experiment scheme included the following experiment options:

1. Option - stratification 40-45 days, substrate: sawdust (control);
2. Option - stratification 45 days, substrate: sawdust + glauconite sand;
3. Option - stratification of 40-45 days, substrate: sawdust + glauconite sand + bentonite clay;

- 4. Option - stratification of 60 days, substrate: sawdust;
- 5. Option - stratification 60 days, substrate: sawdust + glauconite sand;
- 6. Option - stratification of 60 days, substrate: sawdust + glauconite sand + bentonite clay.

The experiment is based on a three-fold repetition, 300 grafts in each option. The stratification of green seedlings was carried out in specially prepared plastic bags. The preparation of the ingraftings and rootstock material was carried out according to the standards generally accepted in the production. Ingrafting was carried out by the method of table ingrafting, care work is standard.

3 Results and discussion

Ingraftings inoculations and intensive growth when grown in a greenhouse, can provide an exceptionally well-chosen substrate. In our experiment, we studied common substrates: sawdust, glauconite and the introduction of a new component to them - bentonite clay, which is associated with a rich chemical composition (Figure 1).

Fig. 1. Chemical composition of used substrates, %

Fig. 2. Moisture content in callus cells of grafted seedlings Crystal × Kober 5 BB, average 2016-2018, %

The moisture content of callus cells varies depending on the duration of stratification. According to Figure 2, an increase in stratification to 60 days slightly reduces the amount of moisture content in the callus at the end of stratification by 1.3-10.2%. The moisture content before planting on the plantation with a stratification duration of 45 days was unstable and varied from 51.8 to 87.7%. For 60 days of stratification, the amount of moisture fluctuated slightly, from 51.8 to 59.2% (Figure 2).

The development of grafted cuttings into seedlings is directly related to the formation of the root system and shoots with leaves that can develop well only with a sufficient amount of nutrients. This statement is clearly visible in the analysis of Figure 3.

Fig. 3. Development of annual grafted seedlings of Crystal × Kober 5 BB on the plantation, average 2016-2018

The most developed root system (11.9 and 16.4 pieces of roots) and the length of annual growth (21.6 and 35.7 cm) were noted in the variants with the addition of bentonite clay (with stratification of 45 and 60 days, respectively).

Thus, when analyzing Figures 2 and 3 together, it can be concluded that the moisture content in the callus tissues does not affect seedlings development. For the full development of seedlings on the plantation, properly selected substrates that meet the plant's need for nutrients are more important.

Fig. 4. Yield of grafted seedlings of Crystal × Kober 5 BB, average 2016-2018

The duration of stratification in combination with a properly selected substrate can provide a high yield of seedlings corresponding to GOST. The lowest yield of seedlings was observed in the control variant of 35.4% with a stratification duration of 45 days on sawdust. The addition of glauconite sand and bentonite clay to the substrate increases the yield of seedlings to 37.8 and 39.6%, respectively. With a stratification duration of 60 days, a more powerful development of the root system was observed, which provides a yield of 41.6 to 51.2%. The highest yield of seedlings was 51.2% with stratification lasting 60 days on the substrate: sawdust + glauconite sand + bentonite clay, which is 15.8% higher than the control variant. (Figure 4).

The planting of vineyards with vegetative seedlings was carried out in the 2nd decade of May in the pits dug by the digger. The higher survival rate of seedlings on the plantation was in variants 2, 3 and amounted - 73.6 and 86.4% (Figure 5).

Fig. 5. Influence of substrates on the development of annual grafted seedlings of the Crystal grape variety at the end of the growing season, average 2016-2018

The best maturation of the vine and the highest carbohydrate content were noted in option 3. The vine maturation is 74.5%, which is higher than the control by 4.6%, and the carbohydrate content is 21.3%, which is higher by 5.3%.

When using a substrate of sawdust + glauconite sand + bentonite clay, the best preservation of shrubs after overwintering was also noted (Figure 6).

Fig. 6. Preservation of Crystal grape shrubs after overwintering, average 2016-2018

4 Conclusion

The introduction of the proposed substrates into wide practice will make it possible to obtain a much larger number of high-quality seedlings from the greenhouse area. The use of heat and moisture for plants growth and development in a controlled environment, a favorable thermal regime of the substrate promotes rapid rooting and growth of plants, allows to repeatedly increase the use of greenhouse area.

It was found that the optimal composition of the substrate for grafted vegetative seedlings growing is a combination of sawdust + glauconite sand + bentonite clay (in a ratio of 1:1:1) with a growing time of 60 days. With this method of cultivation, the yield of first-class grafted seedlings was 51.2%. The duration of grafted vegetative seedlings cultivation, generally accepted in the production of 40-45 days, provides the yield of seedlings at the level of 35.4-39.6%, which is lower than the best variant of the experiment by 11.6-15.8%. Thus, the correct selection of the substrate and cultivation periods of grafted vegetative seedlings in the nursery of viticulture is effective.

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