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EVALUATING THE EFFECTS OF DIFFERENT NUTRIENT MANAGEMENT STRATEGIES ON APPLE (MALUS PUMILA) IN INTENSIVE ORCHARDS OF KAZAKHSTAN. RESULTS FROM A 4-YEAR STUDY

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Abstract. This article presents the findings of a four-year study in intensive apple orchards in southern Kazakhstan, evaluating different nutrient management strategies on apple trees (Malus pumila). The research aimed to assess the impact of nutrition plans on tree growth, productivity, and fruit quality, considering the region's unique soil and climate. The experiment, established in 2014, covered 1.5 hectares and consisted of Jeromini apple trees grafted onto M9 rootstock. Three treatment groups were established: a control group with no additional nutrition, a group with nutrition based on a generally accepted program, and a group with nutrition tailored to the apple tree's needs with fertigation. Phenological and biometric observations were conducted regularly from 2019 to 2022 to monitor tree performance. Soil and leaf samples were analyzed for nutrient content, and soil properties like pH and salinity were assessed. Statistical analysis was used to identify significant differences among the treatment groups. The research was conducted in intensive apple orchards located in the Turkestan region, known for its grey-brown soil. The climate in the study area was characterized as continental, with hot and dry summers and limited precipitation. Soil samples were analyzed for agrophysical and agrochemical properties, including nutrient levels and trace elements. The results showed that the control group had a decreasing trend in yield, while both the generally accepted program and the tailored nutrition program showed increasing trends in yield, with the latter showing a decrease in 2022. Over the four-year period, the fruits from the control group exhibited reduced commercial qualities. Our program demonstrated similar sweetness and superior shape and yield compared to the conventional method. However, the storage quality of apples in our program was lower. Nevertheless, considering its positive impact on soil fertility and cost-effectiveness, our program appears to be an optimal choice. The findings of this study provide valuable insights into the effects of different nutrient management strategies on the growth, health, and productivity of apple trees in a garden setting. This information can benefit orchard growers and researchers seeking to optimize nutrient management practices for apple trees. The study also highlights the importance of considering various factors, such as orchard characteristics and environmental conditions, when designing nutrient management strategies for apple orchards.

Key words: nutrient management strategies, apple orchards, Malus pumila, growth and productivity, fruit quality, Southern Kazakhstan, Customized nutrition plan.

INTRODUCTION:

Only 1 % of the world's agricultural land is perennial fruit crops [1]. that is, only 53,000 square kilometers are devoted to apple trees. The main suppliers of apples are such countries as 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), Germany (2 million tons) per year [2]. It is known that these countries are united by the intensification of apple production.

In Kazakhstan, the apple tree takes the leading place among industrial plantations. However, 57 % of the domestic market is provided by apple imports [3]. According to the balance of land as of November 1, 2020, 147.6 thousand hectares of perennial plantations. The basic areas of fruit crops are concentrated in 3 Southern provinces of the Republic: Turkestan Province – 48 %, Almaty Province – 35 %, and Zhambyl Province – 7 %. The main mass of fruit plantations belongs to peasant and private farms. In the general structure of fruit plantations in the Republic, the first place is occupied by apple trees [4].

Due to the favorable combination of soil and climatic conditions, Kazakhstan is the most important region for the development of fruit growing. The south and southeast of the Republic, where intensive orchards are concentrated, are divided into 4-5 natural-ecological zones, which differ by climatic conditions and different topography [5]. An obligatory element of the intensive orchard is a drip irrigation system, which allows accurate and correct irrigation of the orchard, along with the introduction of mineral nutrition (fertigation), necessary for proper development and fruiting [6].

However, such an effective and widely used method of drip irrigation is not studied in the soil and climatic conditions of southern Kazakhstan. Insufficient study of all kinds of consequences requires additional research. In this connection, the purpose of the research is to determine the optimal nutrition plans and compare the generally accepted diets with our calculations of doses for fertigation, taking into account the dynamics of mobile nutrients in the gray-brown soils of the foothill dry subtropics and the yield of apple trees in an intensive orchard.

