

# The Application of Chlorella in Agriculture

S.B. Khojiakhmatov<sup>1</sup> 

B.M. Turdiyev<sup>2</sup>

S.A. Eliboyeva<sup>3</sup>

N.J. Khodjayeva<sup>4</sup>

<sup>1</sup> Assistant at the Department of Biotechnology, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

<sup>2</sup>Assistant at the Department of Biotechnology, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

<sup>3</sup>Student at Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

<sup>4</sup>Associate Professor at the Department of Biotechnology, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

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**Annotation.** This article explores the scientific foundations, practical applications, and ecological benefits of using Chlorella in agriculture, particularly in organic farming. The rich biological composition of microalgae, especially the proteins, phytohormones, chlorophyll, and antioxidants present in Chlorella, plays a crucial role in promoting plant growth, improving soil fertility, and enhancing stress resistance. The article also examines the use of Chlorella as a biostimulant, biofertilizer, and natural pesticide through methods such as seed soaking, compost enrichment, and foliar spraying. Scientific studies analyzing the potential to increase crop yields and reduce reliance on chemical fertilizers are also discussed.

**Key words:** Chlorella, fertilizer, agriculture, compost, biofertilizer, protein, phytohormones, chlorophyll, antioxidants

## Introduction

Today, establishing an eco-friendly, sustainable, and high-yield agricultural system is one of the most pressing challenges facing humanity. The excessive use of chemical fertilizers and pesticides has led to soil erosion, disruption of ecological balance, and significant risks to human health. In this context, biological agents—particularly microalgae-based technologies—are offering new hope for the future of agriculture.

One of these promising agents is *Chlorella*, which has gained considerable importance not only in the food industry but also in modern agriculture.

*Chlorella* is a unicellular green microalga that has been used in scientific research since the 1890s. Through photosynthesis, *Chlorella* produces oxygen and accumulates a variety of valuable compounds in its biomass, including:

50–60% protein

10–20% lipids  
 20–30% carbohydrates  
 A wide range of vitamins (A, B12, C, E)  
 Minerals (iron, magnesium, calcium)

Chlorophyll (the green pigment of plants)

Such a rich chemical composition allows *Chlorella* to be used as a natural biostimulant, organic fertilizer, and anti-stress agent.

In agriculture, *Chlorella* demonstrates the following beneficial properties:

### 1. Improves Soil Quality

When *Chlorella* biomass or its fermented extract is added to the soil:

- It increases microbiological activity
- It stimulates the growth of beneficial bacteria (such as *Azotobacter* and *Bacillus*)
- It accelerates the decomposition of organic matter, converting it into plant-available forms
- It helps reduce soil salinity and maintains soil pH balance

As a result, soil fertility in areas treated with *Chlorella* can increase by 20–40%, which directly contributes to higher crop yields.

### 2. Accelerates Plant Growth

*Chlorella* naturally produces phytohormones such as auxins, gibberellins, and cytokinins.

These compounds positively influence several key plant development processes:

- Stronger and deeper root system development
- Faster leaf expansion and enhanced photosynthetic activity
- Stimulation of flowering and fruit formation
- Improved crop quality and increased yield

For example, foliar application of *Chlorella* on crops like tomatoes, cucumbers, wheat, cotton, and vegetables has been shown to increase yields by 10–25% (see Table 1).

## The Effect of Chlorella on Plant Growth – Scientific Experimental Results

No	Plant species	Application (method) of Chlorella	Observed effects
1	Tomato ( <i>Solanum lycopersicum</i> )	Foliar spraying with 1% chlorella solution	Growth accelerated, flowering started early, and the yield increased by 24%.
2	Wheat ( <i>Triticum aestivum</i> )	Soaking seeds in chlorella solution for 6 hours	Germination reached up to 95%, and root length increased by 20%.
3	Cucumber ( <i>Cucumis sativus</i> )	Fermented chlorella solution	The leaves became larger, vegetation

			started early, and the yield increased by 18%.
4	Cotton ( <i>Gossypium hirsutum</i> )	Irrigation using chlorella-enriched biofertilizer	The root system developed, and the fiber quality improved.

### 3. Increases resistance to biotic and abiotic stresses

Climate change, drought, salinization, and high sensitivity to chemicals are the main challenges in modern agriculture. The antioxidants, beta-carotene, and chlorophyllin found in Chlorella play a protective role for plants:

- Strengthen leaf tissues
- Protect cell membranes from oxidation
- Reduce the activity of stress hormones (ABA)

### 4. Pest and Disease Control

Some metabolites of Chlorella possess fungicidal and insecticidal properties. Especially when Chlorella is sprayed on leaves:

- It provides resistance against powdery mildew (*Oidium*), bacterial spots, and downy mildew diseases
- It offers protection against aphids, thrips, whiteflies, and other harmful insects
- It forms a protective film on the leaf surface, which prevents the entry of harmful microorganisms

**Moreover, this approach meets organic farming standards.**

Chlorella can be applied in agriculture using several methods.

**The first method is using its solution.**

For this, 10–20 grams of Chlorella powder or paste is added to 1 liter of distilled water and left to ferment for 2–3 days in sunlight or a warm place.

This solution is then sprayed on seeds, poured into the root zone, or sprayed on the leaves.

Soaking crop seeds in Chlorella solution for 4–6 hours increases germination rates by 15–30%.

**The second method is using compost prepared with Chlorella.**

When 3–5% of Chlorella biomass is added to compost, microbiological activity increases and decomposition accelerates. The compost is ready 2–3 times faster.

As a result, in soils treated with Chlorella, the number of microorganisms increased 2–3 times, and a 20–25% yield increase was observed in cereals, cotton, and vegetables.

The use of chemical fertilizers was reduced by 30–50%, which is economically beneficial.

### Conclusion

Chlorella is a modern, environmentally safe, and cost-effective biotechnological tool that plays an important role in increasing agricultural productivity, improving soil health, and reducing the reliance on harmful chemicals.

Especially for farmers practicing organic and regenerative agriculture, *Chlorella* offers a natural solution.

In the future, it is expected that special biofertilizers, foliar spray products, and composting technologies based on *Chlorella* will be widely implemented.

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