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4.1.1. Общее земледелие и растениеводство (биологические науки, сельскохозяйственные науки)

ПРИМЕНЕНИЕ РЕТАРДАНТОВ НА ЯБЛОНИ

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В данной работе исследуется применение ретардантов для регулирования роста и продуктивности яблонь в условиях современного интенсивного садоводства. Ретарданты, как ингибиторы роста, играют важную роль в оптимизации агротехнических мероприятий, увеличении урожайности и улучшении качества плодов. Исследование охватывает механизм действия препаратов, их влияние на формирование кроны и развитие корневой системы. В частности, рассматривается использование препарата Regalis 10WG на сорте Florina, который способствует снижению длины междоузлий и стимулирует образование плодовых почек. Также изучается применение paclobutrazol для улучшения развития корневой системы саженцев яблони при выращивании в контейнерах. Экспериментальные данные показывают, что использование ретардантов приводит к увеличению урожайности на 23% по сравнению с контролем. Полученные результаты подтверждают эффективность ретардантов в управлении архитектурой деревьев, повышении их устойчивости к неблагоприятным факторам окружающей среды и улучшении коммерческих характеристик плодов

Ключевые слова: ЯБЛОНЯ, РЕТАРДАНТЫ, РОСТ, ПРОДУКТИВНОСТЬ

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4.1.1. General agriculture and crop production (biological sciences, agricultural sciences)

APPLICATION OF RETARDANTS ON APPLE TREES

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This study explores the application of retardants to regulate growth and productivity of apple trees in modern intensive orchards. Retardants, as plant growth inhibitors, play a crucial role in optimizing agricultural practices, increasing yield, and improving fruit quality. The research covers the mechanism of action of these compounds, their impact on crown formation, and root system development. Specifically, the use of Regalis 10WG on the Florina variety is examined, which reduces internode length and promotes fruit bud formation. Additionally, the application of paclobutrazol for enhancing root system development in container-grown apple saplings is studied. Experimental data indicates that the use of retardants increases yield by 23% compared to the control group. The results confirm the effectiveness of retardants in managing tree architecture, enhancing resistance to adverse environmental factors, and improving the commercial characteristics of fruits. This approach offers promising solutions for sustainable and efficient orchard management

Keywords: APPLE TREE, PEST RETARDANTS, GROWTH, PRODUCTIVITY

Introduction

The intensification of modern horticulture dictates the need to optimize the growth and development of trees, aimed at increasing yields, improving fruit quality and simplifying agrotechnical measures. In this context, the use of growth regulators is becoming an increasingly common practice in global horticulture.

Plant growth regulators are a class of synthetic organic compounds characterized by the ability to suppress cell elongation processes, primarily by inhibiting the biosynthesis of gibberellins, key hormones that regulate growth processes in plants. The mechanism of action of retardants is often based on blocking the activity of certain enzymes in the gibberellin biosynthesis pathway, such as dioxygenases involved in oxidative reactions necessary for the formation of active gibberellin forms.

At the molecular level, the action of retardants is manifested in a competitive or non-competitive effect on enzymes, which leads to a decrease in the concentration of active gibberellins in plant tissues. This, in turn, causes a slowdown in the rate of cell division and elongation, leading to a decrease in the length of internodes, the formation of a more compact plant structure and an increase in tissue density.

There are several classes of retardants, differing in the mechanism of action and spectrum of activity.

The most common class of gibberellin synthesis regulators includes compounds such as paclobutrazol, dicobutrazol, triazoles and others. They block various stages of the biosynthesis of the phytohormone of growth, leading to its deficiency.

Ethylene synthesis regulators: in some cases, a decrease in ethylene levels can indirectly affect plant growth, although they are not classic retardants.

The effect of retardants depends on many factors, including the type and variety of plant, the concentration and method of application of the drug, the

phase of plant development and environmental conditions. In physiological terms, retardants, in addition to influencing growth, can affect other processes, such as the formation of flower buds, fruit ripening, increased resistance to stress factors (drought, low temperatures) and changes in the hormonal balance of the plant.

