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Impact of Drip Irrigation Procedures on Plant Growth and Development and Cotton Yield in Typical Gray Soils of the Tashkent Region

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Abstract: In the researches, cotton was studied in two different methods of drip and drip irrigation, 65-70-65 and 70-75-65 percent soil moisture before irrigation compared to limited field moisture capacity. As a result, information on the growth and development of the plant under drip irrigation and the irrigation procedure and optimal standards are presented.

Keywords: Horizontal Irrigation, Drip Irrigation, Typical Gray Soils With Old Irrigation, Cotton, Irrigation, Rate, Duration, Soil Moisture, Calculation Layer, Technology, Water Efficiency, Fiber Quality, Cotton Yield.

1. Introduction

As the problem of global warming intensifies year by year, water shortages are increasing significantly in the world, including in our Republic, which negatively affects the productivity of cotton, grain and other agricultural crops.
The shortage of clean drinking water for the growing population and the supply of sufficient irrigation water for cultivated crops is increasing. Given that this problem is increasing year by year, the effective use of existing water resources and the use of water and resource-saving technologies are among the urgent tasks.
In countries based on irrigated agriculture, including Uzbekistan, the urgency of the issue of rational use of water resources is becoming increasingly acute due to the fact that water consumption for agriculture is increasing year by year. In-depth research is being conducted by our country and foreign scientists to find ways to effectively and economically use existing water resources.
The mechanism of water movement in plants and the relationship between physiological processes and productivity of plant water order S.N. Studied by Rizhov and other scientists.

The formula for determining cotton irrigation standards was recommended by S.N. Rizhov. According to him, the main part of the cotton root is 1 m. It is located in the layer, and the main part of the water is 30-90 cm. is used for transpiration from the depths. Therefore, when watering, 100 cm. It was found that the effect of moistening the next layer is low.

Many scientists have stated that water can be 75-90% in the plant organism and 98% in some organs. Water is a necessary resource from the first days of plant development. Depending on its type, origin and size, a plant seed that falls into the soil requires a certain amount of water to germinate. For the growth of a cotton seedling, 90% of water is required in relation to the absolute dry mass. Normal development of plant cells is possible only when they are sufficiently saturated with water, as a result of which the activity of vital processes in them is coordinated, and the remaining part is spent on the formation of some complex organic substances during photosynthesis. As mentioned above, plants contain up to 80-90% water. During the growth period, plants evaporate most of this water. According to observations, plants spend only 0.01-0.03% of the water absorbed during the entire vegetation period on the formation of their organism. The water requirement of plants varies depending on the phases of their development. For example, cotton is most demanding on water during flowering and fruiting.

2. Object and Method of Research

The field experiment was conducted at the Central and Surkhandarya scientific experimental stations of the Scientific Research Institute of Cotton Breeding, Seed Production and Agrotechnologies (SPA) Akkovak experimental field is located in the Kibray district of the Tashkent region, 7-8 km north of the Chirchik River, on the right bank of the Bozsuv Canal. The experimental area consists of non-uniform parent rocks, groundwater (seepage) at a depth of 18-20 meters, covered with old irrigated, automorphic, medium-heavy loamy typical gray soils.

In the field experiments, biometric measurements, soil and plant sample analyzes were carried out on the cotton plant in accordance with the methodological manuals "Metodika polevyx opytov s xlopchatnikom" (1981), "Methods of conducting field experiments" (2007) adopted at UzPITI and performed according to the requirements of GOST GOST 32-2001. Statistical analysis of data on cotton productivity was determined based on the methods of B.A. Dospehov "Metodokiya polevogo opyta" (1979; 1985).

