

Efficiency of a biological growth regulator in the cultivation of branched seedlings

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Abstract. The article presents the results of studies on the effectiveness of biological preparations Gibbersib - obtained on the basis of the *Fusarium moniliforme* strain - a polygibberellin preparation containing a set of gibberellic acids, as well as the preparation 6-Benzyladenine - a synthetic cytokinin intended to activate the vital activity of a plant associated with the growth and development of lateral shoots that improve the crowning of seedlings. According to the results of preparations testing with separate and combined use, the effectiveness of using each of the regulator separately, in comparison with the control, was confirmed. The greatest efficiency was obtained with the use of treatment with combined regulators, which makes it possible to enhance the branching of seedlings.

1 Introduction

When laying intensive-type apple orchards, much attention is currently paid to the quality of planting material. Branched apple seedlings can already produce the first crop in the year of planting, and industrial fruiting begins already in 3-4 years. Selecting seedlings for intensive orchards, the quality indicators of planting material (the number of side shoots, their average length, the number of fruit buds, etc.) are important [1-5]. But the ability to branch is not sufficiently developed in many popular apple varieties, which makes it difficult to obtain crowned seedlings in the conditions of southern Russia.

Seedlings of fruit crops are good for crowning when using growth regulators by spraying the **apical point** of growth. Plant growth regulators or phytohormones are organic substances naturally produced by higher plants that control growth or other physiological functions and are active in small amounts [6-11]. Currently, when growing planting material, 6- Benzyladenine is used as a broad-spectrum growth regulator, which is a synthetic cytokinin that stimulates the appearance of lateral buds, the formation of basal shoots, cell division.

Gibberellins belong to a well-known and widespread group of plant hormones that regulate the vigor of growth, awakening of dormant buds and branching of axillary shoots, leading to crowning of seedlings and intensification of various developmental processes. A large number of varieties of these organic compounds are known, most of the gibberellins

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are acids. Gibberellins stimulate cell division, cause cell elongation, including shoot growth, stem growth, shoot branching, due to activation of the synthesis of nucleic acids and proteins [12-19]. Gibberellins, with the help of specific proteins, help reduce the effect of environmental stress factors on plants (late spring frosts, abnormally high temperatures in summer, droughts, etc.) [20-23]. Gibbersib - first obtained from a parasitic fungus of the genus *Fusarium* and a chemical growth stimulator.

Gibbersib is a polygibberellin preparation containing a set of gibberellins from the fungus *Fusarium moniliforme*. The composition of the Gibbersib preparation, along with gibberellic acid A3, includes gibberellins A4, A7, A9 and a number of other gibberellic acids, the total content of which significantly exceeds the content of gibberellin A3. The active ingredient of the preparation are sodium salts of gibberellic acids. One kilogram of the product contains 90 grams of the active ingredient. Gibbersib is based on the *Fusarium moniliforme* strain. Gibbersib - gray powder.

6-Benzyladenine is a synthetic cytokinin. Considering that 6-Benzyladenine is used in the production of crowned seedlings, the experiments included options for the combined use of this drug with gibbersib 6-benzyladenine - is a plant growth regulator with a diverse spectrum of action, provides a quick exit of the plant from dormancy, stimulates the formation of side shoots from axillary buds. Due to the action of the drug, the rate of synthesis of chlorophyll is enhanced, which improves the processes of photosynthesis, providing the leaves with a darker green color. 6-Benzyladenine is able to help the plant adapt to prolonged low temperatures in late spring, cold rains, as well as during dry, hot summers, helps to reduce stressful weather effects by enhancing immune processes, ensuring a better course of physiological processes during the formation of side shoots and crowning of seedlings [24-25].

The purpose of the research is to determine the effectiveness of growth regulators when crowning apple seedlings that are not prone to branching.

