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Effects of Microelements on Drought Resistance of Cotton Plant

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Abstract --*The following article deals with the physiological indicators of the effects of microelements on the drought resistance of cotton. Experiments that describe droughtresistant properties - the viscosity and elasticity of the protoplasm, the cellular juice thickness and osmotic pressure, the amount of water that binds in the leaf tissue, the water retention properties of the leaves, and the development of microelementsare depend on the changes of cotton development degrees.*

Keywords*--cotton, drought, microelements, physiological indicators, water exchange, productivity, drought resistance.*

I. INTRODUCTION

Problems of drought resistance of plants due to water exchange have been studied for many years. One of the main reasons for this is the frequent drought and its negative impact on agricultural crops [1,2,3].

Drought resistance is determined by the plant cell's ability to withstand prolonged water shortages. The water deficiency in the tissues is observed not only in xerophytes, but also in most mesophyte plants. During the ontogeny of drought resistant plants, the adaptation to drought effects will be high. In such cases, growth, evolvement and multiplying are going on [4,5,6].

Global climate change observed around the world is leading to higher air temperatures in the biosphere, and dry land caused by a sharp decline in relative humidity leads to atmospheric and soil drought. In today's acute water shortage, the introduction of water saving agro technology, including the development of ways to cultivate plant varieties that are resistant to drought and with a high rate of efficient water use, is essential.

In Uzbekistan condition cotton can suffer from negative effects of weather conditions not only at the beginning of vegetation, but also in the flowering and fruiting phases. During this period, other factors have an

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adverse effect on the development of cotton, especially high daytime temperature often exceeding 40^0C and low relative humidity of an air.

These unfavorable weather conditions coincide with the most responsible period in the development of cotton - flowering phase, which is critical in relation to temperature and water conditions. During this period, even the short-term effect of high temperature, combined with high dry air, significantly affects on the processes of growth, development and especially fruiting cotton. Plants react to these tough conditions by slowing down growth processes and dumping fruit, which naturally drastically reduces the yield and its quality.

The actuality of this problem is caused by the fact that the soil-climatic conditions of the cotton in the regions of our republic vary dramatically. Depending on the level of agro technical techniques, the cotton cultivation zone shows its potential in different ways. The study of drought tolerance and protective-adaptive features of medium-fiber cotton varieties in the soil-climatic conditions of the middle part and the lower part of the valley is an actual problem.

The adverse effects of drought and high temperature can be significantly mitigated by various agro technical measures that help to mitigate the microclimate of the planting field. One of the main factors of the debilitating effects of drought and dry land is the widespread use of artificial watering in Uzbekistan. But it does not completely remove the harmful effects of these effects on plants, especially during inter-watering periods, when the surface of the soil dries up strongly and in the daytime the temperature of the adjacent layers of air reaches high limits. Therefore, techniques that contribute to the increase of drought tolerance of cotton, especially in the flowering phase, are of great interest from both theoretical and practical points of view. One way to increase the resistance of plants themselves to the effects of drought conditions is the regulation of mineral nutrition of plants in particular the nutrition of microelements.

II. RESEARCH METHODS

Based on the above, we have conducted a number of vegetation experiments to study the effects of microelements on the drought resistance and productivity of cotton. The objects of the study were the Bukhara-8 cotton variety. The studies were carried out under the following scheme:

1. Control - spraying plants with water.

2. Spraying plants with a mixture of 0.1% sulphuric zinc solution and 0.02% of boric acid solution taken in a 1:1 ratio.

Plant spraying was carried out in the flower bud formation phase (in the evening) until the leaf surface was completely wet. At the beginning of the experiment, all plants were grown at soil moisture 70% of the total moisture intensity. Before budding, some of the plants were switched to watering, bringing soil moisture to 30% of the total moisture intensity.

While the experiments were revealed the drought resistance of plants, the viscosity and elasticity of the protoplasm, the degree of cell juice thickness and its osmotic pressure, the water retention properties of leaves and

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daily and residual water deficiencies. Physiological, morphological, biochemical, biometric, statistical, phenological and plasmolytic and gasometrical research methods and comparative analysis methods were used in the course of the studies.

III. RESULTS AND THEIR DISCUSSION

Data are provided on several indicators received 10 days after spraying (table 1).

From the given data it is clear that in the experimental variants there is an increase in viscosity and elastic protoplasm, an increase in the concentration of cellular juice and osmotic pressure, an increase in the percentage of associated water. These changes, which increase the drought resistance of plants, are best expressed variants in experimental plants. It should be noted that with insufficient hydration, the role of trace elements is manifested more than with optimal hydration.

Table 1 Effects of microelements on some physiological processes with different soil hydration

№	Options for Experience	Viscosity of protoplasm, min	Elasticity of protoplasm, min%	Concentration of cell juice, %	Osmotic pressure, atm	Bound water, %
Optimal hydration						
1	Control	25±2,1	3,0±0,19	4,9±0,03	4,11±0,03	53,2±1,1
2	Experience	70±3,3	4,7±0,33	6,0±0,04	5,31±0.05	66,1±1,3
Lack of hydration						
1	Control	79,3±2,7	4,4±0,40	6,7±0,05	5,50±0,04	61,5±0,9
2	Experience	103,4±2,0	6,8±0,25	11,4±0,02	11,20±0,06	69,00±0,7

An important indicator of the degree of water supply of plants is the water-retaining ability of cotton leaf tissues. Data on the effect of micronutrients at different levels of water supply, on the water retaining ability of cotton tissues (table 2).

