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Improving the methodology of determination of appropriate elements of equipment irrigation technique

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Abstract: In the context of water scarcity, the effective use of river water in the use of all irrigation technologies, including the improvement of elements of irrigation techniques in the technology of furrow irrigation. In this regard, the rate of soil water absorption in field conditions was determined using Dolgov circles.Based on the results obtained, the water consumption to the furrows for a particular field condition was determined, taking into account the mechanical composition of the plowed and minimally cultivated field soil and the associated water absorption capacity.As a result, the most widely used irrigation method is based on the possibility of saving up to 20-27% of river water in plowed fields and 10-22% in minimally cultivated fields when using irrigated irrigation technology.
Keywords: Water permeability, irrigation technique, water problems.

Research work is being carried out in the country aimed at developing new scientific and technical solutions for resource-saving technologies and irrigation in the cultivation of agricultural crops. In this regard, research is being conducted to save water resources in crop irrigation. In this regard, special attention is paid to improving the method of determining the optimal elements of irrigation techniques that ensure the normal growth and development of agricultural crops, to conduct research aimed at substantiating the norms and timing of irrigation.

The water permeability of the soil depends on the granulometric composition of the soil, and its chemical properties, its structural state, density, porosity, moisture and duration of wetting. Water permeability is always lower in soils with heavy mechanical granulometric content than in soils with light mechanical content. Water permeability varies depending on the volume of water passing through the soil cross-sectional surface per unit time.

In order to determine the water consumption of the fields, the water permeability of the soil was measured in the “Dolgov circles” at the beginning of the winter wheat vegetation and at the time of pre-irrigation soil sampling. Based on the data obtained, the soil water absorption rate and the soil water absorption rate were determined.

In the experimental fields, the water permeability of the soil was determined for 6 hours each year before sowing of winter wheat and after harvesting of winter wheat using Dolgov circles, ie “inner and outer rings” according to irrigation procedures. The result of the detected data can be seen in the graph shown in Figure 1.

Irrigation is the most widely used method of irrigating crops. This method of irrigation is also common because it does not require excessive construction and costs. However, if this type of irrigation is neglected when used, a number of disadvantages also arise. These shortcomings include:

- high consumption of water for evaporation during irrigation and in the days after irrigation;
- uneven wetting of the field when irrigation is carried out, when the microrelief of the field is poor and the leveling is poor;
- water leakage from the root layer for filtration and discharge at the beginning and end of the field;
- The irrigation process is relatively labor intensive.

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These shortcomings can be mitigated if the elements of the irrigation technique are chosen correctly. To do this, it is necessary to determine the following parameters that correspond to the specific field conditions of the elements of irrigation techniques:

- Egat length (l), meters;
- Water consumption per unit (q), l / s;
- Time of water reaching the end of the slope (t), hours;
- Mechanical composition and water permeability of soil (t), mm / h;
- Parameters of the arch (width, slope, bottom and depth of the arch);
- Total irrigation time (T), hours understood.

The general assessment of the level of water use in the irrigation process is called FIK of irrigation techniques.

$$\text{Efficiency}_{\text{irrigation}} = \frac{W_{\text{net}}}{W_{gross}}, \qquad (1)$$

Here: W_{net} - volume of water remaining in the root layer, m^3/ha;
W_{gross} - volume of water supplied to the field, m^3/ha.

The higher the efficiency, the better the irrigation, the more water is used in the field, the less water is lost to deep filtration below the root layer and the less it is discharged.

Improving the elements of irrigation techniques in the field of winter wheat sown in different technologies, based on field experiments.

One of the most important factors determining irrigation techniques is the ability of the soil to absorb water. Soil water absorption capacity is divided into five classes:

- A-index, very high permeability soils,> 50 mm/h;
- B-index, strongly permeable soils, 20-50 mm/h;
- V-index, average permeable soils, 10-20 mm/h;
- G-index, weakly permeable soils, 5-10 mm/h;
- D-index, very weakly permeable soils, <5 mm / h.

