European Science Methodical Journal
ISSN (E): 2938-3641
Volume 2, Issue 12, December- 2024

WATER SAVING TECHNOLOGIES FOR POLYMER AND IRRIGATION MELIORATION (NATURAL SCIENCES MAGISTRATES)

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Abstract:

This study highlights the importance of improving furrow irrigation techniques to enhance water conservation, as emphasized by the International Commission on Irrigation and Drainage (ICID). The research focuses on the implementation of subsurface anti-filtration screens made from interpolymer complexes (IPC) to optimize irrigation efficiency. Conducted in the "Omad" farming enterprise of the Urtachirchik district, Tashkent region, the experiments compare furrow irrigation with and without subsurface screens during the 2016 growing season. Key findings reveal a significant reduction in water consumption through irrigation between the rows and increased cotton yields. The application of IPC screens at plow layer depth demonstrated reduced deep infiltration, improved water distribution uniformity, and minimized water runoff. Results indicated that irrigation through inter-row furrows led to 123.0 mm of water savings per season. Additionally, cotton yields increased by 5.9 c/ha, generating an annual economic benefit of $305 per hectare. This research validates the efficiency of scientifically based irrigation practices in conserving water and boosting productivity in cotton farming.

Keywords: Furrow irrigation, water-saving technologies, interpolymer complex (IPC), subsurface anti-filtration screens, cotton farming, water conservation, agricultural productivity, economic efficiency, irrigation efficiency.

ТЕХНОЛОГИИ ВОДОСБЕРЕЖЕНИЯ ПРИ ПОЛИМЕРНОЙ И ОРОСИТЕЛЬНОЙ МЕЛИОРАЦИ (ДЛЯ МАГИСТРОВ НАПРАВЛЕНИЯ ЕСТЕСТВЕННЫХ НАУК)

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Introduction

By now, the International Commission on Irrigation and Drainage (ICID), as an international body, places great importance on implementing advanced irrigation methods as the most effective means of water conservation. This study addresses the improvement of furrow irrigation techniques using water-saving methods, such as irrigation into each furrow and through inter-row spaces with an anti-filtration screen made from an interpolymer complex (IPC) placed at the depth of the plow layer.

The research was conducted at the “Omad” farm in the Urtachirchik district of the Tashkent region, under conditions of deep groundwater levels. The mechanical composition of the soil by fractions was evaluated at a depth of 1.0 m for typical gray soil at the experimental site, where small fractions with particle diameters of 0.01-0.005 mm predominated at depths of 0.32-0.58 m.

The high sorption and swelling properties, as well as the low permeability coefficients of IPC films synthesized from carboxymethyl cellulose and urea-formaldehyde resin, justified their use in creating anti-filtration screens produced with the help of specialized equipment [1]. The IPC solution is prepared using an AZM-0.8 unit, typically intended for the preparation of high-dispersion emulsions.

The research involved comparing furrow irrigation of cotton in fields with a subsurface screen and under regular conditions in furrows of varying lengths, with water supplied to each furrow and through inter-row spaces. Field studies on fields with a subsurface screen were conducted during the 2016 growing season at the “Omad” farm, following methodologies with fourfold repetition.

Two variants (“A” and “B”) were analyzed, including experiments No. 1 and No. 2 in variant “A” with furrow lengths of 180 and 280 meters, respectively. Variant “B” represented control No. 1 for experiment No. 1 and control No. 2 for experiment No. 2. The areas of the experimental and control plots were 1.0 and 1.3 hectares, respectively. To exhaust end runoff, irrigation was performed using a discrete method.

Irrigation schedules and the duration of water supply in the control variant “B” were assigned according to the farm’s irrigation schedule.

The study evaluated the following parameters: water flow into the furrow and surface runoff, the advance and recession time of irrigation streams, furrow length, and deep infiltration. Soil moisture was determined by the thermogravimetric method and an electronic moisture meter developed by the authors of this study.

The average layer (mm) applied to the irrigated area and the volume of end runoff during irrigation were determined using known formulas [2]. Field studies established that to achieve sufficient moisture, end runoff was observed only in control fields. For example, in control plot No. 1, with a water flow rate of 0.5 l/s, the end runoff rates were: first irrigation – 16 mm; second irrigation – 17.6 mm; third irrigation – 16.8 mm; and fourth irrigation – 17.5 mm.

The distribution of irrigation rates along the furrow length, determined by trial irrigations on the experimental and control plots, was studied. According to the research data, the best results were obtained in experiment No. 2, where irrigation was conducted through inter-row spaces. For instance, if the difference in irrigation rates for the first irrigation at the beginning and end of the furrow in control No. 2 was 50.5-33.4 mm, then in experiment No. 2, it was 36-28.8 mm. In experiment No. 1, they were 32-25.6 mm and 48-32.6 mm in control No. 1, respectively.

The reasons for such results are the close values of advance and recession times during irrigation due to the screen at the soil depth. Irrigation rates were calculated based on the total water supply time and water flow into the furrows.

The coefficient of moisture uniformity along the furrow length in experiment No. 1 was 0.80, while in the control it was 0.69. In experiment No. 2 and control No. 2, the coefficients were 0.84 and 0.68, respectively.

It should also be noted that, according to Table 2, during the growing season, water savings amounted to 107.0 mm in experiment No. 1 and 123.0 mm in experiment No. 2. It is worth noting that irrigation through inter-row spaces with long furrows and higher water flow rates is more advantageous, as it results in greater water savings and reduced labor costs for irrigation.

The implementation of scientifically-based water-saving irrigation technologies in production conditions contributes to increased cotton yields. In 2016, at the "Omad" farm fields with a subsurface IPC screen, yields were 5.9 c/ha higher, resulting in an annual economic effect of $305 per hectare, calculated using commonly accepted formulas for implementing the developed proposals.

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