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Impact of Microenvironment on Fungal Diversity

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Subject: Microbiology

Abstract
This study is aimed at determining the prevalence of airborne fungi in 10 different greenhouse environments present at Regional Plant Resource Centre, Bhubaneswar, Odisha. A total of 62 fungal species belonging to 12 genera and unidentified group were isolated from 10 different greenhouses with various plant types. 15 Fungi were obtained from location 1, 12 fungi from location 2, 10 fungi from location 10, 8 fungi from location 9, 7 fungi from location 3, 5, 7 and 8, 6 fungi from location 4 and 6. All the 62 fungi were tested for extracellular enzymatic activity. Out of 62 fungi, 22 fungi (35.5%), 35 fungi (56.5%), 30 fungi (48.4%) and 19 fungi (30.6%) showed amylolytic, proteolytic, lipolytic and phosphate solubilisation potential respectively. 15 fungi (24.2%) were cellulose and organic acid producers.

Keywords: *Air borne fungi, green house, and enzymatic activity.*

Introduction

Microbes are omnipresent and therefore can appear in the aerosphere, hydrosphere, lithosphere and ontosphere (Joshi and shrivastava, 2013). Anemophilous fungi refer to spread of fungal spores by the atmospheric air. The air in green houses may bear heavy load of spores of different kinds of anemophilous fungi. They are microscopic organisms that form visible colonies after being grown on a suitable substrate under favourable environmental conditions (El-Gali and Abdullrahman, 2014). The atmospheric air does not favour growth of microorganisms due to lack of nutrients, therefore microorganisms are present in aerosol form remaining suspended in the air (Pavan and Manjunath, 2014). Fungal spores gradually settle out and become airborne because the fungal spores can survive for several months in suitable climatic conditions. Low humidity, physical activity and the wind speed are the three major factors which are mostly responsible for the release and distribution of spores (Neilson, 2003). Airborne microbial quantity and quality also vary with time of day, year, and location. Airborne fungal spore is related to several factors, such as spore size, shape, weight, and electrostatic properties of their walls (Newhouse and levitin, 2004; Okten et al. 2005). Geographical location, climate, and meteorological factors (temperature, wind speed, relative humidity, and rainfall) also play a role in indoor and outdoor types and levels of fungal spore behaviour and dispersion in the atmosphere (Tomas 2003; Rodriguez-Rajo et al. 2004). This study is aimed at determining the prevalence of airborne fungi in the greenhouse environments where specific types or groups of plants have been grown and maintained.

Materials and Methods
Three media, Potato Dextrose Agar (PDA), High Salt Nutrient Agar and Pikovskaya's Agar medium of pH 5.0 and 7.2 were used for collecting samples to observe any possible effect of media on the collection of the fungal spores from 10 different green houses with different plant types present at Regional Plant Resource Centre, Bhubaneswar, Odisha. Streptomycin was added to each of the media to suppress bacterial growth. After medium plates were made, then Air samples were taken from inside the green houses. Samples were taken by exposing the plates. The sampling period was 2 min. After sampling, the plates were covered, labelled and transported to the laboratory. The exposed plates were incubated in dark for 5 days at 28ºC. After appearance of fungal colonies on plates, they were purified on to the slants. Most of the fungal colonies were identified by genera only by slide culture technique. Identification was based on the macroscopic and microscopic morphology of the colonies. After identification the fungal cultures were tested for their extracellular enzymatic activity such as Amylase, Protease, Lipase, Cellulase, Xylanase, L- Asparaginase etc. These fungi were also observed for their phosphate solubilisation potential, organic acid production as well as IAA activity in-vitro.

