

## DETERMINATION OF THE TIMING AND QUANTITY OF RATIONAL AND EFFECTIVE USE OF MINERAL FERTILIZERS FOR APPLE TREES

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**Annotation.** The article provides information that the intensive development of fruit and vegetable farming and increasing their yield is carried out by supplying them with mineral fertilizers in the necessary quantities and setting their validity period. For the rational and effective use of mineral fertilizers for fruit trees, it is necessary to predict their biological characteristics and the level of use of nutrients, as well as the timing and amount of fertilization. Fertilization of the soil of the Botanical Garden promotes good growth of fruit trees, rapid maturation of woody individuals and the growth of fruiting shrubs, as well as an acceleration of the fruiting period. In the Botanical Garden of the Khoja Akhmet Yassawi International Kazakh-Turkish University, the timing of the application of mineral fertilizers (N, P, K) for the varieties Kirgizskiy Zimniy and Renet Simirenko has been determined and the optimal effect of fertilizers has been established when 50 per cent is given before budding, and 50 per cent after budding.

The research results allowed the determination of the optimal timing and dosage of mineral fertilizers for apple trees in the botanical garden, which contributes to improving fruit quality and increasing yield. This, in turn, opens up opportunities for selecting resistant and productive varieties.

To increase yield and improve fruit quality in apple trees growing at a medium level in the botanical garden, their growth rate and productivity were evaluated after applying mineral fertilizers.

Thus, for the first time, the timing and dosage of mineral fertilizers (N, P, K) for apple trees grown in the botanical garden of MKTU in the Turkestan region were determined. As a result of scientific experiments, the growth rate and productivity of apple trees were assessed following fertilizer application, which made it possible to increase yield and improve fruit quality.

**Keywords:** fruit growing, mineral fertilizers, agrotechnical measures nitrogen, phosphorus, potassium.

**Introduction.** Improving the living conditions of the population in the city of Turkestan, Turkestan region, requires enhancing the quality of fruit products. In addition to advancements in intensive technology, the judicious application of mineral fertilizers boosts soil fertility, resulting in increased yields and improved quality of fruit trees [1].

The campus of the International Kazakh-Turkish University named after H.A.Yasawi in Turkestan hosts one of Kazakhstan's largest botanical gardens. This botanical garden holds significant importance for the region [2].

The Botanical Garden at the university lacks research on the quantity and timing of mineral fertilizer application for apple trees, making it a critical issue. Our objective is to scientifically

establish the appropriate amount and timing of mineral fertilizer application for apple trees growing in the Gray soils of the Botanical Garden. This involves determining the optimal timing and quantity of fertilizer application, assessing their effects on apple tree growth and yield, all with the overarching aim of enhancing soil fertility to produce environmentally sustainable products.

The yield and quality of fruit trees planted in the country, as well as their ability to thrive in specific soil and climate conditions, hinge on the appropriateness of the agrotechnical practices employed. The proper application of agrotechnical measures directly impacts their growth, fruiting, lifespan, resilience against pests, diseases, and unfavorable environmental conditions. Soil fertility and the fertilizer system play crucial roles in promoting their healthy development and productivity. Accelerated fruiting is facilitated through the strategic use of mineral fertilizers [3-4].

At present, one of the most crucial aspects of agricultural agrotechnical systems is the precise fertilization of crops. The selection, quantities, and timing of fertilizer application may vary significantly, even for the same crop. This variability is greatly influenced by factors such as the presence of different varieties of the crop cultivated in diverse soil-climate conditions, as well as the characteristics of preceding crops planted in the same field [5].

For the efficient and effective utilization of fertilizers, it is essential to first anticipate the biological traits of the plant, including its nutrient element requirements and the yield it produces, along with the elemental composition of the harvested product. Fertilizing the garden soil contributes to the robust growth of fruit trees, hastens tree maturation, encourages fruit-bearing shrubs' growth, and accelerates the fruiting cycle. To ensure the steady growth and development of fruit-bearing plants, the soil must contain adequate levels of essential nutrients such as nitrogen, phosphorus, potassium, calcium, sulfur, magnesium, iron, as well as micronutrients like boron, zinc, and molybdenum [6-9].

