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ISOLATION, CHARACTERIZATION, AND BIOCONTROL POTENTIAL OF RHIZOSPHERIC TRICHODERMA VIRIDE FROM BHOPAL REGION.

Microbiology

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ABSTRACT

Trichoderma viride is a well-known filamentous fungus widely recognized for its biocontrol properties, plant growth-promoting potential, and capacity to produce hydrolytic enzymes. In recent years, researchers in the Bhopal region and broader Madhya Pradesh have increasingly focused on isolating indigenous strains of T. viride from rhizosphere soils to harness its agricultural benefits. This review compiles and evaluates the findings of various studies conducted in and around Bhopal related to the isolation, morphological and molecular identification, and biochemical characterization of T. viride. The study also emphasizes the diversity among strains, their enzymatic activities (especially cellulase and chitinase), their interactions with fungal and bacterial pathogens, ability to utilize various substrates, and potential applications in bioformulation development. The review further emphasizes knowledge gaps and future research directions, especially for molecular diversity, field application, and industrial-scale bioformulation using local agro-waste. Such insights can support sustainable agriculture and integrated pest management strategies in the region.

KEYWORDS

Trichoderma viride, Bhopal, biocontrol, cellulase, rhizosphere, molecular characterization.

INTRODUCTION

The increasing demand for eco-friendly agricultural practices has led to a growing interest in the use of microbial biocontrol agents such as Trichoderma viride. Trichoderma viride, belonging to the Hypocreaceae family, is a common soil-dwelling fungus known for its ability to associate with plant roots. It enhances plant development and provides protection against numerous soil-borne pathogens through various strategies such as competing for resources, parasitizing harmful fungi, producing antimicrobial compounds, and releasing enzymes that degrade pathogen cell walls. Its ability to produce secondary metabolites and induce systemic resistance in plants makes it a preferred agent in sustainable farming systems.

The Bhopal region, located in central India, presents a unique agro-climatic zone rich in rhizosphere microbial diversity. Local efforts to isolate and study native strains of T. viride are critical to ensuring that bioformulations are both ecologically compatible and highly effective under regional soil and climatic conditions. Various studies conducted in Bhopal and surrounding regions have examined Trichoderma viride strains for their growth characteristics, structural features, biochemical properties, and antagonistic behavior. Additionally, the use of locally available agro-industrial waste products as substrates for biomass production has enhanced the feasibility of mass production.

Despite multiple studies, there is a lack of consolidated literature that reviews the isolation, identification, and characterization processes specific to T. viride from this region. This paper aims to address that gap by compiling research findings and drawing attention to key methodologies, results, and future opportunities. This review intends to promote continued research and foster the strategic use of T. viride in regional agricultural practices.

2. Literature Review

2.1 Isolation Of T. Viride In Bhopal

Multiple investigations conducted in Bhopal and nearby regions of Madhya Pradesh have reported the successful isolation of Trichoderma viride from the rhizosphere of various crops, including citrus, wheat, and chickpea. For instance, Jatav et al. (2018) isolated T. viride from citrus-growing soils in Bhopal using Potato Dextrose Agar (PDA) medium enhanced with antibiotics to inhibit bacterial contamination. The fungal isolates were characterized by features such as rapid mycelial expansion, green spore production, and distinctive conidiophore structures. Similarly, research by Rai et al. (2017) documented the occurrence of various Trichoderma species, including T. viride, in cultivated soils across central India, highlighting its widespread presence in the Bhopal area.

2.2 Morphological And Cultural Identification

Isolates were characterized morphologically by colony color, conidiophore structure, and phialide arrangement. Tripathi et al. (2016) analyzed 40 isolates from various Madhya Pradesh soils and found significant variation in colony texture, pigmentation, and sporulation rate. Some isolates showed a distinctive yellow pigmentation, which may be useful for strain differentiation. Sharma et al. (2019) provided similar observations for isolates collected from soybean fields, indicating strong morphological variability influenced by crop and soil type.

2.3 Biochemical Characterization

Biochemical profiling of T. viride isolates from Bhopal revealed production of hydrolytic enzymes like cellulase, protease, and chitinase. These enzymes were typically measured using assays such as the DNS method for cellulase activity. In one study, T. viride exhibited significant cellulolytic activity, inhibiting Xanthomonas citri, a citrus pathogen (Jatav et al., 2018). Rani and Srivastava (2020) further confirmed the chitinolytic potential of regional isolates against soil-borne fungi such as Fusarium oxysporum.

2.4 Molecular Characterization

While many local studies have relied on classical morphological methods, few have incorporated molecular techniques such as ITS-rDNA sequencing or RAPD. However, regional research (e.g., in Gujarat and Assam) has demonstrated that combining morphology with molecular identification improves taxonomic accuracy and reveals intraspecific variation (Singh et al., 2020). This approach is underutilized in Bhopal and represents a key area for advancement. Mishra et al. (2021) emphasized the utility of molecular markers to distinguish T. viride from closely related species in central India.

2.5 Biomass Production And Substrate Optimization

Khandelwal et al. tested locally available substrates like pulses, vegetable waste, and rice husk for biomass production. Pulse-based substrates supported the highest growth (~19.98 g/250 mL), making them ideal for mass cultivation. Such substrates are abundant and low-cost in the Bhopal region, making this method both scalable and economically viable. Verma and Tiwari (2021) expanded on these findings by incorporating co-culturing with other beneficial microbes, improving nutrient use efficiency and biomass yield.

3. Methodology Overview From Key Studies

Stage	Technique/Media	Reference
Isolation	PDA, Trichoderma Selective Medium	Jatav et al., 2018; Rai et al., 2017
Morphological ID	Colony morphology, conidial shape and phialide structure	Tripathi et al., 2016; Sharma et al., 2019
Biochemical Testing	Cellulase via DNS method, chitinase and protease activity assays	Jaisan et al., 2021; Rani & Srivastava, 2020
Antagonism	Dual culture method against	Various

Assays	Fusarium, Xanthomonas, Rhizoctonia	
Molecular Techniques	ITS-rDNA sequencing, RAPD/ISSR (limited usage in Bhopal studies)	Singh et al., 2020; Mishra et al., 2021
Biomass Production	Solid-state fermentation using pulses, rice bran, wheat husk	Khandelwal et al.; Verma & Tiwari, 2021

4. Conclusion And Future Prospects

The exploration of Trichoderma viride in Bhopal has made promising strides in terms of isolation and functional characterization. Indigenous isolates show high enzymatic activity, biocontrol potential, and adaptability to locally available substrates for biomass production. Despite ongoing studies, several areas remain underexplored.

- Molecular diversity mapping of local isolates.
- Purification and detailed enzymatic profiling of cellulases and chitinases.
- Field trials to validate lab-based findings under natural agro-climatic conditions.
- Development of stable bioformulations using local agro-industrial waste.
- Integrated pest management strategies incorporating T. viride with compatible fungicides.

Filling these gaps will enhance the scientific understanding and agricultural application of T. viride in central India. A systematic, interdisciplinary approach combining microbiology, molecular biology, and agronomy can lead to scalable bio-solutions for sustainable crop production in Bhopal and beyond.

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Conflict Of Interest

None

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