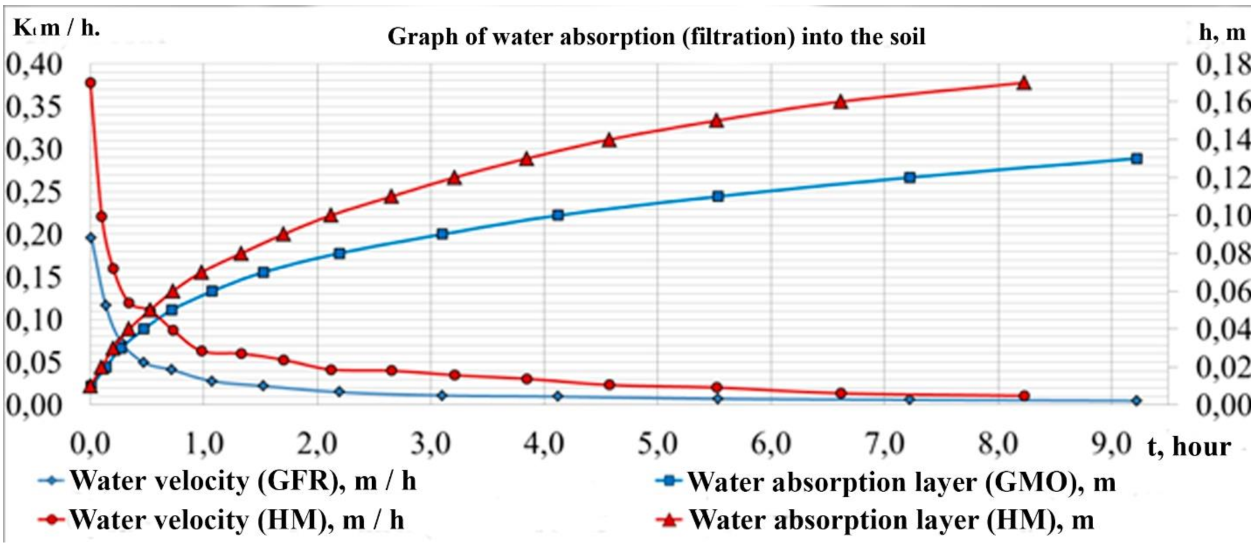

Figure 1. Absorption graph of experimental field soil planted with winter wheat between cotton rows (HQ) and plowed area (H.M).

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In addition, the ability of the soil to absorb water is influenced by the mechanical composition of the soil and the type and return of agro-technical measures performed.

Research work on the technology of sowing winter wheat in semi-hydromorphic and automorphic soils of Jizzakh region was carried out in 3 repetitions.

The research was carried out on two different planting technologies, namely, sowing of winter wheat in the open field and planting with minimal processing between rows of cotton. In order to increase the efficiency of the use of elements of irrigation techniques, the water absorption rate of both experimental field soils was determined using Dolgov circles. We can see that the water absorption capacity of the soil also differed as the agrotechnical measures carried out in our experimental fields differed sharply from each other (Tables 1 and 2). Based on the measurements of the water absorption rate of the soil, we construct stable soil water absorption graphs and determine the sustainable water absorption capacity of the soil based on optimizing the amount of water applied to each field (Figure 1).

Table 1. Calculation of elements of irrigation technique of winter wheat experimental field planted between rows of cotton

long furrow	Irrigation time		Duration of irrigation		Thomson 90^0	water consumption of a canal at the beginning of the canal		
meters	hour	minutes	minutes	seconds	H, sm	Q, l/s	DQ, l/s	liter
0	11	0	0		3,3	0,28		
10	11	8	8	480	3,2	0,26	0,27	128
20	11	19	11	660	3,2	0,26	0,26	169
30	11	32	13	780	3,6	0,34	0,30	234
40	11	49	17	1020	3,8	0,39	0,37	377
50	12	10	21	1260	3,6	0,34	0,37	465
60	12	34	24	1440	2,8	0,18	0,26	380
70	13	2	28	1680	4,0	0,45	0,32	530
80	13	35	33	1980	3,9	0,42	0,43	860
90	14	14	39	2340	3,8	0,39	0,41	953
100	14	55	41	2460	3,8	0,39	0,39	969
Spillway	16	0	65	3900	2,7	0,17	0,28	1095

The rate of water absorption between the experimental fields of winter wheat was 0.024 m / h and the rate of water absorption of the experimental fields of autumn wheat was 0.027 m / h.

Improvements to the elements of irrigation techniques were determined by measuring other parameters required to perform calculations in the field. The length of the Egat was selected to be 100 meters based on the recommendations of the Ministry of Water Resources.

In determining the elements of irrigation techniques Qambarov B.F., Tsoy O.G. used methodological recommendations.