The absence of nitrogen fertilization results in decreased or halted growth of shoots and roots, weakened flowering and fruiting, and premature leaf shedding. Conversely, an excess of nitrogen leads to excessive growth, poor flowering, prolonged fruit ripening, decreased fruit firmness, and reduced shelf life. Insufficient phosphorus results in the appearance of blue and pink spots on leaves, weakened shoot growth, root branching, and fruit shoot formation. Inadequate potassium leads to delayed shoot and branch thickening, leaf dehydration, fruit drop, and slowed ripening. A deficiency in calcium weakens stem strength, causes brittle shoot tips, wilting of peduncles, onset of Tar disease, and brittle fruit. Iron deficiency manifests as chlorosis. Fruit crops require four times more potassium and two to three times less phosphorus [10-12].

For the effective utilization of fertilizers, it's imperative to adapt to various conditions, including soil types, properties, crop varieties, growth and nutritional requirements, local climatic conditions, and agrotechnical practices. These factors constitute the foundation for efficient fertilizer application. As these conditions vary, the types, quantities, and timing of fertilizer application adjust accordingly.

Fertilizers are categorized based on the timing of application: basic fertilization (before sowing), fertilization during sowing, and post-sowing fertilization (top dressing). Each timing serves a distinct purpose in meeting the nutritional needs of the crops at different growth stages [13-15]. Fertilizing the garden soil promotes healthy growth of fruit trees, hastens the maturation of the trees, enhances the growth of fruit-bearing shrubs, and accelerates the fruiting period [16-17]. The gray soils of Turkestan exhibit low fertility, with relatively low levels of humus and nutrients. The humus layer on these soils typically ranges from 10 to 20 cm in thickness, with a humus content ranging from 0.8 to 2.0 percent.

Gray soils are abundant in potassium but deficient in nitrogen and phosphorus. The availability of digestible phosphorus in these soils is limited, primarily due to the formation of carbonate salts with phosphorus, rendering it water-insoluble and less accessible for plant uptake [18-19].

The deficiency of nitrogen compounds in the soil stems from the rapid combustion rather than slow decomposition of plant residues, especially in arid and hot conditions. Consequently, the nitrogenous organic matter in plant residues, which should undergo decomposition to release

nitrogen, burns quickly instead of decomposing gradually [20].

**Material and research methods.** For our research, we selected 10-12-year-old apple trees of the Kirgizskiy Zimniy and Renet Simirenko varieties, cultivated in the Botanical Garden of the University. The experiment was conducted in the Botanical Garden of the International Kazakh-Turkish University, situated in Turkestan, which experiences a climate characterized by rapid fluctuations. The study focuses on apple trees of the Kirgizskiy Zimniy and Renet Simirenko varieties, as well as control apple trees, all cultivated in the Botanical Garden at an average age of 10-12 years. The experimental site comprises barren gray soil. There are 30 trees in total for both the study and control groups, arranged in a grid of 2.5 x 2.5 meters. No fertilizers were applied to the control group.

**Results and Discussions.** In our research, we applied mineral fertilizers to the Kirgizskiy Zimniy and Renet Simirenko varieties, which were approximately 10-12 years old and grown in the Botanical Garden. The fertilizers were applied in varying amounts: 60, 120, 180, and 240 kg of ammonium nitrate for both varieties; 45, 60, 90, and 120 kg of double superphosphate; and 30, 45, 60, and 75 kg of potassium chloride for the Kirgizskiy Zimniy variety and 30, 60, and 75 kg for the Renet Simirenko variety. We attempted to apply 30, 45, and 60 kg of fertilizers for the Renet Simirenko variety. For the Renet Simirenko variety, 100% of the mineral fertilizers were applied in autumn, while for the Kirgizskiy Zimniy variety, the fertilizers were applied in spring (Table 1).

**Table 1 – Scheme of conducting an experiment**

№	Variety name	Control version	Practical version
1	Kirgizskiy Zimniy	not included	Ammonium nitrate 60/120/180/240
			Double superphosphate 45/60/90/120
			Potassium chloride 30/45/60/75
2	Renet Simirenko	not included	Ammonia saltpeter 60/120/180/240
			Double superphosphate 45/60/90/120
			Potassium chloride 30/30/45/60

During the experiment, we administered 50% of the mineral fertilizers to both the Kirgizskiy Zimniy and Renet Simirenko varieties before budding, and the remaining 50% during tuber planting. Each application of mineral fertilizer was accompanied by watering the apple trees. The irrigation period commenced in March and concluded in August (Table 2).

