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WATER-SAVING INNOVATIVE TECHNOLOGY IN THE CREATION OF A CONSUMER APPLE ORCHARD

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Abstract. *The article summarizes information about the creation of experimental consumer and decorative gardens using water-saving innovative technologies (hydrogel, drip irrigation) in arid conditions of South-Eastern and Eastern Kazakhstan (on an area of 1 ha in each zone). For the first time in Kazakhstan, different concentrations of moisture-dampening polymer hydrogels and drip irrigation are being tested when creating a garden of 2 apple varieties. Experimental consumer apple orchards have been established in the arid environment of Kazakhstan with use of two innovative technologies. When studying the influence of water-saving technologies on the growth process of experimental plants, it was found that for the growth of plants in the first year of life, drip irrigation is the most optimal compared to furrow irrigation. When using a hydrogel dose, the data obtained are aligned, but the best indicators are mainly established when using a hydrogel of 2 kg/m^3.*

Keywords: *water-saving technology, experimental production garden, water conservation innovative technology, hydrogel, drip irrigation, furrow irrigation, apple tree.*

INTRODUCTION

At the present stage of agricultural production development, the most effective way to restore and improve the agroecosystem's environment is to prevent further deepening of the ecological crisis by creating industrial apple orchards. Climate warming on our planet creates conditions for expanding cultivation of a range of promising crops from more temperate climatic zones. However, the lack of water is a serious obstacle to this. According to the National Atlas of Kazakhstan, the average temperature in the country over the past 50 years has risen from 0.5°C to 1.0 degrees, in some geographical areas up to 1.5°C. In the next 30 years, warming is expected by another 1.5-2 degrees (National Atlas of Kazakhstan). Thus, the trend of increasing arid territories has a stable and long-term character. The territory of Kazakhstan has a special geographical position.

The geographical position of Kazakhstan is associated with differences in the degree of climate continentality, moisture, changes in temperature during the annual cycle, features of the soil cover, which create conditions for formation of various climatic regions (Belgibaev M. E., Bely A. V). In the Republic, more than a third of the cultivated area falls on arid territories of the steppe and semi-desert regions, the soil and climatic conditions of which are constantly experiencing a lack of moisture and high daily temperatures.

There are a number of technologies designed to conserve and more efficiently use water resources for growing crops. In the last decade, water-absorbing polymers (hydrogels) capable of retaining and releasing water that exceeds their mass by hundreds of times have begun to be used in world practice as an absorbent of soil moisture. These properties of hydrogels contribute not only to the accumulation of natural and additional moisture in the root layer, but also reduce physical evaporation and improve soil structure (Larin P. L.). Being in a gel-like state, they provide an optimal water regime, plant nutrition. The mass distribution of this water-saving technology is hampered by the poor knowledge of how to use it in arid natural and climatic conditions (Danilova T. N., Kozyrev L.V.).

Therefore, the development of consumer gardening in arid conditions in the south-east of the Republic with the use of water-saving innovative technologies is an urgent strategic task that will contribute to the development and stabilization of the agro-industrial complex for the cultivation of highly fortified fruit crops, apple trees.

One of the determining climatic and biological factors of plant development is their water supply, especially under conditions with a lack of this ecosystem resource (Larin P. L.). Water is necessary for the passage of photosynthesis processes, serve as a transport for the absorption of nutrients by the roots, maintaining morphophysiological processes in the cell for active metabolism.

In connection with the foregoing, we have identified the purpose of the study - the development of consumer gardening in the regions of South-East Kazakhstan with the help of water-saving innovative technologies.

In achieving this goal, the task was solved to create an experimental consumer garden using water-saving technologies (hydrogel, drip irrigation) in the conditions of South-East Kazakhstan.

