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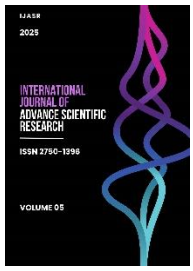

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Research Article

SOME PHYSIOLOGICAL PARAMETERS AND YIELD CHANGES OF FINE-FIBER G. BARBADENSE L. COTTON VARIETIES UNDER STRESS CONDITIONS

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Nazarova Feruza Ilhomovna
Teacher, Bukhara State Medical Institute, Bukhara, Uzbekistan

Kholliev Askar Ergashovich
Doctor of Biological Sciences, Professor, Bukhara State University, Bukhara, Uzbekistan

Abstract

The article presents some data obtained on the study of photosynthesis and respiration rates of fine-fibre cotton varieties in conditions of soils with varying degrees of salinity. During the experiments, the photosynthesis and respiration rates of fine-fibre cotton varieties Surkhon-18, Termiz-202, Termiz-208, SP-1607 and Surkhon-16 were investigated in relation to the level of salinity in the soil. It was found that there is a relationship between the level of salt tolerance of photosynthesis and respiration rates among the studied varieties, and its change varies to varying degrees depending on the stages of growth and development and biological characteristics of the varieties.

Keywords

Fine-fiber cotton, salinity levels, photosynthesis, respiration rates, stress, tolerance, adaptation.

Introduction

Salinity is a global problem for agricultural production. Understanding the sensitivity and transport of Na+ in plants under salt stress will be useful for breeding salt-tolerant crop varieties. First, the salt stress sensor and root meristem zone are proposed as tissues containing salt stress-

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sensing components. Then, the importance of Na+ excretion and vacuolar Na+ sequestration in the overall salt tolerance of plants is emphasized. Finally, some issues related to plant salt stress tolerance, including the cytosolic Na+ concentration and the role of Na+ as a nutrient, are discussed [1].

Sodium is the sixth most abundant element in the world, and sodium salts dominate many of the world's saline soils. The current rate of soil salinization could lead to the loss of 30% of arable land in the next 25 years [2].

To meet the world's food demand by 2050, global agricultural production must increase by 60 percent from 2005-2007 levels. This urgent need requires a major effort to improve agricultural production. One possible way to address this challenge is to breed salt-tolerant crops. Understanding the mechanisms underlying plant salt tolerance will be useful for breeding such crops and alleviating future food shortages [3].

Excessive salt concentration in the soil disrupts water absorption and ion balance in cotton plants, leading to ion poisoning, growth retardation, leaf scorch, and yield reduction. Salinity stress is a major factor limiting agricultural productivity in the biosphere. Salinity significantly threatens the growth, productivity, and quality of cotton fibre [4-5].

Salinity and drought are two of the most important environmental problems that hinder the productivity of agricultural crops worldwide [6-7].

Excessive soil salinity adversely affects cotton growth and yield. Salt stress, which is induced by significant differences between genotypes, has a detrimental effect on germination and vegetative growth. With increasing salinity, the weight of shoots, roots, and leaf area also decreases [8].

The mechanism of photosynthesis plays a crucial role in plant stress responses. Plants downregulate photosynthesis-related proteins as they attempt to slow growth to prevent death and close stomata to prevent water loss. For example, chlorophyll a and b binding proteins are downregulated in photosystems I and II under low temperature and water stress [9].

The object of research and methods. The objects of research were the fine-fibre cotton varieties Surkhon-18, Termiz-202, Termiz-208 and SP-1607 Surkhon-16. The physiological indicators of fine-fibre cotton varieties under stress conditions in saline soils of the Bukhara region were determined, including the rate of photosynthesis and respiration. The experiments were conducted in the fields of the "Akrombobo nabirasi Gulshoda farm" of the Kogon district of the Bukhara region and the "Bukhara Bahor Aobod erlari" farm of the Bukhara district during 2020-2023. The experiments were carried out on fields of alluvial soils with varying degrees of salinity.