In an experimental field, two different irrigation methods, namely, drip irrigation (DI) were studied in comparison with horizontal irrigation. In this, cotton cultivars were irrigated in different order according to limited field moisture capacity (FC) of soil moisture. In particular, the irrigated area, which was accepted as a control, had a soil moisture content of 70-70-60 percent relative to the FC, and the experimental area, where TS was applied, was irrigated in two different regimes: 65-70-65 and 70-75-65 percent relative to the FC. All observations, measurements and analyses in the studies were carried out on the basis of the methodological manuals “Methodology of field experiments with cotton under irrigation conditions”, “Methods of conducting field experiments” UzPITI, T., 2007. In the experiment, seasonal agrotechnical measures were carried out based on the measures used in production and adopted in the experimental farm.

3. Research Results and Their Discussion

In the experiment, the effectiveness of irrigation in the order of 65-70-65 and 70-75-65 percent of soil moisture in relation to FC was studied by comparing DI and egatlab irrigation methods. In this case, the standards of water consumption in irrigation were calculated in relation to the moisture in the soil layers of 0-70 cm in the period of heading, 0-100 cm in flowering and 0-70 cm in opening, and 0-50 cm in the periods of opening, flowering and opening of cotton in the experimental variants of drip irrigation.
Cotton varieties were irrigated 6 times during the growing season, and 11-13 irrigations were carried out according to irrigation measures in the DI method. In the controlled variants, cotton was irrigated by 14.3-14.6 percent before flowering, 14.4-14.9 percent during flowering-harvest, and 12.2-12.6 percent soil moisture during ripening.
In field studies conducted under typical gray soils, the new cotton variety S-8298 was irrigated 13 times with a soil moisture content of 70-75-60% relative to the average annual rainfall, with a seasonal irrigation rate of 3596 m3/ha for 6.0-8.0 hours at an interval of 5-7 days, and the cotton variety Istiklol-14 was irrigated 12 times with a soil moisture content of 70-75-65% at an interval of 6-9 days, with a duration of 6-7 hours, and with a seasonal irrigation rate of 3371 m3/ha for 39.8-43.5% water savings were achieved.

Regionalized, promising and new varieties and lines of cotton (5 in total) were tested in Tashkent region: S-6524 (control), M-6570, L-45/573, Porlok-4, Surkhan-104, Bukhara-102 (control), Sultan, Istiklol-14, SP-1601, Surkhan-106, etc., in Surkhandarya region, using drip irrigation in comparison with overhead irrigation. All observations and calculations were carried out on the basis of accepted methodological manuals. As a result of observations on the growth, development and yield of cotton varieties grown using drip irrigation during the season, the following data were obtained. In the studies, cotton varieties were irrigated in two regimes: 65-70-65 and 70-75-65% of the soil's limited field moisture capacity (LFMC). In field experiments, cotton density averaged 85-95 thousand bolls per hectare. In the Tashkent region, cotton was irrigated 11 times with an average of 303-388 m3/ha in the first regime, and 13 times with an average of 270-380 m3/ha in the second relatively high regime, or a total of 3840 and 4117 m3/ha of water were spent during the season, respectively. In this case, in the control variant with drip irrigation, an average of 5950 m3/ha or 35 and 38% more water was spent than in the variants with regular irrigation through the TS. In Surkhandarya region, cotton was also irrigated in a similar manner. In particular, in the 1st order, cotton was irrigated 11 times, with an average of 315-400 m3/ha per irrigation, and in the 2nd order, an average of 480 m3/ha, with a total of 4090 and 4117 m3/ha.
In Tashkent region, the highest productivity was observed in the L-45/573 (S-8298) cotton variety. In the case of irrigation, the L-45/573 (S-8298) cotton variety consumed the least amount of water compared to other varieties - 146.9 m3 of water to produce 1 c of cotton, achieving a yield of 37.1 c/ha.
In drip irrigation, the highest yield was obtained from the L-45/573(S-8298) series in the variants with soil moisture content of 65-70-65% compared to the FC. In this case, a relatively small amount of 89.9 m3 of water was spent to produce 1 c of cotton yield, which was 39.1 c/ha, and in the variants with an irrigation regime of 70-75-65%, the minimum amount of water was spent to produce 1 c of cotton yield, which was 95.6 m3 of water, and the maximum yield was achieved in the variants with an irrigation regime of 43.5 c/ha.
All factors studied in the studies, including the selection of cotton varieties and their cultivation using drip and sprinkler irrigation technologies, had different effects on plant growth, development and yield.

