The influence of irrigation regimes on cotton productivity

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Abstract. In the article, the authors found that improving soil moisture with irrigation has a positive effect on the growth of cotton, but does not always have a positive impact on the number of bolls. According to the results of the research, it was found that the flowing waters of the Karshi steppe are located at a depth of 1.5-2.0 m and 3-4 m. It has been determined experimentally that the irrigated moisture content of cotton soil under light gray soil conditions is 70-75-65% relative to incomplete field moisture content. According to the research carried out in the first experimental area, the presence of seepage water on its surface, and the salinity of the soil showed the optimality of a particular regime.

1 Introduction

Agriculture is considered one of the important sectors of the economy of Uzbekistan. Today, it is one of the sources of the production of food products, along with the production of export production, which divides the product resources into food products, processing industrial enterprises, industrial production products.

There should be special attention on the proper placement of agricultural crops, irrigation, and soil fertility applying the rotation method. One of the important factors is the development of agriculture in order to improve the reclamation of irrigated lands.

With its natural conditions Kashkadarya region is one of the most convenient places in Uzbekistan for irrigated agriculture. Vegetables, wheat, sugarcane, cotton, fruit trees, vines and other crops are grown in this place, which carry high value for the national economy. An abundant and high-quality harvest is gained from them. In terms of the weight of products grown in irrigated agriculture Kashkadarya oasis is in the leading position in our republic. In the last 3 years (2006-2008), 426,000-458,000 tons of cotton were grown. This is about 10-16 percent of the main crop grown in our republic.

Oasis`s soil is fertile, there is enough labor, machinery, minerals and fertilizers, and the sun heat is abundant. This makes it possible to further increase the production of cotton and other agricultural products in the oasis. However, there is a shortage of water in the country. Here, water is always considered to be a minimum factor. Therefore, development of ways and new methods of rational use of existing water resources, as well as their implementation, is one of the most urgent issues in irrigated agriculture in the oasis.

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A positive solution to this issue will create a solid foundation for a sharp increase in the production of agricultural products in the oasis and, in return, for the improvement of its economic conditions. As a result, villages will become more prosperous, and people's well-being will increase. On the other hand, on the basis of the first President of the Republic of Kashkadarya, Islam Karimov, published in 2009, "The World Financial and Economic Crisis, Ways and Measures to Eliminate It in the Conditions of Uzbekistan", the Anti-Crisis Policy was adopted for 2009-2012. is the reason for its valuable contribution to the successful implementation of the program of measures. Currently, about 515,000 hectares of land are irrigated and cultivated in the Kashkadarya oasis.

2 Materials and methods

It is important to perform this activity for two different purposes regarding the use of irrigation water in irrigated agriculture. First of all, when irrigating cotton, wheat, corn, alfalfa, vegetables, sugarcane and other agricultural crops, it is necessary to develop such optimal irrigation methods, standards and techniques, in which crops to ensure good growth and development, early abundant and high-quality harvest. After that, such a regime of crop irrigation should create opportunities to stabilize the regime of runoff, reduce their mineralization, desalinate old saline lands, prevent secondary salinization, and preserve the purity of the ecological environment.

The impact of irrigation on land reclamation is very large in the middle and lower regions of the region. More than 67 percent of the irrigated areas of the oasis are located in these regions. Water supply at the expense of Amudarya water was assessed as good, but the effect of irrigation water is not satisfactory.

In accordance to the results of long-term research on cotton in the conditions of the Karshi steppe, watering the crop ahead of time or delaying it, as well as excessively reducing or increasing the rates of irrigation, are harmful. In this case, the yield of cotton will not decrease and its quality will not decrease, but the water regime will be disturbed, and the land will become secondary salinity. The only way to prevent this is to develop optimal irrigation regimes for cotton and other crops in rotation. Scientific research has been conducted in this direction since 1971. Initially, the research was aimed at studying medium and fine fiber cotton varieties, as well as alfalfa and corn irrigation regimes in the conditions of barren soils of the Karshi oasis. Then our research in this area was continued in the conditions of light gray soils in the middle region of the country. In this case, the mode and methods of watering the "Termiz-14" variety of thin-fiber goza were studied in the conditions of two (III and VIII) hydromodule districts with different land reclamation conditions.

