ASSESSMENT OF THE IMPACT OF DRIP IRRIGATION ON THE SOIL RECLAMATION REGIME OF COTTON

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Annotatsiya

The article investigates the effect of drip irrigation technology on the soil reclamation regime during cultivation of the cotton variety *“Bukhara-10”* under saline-prone meadow–alluvial soils with medium loamy texture in the conditions of the Bukhara region. Field experiments conducted in 2025 using four treatments and three replications demonstrated that maintaining pre-irrigation soil moisture at **70–80–65% of field capacity (FC)** provided the most favorable results. Under this irrigation regime, increases in soil bulk density and salinity were minimized, while groundwater levels remained within **1.7–2.1 m**, preventing the development of secondary salinization.Compared with the control treatment, seasonal irrigation water use was reduced by **1172 m³/ha**, while cotton yield increased by **28.7%,** reaching **49.3 c/ha**. Water productivity reached **1601 g of cotton per m³ of irrigation water,** and profitability increased to **28.8%.** The obtained results provide a scientific basis for the implementation of this irrigation technology and irrigation regime in regions with similar soil and climatic conditions.

Kalit so'zlar

cotton, drip irrigation, reclamation regime, irrigation scheduling, soil moisture, groundwater level, soil salinity, soil water-physical properties, yield, water use efficiency, economic efficiency, Bukhara-10.

Introduction:Under conditions of increasing water scarcity, the introduction of water- and resource-saving irrigation technologies in agricultural production has become one of the most urgent challenges. In Uzbekistan, large-scale reforms aimed at improving water use efficiency are being implemented, including annual maintenance of more than 5,000 km of irrigation canals and 12,000 km of collector–drainage networks. Although total agricultural water consumption has decreased by approximately 20% in recent years, the increasing frequency of drought periods continues to negatively affect crop productivity.Under these conditions, the introduction of drip, sprinkler, and subsurface irrigation technologies for cotton cultivation is becoming increasingly important to maintain stable soil moisture within

the active root zone, reduce deep percolation losses, and minimize physical evaporation. This study was carried out within the framework of national measures aimed at improving water use efficiency. The objective of the study was to determine the optimal irrigation regime for the cotton variety *“Bukhara-10”* under drip irrigation conditions and to evaluate its effects on soil water-physical properties, salinity dynamics, groundwater regime, and reclamation indicators in saline-prone meadow–alluvial soils with medium loamy texture under the conditions of the Bukhara region, where groundwater depth ranged from 1.9 to 2.2 m and mineralization varied between 1 and 3 g/L.

Materials and Methods:Field experiments were conducted in 2025 on the lands of the “Sherzod Toshev” farm located in the Bukhara region using four treatments and three replications. Treatment 1 (control) consisted of conventional furrow irrigation with pre-irrigation soil moisture maintained at **70–75–65% of field capacity (FC)** and irrigation scheduling according to the **1–3–1** scheme. Irrigation rates were calculated using the **S.N. Ryzhov equation.** Treatments 2, 3, and 4 were implemented under drip irrigation with pre-irrigation soil moisture regimes of **70–75–65% FC, 70–80–65% FC,** and **80–80–65% FC,** respectively. The drip irrigation system was designed with **0.9 m row spacing, 30 cm emitter spacing**, and an emitter discharge of **2.0 L h^{-1},** with one drip line installed per furrow. Theoretical calculations indicated a total of **369,963 emitters per hectare** with a water delivery capacity of **73.99 m^3 h^{-1}.**Soil bulk density, water permeability, field capacity, soil moisture dynamics, groundwater depth and mineralization, chloride ion concentration, and dry residue content were determined through regular laboratory analyses. Cotton growth and development indicators were evaluated through phenological observations, while yield was assessed based on harvesting results. Economic efficiency was calculated using the actual production costs of farms in Vobkent district of the Bukhara region for 2025.

Results and discussion: At the beginning of the growing season, soil bulk density in the 0–100 cm layer was 1.36 g/cm^3. By the end of the growing season, this indicator increased to 1.42 g/cm^3 in the control treatment under conventional furrow irrigation, corresponding to an increase of 0.03–0.04 g/cm^3. Under drip irrigation treatment 3 (70–80–65% of field capacity), the increase in bulk density was only 0.01–0.02 g/cm^3, indicating the lowest level of soil compaction. These results demonstrate the advantage of drip irrigation technology in limiting mechanical soil compaction. At the beginning of the growing season, soil water permeability reached 919 m^3/ha (0.255 mm/min) over a 6-hour period. By the end of the season, this value decreased to 677 m^3/ha (0.188 mm/min) in the control treatment. In treatment 3, water permeability remained at 879 m^3/ha (0.244 mm/min), which was 202 m^3/ha or 0.056 mm/min higher than the control, confirming better preservation of soil structure under drip irrigation conditions. The average field capacity in the 0–100 cm soil layer was 19.4% on a gravimetric basis. In the control treatment, soil moisture varied considerably during the growing season, reaching 73.3–73.6% of field capacity during the flowering and boll formation stage and decreasing to 63.2% during boll opening. In treatment 3 (70–80–65%), soil moisture remained relatively stable at 81.4–81.9% during the flowering–boll formation period, corresponding to the stage of maximum crop water demand and producing the most favorable result. According to irrigation scheduling, the

