

# Analysis of soil composition in experimental areas where scientific research is conducted

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**Abstract.** According to this hydromodule, scientifically based irrigation regimes of cotton rotation crops for hydromodule districts were developed for the conditions of mountainous and desert regions of the region. It was determined that the specific mass of the soil of the first area is slightly heavier than that of the second area. Determination of water permeability of the soil in the experimental areas was carried out in the spring of the year when the experiment began.

## 1 Introduction

Agriculture is one of the important sectors of the economy of Uzbekistan. This sector meets the demand of the population of our country for food products, and the demand of the processing industry for raw materials, and is considered one of the promising sources of strengthening the export potential.

On December 9, 2019, the President of the Republic of Uzbekistan Sh.M. Mirziyoev spoke with the participants of the meeting dedicated to the day of agricultural workers about the most important tasks in the field of agriculture, which is the leading branch of our economy. Currently, more than 51% of the population in our country lives in rural areas. The share of agricultural products in the country's gross domestic product does not exceed 17%. The processing volume of industrial products does not even reach 10%. However, they said that in developed countries this figure is more than 50%. In this regard, the need to develop a comprehensive program for further agricultural reform was emphasized. It is very important to grow agricultural products, increase productivity and effective realization. It is an important issue to develop the development of tree, vegetable and fruit products with high productivity based on modern agro-technologies [1].

It was mentioned that proper placement of agricultural crops, irrigation, and soil fertility should be paid attention to using the rotation method. Improvement of the reclamation of irrigated lands is one of the decisive factors in the development of agriculture.

In the strategy of actions, it is possible to improve the reclamation condition of irrigated lands, rational and economical use of water resources and, on this basis, to achieve production stability of agricultural products. In the action strategy, the implementation of advanced irrigation technologies will be systematically continued and will create a basis for increasing water supply and productivity of crops in the conditions of global water scarcity.

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According to its natural conditions, the Kashkadarya oasis is one of the most favorable places in Uzbekistan for irrigated agriculture. Cotton, wheat, vegetables, sugarcane, fruit trees, vines and many other crops are planted in this place, which are considered valuable for the national economy, and abundant and high-quality harvests are obtained from them. Kashkadarya region takes the leading place in the republic in terms of the weight of products grown in irrigated agriculture [2].

## 2 Materials and methods

In the technology of cotton cultivation, much attention is paid to the irrigation regime, but this issue has not been well studied in the light gray soils of the Karshi steppe. In our research, we have developed optimal irrigation regimes that ensure early and stable abundant harvest of thin-fiber cotton in areas where seepage waters of the Karshi steppe are located at different depths, and we have studied the effect of these regimes on land reclamation. we made learning the main goal. In solving this problem, we considered finding solutions to the following problems as important tasks facing our research:

- Study of the main water-physical and chemical properties of soils, which are considered the main factor in determining the number, duration and standards of irrigation, taking into account the depth of seepage waters.
- Researching the irrigated wet regime in pale gray soils with deep and superficial seepage water and determining its optimal lower limit.
- To determine the optimal number, duration and standards of irrigation and the amount of water consumption of cotton in accordance with the depth of seepage water.
- To study the influence of the regime of watering thin-fiber cotton on the nutrient and salt regimes of the soil, as well as on the level of mineralization of runoff waters.
- To study the influence of the irrigation regime on the growth, development and yield of cotton with thin fibers.
- To study the influence of the depth of seepage on the amount of cotton dry biomass and the photosynthetic potential of the leaf surface.
- To study the influence of the irrigation regime on the yield of thin fiber cotton and the technological quality of cotton fiber.
- Determining the gross consumption of irrigation water, absorption coefficient and productivity under conditions of different irrigation regimes and seepage depth.
- Determining the economic efficiency of the cotton irrigation regime depending on the depth of seepage water.
- Based on the results of the research, it is planned to develop irrigation regimes for cotton rotation crops in hydromodule districts for the conditions of the desert region and give practical recommendations.

