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Indoor Aeromycroflora at Institute of Agriculture Library (Visva-Bharati): A Study

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Abstract

Existence of aeromycoflora inside Institute of Agriculture library, Visva-Bharati, Sriniketan India was studied with the help of Burkard Personal one day Volumetric Sampler for eight months from August 2014 to March 2015 with variation of temperature from 11.20^{0}C to 33.39^{0}C and relative humidity (RH) 51%-86.87%. Ten fungal species namely *Drechslera sp.*; *Aspergilli/penicillin sp.*; *Bispora sp.*; *Basidiospore sp.*; *Ascospore sp.*; *Nigropora sp.*; *Pericornia sp.*; *Fusarium sp.*; *Cladosporium sp.*; *Trichornis sp.* were identified. Maximum fungal spores were identified in September (8052 spores /m^{-3} air) and minimum in November (1056 spore /m^{-3}) in air. The findings help take proper preventive measures to control the presence of fungal spores in the air of the library which in turn will save library collections and reduce cause of health hazards to library personnel as well as users.

Keywords: Aeromycroflora, Fungal Spore, Library Collection, Metrological Condition, Volumetric Sampler

1. Introduction

Library collections including books, manuscripts and other materials provide sufficient nutrient for proliferation of aeromycroflora, which refers to airborne fungal contributors in the environment. Fungi are a specialized group of microorganisms. The inherent characteristics of books (such as glue, fabrics etc) help the growth of fungi. In a conducive environment fungi can damage books by destroying cellulose and other decomposing materials. Thus fungi play a major role in bio deterioration of books in libraries. It is due to hydrolytic activity of aeromycroflora. Their spores and conidia form the major component of aerospora inside library. Many fungi are harmful to human beings causing allergic problems, skin infection, etc. The basic causes of respiratory problems, skin diseases are deposition of dust and fungal spores settled on books and stack of library environment. But different environmental factors like temperature, humidity may influence composition and concentration of fungi in library.

In India different studies on airborne fungal spores to identify diverse number of fungal genera in library environment have been carried out[1–8]. It was observed that aeromycoflora present in library causes deterioration of library collection[9–13]. Favourable environmental factors like temperature, Relative Humidity (RH), rainfall, etc contribute to proliferation of fungal population in library indoor environment[14-15]. Cellulose materials of library collection contribute to pollute library environment and affect health of human beings[16–17]. Presence of fungi and resulting health hazards has also been observed in different studies[18–21]. This study is on presence of aeromycoflora in the Institute of Agriculture Library, Sriniketan, the famous Institute of Rural Reconstruction founded by Rabindranath Tagore in 1921.

2. Objectives

The objectives of this study are

- Identification of predominant fungal spores in the library;
- To measure quantitative and qualitative composition and concentration of airborne fungal spore inside library;
- To identify correlation between the fungal spore concentration and other environmental parameters such as temperature, humidity, etc.
- To suggest preventive measures.

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3. Materials and Methods

The area under study (Sriniketan, West Bengal, India) is located at geographical coordinates of 23.66^{0}N latitude and 87.66^{0}E longitude. Minimum temperature during summer (March to May) is 23^0 C and in winter (December to February) is 12^0 C. The maximum temperature in summer and winter are 37^0 C and 34 ^{0}C respectively.

For collecting samples Burkard personal one-day volumetric sampler was used. The trap of 96 mm height and 88mm diameter with 600 gm weight is made up of light alloy and plastic materials. This sampler requires exposed time of 10 minutes and it has a suction rate of 10 lit/min. Air sampling was carried out for 8 months from August 2014 to March 2015 inside the Institute of Agriculture library, Visva-Bharati to collect culturable and non culturable fungal spores.

In Burkard sampler, a clean glass slide of 75 X 25 mm with 0.8 mm thickness coated with Vaseline jelly was inserted through the slide slit. Then air sampling chamber was closed so that the slots were fully covered. It was placed above 5 ft from the ground. Air samples were collected from six different points in the ground floor of the library. At the end of sampling the slide was removed. A sample of 2 X 14 mm gets deposited on the glass slide. The slide was mounted in DPX by placing a 14 sq. mm microscopic cover slip. It was dried for 2-3 days. In each slide several scans (10) were made across the trace with the use of a compound microscope under low (10x) and high (40x) magnification. The counts were estimated to number/cubic meter air by multiplying with the conversion factor as per following calculation:

Total area of trace = 2 X 14 mm^2 =28mm^2

Scanning width = 430 um, No. of scan= 10

Area of scanned in one trace = 430 X 10= 4300 um= 4.3mm

Total area of scanned = 4.3 X 2mm^2 = 8.6 mm^2

Suction rate = 10 lit/min (sampling time 10 min)

Volume of air sampled= 10 X 10= 100 lit= 10m^{-3}

Fraction of total area scanned = 8.6/2.8 =0.3mm^2

Volume of air sampled as scanning area =Volume of air sampled X fraction of total deposit scanned = 0.1x 0.30 = 0.030m^{-3}

Conversion factor for estimating number /m^3 = 1/0.30 = 33 (round)

Metrological data such as temperature (^{0}C), relative humidity (%) and rainfall (mm) for this study were collected from Metrological office at Sriniketan, Birbhum.