control treatment (1–3–1 scheme) was irrigated six times from 14 June to 28 August at intervals of 16–23 days with irrigation depths ranging from 763 to 1047 m³/ha, resulting in a seasonal irrigation norm of 4250 m³/ha. Under drip irrigation treatments 2 and 3 (3–11–1 scheme), irrigation intervals were reduced to 6–12 days and irrigation depth ranged from 166 to 321 m³/ha per application. As a result, seasonal irrigation water use amounted to 3129 m³/ha in treatment 2, 3078 m³/ha in treatment 3, and 3339 m³/ha in treatment 4, saving 1121, 1172, and 911 m³/ha of water, respectively, compared with the control treatment.

Treatment	Irrigation regime (FC, %	Irrigation schedule	Seasonal irrigation water use, m³/ha	Yield, c/ha	Yield per 1 m³ of irrigation water, g
1 (Control)	70-75-65 (egat)	1-3-1	4250	38,3	901
2	70-75-65	3-11-1	3129	44,5	1395
3	70-80-65	3-11-1	3078	49,3	1601
4	80-80-65	4-11-1	3339	46,7	1446

1-jadval. Key indicators of cotton irrigation technologies *(2025 y.)*

In the experimental fields, the groundwater table at the beginning of the growing season was located at an average depth of 177 cm. During July–August, in plots irrigated by drip irrigation, the groundwater level rose to 184–189 cm. Maintaining the groundwater level within the range of 1.7–2.1 m prevented the intensification of secondary salinization processes, thereby creating favorable conditions for soil reclamation. At the end of the vegetation period, the dry residue content in groundwater under drip-irrigated treatments ranged from 3.178 to 3.297 g/L, which was 0.60–0.719 g/L lower than in the control treatment (3.897 g/L). In the plough layer (0–40 cm), the chloride ion content was 0.009% at the beginning of the growing season. By the end of the season, it increased to 0.034% in the control treatment and only to 0.022% in drip-irrigated treatment 3. The seasonal salt accumulation coefficient based on chloride ions was 2.6 times in the control, whereas it was 2.3 times in treatment 3, confirming that drip irrigation significantly limits excessive salt accumulation in the topsoil.

According to final phenological observations (as of 1 September), plant height in the control treatment was 99.3 cm, with a total of 10.7 bolls per plant and 6.4 opened bolls. In drip-irrigated treatment 3, plant height reached 102.8 cm, with 14.6 total bolls and 9.9 opened bolls, representing the highest recorded values. Plant density was also highest in treatment 3, reaching 93.4 thousand plants/ha, which was 3.1% higher than the control (90.6 thousand plants/ha).The highest yield was obtained in treatment 3 under the 70–80–65% FC regime, reaching 49.3 c/ha, which was 11.0 c/ha (28.7%) higher than the control (38.3 c/ha). Yield in treatments 2 and 4 was 44.5 c/ha and 46.7 c/ha, respectively. Analysis of water use efficiency showed that the total water consumption per 1 centner of cotton was 191.8 m³ in the control, while it decreased to 102.5 m³ in treatment 3, saving 89.3 m³. As a result, cotton

production per 1 m³ of irrigation water increased from 901 g in the control to 1601 g in treatment 3.

Economic analysis based on actual production costs of farms in Vobkent district (2025) showed that net profit in the control treatment was 2890 thousand UZS/ha with a profitability level of 10.3%. The highest economic efficiency was achieved in treatment 3 (70–80–65% FC), where net profit reached 8941 thousand UZS/ha (3.1 times higher than control) and profitability increased to 28.8%. Net profit in treatments 2 and 4 was 4974 and 6020 thousand UZS/ha, respectively, with profitability levels of 16.0% and 18.9%. Excess soil moisture conditions (80–80–65%) showed lower economic efficiency compared to treatment 3.

Conclusion:The results of the study conducted under saline-prone meadow–alluvial soil conditions of the Bukhara region demonstrated the superiority of drip irrigation technology over conventional furrow irrigation. Maintaining pre-irrigation soil moisture at 70–80–65% of field capacity ensured stable soil moisture, improved water permeability, and limited excessive salt accumulation in the root zone. Under this regime, the seasonal irrigation norm was 3078 m³/ha, resulting in water savings of 1172 m³/ha compared with the control treatment. At the same time, the highest yield of 49.3 c/ha was obtained, which was 28.7% higher than the control. Water use efficiency increased up to 1601 g/m³. Economic evaluation showed that this treatment provided a net profit of 8941 thousand UZS/ha and a profitability level of 28.8%. Therefore, under the conditions of the Bukhara region, the drip irrigation regime of 70–80–65% FC for the cotton variety “Bukhara-10” can be recommended as the optimal option for water saving, yield increase, and economic efficiency improvement.

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