The soil in the aeration layer consists of a thick layer of sand formed on loess deposits. According to the results of morphological interpretation and mechanical analysis of the soil sections, the soils of the experimental areas have light and medium sandy mechanical composition [3-4]. The soils of the first experimental field consist only of medium loam to alluvial soils. However, the soil in the upper 0-40 cm layer differed from the lower layers by the large amount of physical clay (41.0-45.0%). The soil structure of the second experimental field is slightly different, and its arable layer contains much less physical clay (29.5-33.0%). Under the arable layer, that is, from 40 cm to 70 cm, the mechanical composition becomes lighter, then in the 70-80 cm layer, medium sand begins, then light sand, and by reaching the layers of 130-150 cm, we encounter medium sand, after that, a light sandy layer goes up to the seepage. Thus, the soil of the first experimental field is composed of medium sand, and the soil of the second experimental field is composed of

medium arable layer, and from below the arable layer to the seepage water, it is composed of medium and light sand.

### 3 Results and Discussions

The irrigation regime of cotton and other agricultural crops is strongly influenced by the mechanical and water-physical properties of the soil (Table 1).

**Table 1.** Mechanical composition of the soil of the second experimental field.

Layer depth, <i>sm</i>	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	-	0.5	1.4	23.1	45.5	8.0	10.0	11.9	29.5
10-20	-	0.7	1.1	20.7	44.5	9.5	9.0	14.5	33.0
20-30	-	0.1	1.5	23.4	50.5	9.0	8.5	7.0	24.5
30-40	-	0.1	0.8	26.6	43.5	12.5	7.5	9.0	29.0
40-50	-	0.1	0.8	36.1	40.0	7.5	7.0	8.5	23.0
50-60	-	-	0.5	38.0	42.0	6.5	7.5	7.5	19.5
60-70	-	-	0.9	41.1	38.0	5.5	8.5	6.0	20.0
70-80	-	-	0.9	43.2	26.0	16.0	7.5	7.0	30.5
80-90	-	-	0.6	31.4	49.5	6.0	6.0	6.5	18.5
90-100	-	-	0.1	32.4	49.5	7.0	5.0	6.0	10.0
100-110	-	-	1.1	38.9	43.5	6.5	5.5	4.5	16.5
110-120	-	1.9	2.5	31.6	45.0	7.5	6.5	5.0	19.0
120-130	-	1.1	2.3	32.6	46.0	7.5	5.5	5.0	18.0
130-140	-	2.4	1.2	31.4	34.5	13.0	11.0	6.5	30.5
140-150	-	1.4	2.0	31.1	36.0	10.0	12.5	7.0	29.5
150-160	-	0.7	1.4	37.4	40.5	7.0	6.5	7.0	20.0
160-170	-	0.5	1.1	34.4	44.0	8.0	7.5	4.5	20.0
170-180	-	1.0	1.1	29.4	47.0	10.0	6.5	6.0	21.5
180-190	-	1.0	1.0	37.0	42.0	8.0	6.5	4.5	19.0
190-200	-	-	0.5	46.0	36.0	7.0	5.0	5.5	17.5
200-210	-	-	1.2	50.3	28.0	7.5	8.0	5.0	20.5
210-220	-	-	0.9	47.6	35.0	7.0	5.5	4.0	16.5
220-230	-	-	0.9	44.6	40.0	6.5	6.0	3.0	17.5
230-240	-	-	1.0	49.0	34.5	5.0	6.0	4.5	15.5
240-250	-	-	0.5	39.0	42.5	7.0	4.5	6.5	18.0
250-260	-	-	0.3	27.8	43.0	5.0	7.5	6.5	19.0
260-270	-	-	0.1	43.9	39.0	7.5	4.5	5.0	17.0
270-280	-	-	0.4	44.6	39.5	6.5	4.5	4.5	15.5
280-290	-	-	0.3	49.7	35.5	4.5	6.5	3.5	14.5
290-300	-	-	1.0	49.5	32.0	5.0	7.5	5.0	16.5

In order to characterize the soils of the experimental areas, before starting the research, the volume and specific masses of the soil were determined in the spring, and its porosity was calculated based on this (Table 2).

According to the inspection results, the soils of the experimental areas differ significantly in terms of density. Volumetric mass in the 0-50 cm layer of the first area was equal to 1.53 g/cm<sup>3</sup>, and in the 0-100 cm layer it was equal to 1.51 g/cm<sup>3</sup>. In the second area, the indicators at the same depths were 1.37 and 1.34 g/cm<sup>3</sup>, respectively, which indicates that the soils of the area have a more porous structure [5].