Table 2 Effects of microelements on some physiological processes with different soil hydration

Phase development	Variants of experience	Lost water in the percentages after:					
		0,5 h	1 h	1,5 h	2 h	2,5 h	3 h
Budding	Optimal hydration						
	Control	6,1	10,3	14,0	17,1	20,3	24,2
	Experience	3,3	5,5	9,0	10,8	14,5	17,3
	Lack of hydration						

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	Control	5,1	8,6	11,0	13,7	16,2	18,2
	Experience	3,0	5,1	7,3	8,9	13,0	14,6
Flowering	Optimal hydration						
	Control	12,2	14,3	16,2	18,8	21,5	24,5
	Experience	6,0	7,1	7,9	11,1	12,8	15,4
	Lack of hydration						
	Control	9,2	11,7	14,0	15,9	18,2	20,2
	Experience	5,1	8,2	10,1	12,2	13,4	16,4

The water retaining ability of plant tissues, reflecting a number of protectively adaptive reactions that determine the stability of the system, under the influence of drought significant changes, the direction of which depends on the degree of the severity of this extreme factor, as well as the nature of the action.

From the data of the table it is clear that microelements contribute to a significant increase in the water retaining ability of the leaves. Both at optimal and insufficiently hydrated, the water is slower to give water to the leaves of the plant variant with the use of micro elements. This pattern is typical for both the budding phase and the flowering phase.

Plant cell resistance or water retention capacity is an integrated indicator that characterizes both water and membrane permeability. The change in water retaining forces in leaf cells is closely related to plant water supply. Increased water retention with insufficient soil hydration helps maintain a fairly high level of water. This in turn has a positive effect on the weight of physiological processes, including cotton resistance [7].

Many agricultural plants, including cotton, are often exposed to such factors as soil water shortages (soil drought), air temperatures, especially in the summer (40-45^{0}C) and relative humidity (atmospheric drought). As a result, the water balance in the body of plants is changed and water deficiency occurs first on the leaves, which are photosynthetic organs. If its value is high in cultured plants, the plants will be severely affected by water shortages [8].

The experimental results are presented in Table 3. The daily water shortage data on leaves of cotton varieties was found to be directly related to soil moisture content.

The difference in the value of this indicator among the variants under moderate humidity conditions also depended on their development stages.

The reduction of soil moisture content has led to an increase in the value of water deficit in the leaves of all control and experimental options. From the results, it was found that in micro elements the value of this indicator was lower than that of the control options, indicating the relatively normalization of water metabolism in plants.

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Table3 Daytime water deficiency, %

№	Variants of experience	Budding	Flowering	Fruiting
	Moderatehumidity			
1	Control	10,6± 0,15	12,3±0,11	13,0±0,19
2	Experience	8,3±0,12	9,2±0,09	11,8±0,16
		Limited humidity		
1	Control	14,6±0,14	16,9±0,21	17,4±0,24
2	Experience	12,0±0,19	13,4±0,18	14,3±0,21

Ongoing soil drought combined with high air temperatures led to a decrease in water content in cells and tissues, resulting in a slower rate of transpiration and photosynthesis. As a result, there has been an increase in the water deficit value in the leaves and the diffusion resistance of the oral cavity.

A drastic reduction in soil moisture results in increased water deficiency in the leaves. Sometimes the nights lost by plants are not replenished even at night. As a result, the plant cells are in the state of plasmotosis in the early hours of the day, resulting in dehydrated water deficiency on the leaves of the plant. The emergence of residual water shortages in plants greatly affects their physiological processes.

In addition to the daily water shortage on the leaves of cotton varieties, residual water shortages were also studied. All the identified results are presented in Table 4.

It was noted that variations in water deficit in leaves varied along with soil moisture levels and microelements, especially depending on the time of day, the stages of vegetation development, environmental factors and climatic conditions.

According to the data, the value of residual water shortages is one of the most important indicators of the state of vegetation, not only in drought but also in conditions of sufficient water.

Table4 Daytime water deficiency, %

№	Variants of experience	Budding	Flowering	Fruiting
	Moderate humidity			
1	Control	1,5± 0,05	2,4±0,07	3,0±0,08
2	Experience	0,8±0,03	1,6±0,05	2,1±0,07
		Limited humidity		
3	Control	2,6±0,08	3,9±0,09	4,3±0,08
4	Experience	1,8±0,05	2,1±0,06	3,0±0,04

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Adequate water and nutrients of plants have increased transpiration efficiency and reduced daily water shortages on the leaves. Increased residual water deficiency in leaves has been shown to adversely affect cell division and all growth processes.

It was also noted in our experiments that the water deficit in plants is directly related to soil moisture and air temperature.

Thus, the data on residual water shortages show that its value is lower in those with moderate soil moisture content and higher in limited water supply options. Depending on the development stages of the cotton crop, the value of this indicator has been different. There was a decrease in the value of residual water deficit in microelement variant plants under limited humidity conditions.

IV. CONCLUSION

The results obtained indicate that microelements contribute to the development of signs in cotton that determine an increase in drought tolerance during the most critical stage of ontogenesis during the reproductive period. A consequence of this effect is a marked decrease in the decline of fruit elements and an increase in the overall productivity of plants.

Thus, fertilizing microelements (boron, zinc) helps to increase the drought tolerance of cotton. Under the influence of microelements, the hydration of tissues increases, the content of bound water increases, the concentration of cell juice and the osmotic pressure, the water holding ability of the leaves. At the same time, there is a decrease in daily and residual water deficiency of leaves of cotton plants. These changes in the metabolism providing an increase in the drought tolerance of cotton plants are well expressed in the experimental plants.

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