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Diversity and antagonistic potential of fungal endophytes of banana var. grown in Odisha, India

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Abstract
Endophytic fungi were isolated from the leaves, petioles, and roots of different banana var. grown in Odisha. The local varieties Bantal, Champa, and Singpuri revealed associations with more number of fungi. All fungal isolates were evaluated against pathogenic fungi *F. javanicum*, *F. equisetum*, *Colletotrichum gloeosporioides*, and *Nigrospora* sp. Three fungal species namely, *Penicillium citrinum*, *Cladosporium variable* and *P. capsulatum* were active against most of the test pathogenic fungi. Bantal and Singapuri exhibited a higher similarity index with the Champa variety. The survey found a substantial and multifunctional diversity of culturable endophytes in Odisha banana varieties.

Keywords: Banana, fungi, antifungal, *Aspergillus niger*, *Penicillium*

Introduction
The banana is one of the most significant fruit crops commercially farmed in a lot of nations across the world for use as a dessert and a staple food in many parts of the world. Diseases caused by fungi, bacteria, and viruses are the principal limiting factors in the crop's successful quality production, and nearly all commercial var. of bananas are highly sensitive to lethal disease (Mendoza and Sikora, 2009; Yang *et al*., 2021) [5, 11]. The use of pesticides and other commercially available fungicides has provided a ray of hope for increasing crop yield; however, the widespread use of these pesticides and fungicides, as well as the rapid development of pathogen tolerance to new pesticides, has intensified the problem of disease management in bananas. Biocontrol agents seem to be one of the promising approaches in this regard that involves the use of naturally occurring nonpathogenic microorganisms that reduce pathogenic activity and suppress diseases (Cao *et al*., 2005) [1]. Following the preliminary investigation, fungus isolations from various banana cultivars were performed and their antifungal potential was assessed.

Materials and Methods
Various plant samples from eight distinct banana kinds were gathered and treated for the isolation of endophytic fungus between June and August 2016. Prior to the isolation of fungi on Czapek dox and Sabouraud medium agar plates, the surfaces were serially sterilised with sodium hypochlorite (0.01%) and rinsed with sterile dist. water (Cao *et al*., 2005; Tafinta *et al*., 2013; Xia *et al*., 2011) [1, 7, 10]. By using the co-inoculation approach, all fungal isolates were provisionally identified morphologically and evaluated for antifungal activity (Raper *et al*., 1984; Nagamani *et al*., 2005; Watanabe *et al*., 2010; Panda *et al*., 2023a) [6, 2, 3, 8]. The isolation rate, colonisation rate, percentage occurrence, and species richness were calculated for each banana variety (Panda *et al*., 2023b) [3].

Results and Discussion
Overall, 36 fungi have been isolated from cultivated varities such as Bantala, Champa, Musapuri, Patakpura, Singapuri, and Sankar, as well as introduced varities such as Fia and Yagambi. Bantala and Champa var. were discovered to be related with 20 fungi from the Asperillus, Chaetomium, Curvaulara, *Fusarium*, and Peniccilium genera (Table 1, Fig. 1). The Jacard similarity index was determined for the fungal isolates from different banana varieties shown in Table 2. Bantal and Champa were the most comparable to Sigapuri in terms of species. Champa and Bantal had the highest percentage of fungus incidence, followed by Singapuri (Fig. 2). Singapuri and Champa had the highest fungal colonisation rates (Fig. 3). Sanker var. had the highest fungus isolation rate (0.166), followed by Patakpura (fig. 4).

All of these fungi were tested for antifungal activity against four pathogenic fungus: *Fusarium equiseti*, *Colletotrichum gloeosporioides*, *Fusarium javanicum*, *Nigrospora* sp., and *Fusarium acuminatum*. *Aspergillus niger ochraceus* and *Penicillium citrinum* were two that showed broad-spectrum action against the pathogen fungi examined. (Table -3). The preliminary survey on the fungal associations of different varieties of Banana grown in Odisha revealed a rich endophytic fungal diversity and bioactive potential that can be explored further for the formulation of biocontrol agents against the deadly fusarial wilt and Anthracnose diseases of local banana varieties (Wang *et al*., 2013; Zhang *et al*., 2021) [11-12].