The obtained results and their discussion. The physiological effect of salinity on the rate of photosynthesis depends on the water balance of plant cells, stomatal closure, and biochemical processes. In saline conditions, salts accumulate in chloroplasts, which reduces the amount of

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chlorophyll. Chlorophyll pigments are the main element for photosynthesis, and their reduction slows down the process of absorbing solar energy.

In our research, we studied the effect of different salinity levels on the rate of photosynthesis during the tillering, flowering and budding stages of fine-fibre cotton varieties. In particular, the value of the photosynthesis rate at the stage of flowering in the Surkhan-18 variety is 0.86 in non-salinity conditions, 0.78 in moderate salinity conditions, and 0.73 in strong salinity conditions; 1.07 in optimal conditions, 1.00 in medium salinity conditions, 0.95 in strong salinity conditions in Termiz-208 variety; 0.93 in unsalinated, 0.85 in medium salinity, 0.80 in strong salinity conditions of Termiz-202 variety; 1.12 in non-saline conditions of SP-1607 variety, 1.07 in moderately saline conditions, 0.94 in strong saline conditions; In the Surkhan-16 variety, it was 0.81 g/m2 in optimal conditions, 0.76 in medium salinity conditions, and 0.72 g/m2 in strong salinity conditions.

The relationships noted in the budding stage of cotton varieties were also observed in the flowering and budding phases. At these stages, it was found that the rate of photosynthesis decreases significantly with increasing salinity. Salinity has a physiologically significant effect on the rate of respiration. This effect is mainly due to the energy requirements of cells, oxidative stress, and metabolic processes. In saline conditions, the rate of respiration increases because the cell increases its metabolic activity to meet its energy requirements. The rate of respiration increases as a result of the oxidation of carbohydrates and other organic substances in large quantities. The process of respiration plays an important role in the adaptation of cells to salinity. In a saline environment, the cell produces additional organic substances to control the osmotic pressure. This process requires energy, therefore, an increase in the rate of respiration is observed.

The respiration rate of cotton varieties was measured under three different conditions: non-saline, moderately saline, and highly saline. Laboratory and field experiments were conducted to study the effect of salinity on respiration rate. The experiments revealed that the selected cotton varieties differed in respiration rate. These differences were observed at the boll, flowering, and staking stages of cotton. According to the results, the respiration rate of cotton varieties was highest under highly saline conditions compared to other conditions, i.e., non-saline and moderately saline conditions. The value of respiration rate in the control variants increased from the boll to the flowering stage in all varieties.

In the Surkhan-18 variety, the combing rate was -12.3 in the control variant and -14.2 in the highly saline, i.e. experimental variant; during flowering, it was -13.2 in non-saline conditions and -14.3 in highly saline conditions; during storage, it was -14.0 in non-saline conditions and -16.3 in highly saline conditions.

The combing phase of the Termiz-208 variety was observed to be equal to -10.0 in the control variant, -11.2 in the medium saline variant, and -12.2 in the highly saline variant; during flowering, -11.9 in the control variant, -12.3 in the medium saline

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conditions, and -13.0 in the highly saline variant; during storage, -13.0 in the control variant, -14.4 in the medium saline variant, and -15.0 in the highly saline variant. The combing phase of the Termiz-202 variety was equal to -11.7 in the non-saline variant, i.e. the control variant, and -12.8 in the highly saline variant, i.e. the experimental variant; during flowering, -13.4 in non-saline conditions, and -13.8 in the highly saline variant; In the absence of salinity, the concentration of CO2 in the storage medium was found to be 14.3 mgCO2/dm2·h, and in the presence of high salinity, it was found to be 15.4 mgCO2/dm2·h.

In the budding stage of the SP-1607 variety, the respiration rate in the unsalted, i.e. control, variant was -10.3, in the medium-salted, i.e. experimental, variant -11.8, and the highly salted variant -12.5; in the flowering stage, the respiration rate in the unsalted variant was -12.4, in the medium-salted variant -12.7, and in the highly salted variant -13.3; in the storage stage, the respiration rate in the unsalted variant was -13.2, in the medium-salted variant -14.8, and in the highly salted variant -15.4 mgCO2/dm2·h.

