The Effect of the Drug Bio Root Plus on the Yield and Quality of Root-Related Seedlings when Propagated by Shortened Lignified

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Abstract. The materials and results of research on the use of Bio Root Plus, produced in France, the effect of which has not been studied in the cultivation of grape seedlings, are presented. For the first time, the degree of influence of the drug on the regenerative activity of shortened grape cuttings was established with the industrial technology of growing seedlings using mulching polyethylene film and drip irrigation in the school. The regulations for the use of Bio Root Plus have been developed. The main research was carried out in the conditions of LLC "Agrovin - Sultan" of the Shelkovsky district of the Chechen Republic. The most developed root system in seedlings is formed when the cuttings are treated with Bio Root Plus at a concentration of 0.5%. In this variant, the best results were obtained in terms of growth – 100.7 cm versus 69.7 cm in the control. The ripening of shoots at the same time was 90.3%, and in the control only 70%. The leaf surface area was noted in this variant of 1200 cm2, which is 234 cm2 more than the control and 88 cm2 more than when treated with heteroauxin. The highest yield of seedlings of 385 pieces per 1 hectare was obtained when Bio Root Plus was processed at a concentration of 0.5%, which is more than when used in the production of heteroauxin by 13,000 pieces. The highest profitability – 317.9% was obtained in the same variant, and 64.1% less when treated with heteroauxin. The conducted studies allow us to recommend the preparation of Bio Root Plus in a concentration of 0.5% in the production of root-related seedlings.

1 Introduction

Extensive research aimed at the practical use of stimulants in the vegetative propagation of grapes was carried out by many scientists [3]. It is known that the effect of certain growth stimulants is most clearly manifested in technologies that provide optimal conditions for growing seedlings. There are practically no works on the use of root formation stimulants during propagation by shortened cuttings in modern technologies. Although this method was widely used for propagating scarce champagne grape varieties in Central Asia, in the

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Krasnodar Territory and in the Crimea, it had no industrial value and was not technologically advanced [7]. When growing seedlings from one- and two-eye cuttings, ordinary greenhouses and greenhouses were used. Planting cuttings in greenhouses is carried out 50-60 days before planting in a school. The day before planting, the vine is placed for a day with the lower end in the water, then the cuttings are cut. If the internodes were too long, one-eyed cuttings of 3-6 cm were cut, leaving part of the internode 1-1.5 cm above and 2-4 cm below. When cutting two-eyed cuttings, the cut from below is made directly under the node. Then the cuttings are placed for kilching in sand or light structural soil to a depth of 2 cm. As soon as callus and small roots form, the cuttings are planted in paper cups or nutrient cubes. The necessary conditions for a high yield of first-class seedlings from shortened cuttings (according to M.I. Markin) [9] are:

- Using first-class, fresh, healthy cuttings;
- Preliminary (in March) kilchevanie and germination at a temperature of 20-30 ° C in the sand of one-eye , two-eye , three-eye and four-eye cuttings in greenhouses or greenhouses;
- Landing kilchevannyh one-eyed cuttings in paper cups;
- Use for preliminary rooting of cuttings of a light substrate (turfy earth and sand), free from pathogens (fusarium, etc.);
- Timely transplantation of seedlings to school;
- Good care of plants (fertilizing, watering, etc.) and protection of plants from diseases.

Seedlings from one- and two-eyed cuttings are suitable for planting if they have a mature part of the vine of 40-50 cm.

If the seedlings have a weak growth, then they are left in the school for the second year and covered for the winter with solid mulch made of organic materials. The yield of seedlings from shkolki is not more than 60%.

In the southern regions, short cuttings, after cutting and soaking, can be planted directly on the ridges or in cold greenhouses. With good care and timely soil moisture, this method of growing seedlings from short cuttings for that time gave good results. In VNIIViV named after Ya. I. Potapenko, various methods of accelerated reproduction of scarce grape varieties were tested. Of all the proven methods in the conditions of the Lower Don region, it was determined as the most promising method of grape propagation. two and three-eyed cuttings in film greenhouses and in a school with polyethylene coatings on metal arcs. All methods based on the use of conventional films require the creation of special temporary or permanent structures (frames or greenhouses) for covering with films [10]. They exclude the mechanization of work, and without structures they pollute the soil and do not allow mechanized work to be carried out for 2-3 years. Economic indicators are significantly inferior to other technologies.

The purpose of the research is to establish the level of influence of the root formation stimulator BiO R oot Plus on the yield and quality of seedlings from short lignified cuttings in a new growing technology in the conditions of the Chechen Republic.

