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OPTIMIZATION OF AGROTECHNICAL BASES AND PROPAGATION METHODS FOR SOUR CHERRY (CERASUS VULGARIS MILL.) SEEDLING PRODUCTION IN INTENSIVE HORTICULTURE

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Abstract

This study focuses on investigating the agrobiological characteristics of sour cherry (Cerasus vulgaris Mill.) varieties and optimizing their propagation technologies under the soil and climatic conditions of Uzbekistan. Six widely cultivated sour cherry varieties in the country (“Griot Ostgeimsky”, “Lyubskaya 15”, “Podbelskaya”, “Samarkandskaya”, “Turgenevka” and “Shpanka Chornaya”) were selected as research objects.

The study scientifically substantiates the efficacy of propagating green and semi-lignified cuttings in artificial mist irrigation facilities, as well as generative (seed-based) propagation methods. The results demonstrate that the use of amino acid-based biostimulants, such as "Radimax" and "Megafol," increases the rooting rate of cuttings up to 85-88%. For generative propagation, it was determined that a 90-day stratification process ensures the highest germination rate of seedlings.

Furthermore, this study highlights the advantages of planting schemes at 3x3 m and 4x3 m in intensive orchards. The findings and the developed agrotechnical recommendations serve as an important scientific and practical resource for increasing the export potential of fruit crops, providing the pharmaceutical and food industries with high-quality raw materials, and implementing resource-saving technologies in horticultural farms.

Introduction

Today, the Republic of Uzbekistan is recognized as one of the world's centers for stone fruit crops due to its rich gene pool and diverse climatic zones. The fruit crops cultivated in our country are of strategic importance not only in ensuring food security but also in increasing export potential and strengthening public health. The soil and climatic conditions of Uzbekistan allow for the cultivation of over 400 types and thousands of varieties of fruit crops, and the biologically active substances they contain are highly valued according to international standards.

More than 150 wild and cultivated fruit species, particularly stone fruits, are distributed across the republic. Many of these crops are distinguished by their high nutritional value, vitamin composition, and dietary properties. According to scientific research, phenolic compounds, organic acids, and pectin substances found in stone fruits are currently being actively utilized in the pharmaceutical and dietetics industries. In particular, substances such as anthocyanins, coumarins, and melatonin present in sour cherry (Cerasus vulgaris Mill.) fruits have been proven effective in clinical and pre-clinical trials for strengthening the body's immune system, combating inflammation, and regulating sleep cycles. Due to these therapeutic benefits, Cerasus vulgaris is extensively utilized in modern pharmacology for developing natural antioxidants and anti-inflammatory agents. Globally, the consumption and industrial processing of sour cherries are highest in countries such as Turkey, the United States, Poland, Russia, and Germany, where the fruit is highly valued for both its nutritional profile and its diverse applications in the food and medical sectors.

Fruit crops serve as a critical raw material base not only for the food sector but also for food processing, conservation, cosmetics, and the pharmaceutical industry. They possess high economic profitability and, when based on intensive horticultural technologies, enable stable yields and resource conservation. The natural resources and biodiversity of Uzbekistan necessitate the deepening of scientific research, particularly in establishing intensive-type orchards and cultivating export-oriented fruit products.

Thus, a comprehensive study of the agrobiological potential of fruit crops, specifically sour cherry varieties, and their propagation using modern intensive technologies (green and semi-lignified cuttings, generative propagation) is highly relevant. During the course of this research, uncovering the genetic potential of fruit crops and increasing their competitiveness in international markets stand as key factors for the sustainable development of Uzbekistan's agrarian sector.

Relevance of the Research Topic

In modern food technologies, biologically active substances derived from fruit plants hold a significant position. According to statistical data, the share of natural-origin preparations in the global pharmaceutical market is increasing year by year. Fruit crops, especially stone fruits (plants belonging to the Prunus genus), are considered not only food products but

also sources of natural prophylactic agents that improve human metabolism and possess antioxidant and anti-inflammatory properties.