Results and Discussion

A total of 62 fungal species belonging to 12 genera and unidentified group were isolated from 10 different greenhouses with various plant types. 9 species of *Aspergillus* ,3 species of *Botrytis*,4 species of *Paecilomyces* and *Penicillium*,7 species of *Phoma*, 17 species of *Sterile mycelium* and 11 unidentified species were isolated from medium plates. Apart from this *Campylospora sp., Endophragmina sp., Memnoniella sp., Phialophora sp., Pseudobotrytis sp., Selenosporella sp., Varicosporium sp.* was also obtained. 15 Fungi were obtained from location 1, 12 from location 2, 10 from location 10, 8 from location 9, 7 from location 3, 5, 7 and 8, 6 from location 4 and 6 (Table-1). *Aspergillus* genera are distributed in all locations. *Botrytis* genera are found in location 2, 5 and 6. *Paecilomyces* genera are present in the aero environment of 1, 7, 9, and 10. The aeromicroflora of 5 locations-1, 3, 4, 5and 7 was occupied with fungi of *Penicillium* genera. Except locations 7 and 9, *Phoma* genera is present in other locations. *Aspergillus sp 3* and *Aspergillus sp 7* are obtained from maximum 4 locations. *Aspergillus sp 3* was present in location 1, 6 , 9, 10 and *Aspergillus sp 7* was present in location 4,7,9 and 10 (Table-1) All the 62 fungi were tested for extracellular enzymatic activity. Location 2 and 9 showed maximum number of amylase producers about 58.33% and 50% respectively whereas Location 4 and 2 showed maximum number of protease producers about 83.3% and 66.60% respectively. Similarly a maximum of 75% cellulase producers were obtained from location 2 and 66.6% of lipase producers were obtained from location 1. Location 5 showed maximum number of phosphate and xylanase producing organisms but most of the organic acid producing organisms were isolated from location 8. L-asparaginase producing organisms were obtained only from location 1 and 2. Similarly IAA producing organisms were obtained from location 8 only. *Varicosporium sp*. obtained from location 10 was the only IAA producing organism from the entire stock. *Aspergillus sp 9* and few of the sterile mycelium showed positive xylanase activity. *Phialophora sp* and *Sterile mycelium sp 3* were the only L-asparaginase producing organisms. Out of 62 fungi, 22 fungi (35.5%), 35 fungi (56.5%), 30 fungi (48.4%) and 19 fungi (30.6%) showed amylolytic, proteolytic, lipolytic and phosphate solubilisation potential respectively. 15 fungi (24.2%) were cellulose and organic acid producers. 6 fungal species are having maximum amylase producing activity. 10 fungal species showed maximum proteolytic activity and *Penicillium sp 1* is the best among the group. 4 fungal species showed highest cellulolytic activity whereas 2 *Sterile mycelium* species showed highest lipolytic activity. 2 *Aspergillus sp* and *Endophragmina sp* can produce highest organic acid on culture plate (Table-2).

Conclusion

Micro-organisms isolated from air of different greenhouse environment are useful in giving knowledge of species and density of airborne fungi in a given environment. It clearly revealed the concentration of different fungal species in these greenhouse environments. Apart from that the fungal species present in the air also have potential extracellular enzymatic activity.

"Cite this Article"

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Table 1: Distribution of fungi in different sites

		SITES									
Sl.no.	**Organism**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	*Aspergillus sp 1*	+			+						
2	*Aspergillus sp 2*	+	+								
3	*Aspergillus sp 3*	+					+			+	+
4	*Aspergillus sp 4*		+								
5	*Aspergillus sp 5*		+								
6	*Aspergillus sp 6*			+							
7	*Aspergillus sp 7*				+			+		+	+
8	*Aspergillus sp 8*					+			+		
9	*Aspergillus sp 9*										+
10	*Botrytis sp 1*		+								
11	*Botrytis sp 2*		+			+					
12	*Botrytis sp 3*						+				
13	*Campylospora sp.*			+							
14	*Endophragmina sp*			+			+				
15	*Memnoniella sp*	+									
16	*Paecilomyces sp 1*	+									
17	*Paecilomyces sp 2*							+			
18	*Paecilomyces sp 3*										+
19	*Paecilomyces sp 4*										+
20	*Penicillium sp 1*	+		+				+			
21	*Penicillium sp 2*	+									
22	*Penicillium sp 3*				+						
23	*Penicillium sp 4*					+					
24	*Phialophora sp.*		+								
25	*Phoma sp 1*	+									
26	*Phoma sp 2*		+								
27	*Phoma sp 3*			+			+				