**Table 2 – Application of mineral fertilizers for apple trees dates**

№	Variety name	Control version	Practical version
1	Kirgizskiy Zimniy	not included	100% of mineral fertilizers were given before budding
			50% of the apple tree before budding
			50% apple tree tuber in time of packing
2	Renet Simirenko	not included	100% of mineral fertilizers were given in autumn
			50% of the apple tree before budding
			50% apple tree tuber in time of packing

In our experiment, we observed differences in the stem thickness of the experimental apple trees, including the Kirgizskiy Zimniy and Renet Simirenko varieties, compared to the control

group. The addition of ammonium nitrate nitrogen fertilizers (applied at rates of 60, 120, 180, and 240 kg/ha), as well as potassium from potassium chloride (applied at rates of 30, 45, 60, and 75 kg/ha), showed noticeable differences in stem thickness. However, no significant changes were noted when fertilizing and processing with phosphorus fertilizers (double superphosphate at rates of 45, 60, 90, and 120 mm) (Table 3). Notably, for the Renet Simirenko varieties, a difference of 6.6 mm was observed in this indicator compared to the control group.

**Table 3 – Kirgizskiy Zimniy of apple trees and Renet Simirenko productivity of varieties**

Indications	Years			Average indicator for 3 years
	2022	2023	2024	
Kirgizskiy Zimniy				
Number of apples, pieces	480	520	580	527
Weight of apples, G	170	190	188	183
Fruit length, CM	6,0	6,2	5,8	6,0
Fruit width, CM	5,2	6,0	5,4	5,5
Apple tree yield, kg / tree	84,4	100,6	86,6	90,5
Renet Simirenko				
Number of apples, pieces	520	560	610	563,3
Weight of apples, G	120	140	175	145
Fruit length, CM	5,0	4,9	5,0	5,0
Fruit width, CM	4,3	3,9	4,4	4,2
Apple tree yield, kg / tree	102,4	74,3	102,7	93,1

During the experiment, it was observed that to enhance nitrogen and nutrient uptake in young apple trees, administering mineral fertilizers both before and after budding yields optimal results. Additionally, it was noted that a combination of nitrogen fertilizers with potash fertilizers, specifically the application of N180P90K60, promotes stem thickening and vigorous growth of shoots and leaves in both the Kirgizskiy Zimniy and Renet Simirenko varieties (Table 4).

**Table 4 – Mineral fertilizers Kirgizskiy Zimniy and Renet Simirenko effect on the biological indicators of apple trees (mineral fertilizers are given before budding)**

Variety name	Experience options	Average length of annual shoots, CM	Average thickness of annual shoots, CM	The average number of leaves on annual shoots, PCs.	Average volume of one leaf, cm <sup>2</sup>
Kirgizskiy Zimniy	Control	20,5	3,8	20,1	20,3
	Option 1 N <sub>60</sub> P <sub>45</sub> K <sub>30</sub>	21,8	4,3	26,5	22,8
	Option 2 N <sub>120</sub> P <sub>60</sub> K <sub>45</sub>	22,1	5,3	32,8	22,3
	Option 3 N <sub>180</sub> P <sub>90</sub> K <sub>60</sub>	23,3	5,7	43,8	31,5
	Option 4 N <sub>240</sub> P <sub>120</sub> K <sub>75</sub>	21,2	5,5	42,4	30,1
Renet Simirenko	Control	21,7	4,1	26,1	30,6
	Option 1 N <sub>60</sub> P <sub>45</sub> K <sub>30</sub>	22,8	5,2	37,6	32,1
	Option 2 N <sub>120</sub> P <sub>60</sub> K <sub>45</sub>	23,1	6,1	42,8	32,3
	Option 3 N <sub>180</sub> P <sub>90</sub> K <sub>60</sub>	23,3	5,7	44,5	30,8
	Option 4 N <sub>240</sub> P <sub>120</sub> K <sub>75</sub>	23,2	5,6	42,4	31,1

According to Table 4, the study of the impact of mineral fertilizers on the biological indicators of Kirgizskiy Zimniy and Renet Simirenko apple trees revealed that the application of mineral fertilizers, specifically N180P90K60 before budding, resulted in significant growth and thickening of shoots, along with an increase in the number and volume of leaves.

