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Physiological Indicators of the Water Balance of Plants in Fine-Fiber Varieties and Cotton Lines in Different Irrigation Regimes

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Abstract: ***The article presents the results on the content of chlorophylls "a" and "b", total chlorophyll, carotenoids, water content and intensity of leaf transpiration in fine-fiber varieties and cotton lines in different conditions of water regime. Compared to optimal water availability, the content of chlorophylls "a" and "b", total chlorophyll and carotenoids increased in varying degrees, water content and leaf transpiration intensity decreased depending on the individual genotypic response of fine-fiber varieties and cotton lines to the lack of soil moisture in the soil.***

Keywords: *G.barbadense* L., cotton, water regime, chlorophyll, carotenoids, water content, transpiration, genotyp

1. Introduction

The global climate change of the Earth and the gradual increase in water temperature require the creation and introduction of new drought-resistant cotton varieties in Uzbekistan with conditions of limited water reserves. In this regard, special attention should be paid to conducting scientific and practical research on the creation of fine-fiber cotton varieties resistant to abiotic stress factors and highly valued in the world market, along with medium-fiber varieties widely grown in the cotton fields of Uzbekistan. In solving these problems, along with studies of other areas, in simulated arid conditions, the study of the physiological parameters of water metabolism of plants of fine-fibered cotton varieties is relevant.

Based on this, in our studies onlysimeters we determined chlorophyll a and b in plant leaves, total chlorophyll, carotenoid content, total water content and transpiration rate during the vegetative period of plants with preliminary creation of optimal water supply (before irrigation, soil moisture relative to the volume of wet soil was 70%) and modeled drought (during the flowering phase, soil moisture relative to the volume of wet soil is reduced to 48-50%).

Cotton adaptation to drought and some physiological principles of endurance have been studied by many scientists [9]. According to these scientists, the physiological and biochemical processes of plants change as a result of water deficiency and this in turn has a negative effect on plant fertility.

M. Ludlow et al. [3] state that when choosing drought-resistant plant samples, their physiological parameters should be taken into account and this can give a good effect.

A number of scientists in their studies observed a change in the content of chlorophyll “a” and “b” and total chlorophyll in the leaves of plants in conditions of water deficiency compared with optimal water conditions [1, 5, 7].

According to MaisuraMuhamad et al.and Mir Aafaq Ahmad et al. [4,6], the content of chlorophyll “b” of plants under conditions of water deficiency varies little and even the content of chlorophyll “b” increases under stress conditions than under optimal conditions.

2. Materials and Methods

In our conditions, fine-fiber varieties and cotton lines in the flowering-fruiting period, the plant leaf tissue was extracted with 96% ethanol. The content of chlorophyll “a”, “b” and carotenoids are determined in a spectrophotometer (Agilent Cary 60 UV-Vis. Germany) and calculated using the following equation [2,8]:

$$\text{Ch-a}=13.36A_{664} - 5.19\ A_{649}$$

$$\text{Ch-b}=27.43A_{649} - 8.12\ A_{664}$$

$$\text{C x+c}=(1000A_{470} - 2.13C_a - 97.63C_b)/209$$

$$\boldsymbol{F}\ [\text{mg/g}] = \boldsymbol{(V * C) / P}$$

Here: F is the chlorophyll content in the leaves of the plant [mg / g]; V is the volume of liquid [ml]; C is the concentration of chlorophyll [mg / l]; P - sheet weight, [g].

In the optimal water regime, a high content of green pigments is recorded for the lines T-450 and T-2006, while the indicator of chlorophyll “a”, respectively, 1.73 mg / g and 1.70 mg / g, chlorophyll “b” 0.77 mg / g and 0.79 mg / g, total chlorophyll 2.50 mg / g and 2.49 mg / g, and carotenoids 0.47 mg / g and 0.44 mg / g. The lowest indices are for chlorophyll “a” at T-5440 (1.30 mg / g), for chlorophyll “b” at T-5440 and T-663 (0.57 mg / g), for total chlorophyll at T-5440 (1.87 mg / g) and carotenoids at T-5440 and T-10 (0.32 mg / g).