3 Results

It is known that the irrigation regime has a great influence on the growth and development of cotton. Especially, seepage water was evident in areas located at different depths. The growth of cotton and the accumulation of crop elements depend on the applied agrotechnical measures, the main of which is the irrigation regime. The effect of the compared irrigation regimes on the growth of cotton was shown after the first irrigation in the water period. This event was held in the field with deep seepage water in the beginning of June, and in the field with surface seepage water in the second half of July.

According to the experiment, the growth and development of thin fiber cotton was observed in variant 1, where the soil moisture regime with irrigation was equal to 60-70-60% of the field moisture capacity. The reduction of irrigation moisture to 60% of

Incomplete Field Moisture Capacity (IFMC) before the flowering period caused the cotton to stop growing and this negative situation could not be corrected even by supplying it with water in subsequent periods. By September 1, the height of cotton in this variant was 48.3-58.0 cm in the first experimental field, and 79.5-98.6 cm in the second field. The height of the cotton stalk increased depending on the soil moisture content, and the highest value was observed in the case of 70-75-65% moisture content of the experiment. Here, in the first experimental field, the length of the cotton stem is 76.0, respectively, according to the years of the experiment; 64.5 and 59.8 cm, and 112.0 in the second experimental field; It was 101.1 and 95.3 cm, 17.2 compared to the condition based on 60-70-65% humidity; It turned out to be 12.3 and 17.8 cm high.

According to variant 3, which is equal to 70-75-65% of irrigated moisture, favorable water conditions for good growth of cotton were created in both conditions of runoff water. In this variant, by the end of the growing season, the height of cotton in the first experimental field was 60.0-70.2 cm, and in the second field it was 93.6-98.3 cm. In option 2, where the wet mode of irrigation was 70-70-65%, the length of the cottons was equal to that in option 3, compared to the first experimental field, and in the second experimental field, this mode of irrigation gave a lower outcome.

Fig. 1. The researchers are observing the crop elements of cotton grown under optimal irrigation conditions.

Various regimes of irrigation had an effect on the accumulation of crop elements. In the 1st variant of the experiment with irrigated humidity of 60-70-65%, the non-irrigation of cotton before flowering affects not only the height of the cotton head stem, but also the crop elements, including it has been proven that it has a negative effect on the number of sacs. In this irrigation regime, it was found that 8.7-9.8 pods were collected in the cottons of the first experimental field, and 9.8-12.2 pods were collected in the cottons of the second experimental field. When we compared these numbers with the parameters of the option with a wet mode of 70-75-65%, we were sure that they were 3.1-3.4 and 7.1-10.5 units less, respectively. In the experiment, in the full (75-75-65%) mode of irrigation, there was no correlation between the rapid development of cotton and the number of bolls, that is, even if the height of the cotton was relatively high, the cysts did not increase accordingly.

In the first experimental field, it was found that the number of pods in this variant is equal to the indicators of the 3rd variant, and in some cases even less. In the second

experimental field, this amount increased even more in favor of the 3rd variant and the difference was 2.6-4.8 units. In the first field, there were no differences in yield between the options when the irrigated wet regime was equal to 70-70-65% of the field moisture capacity and 70-75-65%. In the second experimental field, it was found that the 3rd variant with a moisture regime of 70-75-65% had a clear advantage.

If we compare the results of the research conducted in the fields where seepage waters are located at different depths, it should be stated that the development of thin fibrous cotton was observed relatively slowly in the conditions where seepage waters were located on the surface.

Because of this, the mechanical composition of the soil and weak salinity have a significant effect. The mineralization of runoff waters and their proximity to the surface of the earth caused imbalances by changing the water-physical and chemical properties of the soil, as well as the air-heat and nutrition regimes to a certain extent.

Table 1. The impact of various irrigation regimes on the growth and development of cotton.