At a depth of 1 m in the first area, the volumetric mass is around 1.39-1.56 g/s<sup>3</sup>, while in the second area, the volumetric mass is relatively lighter from the bottom of the arable layer to the seepage water.

The results of the analysis showed that the specific mass of the soil of the first area is slightly heavier than that of the second area.

**Table 2.** Volume, specific mass and total porosity of the soils of the experimental sites.

Layer, cm	First field			Second field		
	Bulk density, g/cm <sup>3</sup>	Relative mass, g/cm <sup>3</sup>	Total porosity, %	Bulk density, g/cm <sup>3</sup>	Relative mass, g/cm <sup>3</sup>	Total porosity, %
0 – 10	1.55	2.68	42.27	1.28	2.68	52.23
10 – 20	1.62	2.68	39.55	1.44	2.68	46.26
20 – 30	1.56	2.69	41.89	1.45	2.68	46.09
30 – 40	1.51	2.69	43.86	1.36	2.69	49.25
40 – 50	1.42	2.69	47.11	1.33	2.69	50.55
50 – 60	1.39	2.69	48.23	1.31	2.69	51.30
60 – 70	1.41	2.69	47.48	1.31	2.69	51.11
70 – 80	1.45	2.70	45.49	1.31	2.69	51.48
80 – 90	1.44	2.70	46.36	1.31	2.69	51.11
90 – 100	1.45	2.70	45.99	1.29	2.69	52.04
100 – 200	-	-	-	1.34	2.68	50.00
200 – 300	-	-	-	1.40	2.68	50.00
0 – 50	1.53	2.68	43.01	1.37	2.68	48.80
0 – 70	1.43	2.68	44.50	1.35	2.68	50.18
0 – 100	1.51	2.69	43.76	1.34	2.68	50.37
0 – 200	-	-	-	1.34	2.68	50.00
0 – 300	-	-	-	1.36	2.68	50.00

For example, the studied indicator in the 0-100 cm layer of the soil of the first area was 2.69 g/cm<sup>3</sup>, and in the second area it was 2.68 g/cm<sup>3</sup>. Depending on the volume and specific mass, the soil porosity also changed. An increase in soil density caused a decrease in porosity, and a decrease in density caused an increase in porosity.

It was calculated that the volumetric and specific mass of soil in the aeration layer of the first area is higher than that of the second area. In the 1 m layer of the first area, the porosity is equal to 43.8%, and it is kept at the same level in the lower layers. In the second area, a different scene is observed, where the porosity in the layer up to 3 m is found to be around 48.9-50.4%, which indicates a rather light and loose composition of the soil [6].

Water permeability of the soil. Determination of water permeability of the soil in the experimental areas was carried out in the spring of the year when the experiment began. In order to determine the level of water permeability of the soil, the amount of water consumed and the rate of water absorption into the soil were taken into account. According to the results of the experiment, 840.8 m<sup>3</sup> of water per hectare was consumed during 6 hours of observation in the first field, while in the second field, this figure was 1277.5 m<sup>3</sup>. The same pattern was observed in the speed of water absorption. This indicator was equal to 0.93 and 1.485 mm per minute in the first and second fields, respectively. In the second experimental field, the degree of waterlogging is much higher. This indicates that it has medium and light mechanical composition (Table 3 and Figure 2).

Limited field moisture capacity of soil (ChDNS). In the experimental field where seepage water was on the surface, the wet capacity of the soil was 21.6% in the 0-50 cm layer, 21.4% in the 0-70 cm layer, and 21.6% in the 0-100 cm layer. In the area with deep seepage water, these indicators were equal to 19.1, 19.8 and 20.6%, respectively, for the above-mentioned layers. A similar pattern was also observed in the maximum molecular

moisture capacity. For example, in the 0-50 cm layer of the soil of the first and second areas, the same indicator is 16.3 and 16.1%, in the 0-70 cm layer, 16.6 and 16.1; In the 0-100 cm layer, it was 17.1 and 16.2% .

**Table 3.** Level of water permeability of soils in experimental areas (Research was conducted before the first irrigation).