**Table 5 – Mineral fertilizers Kirgizskiy Zimniy and Renet Simirenko effect on the biological indicators of the apple tree (50% before the apple tree shoots buds, 50% during the tuber packing time )**

Variety name	Experience options	Average length of annual shoots, CM	Average thickness of annual shoots, CM	The average number of leaves on annual shoots, PCs.	Average volume of one leaf, cm <sup>2</sup>
Kirgizskiy Zimniy	Control	21,8	2,9	19,7	21,3
	Option 1 N <sub>60</sub> P <sub>45</sub> K <sub>30</sub>	22,2	3,3	20,5	23,8
	Option 2 N <sub>120</sub> P <sub>60</sub> K <sub>45</sub>	23,7	4,2	22,8	22,3
	Option 3 N <sub>180</sub> P <sub>90</sub> K <sub>60</sub>	26,3	4,5	33,8	28,5
	Option 4 N <sub>240</sub> P <sub>120</sub> K <sub>75</sub>	24,2	4,5	34,4	27,1
Renet Simirenko	Control	22,9	4,7	25,1	29,7
	Option 1 N <sub>60</sub> P <sub>45</sub> K <sub>30</sub>	22,8	4,8	28,6	32,3
	Option 2 N <sub>120</sub> P <sub>60</sub> K <sub>45</sub>	23,1	5,1	31,8	33,7
	Option 3 N <sub>180</sub> P <sub>90</sub> K <sub>60</sub>	25,7	5,9	42,3	35,3
	Option 4 N <sub>240</sub> P <sub>120</sub> K <sub>75</sub>	24,2	5,4	40,2	34,9

According to Table 5, the impact of mineral fertilizers on the biological parameters of Kirgizskiy Zimniy and Renet Simirenko apple trees during the study, where 50% of mineral fertilizers were applied before budding and the remaining 50% (N180P90K60) during tuber planting, resulted in significant increases. Shoot length increased by 25.7 cm, thickness by 5.9 cm, while the number of leaves rose by 42.3, and the volume increased by 35.3 cm<sup>2</sup>. This observation suggests that when mineral fertilizers are applied in appropriate amounts and at optimal times for each crop, they have a favorable effect on shoot length, thickness, leaf number, and volume.

When mineral fertilizers were applied before budding, the biological indicators in the Kirgizskiy Zimniy apple tree varieties ranged from 67.8 to 94, while in the Renet Simirenko varieties, they ranged from 86.8 to 94. Additionally, the dynamics of carbon dioxide activity in the soil, where the research was conducted, indicated the release of carbon dioxide in the range of 20-40 mg per 100 grams of soil.

The yield and uptake of mineral elements by fruit trees are directly influenced by the nutrient content of the soil. Using mineral fertilizers judiciously enhances soil fertility and improves both the yield and quality of fruit trees. By understanding the timing and dosage of mineral fertilizers applied to them, it's possible to increase the yield of apple trees and enhance the quality of fruits, resulting in a positive effect.

**Conclusions.** In conclusion, the scientific research conducted for the first time determined the timing and acceptable dosage of mineral (N, P, K) fertilizers for apple trees cultivated in the Botanical Garden of the University in the Turkestan region. It was found that the optimal effect was achieved when 50 percent of the fertilizers, specifically N180P90K60, were applied to both the

Kirgizskiy Zimniy and Renet Simirenko varieties of apple trees before budding, with the remaining 50 percent applied after budding.

To enhance fruit quality and increase the yield of 10-12-year-old apple trees of moderate growth in the Botanical Garden, the impact of mineral fertilizers on their growth and yield intensity was evaluated.

The scientific experiments conducted will enable the selection of resilient and beneficial apple varieties by enhancing fruit quality and increasing yield. Furthermore, these experiments will aid in determining the optimal timing and dosage of mineral fertilizers for apple trees cultivated in the Botanical Garden of the University.

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## АЛМА АҒАШТАРЫНА МИНЕРАЛДЫҚ ТЫҢАЙТҚЫШТАРДЫ ҰТЫМДЫ ЖӘНЕ ТИІМДІ ПАЙДАЛАНУДЫҢ МЕРЗІМІ МЕН МӨЛШЕРІН АНЫҚТАУ