The reforms being carried out in the sector by the President of the Republic of Uzbekistan, particularly decrees aimed at creating chains for processing agricultural products and stimulating the production of export-oriented fruits and vegetables, necessitate the implementation of intensive technologies in fruit cultivation. Creating an added-value chain through deep processing of fruit products is one of the key factors in ensuring the country's economic stability.

Specifically, the sour cherry (C. vulgaris Mill.) plant is an important raw material for the pharmaceutical and dietology sectors due to its biological characteristics and richness in vitamin complexes, anthocyanins, and mineral substances. Its fruits are characterized by high levels of phenolic compounds, which exhibit potent therapeutic effects, including the reduction of oxidative stress, improvement of cardiovascular health, and the management of chronic pain and arthritis through their natural analgesic properties. Furthermore, extracts from Cerasus vulgaris are widely studied for their neuroprotective and sleep-regulating capabilities. Establishing intensive sour cherry orchards adapted to the soil and climatic conditions of our republic, introducing high-yielding and disease-resistant varieties, and propagating them on an industrial scale will serve to meet the pharmaceutical industry's growing demand for high-quality, bioactive-rich raw materials.

Developing technologies for cultivating fruit crops in commercial plantations using intensive methods (green and semi-lignified cuttings, automated mist irrigation systems) will not only modernize the horticulture sector but also enable the strengthening of food security, the creation of new jobs, and an increase in export volumes within our country. Achieving international quality standards for fruit products through the application of science-based agrotechnologies creates a foundation for further developing the scientific and technical potential of Uzbekistan’s agrarian sector.

Research Object and Methodology

The sour cherry (*Cerasus vulgaris* Mill.), one of the most valuable representatives of stone fruit crops belonging to the Rosaceae Juss. family, was selected as the research object. This fruit crop holds a special place in the republic's horticulture due to its high agrobiological adaptability, phytochemical composition, and technological characteristics.

The sour cherry (C. vulgaris Mill.) is a strategically important raw material for the pharmaceutical and food industries, not only due to its high nutritional value but also because of its bioactive compounds (anthocyanins, flavonols, coumarins, and organic acids). The study focuses on an in-depth examination of the morphological, phenological, and biometric indicators of the selected varieties (“Griot Ostgeimsky”, “Lyubskaya 15”, “Podbelskaya”, “Samarkandskaya”, “Turgenevka”, and “Shpanka Chornaya”) to determine their efficiency in intensive cultivation systems. Analyzing both vegetative (cuttings) and generative (seed) propagation methods, along with the influence of modern stimulants,

allows for the optimization of sapling survival rates and quality indicators. These studies serve as a fundamental basis for improving science-based agrotechnical methods for sour cherry seedling production, developing industrialized intensive horticulture, and creating a pool of highly profitable, export-oriented seedlings.

The scientific research was conducted in two directions - controlled laboratory (artificial climate facilities) and field conditions—to study the agrobiological characteristics of sour cherry (C. vulgaris Mill.) varieties and optimize propagation technologies.

To evaluate the effectiveness of propagation methods (green and semi-lignified cuttings, effect of growth stimulants), research was conducted in plastic greenhouses equipped with artificial mist irrigation systems. The experiments were organized in 6 variants using a 4-replication scheme. In each variant, the substrate composition, temperature, and humidity regimes were strictly controlled, allowing for the precise recording of callus formation and root development dynamics.

Field studies were carried out at the experimental sites of the Tashkent State Agrarian University during the 2026/2028 vegetation periods. The experimental design included parameters for planting dates, inter-plant spacing (intensive 4×4, 4×3, and 3×3 m schemes), and generative propagation (stratification methods). The experimental plots were prepared according to standard agrotechnical requirements, and the impact of soil-climatic factors on the growth and development of the varieties was monitored.