The objectives of the research include determining the level of manifestation and the degree of variation in the indicators of survival, yield and quality of seedlings depending on the concentration of the biological product solution . Identification of the direction and strength of the drug on the studied grape variety. Identification of the economic efficiency of the drug in the cultivation of grape seedlings.

2 Research Methodology

For the first time, the degree of influence of the root formation stimulator Bio R oot Plus on the regeneration activity of short grape cuttings in the industrial technology of growing seedlings using mulching films, soil and drip irrigation. The regulations for the use of Bio Root Plus for different varieties of grapes Different responsiveness of varieties to the use of root formation stimulants has been established.

Objects and methods of research. The object of research is cuttings and seedlings of the Tsimlyansky black grape variety. The variety belongs to the ecological-geographical group of varieties of the Black Sea basin. The duration of the growing season from bud break to full ripeness of berries is 149 days at a sum of active temperatures of 3308 o C. The scarce harvest is used to make Tsimlyanskoe sparkling and Tsimlyanskoe sparkling Cossack wines. Accounting and observations were carried out according to the generally accepted method of agrotechnical research, developed in VNIIViV named after V.I. ME AND. Potapenko

The main studies were carried out in 2017-2020 in the conditions of Agrovin -Sultan LLC, Shelkovsky district of the Chechen Republic. The average annual rainfall is 401 mm, in addition, from May 25 to September 5, the period of a sharp increase in temperature was accompanied by a lack of precipitation. On the soil surface, the temperature on some days reached +60 0 C, which negatively affected the survival rate of seedlings, the growth and development of plants. Relative air humidity in the summer months did not fall below 50%. The indicators of meteorological conditions during the years of research were close to the average long-term values, which made it possible to fully study their effect on vine plantations. In addition to the traditionally used preparations of auxin nature in nursery breeding, a number of new environmentally friendly plant growth and development regulators with high activity in regeneration processes have been obtained. Bi o preparation R oot Plus is a product from a series of organic activators Bio Boosters . Country of origin - France. Bio Root Plus - organic root activator: improves the root biotope and strengthens the root structure, activates the development of a healthy root mass, promotes resistance to diseases and pathogenic forms, and plant acclimatization in a new environment (when transplanted). Bio Boosters are certified organic according to the European Organic Law No. 2092/91. It contains enzymes, humic and organic acids, vitamins. They actively participate in the processes of root formation, strengthen them and optimize the formation. Organic activator, strengthens and stimulates the plant.

Experiment No. 1: The action of the Bio rooting stimulator Root Plus on ripened short grape cuttings was studied according to the following program:

I. _ Option: Water (Control).

I I . Option: Heteroauxin (indoleacetic acid - IAA) at a concentration of 0.15% (15 mg per 1 liter) with the treatment of the basal ends of matured cuttings for 1.5-2 seconds (control).

II I. _ Option: Bio Root Plus at a concentration of 0.3% (3 ml per 1 liter) with the treatment of the basal ends of green and mature cuttings for 1.5-2 seconds.

IV. Option: Bio root Plus at a concentration of 0.5% (5 ml per 1 liter) with the treatment of the basal ends of lignified shortened cuttings for 1.5-2 seconds.

V. Option: Bio root Plus at a concentration of 0.6% (6 ml per 1 liter) with the treatment of the basal ends of lignified shortened cuttings for 1.5-2 seconds.

The scheme of the experiment provides for the use of Heteroauxin, widely used in nursery breeding, and various concentrations of Bio root plus . The experiments were repeated three times. The number of accounting cuttings in each variant is 150 pieces, grape variety Tsimlyansky black.

In early spring, the soil warms up poorly, and the calcaneal root system develops poorly. To improve the thermal regime, more powerful development of seedlings and in order to control weeds, polyethylene film was used as a soil mulch in open ground.

