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Study of High-Yielding, Environmentally Adapted Pome Fruit Varieties Resistant to Diseases and Pests in the Territory of the Nakhchivan Autonomous Republic

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Abstract. *The article examines the distribution zones of apple and pear varieties identified in the Ordubad and Sharur districts, as well as varieties resistant to diseases and pests. Phenological observations were carried out on these forms starting from the flowering phase, and the development dynamics of their shoots and fruits were measured every ten days with corresponding records taken. Meeting the growing demand of our population for various fruit products has always been a priority. This requires further expansion of orchards, selection and placement of productive and promising varieties, and their propagation. Therefore, we set out to study local and introduced fruit varieties cultivated in the Nakhchivan Autonomous Republic, their distribution across different districts and zones, and to determine which varieties are more productive under the specific climatic and soil conditions of the autonomous republic.*
Scientifically based selection of local and introduced fruit varieties allows for increasing varietal diversity in agriculture and identifying genotypes with superior economic and quality characteristics. In particular, cultivation of varieties distinguished by high productivity, frost resistance, and resilience to major plant diseases can significantly enhance productivity in pome fruit orchards in the near future. Ultimately, this process contributes to ensuring sustainable agricultural production and partially meeting the increasing demand of the population for fresh fruits and fruit-based products.

Keywords: *pomological descriptions, selection, agrobiological characteristics, phenological observations, diseases and pests*

Introduction

The fulfillment of the growing demand of the population for food products and the creation of agricultural abundance in our country have currently gained broad momentum. The development of the agrarian economy of the republic and the establishment of intensive orchards are issues of state importance, requiring the creation of high-quality fruit varieties and an increase in productivity in agriculture.

In the Nakhchivan Autonomous Republic, apple and pear trees are more widely spread than other fruit crops. The main reason for this is that these fruits ripen at certain times, can be stored for a long period, and are consumed by the population throughout the year.

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Ecological fruit growing has a positive impact on the environment, can significantly improve public health, and strengthen the country's food security. These varieties and forms, which represent the living history of our people's fruit-growing culture, are productive, high-quality, resistant to diseases and pests, tolerant to drought, suitable for long-term storage, and have played an important role in the production of ecologically clean products. The production of ecologically pure fruits significantly affects public health, as they are grown without the use of synthetic pesticides and fertilizers, which reduces the risk of harmful substances entering the human body and contributes to overall health improvement. Apples and pears are widely cultivated in most regions of our republic. They are highly productive crops. In traditional orchards, productivity reaches 130–140 centners per hectare, while in intensive orchards it amounts to 300–450 centners per hectare (Talibov & Bayramov, 2013, pp. 154–156).

In the independent Republic of Azerbaijan, alongside the application of high-intensity technologies to increase overall fruit production in farms and agriculture, the establishment of new intensive-type orchards with high productivity, resistance to diseases, pests, and frost—especially spring frosts—and adaptation to soil and climatic conditions has been set as an important objective (Bayramov, 2013, p. 9).

The creation of new productive, early-yielding, compact-canopy, disease- and pest-resistant intensive orchards is one of the key issues in the development of fruit growing and increasing fruit production (Bayramov, 2019, pp. 24–25).

Unlike other regions of the Republic of Azerbaijan, the territory of the Nakhchivan Autonomous Republic is highly favorable for the cultivation of fruit crops and obtaining high-quality abundant yields. Among fruit crops cultivated in the autonomous republic, the apple occupies the first place among pome fruits and constitutes the majority of them. Wild forms of apple are found in the forests of Bichanak and Nasirvaz. Among cultivated forms, summer, autumn, and winter apple varieties are mostly grown in foothill zones. Summer varieties are cultivated more widely, while winter varieties are less common (Talibov & Bayramov, 2013, p. 154).

To successfully accomplish the tasks set in this field, it is first necessary to select highly productive varieties suitable for the natural-economic conditions of each fruit-growing region, including different zones of our autonomous republic, and widely introduce them into production. From this perspective, identifying and propagating ancient but still insufficiently widespread local apple and pear varieties, as well as developing more productive varieties for farms, is of great practical importance for the successful implementation of the national food program currently being pursued in our republic.

The main purpose of fruit and berry cultivation is to obtain products containing valuable and essential substances necessary for human nutrition, normal growth, and development. In addition to fresh consumption during the fruit season, dried fruits, jams, marmalade, preserves, juices, and other products are used throughout the year. One kilogram of whole milk contains 580–640 calories, while one kilogram of apples produces 440–556 calories, which corresponds to approximately 4/3 of the caloric value of milk (Hasanov, 2000, p. 93).

