RESEARCH ARTICLE

Investigation of intramural environmental Aeromicrobiota in Bharati Printing Press Pune, Maharashtra, India

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ABSTRACT

Air sampling was carried out by using continuous Tilak air sampler from 1stJanuary 2013 to 31stMay2013 in the intramural environment of Bharati printing press having a tropical wet and dry climate with average temperature ranging between 19°C to 41°C and RH 49% to 87% to analyze the aerobiodeteriogens causing biodetrioration of papers, books and their relevance to health problems like allergy, sometime skin diseases, respiratory disorders, etc., among the press workers. Qualitative analysis revealed incidence of 64 fungal spore types and 09 other types. Quantitative analysis revealed daily and monthly variation in the percentage contribution of dominant spore types such as *Cladosporium* (23.186%), *Aspergillus* (21.302%), *Nigrospora* (21.03%), *Smut spores* (19.86%), and minor type like *Torula* (1.043%). Diurnal periodicity curve of *Nigrospora* (from 11th January to 20th January 2013)revealed peak point at 04 to 06hrs (11.64%) exhibiting early morning aerospora pattern and minimum at 14 to 16 hrs (10.34%), at average temperature (21 °C) accompanied by rise in average RH (67.8%) have been found responsible for the increase in aerospora. While diurnal periodicity curve of *Chaetomium* (From 8th April to 20th April 2013) exhibited peak at 02 to 04 hrs. i.e. post midnight aerospora pattern at average temperature 22°C and average RH 62%. Prominent biodeterioration of papers and health disorders in press workers have been reported during the study period.

Keywords: Aerospora, Air sampling, Biodetrioration, Allergy, Biodeteriogens and Allergens.

INTRODUCTION

Pune is a big city having 160 km distance from Mumbai located towards the southern direction at the Latitude 18°32' N, Longitude 72° 51' E and at Altitude 560m (1840 ft) above sea level, situated in Western Ghats of India in Maharashtra state. Pune has a tropical wet and dry climate with average temperature ranging between 19C° to 41C°. Aerospora comprises fungal spores, pollen grains, hyphal fragments, insect scales, protozoan cysts, epidermal hairs, bacteria, etc. Some of them are harmful and cause serious health hazards in human beings due to their higher concentration in the air. They also cause environmental bio-pollution.

Some spores of fungi are responsible for allergy in sensitive individuals, since spores are inhaled and deposited on mucosa of lungs in human beings (Tilak and Jogdand, 1989). Many allergic manifestations in human beings such as asthma, rhinitis, skin allergy, etc., and a range of cardio –respiratory diseases are attributed to inhalation of airborne fungal spores and pollen grains. (Reddy, 1970).

MATERIALS AND METHODS

Material for the experiment is the intramural aeromicrobiota which is studied by air sampling method using electrically operated volumetric continuous Tilak air sampler set in the printing press at 1 meter height from ground level in the Yashwantrao Mohite College; Bharati Vidyapeeth deemed university, Erandawne, Pune.

Collection of Data: Petroleum jelly coated cello fane tape was fixed around the drum in the center for every week in the beginning. Starting point was coincided with inlet orifice tube of the sampler and the sampler was started in the evening continuously for seven days. At the end of the week 14 slides have been prepared after cutting loaded (deposited) cello tape with a blade in 14 segments. Each represented twelve hours aerospora. These slides have been labeled with dates, day/night and mounted by using melted glycerin jelly in the laboratory.

Scanning: Each was divided into six equal divisions by marking it over the cover slip with a pointed ball pen. Each division represented two hours spore catches. These slides have been scanned under Japanese Nikon stereo-binocular research microscope using 10x X 40x magnification, as mentioned by Tilak (1987). Identification of aerobiocomponents was made on the basis of size, colour, shape, septation, and structure of spores by using authentic available literature, reference slides and expertise.

Statistical Analysis: Qualitative and quantitative estimation of aeromicrobiota have been entered in record register daily for night and day slides, spore count were multiplied by conversion factor 14 and statistical analysis have been completed for five months i.e. 1st January to 31st May 2013.

RESULTS AND DISCUSSION

The present aerobiological investigation was carried by using Tilak air sampler for the period of five months i.e. January to May 2013. Qualitative analysis of intramural environment, average aeromicrobiota of five months (January to May 2013) in the printing press, revealed 73 total types of airborne biocomponents of which 64 types of fungal spores and 09 other types have been encountered. Out of 64 types of fungal spores, 46 types belonged to Deuteromycotina, 14 types to Ascomycotina, 3 types to Basidiomycotina and 01 type belonged to Phycomycotina. However, Myxomycotina members have not been found during study period. Nine other types include Pollen grains, cellulose fibers, epidermal hairs, fungal hyphae, insect wings, insect scales, algal filaments, protozoan cysts and unidentified types.

