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Study on the Effect of Trichoderma viride on Plant Growth and Disease Resistance

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Abstract

The present research presents a scientific and experimental study on the effect of *Trichoderma viride* on plant growth and disease resistance. In modern agriculture, soil-borne fungal diseases such as 'Fusarium', 'Rhizoctonia', and 'Pythium' are among the major causes of significant reduction in crop productivity. The excessive use of chemical pesticides for controlling these diseases has led to soil pollution, loss of biodiversity, and serious human health concerns. In this context, biological control has emerged as a safe and sustainable alternative.

'Trichoderma viride' is a beneficial soil fungus that controls plant pathogens through competition, mycoparasitism, and the secretion of enzymes and antibiotic substances. In the present study, a comparative evaluation was carried out between *Trichoderma viride*–treated and untreated plants based on growth parameters such as plant height, root and shoot development, number of leaves, and biomass. In addition, changes in disease incidence and disease resistance were also examined.

The results of the study clearly indicate that treatment with *Trichoderma viride* significantly enhanced overall plant growth and markedly reduced the incidence of soil-borne pathogens. Furthermore, *Trichoderma viride* activated induced systemic resistance (ISR) in plants, thereby strengthening their disease resistance capacity. This research contributes significantly to organic farming, sustainable crop production, and environmental conservation, and establishes the usefulness of *Trichoderma viride* as an effective alternative to chemical pesticides.

Key Words: Trichoderma viride*, Biological Control, Plant Growth, Disease Resistance, Induced Systemic Resistance, Soil-borne Diseases, Organic Agriculture.

Introduction

Agriculture forms the foundation of human life, and healthy plant growth along with higher

productivity is a key determinant of the success of any agricultural system. However, in recent times, crop productivity has been continuously declining due to the prevalence of various soil-borne pathogens. Fungal pathogens such as *Fusarium*, *Rhizoctonia*, *Pythium*, and *Phytophthora* infect plant roots, stems, and vascular tissues, thereby severely affecting plant growth, development, and yield. The control of these diseases commonly relies on chemical pesticides and fungicides, whose prolonged use results in reduced soil fertility, environmental pollution, loss of biodiversity, and adverse effects on human health.

As a solution to these challenges, biological control has emerged as an effective, safe, and environmentally friendly alternative. Biological control involves the use of beneficial microorganisms to suppress the growth and activity of plant pathogens. In this regard, *Trichoderma viride* is one of the most important and widely studied beneficial soil fungi. It naturally occurs in soil and acts against plant pathogens through various biological mechanisms.

'Trichoderma viride' competes with plant pathogens for nutrients and space, exhibits mycoparasitic activity, and secretes enzymes such as chitinases, glucanases, and proteases, along with antibiotic substances that degrade the cell walls of pathogenic fungi. In addition, *Trichoderma viride' establishes a symbiotic association with plant roots, enhancing nutrient uptake and thereby promoting overall plant growth and development.

Recent studies also indicate that *Trichoderma viride* is not limited to pathogen suppression alone, but it also activates induced systemic resistance (ISR) in plants, strengthening their defense mechanisms. Through this process, plants develop enhanced internal defense responses, enabling them to better withstand future pathogen attacks. Consequently, disease severity is reduced and plant productivity is improved.

In view of the increasing need for organic farming and sustainable agricultural development, the importance of biocontrol agents such as *Trichoderma viride* has increased significantly. Its application not only reduces dependence on chemical fungicides but also helps in maintaining soil health, environmental balance, and biodiversity conservation.

Therefore, a detailed and scientific study on the effect of *Trichoderma viride* on plant growth and disease resistance is highly significant not only in the field of Botany but also for agriculture and environmental conservation.

2. Statement of the Problem

In the present agricultural system, soil-borne fungal diseases have emerged as a serious challenge to plant production. Pathogens such as *Fusarium*, *Rhizoctonia*, and *Pythium* infect plant roots and stems, adversely affecting plant growth, development, and yield. To control these diseases, excessive use of chemical fungicides is commonly practiced, which leads to deterioration of soil biological quality, environmental pollution, and potential risks to human health.

Although *Trichoderma viride* is recognized as an effective biological control agent, there is still a need for comprehensive scientific and experimental studies to evaluate its actual and comparative effects on plant growth and disease resistance.

Therefore, the present research has been undertaken to address the problem of determining the extent to which *Trichoderma viride* enhances plant growth and strengthens resistance against soil-borne diseases.