Watch hours	First field		Second field	
	minute mm/	to m <sup>3</sup> /	minute /mm	to /m <sup>3</sup>
1	2.33	249.80	3.45	518.25
2	0.545	81.22	1.74	261.17
3	0.885	132.90	1.075	160.39
4	0.675	100.80	0.99	148.67
5	0.675	101.20	0.835	125.24
6	0.500	74.90	0.825	63.82
during 6 hours	5.61	840.80	8.920	1277.54
1 hour on average	0.83	140.1	1.49	212.9

Capillary moisture carrying capacity of the soil. The ability of the soil to carry capillary moisture in the aeration layer is integrally dependent on the mechanical composition, structure and joint of the layers.

In light soils with a mechanical composition, the rate of capillary wetting is greater than in heavy soils, and the height is smaller. Also, capillary wetting is more rapid in soils with a homogeneous or downward structure and with soft joints, than in soils with a layered structure or downwards and with dense joints. In turn, the irrigation regime and water demand of agricultural crops, including cotton, is closely related to the degree of capillary hydration.



**Fig. 1.** Determination of the limited field moisture capacity of the soil by the square frame method.

Therefore, in both experimental fields, the height of capillary wetting of soil in the aeration layer was studied (Table 4).

In the first experimental field, research was carried out in spring and summer, and in the second field, this observation was carried out in spring [7-8].

The soil of the field where the seepage water is on the surface is a medium loam according to its mechanical composition, and it has a joint that becomes lighter towards the bottom. The amount of physical clay (particles smaller than 0.01 mm in diameter) in the upper 0-40 cm layer of the soil decreases from 45-41%, and in the lower 40-180 cm layer, it

decreases to 35.5-29.5%. Therefore, the upper layer of the soil is dense, and the next layer up to the seepage water is soft. This situation had an effect on the speed and height of seepage water moving along the capillaries in the aeration layer [9-10].

**Table 4.** Limited field and maximum molecular moisture capacities of the soils of the experimental fields, in % by weight of the soil.

Layer, cm	First field		Second field	
	Moisture capacity			
	Limited	Maximum-molecular	Limited	Maximum-molecular
0-10	24.5	16.1	19.3	15.9
10-20	22.5	15.5	18.2	15.7
20-30	20.0	15.7	20.2	15.7
30-40	20.1	17.0	18.1	16.6
40-50	21.1	17.5	19.7	16.1
50-60	20.9	17.4	20.8	16.7
60-70	20.0	17.8	21.6	17.1
70-80	23.0	18.2	22.1	16.1
80-90	21.8	18.0	21.5	16.5
90-100	22.0	18.5	23.1	16.7
0-50	21.6	16.3	19.1	16.1
0-70	21.4	16.6	19.8	16.1
0-100	21.6	17.1	20.6	16.2

Based on the results of our many years of research, the growth of thin fiber cotton for the first time in light gray soils with seepage depth of 1.5-2.0 m and 3.5-4.0 m, the optimal periods, number and rates of irrigation, which ensure the development and production of early abundant crops, as well as the maintenance of land reclamation in a stable state, have been developed. At the same time, for the conditions of the lower regions of the oasis, irrigation regimes of cotton and other agricultural crops in the rotation were developed and put into practice [11-12].

## 4 Conclusions

- 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, and it serves as an additional source of water consumption of cotton. In the second field, where seepage waters are deep, the capillary moisture rises almost twice as high as in the first field and improves the moisture supply of the soil in this layer.
- Different regimes of irrigating fine-fiber cotton were tested in these areas with different soil-reclamation conditions and different results were obtained.
- According to the research results, the optimal soil-ameliorative conditions that ensure the good growth and development of fine-fiber cotton in both experimental fields are 70-75-65% of the irrigated wet regime of the soil compared to ChDNS It is created in the irrigations carried out during the establishment.

Based on the results of our experiments devoted to the irrigation regime of crops in the cotton complex for many years in the conditions of the Karshi desert, as well as the information of other researchers who worked in this field, Professor N.F. Under the scientific leadership of Bespalov, a new hydromodule of irrigated lands, enriched with scientific findings, filled and improved, was developed, published as a guide and presented

to the Department of Agriculture and Water Management of Kashkadarya Region for practical application [13].

According to this hydromodule, scientifically based irrigation regimes of cotton rotation crops for hydromodule districts were developed for the conditions of mountainous and desert regions of the region.

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