RESEARCH ARTICLE

Biodiversity of Aeromycoflora from Indoor Environment of Library

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ABSTRACT

Library is a basic source of cellulosic substrate for proliferation of diverse group of fungal organisms provided ambient climate of temperature and humidity. India comprises one third diversity of globe. The study was undertaken for a month at an interval of a week to report the aeromycoflora from various corners of library. Altogether 980 colonies falls under 19 genera and 28 species have been recorded by culture plate exposer method. Ascomycota dominated with more than half of the total colonies recorded followed by Zygomycota and Deuteromycota while Oomycota had least colonies. Member of Basidiomycota did not persist. Significant count of colonies was reported prevalent in third week of January while moderate count was confined in first week of February. *Aspergillus* was dominated with higher colony count as well as greater species number. *Cladosporium cladosporoides, Mucor pusillus* and *Rhizopus stolonifer* were recorded sub-dominant. *Fusarium* was recorded with 3 species; *Penicillium, Curvularia*, *Alternaria* with 2 species and others had single species. Diversity of fungal organisms on cellulosic material in library concerns to changing indoor environment. The climate for third week of January was confined ideal for sporulation. The culture plate exposure technique has proved to be more appropriate over others.

Key words : Aeromycoflora, Indoor, *Aspergillus*, colonies.

INTRODUCTION

Library is the backbone of educational academy and an organized collection of information resources in the form of books, periodicals, newspapers, films, recorded music made accessible to defined community for reference or borrowing. Prevalence of the diverse group of fungal flora in indoor air of library causes biodeterioration of books and other materials in library, as these books provide nutrient source for the proliferation of fungal organisms. Biodeterioration by fungal organisms causes damage of books, discolouration of pictures and prints (Thakre and Bhajbhuje, 1989; Kalbende *et al*., 2012).

Mostly cellulosic material and other articles in libraries contribute to pollute indoor environment, may be hygienic affecting the health of researchers on the globe (Thakre and Bhajbhuje, 1989; Dalal *et al*., 2011).The moderate climate of temperature and relative humidity play an important role in proliferating fungal population in the indoor environment. The investigation of common airborne fungi and their distribution in a particular region can be helpful in identifying association between fungal sensitization and clinical diagnosis and clinical prevention of the seasonal allergic diseases (Chelak and Sharma, 2012). Since diverse fungal species constitute the major components of airborne flora are the major cause of respiratory ailment of humans, causing allergies, asthma and plant diseases and as well as important agents of degradation of cellulosic and non-cellulosic material in

indoor closed environment, thus there is a great need for understanding, aerobiological studies from indoor environment for library of P.G. Department of Botany, RTM Nagpur University, Nagpur. Presently, prevalence of aeromycoflora from indoor environment has so far not been reported earlier from these places, hence it seemed to be worthwhile to undertake a more comprehensive and systematic study of the biodiversity of aeromycoflora from indoor environment for library during winter season.

MATERIALS AND METHODS

The isolation of an indoor aeromycoflora from various corners of Library was made following culture-plate exposure method (Lanjewar and Sharma, 2014) using Potato Dextrose Agar (PDA) media at weekly intervals from 16thJanuary to 15th February 2014. Petri-plates containing sterilized media were exposed in triplicates for 10 minutes in library and brought into the laboratory and incubated at 25 ± 1^0C for 4-5 days. The colonies appeared on agar plates were counted and recorded as percentage for individual species employing standard formula (Kalbende *et al*., 2012). The species were identified on the basis of micro- & macro morphology; reverse and surface coloration of colonies grown on Czapek's medium and finally authenticated by authority.

RESULT AND DISCUSSION

Environmental microfungal population is seemed to act as an indicator of the level of environmental bio-pollution. The viable microfungal propagules in atmosphere, may remain in the same environment or carried to a long distance far away from existing condition by abiotic elicitors particularly wind, may get deposited on healthy flora, can cause many plant diseases, hence the knowledge of their periodicity is of great concern in terms of predicting the plant epidemics (Chelak and Sharma, 2012). Microbial components to indoor air are receiving the greater attention with the framework of potential health hazards to diverse group of biotic elicitors including human beings. Exposure to fungal airspora has been linked to a range of detrimental health effects in both infants and adults (Karvala *et al*., 2010). Conversely, the hygiene hypothesis, which posits that exposure to microbial material early in life can actually be preventative in developing disease later in life, continues to find empirical support (Adams *et al*., 2013).

