

Evaluation of Spore Suspension and Talc-Based Formulation of *Trichoderma Viride* for Sustainable Seed and Nursery Management

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ABSTRACT

Trichoderma viride is an important fungal bio control agent widely utilized in plant disease management because of its antagonistic activity against various soil-borne pathogens and its beneficial effects on plant growth. The present study was conducted to assess the comparative efficacy of different application methods of *Trichoderma viride* for biological disease management in selected crop plants. The investigation involved the use of *Trichoderma* as a spore suspension and as a talc-based formulation for seed treatment, nursery application, and treatment of rhizomatous and bulbous crops. The treated seeds and planting materials were evaluated in comparison with untreated controls.

The results demonstrated that the mode of *Trichoderma* application influenced its effectiveness. Spore suspension treatment exhibited comparatively better performance than talc-based seed treatment under the experimental conditions. Both forms of application showed beneficial effects on plant growth, while nursery application of the talc-based formulation improved establishment and reduced rotting incidence in ginger and garlic. The findings therefore demonstrate the potential of *Trichoderma viride* as an environmentally safe and sustainable bio control agent for improving plant performance and managing disease, providing a promising alternative to conventional chemical-based crop protection practices.

KEYWORDS: *Trichoderma viride*, spore suspension, talc-based formulation, seed treatment, nursery application, biological disease management, plant growth.

INTRODUCTION

Biological control of plant diseases using antagonistic microorganisms has gained importance as an eco-friendly alternative to chemical fungicides. Among the various bio control agents, *Trichoderma* spp. is one of the most extensively studied and widely used fungal bio agents for the management of soil-borne plant pathogens.

Seed and soil-borne diseases are among the major factors responsible for poor crop establishment and yield losses in agricultural systems. The excessive use of chemical fungicides for disease management has led to serious concerns regarding environmental pollution, residual toxicity, and development of pathogen resistance. Therefore, emphasis has shifted towards eco-friendly and sustainable disease management strategies, among which biological control has gained significant importance (Harman et al., 2004).

Trichoderma spp. are free-living, fast-growing filamentous fungi commonly found in soil and root ecosystems. They are well known for their antagonistic activity against a wide range of phytopathogenic

fungi through mechanisms such as mycoparasitism, antibiosis, competition for nutrients and space, and induction of systemic resistance in plants (Benitez et al., 2004; Verma et al., 2007). In addition to disease suppression, *Trichoderma* spp. also acts as plant growth promoters by enhancing seed germination, root development, and nutrient uptake (Harman, 2006).

Previous studies thus support the use and applications of *Trichoderma* spp. through different application methods for sustainable disease management. However, comparative evaluation of different application techniques on crop seeds and planting materials is necessary to identify the most effective method under experimental conditions, which formed the basis of the present study.

MATERIALS AND METHODS

Considering these benefits, the present study was undertaken to evaluate the effect of different *Trichoderma* application methods, namely spore suspension treatment, talc powder seed treatment and nursery application, on seed germination, radicle growth and nursery performance of selected crop plants under laboratory and nursery conditions.

Test Crops:

Vegetable seeds: Bhindi (*Abelmoschus esculentus*), Tomato (*Solanum lycopersicum*), Chilli (*Capsicum annum*)

Rhizomatous / Bulbous crops: Ginger (*Zingiber officinale*), Garlic (*Allium sativum*)

Source of *Trichoderma*

Mother culture of *Trichoderma viride* was obtained from Shri Shivaji College of Agriculture, Biotechnology, Amravati.

Preparation of Spore Suspension:

Actively growing *Trichoderma* culture was scraped and suspended in sterile distilled water to prepare a 1×10^6 spores/ml suspension (Iqbal et al., 2017). Purity was confirmed microscopically.

Talc Powder Formulation:

Colonized Jowar grains were dried, grind, and mixed with talc powder (1:9 ratio) and 0.5% carboxymethyl cellulose. The powder was used for seed treatment and nursery application.

Seed Treatments:

Spore suspension treatment: Seeds of Bhindi, Tomato, and Chilli were soaked in *Trichoderma* suspension for 6 hours and incubated on moist filter paper for germination studies.

Talc powder treatment: Seeds were coated with talc-based formulation before sowing.

Control: Untreated seeds were soaked in sterile distilled water.

Nursery Treatment:

Rhizomatous crops / Bulbous crop (Ginger /Garlic) was treated by applying 10–25 g of *Trichoderma* talc formulation per 100 m² of nursery bed. Growth and establishment were compared with untreated controls.

This experiment was conducted in the research field of the Medico - Botanical Garden of the Shri Shivaji Science College, Amravati.

