

ABSTRACT

of the PhD thesis by Moldir Zhumagulova on the topic “Influence of mineral fertilizers and biological product MƏPC on productivity of apple (variety Aport) in the conditions of dark chestnut soil Ili Alatau” submitted for degree of Doctor of Philosophy (PhD) in the field of specialization 6D080800 – “Soil science and agrochemistry”

Relevance of the research topic

The main task of the country's agriculture is to provide the population with food products, including fruit production in sufficient quantity and good quality. In this regard, the development and introduction of effective agrotechnical measures that would ensure successful cultivation of young orchards, obtaining high and stable yields is of topical importance in intensive fruit growing in our country.

Apple tree is the most widespread fruit crop, which grows in many countries. It accounts for about 50% of all fruit trees in the world. In our country, apple tree is the leading crop among fruit plantations. Thanks to the variety diversity, apple trees have great variability and adaptability to various soil and climatic conditions. Availability of varieties of different ripening dates with long shelf life and high transportability of fruits allows supplying the population with fresh apples all year round.

On 19 January 2024, President Kassym-Jomart Tokayev visited the headquarters of the UN Food and Agriculture Organisation (FAO) in Rome during an official visit to Italy. During the meeting, the head of state emphasised the importance of ensuring global food security and promoting sustainable development of the agro-industrial complex. Treating the head of FAO Director General Qu Dongyu Tokayev K. emphasised that "Kazakhstan is widely known as the birthplace of apples. We intend to jointly bring this variety to the world markets. I count on your personal support in promoting this initiative". Today there are many varieties of apples growing in different climatic conditions. According to the time of ripening, summer, autumn and winter varieties are distinguished, with later varieties having good firmness. Apples are the "Pantry of Health". Natural conditions of the growing season in the south and south-east of Kazakhstan allow to grow a crop of apples of good quality, both for consumption in fresh form and for processing. According to the Ministry of Agriculture, in 1970 there were 3.8 million aporta trees in Kazakhstan, and in 1984 there were only 1.4 million left. By 2000, the KazNII of Fruit Growing and Viticulture had created a collection of 115 forms and clones of the variety. In 2012, scientific research on the revival and rejuvenation of the variety began, including the establishment of an experimental aporta orchard on Sivers apple trees, where the first large fruits weighing 400-500 grams were obtained in 2023.

Achievement of high production and economic indicators is possible only on the basis of intensification of fruit growing industry, where the main decisive factor is optimisation of plant nutrition by observing all agrotechnical methods.

Balanced nutrition with basic nutrition elements (nitrogen, phosphorus, potassium, calcium, magnesium), which further affects the condition of plants, resistance to stressful environmental conditions and insufficient supply of fruit-trees with moisture leads to disruption of water and food regimes of plants, which causes reciprocal, interrelated and profound changes in the processes of transpiration, photosynthesis, enzymatic and energy transformations of carbohydrate, phosphorus and nitrogen metabolism. As a result, these changes often affect the passage of plant development phases, formation of yield and fruit quality, lead to the emergence of periodicity of fruiting, decrease in winter hardiness of trees.

Consequently, optimisation of mineral nutrition under different irrigation regimes in horticulture continues to be a serious problem in obtaining high yields. The issues of application of mineral fertilisers and biopreparations in a port orchard are studied insufficiently, which reveals the relevance of research on the application of fertilisers on productivity of Aport apple trees under different irrigation regimes in Ili Alatau conditions.

Purpose of research: to study the effect of mineral fertilisers and biopreparation MЭPC on fruiting of apple trees of Aport variety under different drip irrigation regimes in conditions of dark chestnut soils of the foothill zone of Iliyskiy Alatau.

To achieve this goal the following research objectives were set:

1. To study the dynamics of agrochemical properties of dark chestnut soil depending on the conditions of mineral nutrition under different drip irrigation regimes of young orchard.

2. To give a comparative assessment of irrigation technology at drip irrigation of apple trees of Aport variety.

3. To determine the effect of mineral fertilisers and biopreparation MЭPC on the growth and development of young apple trees depending on the drip irrigation regime.

4. Determine the productivity of young apple trees depending on mineral fertilisers and biopreparation MЭPC on different drip irrigation regimes

5. To give economic efficiency of application of mineral fertilisers and biopreparation " MЭPC " at cultivation of apple trees of Aport variety.

Description of the main results of the research

The research was conducted in apple orchard of Aport variety to study the effect of mineral fertilisers and biopreparation MЭPC on marketable fruiting. The young Aport orchard was planted in spring 2009 on seed stock with the insertion of Arm-18 dwarf rootstock planted in 2008.

A self-pressure drip irrigation system was installed in the experimental plot. Drip lines are made of irrigation tubes of 17 mm in diameter, in which drip lines with a flow rate of 1.6 litres per hour and a distance between drip lines of 0.75 m are integrated. There are 4 drippers per tree.

Fruit-bearing apple trees need fertilisers to enrich the soil with nutrients, improve soil physical properties, water and air regimes, and carbon dioxide supply to the plants. Fertilisers were applied annually in two terms (1/2 dose in spring and 1/2 dose in summer during the period of active shoot growth) by fertigation method

(mixing and application of soluble fertilisers with irrigation water) under drip irrigation. The foliar treatment of trees with complex fertiliser "Rosasol" and biopreparation " MЭPC " was carried out 2 times during the vegetation period: in spring after bud opening and in summer during the period of active shoot growth.