Average class wise percentage contribution of fungal spore types has been recorded in the descending order as Deuteromycotina (63.0137%), Ascomycotina (19.178%), other types (12.328%), Basidiomycotina (4.102%) and Phycomycotina (1.369%), Average percentage contribution of dominant fungal spore types has been recorded in the descending order of such as *Cladosporium* (27.152%), *smut spores (*17.122%), *Nigrospora* (16.634%), *Aspergillus spp (*15.304%*)* and Bispora (7.898%).

Diurnal periodicity curve of prominent spore like *Nigrospora* the intramural environment like Bharthi printing press at Pune revealed peak (11.64%) between 4.00am to 6.00am hrs. early morning aerospora pattern followed by subsidiary peak (10.34%) have been recorded between 20 to 22 hrs. Diurnal periodicity curve of *Chaetomium* (From 11th April to 20th April 2013) exhibited peak at 02 to 04 hrs. i.e. post midnight aerospora pattern at average temperature 22^{0}C and average RH 62%.

Table 1: Average class wise percentage contribution of aerobiodeteriogens in the intramural environment of printing press YM College, Pune during study period (January to May 2013).

Name of Class	Genera obtained	Total %
Myxomycotina	0	0
Phycomycotina	1	1.5625
Ascomycotina	14	21.875
Basidiomycotina	3	4.6875
Deuteromycotina	46	71.875
Other types	6	12.014

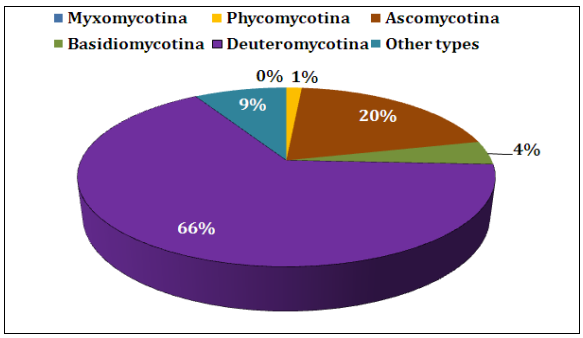

Fig. 1: Class wise percentage contribution of aerobiocomponents during study period (January to May 2013).

Table 2: Average percentage contribution of some of the dominant biodeteriogens in the intramural environment of printing press YM College, Pune during study period (January to May 2013).

Name of Spores	Average %	Total Average %
Cunnighamella	86	0.935
Chaetomium	212	2.304
Smut spore	1399	15.2
Aspergillus	1152	12.52
Bispora	652	7.085
Cladosporium	1990	21.63
Curvularia	520	5.651
Helminthosporium	154	1.674
Heterosporium	264	2.869
Nigrospora	1120	12.17
Torula	501	5.444
Cellulose fiber	498	5.412
Fungal Hyphae	654	7.107
	9202	100

Fig. 2 Average percentage contribution of some of the dominant biodeteriogens in the intramural environment of printing press YM College, Pune during study period (January to May 2013)

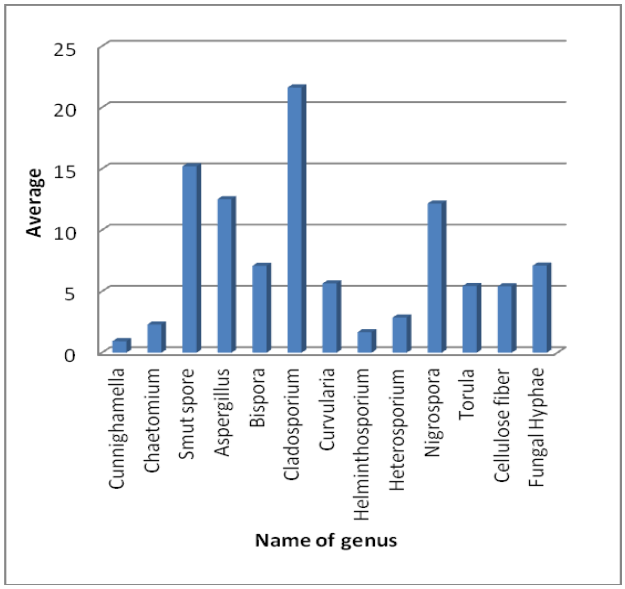

Table 3: Total Average percentage contribution of Nigrospora in printing press from 11/1/13 to 20/01/13 to the total aerospora of that week

