

REVIEW

Aerobiology in North East India in the context of health, heritage and environment

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REVIEW

Aerobiology in North East India in the context of health, heritage and environment

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Aerobiology plays a fundamental role in the diagnosis of allergic human diseases and mycotic diseases of animals including fowls. Monthly, seasonal and yearwise variations in the airborne allergic pollen grains of Imphal revealed Poaceae pollen grains as most abundant followed by *Eucalyptus*, *Alnus*, *Cyperus*, *Artemesia*, *Callistemon*. Further, a total of 52 known allergic plants were recorded in Thoubal District of Manipur.

Chromatographically analysed pollen grains for detection of amino acid revealed the highest number of amino acids in *Acacia australiansis*, *Tinthonia diversifolia* and *Pandanus fercalus*. The body weights of chicken were found to be affected with toxic effect of pollen extracts and fungal spores tested.

An allergic diagnostic camp organized in greater Silchar, Assam revealed most of the patients have shown skin positive reaction either to pollen grains or fungal spores. Higher grade of allergenicity was recorded in the extract of *Cleome gynandra*, *Cocos nucifera*, *Trewia nudiflora* among the pollen grains and *Aspergillus fumigatus*, *Mucor haemilis* and *Aspergillus flavus* among the fungus.

Experimental studies on mycotic infection in cattle in Assam show that *Aspergillus fumigatus*, *Geotrichum candidum* and *Mucor* sp. were isolated from aborted foetuses.

The studies in the variations of airspora in field and cowshed revealed the number of spores presents in the field were much less than in the cowshed. *Torula*, *Cladosporium*, etc were found sufficiently high in the cowshed environment of Imphal district, Manipur. The high humidity condition, low and high temperatures and availability of decomposed hay and straw, cowdung inside and around the cowshed had a correlation with spore concentration.

The studies on Indoor fungal airspora of Manipur museum buildings revealed a total of 11,485 spores in 2002-03 and 14,910 spores in 2003-04. The most dominant fungal airspora types were Aspergilli-Penicilli group (9.36% in 2002-03 and 25.5% in 2003-04). The main building of state museum was never free from fungal airspora. Aeromycoflora inside showcase having animal skull with horn and antler in Manipur state museum were also reported.

Indoor fungal airspora of Manipur state archive building revealed a total of 26,505 spores in 2002-03 and 27,740 spores in 2003-04. The most dominant airspora types were Aspergilli-Penicilli group (18.79% in 2002-03 and 17.25% in 2003-04) followed by *Cladosporium* (7.50% in 2002-03 and 9.83% in 2003-04).

The study of the germination potential of air spores of Shillong and its suburbs (Meghalaya) conducted from June 1974 to May 1976 revealed the maximum germination of spores in August which contributes 16.20% of the yearly total with a value of rainfall (20.5 cm), temperature (20.50c) and relative humidity (86%) and the lowest in July which contributes 0.75% of the yearly total with a maximum rainfall (108.68cm), temperature (19.65°C) and relative humidity (90%).

Monitoring of fungal airspora in Libraries (Site A and B) of Imphal area (Manipur), bakery factory, Manipur University Ladies Hostel and Rice mill building revealed 30 fungal spore types, 29 fungal spore types, 29 fungal types and 30 fungal spore types respectively. Concentration of various spore groups revealed the influence of, apart from meteorological parameters, availability of substrates within the working environ-

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ment.

Importance of airborne pollen grains, fungal spores, etc in the health, heritage and environment sectors in North-East India are well reported. Further, as a management practice more awareness activities are also recommended.

Key words: Aerobiology, pollen grains, fungal spores, allergy, health, heritage, environment, North-East India

INTRODUCTION

Aerobiology in North East India is almost six decades old. The first published work was on the relationship between fungal airspora present in storage chamber and over a potato plantation field with incidence of potato diseases in Shillong (Meghalaya) by employing vaseline coated micro slides and nutrient Petriplates exposure methods. Since then, aerobiology in North East India had been continued in various directions by the students of late Prof. H.K. Baruah. He is now regarded as father of Aerobiology in the region.

In the present context, aerobiology in the North East India are considered under health, heritage and environment.

