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Original article

THE IMPACT OF CULTIVATION TECHNIQUES ON PRODUCING BRANCHED APPLE TREE SEEDLINGS

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ABSTRACT

High yields in intensive gardens rely on high-quality planting material. A field experiment was conducted in the Almaty and Zhambyl regions to investigate the response of the Voskhod apple variety to various cultivation techniques, including mechanical pinching of the tops of annual seedlings, pinching with the removal of 3-4 upper leaves, and chemical treatments in the nursery. The aim was to develop a technology for growing annual apple seedlings using different agrotechnical methods. The study demonstrated the varying effects of mechanical methods and chemical treatments on the branching and growth of annual apple seedlings. Among all the techniques examined, the combination of pinching the top, removing the upper 3-4 leaf blades, and applying foliar treatments with Epin and Energen Aqua resulted in the highest number of lateral branches. Differences in the response of specific variety-rootstock combinations to the combined effect of mechanical techniques and foliar treatments were observed. For the Voskhod variety, in the Zhambyl region on the Zhetysu 5 rootstock and in the Almaty region on the MM106 rootstock, double foliar treatments with Epin and Energen Aqua, along with pinching and leaf removal, significantly increased the number of lateral shoots under optimal growing conditions. The yield of standard branched apple tree seedlings meeting the quality requirements was 93-95% for all variety-rootstock combinations, except for the MM106 rootstock in the Almaty region.

Key words: *nursery, branched seedlings, apple tree, growing techniques, biometric indicators*

1. INTRODUCTION

Modern intensive gardening requires planting material that meets the specific needs of different fruit types in various soil and climate zones. The success of fruiting and achieving high yields in modern gardens depends heavily on the quality of the planting material.

«Knip-baum» type seedlings, common in countries such as Holland, Germany, and Poland, are known for their high quality. These seedlings, which require at least three years to grow, typically have 10-15 well-developed lateral branches and can begin to form flower buds while still in the nursery [1,2]. In North America, «feathered» branched annuals are grown, benefiting from ample heat, solar insolation, high agricultural standards, and effective techniques to stimulate lateral branching [3]. Despite these practices, it is generally recommended to plant modern intensive orchards using one-year-old branched seedlings.

To obtain crowned one-year-old seedlings, several methods are employed:

Selection of suitable variety-rootstock combinations [4].

Use of high-quality rootstocks [5].

Application of high budding techniques [6].

Utilization of protected soil, winter grafting, and long cuttings [7].

Mechanical methods to influence the central conductor [8].

Chemical stimulation of lateral branch formation [9].

Many studies, both domestic and international, focus on developing technologies for producing branched fruit crop seedlings. However, there is a gap in research regarding the effects of specific mechanical methods and foliar treatments, and their interactions on the biometric indicators of various apple varieties in the nursery's second field.

Currently, global apple production ranges from 60 to 70 million tons annually. The leading producers are China (23 million tons), the USA (4.5 million tons), Poland (3 million tons), Turkey (2.3 million tons), Italy (2.1 million tons), France (2.1 million tons), and Germany (2 million tons) [10].

In Kazakhstan, the primary objective is to supply high-quality, domestically-produced fruit and berry products. However, industrial horticulture in the country is largely extensive, utilizing vigorous seed rootstocks established in the 20th century. Intensive plantings account for only 10-15% of the total garden area in Kazakhstan. To increase fruit production, transitioning to intensive plantings is crucial.

In the last decades of the 20th century, European countries, the USA, and Canada shifted to intensive gardening on dwarf rootstocks. This transition halved the total area under gardens while simultaneously doubling fruit production [11]. In the USA, over 50% of garden areas are now under intensive cultivation, in Canada, over 70%, and in France and Italy, almost all garden areas are dedicated to such practices. Gardens on vigorous seed rootstocks with less dense tree placement now constitute no more than 10% [12].

