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# Water-Saving Technology Watering Under Contour Irrigation and Discrete Watering

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**ABSTRACT:** The article presents the results of research that are devoted to water-saving irrigation technology on steep slopes and clarified the elements of irrigation technique under contour irrigation and discrete irrigation in the south of Uzbekistan.

**KEY WORDS:** water saving, furrow irrigation, water distribution, micro button, contour irrigation, discrete irrigation, steep slope, polymer K-9, irrigation technique, irrigation technology, maximum slope.

## I. INTRODUCTION

As it is known, the water saving system includes a wide range of issues: optimization of land-reclamation regimes on the background of drainage and irrigation techniques, agro technical modes that increase fertility, etc. That is, they are reduced mainly to managing the main elements of the water balance of the field: evaporation, filtration, unproductive discharges of water from the field, reduction of water delivery time from the irrigation network, elimination of erosion and subsidence of soil, etc.

The well-known spectrum of applied water-saving technologies includes drip irrigation, frontal sprinkling, laser field planning, etc. They are covered in the works of a number of authors [2, 3, 6, 7, 7, 8. etc.].

The acuteness of the issue of water conservation dictates the mobilization of all the specialists' forces of water management and irrigated agriculture in the use of promising and sufficiently tested irrigation methods and technologies: subsurface, drip irrigation and sprinkling. However, sprinkling, in particular in Uzbekistan, according to the literature review, falls on land with close groundwater flow and is only a small part.

Certain studies are devoted to the improvement of furrow irrigation [1, 3, 4 and others]. When furrow irrigation in the form of anti-erosion measures, a number of authors recommend variable-flow irrigation. At the same time, at the beginning of irrigation (air-dry soil) the minimum jet is fed into the furrow, which after passing 1/3 of the furrow length (after 3-7 hours) is doubled, then after reaching the jet to the end of the furrow, the flow is reduced to the initial, minimum value. Such frequent adjustment of the flow rate of water in the furrows is due to the fact that all soils in the air-dry state are characterized by flushing at a low bottom eroding speed of 4.5 cm / s (Кузнецов, 1978), however, with pre-moistening, the permissible erosion speeds increase somewhat: for loamy and loamy soils up to 6.3 cm / s, medium loamy to 7.7 cm / s, heavy loamy up to 8.8 cm / s. However, frequent adjustment of water makes a dissonance in the organization of water distribution in the farm network.

Another noteworthy agro technical technique for the prevention of irrigation erosion is the modification of the furrow design. The author [5] suggested instead of the usual irrigated furrows to carry out micro-fences with special rollers hung behind cultivating organs. The micro button has a width of 3-6 cm, a depth of 3-4 cm and a cross-sectional area of 2-10 cm2. Water consumption in it can vary from 0.050 to 0.2 l / s. In terms of these microburst's have tortuosity, which reduces their longitudinal slope and water flow rate, and this in turn sharply reduces irrigation erosion on steep slopes in Tajikistan.

Also one of the most important agro technical methods for the prevention of irrigation erosion is the artificial structuring of soil along the bottom of the furrow with polymer preparations of the K series and GWP synthesized in Uzbekistan. The use of drugs in irrigation is devoted to studies [8], in particular, as practical recommendations, it is noted that with slopes of 0.01-0.04, it is necessary to compact the initial part of the furrows and fix them with polymers-structuring agents up to 80 kg / ha, and for steep on the slopes (0.1-0.22), when watering along the greatest gradient, it is necessary to apply K-4, K-7, K-9, K-17 preparations with a dose of up to 180 kg / ha.

But the use of the furrow irrigation method on steep slopes, even in an improved form, has a certain limit. So according to a

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review of research, the value of the maximum allowable slope along the furrows is 0.05 [4; 7]. According to the recommendations of the Institute "Uzgiprozem" (Talipov, 1987) are considered appropriate the following methods of land development foothill zones:

- with slopes up to 0.10-0.14, cut the contour grooves for irrigating crops;
- with the slopes of 0,14-0,21 go to the terracing;
- with slopes greater than 0.21, build a bench-like terrace.

According to N.T. Laktaev [4] with slopes of 0.1 or more, one should switch over to the contour system of agriculture, and with slopes of more than 0.3, build bench-like terraces.