2 Methods and materials

As objects of study were used one-year-old seedlings of the Modi variety apple tree on M9 rootstocks in the second field of the nursery. A distinctive feature of seedlings of the Modi variety is the absence of side shoots when using the usual technology for growing seedlings. During the growing period, growth regulators (6-Benzyladenine and Gibbersib) were sprayed six times from a manual spray gun (06/15/2021; 06/30/2021; 07/15/2021; 07/30/2021; 08/15/2021; 08/30/2021) only on the apical bud of seedlings apple trees of the Modi variety in the nursery according to three options: Option 1 - 6-Benzyladenine - 0.01% solution; Option 2 - Gibbersib - 1% solution; Option 3 - 6-Benzyladenine (0.01% solution) + Gibbersib (1% solution). Adjuvant H-408 (0.3 ml), which has a high wetting ability, was used in all variants. The control was seedlings of the Modi apple tree treated with water. The studies were carried out in the nursery of IP Gevorkyan R.M., st. Novotitarovskaya, Krasnodar region. The first treatment of experimental plants was carried out on June 15 when the plants reached a height of 50-60 cm. Processing was carried out in the morning at an average air temperature of 18 ° C, an average wind speed of 3 m / s, without precipitation.

In the course of the research, the Program and Methodology for Variety Study of Fruit, Berry and Nut Crops VNIISPK was used [1].

3 Results and Discussions

The first treatment of seedlings according to different options was completed on June 15, 2021. Thirty days after - 07/15/2021 the seedlings of all variants were almost the same? however, in the variants with the growth regulators had the small side shoots in the axillary buds, with a greater number of branches in option 3 (Table 1).

Table 1. Biometric parameters of the above-ground part of apple seedlings, Modi variety, rootstock M9, taking into account foliar treatments with growth regulators as of 07/15/2021. (after 3 treatments)

| Experience Variant | Height of seedling, cm | Stem diameter, cm | Length of lateral shoots, cm | Number of lateral shoots, pcs. | Angle of branching from the trunk |
|-------------------------------|------------------------|-------------------|------------------------------|--------------------------------|-----------------------------------|
| Control | 59 | 0,65 | 0 | 0 | 0 |
| 1- Gibbersib | 58 | 0,7 | 1 | 1 | 30 |
| 2-6-benzyladenine | 57 | 0,7 | 2 | 2 | 25 |
| 3-Gibbersib + 6-benzyladenine | 57 | 0,7 | 2 | 3 | 30 |

In the control variant, no natural branching was observed on seedlings of the Modi variety apple tree. The control seedlings had a maximum height of 59 cm, but did not have any lateral branching, and also had the smallest stem diameter of -0.65 cm. As of 07/30/2021 after the fourth treatment, the height of seedlings increased up to 65-72 cm, while the maximum height was also observed in seedlings of the control variant and amounted to 72 cm. At the same time, the same pattern was preserved on these seedlings - the absence of lateral branches.



Control



Treatment of 6-BA + Gibbersib (variant 3)

Fig. 1. The first treatment of seedlings with growth regulators, 06/15/2021.

Forty-five days after the first treatment of the apical bud with growth regulators, 6-Benzyladenine caused more branching (4 shoots) compared to Gibbersib (3 shoots), however, with the combined action of these growth regulators, better crowning of seedlings was noted, where the number of branches reached 5 pieces.

With the combined action of growth regulators in the third variant, the seedlings had the following biometric characteristics - the height of the seedlings was the smallest and amounted to 65 cm, but the seedlings had the greatest length of lateral shoots, which was 14

cm and the largest trunk diameter. At the same time, the side branches had a maximum angle of departure from the trunk - 45° , which is important in assessing the quality and standard of seedlings.

The following treatments of the apical bud contributed to the awakening of the lateral buds and the formation of lateral branches. Already after the fifth treatment, the number of branches in option 3 reached 11 lateral branches, which corresponds in terms of quality to the requirements of GOST for seedlings of the first grade.

The best crowning of seedlings is observed when using 6-benzyladenine, where the number of branches reached 9 lateral branches, while the total length of lateral shoots was 82 cm.

In the variant where Gibbersib was used with a smaller number of branches (4 pieces), a larger angle of deviation of lateral branches was observed all the time - up to 80° , where it can be concluded that the preparation provides better crowning of seedlings, bringing the angle of departure closer to 90° .

At the end of the growing season, the seedlings of the Modi variety in the control variant had a maximum height of 150 cm, which was 8-15% more compared to the experimental variants, but the trunk diameter remained minimal - 0.98 cm, which is compared with the seedlings of the third variant less by 0.39 cm.