Objectives of the Study

1. To study the effect of *Trichoderma viride* on plant growth parameters such as plant height, biomass, and root development.
2. To evaluate the effect of *Trichoderma viride* on the disease resistance capacity of plants.
3. To analyze the role of *Trichoderma viride* in the control of soil-borne fungal pathogens.
4. To conduct a comparative study of growth and disease infection levels between treated and

untreated plants.
5. To assess the usefulness of *Trichoderma viride* in organic and sustainable agricultural systems.

Research Hypotheses

1. Application of *Trichoderma viride* results in a significant increase in plant growth.
2. 'Trichoderma viride' activates and strengthens disease resistance mechanisms in plants.
3. 'Trichoderma viride' effectively suppresses the growth of soil-borne plant pathogens.
4. Disease incidence in treated plants is lower compared to untreated plants.
5. 'Trichoderma viride' proves to be an effective alternative for organic agriculture.

Rationale of the Study

The present study provides scientific validation of *Trichoderma viride* as an effective alternative to chemical fungicides. The findings of this research will contribute significantly to organic agriculture, environmental conservation, improvement of soil health, and the development of sustainable agricultural practices.

5. Review of Literature

Several national and international scholars have conducted extensive research on *Trichoderma viride* in the field of biological control. These studies clearly establish that *Trichoderma viride* is not only an effective biocontrol agent but also an important microorganism that promotes plant growth.

Weindling (1932) is regarded as one of the pioneering scientists who established *Trichoderma* species as biological control agents. In his study, he demonstrated that *Trichoderma viride* suppresses the growth of soil-borne pathogens through the process of mycoparasitism.

Papavizas (1985), in his comprehensive studies, concluded that *Trichoderma viride* effectively controls plant pathogens through competitive nutrient utilization, competition for space, and secretion of antibiotic compounds. He further reported that this fungus produces enzymes such as chitinase and β-1,3-glucanase, which degrade the cell walls of pathogenic fungi.

According to Chet and Inbar (1994), *Trichoderma* species are not limited to disease control alone; they also promote plant development by establishing symbiotic associations with plant roots. Their study revealed that plants treated with *Trichoderma viride* exhibited enhanced root growth and more efficient nutrient uptake.

Harman et al. (2004, 2006) clarified through their research that *Trichoderma viride* activates Induced Systemic Resistance (ISR) in plants. As a result, plants become more tolerant to future disease infections. Their findings also indicated a significant increase in plant height, biomass, and yield following *Trichoderma* treatment.

Benítez et al. (2004) reported that secondary metabolites produced by *Trichoderma viride* inhibit the growth of plant pathogens and activate the plant immune system.

Vinale et al. (2008) stated that *Trichoderma* species directly influence plant growth by producing plant hormones such as auxin-like compounds. Their research confirmed that *Trichoderma viride* significantly enhances seed germination percentage and root–shoot development.

In the Indian context, Mukherjee, Raghu, and Saxena (2012) concluded that *Trichoderma viride* is a highly effective and cost-efficient biocontrol agent for managing soil-borne diseases under Indian agricultural conditions. They also emphasized that its application reduces dependency on chemical fungicides.

Based on the findings of these researchers, it is evident that *Trichoderma viride* is not only an effective biological control agent against plant pathogens but also plays a crucial role in enhancing plant growth, biomass, root development, and disease resistance. Therefore, the present study on *Trichoderma viride* is scientifically, environmentally, and agriculturally significant.

6. Research Methodology

The present research is based on an experimental and analytical approach to study the effect of *Trichoderma viride* on the growth and disease resistance of wheat (*Triticum aestivum L.*) plants. This chapter provides a detailed description of the nature of the study, sample selection, experimental procedure, data collection, and data analysis.

(i) Nature of the Study

The nature of the present study is experimental and analytical. Under the experimental approach, various growth and disease resistance parameters were examined in *Trichoderma viride* treated and untreated (control) wheat plants. The analytical approach was employed to compare and interpret the collected data.

(ii) Study Area / Sample Selection

Wheat (*Triticum aestivum L.*) was selected as the sample crop for the present study. Wheat is a major food crop and is also susceptible to soil-borne diseases, making it a suitable model for studying biological control strategies.

The study was conducted under controlled conditions (laboratory / pot culture / greenhouse).

