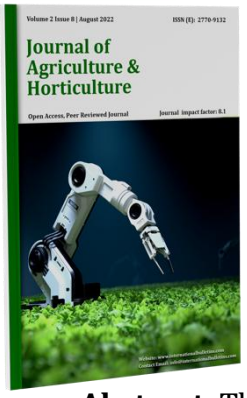

EFFECT OF FERTILIZATION NORMS ON THE GRAFT-TAKE RATE AND QUALITY INDICATORS OF PROMISING APPLE SEEDLINGS

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Abstract. This article presents the results of research dedicated to studying the effects of different mineral fertilizer application rates on the survival and quality of apple seedlings grafted onto clonal rootstocks with varying vigor levels under the conditions of the Pastdargom district in the Samarkand region. The research focused on the Golden Delicious apple cultivar grafted onto the vegetatively propagated dwarf rootstock MIX. A comparative analysis was conducted in the second field of the nursery to evaluate the influence of various mineral fertilizer rates on the survival of grafted plants, their development, and the yield and quality of standard seedlings. The following fertilizer application rates were studied: a) without fertilizers (control); b) N90P60K45; c) N120P80K60; d) N140P100K70; e) N160P120K80; f) N180P140K90. The best results for survival rate (85.5% - 59,773 thousand pieces/ha) and the yield of high-quality seedlings (87% of grade I – 52,062 standard seedlings per hectare) were observed with the application of fertilizers at the rate of N140P100K70.

Keywords: apple tree, cultivar, graft, rootstock, clone, fertilizer, application rate, seedling, standard.

Introduction

In recent years, the Government of Uzbekistan has outlined specific objectives aimed at expanding the area of intensive orchards and gradually replacing outdated and inefficient extensive orchards with modern, high-yielding intensive ones. This transition, in turn, necessitates the annual production of millions of high-quality fruit and berry seedlings [1; 2].

It is essential to remember that each region of our republic possesses distinct soil and climatic conditions that vary significantly from one another. Therefore, using seedlings that have been cultivated under the specific soil and climate conditions of a given area plays a critical role in ensuring strong graft union establishment, prolonged orchard longevity, and high productivity. Similarly, fertilization—regardless of the crop type—must be based on scientifically grounded recommendations that consider local soil conditions, crop species, targeted yield, and other relevant factors [3; 4].

Numerous researchers have emphasized the importance of selecting seedlings adapted to local environmental conditions as a key foundation for achieving high orchard efficiency [5, 7, 9].

Producing high-quality seedlings is influenced by multiple factors, among which fertilization plays a pivotal role. Fertilization is a critical agronomic practice in nurseries as it regulates plant growth and improves seedling quality. To achieve high productivity, nutrients must be supplied in assimilable forms and appropriate quantities. Both deficiency and excess of nutrients can adversely affect seedling quality. Young plants are particularly sensitive to changes in soil conditions, especially mineral nutrition. This sensitivity is even more pronounced in modern varieties grafted onto weakly growing rootstocks commonly used in today's intensive orchards, which demand precise nutrient management [6, 8].

Based on the above considerations, we conducted a research study at the Charkhin Experimental Station of the Mahmud Mirzayev Scientific Research Institute of Horticulture, Viticulture, and Winemaking (Pastdargom district, Samarkand region). The study aimed to investigate the effects of different fertilization rates on the efficiency of cultivating promising apple varieties grafted onto clonal rootstocks with varying growth vigor.

Research Subject and Method

As the object of the research, the *Golden Delicious* apple variety bud-grafted onto the dwarf M9 rootstock was used. The rootstocks, grown by the mound layering method, were planted in late autumn (end of November) according to a 70×20 cm scheme. In the second half of August, the promising *Golden Delicious* variety was bud-grafted onto the rootstocks.

In the second field of the nursery, a comparative analysis was carried out on the effect of fertilization rate on the bud take on the rootstock material, the development of varietal plants from them, and the output quantity and quality indicators of standard seedlings. Mineral nutrients were applied at the following rates: a) No fertilizer applied (control); b) N90P60K45; c) N120P80K60; d) N140P100K70; e) N160P120K80; f) N180P140K90.

In this case, potassium and phosphorus were applied in a 50:50 ratio in autumn (before planting the rootstocks) and in spring. Nitrogen was applied in two feedings during the growing season (in spring during the active growth period and in summer before bud grafting). In the following year, when varietal seedlings were being grown, fertilizers were applied once (potassium and phosphorus during the beginning of bud swelling and nitrogen at the start of active growth) [6, 8].

At the end of the season, the degree of seedling development (height of seedlings), and the percentage of first and second-grade seedlings were calculated according to [10].

Results and Discussion

As in many countries around the world where seedling fruit trees are cultivated, in Uzbekistan, apple seedlings are also grown by budding onto rootstocks propagated through mound layering. In the experiment, the rooted mound-layering cuttings were separated from the mother plants in late autumn (end of November) and transplanted into the first field of the nursery. During soil preparation for the cuttings, 50% of the prescribed amount of potassium and phosphorus fertilizers were applied under the soil. In spring, after the buds began to swell on the cuttings, the remaining 50% of potassium and phosphorus fertilizers were applied. On these swelling buds, shoots developed, and during their rapid growth period (April), 50% of the prescribed nitrogen fertilizers were applied as top dressing. In early August, the remaining 50% of nitrogen fertilizers were applied. From the second half of August, the *Golden Delicious* variety was budded onto these plants.