The technology for preparing cuttings for planting was as follows: 20 days before planting, 2 eye cuttings were cut, according to the experimental scheme, they were tied into bundles of 150 pieces. Next, the grape stalk was soaked for 1 day to restore the required moisture concentration. The basal part was treated with a root formation stimulator according to the experimental options and placed for stratification in polyethylene greenhouses. After the formation of 70% callus cuttings, hardening, waxing and planting in the ground were carried out on a mulch film, pre-perforated. Planting pattern 20 × 10 cm, planting depth 17–20 cm [6, 7]. Prostratified cuttings were subjected to hardening and then planted on a mulching polyethylene film, provided that the soil warmed up to 10-12 o C to a depth of 20 cm . The stalk was planted in the holes on the film according to the scheme 20 × 10 cm up to 500 thousand pieces per hectare. Before planting, it was mandatory to water the site. Irrigation moisture regime depends on the level of soil moisture and hydrometeorological conditions of the region. After planting the cuttings, the humidity is maintained at 85-90% HB. With the formation of 3 true leaves on the seedlings, the pre-irrigation soil moisture was maintained at the level of 70-75% HB in the soil layer of 0-60 cm. Pre-irrigation was given at a rate of 120 m 3 /ha. On average, over the years of research, with a planting technology of 500 thousand plants/ha, irrigation was carried out 25 times per season with an irrigation rate of 120 m3 / ha. The average water consumption of the grape school was 3000 m 3 /ha, on the plot without soil mulching the average water consumption was 5500-6000 m 3 /ha. The most intensive water consumption was observed in the period from the end to the middle of August, during the period when the most intensive shoot growth on seedlings was noted. Care work was carried out according to the technology developed by us.

3 Results and Discussions

For grape plants, light sandy soils with high fertility are the best. In our experimental plot, sandy soils are poor in nutrients. Nitrogen is noted only in the gross analysis and in a very small amount of 0.03-0.40%. Humus content is from 0.60 to 0.65%, pH ranges from 8.7 to 8.9%, total carbonate content is 2.2 -2.3%. The amount of potassium in the horizons is from 124 to 147 mg / kg, phosphorus - from 9.9 to 15.5 mg / kg. The gross content of manganese is from 25 to 26.2 mg/kg.

Table 1. The content of nutrients at different depths of the soil in Agrovin -Sultan LLC, Shelkovsky district of the Chechen Republic, average for 2018-2019

Depth of selection, see	pH			Humus, %			Nutrients, mg/kg dry soil					
	2017	2018	2019	2017	2018	2019	Phosphorus (P_2O_5)			Potassium (K_2O)		
							2017	2018	2019	2017	2018	2019
0-20	8.8	8.8	8.8	0.67	0.66	0.65	15.7	15.4	15.5	147	146	143
20-40	8.7	8.7	8.7	0.68	0.67	0.67	13.1	13.1	13.2	126	142	140
40-60	8.7	8.7	8.7	0.65	0.65	0.64	12	12	12.2	143	140	138
60-150	8.7	8.7	8.7	0.63	0.62	0.61	10	9.9	9.8	130	125	124

Soils are very poor in soluble boron in the range of 0.01-0.14 mg/kg along the soil profile of 0-40 cm, but there is no deeper boron. Its low content is considered to be 0.65 mg/kg of soil. The yield of seedlings and their quality is influenced by the soil, therefore, based on the needs of plants, macro and micro fertilizers were applied.

During the stratification period, the development of root eyes and callus formation were monitored. The highest yield of cuttings with circular callus was observed during processing: Bio root Plus at a concentration of 0.5% (5 ml per 1 liter). At a lower concentration, the number of cuttings with root tubercles decreased. Experience has shown that the optimal dose of Bio root Plus for short-term treatment of shortened cuttings in order to increase their yield after stratification, I use a dose at a concentration of 0.5%. This

concentration inhibited the opening of the eye during stratification. And the treatment of the cuttings with a paraffin composition after stratification also had a negative effect on the blooming of the eyes. All this had a beneficial effect on the development of roots and the survival rate of cuttings in shkolka. When growing seedlings from shortened cuttings up to 25 cm 3 , a calcaneal, more powerful root system was formed on the seedling and, at the same time, the cost of purchasing cuttings was significantly reduced. The most developed root system was formed during the processing of cuttings Bio root Plus at a concentration of 0.5%, where the number of roots was 19.9 pieces, when treated with heteroauxin, 3.2 pieces less, and in the control, when treated with water, 5.9 pieces less.

The average growth diameter was 0.16 mm larger in this variant than in the control. The best results in terms of growth were also obtained in the variants of the experiment with treatment with Bio Root Plus at a concentration of 0.5%, while the growth of the seedling shoot was 100.7 cm, respectively, against 69.7 cm in the control. In the fourth option, when processing Bio Root Plus, 0.5% shoot ripening was 90.3% and 70% in the control (Table 2).