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Conflict of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 1: Distribution of endophytic fungi in different cultivars of banana

Name of fungi	Cultivars of Banana							
	Cultivated verities						Introduced verities	
	Bantala	Champa,	Musapuri	Patakpura	Sankara	Singapuri	Fia	Yangambi
Alternaria alternata	+	-	-	-	-	-	+	-
Aspergillus niger flavus	+	+	-	-	-	-	-	-
Aspergillus niger niger	+	+	-	-	-	+	-	-
Aspergillus niger sp.	-	-	+	-	-	+	-	+
Aspergillus niger tamari	+	-	+	+	-	-	-	+
Aspergillus niger terreus	-	-	-	-	+	-	-	-
Aspergillus niger caespitosus	-	-	-	-	-	-	+	-
Aspergillus niger ochraceus	+	+	+	-	+	+	-	+
Cladosporium cladosporioides	+	-	-	+	-	-	-	-
Cladosporium cladosporum	-	-	-	-	-	-	-	+
Cladosporium variable	-	-	-	-	-	-	+	+
Cochliobolus hawaiiensis	+	+	-	+	-	+	+	+
Colletotrichum gloeosporioides	+	+	-	-	+	+	-	+
Curvularia brachyspora	-	-	-	-	-	-	+	-
Curvularia sp.	-	+	-	-	-	-	-	-
Curvularia lunata	+	+	-	-	-	+	-	-
Curvularia sp.	+	+	-	-	-	-	+	-
Curvularia trifolata	+	+	-	+	-	-	-	-
Curvularia vermicularis	-	+	-	-	-	-	-	-
Eu *Penicillium* brefeldianum	-	+	-	-	-	-	-	-
Fusarium accuminatum	+	+	-	-	-	+	-	-
Fusarium chlamydosporium	+	+	-	-	-	+	+	+
Fusarium culmorum	-	-	-	-	-	-	+	-
Fusarium equiseti	-	+	-	-	-	+	-	-
Fusarium javanicum	+	+	-	-	-	-	-	-
Mycelia sterilia -1	-	-	+	+	-	-	-	-
Mycelia sterilia -2	-	-	-	+	-	-	-	-
Mycelia sterilia -3	+	+	-	-	-	-	-	-
Mycelia sterilia -4	+	-	-	-	+	-	-	-
Mycelia sterilia -5	-	+	-	-	-	+	+	+
Nigrospora *sphaerica*	+	+	-	+	-	-	-	-
Penicillium capsulatum	+	-	+	-	+	+	-	-
Penicillium citrinum	-	-	-	-	-	+	-	-
Penicillium thomii	+	+	-	-	+	+	-	-
Penicillium variculosum	+	-	-	-	+	-	-	-
Ulocladium sp.	-	-	+	-	-	-	-	-

+, Presence of fungi; absence of fungi

Table 2: Jaccard Similarity Index calculated for the fungal types isolated from different cultivars of grown in Odisha

	Champa	Banatal	Patakpura	singapuri	Sankara	Musapuri	Fia	yagmbi
Champa	1.00							
Banatal	0.5	1.00						
Patakpura	0.14	0.22	1.00					
singapuri	0.45	0.33	0.06	1.00				
Sankara	0.1	0.30	0.00	0.29	1.00			
Musapuri	0.04	0.14	0.18	0.23	0.22	1.00		
Fia	0.2	0.17	0.07	0.20	0.00	0.00	1.00	
yagmbi	0.22	0.22	0.15	0.36	0.14	0.30	0.26	1.00

