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PREREQUISITES ABOUT THE EFFECTIVE USE OF IRRIVATED LAND IN AGRICULTURE OF AZERBAIJAN

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ABSTRACT

Optimally moistened soil has the best looseness, lower hardness and resistivity, it is less sprayed during processing and by the wind. However, these properties can be preserved during long-term irrigation only by observing a number of conditions: using a set of agrotechnical practices in crop rotation, appropriate irrigation methods and techniques, and strictly standardized supply of irrigation water. A distorted irrigation regime negatively affects the physical properties of the soil: density increases, porosity and water permeability decrease, structure deteriorates, and irrigation erosion develops.

KEYWORDS:

optimal, irrigation rate, activation, regulation, irrigation regime, water consumption, soil layer, depth, loosening, crop, air, phosphorus, nitrogen, potassium, etc.

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INTRODUCTION

The Republic of Azerbaijan is located in the South Caucasus. The total area of the republic is 8641.5 thousand hectares, of which mountainous and foothill areas account for about 60%. Of the 8641.5 thousand hectares of area, 4514.5 thousand hectares are agricultural land. Of the total area of farmland, irrigated lands account for 1335.2 thousand hectares. These lands provide 85% of the country's total crop production.Due to the complexity of physical and geographical conditions and anthropogenic impact, 43.1% of lands are susceptible to erosion processes to one degree or another. As is known, in terms of climatic conditions, Azerbaijan differs from other regions in that 9 out of 11 climatic zones existing in nature occur in our republic. This circumstance requires a special approach to solving problems of agricultural production. The situation is further complicated by the fact that precipitation on the territory of the republic is uneven, and in a number of regions it is insufficient to meet the needs of agricultural crops during their growing season, i.e. there is a water shortage. In the republic, water-intensive crops are traditionally grown, and water consumption per 1 hectare of irrigated land lags due to water shortages, as a result of which, instead of 4-5 waterings, plants receive 2 waterings.

During irrigation, water and mineral nutrition, including the provision of carbon dioxide and air, can be purposefully regulated by changing the methods, rates and number of irrigations, applying mineral and organic fertilizers, soil cultivation, etc. It is more difficult to influence the supply of light and heat to the plant, but, to a certain extent, it is possible to increase or decrease the temperature of the ground layer of air and the upper layers of the soil.

The purpose of the study: is to study the experience of optimal water supply as an active means of influencing the microclimate of the field: soil and surface air temperature, relative air humidity, wind strength and radiation balance.

Object of study: methods and modes of irrigation.

Optimal water supply allows plants to form a large leaf surface, and due to high water content and turgescence of leaves, it is better to orient them towards the light. Together, this makes it possible to increase the efficiency of using insolation.

Research methods

Irrigation has a great influence on soil processes and microclimate. The transition from rain-fed to irrigated agriculture has a major impact on the soil.

Irrigation water helps improve soil fertility. It dissolves nutrients, makes them more mobile and digestible for plants. The closer the soil moisture reserves are to the optimum, the stronger the positive effect of irrigation on the soil, the higher its effective fertility. And only excessive soil moisture by irrigation can cause negative phenomena over time: rising groundwater, salinization and waterlogging of the soil, and a drop in its fertility. Therefore, the soil water regime should be properly observed. When these changes have no effect negatively affects the growth and development of plants, the water regime is considered positive, and with intensive plant development - optimal. If fluctuations in soil moisture inhibit normal plant growth, the soil water regime is unfavorable. It is often observed under rain-fed crops in areas with insufficient precipitation, where the moisture reserves of the active soil layer at any phase of development can drop to the wilting moisture content, and the amplitude of their fluctuations reaches a maximum. When irrigated, the water regime of the active soil layer takes on a different character. Due to regular watering, it is maintained throughout the entire growing season, and with moisture replenishment during the growing season at a high level, close to optimal, for the growth and development of plants.

