Available online at www.rajournals.in

RA JOURNAL OF APPLIED RESEARCH
ISSN: 2394-6709
DOI:10.47191/rajar/v8i3.02
Volume: 08 Issue: 03 March-2022

International Open Access

Impact Factor- 7.036

Page no.- 181-184

Soil Salinity and Some Physiological Indicators of Cotton Varieties

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ARTICLE INFO
Published Online:
04 March 2022

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ABSTRACT
The article deals with the information about the effect of saline stress factors on some physiological parameters of medium-fiber cotton varieties. According to the results of the study experiments, Bukhara-8 and Bukhara-102 cotton varieties have a high level of resistance to saline stress. The degree of adaptation of cotton in Bukhara-8 and Bukhara-102 varieties to soil salinity and arid unfavorable environmental conditions is higher than in Bukhara-10 and Sultan, Andijan-35 varieties. Variations in the value of physiological parameters studied in the cross-section of varieties were found to depend on their biological and individual characteristics.

KEYWORDS: Cotton, Saline Stress, Salinity, Cell Sap Density, Daytime Water Deficiency, Respiratory Rate, Adaptation.

INTRODUCTION

The current acceleration of soil salinity may lead to a 30% loss of arable land in the next 25 years [1].

To meet the world's food demand by 2050, global agricultural production needs to be increased by 60 percent from 2005-2007 levels. To meet this need, great efforts will be required to improve agricultural production. One possible way to solve this problem is to increase salt-tolerant crops. The study of mechanisms based on salt tolerance of plants will be useful to increase such crops and alleviate food shortages in the future [2].

Climate change causes thermal stress in the air and soil, along with rising sea levels and declining groundwater, increasing the risk of salinization in crop areas and turning it into saline areas [3].

Among various environmental stressors, soil salinity has become a very important problem all over the world due to its drastic impact on the physiological properties and productivity of plants [4].

It is known that global environmental changes as increasing stress, extreme heat, drought, soil salinity and other factors cause great damage to agriculture, especially cotton. Each region is adapted to the soil and climatic conditions, resistant to adverse conditions, flexible selection and proper placement of cotton varieties is one of the urgent tasks of today.

Salts accumulated in the soil increase the osmotic pressure of the soil solution, while drought makes it difficult for water to enter through the root system. Indeed, high temperatures and garm winds alter physiological and biochemical processes, causing water shortages in plant bodies [5].

Sometimes the accumulation of salts in the soil also leads to the occurrence of physiological drought. As a result, despite the fact that there is enough water in the soil, there are significant changes in the water balance of plants, as signs of wilting are observed and lead to a decrease in productivity.

The global climate change in the world is causing an increase in air temperature in the biosphere, and hot winds caused by a sharp drop in relative humidity in the summer months are causing atmospheric and soil drought. In the current period of serious water problems, it is important to introduce water-saving agro-technologies, as well as to develop methods of growing cotton varieties that are resistant to soil and atmospheric drought and high temperatures and high water efficiency [6].

The strongest negative impact of adverse environmental factors falls on the water-demanding-critical period of cotton, we can include here the flowering stage. At the same time, due to the lack of water in the soil, soil salinity and high air temperatures together adversely affect the physiological and biochemical processes that take place in cotton, the yield and its quality indicators decrease. Therefore, it is important to zoning cotton varieties that are resistant to such adverse factors based on specific soil and climatic conditions [7].

RESEARCH OBJECTS AND METHODS

Bukhara-8, Bukhara-102, Bukhara-10, Sultan and Andijan-35 varieties belonging to the group of medium-fiber cotton varieties were used as the object of research. Currently, these varieties are planted in large areas in a number of regions of the country. During the experiments, the most common grassland-alluvial soil type in the region was used. Such soils form the main areas of Bukhara region. The moisture and moisture capacity of the soil obtained for the experiments were determined. For field experiments, non-saline and moderately-strongly saline areas were initially identified, and on this basis, experiments were performed on 2 different backgrounds (non-saline and saline). During the experiments, the physiological indicators that determine the water exchange of cotton - the degree of density of cell sap [8], daytime water deficiency in the leaves [9] and respiratory rate [9] were determined.