To enhance yields in the current phase of intensive gardening, it is essential not only to adopt denser planting pat-

terns and superior variety-rootstock combinations but also to produce high-quality planting material and adhere to comprehensive agrotechnical care, particularly in the formation and pruning of fruit plantings. To shorten the growing period and reduce seedling costs, Kazakh Research Institute of Fruit and Vegetable Growing is developing a technology for growing branched annual seedlings using mechanical methods and chemical growth stimulants.

2. MATERIALS AND METHODS

Research on growing branched apple tree saplings is conducted at the Talgar company in the Talgar district of the Almaty region and at Merkensky Experimental Industrial Farm LLP in the Merken district of the Zhambyl region. The sites are located at altitudes of 1070 meters and 1100 meters above sea level, respectively.

The meteorological conditions during the research period showed typical variability for the regions studied. In the Talgar district, the minimum air temperature in February dropped to -18°C at night, while daytime temperatures reached +4°C. In Merke, the average monthly air temperature in January was -2.9°C, fluctuating between -20.3°C and +14.4°C. In summer, the highest temperatures in the Almaty region were recorded in July, with daytime highs reaching +40°C and nighttime lows of +15°C. In Merke, July temperatures averaged 25.3°C, ranging from 7.5°C to 39.7°C.

The spring of 2022 was notably warm and dry, with temperatures significantly deviating from the usual patterns in both regions.

Precipitation in the region varies significantly: in the mountainous areas, it averages 850-900 mm per year, while in the flat areas, it ranges from 250-300 mm [13].

The research focused on two forms of medium-sized clonal rootstocks of Kazakh selection - Zhetysu 5 and MM106 - combined with the Voskhod apple variety. The study evaluated various agrotechnical methods, including top pinching, removal of the upper 3-4 leaf plates, and foliar treatments with Epin and Energen Aqua.

The experiments were replicated three times, with treatments randomized. Plant care followed standard practices for growing fruit crop seedlings. In November, seedlings were excavated, sorted by commercial variety, measured, and stored. Records, observations, analyses, and data processing were conducted using established methods in fruit growing [14].

3. RESULTS

Numerous recommendations and agrotechnical measures have been developed to enhance planting material quality. As new varieties are continually introduced, it is essential to study the growth and development characteristics of each variety-rootstock combination and to develop technologies for producing high-quality planting material for intensive orchards.

The studies examining the combined effects of mechanical methods and foliar treatments on apple tree seedlings were conducted in early summer. Mechanical and chemical treatments were applied at the end of June, when the plants reached a height of 80 cm. The chemicals used included Epin-extract, Energen Aqua, and Omu Rost. A second round of treatments with these solutions was carried out in mid-July, 12-14 days after the initial application (Table 1).

The addition of foliar treatments to mechanical methods had varying effects on branching. A slight increase in lateral shoots was noted for certain treatments and rootstocks: Epin and Omu treatments on the Zhetysu 5 rootstock in the Zhambyl region, Energen Aqua on the Zhetysu 5 form in the Zhambyl region, and on the MM106 form in the Almaty region. Other combinations did not result in significant changes in the number of lateral shoots (Table 2).

The yield of standard branched apple tree seedlings meeting the requirements was 93-95% for all variety-rootstock combinations, except for the Voskhod variety on the MM106 rootstock in the Almaty region.

4. DISCUSSION

When growing planting material for fruit crops, understanding the growth and development characteristics of each variety is crucial in the nursery. The early fruit-bearing and productivity of future plantations depend significantly on the quality of the planting material, which includes both the underground (root system) and aboveground parts (height, trunk diameter, and the number, length, and angle of lateral shoots).

Table 1 – Effect of Agricultural Practices on Producing One-Year-Old Branched Apple Tree Seedlings in the Almaty and Zhambyl Regions.

Options for non-root treatments	Mechanical action options
Without treatment (control)	No pinching
	Pinching the top of the plant
	Pinching the top + removing the upper leaf blades
Treatment of plant shoots with Epin-extract	No pinching
	Pinching the top of the plant
	Pinching the top + removing the upper leaf blades
Processing of plant shoots with Energen Aqua	No pinching
	Pinching the top of the plant
	Pinching the top + removing the upper leaf blades
Processing of the plant shoot Omu growth	No pinching
	Pinching the top of the plant
	Pinching the top + removing the upper leaf blades

Table 2 – Effect of Foliar Treatments and Mechanical Methods on Lateral Shoot Formation in One-Year-Old Voskhod Apple Seedlings Across Various Rootstocks.