MATERIALS AND METHODS

In 2014, a garden experiment was initiated with apple trees in Kazakhstan, and the garden has now reached the age of 8 years. The study period for the experiment was from 2019 to 2022, during which the effects of different nutrient management strategies on apple trees were evaluated. The apple variety used in the experiment was Jeromini, and the planting pattern was set at 3.5 meters by 0.8 meters. A sample of Apple (Malus domestica) Jeromini fruit by our nutrition plan (figure 1). The apple trees were grafted onto M9 [7] (dwarf) rootstock and covered a total area of 1.5 hectares by 0.5 hectares. Trimming and thinning were conducted using the crown method.

The climatic conditions during the study period were monitored annually using the Bulletin of States and Climate Change as a source of data from Kazhydromet RSE. Three treatment groups were established for the experiment: a control group with no additional nutrition, a group with nutrition according to a generally accepted program along with protection and irrigation (drip), and a group with nutrition based on calculations of the apple tree's needs, along with protection and irrigation (drip) [8].

In this article, we will present the details of the garden experiment and share the results obtained from the 4-year study. The findings of this research could provide valuable insights into the effects of different nutrient management strategies on the growth, health, and productivity of apple trees in a garden setting. The information generated from this study could be relevant for orchard growers and researchers interested in optimizing nutrient management practices for apple trees.

Figure 1 - A sample of Apple (Malus domestica) Jeromini fruit by our nutrition plan

Study Site: The research was conducted on intensive apple orchards located in Kentau LLP near Shakpak-baba village, Tulkubas district of the Turkestan region, which is known for its grey-brown soil typical of the region's south Kazakhstan. The total area of intensive apple orchards in Kentau LLP is 210 hectares. The site is located at coordinates 42050'34.3" N 70030'02.0" E, at an elevation of 975-1028 meters above sea level (MSL) [9]. General view of the Ken Tau plant from the Google Earth program (figure 2).

Figure 2 - General view of the Ken Tau plant from the Google Earth program

Climate: The prevailing climate in the study area is classified as continental, characterized by hot and dry summers. The sum of active temperatures (t) falls within the range of 3900 to 5100°C, with an annual heat accumulation index (FAO) ranging from 120 to 135 kcal/cm^2. Precipitation is limited, varying from 190 to 420 mm annually, with approximately 240 to 300 days experiencing air temperatures above 10°C and 270 to 330 days with soil temperatures above 5°C [10].

Soil Characteristics: The soil in the study area is characterized as grey-brown soil, which is typical of south Kazakhstan. The humus content in the 0-50 cm layer of the soil ranges from 1.11 % to 1.19 %.

The following fertilizers were used on the farm: Ammophos – N - 12 %, P_2O_5 - 52 %, Urea-N - 46 %, Ammonium nitrate – N - 34.4 %, Potassium sulfate - K_2O - 52, SO_4 - 45 %, Calcium nitrate - Ca-26 %, NO_3-15.5 %, MAP - N-12 %, P_2O_5-61 %, MKR - P_2O_5-52 %, K_2O-34 %, White Pearl - SiO_2-5.6 CaO-0.4; MgO-0.4; K_2O-0.2; Fe_2O_3-0.4, Co-0.2; Mo-0.2 %, Tecamine Max-amino acids - 14.4 %, free amino acids L-12.0 %, nitrogen - 7.0 %, organic matter - 60.0 %, Ferrelin Fe - 6 %, Orthophosphoric acid - 72 %, Stopit – Ca - 12 %, Plantafol 20 -20-20 + ME, Boroplus – B - 15 %, Master NPK-10-18-32 + ME, Brexil Zn-10 %, Brexil Mg-8 %, Master NPK-13-40-13+ME, Calbit C-CaO-21 % [11].

