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SALT TOLERANCE AND AGROPHYSIOLOGICAL CHARACTERISTICS OF FINE-FIBER COTTON

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Today, the further development of cotton production requires the selection of fine-fiber cotton varieties that are early-maturing, high-yielding, and characterized by superior fiber quality, while being resistant to various environmental stress factors, including saline soils. It is also essential to develop and widely implement optimal agro-technological practices for their cultivation.

According to the United Nations, more than 1.5 billion people around the world are facing serious food shortages due to soil degradation in agricultural lands. Global mapping data show that soil salinization of agricultural lands covers 833.0 million hectares, which corresponds to 8.7% of the planet's territory [1]. In Uzbekistan, irrigated land area is 4.3 million hectares, and as of October 1, 2021, 44.7% of these lands are saline to varying degrees: 31.0% slightly saline, 11.9% moderately saline, and 1.9% strongly saline [2].

It is well known that under slightly saline conditions crop yields decrease by 10–20%, under moderately saline conditions by 20–50%, and under highly saline conditions by 50–80%. Therefore, one of the main conditions for obtaining high yields from agricultural crops, including cotton, in saline soil and regional climatic conditions is the creation and introduction into production of early-maturing, high-yielding cotton varieties resistant to salinity, with fiber quality meeting the requirements of the IV industrial type and suitable for the textile industry.

Worldwide, extensive scientific research on cotton physiology is being carried out by leading breeder-physiologists and specialists. In the process of developing new varieties and studying their physiology, modern methods of breeding and physiology are being effectively applied. In our republic, due to water scarcity and soil salinity, special attention is paid to creating new cotton varieties that are resistant to salinity and water deficiency, early-maturing, productive, resistant to diseases, and whose fiber productivity and quality meet current international textile market requirements. This involves the effective use of unique traits of wild and ruderal forms in breeding programs and ensuring their adaptation to local soil conditions. At present, cultivated cotton varieties in Uzbekistan demonstrate superiority over many foreign varieties in terms of tolerance to water scarcity and salinity, earliness, productivity, fiber quality, and other valuable agronomic traits. However, the demand of industry and the textile sector for cotton varieties with higher fiber productivity and quality is increasing year by year.

The negative effect of salt (NaCl) on cotton varies depending on the growth stage, the concentration of salt, and the duration of salt exposure. Nevertheless, it delays seed germination. During the seedling and vegetative stages, salt stress may reduce stomatal conductance, increase transpiration rate, affect photosynthesis, reduce water use efficiency, and increase respiration rate [3]. Salinity also decreases primary and lateral root growth, leaf expansion and size, stem thickness, plant height, as well as the weight of buds and roots [4].

The longer the negative effect of salt stress lasts, the more severe it becomes. As a result, mature cotton plants may delay boll formation, reduce the number of fruiting nodes, increase fruit shedding, and lead to late maturation. Seed weight, fiber length, fiber strength, and overall yield are reduced, especially when cotton is grown under prolonged saline conditions or throughout its entire life cycle [5].

Selection for salt tolerance should be based on plant growth over a certain period, since individual varieties of self-pollinating species are almost genetically homozygous but not identical, and differences between varieties may only be observed over a longer period. Short-term studies may show reduced growth rates, but such reductions can be similar for both tolerant and sensitive varieties. Only after extended periods can tolerance or sensitivity be clearly measured in individual plants, or mechanisms can be identified that allow certain plants to withstand NaCl stress at different stages of growth [6].

Plants can be divided into halophytes and glycophytes in terms of stress tolerance to salinity. The majority of crop species are glycophytes. Halophytes and glycophytes have been compared in terms of the different strategies they employ in response to salt stress [7]. In crops, including soybean and bean, the wide variation in salinity tolerance can be used in screening programs by employing relevant indicators of salt tolerance. Alongside agronomic traits, the use of physiological tolerance in practice, and its correlation with salt tolerance indicators, has been considered sufficiently strong to serve as a breeding tool for the selection of salt-tolerant varieties [8].

Soil salinization, which currently affects approximately 45 million hectares of irrigated land, represents a major ecological barrier to plant cultivation and is expected to increase as a result of global climate change and many irrigation practices [9]. Among various ecological stressors, soil salinity has become a significant global problem due to its severe impact on plant physiology and productivity [10].

Phenological observations were carried out for all experimental variants. The following growth and development stages of plants were recorded: the true leaf stage, budding stage, beginning of flowering and full flowering, boll formation, and maturation stage. Plant density was recorded on two plots allocated for each replication with an area of 0.5 m^2. Starting from the third true leaf stage, plant height was measured every 15 days on 25 plants. Measurements were taken from the root collar to the apical growth point of the main stem.

During the research, positive results were obtained regarding the growth, development, and productivity of fine-fiber cotton varieties on slightly and moderately saline soils, demonstrating that claims suggesting cotton cannot produce quality yields under saline conditions are unfounded. It was found that fine-fiber cotton varieties grow and develop well under slightly and moderately saline conditions. Therefore, the cultivation of fine-fiber cotton in such soils can provide domestic oil-processing plants and the textile industry with locally produced, high-quality, and affordable raw materials.

Based on the study of the biophysiological characteristics of fine-fiber cotton varieties under the climatic conditions of the Bukhara region, it was concluded that the plant can be cultivated under slightly and moderately saline soil conditions. Scientific research on growing fine-fiber cotton varieties under different soil-climatic conditions has shown that this crop adapts relatively quickly to diverse environments, including low to moderate saline soils.

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