Table 3: Screening of fungi for antifungal activity

S. no.	Name of fungi	Pathogenic fungi					
		1	2	3	4	5	
1	*Alternaria alternata*	-	-	-	-		
2	*Aspergillus niger flavus*	+	-	+	-		2
3	*Aspergillus niger niger*				+		1
4	*Aspergillus niger* sp.						
5	*Aspergillus niger* tamari	+	+				2
6	*Aspergillus niger* terreus						
7	*Aspergillus niger caespitosus*						
8	*Aspergillus niger* ochraceus	+	+	+	+	+	5
9	*Cladosporium cladosporioides*						
10	*Cladosporium Cladosporium*						
11	*Cladosporium* variable	+	+	+			3
12	*Cochliobolus hawaiiensis*						
13	*Colletotrichum gloeosporioides*						
14	*Curvularia brachyspora*						
15	*Curvularia* gloeosporioides						
16	*Curvularia* lunata			+	+		2
17	*Curvularia* sp.				+		1
18	*Curvularia* trifolata						
19	*Curvularia* sp.			+			1
20	Eu*Penicillium* sp.						
21	*Fusarium* acuminatum		+		+		2
22	*Fusarium* chlamydosporum				+		1
23	*Fusarium* culmorum						
24	*Fusarium* equiseti						
25	*Fusarium javanicum*						
26	*Mycelia sterilia* -1				+		1
27	*Mycelia sterilia* -2						
28	*Mycelia sterilia* -3	+			+		2
29	*Mycelia sterilia* -4						
30	*Mycelia sterilia* -5	+		+			2
31	*Penicillium capsulatum*	++	++	+		+	4
32	*Penicillium citrinum*	++	+++	+	+++	++	5
33	*Penicillium thomii*			+	+		2
34	*Penicillium* sp.						
35	*Ulocladium* sp.						

Pathogenic fungi -1 *Fusarium equiseti*, *2 Colletotrichum gloeosporioides* 3 *Fusarium javanicum*, 4 *Nigrospora* sp. 5. *Fusarium accuminatum*