Discussion of the research results:

It is believed that the soil air regime is of great importance for the normal growth and development of plants. Air occupies all water-free pores in the soil. In addition, a small amount of it is adsorbed on the surface of soil particles and dissolved in soil water. The higher the soil moisture, the less air it contains. After watering, almost all soil pores are filled with water. At humidity corresponding to NV, only about 20% of soil pores are occupied by air. Its composition is heterogeneous and very different from the atmospheric one. Soil air is always more saturated with water vapor up to 90-100%. The oxygen content in it decreases, and carbon dioxide increases with the decomposition of organic compounds and the activation of the nitrification process.

The oxygen content also decreases due to its greater consumption by plant roots due to their increased growth, as well as due to intensive microbiological activity in the soil.

Carbon dioxide in soil air with weak aeration under a closed crop cover and in compacted soil often contains 1.5-2%, while in atmospheric air it is 0.03%. The optimal concentration of carbon dioxide is less than 1%. Under the influence of gas exchange between soil and atmospheric air, the concentration of oxygen in soil air increases, and carbon dioxide decreases. The intensity of gas exchange changes under the influence of daily fluctuations in temperature, atmospheric pressure, under the influence of rain, wind, diffusion of irrigation water and other reasons.

A prerequisite for regulating the air regime is the correct regulation of irrigation, the prevention of waterlogging of the soil, the formation and long-term standing of puddles. Deep loosening, slotting, and hilling actively improves soil aeration. Not wetted from the surface, between furrows and under subsoil humidifiers, they easily allow atmospheric air to pass to the roots of plants.

Aeration is enhanced by periodic loosening after watering and precipitation. It should also be noted that the thermal and nutrient regime of the soil is necessary for the life of plants. Moist soil promotes the flow of heat from the lower non-freezing horizons; when moisture freezes, latent heat of phase transition is released, as a result of which the soil temperature in winter does not drop as low as without winter watering and rises more slowly in the spring. Thanks to this, fruit trees bloom later and avoid spring frosts. In addition, irrigation greatly changes the nutritional conditions of plants. Nitrates, moving into the zone of activity of the active root system, improve plant nutrition. However, watering with excessively high rates washes nitrates beyond this zone, and then the nitrogen nutrition of plants deteriorates.

Numerous studies have revealed that in an orchard an accumulation of nitrate nitrogen in a layer of 80-100 cm was established up to 30-40 mg per 1 kg of soil as a result of systematic moistening to a depth of 100-120 cm, while in the upper horizons its content was not exceeds 10-15 mg.

Soluble compounds of phosphorus and potassium are less mobile, but they can also be washed to depth, which contributes to the cultivation of the underlying layers.

Long-term experiments show that the potassium content in the soil solution changes more noticeably depending on humidity. The potassium concentration in soddy-podzolic soil at a moisture content of 16.5% was 5.2, and at 25.2 – 1.5 mg/l.

Irrigation also changes the conditions for the supply of microelements to plants, especially when it impairs aeration, the resulting ferrous compounds are poorly absorbed by plants, and the supply of boron, copper and other microelements is hampered. Irrigation water itself often contains significant amounts of nutrients and enriches the soil with them.

Based on the above, we find criteria for the impact of irrigation on the physical state of the arable layer.

It should be taken into account that under the influence of irrigation, the mechanical composition of the soil profile often changes - silt fractions from the arable layer move to the lower horizons.

As a result, at a depth of 30-80 cm in heavy soils and at a depth of 1.5-3 m in light soils, a compacted layer is formed, which impedes root growth and the penetration of air and water. On heavy soils it usually formsI'm at the depth of plowing. The mechanical composition of the soil is often improved due to silt particles brought by irrigation water.

The water-air and nutrient regime of the soil is significantly influenced by its structure. Crop rotation and proper agricultural technology, even with prolonged use of irrigation, make it possible to maintain the structure of the soil. At the same time, the regular supply of irrigation water reduces the concentration of the soil solution, thereby promoting the dissolution of minerals.

Depending on irrigation rates and the filtration capacity of the soil, these salts accumulate at a certain depth or are carried out by groundwater outside the irrigated field.

Moreover, irrigation also changes the qualitative composition of soluble salts and the reaction of the soil solution. Thanks to its hydrolyzing effect, water breaks down salts of strong acids and weak bases in the soil.