The authors of [9] recommend to irrigate maize on contoured furrows when irrigating typical down whole serozems with a slope of 0.04-0.15, and in the range of slopes from 0.15 to 0.25 - on joking furrows. It is also noted that in conditions of highly intersected relief, where it is not possible to irrigate along contour and joking furrows, irrigation is most effective along the greatest slope, but using K-4 and K-9 polymers with a dose of up to 180 kg / ha.

Surin V.A. [7] notes the possibility of applying furrow irrigation along the greatest slope with the help of flexible hoses on slopes even up to 0.3 a and above this value to move to terraced irrigation.

At the pilot production site with a steepness of 0.077 and a length of 150 m, irrigation is carried out along furrows with a water consumption of 0.058 l / s at a rate of 400 m3 / ha for 3.33 days, and irrigation rates of up to 1000 m3 / ha require irrigation of up to 7 days or more. With a certain combination of them with irrigation on the greatest slope for the rate of irrigation: 400, 700, 1000 m3 / ha on a plot with a gradient of 0.077, and a jet of 0.057 l / s, the length of furrows required: 145, 175, 210 m irrigation time was 23, 48 , 130 hours with the efficiency of irrigation equipment 0.87, 0.92, 0.91. At the fifth irrigation, due to the fact that the soil is compacted at a flow rate of 0.083 l / s, the same rates required irrigation time at those irrigation rates of 52, 112, 148 hours with furrows length: 240, 260, 280 m with irrigation equipment efficiency 0 , 80, 0.87, 0.91. This indicates the need to regulate the flow of water in the furrow from irrigation to irrigation. On the same slope, the latter was irrigated by a jet of 0.133 l / s, and then 0.0695 l / s with the same length of the furrows.

Contour irrigation. The use of the same irrigation jets as during irrigation along the maximum slope of 0.098 l / s on contour furrows showed irrigation time: 10, 33, 64 hours for the same irrigation rates with the same efficiency of irrigation technique on the greatest slope. The length of the contour furrow due to the increase in water absorption became shorter - 65, 100, 110 m, i.e. decreased by more than 2 times. Thus, the direction of irrigation across the slope can significantly change the absorption parameters using loosening compared to the field without loosening the soil suggests that the contour grooves cut across the slope on weakly permeable soils increase water absorption into the soil compared to the control - irrigation by the greatest bias, respectively, change the irrigation parameters.

Corn crop when irrigating along contour furrows. In contour furrows with a spacing of 0.7 m with soil loosening by 90 cm, the water permeability increased and, therefore, compared to the option without soil loosening, the irrigation streams were higher. Irrigation sprays less than 0.105 l / s reduce the length of the furrow; above 0.185 l / s they cause the soil to be washed away along the slope of the contour furrows 0.02-0.02. Against the background without loosening, irrigation jets turned out to be 0.04-0.10 l / s in size. The advantages of contour irrigation on the slope against the background of soil loosening were expressed as follows (Table 1.):

Table 1.
Corn irrigation results on contour furrows

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| Water consump-tion in furrow, l/s | Biometric indicators of plants by the end of the growing season | | | Num-ber of irriga-tions | Irrigation norm, $m^3$/ha | Harvest, t/ha | |
|---|---|---|---|---|---|---|---|
| | Height, cm | Quantity | leaves, pcs | | | For grain | For Silage |
| A. On the background with loosening of the soil by 90 cm | | | | | | | |
| 0,185 | 217,1 | 16,0 | 2,1 | 4 | 3400 | 99,1 | 342,5 |
| 0,145 | 221,2 | 16,4 | 2,2 | 4 | 3420 | 101,0 | 351,0 |
| 0,105 | 229,5 | 17,6 | 2,4 | 4 | 3700 | 106,4 | 364,2 |
| | | | | | $S_x$=1,6% | $S_a$=2,3 ц | |

| Water consump-tion in furrow, l/s | Biometric indicators of plants by the end of the growing season | | | Num-ber of irriga-tions | Irrigation norm, $m^3$/ha | Harvest, t/ha | |
|---|---|---|---|---|---|---|---|
| | Height, cm | Quantity | leaves, pcs | | | For grain | For Silage |
| B. On the background without loosening the soil. | | | | | | | |
| 0,10 | 207,0 | 15,0 | 2,0 | 5 | 4930 | 95,2 | 320,8 |
| 0,07 | 210,2 | 15,2 | 2,0 | 5 | 4600 | 96,6 | 325,5 |
| 0,04 | 218,1 | 16,1 | 2,2 | 5 | 4580 | 100,2 | 337,6 |
| | | | | | $S_x$=0,36 % | $S_a$=0,5 ц | |

- irrigation rates have decreased (compared with the option without loosening the soil);
- The number of watering decreased by one;
- the highest yield of maize was obtained in the irrigation variant with a consumption of 0.105 l / s - 374.2 centners/ha for silage and 106.4 centners/ ha for grain with an irrigation rate of 3,700 m3 / ha.