Sr. no.	Date	Time												
		06 to 08	08 to 10	10 to 12	12 to 14	14 to 16	16 to 18	18 to 20	20 to 22	22 to 24	24 to 02	02 to 03	04 to 06	Total
1	1/11/2013	6	9	6	7	7	4	6	4	8	7	1	1	66
2	1/12/2013	1	3	2	3	2	10	3	3	3	3	9	7	49
3	1/13/2013	6	3	5	2	2	3	0	1	2	1	2	5	32
4	1/14/2013	1	3	1	3	3	1	2	2	2	1	2	3	24
5	1/15/2013	8	6	4	9	4	3	6	7	1	1	2	1	52
6	1/16/2013	2	4	4	2	6	7	2	3	4	4	3	2	43
7	1/17/2013	6	6	3	5	7	5	3	3	4	3	4	3	52
8	1/18/2013	4	6	3	7	7	9	4	6	7	9	3	3	68
9	1/19/2013	6	4	4	6	6	3	0	2	5	1	2	6	45
10	1/20/2013	2	1	3	1	2	4	2	2	0	4	6	2	29
Total		42	45	35	45	46	49	28	33	36	34	34	33	460
Average total		4.2	4.5	3.5	4.5	4.6	4.9	2.8	3.3	3.6	3.4	3.4	3.3	46
Average total %		9.13	9.78	7.61	9.78	10	10.7	6.09	7.17	7.83	7.39	7.39	7.17	100

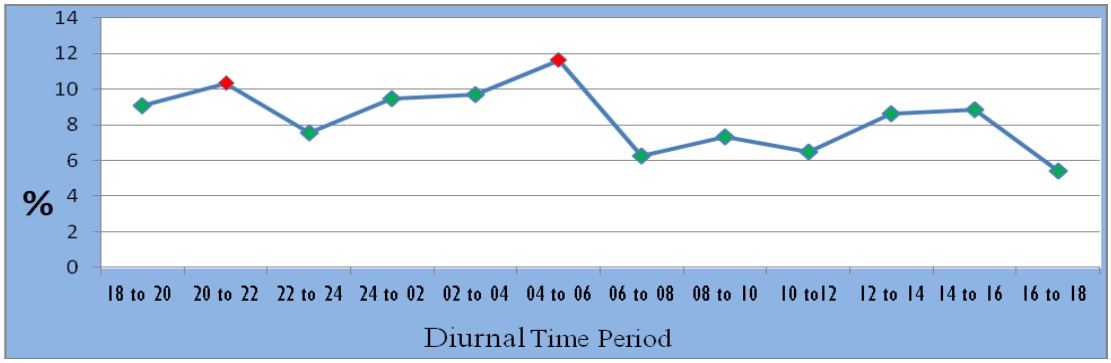

Fig 3: Diurnal periodicity curve of average percentage contribution of Nigrospora in the intramural environment of printing press from 11/1/13 to 20/01/13 to the total aerospora of that week .

Table 4: Average percentage contribution of Chaetomium in printing press from 11/04/13 to 20/04/13 to the total aerospora of that week

Sr. No.	Dates/ Time ⇩ ⇨	06 to 08	08 to 10	10 to 12	12 to 14	14 to 16	16 to 18	18 to 20	20 to 22	22 to 24	24 to 02	02 to 03	04 to 06	Total
1	4/11/2013	2	0	1	2	0	0	1	1	1	0	2	1	11
2	4/12/2013	0	1	0	0	1	0	0	2	0	1	1	2	8
3	4/13/2013	1	0	2	0	1	2	1	0	0	3	2	1	13
4	4/14/2013	0	0	0	0	0	0	2	1	1	2	0	2	8
5	4/15/2013	0	0	0	0	0	0	1	1	0	0	0	0	2
6	4/16/2013	1	0	0	1	0	0	0	0	0	0	0	0	2
7	4/17/2013	2	2	0	1	0	2	0	0	0	0	0	1	8
8	4/18/2013	0	0	0	0	0	0	2	0	2	0	3	0	7
9	4/19/2013	0	0	0	0	0	0	0	0	0	0	0	0	0
10	4/20/2013													0
	Total	6	3	3	4	2	4	7	5	4	6	8	7	59
	Average total	0.6	0.3	0.3	0.4	0.2	0.4	0.7	0.5	0.4	0.6	0.8	0.8	6
	% average total	10	5	5	6.66	3.33	6.66	11.6	8.33	6.66	10	13.3	13.3	100

