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INCREASING THE EFFICIENCY OF WATER AND RESOURCE- SAVING IRRIGATION TECHNOLOGIES USED IN GREENHOUSE GROWING OF CROPS

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ABSTRACT
Increasing crop yields through the rational use of water and energy resources, the development of water and resource-saving irrigation technologies, as well as increasing the efficiency of their use based on the use of mathematical methods for modeling the cultivation of crops in greenhouses.
KEY WORDS: ***Irrigation regime, degree of salinity of soils, index of deepening, arrangement of seedlings, duration of the light period, heat supply.***

INTRODUCTION

In the modern world, special attention is paid to the issue of ensuring a guaranteed supply of high-quality food to the population, rational and efficient use of available land, water, energy, food and drinking resources**.**

During the reduction of water resources due to climate change on the globe, the demand for water in our country Uzbekistan is also increasing. In this connection, to solve the most important economic problems in this area, the National Concept of Uzbekistan for the Development of the Water Sector until 2030 and the Strategy for Water Resources Management and Development of the Irrigation Sector for 2022-2026 were developed .

The Development Strategy of the Republic of Uzbekistan for 2022-2026 emphasizes the need for " radical reform of the water management system to ensure the rapid development of the national economy and high growth rates... " .

Based on this, the main attention was directed to increasing crop yields through the rational use of water and energy resources, the development of water and resource-saving irrigation technologies, as well as increasing the efficiency of their use through the use of mathematical modeling methods, including when growing agricultural products in greenhouses.

The processes of studying the moisture content of the salt, climatic, nutrient regimes of the soil were studied in the scientific works of A.N. Kostyakov, S.F. Averyanov, R.A. Muradov, E. Lyana, R.A. others. [1; 3; 5].

The dependence of the yield of agricultural crops grown in greenhouses on the depth of excavation, the duration of the light period, the degree of soil salinity, temperature changes, the density of seedlings and the basis of resource-saving technologies requires further study.

GOAL

Development of science-based water and resource-saving technology and cultivation of agricultural crops in local greenhouses, taking into account their design features (for example, tomato, since the need for tomato both in the republic and beyond it is great) and is our main goal.

To achieve the above goal, studies were carried out to change water and resource-saving technologies in the cultivation of tomato plants in local greenhouses under the influence of such parameters as daylight hours, greenhouse depth, seedling density, average temperature difference, soil salinity.

MATERIAL AND METHODS OF RESEARCH

Based on the research, seasonal irrigation rates and the yield of fractional experiments were determined, respectively, by developing an irrigation regime for the cultivation of tomato plants in local greenhouses;

In the course of the research , we were guided by generally accepted and other proven methods for conducting experiments in greenhouse conditions, processing observational data: analysis, comparison, mathematical statistics and mathematical modeling.

Scientific and research were carried out on the closed 800 m^2 area of Etibor Fayz LLC, 950 m^2 of the covered fields of the Temirkadam Ilkhomov Sanzharbek farm, 30000 m^2 of the area of Salar Yerkin Ganiev LLC, Kibray district of the Tashkent region, as well as m^2 hectares of the farm "Komoliddin Muydinovlar Sulolasi", on 6200 m^2 of the area of the farm "Mirzakhamdam limonlari" of the Kurgantepa district, 12000 m^2 of the area of LLC "Davron agrosanoat" of the Bulakbashi district of the Andijan region of Uzbekistan.

Of the most common tomato varieties in the Republic of Uzbekistan, such as "Pinkparadise F1", "Lamia F1", "Buran F1", "Yusupovsky F1", experiments were carried out on the

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most popular tomato variety, resistant to diseases and transportation, adapted for winter cultivation. Lamia F1".

The experiments were carried out in greenhouses with non-saline and slightly saline soil, with deepened and non-deepened floors of the structure. At the same time, it was recorded that with a greenhouse pit depth of about 1 meter, with a small amount of water resources, it is possible to obtain the maximum yield of tomato.

RESEARCH RESULTS

In the process of growing tomatoes, the temperature regime of the air is important. The main values of the results of the analysis were obtained at constant daytime temperatures within +28 ° ^{C} and night temperatures not less than +14 ˚ C, i.e. at an average temperature of +21 ° C ˒ the effect of short daylight hours and a long dark period of the day was taken into account in the autumn -winter season on crop productivity. In the process of growing tomatoes, diode lighting devices were also used.

