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Efficiency of Use of Resource-Saving Technology in Reducing Irrigation Erosion

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Abstract. Protecting soils from irrigation erosion is an urgent problem for many countries with arid climate, including the territory of Uzbekistan. It is known that there are a number of factors have for irrigation erosion, one of the main factor is depends on the movement of the water flow in the field vegetation bed. This paper presents results of a study of the laws of flow movement in fields of different shapes to assess and prevent irrigation erosion. Studies have shown that obtaining trapezoidal ridges in cotton irrigation can optimize the flow regime. At the same time, special constructed water meters were used for irrigation. The value of the hydraulic parameters of the flow in the field and the amount of erosion were determined, with taking into account the mode of movement and energy condition of the flow in the fields with a whole diameter of 15 mm in the water meter. As a result, in the washed part of the soil, the leaching of soil particles per season is 40.58 t / ha when irrigating cotton with ordinary simple straight furrows, and in the case of trapezoidal furrows, soil leaching is 13.07 t / ha when irrigated with a water meter with a hole diameter of 15 mm. formed.

Keywords. Irrigation, erosion, trapezoidal ridges, irrigating cotton, soil.

INTRODUCTION

Recent time, 1,100 million hectares area or in total 56 percent of the crop area is damaged from irrigation erosion, including 81% in Australia, 74% in Central America, 63% in North America, 50.6% in South America, 52.3% in Europe, 59.0% in Asia and 46.0% in Africa. [1,2]. Also, due to irrigation erosion around the world, annualy 75 billion tons of fertilized and topsoil is lost in agriculture [3,4]. Irrigation erosion leads to deterioration of plant nutrition and soil reclamation, agrochemical, agrophysical properties, crop yields and product quality [1,2,3,4].

Due to the severe shortage of agricultural land and water resources in the country, it requires the rational use of water resources. Efficient use of water and introduction of new technologies for irrigation of crops in areas with high slopes reduce water wastage and irrigation erosion, resulting in the prevention of adverse effects on agricultural production and the environment.

Problem statement. As a result of the negative impact of irrigation erosion, the Republic's agriculture annually produces less than 0.3 million tons of cotton from normal [1,5,6]. Due to this type of erosion process, the most fertile part of the soil, its fertilizers, are washed away by toxic agrochemicals, which not only reduces soil fertility, but also pollutes the environment. In most farms, under the conditions of typical gray soils, its driving layer is washed away. Scientists estimate that it takes 300 to 3,000 years for soil formation in a 20 cm layer [7,8,9].

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To produce a rich and high-quality crop from this type of soil, it is necessary to take control measures and apply more fertilizers and water than eroded soils. So far, most crops are irrigated by furrows, which have the following disadvantages: requires a lot of human works, same amount of water is not distributed to each furrow, excess irrigation water is used, each ridge needs to be covered with grass, paper or polyethylene, while the spread of the cultivator with the working bodies into the field, especially the ditches, causes cracking, while the polyethylene films do not rot quickly and pollute the environment [10,11].

Currently, irrigation is divided into geological (normal) and accelerated erosion types depending on the development of erosion processes [12].

In geological erosion, under the influence of meteorological factors, observed a moderate process of leaching of fine particles from the soil surface. In this process, it does not have an excessive effect on the composition and properties of the soil, over time, in the process of soil formation, the particles in the washed or eroded, discarded soil layers are restored.

Due to careless use of land, the loss of vegetation on gray soils, leads to increase erosion, resulting in accelerated erosion. In this case, the lost soil layers are not restores, the soil loses its fertility. These processes are called accelerated soil erosion.

SOLVING METHOD AND TECHNIQUES

One of the main factors in preventing irrigation erosion in irrigated areas is related to the regulation of water movement regime in irrigated areas. In the technology proposed in the article, the demand for water in the irrigation of cotton is determined on a refractometer, the beds are opened in the form of a trapezoid, and irrigation is provided with using a special device [13,14,15]. The main purpose of using the device is to control the movement of water in the field to a certain extent. The device consists of a flat wall with holes of different diameters in the middle of the flat wall. The parameters of the water transfer part of the device were determined based on the laws of motion of the water flow in the field [16,17,18]. Depending on the slope of the site, the diameter of the device in the experimental field was determined to be 15 mm.

The experiments were performed on beds with two different shapes (triangle and trapezoid). Based on field studies, the hydrodynamic parameters of the flow were determined for the control owner and the results are presented in the table (Table 1).

TABLE 1. Hydrodynamic parameters of the flow in the control valve (triangle)

№	*l, m*	*t, s*	*B, sm*	*Q, sm^3/s*	*ω, sm^2*	*R, sm*	*ϑ, sm/s*	*Re*	*Fr*
1	50	15	9,5	245	6,08	3,5	40,3	49491	0,4735

there: l- is the length of the furrow, m;t- is the temperature of the water, ^{0}C; - water speed in the field, m/s; B- is the width of the furrow along the water level, m; Q- water discharge, sm^3/s; - the cross-sectional area of the furrow, sm^2.