OBSERVATIONS AND RESULT

Seed Treatments:

Crop Seeds	Types of Treatment	Radicle length(cm) (Control)	Radicle length(cm) (Treatment)
Bhindi	Spore suspension	1.20	1.61
	Talc powder	1.03	1.50
Tomato	Spore suspension	3.99	4.756
	Talc powder	3.34	3.40
Chilli	Spore suspension	1.74	1.964
	Talc powder	1.62	1.832

Seed treatment with Trichoderma in the form of spore suspension and talc powder enhanced radicle length in all tested vegetable crops compared to the untreated control. In bhindi, radicle length increased from 1.20 to 1.61 cm with spore suspension and from 1.03 to 1.50 cm with talc powder. In tomato, spore suspension treatment increased radicle length from 3.99 to 4.76 cm, while talc powder showed a slight increase from 3.34 to 3.40 cm. In chilli, radicle length improved from 1.74 to 1.96 cm and 1.62 to 1.83 cm under spore suspension and talc powder treatments, respectively. Overall, spore suspension was more effective than talc powder in promoting radicle growth.

Nursery Treatment:

Crop	Treatment	Observations
Garlic	Talc powder	Improve establishment and growth compared to control, reduced rotting incidence.
Ginger	Talc powder	Enhance rhizome growth and reduced rotting incidence

Nursery application of Trichoderma talc powder improved growth, establishment, and disease suppression in underground crops.

The results of the study revealed that all Trichoderma-based treatments were superior to the untreated control, indicating the beneficial role of Trichoderma in improving plant health and reducing disease incidence. Among the treatments, application of Trichoderma through spore suspension showed better effectiveness in terms of plant response and disease reduction when compared to talc powder-based seed treatment. Talc powder application and nursery treatment also exhibited significant improvement over control, though variations were observed among treatments. Application of Trichoderma on rhizomatous spice crops resulted in healthier plant establishment compared to untreated planting materials.

DISCUSSION

Seed treatment is considered one of the most effective and economical method for delivering Trichoderma to crops, and recent studies have confirmed its role in improving germination, seedling vigour, and disease suppression (Sing et al., 2024 and Patel, 2025). Bio-priming of seeds using spore suspension has been reported to improve germination percentage and seedling vigor by early

colonization of the rhizosphere (Singh et al., 2016). Similarly, talc-based formulations of *Trichoderma* are widely used for dry seed treatment due to their ease of application, longer shelf life and effectiveness in managing seed-borne and soil-borne pathogens (Ramanujam et al., 2010).

Nursery application of *Trichoderma* is particularly important for crops susceptible to rotting diseases, such as bulbous and rhizomatous crops. Soil application and dressing of planting material with *Trichoderma* have been found effective in reducing rot incidence in crops like garlic, onion, ginger and potato (Dubey et al., 2007; Shukla et al., 2012).

Chet and Baker (1981) demonstrated the antagonistic potential of *Trichoderma* spp. against several phytopathogenic fungi by direct parasitism and inhibition of pathogen growth. Further studies by Chet and Inbar (1994) emphasized that *Trichoderma* plays a significant role in biological disease control under different environmental and crop conditions due to its strong rhizosphere competence and adaptability.

In addition to disease suppression, *Trichoderma* spp. is known to enhance plant growth and development. Harman et al. (2004) reported that *Trichoderma* acts as a plant growth-promoting fungus by improving root growth, nutrient uptake and inducing systemic resistance in plants. These attributes contribute to improved plant vigor and tolerance against diseases.

The effectiveness of *Trichoderma* largely depends on the method of its application. Harman (2006) highlighted that application techniques such as spore suspension, talc-based formulations, seed treatment and nursery treatment influence the establishment and performance of *Trichoderma* in the soil and rhizosphere. Proper application at early growth stages ensures better colonization and prolonged protective effects.

The study confirms that *Trichoderma* application improves seed germination, radicle length, and establishment. Seed bio-priming with spore suspension was highly effective for vegetable seeds, while talc powder formulation provided better field stability and ease of application. Nursery treatment in Ginger and Garlic further demonstrated its potential for eco-friendly crop management, consistent with previous studies (Sood et al., 2020; Shukla et al., 2023; Mukhopadhyay et al., 1992).

CONCLUSION

Trichoderma viride can be effectively applied via spore suspension, talc powder seed coating, and nursery treatments to enhance seed germination, radicle length, seedling vigor, and establishment of rhizomatous crops. Seed and nursery applications provide sustainable and eco-friendly alternatives to chemical treatments for vegetable, rhizomatous, bulbous crops.

Plate-I: Spore Suspension Treatment on Bhindi, Chilli and Tomato Seeds



Bhindi



Tomato



Chilli

Bhindi



Tomato



Chilli

Plate-II: Talc Powder Treatment on Bhindi, Chilli and Tomato Seeds

Control



Bhindi

Treatment



Bhindi



Tomato



Tomato



Chilli



Chilli

Plate-III: Treatment on Garlic and Ginger with Talc Powder

Control

Treatment



Garlic



Garlic



Ginger



Ginger

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