Agrophysical and agrochemical properties were determined in the soil samples, including bulk weight - volumetric weight method; soil density - by pycnometer; humus content by Tyurin; soil pH by pH meter; granulometric composition by Kachinsky; nitrate nitrogen ($N\text{-}NO_3$) - by Grandwal-Laju method with disulfophenolic acid; ammonia nitrogen ($N\text{-}NO_4$) - by Nessler reagent; mobile phosphorus by Machigin - colorimetrically; exchange potassium by flame photometer in the same extract as mobile phosphorus 1 % $(NN_4)_2CO_3$; trace elements in soil samples were determined by atomic absorption spectrometry [12].

Phenological and Biometric Observations: The following phenological and biometric observations were made during the study:

The number of flowers and fruits: The number of flowers and fruits on the apple trees was recorded to assess the reproductive performance of the trees.

Diameter of stems: The diameter of the apple tree stems was measured to determine the growth rate and development of the trees.

Productivity: The productivity of the apple trees, measured as the yield per tree or hectare, was recorded to evaluate the overall fruit production of the orchard.

The average weight of fruits: The average weight of the fruits harvested from the apple trees was measured to assess the fruit quality and size [13].

Total nitrogen, phosphorus, potassium, and calcium in leaves and fruits: Leaf and fruit samples were collected and analyzed for their nutrient content, including nitrogen, phosphorus, potassium, and calcium, to assess the nutrient status of the apple trees.

Soil analysis: Soil samples were collected and analyzed for various parameters, including ammonium and nitrate nitrogen, mobile phosphorus, exchangeable potassium, mobile and exchangeable calcium, as well as other trace elements such as boron, zinc, magnesium, iron, sodium, sulfur, and molybdenum. Soil pH, the number of exchangeable bases, soil moisture, and humus content were also measured to assess soil fertility and conditions [12].

Fruit quality analysis: The amount of vitamin C, acids, mono- and disaccharides, and dry matter in the fruits were analyzed to assess the fruit quality.

Fruit hardness: The hardness of the fruits, which is an important parameter for fruit storage and handling, was measured using appropriate methods [14]

These observations were made conventional methods periodically throughout the study period to capture the changes in the phenological and biometric parameters, nutrient content, soil characteristics, and fruit quality in response to the different nutrient management strategies employed in the experiment. Statistical analysis was performed on the collected data to determine significant differences among the treatment groups and draw conclusions based on the findings [15].

Table 1 - 4-year dynamics of changes in the characteristics of irrigated soil under different nutrition plans

	Indicators	2019			2020		
		1	2	3	1	2	2
	pH. water	7.8	7.7	7.4	8	7.8	7.4
	EC (Electrical Conductivity). mS/cm	0.06	0.05	0.06	0.07	0.05	0.06
	Organic matter (Humus). %	1.79	2.11	1.54	1.18	1.11	1.19
	Available phosphorus. mg/kg	25.2	15.6	20.8	22.4	25.6	28.4
	Exchangeable potassium. mg/kg	208	275	162	179	275	308
	Ammonium nitrogen. mg/kg	6.5	5	5.5	5.5	5	6.5
	Nitrate nitrogen. mg/kg	6.9	7.4	10.4	18.1	20.4	26.9
	Calcium. mg/kg	1900	2000	1950	2000	2000	1900
	Magnesium. mg/kg	140	230	185	132	230	140
	Sulfur. mg/kg	14.1	9.2	19.2	6.3	9.1	8.1
	Manganese. mg/kg	54.1	28.5	46.8	60.2	28.5	54.1
	Iron. mg/kg	3.5	2.8	3.8	5	2.8	3.5
	Copper. mg/kg	0.27	0.12	0.21	0.5	0.12	0.27
	Zinc. mg/kg	2.4	2.3	2.2	2.4	1.7	2
	Molybdenum. mg/kg	0.19	0.21	0.32	0.53	0.21	0.19
	Sodium. mg/kg	15	15	16	15	15	19