It is known that irrigation creates more favorable conditions for soil microorganisms. The optimal humidity for them and plants is approximately the same.

Consequently, the activity of microorganisms that provide plants with nitrogen nutrition is favored by maintaining humidity at a level of at least 50-60% for light sandy soils and 70-80% NV for heavy clay soils.

Optimal soil moisture enhances the activity of nodule bacteria. When there is a lack of soil moisture, few of them settle on the roots of leguminous plants, and often they not only do not absorb gaseous nitrogen, but also feed on nitrogen at the expense of the plants.

To increase the fertility and productivity of plants, it is necessary to take into account the microclimate. Irrigation is the most active means of influencing the field microclimate: soil and surface air temperature, relative air humidity, wind strength and radiation balance.

Changes in soil temperature under the influence of irrigation are closely related to changes in its heat capacity and thermal conductivity, as well as with the evaporation of soil moisture. In addition, most of the heat flowing to the surface of dry soil is spent on its direction, and on moist soil it is spent on evaporation.

The temperature difference between rain-fed and irrigated soil increases especially sharply in the sun in its upper layers during the daytime. Thus, in the Shirvan steppe, the average daily temperature of the soil surface during flowering - fruit formation in a cotton field was 16-17°C lower than in the control, non-irrigated area with natural vegetation, and with irrigation at 70% NV it was 3-5°C lower, than with irrigation at 65% NV.

The research results revealed that reducing soil temperature fluctuations under the influence of irrigation is of great agrotechnical importance. In summer, a decrease in soil temperature enhances the growth of roots and tubers, and an increase in soil temperature in the fall improves the growth and development of winter wheat.

The microclimate of the irrigated field is characterized by more moderate temperatures and increased humidity of the ground layer of air.

For example, when sowing irrigated spring wheat after heading in the ground half-meter layer of air, the temperature was on average 1.2-1.6°C lower, the relative humidity was 6-12% higher, and the wind speed was three times lower than without irrigation. The relative humidity in a cotton field in the Shirvan steppe after the first growing season irrigation increased by 13-15% compared to the control, and the flowering–fruit formation period increased by 20%.

The air temperature in an unirrigated area reaches its maximum in close proximity to the soil, indicating that heat is being radiated by the overheated ground. In irrigated areas, the same layer of air (0-10 cm) has the lowest temperature. Daily changes in air temperature over an irrigated field are much smaller than without irrigation.

The intensity of plant transpiration and the productivity of photosynthesis largely depend on meteorological factors.

For example, the saturation of air with moisture and soil moisture determine the rate of transpiration, prevent overheating of the leaf surface, and increase the intensity of photosynthesis.

Even under conditions of the same moisture supply to plants at an air humidity of 32%, more powerful plant development during watering acts as a secondary factor that positively affects the microclimate.

Irrigation affects the radiation balance of the field. In the cotton plot in the flowering - fruiting phase, it was: with irrigation at 70% IR - 71-85%, with 65% IR - 63-77%, and in the non-irrigated area with natural vegetation - 56-64% of total solar radiation.

Water is the most accessible means in the fight against frost. Moistened soil and ground layers of air cool more slowly, and condensing water vapor forms fog and dew, which reduce heat loss due to radiation. A simple and effective way to protect plants from spring and autumn frosts is sprinkling directly during the period of temperature drops that are dangerous for plants. It is used on berries, fruits, vegetables and other crops.

As long as the plants are surrounded by a film of water, their temperature does not drop below zero. It is very important to sprinkle continuously, since even a short-term cessation of ice formation leads to a sharp decrease in the temperature of the icy areas.Thus, irrigation has a positive effect on both the water supply of plants and their surrounding habitat.

The amount of water contained in plants depends on their type, age and physiological activity. Water plays an essential role in maintaining the shape and structure of herbaceous plants, maintaining their cells in a turgorous state.

Turgor pressure provides not only the mechanical strength of plant tissues, but also the regulation of transpiration and gas exchange through stomata. Turgor pressure determines the growth process, promoting the elongation of young cells.

