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Biocontrol Potential of *Ageratum conyzoides* L. Against Blight Disease of *Bambusa* Roxb. in Assam, India

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Abstract

Bamboo blight, caused by *Fusarium* species, is a major constraint to bamboo cultivation in India. This study assessed the antifungal efficacy of aqueous leaf extract of *Ageratum conyzoides* against blight in *Bambusa tulda* seedlings under screenhouse conditions. A Completely Randomized Design with three treatments. *A. conyzoides* extract, a commercial *Trichoderma viride* formulation, and distilled water (control) as employed, each replicated four times. Inoculation with *Fusarium* isolates was performed using the pin-prick method and disease incidence was measured as Percent Disease Incidence (PDI). The extract reduced disease incidence to 50%, compared to 75% with *T. viride* and 100% in the control. These results suggest *A. conyzoides* as a promising eco-friendly biocontrol agent for sustainable bamboo blight management.

Keywords: *Bamboo blight, Ageratum conyzoides, biocontrol, Fusarium, eco-friendly management*

Introduction

Plants have long been recognized as reservoirs of bioactive compounds with antimicrobial properties. Several species produce secondary metabolites such as alkaloids, phenolics, flavonoids, and terpenoids, which are capable of suppressing the growth of pathogenic fungi and bacteria (Maity *et al.,* 2009; Saha *et al*., 2005). These natural products act through diverse mechanisms, including disruption of cell membranes, inhibition of spore germination, and interference with enzymatic activity, thereby offering broad-spectrum protection against microbial invasion. The use of medicinal plants in disease management is an ancient practice that continues to attract scientific interest, particularly because plant-based extracts are cost-effective, biodegradable, and environmentally safe alternatives to synthetic agrochemicals (Dwivedi, 1998).

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Bamboo, a fast-growing and economically important resource, plays a vital role in rural livelihoods, construction, handicrafts, and ecological restoration. Among the bamboos, *Bambusa tulda*, *B. balcooa*, and *B. nutans* are the most commercially important species in India. However, the productivity of these species is constrained by various diseases. Blight and rot are particularly destructive, affecting bamboo seedlings as well as plants at premature stages. Blight diseases severely limit bamboo growth and survival, impacting several species including *Bambusa bambos*, *B. balcooa*, *B. tulda*, and *B. vulgaris* (Gibson, 1975; Rahman, 1978; Boa, 1987). In India, blight outbreaks have been frequently reported, with *Fusarium semitectum*, *F. udum*, *F. oxysporum*, and *Sarcocladium oryzae* identified as major causal agents in *B. balcooa*, *B. nutans*, *B. tulda*, and *B. pallida* across Odisha, Nagaland, and Assam (Gupta et al., 1990; Jamaluddin et al., 1992; Borah et al., 2011; Gogoi et al., 2013; Gogoi et al., 2015). The humid climate and frequent waterlogging in Assam further predispose bamboo stands to various disease including blight and rot diseases (Gogoi et al., 2010). These pathogens not only reduce seedling survival and growth but also threaten large-scale bamboo cultivation programs aimed at meeting industrial and ecological demands. Conventional management strategies rely heavily on chemical fungicides, which, while effective, raise concerns about environmental contamination, pathogen resistance, and adverse impacts on non-target organisms.

In this context, biocontrol approaches using plant-derived extracts and microbial antagonists have emerged as promising alternatives. Among medicinal plants, *Ageratum conyzoides* has attracted attention due to its rich phytochemical profile and reported antimicrobial activity. Extracts of *A. conyzoides* have been shown to inhibit several plant pathogens, suggesting its potential role in sustainable crop protection. The present study was therefore undertaken to evaluate the antifungal efficacy of aqueous leaf extract of *A. conyzoides* against bamboo blight in *Bambusa tulda* seedlings caused by *Fusarium* species. By comparing its performance with a commercial *Trichoderma viride* formulation under controlled conditions, this work aims to establish the relevance of *A. conyzoides* as an eco-friendly biocontrol agent for bamboo disease management.

Materials and Methods

The study was conducted at the Rain Forest Research Institute, Indian Council of Forestry Research and Education, Jorhat, Assam, India (26.782291° N, 94.292766° E) between January and October 2025.
The seedlings of the *Bambusa tulda* were obtained from the ICFRE-Rain Forest Research Institute, Jorhat, Assam (ICFRE- RFRI) nursery and maintained in pots until inoculation.