	Indicators	2019			2020		
		1	2	3	1	2	2
	pH. water	7.8	7.7	7.4	8	7.8	7.4
	EC (Electrical Conductivity). mS/cm	0.06	0.05	0.06	0.07	0.05	0.06
	Organic matter (Humus). %	1.79	2.11	1.54	1.18	1.11	1.19
	Available phosphorus. mg/kg	25.2	15.6	20.8	22.4	25.6	28.4
	Exchangeable potassium. mg/kg	208	275	162	179	275	308
	Ammonium nitrogen. mg/kg	6.5	5	5.5	5.5	5	6.5
	Nitrate nitrogen. mg/kg	6.9	7.4	10.4	18.1	20.4	26.9
	Calcium. mg/kg	1900	2000	1950	2000	2000	1900
	Magnesium. mg/kg	140	230	185	132	230	140
	Sulfur. mg/kg	14.1	9.2	19.2	6.3	9.1	8.1
	Manganese. mg/kg	54.1	28.5	46.8	60.2	28.5	54.1
	Iron. mg/kg	3.5	2.8	3.8	5	2.8	3.5
	Copper. mg/kg	0.27	0.12	0.21	0.5	0.12	0.27
	Zinc. mg/kg	2.4	2.3	2.2	2.4	1.7	2
	Molybdenum. mg/kg	0.19	0.21	0.32	0.53	0.21	0.19
	Sodium. mg/kg	15	15	16	15	15	19

RESULTS AND DISCUSSIONS:

To assess the changes in the dynamics of mobile nutrient components, the initial data can be referenced using the following baseline condition table for a duration of 4 years (table 1) [16].

pH water: Control (sample 1) remains stable around 7.8-7.7, a slight decrease to 7.7 in 2022. Generally Accepted Program (sample 2) shows an increasing trend from 7.7 in 2019 to 8.0 in 2022. Our Program (sample 3) fluctuates between 7.4-7.6, with the lowest value of 7.2 in 2022.

Salinity (EU): Control (sample 1) increases from 0.06 mS/cm in 2019 to 0.08 mS/cm in 2021, a slight decrease to 0.06 mS/cm in 2022. Generally Accepted Program (sample 2) remains stable around 0.05-0.08 mS/cm, with the highest value of 0.08 mS/cm in 2022. Our Program (sample 3) remains stable around 0.06-0.07 mS/cm, with the highest value of 0.07 mS/cm in 2021.

Humus Content: Control (sample 1) decreases from 1.79 % in 2019 to 1.11 % in 2022. Generally Accepted Program (sample 2) fluctuates, a slight decrease from 2.11 % in 2019 to 1.15 % in 2022. Our Program (sample 3) increases from 1.54 % in 2019 to 2.44 % in 2022.

Mobile Phosphorus: Control (sample 1) decreases from 25.2 mg/kg in 2019 to 5.2 mg/kg in 2022. Generally Accepted Program (sample 2) fluctuates, with the highest value of 28.4 mg/kg in 2020, and the lowest value of 20.8 mg/kg in 2021. Our Program (sample 3) shows a decreasing trend from 20.8 mg/kg in 2019 to 30.8 mg/kg in 2022.

Exchangeable Potassium: Control (sample 1) decreases from 208 mg/kg in 2019 to 155 mg/kg in 2022. Generally Accepted Program (sample 2) fluctuates, with the highest value of 325 mg/kg in 2022, and the lowest value of 177 mg/kg in 2021. Our Program (sample 3) fluctuates, with a slight increase from 162 mg/kg in 2019 to 322 mg/kg in 2022.

Ammonium Nitrogen: Levels generally decrease over four years in all three programs for all three samples (sample 1, sample 2, sample 3).

Nitrate nitrogen: Varied changes in all three programs. The control program showed mixed trends. Generally accepted programs showed a decrease. Our program showed mixed trends.

Calcium: Relatively stable with a slight decrease for sample 1 in 2022. Potentially positive impact on sample 3 in Our program.

Magnesium: Fluctuations with highest levels in 2022 for sample 1 in Our program, sample 2 in the generally accepted program, and sample 3 in Our program. Potentially positive impact on all three samples in Our program.

Sulfur: Slight fluctuations. Potentially positive impact on sample 3 in Our program.

Manganese: Fluctuations with highest levels in 2020 for all samples in Our program. Potentially positive impact on all three samples in Our program.

Iron: Fluctuations with highest levels in 2020 for all samples in Our program. Potentially positive impact on all three samples in Our program.