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**Аңдатпа.** Мақалада жеміс шауашылығының қарқынды дамуы және олардың өнімділігінің жоғарылауы - оларға минералдық тыңайтқыштарды қажетті мөлшерде беру арқылы және оның мерзімін белгілеу арқылы жүзеге асыратылатындығы туралы мәлімет берілген. Минералдық тыңайтқыштарды жеміс ағаштарына ұтымды және тиімді пайдалану үшін олардың биологиялық ерекшеліктерін және қоректік элементтерді пайдалану деңгейін, сонымен қатар, тыңайтқыштарды енгізу мерзімі мен мөлшерін болжау қажет. Ботаникалық бақтың жерін тыңайту - жеміс ағаштарының жақсы өсуіне, ағаш тұлғасының тез жетілуіне және жеміс беретін бұталардың өсуіне, сонымен қатар, жеміс беру кезеңінің тездетілуіне көмектеседі. Түркістан қаласындағы Қ.А.Ясауи атындағы ХҚТУ-нің Ботаникалық бағында өскен алма ағаштарының Киргизский Зимний және Ренет Симиренко сұрыптарына минералдық (N,P,K) тыңайтқыштарды енгізу мерзімі мен оларға қолайлы мөлшері анықталып, тыңайтқыштардың 50 пайызын бүршік атқанға дейін, ал 50 пайызын бүршік атқаннан кейін бергенде оңтайлы әсері анықталды.

Ғылыми тәжірибелердің нәтижесінде Ботаникалық бақта өскен алма ағаштарына берілетін минералды тыңайтқыштың мерзімі мен мөлшерін анықтай отырып, жемістердің сапасын жақсарту және өнімділігін көтеру арқылы төзімді және пайдалы сорттарды таңдауға мүмкіндік туады.

Ботаникалық бақта орташа деңгейде өскен алма ағаштарының өнімділігін көтеру және жемістердің сапасын жақсылау мақсатында минералды тыңайтқыштарды енгізу арқылы олардың өсу қарқындылығы мен өнімділігі бағаланды.

Алғаш рет Түркістан өңіріндегі ХҚТУ Ботаникалық бағында өскен алма ағаштарына минералдық (N,P,K) тыңайтқыштарын беру мерзімі мен мөлшері анықталды.

Ғылыми тәжірибелердің нәтижесінде Ботаникалық бақта орташа деңгейде өскен алма ағаштарының өнімділігін көтеру және жемістердің сапасын арттыру мақсатында минералды тыңайтқыштарды енгізу арқылы олардың өсу қарқындылығы мен өнімділігі бағаланды.

**Тірек сөздер:** жеміс шаруашылығы, минералдық тыңайтқыштар, агротехникалық шаралар, азот, фосфор, калий.

## ОПРЕДЕЛЕНИЕ СРОКОВ И КОЛИЧЕСТВА РАЦИОНАЛЬНОГО И ЭФФЕКТИВНОГО ИСПОЛЬЗОВАНИЯ МИНЕРАЛЬНЫХ УДОБРЕНИЙ ДЛЯ ЯБЛОНЕВЫХ ДЕРЕВЬЕВ

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**Аннотация.** В статье приводятся сведения о том, что интенсивное развитие плодовоовощного хозяйства и повышение их урожайности - осуществляется путем подачи им минеральных удобрений в необходимых количествах и установления срока их действия. Для рационального и эффективного использования минеральных удобрений для плодовых деревьев необходимо прогнозировать их биологические особенности и уровень использования питательных элементов, а также сроки и



количество внесения удобрений. Удобрение земли Ботанического сада-способствует хорошему росту плодовых деревьев, быстрому созреванию древесной особи и росту плодоносящих кустарников, а также ускорению периода плодоношения. В Ботаническом саду МКТУ имени Х.А.Ясави г.Туркестан определены сроки внесения минеральных удобрений (N, P, K) для сортов Киргизский Зимний и Ренет Симиренко и установлено оптимальное действие удобрений, когда 50 процентов дают до распускания почек, а 50 процентов - после распускания почек.

Результаты исследований позволили определить оптимальные сроки и нормы внесения минеральных удобрений для яблоневых деревьев в ботаническом саду, что способствует улучшению качества плодов и увеличению урожайности. Это, в свою очередь, открывает возможность для выбора устойчивых и продуктивных сортов.

Для повышения урожайности и улучшения качества плодов у яблоневых деревьев, растущих в ботаническом саду на среднем уровне развития, была проведена оценка их темпов роста и продуктивности при внесении минеральных удобрений.

Таким образом, впервые были определены сроки и нормы внесения минеральных удобрений (N, P, K) для яблоневых деревьев, выращенных в ботаническом саду МКТУ в Туркестанском регионе. В результате научных экспериментов проведена оценка темпов роста и продуктивности яблоневых деревьев при внесении удобрений, что позволило повысить урожайность и улучшить качество плодов.

**Ключевые слова:** плодоводство, минеральные удобрения, агротехнические мероприятия, азот, фосфор, калий.