The culture plate exposure technique has proved to be more appropriate over others, has been employed for detection of indoor aeromycoflora in present study to record fungal diversity (Lanjewar and Sharma, 2014). Altogether 980 fungal colonies were recorded which arefall under 19 genera and 28 species. Ascomycota dominated with 53% colonies exhibiting highest fungal count followed by Zygomycota (22.5%) and Deuteromycota (21.9%). Sterile mycelia contributed a count of 2% colonies while two colonies have been detected for Oomycota. The member of Basidiomycota did not appear on the agar plates for an area understudy (Table 1).This is in agreement with the findings of Ananna *et al*., (2013), Bhajbhuje (2013); Lanjewar and Sharma (2014) who reported the greatest count of fungal isolates as well as higher fungal colony count of indoor aeromycoflora by culture plate exposure test. This method was preferred for isolation of aeromycoflora in response to certain advantages such as (i) fungal spores with similar appearance can be identified to their generic level; (ii) fungal species of too small size with sufficient individual characteristics to be used as means of identification (iii) viable fungal hyphae can also be identified on the slides; and (iv) material on slides does not blow away with strong current of wind (Luka *et al*., 2014).

Deuteromycota contributed highest count of isolates followed by *Ascomycota*, while minimum fungal count was associated with Oomycota, Zygomycota and Sterile mycelia. The dominant microfungal genera of this group include *Alternaria, Cladosporium, Curvularia, Fusarium, Helminthosporium and Trichothecium*. These results are in confirmation with the earlier findings (Adams *et al*, 2013; Luka *et al*., 2014).The most common fungus *Aspergillus* contributed highest 49.7% of the total colony count followed by *Cladosporium* (14.5%), *Rhizopus* (11.2%), *Mucor* (11.2%) and *Fusarium* (4%). The genera*, Alternaria, Curvularia, and Penicillium* were recorded most significant or equally dominant. Among these, *Aspergillus flavus , A. niger and A. fumigatus* were observed most dominant followed by *Cladosporium* and two members of Mucorales viz.,*Rhizopus stolonifer* and *Mucor pusillus.* Other members, *Alternaria solani*, members of *Fusarium* and Sterile black mycelia contributed 0.5– 1.9% air spora(Table 1). It is in agreement with the earlier finding of Kalbende *et al*., (2012) who reported higher colony count and greater species number for *Aspergillus*. It was confirmed by Bhajbhuje (2013); Lanjewar and Sharma (2014).

Diverse group of fungal species of saprophytic nature inside library grew profusely on organic substrates such as cellulosic and non-cellulosic materials with different shades as compared to other group of microbes, producing allergens, enzymatic proteins, secondary metabolites and other toxins that caused many respiratory disorders (MBL, 2012). The occurrence of comparatively higher count of fungal isolates of *Deuteromycota* may be attributed to prevalence of diverse viable fungal spores with high indoor humidity of library area understudy. Members of *Deuteromycota* produce enormous resistant thick walled conidia asexually; remain dormant in unfavourable indoor environment for longer duration and able to germination on the onset of favorable condition of optimum temperature and high relative humidity (Adams *et al*., 2013). The conidia of *Cladosporium, Alternaria, Helminthosporium, Trichotheci - um, and Curvularia* remained in greatest abundance in indoor air even at low humidity, generally during warmer climate (Dalal *et al*, 2011). It was interesting to record that members of Basidiomycota did not persist in indoor environment of the area understudy, may be possibly attributed to mode of nutrition, as majority of fungal organisms of these groups are obligate parasites of crop plants. Major component included *Aspergilli, Cladosporium, Rhizopus, Mucor* while minor components included less frequent and sporadic types. Other stable components recorded were *Botryodiplodia*, *Chaetomium,* and Sterile mycelia.