Pathogen inoculation

Fusarium isolates cultured on potato dextrose agar (PDA) were used to inoculate seedlings via the pin-prick method. Inoculated plants were covered with moist polyethylene bags to promote disease development (Plate -1)

Preparation of extract

Fresh leaves of *Ageratum conyzoides* collected from the ICFRE- RFRI, Botanical Garden were washed, air-dried, and ground. A 30% (w/v) aqueous extract was prepared (30 g leaf/100 ml distilled water), filtered and used for treatments.

Experimental design

A Completely Randomized Design (CRD) with three treatments—(T1) *A. conyzoides* extract, (T2) commercial *Trichoderma viride*, and (T3) distilled water (control)—was employed, each with four replications.

Data collection and analysis

Disease incidence was recorded as Percent Disease Incidence (PDI) using the formula:

$$PDI(\%) = \frac{n}{N} \times 100$$

where n = infected plants and N = total plants assessed. Data were analyzed under CRD using ANOVA after angular transformation.

Results and Discussion

Application of A. conyzoides extract resulted in a PDI of 50%, whereas T. viride treatment recorded 75% PDI. The untreated control showed complete disease incidence (100%). These results confirm that A. conyzoides extract is more effective in reducing bamboo blight incidence compared to *T. viride*. (Plate -2 & Plate -3)

Previous studies have documented antifungal properties of *A. conyzoides* extracts against *Fusarium species*. Leaf extracts in aqueous, methanolic, and n-hexane forms have demonstrated significant inhibitory effects on *Fusarium solani* growth (Javed et al., 2012). Active compounds such as precocene II and nobiletin have been reported to possess antifungal potential against *Fusarium oxysporum* and *Fusarium solani*. The findings of this study align with earlier research and emphasize the potential of *A. conyzoides* as a natural, eco-friendly substitute for chemical fungicides (Table -1 & Fig-1).

Further investigations are recommended to optimize dosage, formulation, and field-level applications of *A. conyzoides* extract. Additionally, combining it with other biocontrol agents may enhance its effectiveness and sustainability in bamboo disease management.

Table.1: Disease incidence after treatment

Sl. No.	Treatments	Percent Disease Incidence (PDI)
1	T_1: *Ageratum conyzoides* aqueous leaf extract	50.00 (45.00)
2	T_2: *Trichoderma viride* commercial product-AAU Bio-green	75.00 (60.00)

3	T_3: Control	100.00 (90.00)

(Figures in the parenthesis are the angular-transformed values)

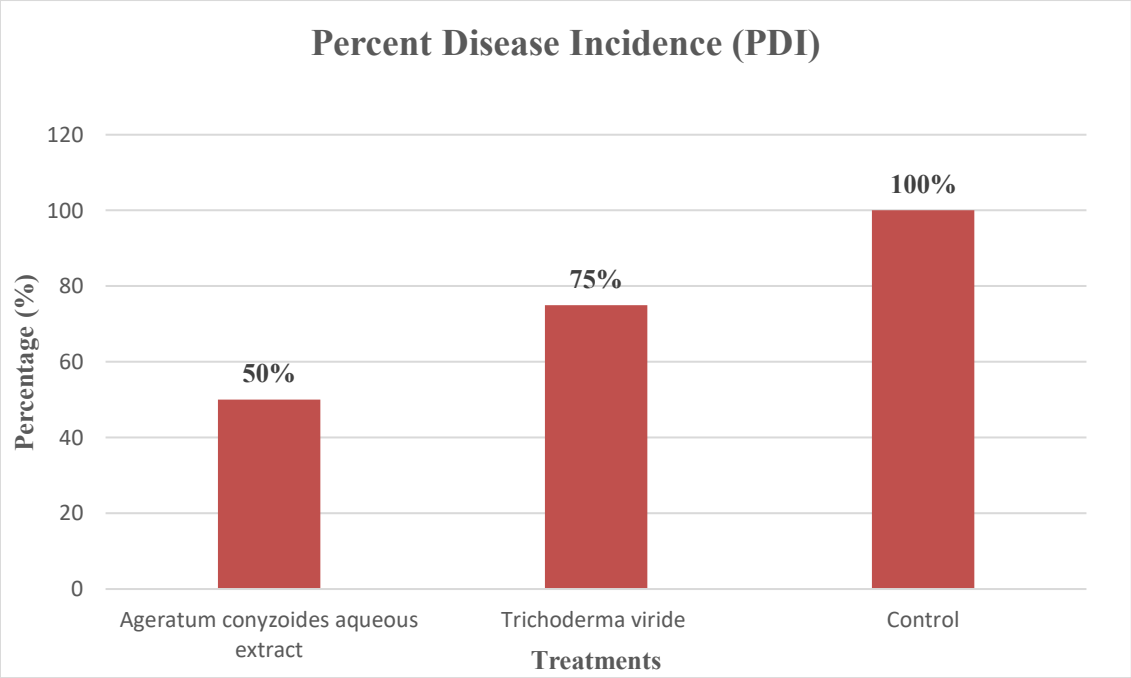

Fig. 1: Percent Disease Incidence (PDI)