Water is not only a medium, but also a participant in all enzymatic processes of the cell, primarily photosynthesis, during which 0.2-0.3% of its total consumption is spent on the formation of carbohydrates.

The state of water is one of the factors regulating the course of physiological processes, and this must be taken into account when developing the biological foundations of irrigated agriculture.

The calculated values correspond to the actual water flow by zone, obtained by A.M. Alpatiev.

Using established patterns, it is possible to determine the amount of absorbed solar energy, build a graph of the necessary plant moisture and leaf surface growth.

The most important feature of plant transpiration under irrigation is its stability, while in non-irrigated fields transpiration varies greatly not only over the growing season, but also during the day.

The above parameters serve to regulate the water regime of the soil. Water consumption for evaporation from the soil surface and for transpiration of plants is called total evaporation (water consumption) and is expressed in m3/ha or mm of layer. The total evaporation per unit of main product is called the water consumption coefficient (Kw).

E = VHF (1).

Where E is the total evaporation by one sector of the field;

Y – harvest.

Evapotranspiration serves as the initial value in calculations of the irrigation regime - an irrigation system in which the types, norms, timing and number of irrigations are determined for each crop and its cultivation area.

There are several methods for determining total water consumption. The calculation of the water balance method of the active soil layer is widely used. Typically, methods and calculations of water consumption are carried out according to the formula of A.N. Kostyakova

$$E = WH – WK + 10A\square + M \quad (2).$$

Where WH and WK are the moisture reserve at the beginning and end of the growing season, m3/ha;

A is the amount of productive precipitation, mm. Precipitation less than 5 mm is unproductive and is not taken into account;

□ - precipitation utilization factor equal to 0.6-0.7;

10 – multiplier for converting mm to m3/ha;

M – irrigation norm, m3/ha.

When groundwater is close to the groundwater, water consumption occurs at their expense. Then the formula is supplemented with the term lgr and takes the form

E = WH – WK + 10A□ + M + lgr(3).

Water consumption from groundwater depends on the depth, degree of mineralization, mechanical composition of soils, biological characteristics of crops and other conditions.

Theoretically, the most justified energy method for determining total evaporation, or the heat balance method, which is expressed by the formula

R = lE + B + P (4).

Where R is the amount of heat supplied to the active surface, J/(cm2 □ h);

l – specific heat of evaporation (251.21 J/cm3);

B – heat exchange between the active surface and underlying layers J/(cm2 □ h);

P – heat consumption for turbulent exchange, J/(cm2 □ h).

Hence the total evaporation in mm/h:

$$E = \frac{R - P - B}{251{,}21} \quad (5).$$

Thus, by measuring the values of l, P and B, it is possible to determine evapotranspiration with great accuracy.

Aliev B.G. and Nosenko V.F. established that when maintaining soil moisture at a level not lower than 65% NV, there is a functional connection between the gross water consumption of the field and the deficit of air humidity, taking into account the biological characteristics of the crop and the phases of its development. They proposed a formula for calculating evapotranspiration and called it the bioclimatic method

E = K□d (6).

Where K is the bioclimatic coefficient, mm/mb;

□d – sum of average daily air humidity deficits, mb.

The bioclimatic coefficient shows the amount of evaporated water in mm per mb of air humidity deficit. It has different indicators both for different crops and for one in separate phases of its growing season. According to S.M. Alpatiev, the lowest values vary within the range (0.2-0.3). These values are determined at the beginning and end of the plant growing season. The highest value - K = 0.5 - is during the period when the leaf surface reaches its greatest size. In this case, it is necessary to know irrigation and watering norms.

The irrigation rate can be determined as the difference between total water consumption and natural moisture using the following formula

M = E – (WH –WK) – 10A□ - lgr (7).

