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Effectiveness of Drip Irrigation with Mineralized Drainage Water for Cotton Cultivation

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Annotation

The article presents the results of growing cotton under the conditions of saline meadow–alluvial soils in the Bukhara region, where the groundwater level is 2.0 - 2.5 m, using mineralized water for drip irrigation. When the pre-irrigation soil moisture was maintained at 70 – 80 - 65% of the field capacity, cotton was irrigated 15 times according to the 3 - 10 - 2 scheme. The crop was not irrigated during the period from germination to flowering, while during the flowering and boll formation stages, irrigation norms ranged from 273 to 437 m³/ha, with a total seasonal irrigation rate of 4483 m³/ha. As a result, compared to the control variant, water savings of 1594 m³/ha were achieved.

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

Under conditions of water scarcity, food security is becoming a global issue, as it is necessary to produce more food with limited water resources. Water shortage leads to a reduction in the amount of water available for agricultural production, which in turn decreases food output and negatively affects food security [1]. Worldwide, soil salinization affects about 160 million hectares of cropland, rendering approximately 1.5 million hectares of land unsuitable for agriculture each year. Such adverse effects are causing the withdrawal of fertile lands from agricultural use [2].

In the practice of global irrigated agriculture, under conditions of water scarcity, the use of slightly mineralized drainage water as an additional water source for scientifically based crop irrigation has made it possible to save river water resources and increase crop yields by up to 10 - 15%. Therefore, in response to the growing problem of water shortage, scientific research on the use of slightly mineralized drainage water in irrigated agriculture is of great importance for mitigating its negative impacts [3].

Research Objective

The purpose of this study is to develop scientifically grounded irrigation regimes for cotton cultivation using mineralized water under the conditions of meadow - alluvial soils of the Bukhara region. These soils are characterized by a heavy loamy texture, groundwater levels of 2.0 - 2.5 m, and mineralization rates of 1.0 - 3.0 g/l. The research seeks to determine the effects of drip irrigation with mineralized water on soil properties, cotton growth and development, yield, and fiber quality, and to provide scientifically based practical recommendations.

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Figure 1. Experimental field under drip irrigation.

Objectives of the Study

- To determine the soil conditions of the experimental fields, including soil type, mechanical composition, hydro-physical properties, and fertility;
- To assess the hydrogeological and reclamation conditions of the experimental fields;
- To establish scientifically based irrigation regimes under the drip irrigation method;
- To study the effects of scientifically based drip irrigation regimes on the soil's hydro-physical properties, salt regime, groundwater level and mineralization, as well as on cotton growth and development.

Field experiments were conducted in the Vobkent district of the Bukhara region under the conditions of meadow–alluvial soils with a medium loamy texture, groundwater levels of 2.0 - 2.5 m, and mineralization ranging from 1.0 to 3.0 g/l. The study investigated scientifically based irrigation regimes for cotton cultivation using mineralized water through the drip irrigation method, focusing on their effects on cotton growth, development, and yield [4]. The experiments were carried out under the following systems (Table 1).

Table 1

№	Pre-irrigation soil moisture, % of field capacity (FC)	Irrigation method
1	Production control	Furrow irrigation
2	70-80-65 %	Drip irrigation

At the beginning of the growing period, the bulk density of the experimental field soil was 1.33 - 1.35 g/cm³ in the plow layer (0–30 cm), 1.41 - 1.43 g/cm³ in the sub-plow layer (30 - 50 cm), and 1.39 - 1.40 g/cm³ in the 0 - 100 cm layer [5,6]. According to the data presented in Table 2, in the production control (Variant 1), cotton was irrigated five times during the growing period following the 1-3-1 irrigation scheme.

Table 2

Irrigation regime of cotton under the drip irrigation method

№	Variants		

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		Irrigation scheme	Seasonal irrigation rate, m^3/ha	
1	V-1	1-3-1	6077	
2	V-2	3-10-2	4483	

Based on the study of scientifically grounded irrigation regimes for cotton under drip irrigation technology on the traditionally irrigated meadow–alluvial soils of the Bukhara oasis, the following conclusions were drawn:

At the beginning of the growing period, the bulk density of the soil in the experimental cotton field was 1.33 - 1.35 g/cm³ in the plow layer (0–30 cm), 1.41–1.43 g/cm³ in the sub-plow layer (30 - 50 cm), and 1.39 - 1.40 g/cm³ in the 0 - 100 cm layer. By the end of the growing period, in Variant 2, which was irrigated by the drip irrigation method, the soil bulk density reached 1.34 - 1.35 g/cm³ in the plow layer (0–30 cm), 1.42 - 1.43 g/cm³ in the sub-plow layer (30 - 50 cm), and 1.40 - 1.41 g/cm³ in the 0 - 100 cm layer. An increase of 0.01 g/cm³ in soil bulk density was observed, which was the lowest among all variants.

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