Copper: Fluctuations with mixed impacts depending on program and sample, with increases and decreases observed in different years.

Zinc: Sample 1 showed a decrease under the Control program, but a slight improvement under Our program. Sample 2 had a decrease followed by stabilization. Sample 3 showed an overall increase under Our program.

Molybdenum: Sample 1 had an initial increase but then decreased under Our program. Sample 2 showed stabilization or potential decrease. Sample 3 showed an overall increase under Our program.

Sodium: Fluctuations were observed, with Our program for Sample 3 initially showing an increase and subsequent stability at a higher level.

First, it is important to note that the control group had a decreasing trend in yield from 2019 to 2022, with a total decrease of approximately 10 %. On the other hand, both the common program and program 1 had an increasing trend in yield

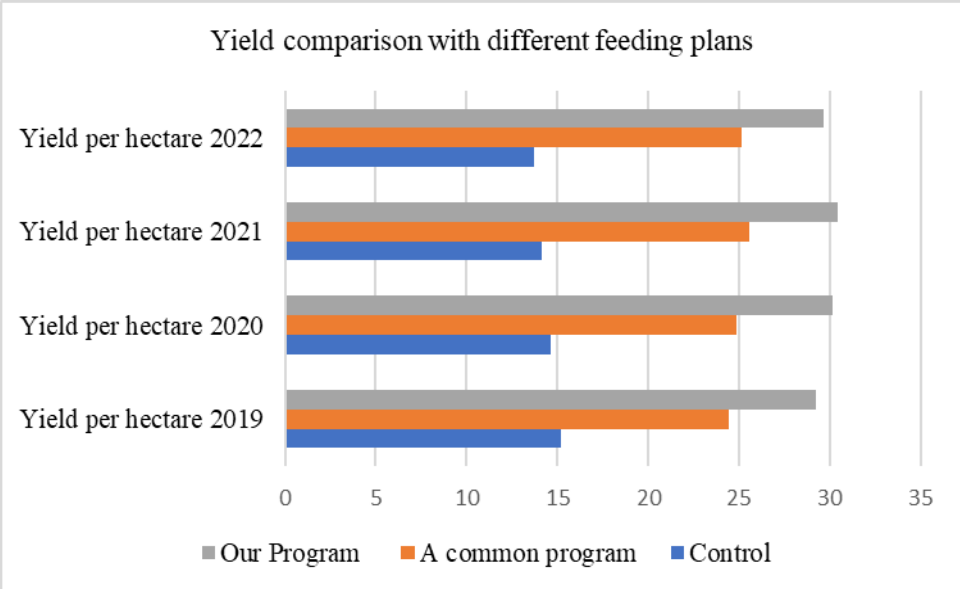

Figure 3 - Yield comparison with different feeding plans

From table 2, it can also be concluded that over four years without fertilizers, the yield, sweetness, size, and storage quality of the fruits decreases. The commercial qualities reduce the revenue from the control apples. Our program has demonstrated equal effectiveness in terms of sweetness and superiority in shape and yield compared to the conventional method. However, our method's storage quality of apples was lower than that of the conventional nutrient regime. However, considering other advantages, including the positive impact on soil fertility and the relative cost-effectiveness of fertilizers, our program appears to be optimal [17].

Table 2 - Comparison of apple tree fruit characteristics after a four-year period

Nutrition Plan	Apple firmness	Sugar	Average diameter	Number of fruits per tree
Control	14.5	18.4	3.2*4.4*3.7	60-75
Common program	16.5	20+	4.1*5.3*4.5	75-85
Our program	15.3	20+	4.7*5.3*5.0	70-95

During the correlation analysis of the results presented in tables 1 and 2, noticeable stable changes in pH were observed for the conventional nutrition plan. Our program, which considers growth vigor, age of the orchard, applied pruning, current year's yield, level of weed competition, climatic conditions, soil type, and structure, has shown a consistent increase in organic matter.