Health

It can be considered under

- (a) **Aerobiology and allergic human diseases and**
- (b) **Aerobiology and mycotic diseases of animals including fowls.**

AEROBIOLOGY AND ALLERGIC HUMAN DISEASES

The roles of aeroallergens such as pollen grains, fungal spores, etc in causing allergic human diseases are well known. Some of the important and outstanding research contributions in this field from NE India are described below:

Monthly, seasonal and yearwise variations in the airborne allergic pollen grains of Imphal were studied. Monthly variations were more frequent than yearwise variations. The monthly frequency of allergenically significant pollen grains is listed graphically (Fig. 1a –c)

Poaceae rank first followed by *Eucalyptus*, *Alnus*, *Cyperus*, *Artemisia*, *Callistemon*, *Cassia*. The atmosphere of Imphal was found never free from pollen grains.

Systemic field studies of the known allergic plants growing in Thoubal district, Manipur was carried out of which, a total of 52 known allergic plants were recorded. Among the known allergic plants the number of cultivated plant species such as *Mangifera*, *Melia*, *Callistamon*, *Eucalyptus*, *Amaranthus*, *Coriandum*, *Oryza*, etc. were less than the number of wild types such as *Cassia*, *Datura*, *Ricinus*, *Cyperus*, *Parthenium*, *Plantago*, *Xanthium*, etc. The common outdoor pollen airspora of Thoubal district, Manipur were *Acacia*, *Artemisia*, *Eucalyptus*, *Ricinus*, *Solanum* etc.

Further, pollen grains of *Acacia australiansis*, *Acacia nilotica*, *Tithonia diversifolia*, *Artemesia vulgaris*, *Pandanus fercalus*, *Ricinus communis*, *Xanthium strumarium*, etc were analyzed chromatographically for detection of amino acid. Amino acids like tyrosine, serine, glutamine, alanine, lysine, cystine, tryptophan, valine, isoleucine, arginine, glycine were present frequently. The highest number of amino acids was present in *Acacia australiansis*, *Tinthonia diversifolia* and *Pandunus fercalus* whereas the lowest number of amino acids was found in *Artemisia vulgaris*.

Experiment were undertaken to determine the toxic action of pollen extracts on the chicken by studying the antibody production in the blood and changes in body weights of experimental chicken during the period of treatment. The result showed (i) Chicken has gained weight due to inoculation of antigen from *Ricinus*, Goldmohur, Garden poppy and paddy (ii) Chicken inoculated with the antigens of grass and *Amaranthus* have shown gain in body weight till 12th day of treatment and after which there is loss in their body weight; maximum loss being 3.27% in the case of grass pollen. The control groups of chicken have gained in their body weight at a normal rate during the period of treatment.

Similar experiment to chicken with fungal spores showed (i) increase in the body weight of chicken inoculated with the extract of different types of fungal spores till 6th day of treatment except in the

case of the spore of *Cladosporium* and *Aspergillus*, (ii) increase in the body weight of the chicken inoculated with the antigens from the spores of *Penicillium*, *Alternaria*, *Helminthosporium* and *Absidia* till the 9th day of treatment and after which there was loss in their weight till the end of the experiment, maximum loss being 7.85%, (iii) in the case of *Curvularia* the loss in body weight of chicken was found from the 9th day of treatment the maximum loss being 7.80%, (iv) chicken inoculated with the spores of *Aspergillus* and *Cladosporium* gain in the body weight till 3rd day of treatment after which there was gradual loss in their weight till the end of experiment, maximum loss being 12.93% with *Aspergillus* spores. The loss in body weight of these chickens was gradual till the end of the treatment. The control group of chicken had gained in their body weights at a normal rate till the end of the experiment.

Clinical investigation and allergenic skin test

An allergic diagnostic camp was organized for clinical investigation and diagnosis of suspected allergic patients of greater Silchar, Assam. A total of 140 allergic patients had attended the diagnostic camp. A total of fifteen (15) patients were selected for the allergy skin test. Intradermal skin tests were done on 2 (two) patients and skin pick test was done on the rest of 13 selected allergic patients. Out of the 15 patients tested, 50% were having skin allergy. Most of the patients have shown skin positive reaction either to pollen grains or fungal spores (Fig. 2a and 2b). Among the antigen tested, *Acacia auriculaeformis* and *Mucor haemilis* have shown positive result in maximum number of the patients tested. Higher grade of allergenicity was recorded in the extract of *Cleome gynendra*, *Cocos nucifera*, *Trewia nudiflora* and *Aspergillus fumigatus*, *Mucor haemilis* and *Aspergillus flavus* among the fungus, all showing +3 and +4 grade of result (Sharma, 2005).