Table 2. Calculation of elements of irrigation technique of winter wheat experimental field planted between rows of cotton

Watering times	Irrigation time			Water consumption			Square	The norm
	minutes	seconds	hour	$Q_{average}$	l/s	liters	$м^2$	$м^3$/ha
Reach out	235	14100	3,92	0,34	0,36	5066	0,0126	**563**
Moisturizing	65	3900	1,08	0,28	0,28	1095	0,0126	**122**
Total time	300	18000	5,0	0,33	0,34	6162	0,0126	**685**

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Table 3. Table of calculation of elements of irrigation technique of experimental field planted with plowed autumn wheat

long furrow	Irrigation time		Duration of irrigation		Thomson 90^0	water consumption of a canal at the beginning of the canal		
meters	hour	minutes	minutes	seconds	H, sm	Q, l/s	DQ, l/s	liter
0	9	0	0		3,3	0,28		
10	9	15	15	900	3,9	0,42	0,35	314
20	9	32	17	1020	3,9	0,42	0,42	429
30	9	52	20	1200	3,9	0,42	0,42	505
40	10	15	23	1380	3,9	0,42	0,42	580
50	10	41	26	1560	3,8	0,39	0,41	635
60	11	11	30	1800	3,9	0,42	0,41	733
70	11	47	36	2160	3,8	0,39	0,41	880
80	12	27	40	2400	3,8	0,39	0,39	946
90	13	12	45	2700	3,8	0,39	0,39	1064
100	14	1	49	2940	3,8	0,39	0,39	1159
Ташлама	16	0	119	7140	2,9	0,20	0,30	2123

In the winter wheat experimental field planted between rows of cotton, the 2nd irrigation norm in option 3 was 743 m^3/ha, and the irrigation duration was 7 hours. It took 5 hours and 575 m^3/ha to reach the end of the Egat. Egat was given 0.36 l/s of water.

In the experimental field planted with plowed autumn wheat, in option 6, the 2nd irrigation norm was 685 m^3/ha, and the irrigation duration was 5 hours. It took 4 hours and 563 m^3/ha to reach the end of the Egat. Egat was given a water consumption of 0.4 l/s, and the slope of the field was 0.001.

Table 4. Results of calculation of elements of irrigation technique of experimental field planted with plowed autumn wheat.

Watering times	Irrigation time			Water consumption			Square	The norm
	minutes	seconds	hour	$Q_{average}$		minutes	seconds	hour
Reach out	301	18060	5,02	0,40	0,40	7244	0,0126	**575**
Moisturizing	119	7140	1,98	0,30	0,30	2123	0,0126	**168**
Total time	420	25200	7,0	0,39	0,37	9367	0,0126	**743**

Analysis of field studies on the study of the elements of irrigation techniques showed that the process of movement of water flow in the field, the length of the field and the possibility of its redistribution, corresponds to the length of the moisture distribution.

$$\frac{X_t}{l_{\text{humidity}}} = \frac{1}{1+\dfrac{A}{t^{\alpha}}} \quad (2)$$

where l is the moisture content limit of the egat, m.

$$l_{\text{humidity}} = \frac{q_0}{\chi * K_{\text{stable}}} \quad (3)$$

where q_0 - water consumption per head, m^3/hour;
X_t –time of water movement distance, m;

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A and α –are parameters;параметрлар;

χ – is the active wetting perimeter of the egat, m;

K_{stable} – stable water absorption rate of the soil, m/h.

From expression 1 above *X*=*f*(t) function can be obtained and we accept the following elements of irrigation techniques:

$$X_t = l_{\text{humidity}}\left(1+\frac{A}{t^{\alpha}}\right)^{-1} \quad (4)$$

Elements of irrigation techniques *A* and α parameters are calculated on the basis of experimental data for the case where t = 1, during the experimental irrigation. Here are the expressions:

After the water flow reaches the end of the slope $t_{humidity.}$ – wetting and *t* determine the total irrigation time.

$$t_{\text{humidity}} = \frac{V_{net.} - V_{\text{reached.}}}{K_{\text{leave.}} \cdot \chi_{\text{leave.}} \cdot l_{\text{furrow}}} \quad (5)$$

$$t = t_{reached} \cdot t_{humidity.} \quad (6)$$

For an egat, we determine the water consumption that goes until the water reaches the end of the egat.

$$V_{reached} = q_o \cdot t_{reached} \quad (7)$$

Once the water reaches the end of the ditch for an egat, we determine the water consumption that goes into fully wetting the root layer.

$$V_{humidity} = V_{net} \cdot V_{reached} \quad (8)$$

For a ditch, once the water reaches the end of the ridge, we determine the water consumption, which ensures that the root layer is completely moistened, preventing excessive water consumption, m^3/h.

$$q_{humidity} = V_{humidity} \cdot t_{humidity} \quad (9)$$

The flow movement of the water in the effluent is controlled at two values, moderate and active humidification.