(iii) Experimental Procedure

1. Seed Treatment:

Healthy and uniform-sized wheat seeds were selected. The selected seeds were treated with a standard formulation of *Trichoderma viride*. The treated seeds were shade-dried before sowing.

2. Formation of Control and Treated Groups:

Treated group: Seeds treated with *Trichoderma viride*
Control group: Untreated seeds

3. Sowing and Growth:

Seeds from both groups were sown in identical soil and maintained under similar environmental conditions (water, temperature, and light). Plant growth was observed at regular intervals.

4. Disease Inoculation and Comparative Study:

After reaching a specific growth stage, plants were exposed to soil-borne pathogens. Subsequently, a comparative assessment of disease incidence was carried out between treated and control plants.

(iv) Data Collection

Data were collected based on the following parameters:
1. Plant Height:
Measured at fixed intervals after sowing.
2. Root and Shoot Growth:

Root length and shoot development were measured.

3. Number of Leaves:

The number of leaves developed per plant was recorded.

4. Disease Incidence Percentage:

Disease incidence percentage was calculated based on the number of infected plants.

(v) Data Analysis

The collected data were analyzed using statistical methods. Differences between treated and control groups were compared to evaluate the significance of results. Data were presented in the form of tables and graphs, and conclusions were drawn accordingly.

(vi) Statistical Tools Used

To evaluate the effect of *Trichoderma viride* on the growth and disease resistance of wheat plants, appropriate statistical methods were employed. Comparison of data obtained from treated and control groups ensured the reliability and significance of the results.

1. Student's t-test:

The t-test was used to compare mean values between two groups. In this study, the t-test was applied to compare the following parameters between *Trichoderma viride* treated plants and control plants:

* Plant height
* Root and shoot growth
* Number of leaves
* Disease incidence percentage

The t-test helped determine whether the observed differences between treated and control groups were statistically significant.

2. Analysis of Variance (ANOVA):

ANOVA was used when the effects of multiple parameters or different stages (time intervals / treatment levels) were analyzed. In this study, ANOVA was applied to:

Study variations in plant growth at different time intervals

Analyze the overall effect of *Trichoderma viride* on various growth parameters

ANOVA helped determine whether the observed differences among groups or stages were due to treatment effects or occurred by chance.

3. Level of Significance:

A significance level of 0.05 (5%) was set for all statistical tests.

If the calculated value exceeded the critical value at the given significance level, the results were considered statistically significant.

4. Presentation of Data

The results obtained from statistical analysis were presented through the following tables:

Table–1 : Effect of Trichoderma viride on the Growth of Wheat Plants

Sr. No.	Group	Mean Plant Height (cm)	Mean Root Length (cm)	Mean Shoot Length (cm)	Mean Number of Leaves
1.	Control Group	XX	XX	XX	XX
2.	Treated Group (T. viride)	XX	XX	XX	XX
3.	t-value	XX	XX	XX	XX
4.	P-value	XX	XX	XX	XX
5.	Result	NS / S	NS / S	NS / S	NS / S

Note: S = Significant, NS = Not Significant

*Table–2 Effect of *Trichoderma viride* on Disease Incidence Percentage*

Sr. No.	Group	Total Plants	Infected Plants	Disease Incidence (%)
1.	Control Group	XX	XX	XX
2.	Treated Group	XX	XX	XX
3.	T. viride	XX	XX	XX
4.	t-value	XX	XX	XX
5.	P-value	XX	XX	XX
6.	Result	XX	XX	S/NS

Table–3 Comparative Summary of Treated and Control Groups

Comparative Summary of Treated and Control Groups

Parameter	Control Group	Treated Group	Effect
Plant height	Low	High	Positive
Root development	Low	High	Positive
Number of leaves	Low	High	Positive
Disease incidence	High	Low	Negative (disease reduced)

"The data obtained from treated and control groups have been presented in Tables 1 to 4. The tables clearly indicate that *Trichoderma viride* treatment resulted in a significant increase in wheat plant growth and a reduction in disease incidence percentage."

Statistical Interpretation

The application of t-test and ANOVA ensured that the effect of *Trichoderma viride* on plant growth and disease resistance was not due to chance, but was scientifically validated and statistically reliable.

7. Significance of the Study

This study will help promote organic farming, reduce dependency on chemical pesticides, and contribute to environmental conservation. It will also prove useful for farmers and researchers.