AEROBIOLOGY AND MYCOTIC DISEASES OF ANIMALS INCLUDING FOWLS

Experimental studies on mycotic infection in cattle in Assam show that *Aspergillus fumigatus*, *Geotrichum candidum* and *Mucor* sp. were isolated from aborted fetuses collected from different regions of Assam (Fig. 3 i-iv). *Aspergillus* sp., *Penicillium* sp., *Nigrospora* sp., *Cladosporium* sp., *Mucor* sp. and *Geotrichum* sp. were isolated from samples of hay and straw given to cattle as feed.

The variations in the airspora in field and in the cowshed were studied by means of exposure of

nutrient plates and sticky slides. The numbers of spores presents in the field were much less than in the cowshed. Airborne fungi of a cowshed in Imphal district, Manipur was carried out by employing rotorod air sampler for a period of six months (1st May to 31st October, 1990). Some of the spores types viz. *Torula*, *Cladosporium*, etc were found sufficiently high in the cowshed environment. The high condition, low and high temperatures and availability of decomposed hay and straw, cowdung inside and around the cowshed had a correlation with spore concentration. The overall activities such as milking, cleaning, washing, etc., had a correlation with dispersal of spores.

Heritage

It can be considered under:

Indoor fungal airspora of Manipur state museum and

Indoor fungal airspora of Manipur archive building.

INDOOR FUNGAL AIRSPORA OF MANIPUR STATE MUSEUM

Indoor fungal airspora of Manipur state museum buildings revealed a total of 11,485 spores in 2002-03 and 14,910 spores in 2003-04 fungal airspora. It was studied using Burkard personal volumetric air sampler. The most dominant fungal airspora types were Aspergilli-Penicilli group (9.36% in 2002-03 and 25.5% in 2003-04). Other common types were *Mucor-Rhizopus* group (12.01% in 2002-03 and 25.38% in 2003-04), *Cladosporium* (10.70% in 2002-03 and 11.36% in 2003-04), *Alternaria* (4.26% in 2002-03 and 2.91% in 2003-04), *Curvularia* (3.65% in 2002-03 and 3.10% in 2003-04), Smut (3.26% in 2002-03 and 2.61% in 2003-04), *Nigrospora* (3.13% in 2002-03 and 1.66% in 2003-04).

The incidences of fungal airspora were maximum in rainy season followed by winter season, summer season and retreating monsoon respectively. The main building of state museum was never free from fungal airspora. Aeromycoflora inside showcase having animal skull with horn and antler in Manipur state museum was studied using Burkard personal volumetric air sampler. A total of 7820 spores in 2002-03 and 8775 spores in 2003-04 fungal airspora were recorded during October 2002 to September 2004. The most dominant fungal airspora types were Aspergilli-Penicilli group

Table 1 : Changes in body weight of chicken during the period of inoculation with spore extracts (Weight are calculated in gm %)

Antigens used	3 rd day of treatment	6 th day of treatment	9 th day of treatment	12 th day of treatment	15 th day of treatment	External observation
<i>Cladosporium</i>	+2.09	-0.42	-1.89	-5.43	-8.38	Remained weak and loss appetite found from 13 th day of treatment.
<i>Aspergillus</i>	+1.74	-0.87	-3.14	-8.04	-12.93	Remained very weak from 10 th day treatment. Partially paralyzed from 13 th day and 50% died within 18 days.
Control	+3.89	+8.05	+11.67	+15.83	+21.11	No indication
<i>Penicillium</i>	+6.54	+8.33	+6.54	-1.19	-5.95	Remained weak from 14 th day of treatment.
<i>Alternaria</i>	+5.71	+8.93	+5.0	-2.86	-7.85	Remained weak and lost tendency for taking feeds.
Control	+2.38	+5.81	+7.42	+9.67	+12.25	No indication is seen
<i>Helminthosporium</i>	+2.8	+8.4	+0.32	-0.16	--2.8	No indication.
<i>Curvularia</i>	+6.46	+5.23	-0.92	-3.38	-7.08	Remained weak from 14 th day of treatment.
<i>Absidia</i>	+5.29	+8.23	+1.77	-2.65	-6.47	Weakness observed from 14 th day.
Control	+3.2	+7.2	+10.93	+13.6	+17.6	No indication.