When conducting an experiment with a fractional factor, the interrelated conditions of the factors were observed **under the conditions of a controlled agricultural system** UAS. Guided and regulated by the indicators of the regime and norms of tomato irrigation, the degree of soil salinity, the depth of tillage, the duration and light period, the depth of the greenhouse, the density of seedling placement, the effect of temperature on productivity, the results of fractional factor experiments and their economic indicators were obtained. At the same time, the representativeness of the experimental fields, the scheme and methodology for conducting field experiments when growing this tomato variety were taken into account.

Development of a tomato irrigation regime depending on the degree of soil salinity, the index of deepening or not deepening, the layout of seedlings, the duration of the light period and heat supply. Tomatoes were irrigated with drip irrigation based on the FAO CropWAT program.

In the initial stage (before flowering), the root-inhabited topsoil was provided with constant moisture for 25 days. In the development stage (before the first harvest ripened), the plants were watered every 3-5 days to provide a moisture layer of 0.40 m for 35 days. In the middle phase (fruiting phase), tomatoes were watered every 4-5 days. In the final (harvesting) stage, moisture was provided in 0.4 - 0.5 meter depth of the soil. The final watering for 8-12 days was carried out in order to harvest, waiting for the ripening of the last fruits. In the initial phase of cultivation, to provide moisture to the upper soil layer to a depth of 0.20 - 0.4 m, watering was carried out every 3 - 5 days for 25 days; in the stage of development of the tomato, the moisture supply of 0.4 m of the soil layer was carried out every 4-5 days. In the final stage, watering every 6 - 8 days was carried out in order to collect the entire crop.

In conditions of deep excavation of greenhouse soil, less evaporation was observed than in conditions without deepening. Under conditions of soil deepening in greenhouses, irrigation water savings were observed in relation to greenhouse conditions without deepening by 180-220 m^3

Based on the change and survey of factors affecting yield (Y) such as seasonal irrigation rate (M), soil salinity (S), excavation depth (h), length of the light period (t), seedling density (n) and temperature fluctuation (±T) of tomatoes grown in greenhouse conditions, **an irrigation regime was developed.**

Yields depend on the irrigation regime. The experiments were carried out in greenhouses with non-saline and slightly saline soil, with deepened and non-deepened floors of the structure. Let's take a look at the next two variations.

Option 1: with initial data: n = 25 thousand seedlings/ha; h = 0.1 m; t = 14 hours/day; S = 1 ds/m; temperature fluctuations T_{orp}= ±5 ˚ C, adjusting the seasonal irrigation rate (M) within 3500 - 5000 m^3/ ha, the yield was analyzed. The yield varied between 75 t/ha -84 t/ha .

Option 2: with initial data: - n = 30 thousand seedlings / ha; h = 0.1 m; t = 16 hours / day; S = 1 ds / m; temperature change T_{orp}= ±5 ^{o}C and seasonal irrigation rate (M) 3500 m^3 /ha, the yield was 102 t/ha. With a change in the seasonal irrigation rate to 4000 m^3 /ha, the yield was 107 t/ha ; at a seasonal irrigation rate of 4500 m^3 /ha and 5000 m^3 /ha, the yield was 108 t/ha; 107 t/ha, respectively.

By changing the method of planting and the depth of planting tomatoes in the second variant, a high yield was achieved. 9

Effect (S) of soil salinity on tomato yield. The degree of soil salinity in the greenhouse was determined on the basis of the NIIIVP methodology using a Chernyshev conductometer . Data were taken in the same varieties of non-saline and slightly saline soils (up to 4 ds/m) in greenhouses .

In the first variant, at M=5000 m^3 /ha; h=0.1 m; t=14 hours/day; n=25 thousand seedlings/ha; temperature change T_{orp}= ±5 ^{o}C, in non-saline soils, the yield Y corresponded to 83 t/ha; in low salinity soils, the Y yield was 68 t/ha.

In the second variant, with M = 5000 m^3/ ha; h = 1 m; t = 16 hours/day; n = 30 thousand seedlings/ha; temperature fluctuation Tagr = ±5 ^{o}C, in non-saline soils, the yield was 104 t/ha, while in slightly saline soil conditions, the yield reached 86 t/ha.

stopped at the water consumption of a tomato plant in the same conditions of non-saline and slightly saline soils of greenhouses.

With initial n = 30 thousand seedlings/ha; h = 0.1 m; t = 14 hours/day; change Tagr = ±10 ^{o} C in a non-deepened greenhouse and non-saline soil conditions, water consumption corresponded to 4129 m^3 /ha, in slightly saline conditions, water consumption is 4421 m^3/ha .