CONCLUSION:

In conclusion, the findings of this study highlight the effectiveness of the nutrient management method both economically and ecologically, considering various factors such as expected yield, growth vigor, orchard age, management practices, pruning methods, current year's harvest, weed competition, climatic conditions, soil type, and structure.

The results demonstrate that the nutrient management program offers several advantages. Economically, it reduces the cost of fertilizers by an average of 7 % compared to conventional methods due to its flexibility. Moreover, it leads to a higher yield, surpassing the traditional average by 19.5 %. Ecologically, the program promotes an acid-alkaline balance that tends to shift towards optimal conditions, resulting in improved phosphorus uptake.

However, the decrease in storage quality compared to the conventional nutrient regime indicates the presence of imperfections in the nutrient management regimen. This emphasizes the need for a further in-depth investigation into the impact of various nutrient management strategies on apple trees (Malus pumila) in intensive orchards of Southern Kazakhstan.

Overall, this study provides valuable insights into the economic and ecological benefits of the nutrient management method, while also highlighting the areas that require further refinement. The findings serve as a foundation for future research endeavors to optimize nutrient management practices and enhance the overall sustainability and productivity of apple orchards in the region.

REFERENCES

1 Carranca C., Brunetto G., Tagliavini M. Nitrogen nutrition of fruit trees to reconcile productivity and environmental concerns// Plants. – 2018. – Т. 7. – № 1. – С. 4.

2 Zhumagulova M. K. et al. Fruit quality and yield of apple fruit with application of fertizers and bioproduct from Ili Alatau hills, Kazakhstan // News of the National Academy of Sciences of the Republic of Kazakhstan – 2018. - №.45. – С. 10-16.

3 Maulenova S. et al. Prospects for development and features of apple production in Kazakhstan // Student Forum Founders: Limited Liability Company "International Center for Science and Education". – 2022. – С. 12-16.

4 Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [Electronic resource]. Access mode: https://www.gov.kz/memleket/entities/stat/?lang=en (2020), svobodnyj.

5 Ahmadi H., Ghalhari G. F., Baaghideh M. Impacts of climate change on apple tree cultivation areas in Iran// Climatic Change. – 2019. – Т. 153. – С. 91-103.

6 Ahad S. et al. Nutrient Management in High Density Apple Orchards–A Review// Current Journal of Applied Science and Technology. – 2018. – Т. 29. – №. 1. – С. 1-16.

7 Sagi, S., Svetlana, D., Moldir, Z., Aigul, M., Zhanna, I., & Balnur, K. (2022). Physiological and phyto-pathological assessment scion-rootstock combinations for apple cv. Aport and M. sieversii// Research on Crops, № 23. - P. 795-800

8 Jensen M. E., Robb D. C. N., Franzoy C. E. Scheduling irrigations using climate-crop -soil data //Journal of the Irrigation and Drainage Division. – 1970. – Т. 96. – №. 1. – С. 25-38.

9 Nachtergaele F. et al. The harmonized world soil database// Proceedings of the 19th World Congress of Soil Science, Soil Solutions for a Changing World, Brisbane, Australia, 1-6 August 2010. – 2010. – С. 34-37.

10 Navarro-Racines C. et al. High-resolution and bias-corrected CMIP5 projections for climate change impact assessments// Scientific data. – 2020. – Т. 7, – №. 1. – С. 7.

11 Maliuk T., Pcholkina N., Kozlova L., & Yeremenko O. Nitrogen in soil profile and fruits in the intensive apple cultivation technology. In Modern Development Paths of Agricultural Production. - 2019. - P. 737-751.

12 Aleksandrova L.N, Naydenova O.A. Laboratory and practical studies in soil science// L.: Agropromizdat – 1986. – P. 295

13 dos Santos Assis M. et al. Phenology and fruit biometrics in different positions of reproductive branches of Campomanesia adamantium (Cambess.) O. Berg: Fenologia e biometria de frutos de Campomanesia adamantium //Revista de Ciências Agrárias. – 2020. – Т. 43. – № 1. – С. 39-51.

14 Pissard A. et al. Evaluation of a handheld ultra-compact NIR spectrometer for rapid and non-destructive determination of apple fruit quality //Postharvest Biology and Technology. – 2021. – Т. 172. – С. 111375.