Table 1: Report on fungal air spora from indoor environment of Library

S.No	Fungal organism	Number of fungal colonies				Total colonies	% Contribution	
		1-week	2-week	3-week	4-week		Species	Genera
A.	Oomycota	-	-	-	2 (2.02)	2 (0.2%)	0.20	0.20
1	*Phytophthora infestans*	-	-	-	1	1	0.10	0.10
2	*Pythium aphanidermatum*	-	-	-	1	1	0.10	0.10
	Genera /(species)	-	-	-	2 (2)	2 (2)		
B.	Zygomycota	100 10.2)	10 (1.02)	98 (10.0)	12 (12.2)	220(22.4%)	22.44	22.44
3	*Mucor pusillus*	49	6	50	5	110	11.22	11.22
4	*Rhizopus stolonifer*	51	4	48	7	110	11.22	11.22
	Genera /(species)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)		
C.	Ascomycota	160(16.3)	122(12.4)	114(11.6)	124 (12.7)	520(53%)	53.06	53.06
5	*Aspergillus flavus*	68	56	60	43	227	23.16	49.69
6	*Aspergillus fumigatus*	32	23	13	24	92	9.39	
7	*Aspergillus niger*	41	32	34	42	149	15.20	
8	*Aspergillus sulphureus*	7	2	1	1	11	1.12	
9	*Aspergillus terreus*	1	2	-	5	8	0.82	
10	*Chaetomium glabosum*	6	2	3	3	14	1.43	1.43
11	*Penicillium citrinum*	3	4	1	3	11	1.12	1.73
12	*Penicillium oxalicum*	2	1	1	2	6	0.61	
13	*Phoma glomerata*	-	-	1	1	2	0.20	0.20
	Genera /(species)	3 (8)	3 (8)	3 (8)	4 (9)	4 (9)		
D.	Basidiomycota	-	-	-	-	-	-	
E.	Deuteromycota	51(5.20)	69 7.04)	44 4.49)	51(5.20)	215(21.9%)	21.94	21.94
14	*Alternaria alternata*	1	1	1	1	4	0.41	1.23
15	*Alternaria solani*	1	5	-	2	8	0.82	
16	*Botryodiplodia sp*	-	-	1	-	1	0.10	0.10
17	*Cladosporium cladosporoides*	34	45	34	29	142	14.49	14.49
18	*Curvularia lunata*	2	1	1	2	6	0.61	1.43
19	*Curvularia tetramera*	2	5	-	1	8	0.82	
20	*Fusarium moniliformae*	5	8	2	4	19	1.94	3.98
21	*Fusarium oxysporum*	3	1	3	3	10	1.02	
22	*Fusarium solani*	2	3	1	4	10	1.02	
23	*Helminthosporium tetramera*	-	-	-	2	2	0.20	0.20
24	*Nigrospora sp.*	-	-	1	-	1	0.10	0.10
25	*Pyricularia sp*	-	-	-	2	2	0.20	0.20
26	*Trichothecium roseum*	1	-	-	1	2	0.20	0.20
	Genera /(species)	5 (9)	4 (8)	6 (8)	7 (11)	9 (13)		
F.	Other types	7 (0.71)	5 (0.51)	7 (0.71)	4 (0.41)	23(2.3%)	2.35	2.35
27	*Sterile black mycelia*	5	3	4	2	14	1.43	1.43
28	*Sterile white mycelia*	2	2	3	2	9	0.92	0.92
	Genera /(species)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)		
	Genera /(species)	12 (21)	11 (20)	13 (20)	17 (26)	19(28)		
	Total colonies	318	206	263	193	980	99.97	99.97
	Per cent contribution	32.45	21.02	26.84	19.69			

1. Values in parenthesis indicate per cent contribution of fungal flora over total colonies recorded.
2. Values in parenthesis indicate total number of isolates recorded.

found prevalent only 2-4 times during sampling. This is in agreement with the findings of Lanjewar & Sharma (2014) who reported frequent appearance of these fungi in indoor environment of rice mill.

The isolation of aeromycoflora from indoor environment of area understudy was made at an interval of a week from various locations for a month. Mycological analysis revealed an existence of a fungal population in higher concentration in third week of January, contributing 32.5%. In the fourth week of January, the concentration of fungal air spora declined to 21%and again increased to 26.8% in first week of February. It becomes least (19.7%) at the end the survey i.e., the second week of February. These results are in confirmation with earlier findings (Ghosh *et al*., 2011; Chelak and Sharma. 2012).

A fungal population of 28 diverse isolates representing 19 genera was seemed to be prevailing inside the library. Of these, a population of 11 isolates representing 7 genera, were encountered on agar plates throughout a month (Table 1). Among these *Aspergillus flavus* appeared predominant contributing 23.2% airspora, followed by *Aspergillus niger* (15.2%) and *Cladosporium cladosporoides* (14.5%), while others contributed less than 12% of total fungal air spora.*Fusarium*, a most prevalent toxin-producing deuteromycetous fungal organism contributed with 4% of total colony count (Table1), reported to degrade carpet, mattresses, damp walls, polyester, polyurethane foam, humifier pans and produce a diverse range of mycotoxins includes trichothecenes, zearalenon and fumonisins have significant impacts on human health (MBL, 2012).Inhalation of spore of *Mucor pusillus* caused mucocutaneous & rhinocerebral infections, septic arthritis, renal infections, gastritis and severe pulmonary infection, and difficulty in breathing;*Aspergillus niger* has potential to produce *ochratoxin-A* and degrade polysaccharide;*Aspergillus flavus* secretes aflatoxin B_1, B_2, G_1& G_2 and other toxic compounds including *strigmatocystin, cyclopiazonic acid, kojic acid, β-nitropropionic acid, aspertoxin, aflatrem, gliotoxin*and*aspergillic acid*.(Wikipedia, 2014).*Alternaria* conidia have implication to asthmatic and allergy patients. A sector of population inhaling conidia develops hay fever, woodworker's lung or apple store hypersensitivity; susceptible individuals can become sensitized to the protein on the spore surface and develops allergies (MBL, 2012).

CONCLUSIONS

Indoor aeromycoflora from Library is known to be significant in respect of allergic as well as air borne diseases and also involve in deterioration of cellulosic and non-cellulosic materials. Present investigation revealed that the third week of January had very pleasant weather with moderate temperature and high humidity is expected ideal for rapid proliferation and enhancement of the growth of diverse group of fungal organism. Impact of airborne fungal spores including their release, dissemination, deposition and effect is of great significant to identify the health hazards and physiological disorders in human beings. Exposure to indoor airborne inhalant mould allergens develops respiratory symptoms, airways disorders and allergies. Thus clean indoor environment is of prime importance for maintenance of good health.

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