RESEARCH RESULTS AND ITS DISCUSSION

According to scientific data, the increase in moisture in the saline soil environment has a positive effect on the water supply of cotton. As a result of irrigation, the concentration of salts in the soil decreases, which is of great importance in providing adequate water to plants in soil salinity. The decrease in moisture in the top layer of the soil raises the salts with the soil solution from the deeper layers in a capillary manner, and as a result the penetration of salts into the plant body becomes more active [10].

An increase in the concentration of salts in the soil solution prevents water from entering the plant body. Under these conditions, the amount of water in the cell decreases and the concentration of cell sap. In plants with high levels of cell sap density, osmotic pressure and suction power are also high. This in turn is one of the adaptation mechanisms aimed at providing more water to plants [11,12].

The negative effect of salts is observed primarily in the colloid-chemical properties of the protoplasm. This has a negative effect on the rate of water exchange in plants. According to the data, with increasing soil salinity, the concentration of cell sap in plant leaves increased, and the amount of total and free water decreased. In a saline environment, the osmotic pressure of cotton plants rose sharply. As a result of water scarcity in saline environments, the suction power of cotton leaves reaches 30 atmospheres [13,14].

Field experiments were conducted to assess the effect of salinity on the density of cell sap. The effect of salinity on the degree of thickening of leaf cell sap was determined during the stages of sprouting, flowering and budding of cotton. According to the data obtained during the experiments, the value of this indicator was directly related to the developmental phases of varieties in non-saline and moderately strongly saline soils. An increase in the value of this indicator was noted in all varieties and variants, regardless of the level of soil salinity, from the stage of weeding to the stage of weeding.

The density of cell sap is significantly higher in all cotton varieties grown in saline soil conditions than in plants grown in unsalted conditions. In the unsalted variants of all varieties, the concentration of cell sap was lower than in the saline variants. It was noted that with the increase in soil salinity, the concentration of cell sap in all varieties also increases. The highest rates were found in plants grown under soil salinity.

In particular, the value of this indicator at the stage of salinity is 9.7% in the unsalted conditions of Bukhara-10, 10.8% in the saline variant, 10.3% in the unsalted conditions of Bukhara-8, 12.0% in the saline variant, 10 in the unsalted conditions of Bukhara-102, 5% in the saline variant 12.4%, Andijan-35 in the unsalted conditions 9.0%, in the saline variant 9.6%, in the unsalted variant of the Sultan variety 9.4%, and in the saline variant 10.1%.

Evaluation of the effect of salinity on the concentration of cell sap shows that the same patterns were observed in the flowering and budding stages of all cotton varieties studied as in the flowering stage. That is, salinity led to an increase in cell sap density in all studied varieties.

Based on the above, it can be said that the concentration of cell sap of cotton leaves depends on the concentration of salts in the soil, the stages of development of cotton, as well as the biological characteristics of the varieties. Significant differences were also observed between varieties, according to the data obtained on the assessment of the effect of salinity on the density of cell sap. At the same time, high results were found in Bukhara-102 and Bukhara-8 varieties. The lowest rate was recorded in Andijan-35.

These indicators have been widely used by a number of scientists to determine the degree of resistance of agricultural plants to salinity. Soil salinity also affects the uptake and consumption of water by plants, leading to changes in water balance and water shortages in plant organs, especially its leaves.

It is known that when the air temperature is high and its relative humidity is low, especially in the afternoon, the lack of water in the leaves of plants is high. This has a negative effect on the water balance in plants.

When plants are grown in conditions of prolonged soil and atmospheric drought and soil salinity, daytime water shortages increase, and leaf cells do not return to a stable state even in the evening. As a result, there is a lack of residual water in the leaf cells in the morning. The occurrence of residual water shortages has a serious impact on water metabolism in plants [15,17].

According to the data obtained on the daytime water shortage in the leaves of cotton varieties, this figure has increased in all variants from weeding to weeding. As the salinity level in the environment increased, the value of daytime water shortage was found to increase in all varieties.