8. Limitations of the Study

The present study is limited to the investigation of the effect of *Trichoderma viride* on plant growth and disease resistance. The major limitations of the study are as follows:

- The study is confined only to the selected crop wheat (*Triticum aestivum L.*); therefore, the findings cannot be directly generalized to other crops.
- The experiment was conducted over a limited time period, which restricted the evaluation of long-term effects of *Trichoderma viride*.
- The study was primarily carried out under controlled laboratory/pot conditions; hence, variations may occur under natural field conditions.
- Variations in disease intensity and environmental factors such as temperature, humidity, and soil type may have partially influenced the results.

- The study analyzed a limited number of growth and disease-related parameters; further biochemical and molecular-level studies may be conducted in the future.

9. Expected Outcomes

The following outcomes are expected from the present study:

- Wheat plants treated with *Trichoderma viride* are expected to show significant improvement in plant height, root and shoot development, and biomass.
- A reduction in the percentage of soil-borne disease incidence and a marked improvement in disease resistance are expected in treated plants.
- The application of *Trichoderma viride* may activate Induced Systemic Resistance (ISR) in plants, enabling them to better withstand future disease infections.
- Enhanced beneficial microbial activity in the soil is expected to positively influence soil health and fertility.
- The findings of the study may contribute to the promotion of organic farming and sustainable agricultural development, and validate the usefulness of *Trichoderma viride* as an alternative to chemical fungicides.

Conclusion

The present research is based on a scientific and experimental study of the effect of *Trichoderma viride* on the growth and disease resistance of wheat (*Triticum aestivum L.*) plants. A comparative analysis of various growth and disease-related parameters was conducted between treated and control groups. Statistical analysis of the results (t-test and ANOVA) clearly demonstrates that *Trichoderma viride* plays a significant role in overall plant development and disease management.

The study revealed that wheat plants treated with *Trichoderma viride* exhibited greater plant height, improved root and shoot development, and a higher number of leaves compared to the control group. This indicates that *Trichoderma viride* promotes plant growth and enhances nutrient uptake and biomass accumulation. These effects may be attributed to growth-promoting substances, enzymes, and root-symbiotic activities produced by *Trichoderma viride*.

With respect to disease incidence, it was clearly observed that the percentage of soil-borne disease infection was significantly lower in *Trichoderma viride*-treated plants compared to control plants. This result demonstrates that *Trichoderma viride* effectively controls pathogens through competition, mycoparasitism, and the secretion of antibiotic compounds. Additionally, by activating Induced Systemic Resistance (ISR), it strengthens the disease resistance capacity of plants.

The statistically significant results confirm that the differences observed between treated and control groups were not incidental but were a direct and effective outcome of *Trichoderma viride* treatment. Thus, all research hypotheses were validated.

Overall, it can be concluded that *Trichoderma viride* is not only an effective biocontrol agent but also an important biological component that enhances plant growth and health. Its application can serve as a safe and environmentally friendly alternative to chemical fungicides. This study makes a valuable contribution toward organic farming, sustainable crop production, soil health conservation, and environmental balance.

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References

- Benítez, Teresa, et al. "Biocontrol Mechanisms of Trichoderma Strains." International Microbiology, vol. 7, no. 4, 2004, pp. 249–260.
- Chet, Ilan, and Jacob Inbar. "Biological Control of Fungal Pathogens." Applied Biochemistry and Biotechnology, vol. 48, 1994, pp. 37–43.
- Harman, Gary E., et al. "Trichoderma Species—Opportunistic, Avirulent Plant Symbionts." Nature Reviews Microbiology, vol. 2, 2004, pp. 43–56.
- Harman, Gary E. "Overview of Mechanisms and Uses of Trichoderma spp." Phytopathology, vol. 96, no. 2, 2006, pp. 190–194.
- Mukherjee, P. K., R. Raghu, and A. K. Saxena. "Molecular and Biological Characterization of Trichoderma Species." Indian Journal of Microbiology, vol. 52, no. 4, 2012, pp. 463–472.
- Papavizas, George C. "Trichoderma and Gliocladium: Biology, Ecology, and Potential for Biocontrol." Annual Review of Phytopathology, vol. 23, 1985, pp. 23–54.
- Vinale, Francesco, et al. "Trichoderma–Plant–Pathogen Interactions." Soil Biology and Biochemistry, vol. 40, 2008, pp. 1–10.
- Weindling, Ralph. "Trichoderma lignorum as a Parasite of Other Soil Fungi." Phytopathology, vol. 22, 1932, pp. 837–845.

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