Rootstock/Region	Chemical techniques, A	Mechanical techniques, B		Average, A
Number of lateral premature shoots				
MM106 / Almaty region	Without processing	2,6	3,7	3,1
	Epin-extract	2,6	3,3	2,9
	Energen aqua	2,8	3,6	3,2
	Omu growth	2,7	3,2	2,9
	Average	2,7	3,4	
	$HCP_{0,05}$	0,1	0,2	0,2
Zhetysu 5/ Almaty region	Without processing	1,0	1,6	1,3
	Epin-extract	0,9	1,3	1,1
	Energen aqua	0,8	1,4	1,1
	Omu growth	0,9	1,3	1,1
	Average	0,9	1,4	
	$HCP_{0,05}$	-	0,1	-
MM106/ Zhambyl region	Without processing	2,3	3,2	2,7
	Epin-extract	1,9	3,2	2,5
	Energen aqua	2,2	2,9	2,5
	Omu growth	1,9	2,6	2,2
	Average	2,1	3,0	
	$HCP_{0,05}$	0,3	0,4	0,3
Zhetysu 5/ Zhambyl region	Without processing	2,7	3,5	3,1
	Epin-extract	2,9	4,3	3,6
	Energen aqua	3,0	3,6	3,3
	Omu growth	2,7	3,7	3,2
	Average	2,8	3,8	
	$HCP_{0,05}$	0,2	0,6	0,3