(+) = weight increased than the original weight

(-) = weight decreased than the original weight

Table 2 : Changes in weight of chicken due to inoculation for pollen antigens

Antigens	3 rd day	6 th day	9 th day	12 th day	15 th day	External observation
Grass	+4.73	+8.36	+10.55	+1.82	-3.27	No indication
<i>Amaranthus</i>	+3.79	+7.24	+7.59	+3.79	-1.03	No indication
<i>Ricinus</i>	+3.11	+6.22	+8.07	+9.01	+8.07	No indication
Goldmohur	+2.89	+6.4	+9.29	+9.29	+9.29	No indication
Garden poppy	+3.6	+7.2	+10.07	+12.59	+12.95	No indication
Paddy	+4.05	+6.08	+7.43	+8.78	+9.12	No indication
Control	+3.69	+7.08	+10.46	+14.15	+17.84	No indication

(+) = weight increased than the original weight

(-) = weight decreased than the original weight

Table 3 : Grading of skin tests carried out in suspected allergic patients with antigens fungal extracts

Antigens	Total patients tested	-ve	±	+1	+2	+3	+4
<i>Aspergillus clavatus</i>	15	10	1	2	1	1	-
<i>Aspergillus flavus</i>	15	11	-	3	-	1	-
<i>Aspergillus fumigatus</i>	15	10	-	2	-	2	1
<i>Aspergillus humicola</i>	15	13	-	1	1	-	-
<i>Aspergillus nidulans</i>	15	13	-	1	-	1	-
<i>Aspergillus niger</i>	15	15	-	-	-	-	-
<i>Mucor haemilis</i>	15	9	-	-	1	4	1
<i>Penicillium citrinum</i>	15	12	-	1	1	1	-

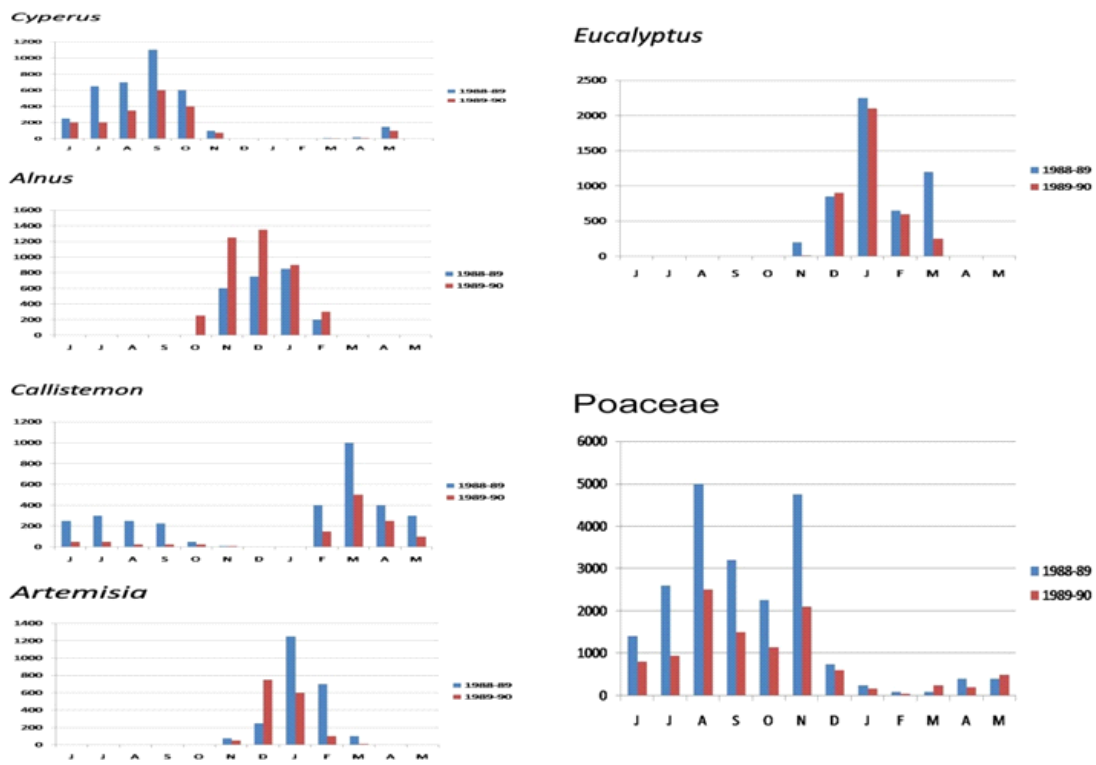


Fig. 1a : Monthly collection of allergenic pollen grain for 2 consecutive years (June 1988 to May 1990)