15 Khasanov O. S., Enileev N. S., Namozov I. C. Influence of root growth force on morphological indicators of development of above-ground part of spur-growing varieties of apple //ACADEMICIA: An International Multidisciplinary Research Journal. – 2021. – Т. 11. – №. 5. – С. 1214-1220.

16 Gentile R. M. et al. System nutrient dynamics in orchards: a research roadmap for nutrient management in apple and kiwifruit. A review //Agronomy for Sustainable Development. – 2022. – Т. 42. – № 4. – P. 64.

17 dos Santos M. A. et al. Phenology and fruit biometrics in different positions of reproductive branches of Campomanesia adamantium (Cambess.) O. Berg //Revista de Ciências Agrárias. – 2020. – Т. 43. – № 1. – P. 39-51.

18 Licina V. et al. Nutrition and fertilizer application to apple trees-a review// NIBIO Rapport. – 2021. - P. 5.

ТҮЙІН

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ҚАЗАҚСТАННЫҢ ҚАРҚЫНДЫ БАҚТАРЫНДА АЛМА АҒАШЫН (MALUS PUMILA) ҚОРЕКТЕНДІРУДІҢ ТҮРЛІ СТРАТЕГИЯЛАРДЫҢ ӘСЕРІН БАҒАЛАУ. 4-ЖЫЛДЫҚ ЗЕРТТЕУ НӘТИЖЕЛЕРІ

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Бұл мақалада алма (Malus pumila) ағаштарындағы қоректік заттарды басқарудың әртүрлі стратегиялары бағаланған Қазақстанның оңтүстігіндегі қарқынды алма бақтарының төрт жылдық зерттеу нәтижелері берілген. Зерттеу аймақтың ерекше топырағы мен климатын ескере отырып, қоректендіру жоспарының ағаш өсуіне, өнімділігі мен жеміс сапасына әсерін бағалауға бағытталған. Тәжірибе ретінде 2014 жылы бақшаға отырғызылған 5 жылдық ағаштар 1,5 га аумақты алды және М9 егілген Джеромини алма ағаштарынан тұрды. Үш топ құрылды: қосымша қоректендірусіз бақылау тобы, жалпы қабылданған бағдарлама бойынша қоректендірілетін топ және фертигациясы бар алма ағашының қажеттілігін ескере отырып қоректендіретін топ. Ағаштардың өнімділігін бақылау үшін 2019-2022 жылдар аралығында фенологиялық және биометриялық бақылаулар жүйелі түрде жүргізілді. Топырақ пен жапырақ үлгілерінің құрамындағы қоректік заттарға талдау жасалды, сондай-ақ топырақтың pH пен тұздылығы анықталды. Емдеу топтары арасындағы елеулі айырмашылықтарды анықтау үшін статистикалық талдау қолданылды. Зерттеу жұмыстары сұр-қоңыр топырағы бар Түркістан облысында орналасқан қарқынды алма бақтарында жүргізілді. Зерттелетін аймақтың климаты континенттік, жазы ыстық

және құрғақ, жауын-шашын мөлшері шектеулі болды. Топырақ үлгілері қоректік заттар мен микроэлементтерге, агрофизикалық және агрохимиялық құрылымына сәйкес талданды. Нәтижелер бақылау тобында өнімділіктің төмендеу тенденциясын көрсетті, ал жалпы қабылданған бағдарлама мен жеке қоректендіру бағдарламасы бойынша өнімділіктің жоғарылау үрдісін көрсетті, соңғысы 2022 жылы төмендегенін көрсетті. Төрт жыл ішінде бақылау тобындағы өнімдердің тауар сапасының төмендеуін көрсетті. Біздің бағдарлама жалпы қабылданған әдіске қарағанда пішіні келіскен, дәмі тәттірек өнімді ұсынды. Дегенмен, біздің бағдарламадағы алманың сақталу мерзімі төмен. Ұсынылып отырған бағдарлама топырақ құнарлылығы мен экономикалық тиімділікке оң әсер ететінін ескерсек, оңтайлы таңдау болып табылады. Бұл зерттеудің нәтижелері қоректік заттарды басқарудың әртүрлі стратегия-ларының бақтағы алма ағаштарының өсуіне, денсаулығы мен өнімділігіне әсері туралы құнды түсінік береді. Бұл ақпарат алма ағаштары үшін қоректік заттарды басқаруды оңтайландыруға ұмтылатын бағбандар мен зерттеушілер үшін пайдалы болуы мүмкін. Зерттеу сонымен қатар алма бақтарында қоректік заттарды басқару стратегияларын әзірлеу кезінде бақ сипаттамалары мен қоршаған орта жағдайлары сияқты әртүрлі фак-торларды ескерудің маңыздылығын көрсетеді.