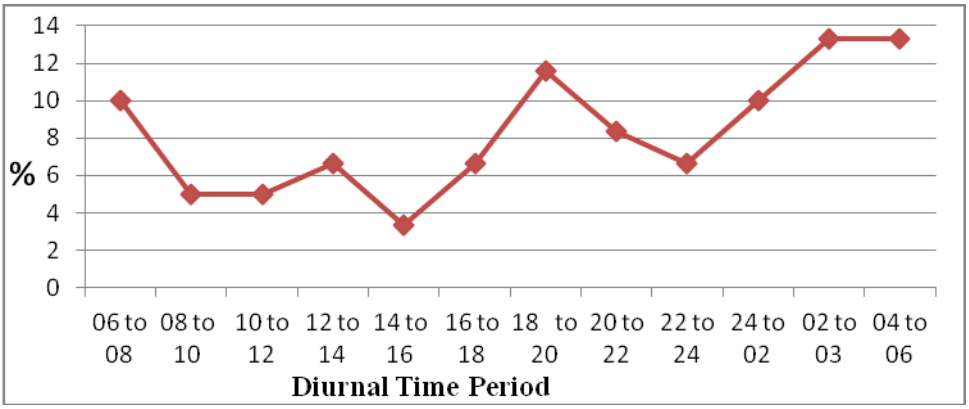

Fig 4: Diurnal periodicity curve of average percentage contribution of *Chaetomium* in the intramural environment of printing press from 11/04/13 to 20/04/13 to the total aerospora of that week .

DISCUSSION

The present aerobiological investigation was undertaken to study the intramural environmental aeromicrobiota from printing press which revealed 73 aerobiocomponents dominanted by *Cladosporium*. The study was carried out to find out cause of biodeterioration of paper material in the printing press and health hazards of the workers due to inhalation of airborne microbes reported in the printing press. The cellulytic fungi like *Cladosporium (27.17%), Aspergillus sp. (15.304%), Chaetomium (2.893%), etc.,* responsible for the damage of papers have been encountered in significant number in the press. Bhattacharjee et al (2010) reported Aspergillus (27.98%), Cladosporium (20.55%) and Penicillium (15.33%) at Guwahati, Assam as biodetrogens causing damage to papers.

Aeromicroflora studies revealed *Cladosporium* (27.17%), *Aspergillus* (15.304%), in higher concentration towards the end of winter and beginnning of the summer, whereas Pavan and Manunath (2012) reported higher concentration of fungi in summer as compared to winter and rainy season.Present investigation revealed Deuteromycotina (58%) as dominant class as compared to Ascomycotina (17%), other types (17%) Basidiomycotina (6%). While, Nayak and Nanda (2009) reported Deuteromycotina as dominant class followed by Zygomycotina, at three sites of indoor environment at Chennai. In this study *Cladosporium, Aspergillus, Nigrospora, Smut spores, Alternaria, Bispora, etc* are common fungal spores revealed inside the intramural environment of printing press, this finding is in agreement with findings of several other researchers (Tilak and Kulkarni, 1992; Mandal et al., 2010 and Jogdand and Ingole 2013), However Thaware et al., 2011, have reported Aspergillus spp as dominant type and frequently found in the intramural environment in library. Pawar and Ingole (2013) reported six other types like algal filaments, cellulose fibres, epidermal hairs, fungal hyphae, insect wings/scales & pollen grains, of which algal filaments and fungal hyphae may act as aerobiodeteriogens.

The diurnal periodicity curve (Fig. 2) of Nigrospora from 11th January to 20th January 2013 in the aerospora of printing press revealed bihourly variation in percentage contribution and attained main peak point (11.64%)between 04 to 06 hrs in the intramural environment and subsidiary peak (10.34%) have been recorded between 20 to 22 hrs. While diurnal periodicity curve of *Chaetomium* (From 11th April to 20th April 2013) exhibited peak at 02 to 04 hrs. i.e. post midnight aerospora pattern at average temperature 22^{0}C and average RH 62%.

The impact of representative environmental parameters on percentage contribution of total aerospora on 8th January 2013 have revealed 1.062% ,at average temperature 22.5^{0}C and RH 59.5%. Similarly the impact of representative environmental parameters on percentage contribution of total aerospora on 16th January 2013 have revealed 4.689% at average temperature 19.2^{0}C and RH 67.8%. Thus higher percentage contribution of average aerospora on 16th January 2013 have been encountered at 19.2 ^{0} C. temp. and 67.8 % RH while lower percentage contribution of aerospora have been recorded on 8th January 2013 at 22.5 ^{0} C. temp. and 59.5% RH to the monthly total average aerospora of January 2013,revealing prominent effect of environmental parameters on the incidence of aerospora.

CONCLUSION

From these observations it may be concluded that Nigrospora belongs to "night aerospora" group.Decrease in temperature (19.2 ^{0}C) accompanied by rise in RH (67.8%) have been found responsible for the increase in aerospora on 16th January 2013 and rise in temperature (22.5 ^{0} C) and fall in RH (59.5%) have been found responsible for decrease of aerospora. Thus environmental parameters exhibited profound impact on the arospora clearly.

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