Number of variant	1st July						1st August					
	The height of the main stem, cm			Number of crop joints			The height of the main stem, cm			Number of crop joints		
	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year	1st year	2nd year	3rd year
1st- field of experience												
1	26.2	38.0	27.8	5.7	9.1	9.3	55.0	46.8	46.3	12.8	12.1	11.0
2	38.0	41.1	31.0	6.1	9.2	7.0	62.0	53.8	53.7	13.6	13.2	13.1
3	37.1	41.5	32.0	7.4	10.2	10.9	66.1	54.2	53.6	17.0	13.3	13.3
4	40.1	46.1	35.2	7.2	11.2	11.3	69.9	54.4	51.7	14.0	13.4	13.9
2nd - field of experience												
1	33.6	29.6	28.3	3.3	6.9	9.3	73.4	67.2	65.0	13.2	15.0	15.6
2	31.7	39.2	28.1	3.1	7.1	9.6	76.2	71.5	75.8	13.4	19.7	18.6
3	32.6	39.3	39.1	3.3	8.1	9.6	78.6	72.1	81.4	14.3	21.3	16.7
4	34.6	40.4	46.2	3.4	7.0	13.6	77.3	80.6	83.7	13.8	20.8	17.6

It can be concluded that increasing the soil moisture with irrigation in such conditions has a positive effect on the growth of cotton, but it does not always have a positive effect on the increase in the number of bolls. According to the results of the research, seepage waters of the Karshi oasis are located at a depth of 1.6-2.0 m and 3-4 m, and in the conditions of light gray soil, cotton has 70-75-65% relative to the irrigated moisture of the soil. It was concluded that irrigation is the most suitable moderate regime during the period. In the first experimental field, seepage water is located on the surface, but the salinity of the soil indicates the optimality of the permanent regime.

We are aware of that the genetic layers have a homogeneous structure, so it becomes lighter from top to bottom. Different amounts of carbonates can be accumulated in different layers of the soil. On the walls of the first experimental field, carbonates are evenly distributed over the surface, while in the second experimental field, they are scattered starting from the 80 cm layer.

Capillary capacity of the soil moisture. In the aeration layer, the ability of soil soils to carry capillary moisture is integrally dependent on the mechanical composition, structure and joint of the layers. The rate of capillary wetting is higher and the height is lower in a light soil with a mechanical composition than in a heavy soil. At the same time, capillary wetting occurs faster in soils with a homogeneous structure or downwards and soft jointed soils, compared to layered or downwardly heavy and densely jointed soils. The irrigation regime and water demand of agricultural crops, especially cotton, are closely related to the degree of capillary moisture.

Table 2. Mechanical composition of the soil of the first experimental field.

Soil layers, cm	Amount of fractions, % and size (mm)								
	1.0	**1.0-0.25**	**0.25-0.10**	**0.10-0.05**	**0.05-0.01**	**0.01-0.005**	**0.005-0.001**	**less than 0.001**	**0.01-0.001**
0-10	-	0.7	0.1	16.1	39.5	14.0	14.0	15.6	43.6
10-20	-	0.1	1.0	15.4	38.5	11.6	17.5	16.0	45.0
20-30	-	0.3	1.1	23.4	30.0	13.5	14.0	17.5	45.0
30-40	-	1.0	0.4	30.6	27.0	14.0	13.0	14.0	41.0
40-50	-	1.0	0.2	47.4	18.0	11.0	11.0	11.5	33.5
50-60	-	0.1	1.1	28.3	36.5	9.5	12.1	12.5	34.0
60-70	-	0.7	0.7	31.1	38.0	7.5	9.5	12.5	29.5
70-80	-	0.4	0.2	27.4	36.4	11.0	12.0	12.5	35.5
80-90	-	0.8	0.8	20.8	49.5	9.0	11.0	8.1	28.0
90-100	-	0.8	0.3	29.9	41.5	9.0	8.5	10.0	27.5
100-110	-	1.0	0.2	21.7	45.0	13.5	8.0	10.6	32.0
110-120	-	1.2	1.1	32.7	30.0	14.0	11.5	9.5	35.0
120-130	-	0.2	1.0	48.4	16.0	16.6	9.1	9.0	34.6
130-140	-	0.5	0.2	31.8	36.5	10.6	11.5	9.1	31.0
140-150	-	0.7	0.5	30.5	43.6	9.0	8.0	8.0	25.0
150-160	-	0.1	0.7	28.3	39.0	10.1	10.5	11.5	32.1
160-170	-	0.8	0.3	25.1	39.6	13.5	10.0	11.1	34.5
170-180	-	0.5	0.2	42.3	29.6	8.0	8.1	11.6	27.5

Fig. 2. Determining the field moisture capacity of the soil by the square frame method.

4 Discussion

In accordance to the results of a three-year study, the amount of cotton harvested in the first harvest in this variant was 20.6% in the first experimental field, and 27.4% in the second. In fact, it proved that these indicators reached 33.3 and 34.5%, respectively, in the regime of 70-75-65% irrigation.