The results of scientific research indicate that by propagating and expanding the cultivation of these recommended varieties over large areas, the demand of the population of the autonomous republic for high-quality apples can be met in the future. This will also improve the financial income of farming enterprises. The brown, gray-brown, gray-forest, and meadow-steppe soils existing in the Nakhchivan zone ensure the long-term effective cultivation of the recommended apple varieties (Hasanov, 2000, p. 93).

The main objective is to identify apple varieties and forms in the territory of the Nakhchivan Autonomous Republic, to propagate endangered local varieties, study their agrobiological characteristics, and provide pomological descriptions in order to recommend promising varieties to farmers and private households. For this purpose, along with the application of high-intensity technologies in farms to increase overall fruit production, the development of new high-quality, high-yielding, disease- and pest-resistant, frost-resistant—especially to spring frosts—intensive apple varieties adapted to local soil and climatic conditions has been set as an important task (Bayramov, 2017, p. 9).

Research Objective

Our objective was to select productive, high-quality varieties adapted to local soil and climatic conditions that are resistant to diseases and pests, and to recommend them to farmers and private households. The Nakhchivan Autonomous Republic has long been renowned for its high-quality and diverse fruit varieties. Through traditional folk selection, numerous pome, stone, nut, and other fruit varieties have been developed, which, in terms of taste, aroma, and other characteristics, are not only comparable to varieties grown in other regions but in many cases even superior to them (Nasir, 1995, pp. 140–141). The purpose of studying these varieties is to identify ancient, highly productive, frost-, disease-, and pest-resistant pome fruit varieties and, by examining their biological and economic characteristics, to recommend the best of them for agricultural production (Hasanov, 2000, p. 93).

Materials and Methods

In carrying out the research work, generally accepted methods in fruit growing were used, including the methodology of the All-Union Scientific Research Institute named after I.V. Michurin (pp. 93–124); I. N. Beideman's "Methodology for Studying the Phenology of Plants and Plant Communities" (pp. 120–136); Z. M. Hasanov's "Fruit Growing" (Laboratory-Practicum) (pp. 12–13); as well as methods for studying the agrobiological characteristics of varieties. Based on these, a study was conducted on the biological characteristics of aboriginal apple varieties cultivated under the conditions of the Nakhchivan Autonomous Republic. For this purpose, research work was initiated in apple orchards in the Sharur and Ordubad districts using the accepted methodology.

The development of the republic's agrarian economy, improvement of food security for the population, and establishment of intensive orchards are issues of state importance, requiring the creation of high-quality fruit varieties and an increase in productivity in agriculture. During the research year, phenological observations were carried out. For this purpose, the calendar timing of the same developmental phases was recorded annually; the periods of flower and leaf formation, flowering stages (beginning, mass flowering, end), fruit ripening time, and the period of leaf fall (from beginning to end) were studied and documented. Highly productive, frost-, disease-, and pest-resistant pome fruit varieties cultivated in the territories of Ordubad and Sharur districts were studied. In addition, several other varieties such as Autumn Apple, Winter Apple, Summer Pear, Juicy Pear, Winter Pear, Sour Pear, and others were identified by us and included in the study.

Depending on climatic conditions, apple varieties were less affected by diseases and pests this year. In cultivated agriculture, agro-technical measures such as deep plowing, cultivation, winter irrigation, crop rotation schemes, row and plant spacing management, sowing or planting timing, fertilization, optimal harvesting period, and selection and application of resistant varieties prevent the spread and development of diseases. Along with all agro-technical measures, timely and effective control against pests, diseases, and weeds is of great importance for obtaining high and quality yields. Thus, to produce plant products free from pesticides, it is necessary to use agro-technical and biological control methods to the maximum extent possible against harmful organisms (pests, diseases, and weeds).

Plants with a long period of relative dormancy are more frost-resistant. Under favorable conditions in autumn, as plant tissues harden, frost resistance develops. During this process, plant tissues transition from one physiological state to another, which increases their frost tolerance. The main reason for frost damage in pome fruit plants is the formation of ice in their tissues. The formed ice exerts pressure on the protoplasm, dehydrates it, damages the cell membrane, and destroys cells. Roots located near the soil surface are less resistant to frost. Depending on the species, the above-ground part of the apple tree can withstand frost down to −32.5 °C during the relative dormancy period, while its roots can tolerate only −7 to −12 °C. Once vegetation begins, roots can freeze at −3 °C.