In early spring of the second year, the shoots from the mound-layering were completely cut off 1–3 cm above the bud graft, allowing the grafted bud to develop. Simultaneously with this agrotechnical measure, the full annual norm of potassium and phosphorus fertilizers was applied. When the grafted buds developed and the resulting varietal seedlings reached 15–20 cm, the full annual norm of nitrogen fertilizers was applied.

Observations showed that the fertilization rate with mineral fertilizers had a significant effect on the bud take of the *Golden Delicious* variety grafted onto the M9 rootstock. In this case, compared to the control variant (plants without fertilization), the highest bud take was observed in plants fertilized at the rate of N140P100K70. At the end of the season—during the time of seedling digging—the total number of successfully grafted seedlings (including I, II, and

non-standard) in this variant was 85.5% (59,773 seedlings), which was 20.3% higher than the indicator of the control variant. This means 16,617 more seedlings than the control (see Table 1).

Table 1

Resistance of grafted shoots of Golden Delicious apple variety grafted onto MIX rootstock depending on the rate of mineral fertilizer application

Experimental option	Cuttings, pcs			Budding bud retention, pcs				
	Total planted	Budded	Perished	in autumn inspection		until seedling excavation		%
				perished	Retained	Perished	Survived	
No fertilizer – control.	71428	66190	5238	3290	57662	13506	43156	65,2
N90P60K45	71428	68402	3026	2950	62426	8004	53422	78,1
N120P80K60	71428	69650	1778	2745	65127	6248	57879	83,1
N140P100K70	71428	69910	1518	2430	65962	5189	59773	85,5
N160P120K80	71428	69720	1708	2441	65571	5727	58844	84,4
N180P140K90	71428	69690	1738	2450	65502	6102	58400	83,8

The table data indicates that as the rate of mineral fertilizer application increased, the percentage of successfully grafted seedlings also increased linearly. However, when the fertilizer rate was excessively increased beyond a certain threshold, the effect began to reverse. Specifically, the highest bud take rate was recorded in the experimental variant fertilized with N140P100K70, where bud take reached 85.5%. Increasing the fertilizer rate to N160P120K80 led to a decrease in bud take to 84.4%. This effect was even more evident in the experimental variant with the highest fertilizer application rate—N180P140K90—where the bud take rate did not exceed 83.8%.

Observation of the annual growth development of the varietal seedlings showed that their height varied depending on the rate of mineral fertilization. In comparison with the control (unfertilized) experimental variant, the strongest growth was observed in the plants fertilized with N140P100K70. By the end of the season—during seedling excavation—the average height of the seedlings in this variant reached 178.3 cm, which was 31.2 cm taller than that of the control variant seedlings. At that time, the average seedling height in the control variant did not exceed 147.1 cm.

The data in Table 2 also shows that the same trend observed in bud take rates was recorded for seedling height. That is, as the rate of mineral fertilization increased, the height of the grafted seedlings also increased linearly. However, when the fertilizer rate was excessively increased beyond a certain point, the seedling height began to decline. For instance, seedling height increased up to a fertilization rate of N140P100K70 (178.3 cm), but further increasing the rate to N160P120K80 resulted in a slight decrease in height, not exceeding 175.7 cm. In the experimental variant with the highest fertilizer rate (N180P140K90), the seedling height further decreased to 171.8 cm.

Table 2.

The effect of mineral fertilizer norms on the output rate of seedlings of the Golden Delicious

apple variety grafted onto the MIX rootstock

Experimental option	Seedling height, cm	Total viable seedlings	From that amount:					
			I grade		II grade		Non-standard	
			%	pcs	%	pcs	%	pcs
No fertilizer – control.	147,1	43156	65,6	28310,3	12,4	5351,3	22	9494,3
N90P60K45	155,6	53422	80,6	43058,1	9,3	4968,2	10,1	5395,6
N120P80K60	167,2	57879	85,2	49312,9	6,5	3762,1	8,3	4804,0
N140P100K70	178,3	59773	87,1	52062,3	5,7	3407,1	7,2	4303,7
N160P120K80	175,7	58844	86,7	51017,7	6,0	3530,6	7,3	4295,6
N180P140K90	171,8	58400	82,2	48004,8	7,8	4555,2	10	5840,0

According to the data presented in the table, the yield of standard (Grade I) seedlings during the autumn digging and sorting process varied significantly between experimental treatments, depending on the rate of mineral fertilization applied. The highest yield of standard seedlings, compared to the control (where no fertilizer was applied), was observed in the variant fertilized with N140P100K70. At the end of the growing season—during the seedling excavation—the number of Grade I seedlings obtained from grafted plants in this variant reached 85.5% (59,773 seedlings), which was 20.3% higher than that of the control group. This translates to 16,617 more seedlings compared to the unfertilized variant.

Reducing the fertilizer rate below or increasing it beyond this optimal level did not lead to improved results. As previously mentioned, this phenomenon is consistent with the findings of Yu.V. Trunov et al. [8], who stated that both deficiency and excess of mineral nutrients negatively affect the quality and yield of seedlings in nurseries.

Conclusion

Under the agro-climatic conditions of the Samarkand region, for the purpose of growing planting material for intensive apple orchards, the application of mineral fertilizers at the rate of N140P100K70 in the nursery is recommended. When this rate was applied in both the first and second nursery fields, the proportion of Grade I seedlings obtained from grafted plants reached 85.5% (59,773 seedlings), which is 20.3% higher than the control variant. This equates to 16,617 more seedlings in comparison with the unfertilized control..

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