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APPLICATION OF THE BIOPREPARATION "MICROZIM" IN AGRICULTURAL CROPS WITH SPECIAL REFERENCE TO COTTON CULTIVATION IN THE BUKHARA REGION

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Abstract
The transition towards biologically based agricultural technologies has become a priority in the arid regions of Central Asia, where soil degradation, salinity, and low organic matter content significantly limit crop productivity. This article examines the application of the biopreparation Microzim in agricultural crops, with special emphasis on cotton (Gossypium hirsutum L.) cultivation under the environmental and soil conditions of the Bukhara region of Uzbekistan. The study presents detailed results on the effects of Microzim on soil microbial activity, nutrient availability, plant development, and cotton yield in saline and low-humus soils typical for the region. Field experiments conducted between 2021–2024 in the Bukhara, Kagan, Jondor, and Peshku districts demonstrated that the application of Microzim significantly improves soil biological properties and enhances cotton productivity by 12–22%, depending on the level of soil salinity and irrigation regime.

Keywords: Microzim; biological preparation; biofertilizer; cotton cultivation; Gossypium hirsutum; soil microbiological activity; saline soils; arid regions; Bukhara Region; organic matter decomposition; enzymatic activity; sustainable agriculture; soil fertility; microbial consortium; drip irrigation; plant growth stimulation; yield increase; Uzbekistan agriculture; environmental biotechnology.

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Introduction

Cotton is the leading agricultural crop of Uzbekistan and occupies over one-third of the irrigated area in the Bukhara region. However, cotton yields are often constrained by: secondary salinization, low humus content (0.6–1.2%), weak microbial activity in soils exposed to long-term monoculture, limited decomposition of plant residues, low water-use efficiency under arid climate conditions.

These factors reduce soil fertility, worsen nutrient cycling, and increase dependence on mineral fertilizers. Transitioning to environmentally safe biotechnologies is therefore essential for ensuring stable cotton production.

Microzim is a biologically active preparation consisting of: -nitrogen-fixing bacteria, -phosphorus- and potassium-mobilizing microorganisms, -cellulolytic fungi, -enzymatic complexes enhancing soil biochemical cycles.

The preparation is intended to accelerate organic matter decomposition, increase soil microbiota activity, and stimulate plant growth processes. Its application has shown significant potential in saline soils of arid regions, including the Bukhara oasis.

2. Materials and Methods

2.1 Study Area

Field trials were conducted in four districts of Bukhara Region:

Bukhara (light loamy soils, medium salinity)

Kagan (sandy loam, low humus, high temperature stress)

Jondor (loamy soils, variable salinity)

Peshku (desert-steppe soils, high salinity and low organic matter)

Average climatic conditions:

Annual precipitation: 110–150 mm

Summer temperature: up to 45°C

Irrigation: drip and furrow methods

2.2 Experimental Design

Cotton variety *Sulton*, widely cultivated in the region, was used.

Treatments included:

1. **Control** – without biopreparations

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2. **Microzim-Soil** – application during pre-sowing tillage
3. **Microzim-Seed** – seed treatment before planting
4. **Microzim-Irrigation** – application through drip irrigation

2.3 Application Rates

Soil treatment: 4–5 L/ha
Seed soaking: 0.5 L per 10 L water
Drip irrigation: 2 L/ha every 20–25 days

2.4 Measurements

Measured parameters included: soil microbial biomass, enzymatic activity (urease, catalase, phosphatase), leaf area index (LAI), chlorophyll content (SPAD values), boll number per plant, total cotton yield and fiber quality indicators.

3. Results and Discussion

3.1 Effects on Soil Properties in Bukhara Region

Application of *Microzim* significantly increased soil biological activity even in high-salinity zones (table-1).

Table-1. Average improvements across districts.

Indicator	Control	Microzim	Increase
Microbial biomass (mg C/kg soil)	210–235	290–340	+28–40%
Urease activity	–	–	+22–30%
Phosphatase activity	–	–	+25–33%
Organic matter decomposition	–	–	+30–50%

In **Peshku district**, where salinity levels reach 0.35–0.45% Cl-ions, the biological preparation stimulated root-associated microflora and mitigated salt stress effects on cotton plants.

3.2 Acceleration of Plant Residue Decomposition

Farmers in Kagan and Jondor noted that cotton stalk residues decomposed **1.5–2 times faster** after *Microzim* application.

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This resulted in: improved soil aeration, increased nutrient release, reduced mechanical tillage costs.

3.3 Effects on Cotton Growth and Physiology

Cotton treated with *Microzim* demonstrated: enhanced root system development (up to +32%), stronger early growth, 15–20% higher chlorophyll content, reduced susceptibility to early-season drought stress.

In Bukhara and Kagan districts, plants reached the flowering stage **4–6 days earlier**, which is critical in regions with extreme summer temperatures.

3.4 Yield Effects in Different Districts

Table-2. Cotton yield improved significantly across all study areas.

District	Control (t/ha)	Microzim (t/ha)	Increase
Bukhara	2.65	3.10	+17%
Kagan	2.40	2.88	+20%
Jondor	2.58	3.05	+18%
Peshku	2.10	2.60	+24%

Overall yield increase: **12–24%**

Fiber quality also improved slightly:

fiber length: +2–3%

micronaire: +0.1–0.2 units

3.5 Economic and Environmental Benefits

Farmers reported: 10–20% reduction in mineral fertilizer use, lower input costs for cultivation, improvement of long-term soil fertility.

Use of *Microzim* aligns with Uzbekistan's strategy for transition to biological fertilizers and reduction of chemical load on the environment.

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4. Examples of Practical Use in Bukhara Region

Example 1 — Bukhara District

A farm implementing drip irrigation applied *Microzim* three times during the season.

Results:

- Soil salinity decreased by 8–12% in the root zone
- Yield increased by 0.45 t/ha
- Water-use efficiency improved by 15%

Example 2 — Kagan District

Light sandy soils with low humus (0.6–0.8%).

After seed treatment and soil application:

- Emergence rate increased by 9–12%
- Root mass increased by 30%
- Plants showed greater heat tolerance during July heatwaves

Example 3 — Peshku District

Harsh desert-steppe conditions, high salinity.

Farmers reported:

- improved survival rate of seedlings,
- decreased leaf burn due to salinity,
- yield increase from 2.1 to 2.6 t/ha

Example 4 — Jondor District

Combined use of *Microzim* and farmyard manure.

Effect:

- the highest decomposition rate of cotton residues
- visibly healthier soil structure
- integrated biological system reduced fertilizer cost by 18%

5. Conclusion

The biopreparation *Microzim* demonstrates high effectiveness in improving soil biological processes, supporting plant development, and increasing cotton productivity under the arid and saline conditions of the Bukhara region. Field results confirm that the preparation: enhances microbial activity and nutrient cycling, increases plant stress tolerance, accelerates organic matter decomposition, improves cotton yield and fiber quality.

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Given the climatic challenges of the region, *Microzim* can be considered an essential component of sustainable cotton production strategies, and its use should be expanded across other agricultural crops.

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