Results

As a result of the conducted research, the following findings were determined. The apple tree is mainly cultivated in foothill and mountainous areas. It was observed that apple varieties grown in these zones are resistant to frost as well as to diseases and pests. In mountainous regions, the cultivation of high-quality winter apple varieties is favorable. The fruits of apple varieties grown in mountainous zones can be stored for a long time and maintain good quality. The pear tree is mainly cultivated in foothill and lowland areas. It was observed that pear varieties grown in these zones are resistant to frost as well as to diseases and pests. The frost resistance of the studied apple varieties depends on the origin of the variety and the environmental conditions of the region. Local apple varieties cultivated in Nakhchivan are not only of high quality but also frost-resistant. In apple flowers, stamens are frost-resistant, whereas pistils are frost-sensitive and perish at −2 to −3 °C.

The conducted studies revealed that warm and humid weather in spring and early summer creates favorable conditions for the spread of powdery mildew. Infection of leaves and shoots by fungal pathogens was observed repeatedly throughout the vegetation period. Seasonal diseases were monitored several times during the growing season and recorded accordingly. In apples, scab and fruit rot (moniliosis), as well as powdery mildew on fruits, flowers, leaves, and shoots were studied. In apples and pears, observations of scab disease were conducted from its initial appearance until harvest. The infection level of fruits by scab was assessed several times on 10 selected trees per variety. Collected fruits were analyzed according to a scale, and the percentage of infection was calculated (Khalilova et al., 2017, pp. 133, 194).

To prevent diseases, it is necessary to thoroughly study the biological characteristics of their pathogens and implement a comprehensive control system. The control measures should be adapted to local conditions and carried out according to a planned program. Ordubad district has long been famous for its high-quality and diverse fruit species and varieties. Through folk selection, hundreds of rare pome, stone, and nut fruit varieties have been developed here.

A. X. Rollov (1896) noted that fruit growing had been practiced in Nakhchivan since ancient times and highlighted the presence of valuable fruit varieties in the region. He documented the diversity of major fruit crops cultivated in Nakhchivan, among which apples were the most numerous. In the Nakhchivan Autonomous Republic, the highest number of productive, frost-, disease-, and pest-resistant pome and stone fruit varieties is concentrated in Ordubad district. Among them are cherry plum varieties such as Yaz Malasi, Yay Malasi, Rajabi, Qirmizi Alcha, Tabarza, Goycha, cherry, Novras, Gilanar, Ganza, Dirnis, Kulus; apple varieties such as Misri Alma, Qizil Alma, Abrash Alma; pear varieties such as Dagh Armudu, Chil-Chil Armudu, Qirmizi Yanaq Armudu; and quince varieties such as Sari Heyva, Malayi Heyva, Vezri Heyva, Novras Heyva, among others.

In the Nakhchivan Autonomous Republic, apple orchards constitute approximately 50% of all fruit orchards. The main reasons for this are the high quality of apples, their different ripening periods, and their long storage capacity. Winter apple varieties are considered especially valuable. Although

autumn and winter apple varieties are less widespread, the demand for them among the population is high. Apple trees are mainly cultivated in foothill and mountainous zones, where they demonstrate resistance to frost, diseases, and pests. Therefore, it is appropriate to expand apple cultivation in the mountainous and foothill villages of the Nakhchivan Autonomous Republic. To increase the production of apple and pear varieties with different ripening periods, it is planned to propagate these varieties through grafting in Sharur and Ordubad districts and distribute them to farms.

Discussion

Our objective was to select local apple and pear varieties adapted to the soil and climatic conditions of Ordubad and Sharur districts, resistant to diseases and pests, to use them in breeding programs, propagate promising varieties and forms, and recommend them for cultivation in farming enterprises. Based on the research conducted in apple orchards in Ordubad and Sharur districts, the following results were obtained:

The Nakhchivan Autonomous Republic, being a fruit-growing region characterized by rich diversity of local and introduced apple and pear varieties and favorable soil and climatic conditions, has significant potential for further development of fruit growing. As a result of the study, 2 apple varieties and 3 pear varieties were identified. The apple varieties Autumn Apple and Winter Apple, as well as pear varieties Summer Pear, Juicy Pear, and Sour Pear, were found to be productive and resistant to diseases and pests. Although summer-ripening local pear varieties are less widespread, their demand is high. Therefore, their cultivation in lowland zones is also necessary.

The recommended apple varieties are resistant to disease and pest pathogens and meet the requirements of the market economy in terms of productivity and fruit quality. It is recommended to expand the area of apple and pear orchards in the Nakhchivan Autonomous Republic by using advanced cultivation technologies and high-yielding varieties.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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