28	*Phoma sp 4*				+							
29	*Phoma sp 5*				+	+						
30	*Phoma sp 6*					+			+			
31	*Phoma sp 7*											+
32	*Pseudobotrytis sp 1*		+									
33	*Selenosporella sp*	+										
34	*Sterile mycelium sp 1*	+										
35	*Sterile mycelium sp 2*	+						+		+		
36	*Sterile mycelium sp 3*	+		+								
37	*Sterile mycelium sp 4*		+									
38	*Sterile mycelium sp 5*			+								
39	*Sterile mycelium sp 6*					+						
40	*Sterile mycelium sp 7*					+						
41	*Sterile mycelium sp 8*							+	+			
42	*Sterile mycelium sp 9*								+		+	
43	*Sterile mycelium sp10*								+			
44	*Sterile mycelium sp11*									+		
45	*Sterile mycelium sp12*									+		
46	*Sterile mycelium sp13*										+	
47	*Sterile mycelium sp14*										+	
48	*Sterile mycelium sp15*										+	
49	*Sterile mycelium sp16*											+
50	*Sterile mycelium sp17*											+
51	*Unidentified 1*	+	+									
52	*Unidentified 2*	+										+
53	*Unidentified 3*	+										
54	*Unidentified 4*		+									
55	*Unidentified 5*		+									
56	*Unidentified 6*				+							
57	*Unidentified 7*								+			
58	*Unidentified 8*									+		
59	*Unidentified 9*									+		
60	*Unidentified10*										+	
61	*Unidentified11*											+
62	*Varicosporium sp*										+	

1-Cactus house, 2-Glass house with few creepers, 3-Ornamental and house hold plants, 4- Banana Primary hardening, 5- Ornamental nursery, 6-Orchid house, 7-Crysanthemum collection, 8-Vermicompost unit, 9-Mangrove nursery, 10-Bamboo nursery