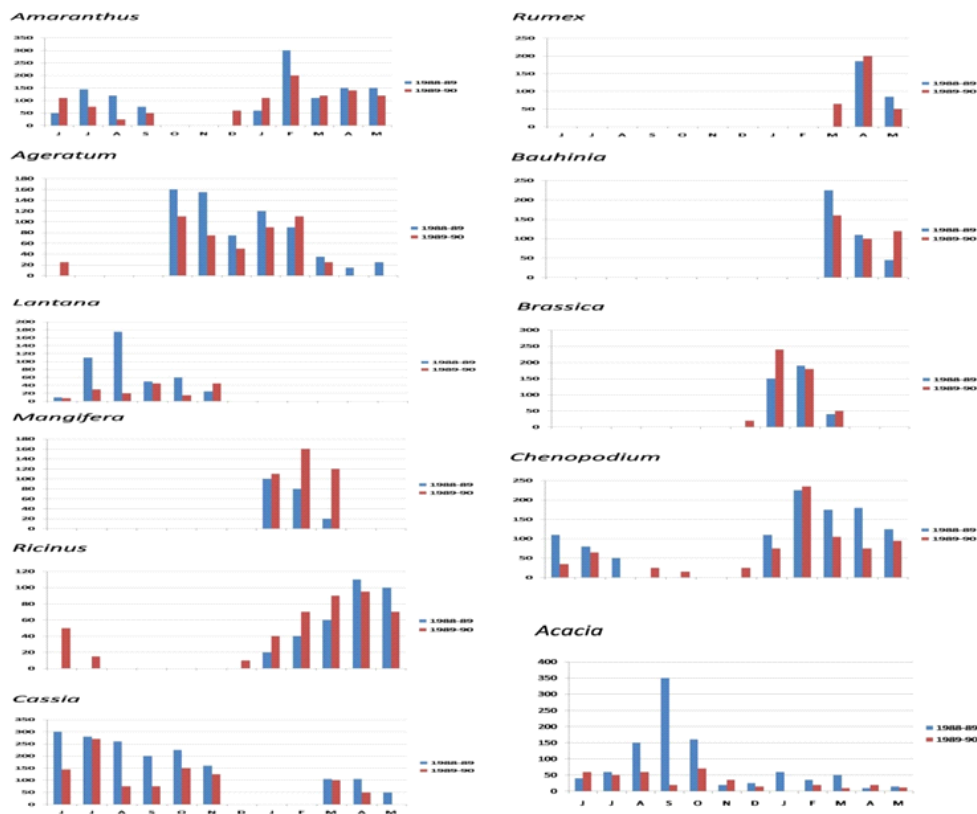


Fig. 1b : Monthly collection of allergenic pollen grain for 2 consecutive years (June 1988 to May 1990)