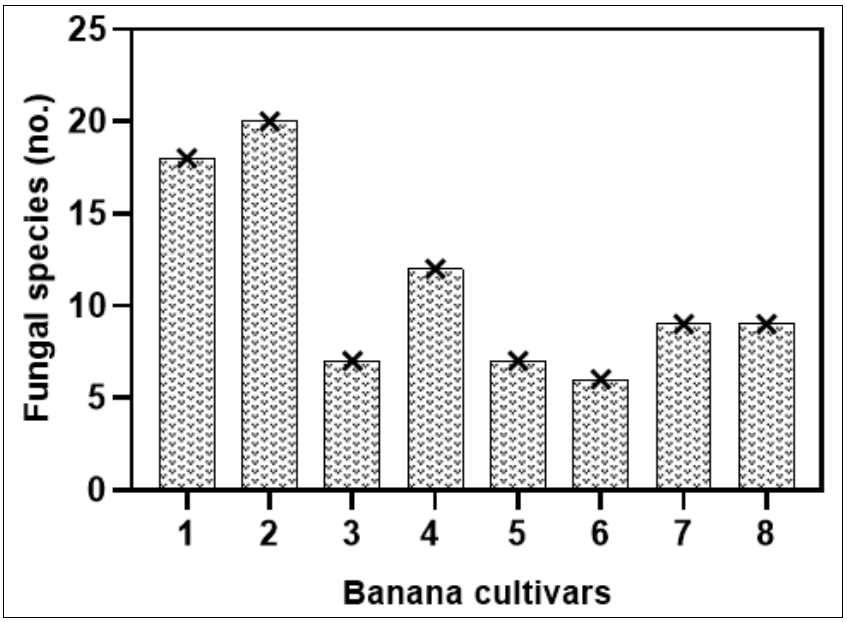

Fig 1: Fungal species richness in cultivera of banana

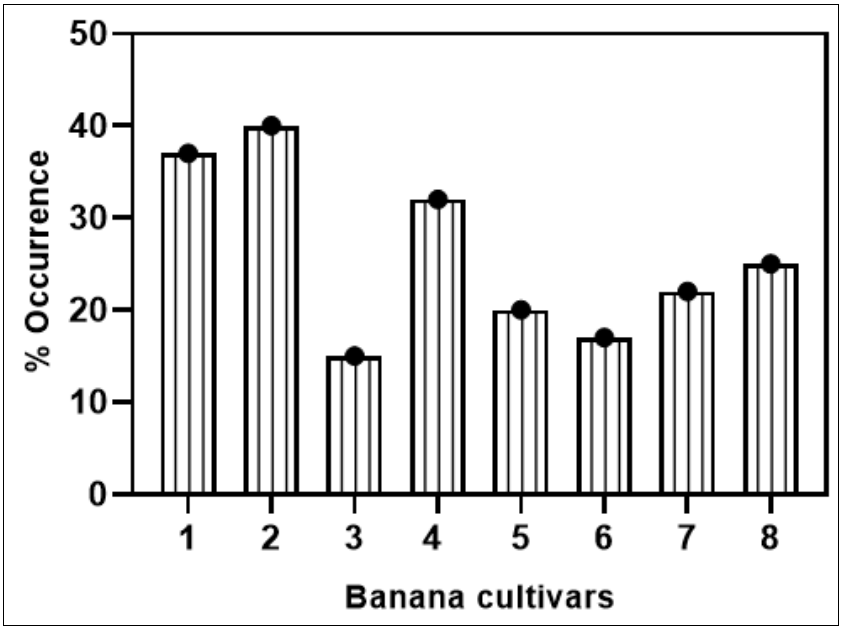

Fig 2: Occurrence of fungi in different cultivers of banana

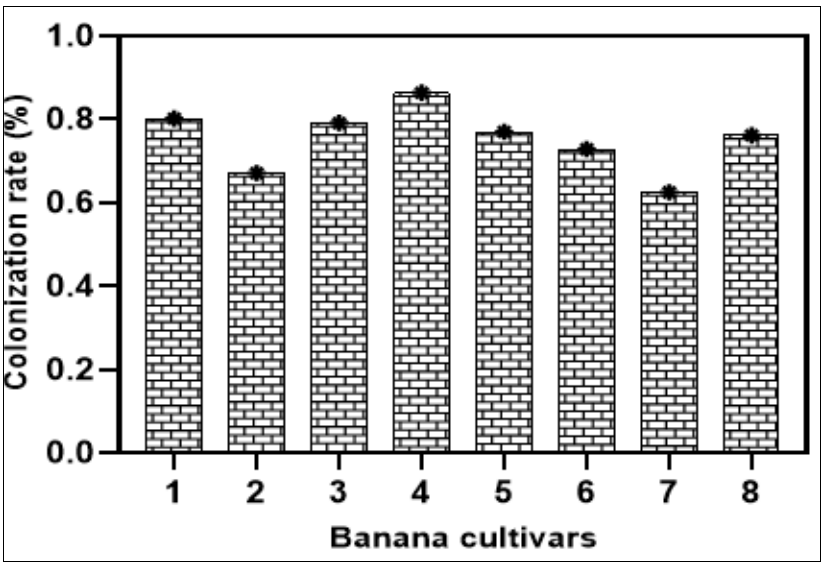

Fig 3: Rate of fungal colonization (%) in banana cultivers

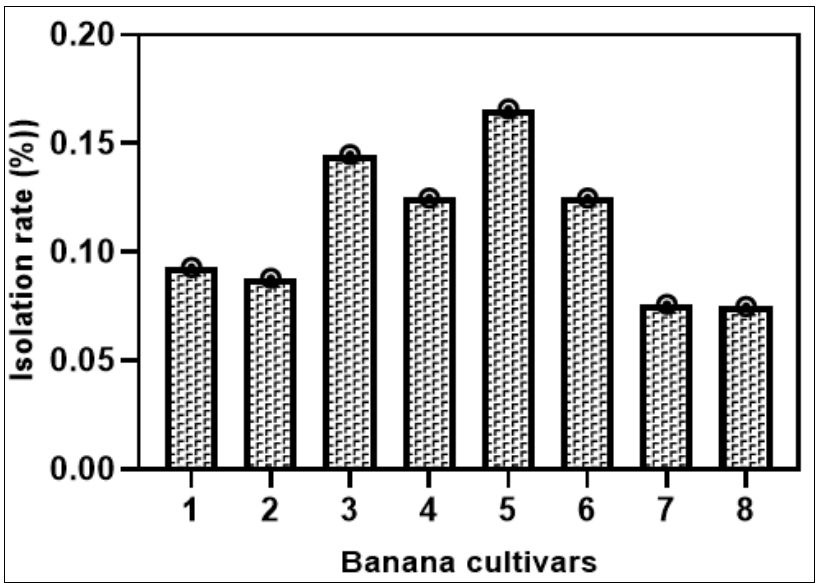

Fig 4: Isolation rate of fungi in banana cultivers

References

1. Cao LX, Qiu ZQ, You JL, Tan HM, Zhou SN. Isolation and characterization of endophytic streptomycete antagonists of *Fusarium* wilt pathogen from surface-sterilized banana roots. FEMS Microbiol. Lett. 2005;247:147–152.
2. Nagamani A, Kunwar IK, Manoharachary C. Hand book of Soil Fungi I. K. International Pvt. Ltd., New Delhi; c2005. p. 1- 461.
3. Panda J, Vetrivelkalai P, Bhagawati B, Gupta N. Diversity of Endophytic Fungi in Banana Var. of Assam India. Journal of Botanical Research. 2023;5(2):49-58
4. Panda Jiban Jyoti, Vetrivelkalai P, Bhagawati B, Nibha Gupta. Preliminary profiling of extracellular enzymes, polysaccharide and bioactive secondary metabolites of *Pseudomonas* sp. and *Lysinibacillus* sp. isolated from Banana var. of Assam. Journal of Bioresearch. 2023;2(2):19-26
5. Mendoza AR, Sikora RA. Biological control of *Radopholus similis* in banana by combined application of the mutualistic endophyte *Fusarium oxysporum* strain 162 the egg Pathogen *Purpureocillium lilacinum* strain 251 and the antagonistic bacteria *Bacillus firmus*. Biocontrol. 2009;54:263–272.