Under the same initial conditions, under conditions of deepening of the soil of the greenhouse by 1 m in non-saline and also in slightly saline conditions, water consumption corresponded to 4014 m^3/ha and 4238 m^3/ha.

Based on the above, it can be argued that in the variant under conditions of non-saline soils 115 m^3/ha was saved, in conditions of low salinity of the soil 183 m^3/ha of irrigation water was saved. 10; 12

Influence of the depth of the greenhouse on the yield and water consumption of tomato.

In the first variant (M = 5000 m^3/ha; t = 14 hours / day; S = 1 ds / m; change T_{orp}= ± 5 ˚C; n = 25 thousand seeds / ha) the yield in the greenhouse with planting on the surface soil at 0 - 0.10 m was 61 t/ha, with a greenhouse deepening of 0.50 m, the yield was 82 t/ha, with a deepening of 1.0 m, the

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yield was 84 t/ha, with a deepening of 1.50 m, the yield amounted to 79 t/ha.

In the second variant M = 5000 m^3/ha; t = 15 hours/day; S = 1 ds/m; change T_{orp}= ±5 °C; n \u003d 30 thousand seeds / ha) with planting on the soil surface at 0 - 0.10 m, the yield was 73 t / ha, in greenhouses with a depth of 0.50 m - 91 t / ha, with a greenhouse deepening to 1 , 0 m, the yield was 92 t/ha, with the deepening of the greenhouse to 1.50 m, the yield was 86 t/ha.

From this it follows that due to energy savings during heating and cooling of greenhouses with soil deepening by 0.50-1.0 m, crop yields increase.

It should be noted that even under protected soil conditions, as a result of irrigation in the period from the initial stage to harvesting, the nutrients supplied to the plants contain a variety of mineral salts, increasing the mineralization of the soil. Soil salt gradually enters the lower layers , which in turn leads to gradual soil salinization. Therefore, it is recommended to wash the soil once a year, preferably in the summer.

CONCLUSIONS

1. In the studies, the tomato was grown in traditional greenhouses, with the right choice and implementation of resource-saving technologies, the parameters of the greenhouse were optimized (depth, temperature difference, light period).
2. On the basis of field experiments, a formula was obtained showing the effect on the yield of the depth of planting seedlings in the greenhouse, the temperature range, the light period, the thickness of seedlings, seasonal irrigation rates, the degree of soil salinity according to the results of fractional factor experiments.
3. As a result of the field experiments, it was calculated that the most optimal option in terms of energy consumption is the option in which the depth of the greenhouse soil reaches 0.75-1.0 m.
4. It has been established that the seasonal irrigation rate for greenhouses with a certain depth of non-saline soil is 3300-3500 m^3/ha, in conditions of soil salinity up to 4 ds/m, the seasonal irrigation rate was 4200-4500 m^3/ha. While the seasonal irrigation rate for greenhouses with non-deployed soil and non-saline soil is 4000-4200 m^3/ha, with soil salinity up to 4 ds/m, the irrigation rate was 4600-4900 m^3/ha.
5. With an increase in the density of seedlings, the need for light intensity increases. It has been proven that under conditions of a soil excavation depth of up to 0.75-1.0 m, the optimal density of seedling placement is 30,000 seedlings/ha.
6. When growing tomatoes in greenhouse conditions, it is important to manage the difference between the maximum and minimum temperatures. Reducing the temperature to optimal values, that is, to 5-10 ° C, by spraying water, shading (using a tour or spraying with wet clay) and airing greenhouses, it was possible to obtain the maximum yield.
7. According to the method of academician F.B. Abutaliev developed a system of soil moisture equations and substantiated the optimization of the timing of planting seedlings and their top dressing, taking into account changes in moisture and nutrients in the soil.
8. As a result of theoretical studies, formulas have been developed for predicting the regime of heat, humidity and top dressing in greenhouse conditions. Based on them, the possibility of efficient use of thermal energy and water resources was created at a soil depth of 0.75-1.0 m for sustainable crop growth.
9. If the traditional method of growing tomatoes consumed 4510-5012 m^3/ha of water, then in greenhouse conditions this figure was 3510-4015 m^3/ha due to the use of fractional factors and water savings of up to 20-22% were achieved.
10. Based on the above analyzes of growing crops in greenhouses (on the example of uprooting tomato variety "Lamia F1".) Recommended, soil depth 0.75 - 1.0 m, seedling density - 30,000 seedlings / ha and temperature within +11 , +31 °C.

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