The data of soil analyses showed that the most favourable nutrition regime was formed on the variants with $N_{110}P_{110}K_{120}$ and $N_{55}P_{55}K_{60} + MЭPC$ application, where the content of mobile easily hydrolysable nitrogen, phosphorus and exchangeable potassium maintained the average and high degree of provision.

The best results of biometric measurements and biochemical composition of apple fruits of Aport variety were obtained at application of $N_{110}P_{110}K_{120}$ through the drip irrigation system and at foliar spraying of trees with MЭPC preparation on the background of $N_{55}P_{55}K_{60}$ regardless of the drip irrigation regime.

On daily irrigations the best average yield for 4 years was obtained at application of $N_{110}P_{110}K_{120}$ kg a. i./ha (21.37 kg/ha), when on the control variant - 10.67 kg / ha, and at application of $N_{55}P_{55}K_{60}$ kg a.i./ha + foliar treatment with MЭPC preparation on periodic irrigations - 21.88 kg / ha, when the control - 9.93 kg / ha.

The norms of daily irrigations ranged from 30-48 litres per young orchard tree. Irrigations were not carried out when precipitation was more than 5 mm. On average per 1 ha, the highest total irrigation rate for one decade was 320, the lowest - 240 m³/ha. The interval in the variant with periodic irrigation varied from 8 to 10 days. A total of 7 irrigations with the rate of 180÷280 m³/ha were carried out in this variant during the growing season.

Irrigation rates were the lowest in the variants with periodic irrigation and the highest due to increased evaporation losses at daily irrigation. In general, irrigation rates under daily irrigations were 12-15% higher than in the variants with periodic irrigations.

Scientific novelty. For the first time scientific substantiation of the regulation of application of mineral fertilisers, biopreparation MЭPC and irrigation technique on the state of dark chestnut soil and development of young orchard of apple-tree variety Aport was given.

Theoretical and practical significance. The obtained research results had a significant impact on the development of agrochemical science and fruit growing, which allowed to obtain new knowledge on the peculiarities of mineral nutrition of apple-tree variety Aport under different irrigation techniques in the drip irrigation system to achieve maximum productivity of apple-tree (up to 22 c/ha). Recommendations on optimisation of mineral nutrition in conditions of Aport orchard are given.

The main provisions put forward for defence:

1. Dynamics of agrochemical properties of dark chestnut soil depending on mineral nutrition conditions under different drip irrigation regimes.
2. Comparative evaluation of irrigation technology under drip irrigation of apple-tree of Aport variety.
3. Effect of mineral fertilisers and biopreparation MЭPC on growth and development of young apple trees depending on drip irrigation regime.

4. Formation of productivity of young apple trees depending on mineral fertilisers and biopreparation MЭPC on different drip irrigation regimes.

5. The economic efficiency of fertiliser and MЭPC biopreparation application in apple-tree cultivation is given.

Degree of reliability and approbation of research results.

The main research was carried out in accordance with the thematic plans of research and development, the results of which are annually reported and presented at the meetings of the Academic Council of the Kazakh Research Institute of Fruit and Vegetable Growing, in the materials of the international scientific-practical conference "Modern european science-2018" (UK). Reliability and validity of the research results are provided by the clarity of methodological positions applied in the experimental work, corresponding to the object, subject, goals and objectives of the thesis.

The results of this dissertation can be useful for agricultural commodity producers and farmers engaged in apple growing in the Ili Alatau region, and can also serve as a basis for the development of recommendations for the optimisation of fertilisation and care of apple orchards in this region, which contributes to the sustainable development of agriculture and food security.

Relation to other research works. The work was carried out within the framework of BP 255 of the Ministry of Agriculture of RK NTP "Creation of varieties of fruit, berry crops and grapes with increased stress resistance, high quality indicators using the world agrobiodiversity and biotechnology for high-yielding intensive plantations", under the activity "Study of molecular-genetic, physiological features and resistance to major bacterial and fungal diseases of varietal-podstock combinations of M. Sieversii in plantation plantations with selected forms of Aporta. Sieversii in plantation stands with selected Aporta forms, including those obtained in vitro and improvement of cultivation technology" (Programme code O.0724). Project Registration Number 0115RK02205) 2015-2017.

Publication of the results of the thesis. The main results of the thesis have been published in 8 scientific articles in journals and conference proceedings, including 1 article in the journal included in the Scopus database; 4 scientific articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan; 3 publications in the proceedings of international scientific conferences. The author directly participated in the development of 2 recommendations.

Author's personal contribution. The author personally formulated the aim and objectives of the research, conducted field studies and laboratory analyses on the influence of fertiliser application methods on the parameters of apple trees vital activity and soil properties, as well as the influence of fertilisers on the peculiarities of fruit storage, processed the obtained data and their interpretation, performed statistical processing of the results.

Structure of the thesis. The total volume of the thesis is 126 pages. The list of used literature includes 188 names, the thesis contains 15 figures, 10 tables and appendices.