In order to study the effectiveness of using different irrigation methods in the experiment and their effect on the growth, development and harvest of cotton, phenological observations were conducted on 50 labeled plants in each variant at the beginning of June, July, August, and September. Phenological observations were conducted to assess the effect of irrigation methods and regimes on the growth and development of cotton, the weight of cotton in 1 boll, and the yield were obtained. Based on them, regardless of the conditions of the studied soils, no significant differences were observed between the variants in the initial phases of cotton vegetation - up to the period of germination and combing. No significant differences were observed between the varieties in the variants during the flowering and harvest period. In this case, a difference was observed between the experimental variants in the period of the main formation of the vegetative and generative organs of the plant in August.


Figure 1. Process of phenological observations in cotton

In the case of typical gray soils, in the case of conventional irrigation (control - 70-70-60 %) in August, the average length of the cotton head stem is 61.9-75.9 cm, 7.5-9.5 branches, 4.6-6, 6 pieces and the number of formed cysts was 6.1-8.6 pieces. In the options where TS of the experiment was used, irrigated in the order of 65-70-65% compared to FC, these indicators were 71.5-81.6 cm, 8.5-10.6 units and 5.7-8.0 units, respectively, with high irrigations of 70 - 75-65% in order 77.4-89.5cm, It was 8.2-13.2 and 5.2-6.3 units. It can be seen that in autumn, cotton varieties produced 8.9-14.3 full bolls in fields irrigated by direct irrigation, and 9.9-14.7 bolls in drip irrigation (70-75-65%). The opening of pods accumulated in the experimental variants, compared to the total number of pods, was 2.2-5.2 units in the irrigated control and 2.5-5.7 units in the TS. In September (two years), the average number of complete cysts collected was 8.6 in the control and 3.2 of them opened, 9.1 and 4.0 in the first order of DI, and 10.1 and 4.3 in the second order of TS, respectively. organized. It can be noted that, compared to the control, the number of bolls collected in one boll of cotton in DI was 10-12% higher, and their opening rate was 8-10%. In general, the growth, development and yield indicators of cotton were analyzed by variety. According to which irrigation method Despite the fact that the central region of the republic (Tashkent region) was characterized by the highest cotton yield from the promising medium-fiber L-45/573 (C-8298) system and the regionalized C-6570 varieties.

Table 1Cotton harvest, (central experimental farm of CBSPGRI)

№	Cotton varieties	2020 year			2021 year		
		Harvests		Total productivity	Harvests		Total productivity
		1	**2**		**1**	**2**	
		5.10	**19.10**		**10.10**	**27.10**	
Furrow irrigation (Soil moisture, relative to FC, 70-70-60 %)							

1	С-6524	35,2	4,6	41,8	35,5	4,0	39,5
2	С-6570	35,1	6,6	40,7	34,4	4,6	39,0
3	Л-45/573	36,4	5,2	41,6	37,0	3,5	40,5
4	Porlok-4	35,0	5,9	40,9	34,5	3,8	38,3
5	Сурхон-104	12,7	11,0	22,7	13,0	8,2	21,2
Drip irrigation (Soil moisture, relative to FC, 65-70-65 %)							
6	С-6524	38,0	5,3	43,3	36,4	5,0	41,4
7	С-6570	37,9	4,5	42,4	36,0	4,3	40,3
8	Л-45/573	41,1	4,1	45,2	36,6	5,1	41,7
9	Porlok-4	38,0	4,4	42,4	35,6	4,0	39,6
10	Surkhon-104	17,1	7,0	24,1	12,9	10,0	22,9
Drip irrigation (Soil moisture, relative to FC, 65-70-65 %)							
11	С-6524	40,0	4,2	44,2	39,0	3,3	42,3
12	С-6570	39,4	6,7	46,1	40,0	3,5	43,5
13	Л-45/573	44,6	6.0	50,6	41,0	2,8	43,8
14	Porlok-4	42,6	6,1	48,7	37,2	3,0	40,2
15	Surkhon-104	16,0	8,4	24,4	21,2	3,0	24,2