According to the laws of hydrodynamics [19,20,21], the Reynolds number represents the mode of motion of the flow and is determined by the following formula:

$$\mathrm{Re} = \frac{\vartheta 4R}{\nu}; \quad (1)$$

there: ν - is the kinematic viscosity coefficient, determined depending on the type and temperature of the liquid; R - hydraulic radius;

The Frud number represents the energy state of the flow and is determined based on the following formula [22-26]:

$$Fr = \frac{\vartheta^2}{g \cdot h}; \quad (2)$$

There: h- flow depth; g - is the acceleration of free fall;

Based on the research, the hydraulic parameters of the flow in the control unit were determined as follows:

Wet perimeter of the stream: $\chi = 2h\sqrt{m^2+1}$;

there: h- flow depth; m- slope coefficient.

Cross-sectional area of the stream: $\omega = mh^2$;

Hydraulic radius of flow: $R = \frac{\omega}{\chi}$;

Water discharge: $Q = \omega \cdot \vartheta$;

Based on the studies, the hydraulic parameters of the flow in the proposed furrow (trapezoidal shape) were determined and the results are presented in the table (Table 2).

TABLE 2. Hydraulic parameters of the flow in the trapezoidal form

№	t, s	B, sm	Q, sm^3/s	ω, sm^2	R, sm	ϑ, sm/s	Re	Fr
1	15	9,4	260	7,3	3,3	35,6	187368	0,08621

The hydraulic parameters of the flow for the proposed slope shape were determined as follows:

Wet perimeter of the stream: $\chi = b + 2h\sqrt{m^2+1}$;

The surface of the cross section of the stream is the section of motion: $\omega = (b + mh)h$;

Hydraulic radius of flow: $R = \frac{\omega}{\chi}$;

Water discharge: $Q = \omega \cdot \vartheta$;

Influence of the shape of furrows and irrigation methods on soil particle washing in irrigated eroded soils [27-31], t /ha

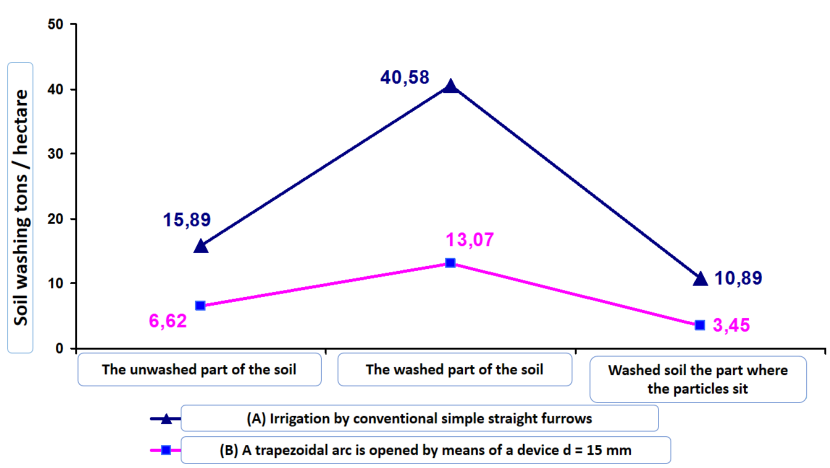

FIGURE 1. (A) Irrigation by conventional simple straight furrows (B) A trapezodial arc is opened by means of a device.

TABLE 3. Shape of the furrows and irrigation methods

The shape of the furrows and irrigation methods	Irrigation					In season
	1	2	3	4	5	
The unwashed part of the soil						
Irrigation by conventional straight furrows	4,47	3,05	3,38	2,71	2,32	15,93
Irrigation by means of a trapezoidal opening d = 15mm	1,21	2,06	1,13	1,34	0,88	6,62
Washed part of the soil						
Irrigation by conventional straight furrows	9,69	8,85	8,64	7,75	5,65	40,58
Irrigation by means of a trapezoidal opening d = 15mm	2,47	3,22	2,37	2,91	2,10	13,07
The part where the washed soil particles sit						
Irrigation by conventional straight furrows	2,18	2,32	2,75	2,26	1,38	10,89
Irrigation by means of a trapezoidal opening d = 15mm	0,79	0,76	0,84	0,69	0,37	3,45

According to the data in Table 3 and Figure 1, 15.93 tons of soil particles per hectare were washed during the season when conventional simple straight furrow were taken in the unwashed part of the soil and cotton was flooded, when trapezoidal furrowswere opened and new water meters with a hole diameter of 15 mm were installed 6.62 t / ha the soil was washed away or the washing processes were reduced by 2.4 times.

CONCLUSION

Based on the research and analysis in natural field conditions, it can be said that the hydraulic parameter of water flow in the trap is significantly reduced in the trapezoidal furrow (erosion accelerator) in the trapezoidal trays, compared to the traditional simple straight furrow irrigation method, when much water saves in new method in the field, reduced the washing of soil particles. As a result, the growth and development of cotton is optimized and its yield is increased due to the good retention of moisture in the soil and the emergence of an optimal nutrient regime.

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