With water deficiency, high rates of chlorophyll “a”, “b”, total chlorophyll and carotenoids were recorded (respectively 2.81 mg / g; 1.41 mg / g; 4.23 mg / g and 0.56 mg / g) and the lowest indices of chlorophyll “a”, chlorophyll “b”, total chlorophylls and carotenoids were recorded in Termez-31 (respectively 1.84 mg / g; 0.75 mg / g; 2.60 mg / g and 0, 43 mg / g).

In general, it was found that the indicators of the studied signs of varieties and lines during drought increased to varying degrees (for chlorophyll a) 15.7-78.5%, for chlorophyll b for 17.2-113.6%, for the total chlorophylls 17.1-88.0% and carotenoids 4.9-56.3%).

Analysis of the obtained data showed that against the background of optimal water supply in the leaves of varieties and lines, the total water content ranged from 77.8% (T-2006) to 80.5% (Termez-31), and against the background of water deficit, the indicators of these signs decreased from 1.9% (Termez-31) to 8.8% (T-1). In general, under these stressful conditions, the total water content in the leaves of Termez-31 is the highest at 78.6% and the lowest at T-1 and was 70.2% (Fig. 1).

At the optimum water regime, the transpiration rate in the Marvarid variety was the highest - 356.77 mg, in the T-10 and T-2006 lines it was the lowest - 149.04 mg and 156 mg, respectively.

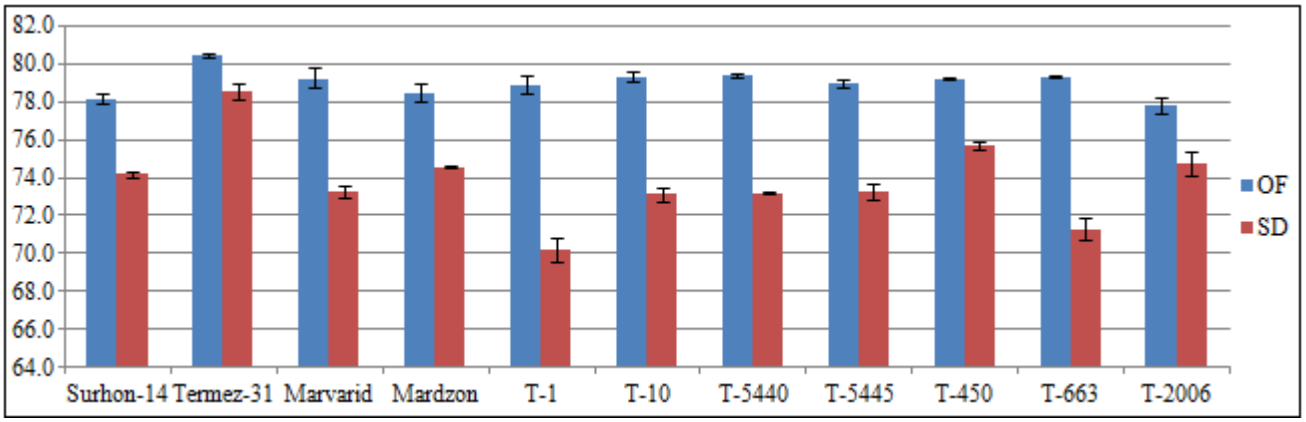

Figure 1: The total water content in the leaves of fine-fiber varieties and lines at different water regimes
Note: OF - Optimum water regime, SD - simulated drought

With water deficiency in all varieties and lines of fine-fiber cotton, the rate of transpiration decreased in different ways (in Termez-31 from 12.6% to 43.9% in Marvarid). Against this background, the highest indicator of signs appeared in the variety Marvarid (200.26 mg) and the lowest indicators in the lines T-10, T-2006 and T-663 (respectively, 106.45 mg; 109.19 mg and 111.03 mg) (Fig.2).