It is obvious from the formula that the greater the natural moisture resources, the smaller the share of irrigation norm in the total water consumption of plants. It follows that the irrigation rate changes under the influence of many factors, a more complete account of which increases its efficiency. To determine the criterion for the irrigation regime, it is necessary to know the role of the significance of the irrigation norm. Irrigation rate - the amount of water consumed during one irrigation per 1 hectare is determined by the difference in moisture reserves at NI and before irrigation:

$$m = WHB - W0 \ (8).$$

Where m is the irrigation rate, m3/ha;

WHB – W0 – moisture reserve at low water level and before irrigation, m3/ha.

$$WHB - W0 = 100hz(□HB - □0) \ (9).$$

Where h is the depth of the active soil layer, m;

z – volumetric mass in the same layer, g/cm3;

□HB – moisture content of the calculated layer at NV, % of absolutely dry soil;

□0 – moisture content of the same layer before watering, % of absolutely dry soil;

100 is the conversion factor.

From the ratio of the irrigation norm to the irrigation norm, the number of irrigations (n) is determined:

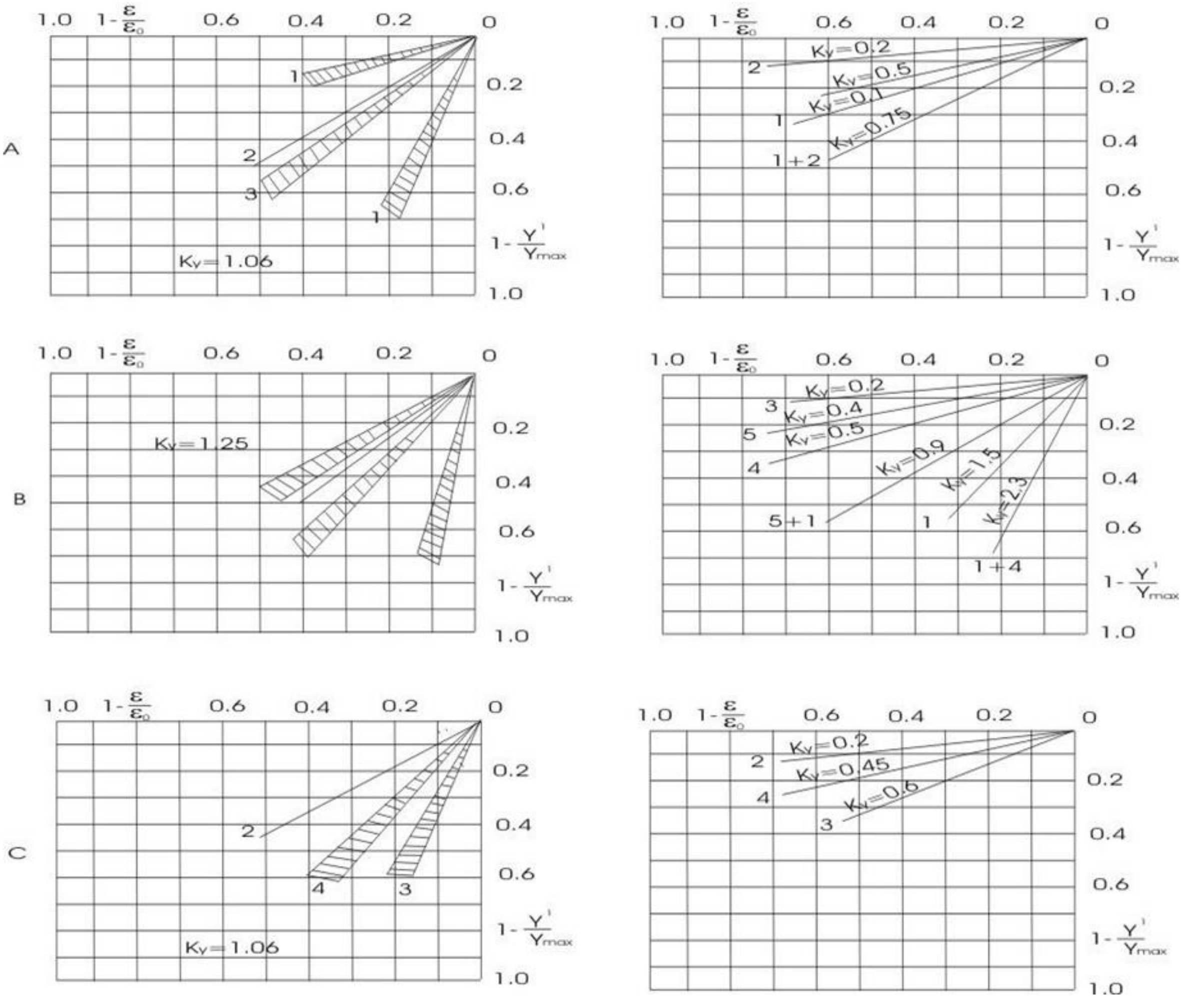
$$n = \frac{M}{m} \ (10).$$

Under the leadership of B.G. Aliyev, a generalized analysis of the effect of evapotranspiration deficiency on plant productivity was carried out. Exact connections have been established experimentally (Fig. 1) between the yield reduction coefficient 1-y□/ymax and the evapotranspiration deficit 1-E/E0 or total water consumption, including water consumption for plants.

Here E and E0 are the actual and maximum evapotranspiration, respectively;

y□ - gross increase in dry matter;

ymax – maximum yield.



Rice. 1. The influence of evapotranspiration deficiency on the yield coefficient of plants: a) spring wheat; b) corn; c) cabbage at various phases of their development. 1-flowering; 2-vegetation; 3-maturity; 4-harvest formation; 5-height.

In the figures, Ku is the ratio of the yield reduction coefficient to the water consumption deficit.

Conclusions:

1. Irrigation regime and irrigation technique as categories that determine the intensity and duration of the impact of irrigation measures on the plant and its habitat (soil, ground layer of air), which are closely and inextricably linked with each other. Their mutual influence is multifaceted...