In the Surkhan-16 variety, the values of CO2/dm2·h were determined in the non-saline, i.e. control variant, and in the highly saline, i.e. experimental variant, at budding, 12.6 mg/dm2·h; in the non-saline, i.e. flowering, 13.6 mg/dm2·h, and in the highly saline, i.e. experimental variant, 15.6 mg/dm2·h; in the non-saline, 14.7 mg/dm2·h, and in the highly saline, 17.7 mg/dm2·h.

Even under such conditions, no significant changes were observed in this indicator in the SP-1607 and Termiz-202 varieties. This indicates a high level of adaptation to adverse factors. The highest respiration rate was recorded in the Surkhan-16 variety. These indicators reflect the level of adaptation of plant varieties to salinity conditions and their tolerance to stress.

Excessive soil salinity has a detrimental effect on the growth and development of cotton, resulting in a decrease in the yield and quality of the cotton plant. The effect of soil salinity on selected cotton varieties was also studied during our research. In the non-saline variant, the yield of the cotton variety Surkhan-18 in 2021 was 33.2 c/ha, the Termiz-208 variety was 35.1 c/ha, the Termiz-202 variety 33.1 ts/ha, It was 38.3 t/ha in SP-1607 cotton variety, and 34.7 t/ha in Surkhan-16 variety. In the experimental option, i.e., in medium salinity conditions, the yield was 33.5 t/ha in the Surkhan-18 cotton variety, 32.7 t/ha in the Termiz-208 variety,33.6 ts/ha in the Termiz-202 variety, It was 33.8 t/ha in SP-1607 cotton variety and 27.6 t/ha in Surkhan-16 variety.

If we compare the varieties in 2022, the yield under control, that is, non-saline conditions, was 36.6 c/ha for the Surkhan-18 cotton variety, 36.9 c/ha for the Termiz-208 variety,35.6 ts/ha in the Termiz-202 variety, It was 41.1 t/ha in SP-1607 cotton variety, and 36.4 t/ha in Surkhan-16 variety. According to this indicator, in saline conditions, 30.7 tons of Surkhan-18 cotton, 35.2 tons of Termiz-208 cotton per hectare,30.5 from Termiz-202 variety,38.0 quintals of cotton variety SP-1607 and 28.4 quintals of Surkhan-16 variety were obtained.

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In the 3rd year of our experiments (2023), the salinity factor also caused a decrease in yield in each variety. Overall, the average yield per hectare in non-saline conditions was 34.0 cwt for the Surkhan-18 cotton variety, 38.7 cwt for the Termiz-208 variety,38.1 from the Termiz-202 variety, The SP-1607 cotton variety yielded 37.6 and the Surkhan-16 variety yielded 30.9 centners, while the yield per hectare in the average saline soil was 29.4 centners per hectare in the Surkhan-18 variety and 36.5 centners in the Termiz-208 variety.34.3 in Termiz-202 variety, It was 37.9 centners in the SP-1607 variety, and 32.1 centres in the Surkhan-16 variety.

Conclusions

The highest photosynthesis rate is observed in the SP-1607 variety, which is better adapted to salinity conditions and has a high ability to maintain water and salt balance. The lowest photosynthesis rate is observed in the Surkhan-16 variety, which indicates its intolerance to salinity. These results are related to the physiological characteristics of plant varieties and reflect the degree of adaptation to saline environments.

According to the data explained above, soil salinity harmed all stages of the development of cotton varieties. The respiration rate was lowest at the boll stage of the varieties compared to the flowering and tillering stages.

During scientific studies, it was noted that cotton productivity depends on soil salinity. As a result of the degree of salinity, the difference in the yield of the studied cotton varieties depends on the biological characteristics of the varieties. High resistance to soil salinity was observed in Termiz-208 and SP-1607-18 varieties. According to this indicator, the Surkhan-18 and Termiz-202 varieties took the intermediate place, and the Surkhan-16 variety took the lower place.

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