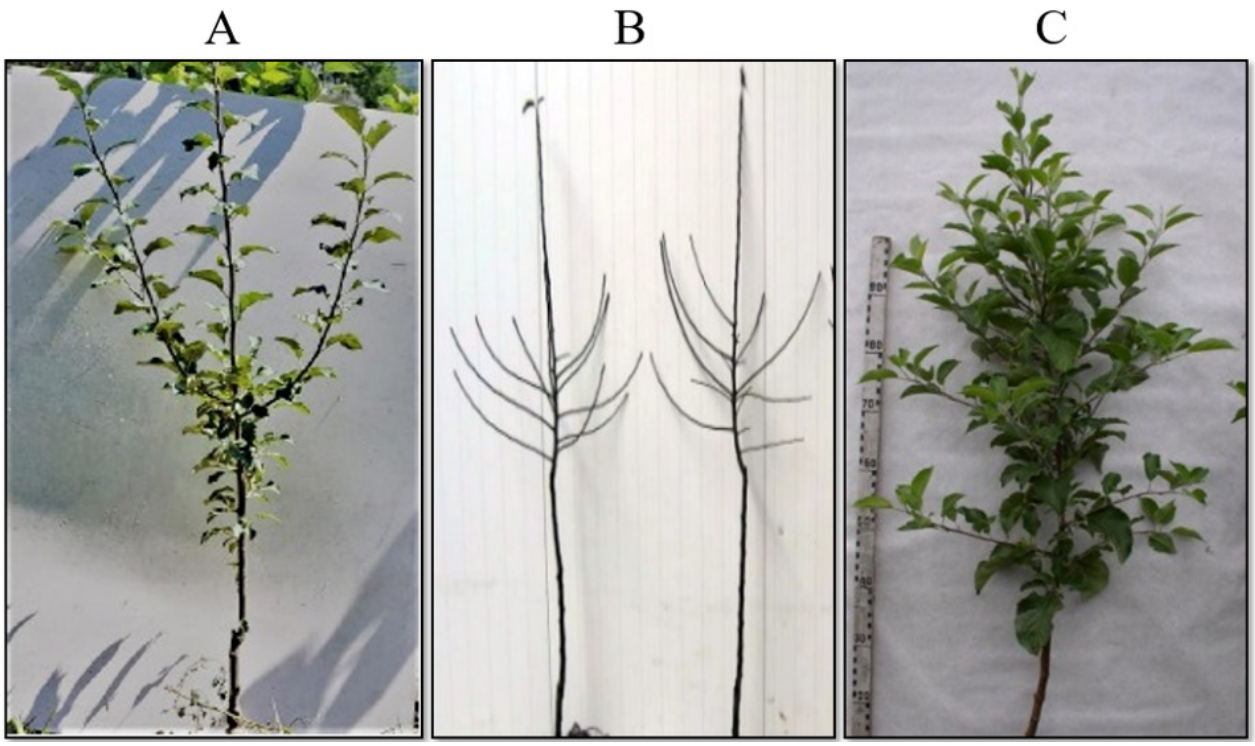

Figure 1 – Various types of branched apple 1-year trees formed by different mechanbocal and chemical ways of branching: A - C – chemical ways of branching, B – mechanical way of branching.

The research revealed that the degree of branching in the one-year-old seedlings varied depending on their growing location. In the Zhambyl region, the Voskhod variety demonstrated the ability to form single lateral branches, whereas in the Almaty region, natural branching was not observed.

Mechanical techniques, including top pinching and top pinching with the removal of the upper 3-4 leaf blades, significantly reduced seedling height in both regions compared to the control. Seedlings in the Zhambyl region were notably taller than those in the Almaty region, irrespective of the rootstock used.

Foliar treatments combined with mechanical techniques did not significantly affect seedling height. Among the variants, the control group of Voskhod seedlings in the Zhambyl region exhibited the greatest height, regardless of rootstock. However, in the Almaty region, Voskhod seedlings treated with Epin-Extrat, Energen Aqua, and Omu Rost in conjunction with mechanical methods showed a slight increase in height compared to the control.

In the absence of mechanical action, no lateral branch formation was observed. However, the use of mechanical methods to influence the central conductor resulted in an increase in lateral shoots across all variety-rootstock combinations, regardless of the growth region. Both mechanical methods positively affected branching, though they differed in effectiveness.

Pinching the top led to the formation of 1.0 lateral shoot in the Voskhod variety on the Zhetysu 5 rootstock in the Almaty region, and up to 2.7 lateral shoots in the Voskhod variety on the same rootstock in the Zhambyl region. Pinching the top and removing the upper 3-4 leaf blades resulted in a significant increase, with up to 3.7 lateral branches for the Voskhod variety on the MM106 rootstock in the Almaty region. The weakest response to mechanical methods was observed in the Voskhod variety on the Zhetysu 5 rootstock in the Almaty region.

Based on the response to mechanical methods, the varieties can be classified into two groups: weakly branching-Voskhod on the Zhetysu 5 rootstock in the Almaty region; and moderately branching-Voskhod on the MM106 rootstock in the Almaty region and on both MM106 and Zhetysu 5 rootstocks in the Zhambyl region.

CONCLUSION

The most effective method for producing the highest number of lateral shoots in one-year-old apple tree seedlings involves pinching the top and removing the upper 3-4 leaf blades when plants reach 80 cm. This approach, applied to all studied variety-rootstock combinations, resulted in a reliable increase in the average number and angle of lateral shoots, along with a reduction in height, compared to simple top pinching. Foliar treatments with growth regulators and soluble fertilizers also improved certain biometric indicators. Specifically, solutions of Epin and Energen Aqua had a slight but positive effect on trunk diameter and the number of lateral shoots for the Voskhod variety on Zhetysu 5 rootstock in the Zhambyl region and on MM106 rootstock in the Almaty region.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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ВЛИЯНИЕ МЕТОДОВ ВЫРАЩИВАНИЯ НА ПОЛУЧЕНИЕ РАЗВЕТВЛЕННЫХ САЖЕНЦЕВ ЯБЛОНЬ