2. To select irrigation technology and irrigation regime, it is extremely necessary to know irrigation and irrigation standards. Consequently, the value of the irrigation norm depends on soil-climatic and hydrogeological conditions.

Literary source:

1. Aliev B.G., AlievI.N..Aliyev Z.H. Equipment and technology of low-intensity irrigation in the conditions of Azerbaijan.Edlm Publishing House Baku-1999 220 p.

2. Kostyakov A.N. Fundamentals of land reclamation.Publishing house Selkhozizdat. Moscow.1961p376

3. Alimov A.K. and others. Hydrological bases for regulating the water-salt regime of irrigated lands in the arid zone. Publishing house "Elm".Baku-1993, 218 p.

4. Bondarenko N.F. and others.Modeling the productivity of agroecosystems. L. Hydrometizdat., 1982. 338 p.

5. Kolobotsky B.A. Dynamics of water in soil. Publishing house "Science" Leningrad. 1984. 118 p.

6. Nosenko et al. Impact of SD on the development of perennial plantings and their habitat. Reports of VASKHNIL, No. 3. Moscow. 1980 11 p.

7.Nerpin S.V. etc. Dependence of water consumption of plants on physical environmental factors. L. "Science" 1978

SUMMARY

To articles assistant professor, a.c.s.c. Aliev Z.H. on "Background on the effective use of irrigated land in the agricultural sector of Azerbaijan."

At irrigation water and mineral feeding, including provision by carbon dioxide and air, yields to the goal-directed regulation by changing the ways, rates and number of an irrigation, contributing mineral and organic fertilizers, processing of ground and etc. The Irrigation has the greater influence upon soil processes and microclimate. Transition from without irrigated to irrigate husbandry renders the greater influence upon ground. Irrigation water promotes increasing soil fertility. It dissolves the nutrients, does their more rolling and adopted for plants. Than closer to optimum reserves soil humidity, that strong positive influence of irrigation on ground, that above its efficient fertility. And only overweening moistening of ground irrigation water can since time to cause the negative phenomena's: ascent of underground water, get salty and swamping ground, fall of its fertility. So follows correct to keep the water mode of ground.. When these change do not affect on growing negatively and development of plants, water mode is considered positive, but under intensive development of plants - optimum. If fluctuations to moisture of ground hold up the normal growing of plants, water mode of ground is disadvantageous.