The calculated normal water flow to the egat was determined by measuring the water absorption capacity of the experimental field soil and the parameters of the egat (slope, bottom, height of water filling, side slopes and slowing of water movement). The results of the calculations are detailed in Table 5 below.

Table 5. Development of elements of irrigation techniques for winter wheat sown in different technologies based on the results of field research

Elements of irrigation techniques	Formula, unit	For plowed area	For the area planted between rows of cotton
The water absorption capacity of the soil	K_{stable}	0,04	0,03
	K	0,05	0,04
Time for the water to reach the end of the ridge	$t_{attention.}$, соат	5,00	3,33

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Time to moisten the root layer	$T_{humidity}$, соат	5,79	6,31
Maximum wetting length of the ditch	$\ell_{humidity.}$, m	160,85	120,12
The wet perimeter of the canal	χ_{cp}, m	0,22	0,43
Active wet perimeter of the canal	χ_a, m	1,00	0,98
Total watering time	t, соат	10,79	9,64
Water consumption at the end of the spring	$V_{attention.}$, m^3	7,38	4,56
Water consumption for humidification	$V_{humidity.}$, m^3	5,14	7,16
The net amount of water supplied to the root system	V_{net}, m^3	12,52	11,72
Total water consumption per unit	$V_{total.}$, m^3	15,93	13,19
Water consumption for filtration and disposal	$V_{wasting.}$, m^3	3,41	1,47
Water consumption for filtration and disposal	$V_{wasting.}$, m^3/ha	283,8	244,3
Efficiency of irrigation equipment	Profitability ratio, %	78,62	88,89
Water consumption until the end of the season	q_o, m^3/time	1,48	1,37
Consumption of water supplied to moisten the root layer	q_{hum}, m^3/time	0,89	0,79
Water consumption until the end of the season	q_o, l/s	**0,41**	**0,38**
Consumption of water supplied to moisten the root layer	q_{hum}, l/s с	**0,25**	**0,22**

In Jizzakh region, in the conditions of medium and light sandy soils, the water flow to the fields for the experimental field planted with winter wheat between rows of cotton was 0.38 l/s, the water flow to the fields for the experimental field planted with plowed autumn wheat was 0.41 l/s. If we pay attention to the results of the calculations, once the water reaches the end of the field, there will be an excess water consumption of 284-294 m^3 per hectare for filtration and discharge. To save the excess water consumption, we determined the calculated water consumption of the egat to ensure that it is evenly distributed and absorbed into the root layer. The wetting water level for the experimental field planted with winter wheat between rows of cotton was 0.22 l/s, and the wetting water level for the experimental field planted with plowed autumn wheat was 0.25 l/s.

When irrigating winter wheat, the slope is 0.002, the distance between the rows is 0.9 m when sowing between rows of cotton and 0.6 m when sowing in the open field. was reduced to 0.22-0.25 l/s at the end of the year, and in automorphic soils, up to 22% less water was used when planted between rows of cotton and up to 27% less when planted in the open. In semi-hydromorphic soils, up to 10% less water was used when cotton was planted between rows than control, and up to 20% less when planted in the open.

CONCLUSIONS

1. As a result of improving the elements of irrigation techniques in the cultivation of winter wheat, the efficiency of total water consumption relative to the yield was found to be 122 m3 / ts, 126 m3 / ts and 150 m3 / ts in three years. .

2. In the case of medium and light sandy soils, the slope of the field is 0.002, the distance between the furrows is 0.9 m when planted between rows of cotton and 0.6 m when planted in the

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open field, the length of the furrow is 100 m. it is recommended that the water consumption be given first 0.38-0.41 l / s, then the water consumption be reduced by 0.22-0.25 l / s.

3. In the cultivation of agricultural crops, on average 22-27% less water in experiments under automorphic soils, due to the reduction of wasteful costs for filtration and discharge as a result of the correct choice of the length of the ridges and the water consumption to it based on the determination of individual irrigation techniques on the mechanical composition and slope of the soil In experiments carried out in semi-hydromorphic soils, it is possible to achieve an average water consumption of 10-20% less, and it is recommended to divert the saved water to the next field.

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