Retardants (Latin Retardo - to slow down) are plant growth inhibitors. Growth regulators reduce the stretching of stem cells during their development, increasing their division in the transverse direction, in the plant body, without harming other physiological processes [1].

In fruit growing, retardants are used to solve a number of problems: from reducing the intensity of pruning and crown formation to increasing the resistance of trees to adverse environmental factors and optimizing fruit ripening. In particular, in apple orchards, where high growth intensity can lead to crown thickening, reduced illumination and deterioration in fruit quality, the use of retardants is an effective tool for managing tree architecture and improving the commercial characteristics of the crop.

Material and object of research

This work is devoted to the study of the influence of retardants on apple trees, analysis of their mechanisms of action, consideration of the effectiveness of various preparations depending on the variety, age of trees and the applied cultivation technology. The purpose of the work is to assess the prospects of using retardants in modern apple orchards to increase their productivity and economic efficiency.

Results and discussion

Regulation of excessive growth of fruit plants is one example of the use of growth regulators in horticulture. In intensive orchards, control of excessive vegetative growth of trees is an important task. Particular attention is paid to technologies aimed at limiting shoot growth and suppressing excessive

branching. Slowing down shoot growth and stopping branching stimulation are of particular interest to researchers and practitioners.

Pruning, despite the reduction in overall biomass growth, remains a key agrotechnical technique in intensive orchards, allowing to regulate the balance between vegetative and reproductive development, optimize the light regime inside the crown and stimulate the formation of flower buds. Numerous studies confirm the inefficiency of large-scale crowns. Increasing the crown diameter from 2.5 to 10 meters leads to a decrease in yield by more than 150 grams for every 0.09 m² increase in the crown projection area. This means that a tree with a crown of 10 meters yields half as much as a tree of the same variety with a crown of 2.5 meters.

In addition, pruning increases resistance to diseases by improving ventilation and reducing humidity inside the crown, thereby preventing the development of fungal diseases of the apple tree. Ultimately, it helps to increase yields and improve the quality of fruits.

Pruning is associated with significant labor costs due to the need to perform a large volume of manual operations that require highly qualified personnel. In addition, effective pruning involves maintaining the specified bioconstructive parameters of the crown and optimizing its structure to achieve maximum productivity of the apple tree. There is a need to simplify and reduce the cost of reducing vegetative mass. In modern fruit growing, this problem should be solved by using growth regulators with a retardant effect.

Figure 1 - Apple tree of the Florina variety

As an example, for an accurate assessment of the properties of the preparation, the growth regulator Regalis 10WG (the active substance is calcium prohexadione), developed by the German concern BASF, was taken. It is designed to reduce the intensity of growth of tree shoots and the experiment was carried out on an apple tree of the Florina variety, the drawing of which is presented below.

The mechanism of action of the preparation is to modulate the metabolic processes of the plant, which leads to an increase in the synthesis of flavonoids and other phenolic compounds. These compounds increase the plant's resistance to the penetration of pathogenic agents and activate its own defense mechanisms.

To assess the effectiveness of the preparation, data on the yield of the Florina apple tree variety are presented, obtained depending on the pruning scheme and treatment with a growth regulator.

Table 1 - Effect of pruning and growth regulator on the yield of the Florina apple tree variety.