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АБСТРАКТ

Высокие урожаи в садах интенсивного типа зависят от качественного посадочного материала. В почвенных климатических условиях Алматинской и Жамбылской областях в полевом опыте проводилось изучение реакции сорта яблони Восход на действие механического прищипывания верхушек однолетнего саженца, прищипывание с удалением 3-4 верхних листьев и химических приемов в питомнике. Целью данной работы являлось разработка элементов технологии выращивания однолетних саженцев яблони в питомнике с использованием различных агротехнических приемов. Показано различное влияние механических приемов и химических препаратов на ветвление и ростовые процессы однолетних саженцев яблони. Среди всех изученных агротехнических приемов, максимальное число боковых разветвлений было получено при прищипывании верхушки и удалении верхних 3-4 листовых пластин совместно с некорневыми обработками Эпином и Энерген аква. Установлены различия в реакции отдельных сорто-подвойных комбинаций в зависимости от региона произрастания на совместное воздействие механических приемов с некорневыми обработками. У сорта Восход в Жамбылской области на подвое Жетысу 5 и в Алматинской области на подвое ММ106 при оптимальных условиях вегетационного периода двукратные некорневые обработки Эпином и Энерген аква совместно с прищипыванием верхушки и удалением верхних 3-4 листовых пластин способствовали достоверному увеличению количества боковых побегов. Выход стандартных разветвленных саженцев яблони, соответствующих требованиям в зависимости от использования агротехнических приемов у всех сорто-подвойных комбинациях, за исключением подвоя ММ106 в Алматинской области составил 93-95%.

Ключевые слова: питомник, разветвленные саженцы, яблоня, приемы выращивания, биометрические показатели.

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БҰТАҚТАНҒАН АЛМА АҒАШЫНЫҢ КӨШЕТТЕРІН ӨНДІРУГЕ ӨСІРУ ӘДІСТЕРІНІҢ ӘСЕРІ

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АБСТРАКТ

Интенсивті бақтарда жоғары өнімділік сапалы отырғызу материалына байланысты. Алматы және Жамбыл облыстарының топырақ-климаттық жағдайында далалық тәжірибеде алманың «Восход» сортының біржылдық өскінінің ұштарын механикалық шымшу әрекетіне, 3-4 түптерін алып шымшу әрекетіне зерттеу жүргізілді. жоғарғы жапырақтар және питомниктегі химиялық әдістер. Бұл жұмыстың мақсаты әртүрлі ауылшаруашылық тәжірибелерін пайдалана отырып, питомникте біржылдық алма көшеттерін өсіру технологиясының элементтерін жасау болды. Біржылдық алма ағашының көшеттерінің бұтақтану және өсу процестеріне механикалық әдістер мен химиялық заттардың әртүрлі әсері көрсетілген. Барлық зерттелген агротехникалық әдістердің ішінде бүйірлік бұтақтардың максималды саны жоғарғы жағын қысып, үстіңгі 3-4 жапырақ тақталарын эпин және Энерген аквамен жапырақты өңдеумен бірге алып тастау арқылы алынды. Өсімдік аймағына байланысты жеке сорт-тамыр комбинацияларының жапырақты өңдеумен механикалық әдістердің аралас әсеріне жауап беруіндегі айырмашылықтар анықталды. Жамбыл облысындағы «Восход» сортында «Жетісу 5» және Алматы облысындағы ММ106 тамырсабағында вегетациялық кезеңнің оңтайлы жағдайында «Эпин» және «Энерген аквамен» қосарланған жапырақты өңдеулер, үстіңгі жағын шымшып, үстіңгі жағын 3 алып тастаумен бірге. -4 жапырақ тақтасы, бүйірлік қашу санының айтарлықтай өсуіне ықпал етті. Алматы облысы бойынша ММ106 тамырсабақты қоспағанда, барлық сорт-тамыр комбинацияларында ауылшаруашылық тәжірибелерін қолдануға байланысты талаптарға сай келетін стандартты тармақталған алма көшеттерінің өнімі 93-95% құрады.

Кілтті сөздер: питомник, тармақталған көшеттер, алма ағашы, өсіру техникасы, биометриялық көрсеткіштер