Table 2. Development of self-rooted seedlings of the Tsimlyansky black variety in Agrovin -Sultan LLC, Shelkovsky district of the Chechen Republic, 2017-2019

No.	Experience Variant	Average growth diameter, mm.	Growth length, cm		The number of roots per seedling, pcs.	Leaf surface area, cm ^{2}
			general	Growth Aging %		
1.	Control(water)	4.06	69.7	70.0	14.0	956.1
2.	I option Hetero-auxin, 0.02%	4.12	77.4	87.1	16.0	1112.4
3.	II option BioRoot Plus 0.3%	4.08	70.41	72.5	14.3	960.5
4.	III option BioRoot Plus 0.5%	4.22	100.7	90.3	19.9	120 0.0
5.	IV option BioRoot Plus 0.6 %	4.18	82.1	87.9	17.0	1125.3

The leaf surface area of any plant is the main factor in its growth and development and determines its potential and economic productivity. Measurements of the area of the leaf surface of seedlings were carried out in early September before the minting of growth. High results in terms of the leaf surface area of seedlings were noted in the fourth variant of 1200 cm2, which is 234 cm more than in the control and 88 cm2 more than when treated with Heteroauxin.

Table 3. Economic efficiency of the use of FAS in the technology of growing own-rooted seedlings of the Tsimlyansky black grape variety in terms of 1 ha of shkolki

Indicators	Control (water)	Heteroauxin, 0.02%	In io Root Plus, 0.3 %	In io Root Plus, 0.5%	Bio Root Plus 0.6 %
Planted on 1 ha thousand cuttings	500	500	500	500	500
Seedling output 1 grade	360	372	368	385	370
Selling price	thirty	thirty	thirty	35	35
The cost of production per 1 ha, thousand rubles	10800	11160	11090	13825	13895
Costs for growing seedlings, thousand rubles	3300	3305	3309	3310	3311

Additional costs (for stimulants, thousand rubles)	-	25	17	18	19
Total costs, thousand rubles, including UAT tax	3300	3325	3317	3318	3318
Conditional net income	7500	8275	7773	10525	9982
Profitability of production	227.0	253.8	268.0	317.9	301.4
Seedling cost	9.16	8.93	9.01	8.61	8.96

Economic efficiency was determined by the actual costs of growing seedlings, presented in table 3 at various concentrations of cuttings treatment. The highest yield of seedlings of 385 thousand pieces per 1 hectare was obtained when shortened cuttings were treated with Bio Root Plus 0.5% concentration or more than when used in the production of Heteroauxin for 13 thousand pieces.

The lowest cost of a seedling grown from a shortened grape cutting was 8.61 rubles and was obtained in the fourth variant when processing Bio Root Plus 0.5%, which is 32 kopecks less than when used in the production of Heteroauxin.

The highest profitability - 317.9% was obtained in the same variant. And when treated with Heteroauxin, the profitability is 64.1% less than when treated with Bio root plus.

4 Conclusions

The analysis of the use of the treatment of cuttings with preparations of various concentrations allows us to recommend the concentration of the root formation stimulator Bio for production testing. Root Plus 0.5% in the production of self-rooted seedlings from a short cutting, where high quality seedlings are achieved at a low cost.

References

1. E. I. Zakharov, Agrotechnical research on the creation of intensive vine plantations on an industrial basis, 173 (1978).
2. G. G. Vardanyan, Physiologically active compounds in the acceleration of hard-to-root grape varieties, 20-22 (1988).
3. E. N. Gubin, V. V. Logachev, The influence of the drug DV - 47-4 on economically valuable traits of the Citron grape variety Magaracha, **6**, 62-65 (2013).
4. T. G. Kiseleva, Influence of Epin on regenerative processes during grape grafting, Winemaking and viticulture, **5**, 36 (2013).
5. G. P. Malykh, V. P. Malykh, T. I. Kalmykova, Soil mulching with polyethylene films in shkolka and young vineyards, **236**, 49-52 (1977).
6. G. P. Malykh, Aerosol humidification - a new way of watering grape seedlings, **592**, 12-16 (2020).
7. G. P. Malykh, Accelerated reproduction of grapes, 196 (1992).
8. T. I. Mikhailova, S. A. Khabarov, The use of growth regulators to enhance the root formation of green apple cuttings, 115-117 (2005).
9. M. I. Markin, Acceleration of reproduction of grapes by shortened cuttings, **234**, 17-20 (2005).
10. V. V. Monogarov, Methods of accelerated reproduction of grapes: abstract for a Ph.D. thesis, 17 (1990).

11. M. Kh. Chailakhyan, M. M. Sarkisova, Growth regulators for vines and fruit trees, 185 (1980).