Experimental variant	Number of fruits, pcs./tree	Average fruit weight, g.	Yield, t/ha
1. Control	68	160	9,07
2. Regalis-1.25+1.25kg/ha	74	160	9,83
3. Regalis 2.5 kg/ha + 1/3 of the remaining shoots were shortened to branches of cm in length.	88	160	11,75

The highest yield (14.1 kg per tree or 11.75 t/ha) was achieved with treatment with Regalis 10WG at a dosage of 2.5 kg/ha in combination with shortening of shoots by 40 cm. This option exceeded the control indicators by 2.68 t/ha, which is 23%. The mechanism of action of Regalis 10WG is to reduce the length of internodes, which leads to a decrease in the length of annual shoots and stimulates the formation of fruit formations. Winter pruning of annual shoots 50 cm or more long, not involved in the formation of the crown skeleton, with shortening to 40 cm also affected the formation of the yield. This method stimulates differentiation of apical buds into 1-3 growth shoots, while more distal buds form shortened shoots (15-20 cm), characterized by early completion of growth and the formation of terminal generative buds.

Intensive pruning with shortening of shoots to 20 cm, on the contrary, causes active vegetative growth with the formation of strong growth shoots, which lead to thickening of the crown and deterioration of the light regime. Thus, moderate shortening of shoots reorients development towards the generative phase, and more radical pruning stimulates vegetative growth [2].

Growth regulators have a wide range of applications in apple orchards. Retardants are also used in the production of planting material for garden crops in containers. An example of this type of cultivation is shown in the figure.

Figure 2 – Planting material of apple trees in containers

This method of planting cuttings is becoming increasingly popular every year, and various difficulties arise when propagating and growing apple trees in this way.

When grown in containers, the tips of the first-order roots are deformed when in contact with the container walls. This limits the branching of the root system, which leads to a decrease in the overall length of the roots and a decrease in the number of suction roots.

The limited volume of substrate in the container significantly affects the development of the root system. Reaching the walls, the roots begin to grow along the surface of the container, forming a dense peripheral layer of small roots. As a result, the root system is deformed and the bulk of the roots shift from the center of the root ball to the walls. This distribution makes the root system more vulnerable to temperature fluctuations, drought and waterlogging, since the near-wall zone is most exposed to external factors.

To improve the survival rate and adaptation of plants after transplanting to a permanent location, it is important to stimulate the branching of adventitious first-order roots before they reach the container walls. This will prevent root twisting and deformation. The goal of this strategy is to form a stable and functional root system that effectively absorbs nutrients and water and has increased resistance to adverse environmental factors.

One way to optimize the development of a healthy root system when growing in containers is to treat the inner walls of the container with physiologically active substances with a retardant effect, such as paclobutrazol. It is assumed that paclobutrazol will suppress axial root growth and stimulate their branching, thereby preventing root twisting.

An experiment was conducted to evaluate the effectiveness of this strategy. Antonovka apple tree seedlings on 54-118 rootstock were planted in 6-liter containers filled with a substrate consisting of peat and sand in a 1:1 ratio. Immediately before use, a retardant solution was applied to the inner walls of the containers using a sprayer, which was then dried for 30 minutes. An inversely proportional relationship was found between the paclobutrazol concentration and the average length of the first-order roots, which was maintained even when the preparation was used together with latex paint. The greatest decrease in the length of the first-order roots compared to the control (on average by 45%) was observed at a paclobutrazol concentration of 1 ml/l. At a concentration of 0.5 ml/l, the decrease was 29%. At lower paclobutrazol concentrations, no significant effect on the length of the first-order roots was noted.

The use of paclobutrazol in combination with latex paint stimulated root branching, prevented their twisting, increased the total length of the root system and the number of absorption roots. These results indicate a positive effect of this method on the growth and development of both the root system and the above-ground part of the Antonovka Obyknovennaya apple tree seedlings, confirming the effectiveness of using paclobutrazol for chemical root pruning.

In conclusion, it should be noted that the use of retardants in the cultivation and propagation of apple trees has a great positive effect. With scientifically sound agricultural technology and the use of fertilizers, the action of regulators will increase the growth of generative mass, as well as increase the resistance of seedlings to unfavorable environmental conditions. Retardants should be used in gardens taking into account the available data on technology and doses of use, as well as conduct their own research and observations based on local factors at the site of crop cultivation.

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