Түйінді сөздер: қоректік заттарды басқару стратегиялары, алма бақтары, Malus pumila, өсу және өнімділік, жеміс сапасы, Оңтүстік Қазақстан, қоректендіру жоспары.

РЕЗЮМЕ

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ОЦЕНКА ВЛИЯНИЯ РАЗЛИЧНЫХ СТРАТЕГИЙ УПРАВЛЕНИЯ ЭЛЕМЕНТАМИ ПИТАНИЯ ЯБЛОНИ (MALUS PUMILA) В ИНТЕНСИВНЫХ САДАХ КАЗАХСТАНА. РЕЗУЛЬТАТЫ 4-ЛЕТНЕГО ИССЛЕДОВАНИЯ

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В данной статье представлены результаты четырехлетнего исследования интенсивных яблоневых садов на юге Казахстана, в котором оценивались различные стратегии управления элементами питательными на яблонях (Malus pumila). Исследование было направлено на оценку влияния планов питания на рост деревьев, продуктивность и качество плодов с учетом уникальных почв и климата региона. Эксперимент, заложенный в саду 2014 году с 5-летнего возраста, занимал площадь 1,5 га и состоял из яблонь Джеромини, привитых на подвой М9. Были созданы три группы: контрольная без дополнительного питания, группа с питанием по общепринятой программе и группа с питанием с учетом потребностей яблони с фертигацией. Фенологические и биометрические наблюдения проводились регулярно с 2019 по 2022 год для мониторинга продуктивности деревьев. Образцы почвы и листьев были проанализированы на содержание питательных веществ, а также были оценены такие свойства почвы, как pH и соленость. Статистический анализ был использован для выявления существенных различий между группами лечения. Исследования проводились в интенсивных яблоневых садах, расположенных в Туркестанской области, известной своей серо-бурой почвой. Климат в районе исследования характеризовался как континентальный, с жарким и сухим летом и ограниченным количеством осадков. Образцы почвы были проанализированы на агрофизические и агрохимические свойства, включая содержание питательных веществ и микроэлементов. Результаты показали, что в контрольной группе наблюдалась тенденция к снижению урожайности, в то время как как по общепринятой программе, так и по программе индивидуального питания наблюдалась тенденция к повышению урожайности, причем последняя показала снижение в 2022 г. За четырехлетний период плоды из контрольной группы показали снижение товарных качеств. Наша программа продемонстрировала аналогичную сладость, превосходную форму и выход продукта по сравнению с традиционным методом. Однако сохранность яблок в нашей программе была ниже. Тем не менее, учитывая положительное влияние на плодородие почвы и экономическую эффективность, наша программа представляется оптимальным выбором. Результаты этого исследования дают ценную информацию о влиянии различных стратегий управления питательными веществами на рост, здоровье и продуктивность яблонь в саду. Эта информация может быть полезна садоводам и исследователям, стремящимся оптимизировать методы управления питательными веществами для яблонь. В исследовании также подчеркивается важность учета различных факторов, таких как характеристики сада и условия окружающей среды, при разработке стратегий управления питательными веществами в яблоневых садах.

Ключевые слова: стратегии управления элементами питания, яблоневые сады, Malus pumila, рост и продуктивность, качество плодов, Южный Казахстан, индивидуальный план питания.

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