6. Raper KB, Thom C, Fennel DI. A manual of the Penicillia, International books and periodicals supply service, New Delhi; c1984. p. 1-851.
7. Tafinta IY, Shehu K, Abdulganiyyu H, Rabe AM, Usman A. Isolation and identification of fungi associated with the spoilage of sweet orange *Citrus sinensis* fruit in Sokoto state. Nigeria J. Basic App. Sci. 2013;2:1-3.
8. Watanabe T. Pictorial Atlas of soil and seed fungi. Morphologies of cultured fungi and Key to species, third edition. CRC Press, Taylor & Francis Group London; c2010. p. 1-399.
9. Wang BB, Yuan J, Zhang J, Shen ZZ, Zhang M, Li R, *et al*. Effects of novel bioorganic fertilizer produced by *Bacillus amyloliquefaciens* W19 on antagonism of *Fusarium* wilt of banana. Biol. Fert. Soils. 2013;49:435–446.
10. Xia X, Lie TK, Qian X, Zheng Z, Huang Y, Shen Y. Species diversity, distribution, and genetic structure of endophytic and epiphytic trichoderma associated with banana roots. Microb. Ecol. 2011;61:619–625.
11. Yang D, Wang L, Wang T, Zhang Y, Zhang S, Luo Y. Plant Growth-Promoting Rhizobacteria HN6 Induced the Change and Reorganization of *Fusarium Microflora* in the Rhizosphere of Banana Seedlings to Construct a Healthy Banana Microflora. Front. Microbiol. 2021;12:685408.
12. Zhang L, Zhang H, Huang Y, Peng J, Xie J, Wang W. Isolation and Evaluation of Rhizosphere Actinomycetes With Potential Application for *Biocontrolling Fusarium* Wilt of Banana Caused by *Fusarium oxysporum* f. sp. cubense Tropical Race 4. Front Microbiol. 2021;25;12:763038.