In all saline variants, the value of daytime water shortage was much higher than in the non-saline variants. Significant differences were also observed between the varieties studied on the above indicators. The highest daytime water shortage was found in the saline variants. In non-saline variants, a decrease in the value of this indicator was found. The lowest values were observed in Bukhara-8 and Bukhara-102 varieties. The highest daytime water shortages were recorded in the Sultan and Andijan-35 varieties. In the intermediate position is Bukhara -10 variety.

Respiration is one of the main gas exchange pathways for plants, which ensures that plants are in constant contact with the external environment. Its intensity is negatively affected by environmental factors, especially salinity.

During the experiments, the respiration rate of cotton varieties was carried out under two different saline and saline soil conditions. A series of field experiments were conducted to study the effect of salinity on respiratory rate. In the conducted experiments, it was observed that the differences of the studied cotton varieties in terms of respiratory rate depend on their individual and biological characteristics.

Respiratory intensity was determined during the mowing, flowering, and germination stages of cotton varieties. It was observed that the intensity of respiration was directly related to the level of soil salinity. It was noted that the value of this indicator was higher in the saline variants than in the non-saline variants.

This regularity was also observed in saline variants. In the case of soil salinity, the value of this indicator was the highest in all varieties compared to the unsalted variant. In our experiments on cotton varieties, it was found that soil salinity had a negative effect on the respiration rate of cotton varieties. The strength of such observed adverse effects affected the studied physiological characteristics of the varieties.

In non-saline variants, an increase in respiration rate was observed in all cultivars of flowering stage.

The value of respiration rate in the non-saline variant of Bukhara-10 is -13.0, in the saline variant - 14.9, in the non-saline variant - 14.7, in the saline variant - 16.0, and in the coagulation phase - 16.0 in the variant the respiratory rate was -15.1, in the saline variant -17,2 $mgCO_2/dm^2$.

At the stage of salting, Bukhara-8 variety had -11.1 mg in the unsalted variant and -12.0 $mgCO_2/dm^2$ in the saline variant. In non-saline conditions during flowering - 12.4 mg, in saline conditions - 13.7, in non-saline conditions - 13.5mg, in saline conditions - 14.8 $mgCO_2/dm^2$. At the stage of salting Bukhara-102 variety - 12.0 in the unsalted variant, -13.7 in the saline variant; -13.5 in unsalted conditions and -14.2 in saline conditions during flowering; 14.6 $mgCO_2/dm^2$ per hour in unsalted conditions and 15.2 mg in saline conditions.

In Andijan-35 variety - 14.6 in the unsalted version, -16.0 in the saline variant, -15.4 in the non-saline condition during flowering, -18.3 in the saline condition, -17.8 in the non-saline condition, and -19.6 in the saline condition. $mgCO_2/dm^2$ was observed to be equal to per hour.

In the Sultan variety, the salinity is 13.7 mg, the salinity is 15.8, the flowering is -14.9, the salinity is -17.8, the salting is 16.6, and the salinity is 18.5 $mgCO_2/dm^2$ per hour.

The highest values were observed during the coagulation phase during the experiments. Depending on the stages of development of cotton varieties, sharp differences in this indicator were observed among the studied varieties. The value of such differences may be one of their adaptive reactions to adverse factors.

From the data analyzed above, soil salinity has negatively affected all stages of development of cotton varieties. Respiratory intensity was highest during the flowering stage of the cultivars and during the flowering stage. Under such conditions, Bukhara-8 and Bukhara-102 varieties did not show any significant changes in this indicator. This indicates a high degree of adaptation to the influence of adverse factors.

CONCLUSION

In the conditions of Bukhara region, salinity stress from adverse environmental factors has been found to have a negative impact on the physiological properties of all studied cotton varieties. The degree of thickening of cell sap, daytime water shortages in the leaves, and levels of respiratory intensity, which determined the physiological tolerance characteristics of cotton varieties studied during the experiments, were directly related to soil salinity. In the unsalted variants, the value of the above indicators was low in all cultivars and was observed to increase during the development period from mating to mating. According to the data, Bukhara-8 and Bukhara-102 cotton varieties have a high level of resistance to saline stress. In saline soils and arid unfavorable environmental conditions, the level of adaptation of cotton in Bukhara-8 and Bukhara-102 varieties was higher than in Andijan-35, Bukhara-10 and Sultan varieties.

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