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Cultivation Of Cotton Using Drip Irrigation Technology

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Abstract: The article presents the results of an experiment conducted on meadow-alluvial soils of the Bukhara region, where the groundwater table is at a depth of 2.0–2.5 m. In the experimental cotton field irrigated using drip irrigation, when the pre-irrigation soil moisture was maintained at 75–80–65% of the field capacity (FC), the cotton was irrigated four times according to the 0-4-0 irrigation scheme. No irrigation was applied during the period from germination to flowering, while during the flowering–boll formation stages, four irrigations were carried out with irrigation rates ranging from 616 to 651 m³/ha. The total seasonal irrigation norm amounted to 2521–2537 m³/ha, which is 1594–1633 m³/ha less compared to the control variant, indicating significant water savings.

Keywords: Cotton, water scarcity, drip irrigation, irrigation rate, seasonal irrigation norm, groundwater, mineralization, vegetation period.

Introduction: The development of global agriculture is directly linked to the availability of water resources. The increasing tension in the use of water - often referred to as the “blue gold” of the planet - necessitates the rational utilization of water resources, the reduction of water consumption in agriculture, and the improvement of farming systems through the implementation of modern water-saving technologies. This is particularly important because, according to projections, by the year 2040 the world’s population will reach nine billion, while available freshwater reserves will be sufficient to meet only about 70% of humanity’s needs [1].

Research Objective

The purpose of the study is to develop scientifically based irrigation regimes for cotton cultivation under drip irrigation conditions on meadow-alluvial soils of the Bukhara region. These soils are characterized by a heavy loamy texture, groundwater table at a depth of 2.0 - 2.5 m, and mineralization levels ranging from 1.0 to 3.0 g/L. The research aims to provide scientific and practical recommendations on how these irrigation regimes affect cotton growth and development, yield, and fiber quality indicators.

Figure 1. View of the experimental field under drip irrigation

Objectives of the Study

The main objectives of the study are as follows:

- To determine the soil conditions of the experimental fields, including soil type, mechanical composition, water-physical properties, and fertility;
- To assess the hydrogeological and reclamation conditions of the experimental sites;
- To establish scientifically based irrigation regimes for cotton cultivation using drip irrigation under the conditions of the Bukhara region's meadow-alluvial soils, characterized by a groundwater table depth of 2.0–2.5 m and mineralization levels ranging from 1.0 to 3.0 g/L;
- To study the effects of the scientifically based drip irrigation regime on the soil's water-physical properties, salt regime, groundwater level and mineralization, as well as on cotton growth and development.

Field experiments were carried out under the conditions of meadow-alluvial soils with a heavy loamy texture in the Vobkent district of the Bukhara region, where the groundwater table lies at a depth of 2.0–2.5 m and the mineralization level are 1.0–3.0 g/L. The study examined the impact of scientifically based drip irrigation regimes on cotton growth, development, and productivity [4].

The experiments were carried out under the following systems according to the classification of N.A. Kachinsky, the mechanical composition of the experimental field soil belongs to the heavy loamy soil type.

Table 1

№№	Pre-irrigation soil moisture (% of FC)	Irrigation method	Irrigation rate (m^3/ha) / Regulation method
11	Production control	Furrow irrigation	Actual measurements
22	70–80–60%	Drip irrigation	Based on soil moisture deficit in 0–100 cm layer
33	80–80–60%	Drip irrigation	Based on soil moisture deficit in 0–100 cm layer

The bulk density of the soil in the experimental field at the beginning of the vegetation period was 1.33–1.35 g/cm³ in the 0–30 cm plow layer, 1.41–1.43 g/cm³ in the 30–50 cm sub-plow layer, and 1.39–1.40 g/cm³ within the 0–100 cm soil layer [5].

According to the data presented in Table 2, in the production control variant (Variant 1) of the experiment, cotton was irrigated three times during the vegetation period following the 0-3-0 irrigation scheme.

Table 2

Irrigation Schedule for Cotton under Drip Irrigation Conditions

№	Variants	Indicators (m^3/ha)	Number of Irrigations (m^3/ha)					Irrigation Scheme	Seasonal Irrigation Rate, m^3/ha
			1	2	3	4	5		
2013 йил									
1	V-1	Irrigation rate	1422	1383	1362			0-3-0	4167
2	V-2	Irrigation rate	616	651	631	626		0-4-0	2524
3	V-3	Irrigation rate	664	685	676	682	668	1-4-0	3375
2014 йил									
1	V-1	Irrigation rate	1362	1446	1313			0-3-0	4121
2	V-2	Irrigation rate	621	639	636	642		0-4-0	2536
3	V-3	Irrigation rate	653	683	672	679	649	1-4-0	3336
2015 йил									
1	V-1	Irrigation rate	1461	1371	1345			0-3-0	4175
2	V-2	Irrigation rate	617	635	649	643		0-3-1	2544
3	V-3	Irrigation rate	665	672	674	664	622	1-4-0	3297

Based on the study of the scientifically grounded irrigation regime of cotton under drip irrigation technology on the meadow-alluvial soils that have been irrigated since ancient times in the Bukhara oasis, the following conclusions were drawn: At the beginning of the vegetation period in the experimental field where cotton was planted, the bulk density of the soil in the arable 0 - 30 cm layer was 1.33 - 1.35 g/cm³, in the subsurface 30–50 cm layer it was 1.41 - 1.43 g/cm³, and in the 0–100 cm layer it was 1.39 - 1.40 g/cm³. By the end of the vegetation period, in the second variant irrigated by the drip irrigation method, the bulk density of the soil in the arable 0–30 cm layer was 1.34–1.35 g/cm³, in the subsurface 30–50 cm layer it was 1.42–1.43 g/cm³, and in the 0–100 cm layer it was 1.40–1.41 g/cm³.

An increase of 0.01 g/cm³ in soil bulk density was observed, which was the lowest value compared to other variants.

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