EXPOSITION

Materials and methods

In solving the problems and goals of this problem, empirical research methods (observations, comparisons, measurements and experiments) were used, which made it possible to give a comparative assessment of experimental apple plants' adaptive capabilities when using various water-saving technologies (Molchanov A., Smirnov V.; Viktorov D. P.). Setting up and conducting agro-technical experiments was carried out by the method of test plots according to B. A. Dospekhov (Dospekhov B. A.). Experimental plants on three experimental fields identified 8 trees for 2 varieties of apple trees. Species were selected in the conditions of South-Eastern Kazakhstan based on the results of numerous observations of experimental apple trees. Experimental plots with an area of 1 hectare were created with experiments in five variants on the use of two innovative agricultural technologies - hydrogel, drip irrigation in comparison with furrow irrigation.

Research results and condemnation of results

In arid conditions, the study created experimental consumer gardens using two innovative technologies. - The first technology was carried out using hydrophilic polymers (hydrogel). The hydrogel was introduced into the soil with doses of the drug in the root zone of tree crops - 125, 188, 250 g when planting the life form (Figure 1).

Fig. 1. Mounted equipment for drip irrigation of experimental field

- The second technology was carried out under drip irrigation and it was created as a drip irrigation system. The nozzles of the irrigation system are located in the near-stem zone. The main irrigation system consists of a pipe with a diameter of 40 mm, to which droppers are connected to regulate the water pressure through the nozzles. The control was the most common method of surface irrigation - watering plants along the furrows. The second technology was carried out with drip irrigation – 0.25 ha. droppers that allow you to regulate the pressure of water through nozzles.

The control was the most common method of surface irrigation, watering plants along furrows, with a total area of 0.25 ha each.

In technology with drip irrigation (0.25 ha), a drip irrigation system has been created. The nozzles of the irrigation system are located in the near-stem zone along the line of rows of plantings. The line consists of a pipe with a diameter of 40 mm, to which they are connected. On another plot of 0.25 ha, in the variant where irrigation was carried out in furrows (control), the furrows are placed along mutually parallel lines and dug with a slight slope to move the water flow. Longitudinal, stagnant grooves are deepened by at least 10 cm and are placed near planted crops

The remaining area of 0.5 ha was given to the experiment with the water-absorbing polymer “AQUASORB”. Research is carried out to determine the optimal concentration of the hydrogel, which favorably affects the growth and development of plants (Fig. 2).

Figure 2. Experimental plot using hydrogel in the experiment

Planting of experimental plants was done in the spring. Planting hole for trees was 50×50×50 cm. The seedlings were planted in the planting holes with the root system exposed and covered with soil. For the site with hydrogel, a soil composition was prepared with the addition of a dry polymer. After preparing the mixture, the required amount of water was added to maximize the saturation of the hydrogel. Its quantity was added according to the scheme of experiments before filling seedlings with it (Table 1).

Table 1. The rate of water consumption when planting trees and shrubs

Norm of applying hydrogel, g	Water-absorption ability, 1g/mm	Water consumption for 1 plant, l	Quantity of plants in variant, pcs	Total water consumption, l	Total water spent m^3
Water consumption for trees					
125	200	25,0	61	1525	1,5
188	200	37,6	61	2293	2,3
250	200	50,0	61	3050	3,0

A small amount of earth is left uncultivated, which is subsequently covered with a layer of 5 cm on the soil surface over the hole to protect the polymer from destruction by ultraviolet rays and stagnant water. The experimental plants were planted in the spring into the planting pits with an open root system and covered with soil or prepared mixture (Fig. 3).

Fig. 3. Planting of experimental plants using dry polymer

On experimental plantings using innovative water-saving technologies during the growing season, the crops received some agrotechnical work such as planting, weeding, loosening the soil, watering plants, etc. (Terpigorev A. A; FGNU RosNIIPM). The frequency of irrigation and the amount of water used depend on the general condition of plants, the degree of dryness, the mechanical composition of soil and weather conditions. After each irrigation, the soil was loosened. In autumn, mouse bait was laid out to preserve fruit crops. In spring and autumn, tree trunks were mulched (Fig. 4).

Fig. 4. Experimental gardens with use of drip irrigation under water-saving innovative technologies

The results obtained reflect the visual passage of the rhythms of seasonal development, providing factual material for studying the plants' biological characteristics to soil and climatic conditions and the influence impact of new technologies in this case, water-saving technologies that change soil’s water-physical properties.