Water saving by applying the optimal elements of the technique of discrete irrigation. In areas with a water deficit, subsurface and drip irrigation is recommended, but their high cost is noted

Table 2 shows the normative elements of irrigation equipment when using discrete irrigation.

Table 2

Corn irrigation results using the discrete water supply method[1]

| Polymer | Water consumption in furrow, l/s | Biometric indicators plants by the end of the growing season | | | Number of watering | Irrigation rate, $m^3$/ha | Crop, c/ha | |
|---|---|---|---|---|---|---|---|---|
| | | height, cm | number of leaves | pieces of cob | | | pieces Grains | Silage mass |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| -9 | 0,145 | 184 | 14,4 | 1,9 | 4 | 3180 | 92,6 | 365,5 |
| Without it | 0,100 | 170 | 13,0 | 1,6 | 4 | 2910 | 78,5 | 280,0 |
| | | | | | $S_x$=0,56% | | $S_a$=0,68 c | |

The data in the table indicate that the optimal length of the furrows during cyclical irrigation and the flow of water into the furrow will vary. In this case

Polymer K-9 reduces soil washout by 1.6 times. Furrows with K-9 turned out to be more convenient for discrete irrigation, because their throughput increases 1.5 times. This circumstance orients irrigators to the application of water consumption in the furrow 1.5 times more than in ordinary furrows, without washing away the soil, and in subsequent irrigation the flow to the furrow can be reduced by the amount of water discharge after the jet run.

To increase the moisture content in the soil, the use of K-9 + loosening the soil to a depth of 90 cm makes it possible to increase the moisture content when using discrete irrigation.

Harvest maize with discrete irrigation of the furrows, cut on the greatest slope. Against the background of soil loosening, the discrete supply of water to the furrows was carried out with the supply of water to ordinary furrows along the greatest gradient and in the same furrows using K-9. Discrete watering evens out moisture content along the furrow length due to a change in the soil absorbency during the intervals between water supply cycles 2 hours after the jet run. Due to the quality of soil moistening, advantages in the cost of water and yield are obtained in comparison with irrigation according to the greatest slope (Table 2). The attempt to supply water in a discrete manner without loosening was not successful - irrigation is heavily delayed in time, evaporation of soil moisture in the intervals between irrigation is more intense than with irrigation without interruption. The features of the discrete method imply that at first water was supplied to the left side of the 100 meter irrigated area for 2 hours, and then to the right side with the help of flexible hoses. This increases the efficiency of irrigation in terms of irrigation rate and yield, but irrigation time increases due to interruptions and decrease in soil absorption with shrinkage of soil aggregates along the furrow length during subsequent water supply cycles. However, the advantages of discrete irrigation in leveling off moisture are obvious (Table 2).

**Conclusion**

1. Developed concepts for the use of irrigation techniques with the closed use of water inside the field, which allows reducing or eliminating the discharge of water out of the field and filtration losses inside the soil, in conditions of negative processes: subsidence, suffusion, soil erosion; provide water savings of up to 30-48% compared with conventional furrow irrigation.

2. Schemes have been developed for the placement of advanced irrigation technologies along furrows on the on-farm irrigation system: contour irrigation and pulse-discrete irrigation.

3. In the conditions of the south of Uzbekistan, when choosing a basic technological scheme of irrigation, elements of irrigation equipment and irrigation methods, the following factors should be taken into account:

- high erosion and subsidence of the soil;
- weak soil permeability;
- the need to develop and implement relatively inexpensive methods and irrigation equipment with low operating costs.

In this regard, we set the task of conducting targeted in-depth research: on the development of water-saving and anti-erosion irrigation technology in relation to the conditions of southern Uzbekistan, their testing on specific experimental plots and the creation of practical recommendations for farms and farmers.

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