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DEVELOPING AN ENVIRONMENTALLY SAFE AND RESOURCE-SAVING BIOTECHNOLOGY FOR COTTON CULTIVATION IN THE SALINE SOILS OF BUKHARA REGION

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Abstract
This article analyzes resource-saving and environmentally safe biotechnological approaches to cotton cultivation on saline soils of the Bukhara region. It examines the factors affecting cotton growth under salinity conditions, biotic and abiotic methods of soil improvement, as well as new technologies developed based on biofertilizers, microorganisms, and green microalgae. The results of the research identify opportunities to increase cotton yield, reduce water and mineral fertilizer consumption, and ensure environmental sustainability.

Keywords: Resource saving, environmental safety, green micro-waters, microorganisms, biostimulant, biofertilizer, cotton, saline soil.

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Introduction

Cotton growing is one of the most important sectors in the agriculture of the Republic of Uzbekistan. In particular, the climatic conditions of Bukhara region are hot and dry, providing favorable opportunities for cotton cultivation. However, most of the soils in the area are saline, which seriously negatively affects cotton yield. As a result of salinization, the water-physical properties of the soil deteriorate, the development of the plant root system is restricted, and nutrient uptake decreases.

Under such conditions, the use of traditional chemical fertilizers provides only short-term results, but poses ecological risks and disrupts the biological balance of the soil. Therefore, the use of resource-saving and environmentally safe methods developed on a biotechnological basis has become a pressing issue today.

Literature Review and Theoretical Basis

In recent years, both Uzbek and foreign scientists have proven the effectiveness of using biofertilizers and biostimulants in cultivating agricultural crops on saline soils. For example, preparations such as “Rhizocom,” “Phosstim,” “Biogum,” “Trichodermin,” and “Azotobacterin” increase plant growth rates, promote root system development, and boost productivity by 10–25%.Experiments conducted on moderately saline meadow soils in the Bukhara region showed that the use of green microalgae *Chlorella vulgaris* and *Scenedesmus obliquus* increased the humus content in the soil, improved water retention capacity, and positively changed the physiological indicators of cotton growth. Green microalgae not only improve the nutrient balance but also enhance the photosynthesis process and reduce salt stress.Additionally, planting siderate crops

(vetch, oats, chickpeas) helps restore soil biological activity, increase organic matter content, and gradually reduce the degree of salinization.

Research Materials and Methods

The research was conducted on moderately saline soils in the Qarako‘l and Jondor districts of Bukhara region. The soils had an average electrical conductivity (EC) ranging from 4 to 6 dS/m and were classified as heavy loam in terms of mechanical composition.

The following treatments were tested in the experimental plots:

1. Traditional method (control): cultivation using standard agro-technology with mineral fertilizers;
2. Treatment with biofertilizers: using the preparations “Rhizocom” and “Phosstim”;
3. Irrigation with microalgae: suspension of *Chlorella vulgaris* (10^6 cells/ml);
4. Application of biostimulants: “Trichodermin” and “Microustirgich”;
5. Combined biotechnology: biofertilizer + microalgae + optimized drip irrigation.

Measurements were carried out during different growth stages of the plants. The main indicators included: yield, leaf area, water consumption, soil moisture, electrical conductivity (salinity level), microbial activity, and fiber quality analysis.

Results and Analysis

The research results showed that in cotton fields treated with biofertilizers and microalgae, yield increased by 20–30%. Notably, in the combined treatment variant, fiber yield rose from 35 quintals per hectare to 47 quintals per hectare. The humus content in the soil increased by 0.18%, and the number of beneficial microorganisms grew by 1.3 times. Water consumption for irrigation decreased by 15–20%, which is an important indicator of resource saving.

The salinity level (EC) decreased from 6 dS/m to 4.2 dS/m, which can be explained by the increased microbiological activity. Additionally, the content of chlorophyll “a” and “b” in plant leaves increased, indicating improved photosynthetic efficiency.

Discussion

The results indicate that biotechnological approaches significantly improve cotton growth on saline soils. Biofertilizers activate the microflora around the roots, while green microalgae act as natural biostimulants for the plants. These methods not only increase yield but also restore the ecological balance of the soil and reduce the use of pesticides and chemical fertilizers.

Significant achievements were also made in resource saving. In particular, when microalgae were applied together with drip irrigation, water consumption decreased and crop quality improved.

Conclusion and Recommendations

1. The highest results in cotton cultivation on saline soils are achieved when biofertilizers, microalgae, and biostimulants are used in combination.
2. From the perspective of environmental safety, the use of chemical fertilizers can be reduced by 30–40%.

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3. The application of biotechnologies together with resource-saving irrigation technologies (drip irrigation) is also economically beneficial.
4. In the future, it is necessary to develop salt-tolerant cotton varieties based on biotechnological breeding, and to expand genetic and microbiological research.

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