The adaptive potential of plants is accompanied by a change at all levels of organization of the experimental plant development environment under the influence of environmental factors, which allows plants to ensure sustainable growth.

The main abiotic factor determining the seasonal development of experimental plants is the nature of the annual cycle’s thermal conditions. The first year of planting in the extreme conditions of the arid zone had a negative impact on the phenological parameters of the experimental plants. First, the inevitable damage to the physiologically active parts of the plant root systems led to a general weakening of the plants after transplantation. Secondly, the direct impact of environmental ie. abiotic environmental factors. Therefore, the timing and duration of seasonal cycles, which are at the initial stages of survival, in the year of planting affected the new growing conditions. A similar phenological development of plants in the experimental fields allows us to make a generalized description of the vegetative development of tree species.

The initial stages of vegetative development correlate with the sum of effective spring temperatures associated with the change in seasonal structural and metabolic rhythms of the experimental plants' development. Under conditions of sharp diurnal changes in spring temperatures and solar radiation, the threshold indicator transitions from dormancy to the beginning of active vegetation were noted in experimental plants in the third decade of April - *Picea obovata Ledeb., Malus domestica cv. "Saltanat", Crataegus oxyacantha L.., Tilia L., Berberis L.*

The remaining species of woody plants were planted in the phase of swelling and bud deployment. The transition from bud break to leaf formation and the beginning of growth was observed from 7 to 15 days.

Full leafing of the plant occurred by the beginning of the second decade of May. In calendar terms, the date of the active phase of plant development fell from the third decade of April to the first or second decade of October with a growing season of about 154-184 days. A relatively short period of growth and maturation of shoots within 25-36 days against the background of increasing temperatures in the summer period was characterized by species of the genus *Crataegus L.* and *TiliaL.* Within 60-75 (90) days until the second half of July and the first half of August grew *Picea Dietr., Maluscv.AcerL.* Vegetated until autumn *BetulaL., ThujaL.* and coppice shoots of *Padus Mill., Ribescv., Berberis L.*

The dynamics of seasonal growth shows the greatest energy after the start of growth processes. Already by mid-June, the total annual increase in the main part of the species amounted to 30-45 (79) %. With the onset of high summer temperatures, the development and growth processes of tree species slowed down. The leaves began to turn in the first half of October. The planted species are characterized by a weak coloring of foliage and the end of annual growth lignification for *ThujaL., Ribescv., Padusracemosa (Lam.) Gilib., Betulapendula Roth.* (50-75 %), which indicates insufficient completion of morphophysiological processes in plants.

In general, studies on the effect of water-saving technologies on experimental plants' growth process made it possible to conclude that for plant growth in the first year of life, drip irrigation is the most optimal compared to furrow irrigation. When using a dose of hydrogel, the obtained data are aligned, but mostly the best indicators were found when using a hydrogel of 2 kg/m^3.

CONCLUSION

The results obtained reflect the visual passage of seasonal development rhythms, providing factual material for studying the plants' biological characteristics depending on soil and climatic conditions and the influence impact of water-saving methods under the new technologies. The adaptive potential of plants is accompanied by a change at all levels of organizing the experimental plant environment under the influence of ecology factors, which allows plants to ensure sustainable growth.

Data on creation of experimental consumer and ornamental gardens by using innovative water-saving technologies (hydrogel, drip irrigation) in arid conditions of South-East and East Kazakhstan (on an area of 1 ha in each zone) is summarized. For the first time in Kazakhstan, different concentrations of moisture-swellable polymer hydrogels and drip irrigation are being tested when creating a garden of 16 species, 10 genera of ornamental trees, shrubs and fruit species. In the arid conditions of Kazakhstan, experimental consumer and ornamental gardens have been created using two innovative technologies.

When studying the influence of water-saving technologies on the growth process of experimental plants, it was revealed that for plant growth in the first year of life, drip irrigation is the most optimal compared to furrow irrigation. When using a dose of hydrogel, the obtained data are aligned, but mostly the best results are established when using a hydrogel of 2 kg/m^3.

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