To determine the yield of cotton plants under different irrigation methods and moisture regimes, it is necessary to know the weight of cotton in one boll at the end of the growing season. In the experimental plots, the weight of cotton in one boll varied between 5.1-6.0 g for medium-fiber varieties. The highest indicator (6.0 g) was obtained in the drip-irrigated variant, with a soil moisture content of 70-75-65%, and the smallest bolls (5.1 g) were obtained in the surface-irrigated variant. Also, among medium-fiber cotton varieties, the L-45/573 (S-8298) line stands out for its high weight in the Tashkent region, and the Sultan variety in the Surkhandarya region. In general, it can be noted that in 2021, due to the high temperature and significantly lower precipitation compared to many years, the bolls of cotton varieties were somewhat smaller. Detailed information is provided on the weight of raw cotton collected in one boll.

Also, the growth, development and yield indicators of cotton were higher in TS. In the central region of the republic (Tashkent region), the highest cotton yields were obtained from the medium-fiber L-45/573 (C-8298) system (40.5 c / ha) and C-6570 variety (39.0 c / ha). The weight of cotton per boll by variety varied between 5.1-6.0 g in medium-fiber varieties, with the highest figure (6.0 g) in the TS in the order of 70-75-65%, and the smallest bolls (5.1 g) were obtained in the well-irrigated variant. Also, among medium-fiber cotton varieties, the L-45/573 (S-8298) line stands out for its high weight in the Tashkent region, and the Sultan variety in the Surkhandarya region. In general, it can be noted that the bolls of cotton varieties are somewhat smaller due to the high temperature and precipitation in the experimental years compared to perennial varieties. In conclusion, it should be said that the average yield for the Tashkent region (in 2020-2021) was 47.2 c/ha for the L-45/573 (C-8298) variety, and 44.7 c/ha for the C-6570 variety. In this case, it was proven that in the Tashkent region, compared to the controlled irrigated variant, it is possible to obtain an additional yield of 6.7 c/ha for the L-45/573 (C-8298) variety and 5.7 c/ha for the C-6570 variety.

4. Conclusions

The following conclusions were reached as a result of scientific research on the development of effective agrotechnologies for the maintenance of newly zoned and promising cotton

varieties suitable for drip irrigation in the conditions of old irrigated typical gray soils of Tashkent region.

It was found that the use of drip irrigation (DS) system in the maintenance of regionalized, new and promising varieties of cotton is an effective agrotechnical measure. As a result, it was observed that this method evenly moistens the soil along the edge, has a positive effect on the growth and development of plants.

In the field studies conducted on the cotton drip irrigation system at the Central Experimental Farm, irrigation was carried out 9-11 times when soil moisture was 65-70-65% relative to FC, and 11-13 times when it was 70-75-60%. Irrigation rates are on average 270-400 m3/ha according to irrigation procedures, the duration of drip irrigation is 3.5-7.0 hours depending on the irrigation rate, seasonal irrigation rates are 3210-3840 m3/ha at soil moisture 65-70-65%, 70 3365-4117 in 75-60% options m3/ha.

According to the analysis of the data obtained as a result of the research, cotton TS was evaluated as an effective water-saving, high-yielding, innovative and promising method for commercialization, and this method is recommended for use in the typical gray and barren grassland soils of the Republic.

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