4. Results

During the study ten (n=10) types fungal spores were identified with the help of Burkard sampler during the period under study as shown in Table 1.

It is observed from the table that there are different counts of fungal spores in different months. *Aspergilli/penicillin sp.* were 660 spore/m^{-3} in August and 2244s pore/m^{-3} of air in September were dominant in library; but in December, January and February it was not found in the air of the library. Similarly *Basidiospore sp.* 2112 spore/m^{-3} and *Ascospore sp.* 1848 spore/m^{-3} were most dominant in September. Maximum fungi was found in September 8052 spore/m^{-3} and minimum in November 1056 spore/m^{-3} in the air of library. On the other hand *Basidiospore sp*. is ranked 1 with the presence of 7920 spore/m^{-3} throughout the period of investigation. Monthly and total fungal spore concentration is shown in Figure 1 and 2.

Table 1. Month-wise richness of fungal spores

Fungal spores	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	Total	Rank
Drechslera sp.	264	528	462	99	66	66	66	99	1650	6
Aspergilli/penicillin sp.	660	2244	1485	0	0	0	0	891	5280	2
Bispora sp.	132	528	297	264	0	0	0	0	1221	7
Basidiospore sp.	132	2112	1782	363	726	1287	924	594	7920	1
Ascospore sp.	0	1848	1188	33	165	165	165	231	3795	3
Nigropora sp.	0	264	99	0	33	0	66	66	528	9
Pericornia sp.	0	132	99	231	0	759	660	99	1980	5
Fusarium sp.	0	396	132	0	0	0	0	33	561	8
Cladosporium sp.	0	0	0	66	330	528	759	528	2211	4
Trichornis sp.	0	0	0	0	0	0	33	0	33	10
Total	**1188**	**8052**	**5544**	**1056**	**1320**	**2805**	**2673**	**2541**	**25179**	

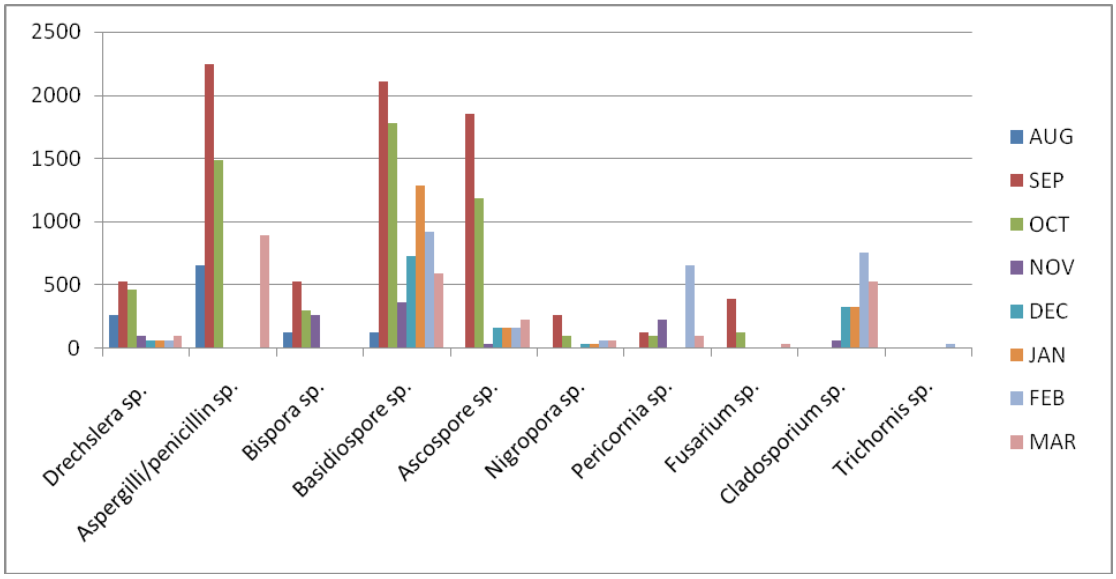

Figure 1. Monthly fungal spore richness.

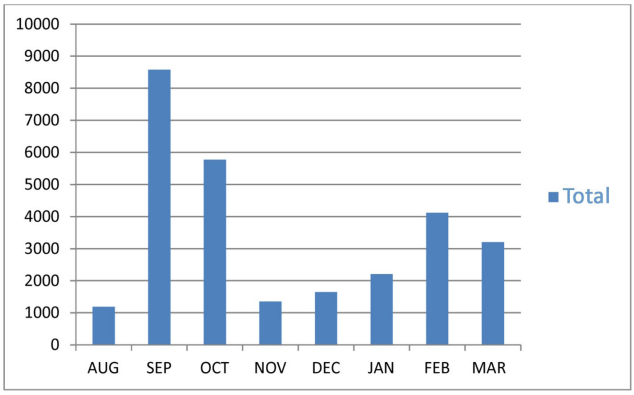

Figure 2. Total fungal spore concentration.