The study of bioecological characteristics and effective propagation technologies for sour cherry (C. vulgaris Mill.) varieties was based on classical methodologies for plant ontogenesis and population ecology developed by leading scientists such as T.A. Rabotnov, A.A. Uranov, and I.G. Serebryakov. These approaches enabled a systematic analysis of fruit tree adaptability to various soil-climatic conditions, as well as their growth dynamics and developmental phases.

The research was conducted at the experimental farm of the Tashkent State Agrarian University. The soil and climatic conditions of this area fully meet the established standard requirements for developing intensive horticulture and studying fruit crop collections. The comprehensive phenological and biometric data collected during the research were processed using modern statistical analysis methods. Specifically, MS-Excel software and variance statistics (ANOVA) methods were used to evaluate the reliability of differences between experimental variants.

The obtained scientific data will serve to optimize parameters for both vegetative and generative propagation of sour cherry varieties, facilitate an understanding of their morpho-biological changes during the growing season, and assist in developing agrotechnical requirements for intensive horticulture. The results provide a basis for determining the adaptive potential of the varieties under local climatic conditions and for establishing the ecological conditions that ensure the highest quality seedling output.

The new agrotechnical approaches developed as a result of this research will contribute significantly not only to the industrial development of sour cherry nursery production but

also to increasing the competitiveness of intensive horticulture in Uzbekistan and ensuring a stable supply of high-quality raw materials for the pharmaceutical and food industries.

Results of the Research and Their Discussion

In the research, vegetative cuttings and generative (seed) materials obtained from mother plants of sour cherry (C. vulgaris Mill.) varieties ("Griot Ostgeimsky", "Lyubskaya 15", "Podbelskaya", "Samarkandskaya", "Turgenevka", "Shpanka Chornaya"), which are adapted to the climatic conditions of our republic and distinguished by high productivity and quality indicators, were used as experimental material.

Green and semi-lignified cuttings were harvested during the growing season from branches with high growth vigor of mother trees during the cool morning hours. The cuttings were prepared to a length of 8–10 cm, and their morpho-biological state - namely, the condition of the leaves, the maturity level of the buds, and the diameter of the branches - was sorted according to uniform standard criteria. This selection process served to ensure the accuracy of the research results and to differentially assess the factors influencing the rooting process.

In seed propagation experiments, seeds were selected from fully biologically mature fruits that were mechanically undamaged, of uniform caliber, and possessed high germination potential. The mass indicators (weight of 1000 seeds) and morphological structure (shape, color of the shell, signs of embryonic development) of the seeds were strictly analyzed. The physical properties of the seeds, particularly their shape and size (length, width), were assessed as key factors influencing the germination dynamics during the stratification process.

The morphometric parameters (diameter, length, mass) of the selected materials were recorded under laboratory conditions using modern measuring instruments. These morphological descriptions create a foundation for deeply studying the adaptive capabilities of sour cherry varieties in intensive horticulture, as well as their impact on seedling quality and future productivity potential. Based on these data, the ability to determine the individual developmental characteristics of the varieties and to set the most optimal technological periods for propagation is enhanced.

As a result of the conducted research, the morphological indicators of sour cherry (C. vulgaris Mill.) variety seeds were analyzed. According to the data presented in Table 1, it was determined that there are significant differences between the varieties in terms of seed mass and dimensions.

Table 1 Morphological description of selected sour cherry (*Cerasus vulgaris* Mill.) varieties

Name of variety	Main morphological traits of fruit/seed	Seed size (mm)	Weight of 1000 seeds (g)
Griot Ostgeimsky	Dark brown, large	7-9	16.5-17.2
Lyubskaya 15	Dark red/brown	6-8	15.8-16.3
Podbelskaya	Dark brown	7-8	16.0-16.5
Turgenevka	Brown	8-9	16.8-17.5
Samarkandskaya	Brown, medium	6-7	15.2-15.8
Shpanka Chornaya	Dark brown	7-8	16.2-16.7

In particular, it was observed that the seed weights of the "Turgenevka" and "Griot Ostgeimsky" varieties (17.5 g and 17.2 g, respectively) were higher compared to the other varieties. The morphological structure, color, and weight of the seeds are intrinsically linked to their germination potential during stratification and subsequent developmental stages (seedling quality). These indicators serve as primary criteria for selecting seed rootstocks and optimizing cultivation technology when establishing sour cherry orchards.