In both experimental fields, early ripening of the crop is observed in the strict regime (60-70-65%) of irrigation. In the cotton season, it was found that the rate of ripening of cotton occupied intermediate conditions in the conditions of 70-70-65% and 70-75-65% of the soil with irrigation. Concluding the results of the research, it can be mentioned that the highest productivity was achieved in the regime of 70-75-65% irrigation in both experimental fields with different amelioration conditions.

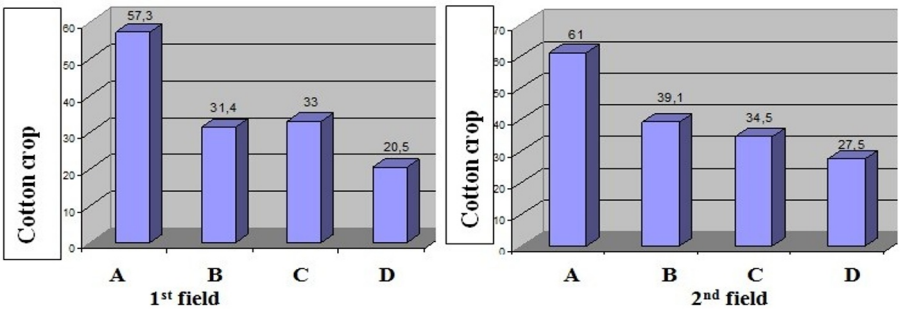

Fig. 3. The effect of cotton irrigation regime on the weight of the first cotton crop: A- Option 1, B-Option 2, C-Option 3, D-Option 4.

In accordance to the results of the research, a relative decrease in fiber output regardless of the depth of seepage was observed in the 4th variant of the experiment, that is, in the conditions where irrigation was carried out according to the 75-75-65% regime. According to the results of the study, according to the reclamation conditions, the thin-fiber cotton in shallow and deep, saline and non-saline lands with irrigated wet regime of the soil is 60-70-65 and 75-75-65%. showed that irrigation based on solid and partial regimes is not economically effective.

In both experimental fields, the highest efficiency was achieved when cotton was irrigated according to the wet regime of 70-75-65%. In favor of this regime, conditional net income of 242,700 soums per hectare was obtained in fields with shallow seepage and saline soil.

5 Conclusion

It can be summarized that, from the above-mentioned points, it is necessary to carry out reserve irrigation as a very important agrotechnical measure in the lands of Karshi oasis with weak salinity. The effectiveness of reserve irrigation is increased due to the combination of other agrotechnical measures during the growing season - feeding, inter-row cultivation, weed control. Coordination of measures prevents the rising of salts from the lower layers and allows maintaining the surface active layer of the soil in a meliorational state suitable for agriculture during the growing season.

In the conditions of light gray soils of the Karshi oasis, thin-fiber cotton can be irrigated at 70-75-65% relative to the irrigated moisture regime of the soil in both conditions of the depth of irrigation water (1.4-2.0 and 3.6-4.0 m) opportunities to reduce water consumption per 1 s of goods are created. At the same time, this irrigation mode was one of the leaders in terms of the crop grown per 1 m3 of water.

The analyzes were carried out in the conditions of light gray soils that have been irrigated since ancient times. That is, the experimental fields are very different from each other in terms of water-physical properties and melioration conditions of the soil.

Light gray soils occupy 19.3% of the land reserve of the Kashkadarya oasis. They are considered the main source of production in the cultivation of medium and thin fiber cotton and other agricultural crops and their high yield.

The soils of the area where the seepage waters are located on the surface (1.6-2.0 m) are distinguished by the medium sand mechanical composition, relative density of the joint and weak chloride-sulfate type salinity, at the same time, the average amount of mineralization of the seepage waters. Field soils with deep seepage water (3.5-4.0) are composed of non-saline loam and light sand, with soft joints and favorable water, air and physical properties.

In the first experimental field where seepage water is on the surface, the height of capillary rise in the aeration layer of the soil reaches 70-80 cm. This determines the role of cotton as an additional resource in water consumption. In the second field, where seepage waters are located deep, the capillary moisture rises by almost two times higher than in the first field and improves the moisture supply of the soil in this layer.

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