Monthwise metrological data and fungal spore concentration can graphically be represented as under (Figure 3).

It is seen from the above graph that during rainy season and heavy rainfall, fungal spore concentration was higher. Fungal spore concentration is higher in October and minimum in November-December. It is because of low temperature, cold weather and absence of rainfall. Due to increase in temperature in subsequent months (January-March) fungal spore concentration gradually increased. Thus fungal spore concentration has a positive correlation with temperature and rainfall.

5. Conclusion

Library atmosphere is never free from fungal spores. There is direct impact on human health and presence of fungal spore in the working environment[22–27]. Its effects include infection, allergic, toxic and inflammatory reactions. If airborne fungal spores are inhaled down to the bronchia

Table 2. Month-wise metrological data

Month rainfall	Average	Average	Average	Average	Total Rainfall (mm)
	Min.Temp.(°C)	Max. Temp.(°C)	RH(%)at 8.30 hrs	RH(%)at 17.30 hrs (mm)	
Aug'14	26.00	33.39	86	83	326
Sept.'14	25.62	32.53	80	82	154
Oct.'14	22.25	31.86	87	86	380
Nov.'14	15.85	30.78	78	73	0.00
Dec.'14	11.57	24.27	81	70	0.00
Jan.'15	11.20	24.73	85	67	7.70
Feb.'15	13.40	27.10	75	59	33.00
March.'15	18.27	32.60	66	51	32.30

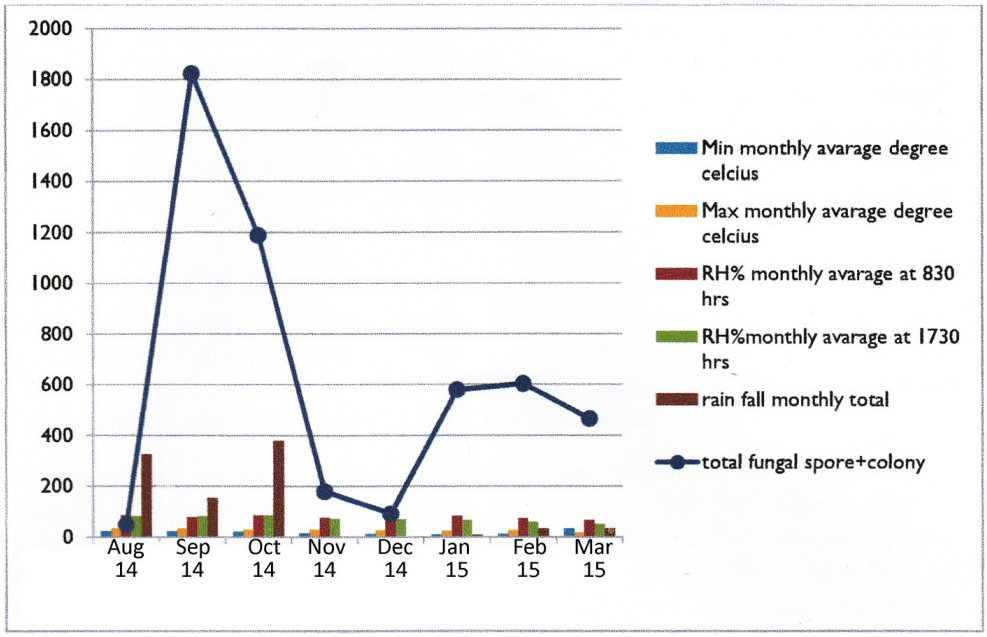

Figure 3. Correlation between fungal spore concentration and metrological parameters.

and alveoli, then human body may be exposed to primary and secondary metabolites. In some cases mycotoxins are clearly involved in pathogenesis. Inhaling may cause kidney failure, central nervous system damage and damage the upper respiratory tract[28]. *Aspergillus sp*. and *Penicillium sp*. have recently been recognized as significant indoor air allergens[29]. The genera *Penicillium sp*. and *Aspergillus sp*. are more closely associated with respiratory allergic symptoms and allergen sensitization asthma has been associated with sensitization to allergens of other fungi (*Atternaria*) and house dust, with a prevalence of 25.4% for moulds among eight different allergens tested[30].

To protect the library environment from fungal spores preventive measures like regular vigilance particularly of old and rare archival collections, proper cleanliness, and measurement of surface moisture to keep the library stack damp free and in a controlled environment are necessary. Temperature and humidity ought to be maintained between 18 to 22°C. and 55% respectively. Environmental condition must be adjusted in such a way that fungal growth diminishes. Chemical and other methods of disinfection may also be considered.

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