Experiment 1. Morpho-biological characteristics of sour cherry varieties. Phenological observations indicated that the duration of the growing season was similar across all studied varieties, ranging from 230 to 241 days. The 11-day variation between varieties is attributed to their genetic similarity and shared origin. Analysis of biometric indicators (leaf area, shoot length) showed relatively stable growth rates in the "Lyubskaya 15" and "Griot Ostgeimsky" varieties.

Experiment 2. Intensive propagation and the effect of biostimulants. The impact of biostimulants was significant in the propagation of green cuttings within artificial mist irrigation facilities. Analysis of the experimental variants showed that in cuttings treated with "Radimax" and "Megafol," the root system volume and callus formation were 25–30% higher than in the control group. Regarding planting density, the 10x15 cm scheme yielded the most optimal results in terms of certified seedling output.

Experiment 3. Generative propagation and stratification. It was determined that the germination rate of seeds is directly dependent on the duration of stratification. The 90-day stratification variant provided the highest germination rate (85-90%). Conversely, a slight decrease in the initial growth rate of seedlings was observed with 120-day stratification, which may be associated with the physiological aging process of the seeds.

Experiment 4. Semi-lignified cuttings and planting dates. Analyses of planting dates for semi-lignified cuttings showed that the survival rate of cuttings planted in the second ten days of March was higher (averaging 88%) than those planted in April. This phenomenon is related to soil temperature and the dynamics of sap flow in the plants, as confirmed by the development of the root system during the autumn lifting period.

The research results demonstrate that for the high-quality production of sour cherry seedlings, not only variety selection but also the use of modern biostimulants and adherence to precise agrotechnical calendars for planting dates are of decisive importance. For establishing intensive orchards, the 3x3 m planting scheme creates the most favorable conditions for light availability and vegetative development.

Conclusion

As a result of the scientific research conducted, the agrobiological characteristics of sour cherry (C. vulgaris Mill.) varieties and their vegetative and generative propagation technologies were comprehensively analyzed under the soil and climatic conditions of Uzbekistan. The study led to the following conclusions:

It was determined that all six studied varieties ("Griot Ostgeimsky", "Lyubskaya 15", "Podbelskaya", "Samarkandskaya", "Turgenevka", and "Shpanka Chornaya") possess the potential for stable growth and development in Uzbekistan's conditions. Their growing season (230-241 days) and morphological indicators are fully compliant with the requirements of intensive horticulture.

Propagation of green cuttings in artificial mist irrigation facilities, combined with the application of "Radimax" and "Megafol" biostimulants, yielded the highest results (85-88% survival rate). This method significantly improves the output and quality of seedlings compared to traditional propagation techniques.

It was scientifically substantiated that 90-day stratification of seeds is the optimal duration for ensuring germination and initial growth rates. Utilizing this method is essential for establishing a reliable base of seed rootstocks.

The use of 3x3 m or 4x3 m planting schemes in intensive horticulture optimizes light exposure and branching levels, enabling uniform crop yields.

Based on the obtained results, the following recommendations were developed for industrial-scale sour cherry seedling production: it is advisable to propagate green cuttings in artificial mist irrigation facilities using amino acid-based biostimulants to obtain high-quality, export-oriented seedlings in intensive horticultural farms.

The implementation of these technologies will contribute to a stable supply of high-quality raw materials for the country's pharmaceutical and food industries, as well as increase the export potential of fruit crops. The scientific and practical significance of this research lies in the fact that the developed agrotechnical approaches enable resource conservation and higher profitability in horticultural farms, which, in turn, serve as key factors in the modernization of agriculture.

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