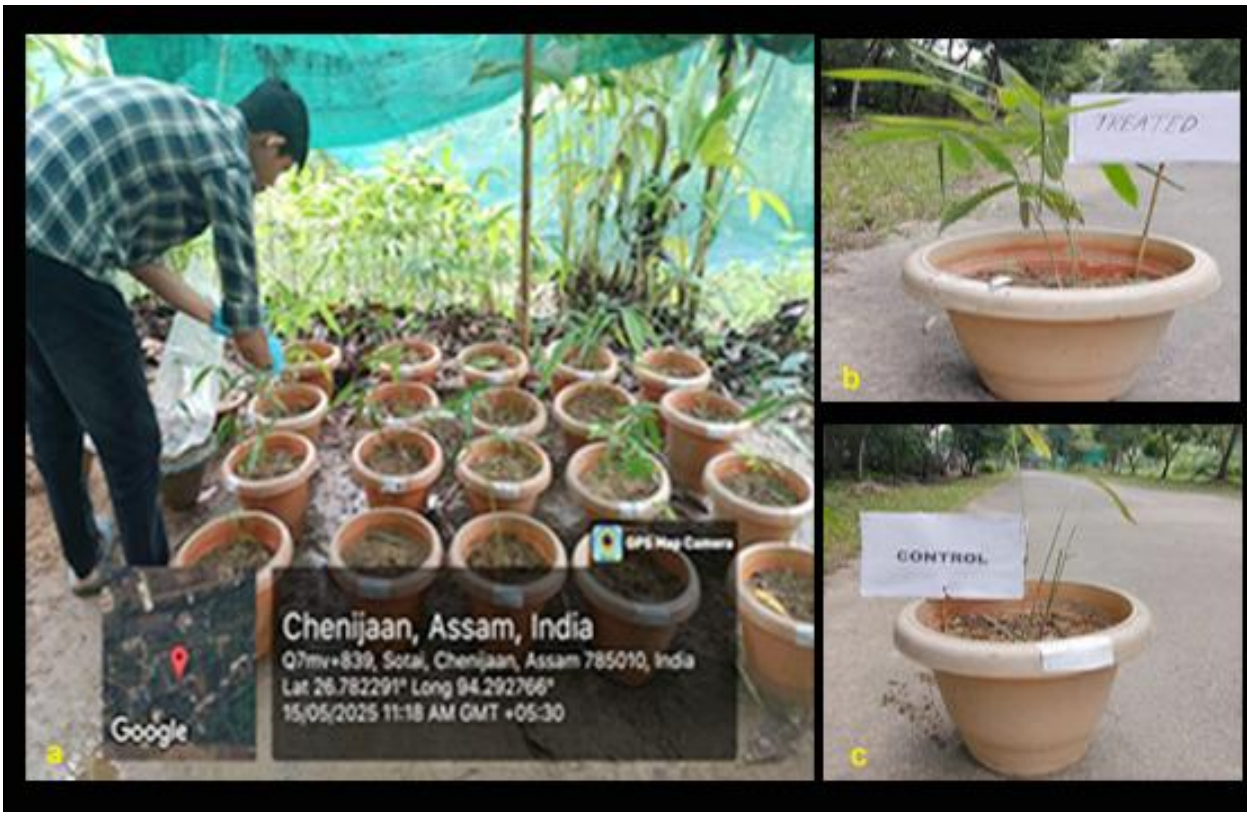

Plate 1: (a.) Inoculation of *Fusarium sp*. on healthy seedlings of *B. tulda*; (b.& c) *A. conyzoides* and AAU Bio-green treated seedling, Plate-3: controlled seedling

Conclusion

The present study confirms that aqueous leaf extract of *Ageratum conyzoides* exhibits significant antifungal activity against *Fusarium*-induced blight in *Bambusa tulda*. Under screenhouse conditions, the extract effectively reduced disease incidence, performing better than the commercial *Trichoderma viride* formulation. These findings highlight the potential of *A. conyzoides* as a cost-effective and eco-friendly biocontrol agent for bamboo disease management. Utilizing locally available plant resources offers a sustainable approach that reduces reliance on synthetic fungicides and promotes environmentally sound cultivation practices. Future research focusing on field-scale validation and phytochemical characterization of the active constituents will be essential to establish its role in integrated bamboo health management across Assam and other bamboo-growing regions of India.

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Declaration

Conflict of Interest: The authors declare that they have no conflict of interest.

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