As a result of treatment with growth regulators, the improvement in branching on apple seedlings was noted. Good results were obtained in option 2 (6-Benzyladenine), where the number of side shoots reached 10 pieces, however the height of the seedlings was lower than in the control (Table 2).

Table 2. The influence of growth regulators on the formation of biometric indicators of apple seedlings (as of August 30, 2021, after 6 treatments).

| Experience Variant | Seedling height, cm | Length of lateral shoots, cm | Stem diameter, cm | Number of branches, pcs. | Angle of branching from the trunk |
|-------------------------------|---------------------|------------------------------|-------------------|--------------------------|-----------------------------------|
| Control | 150 | 0 | 0,98 | 0 | 0 |
| 1- Gibbersib | 139 | 96 | 1,29 | 4 | 85 |
| 2-6-benzyladenine | 134 | 107 | 1,25 | 10 | 80 |
| 3-Gibbersib + 6-benzyladenine | 128 | 112 | 1,37 | 12 | 90 |

When applying the combined treatment of seedlings with 6-Benzyladenine and Gibbersib the best biometric indicators of seedlings were noted, having a greater number of branches, the length of lateral shoots, the diameter of the stem, and the height of the plants in this variant was 15% less than in the control.

Analyzing the results of the use of various preparations (Gibbersib, 6-Benzyladenine) to improve seedling crowning, we can conclude that the combined use of gibberellic acids and cytokinins increases the efficiency of physiological processes in grown seedlings, which made it possible to obtain seedlings with a large number of lateral branches, having an angle of departure close to 90 degrees.

In the course of studying the effectiveness of growth regulators aimed at enhancing the crowning of seedlings, timely technological methods are also important, aimed at providing plants with mineral fertilizers and sufficient moisture, which together contribute to the intensive growth of seedlings. Only under these conditions is it possible to obtain a greater number of high-quality branched seedlings suitable for laying intensive gardens.

Our studies have shown that the result of applying special agricultural practices to obtain branching in annual seedlings largely depended on the activity of their growth processes. Considering that cytokinins are able to reduce the synthesis of auxin in the apex,

it can presumably be said that due to their action in the zone of lateral branches, with an additional influx of gibberellins as a result of spraying with growth regulators, better branching of annual seedlings was noted.

According to the results of the research, it was found that in order to obtain apple seedlings suitable for the further formation of spindle-shaped crowns, the most promising method is the use of a complex of preparations (Gibbersib, 6-Benzyladenine), which made it possible to increase the yield of branched seedlings up to 100%: a greater number of side shoots (up to 12 pcs.), the maximum total increase (up to 112 cm).

4 Conclusion

According to the results of testing the drugs "Gibbersib", "6-Benzyladenine" with separate and combined use, the effectiveness of using each of the drugs separately, in comparison with the control, was confirmed. The highest efficiency was obtained with the combined use of gibberellins and cytokinins, which improved the biometric parameters of branched seedlings by increasing the side shoots (12 shoots) and achieving the maximum total growth (112 cm).

Thus, the results of the study of the use of the drug "Gibbersib" alone and in combination with the drug "6-Benzyladenine" in the nursery allows us to conclude that the effectiveness of the six-fold treatment of the apical meristem of the seedling every 15 days when the plants reach a height of 50-60 cm, with the consumption of the drug - 100 ml (1 ml Benzyladenine, 0.1 g Gibbersib and 0.3 ml Adjuvant H-408) for 500 seedlings. With a quantity of 2500 seedlings per hectare, the consumption of a working solution consisting of 50% benzyladenine and 50% gibbersib is 0.5 l / ha (5 ml of 6-Benzyladenine, 0.5 g of Gibbersib and 1 ml of Adjuvant H-408 per 500 ml of water). The use of an adhesive - Adjuvant H-408, which has a high wetting ability, allows to increase the efficiency of processing.

The results of testing the influence of the growth regulator "Gibbersib" alone and together with the growth regulator "6-Benzyladenine" on the growth of the vegetative mass, the formation of side shoots and the formation of the crown allow us to consider them as promising for use in horticulture when growing planting material.

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