Table 2: Extracellular properties of fungi isolated from different environment

Sl.no.	Organism	Amylase	Protease	Cellulase	Lipase	Xylanase	L-asparaginase	Phosphate Solubilization	Organic acid	IAA
1	*Aspergillus sp 1*	++++	++++	-	+	-	-	-	-	-
2	*Aspergillus sp 2*	-	-	-	+	-	-	-	-	-
3	*Aspergillus sp 3*	+	-	-	-	-	-	-	-	-
4	*Aspergillus sp 4*	-	+	++++	++	-	-	-	++++	-
5	*Aspergillus sp 5*	+	+++	-	+++	-	-	-	-	-
6	*Aspergillus sp 6*	-	+	++++	-	-	-	-	-	-
7	*Aspergillus sp 7*	-	-	-	-	-	-	-	-	-
8	*Aspergillus sp 8*	-	++++	-	+++	-	-	++	+++	-
9	*Aspergillus sp 9*	+	+	-	-	+	-	-	++++	-
10	*Botrytis sp 1*	++	+++	++	-	-	-	-	-	-
11	*Botrytis sp 2*	-	-	+	-	-	-	-	-	-
12	*Botrytis sp 3*	-	++++	-		-	-	-	-	-
13	*Campylospora sp.*	++++	-	-	++	-	-	++	-	-
14	*Endophragmina sp*	-	-	-	-	-	-	-	++++	-
15	*Memnoniella sp*	+	+	+	+++	-	-	++	-	-
16	*Paecilomyces sp 1*	+	+++	-	-	-	-	++	-	-
17	*Paecilomyces sp 2*	-	++++	-	-	-	-	-	-	-
18	*Paecilomyces sp 3*	+	+++	-	++	-	-	-	-	-
19	*Paecilomyces sp 4*	-	-	-	++	-	-	+++	-	-
20	*Penicillium sp 1*	-	+++++	-	++	-	-	-	-	-
21	*Penicillium sp 2*	-	-	-	+	-	-	-	-	-
22	*Penicillium sp 3*	-	+	-	+++	-	-	-	+	-
23	*Penicillium sp 4*	-	+	-	+++	-	-	-	+	-
24	*Phialophora sp.*	-	+++	++	-	-	+	++	-	-
25	*Phoma sp 1*	-	-	-	-	-	-	-	-	-
26	*Phoma sp 2*	+	-	+++	-	-	-	-	-	-
27	*Phoma sp 3*	-	-	-	-	-	-	-	-	-
28	*Phoma sp 4*	-	+	-	-	-	-	-	-	-
29	*Phoma sp 5*	-	+	-	-	-	-	+++	-	-
30	*Phoma sp 6*	-	-	-	-	-	-	-	-	-
31	*Phoma sp 7*	-	+	+++	+++	-	-	++	++	-
32	*Pseudobotrytis sp 1*	+	+++	+	+++	-	-	-	-	-
33	*Selenosporella sp*	-	-	-	-	-	-	-	-	-
34	*Sterile mycelium sp 1*	-	+++	-	+	-	-	-	-	-
35	*Sterile mycelium sp 2*	-	+	-	+	-	-	+	-	-
36	*Sterile mycelium sp 3*	-	+	-	-	++	+	+	-	-
37	*Sterile mycelium sp 4*	+++	+	+	++++	-	-	-	++	-
38	*Sterile mycelium sp 5*	-	-	-	-	-	-	++	-	-
39	*Sterile mycelium sp 6*	++	++++	-	++++	+	-	++	-	-
40	*Sterile mycelium sp 7*	-	-	-	-	+	-	+	-	-
41	*Sterile mycelium sp 8*	-	++++	-	-	-	-	++	-	-
42	*Sterile mycelium sp 9*	-	++++	-	+	-	-	-	+	-
43	*Sterile mycelium sp10*	++++	-	+	-	+	-	-	-	-

44	*Sterile mycelium sp11*	-	++	-		-	-	-	-	-
45	*Sterile mycelium sp12*	-	-	-	++	+	-	-	-	-
46	*Sterile mycelium sp13*	-	-	-	++	-	-	-	+	-
47	*Sterile mycelium sp14*	++	-	-	-	-	-	-	-	-
48	*Sterile mycelium sp15*	+	-	-	++	++++	-	++	++	-
49	*Sterile mycelium sp16*	-	-	-	-	+++	-	-	-	-
50	*Sterile mycelium sp17*	-	+	-	-	-	-	-	-	-
51	*Unidentified 1*	-	-	++++	+	-	-	-	++	-
52	*Unidentified 2*	-	-	-	+	-	-	++	+++	-
53	*Unidentified 3*	++	++++	-	+++	-	-	++	+++	-
54	*Unidentified 4*	++	+	-	++	-	-	-	-	-
55	*Unidentified 5*	+	+	++++	-	-	-	-	-	-
56	*Unidentified 6*	++++	++	+	+	-	-	-	-	-
57	*Unidentified 7*	-	-	-	-	-	-	-	-	-
58	*Unidentified 8*	++++	+	-	++	-	++++	++	-	-
59	*Unidentified 9*	-	-	-	-	-	-	+	-	-
60	*Unidentified 10*	++++	-	++	-	-	-	-	+	-
61	*Unidentified 11*	-	-	-	+	-	-	-	-	-
62	*Varicosporium sp*	-	++++	-	-	-	-	-	-	+++

(+++++)- Highest activity, (++++)- High activity, (+++)- Good activity, (++)- Medium activity, (+)- Low activity, (-) - No activity

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