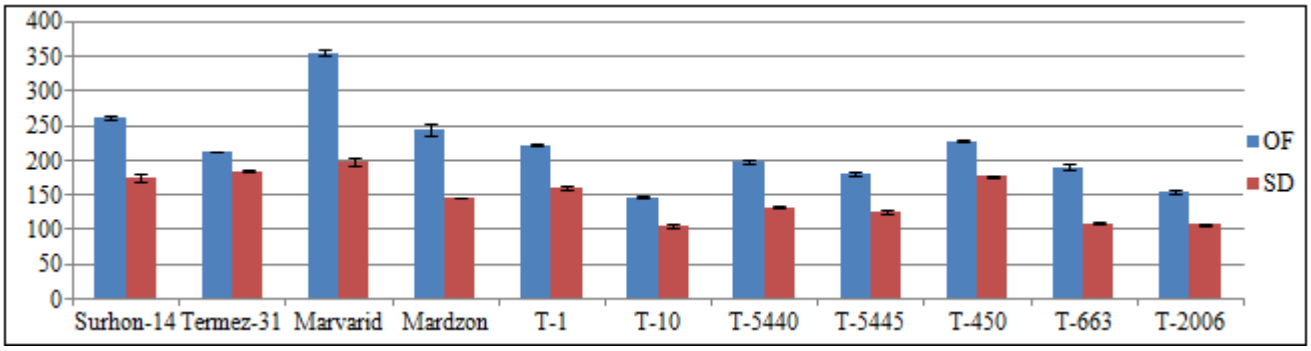

Figure 2: The rate of transpiration in the leaves of fine-fiber varieties and cotton lines in different water regimes
Note: OF - Optimum water regime, SD - simulated drought

Thus, in the leaves, the content of pigments and water metabolism of fine-fiber varieties and cotton lines in physiological indicators exerts different genotypic irritability to different water regimes. With a shortage of water in all genotypes, it was found that the total water content and the rate of transpiration in the leaves decrease differently, and the content of chlorophyll and carotenoids increase differently.

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Table 1: The pigmentcontent of fine-fiber varieties and lines of cotton in different water regimes

Varieties and lines	Chlorophyll (a),mg/g		Chlorophyll (b),mg/g		Common chlorophyll,mg/g		Carotenoids,mg/g	
	OF	*SD*	OF	*SD*	OF	*SD*	OF	*SD*
Surhon-14	1,67±0,01	2,24±0,12	0,72±0,03	0,88±0,06	2,40±0,04	3,13±0,18	0,45±0,01	0,49±0,01
Termez-31	1,59±0,0,2	1,84±0,02	0,64±0,01	0,75±0,01	2,22±0,02	2,60±0,02	0,41±0,01	0,43±0,01
Marvarid	1,68±0,02	2,28±0,01	0,71±0,01	0,90±0,01	2,39±0,02	3,18±0,01	0,43±0,01	0,55±0,01
Mardzon	1,61±0,04	2,43±0,05	0,66±0,03	0,98±0,03	2,27±0,08	3,42±0,08	0,42±0,01	0,54±0,01
T-1	1,55±0,01	2,08±0,01	0,66±0,02	1,02±0,01	2,21±0,03	3,10±0,01	0,39±0,01	0,49±0,01
T-10	1,42±0,01	2,27±0,02	0,67±0,01	0,92±0,01	2,10±0,01	3,20±0,04	0,32±0,02	0,48±0,01
T-5440	1,30±0,07	2,32±0,03	0,57±0,03	0,95±0,01	1,87±0,11	3,29±0,03	0,32±0,02	0,50±0,01
T-5445	1,60±0,01	2,81±0,01	0,66±0,02	1,41±0,02	2,25±0,02	4,23±0,03	0,40±0,01	0,56±0,01
T-450	1,73±0,01	2,31±0,05	0,77±0,01	1,02±0,01	2,50±0,03	3,34±0,05	0,47±0,01	0,53±0,01
T-663	1,46±0,03	2,54±0,10	0,57±0,02	1,06±0,06	2,03±0,05	3,61±0,16	0,40±0,01	0,54±0,01
T-2006	1,70±0,01	2,39±0,02	0,79±0,02	1,03±0,01	2,49±0,03	3,43±0,03	0,44±0,01	0,53±0,02

Note: OF - Optimum water regime, SD - simulated drought