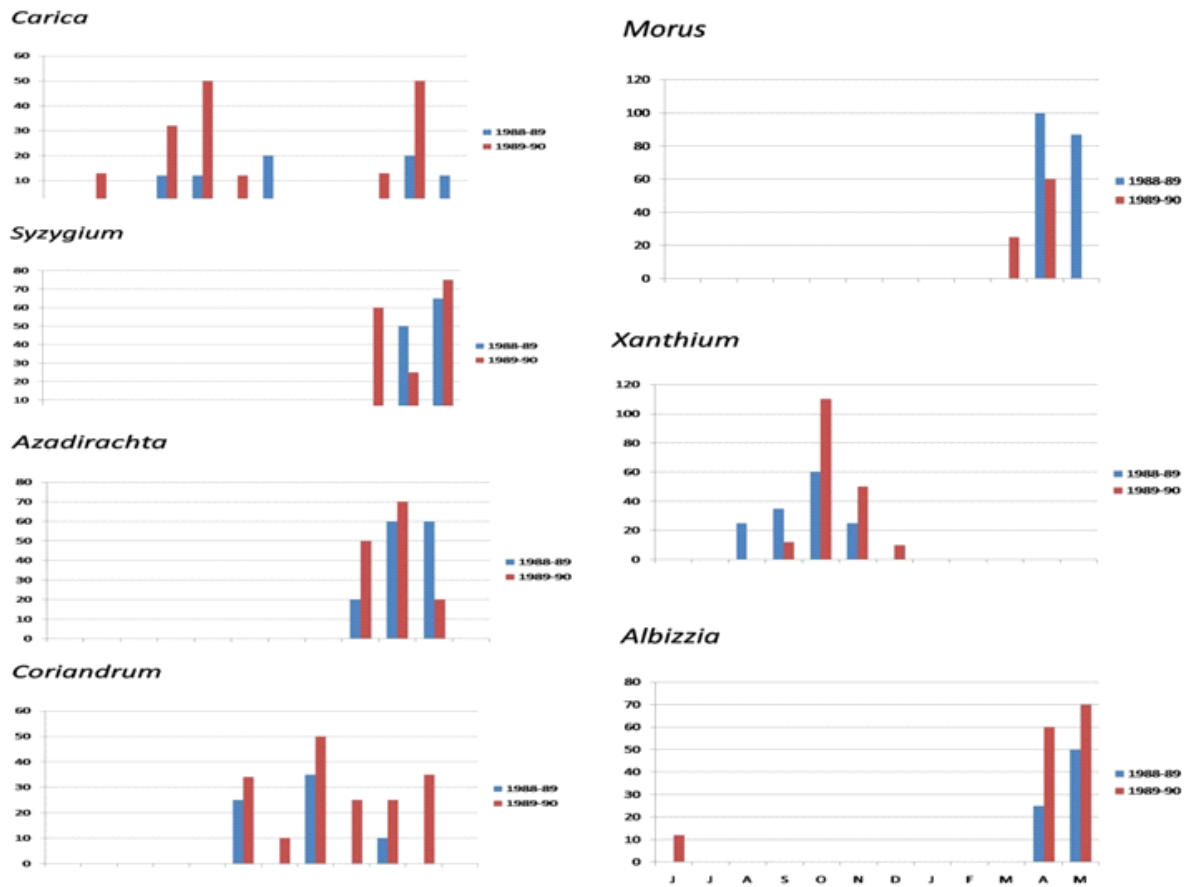


Fig. 1c : Monthly collection of allergenic pollen grain for 2 consecutive years (June 1988 to May 1990)



Fig.2a : Development of wheal and erythema

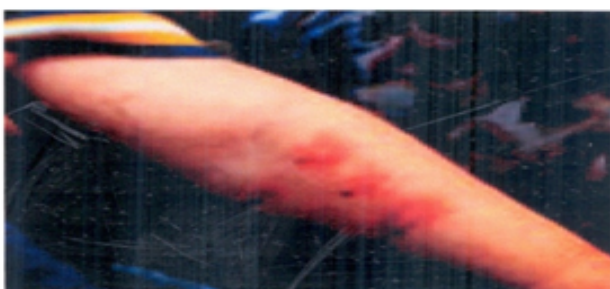


Fig.2b : Development of wheal

(62.97% in 2002-03 and 9.4% in 2003-04), Ascospores 93.64% in 2002-03 and 3.25% in 2003-04). The incidences of fungal airspora were maximum in rainy season followed by winter season, summer season and retreating monsoon respectively. The showcase having animal skull with horn and antler of Manipur state museum was never free from fungal airspora.

Aeromycoflora inside tribal showcases in Manipur state museum was studied using Burkard personal volumetric air sampler. A total of 4515 spores in 2002-03 and 4410 spores in 2003-04 fungal airspora were recorded during October 2002 to September, 2004. The most dominant fungal airspora types were Aspergilli-Penicilli group (36.21% in 2002-03 and 31.63% in 2003-04) followed by *Mucor-Rhizopus* group (16.94% in 2002-03 and 15.93% in 2003-04), *Cladosporium* (6.31% in 2002-03 and 4.42% in 2003-04), Smut (2.65% in 2002-03 and 3.04% in 2003-04), *Scopulariopsis* (2.65% in 2002-03 and 2.83% in 2003-04), *Nigrospora* (1.99% in 2002-03 and 1.70% in 2003-

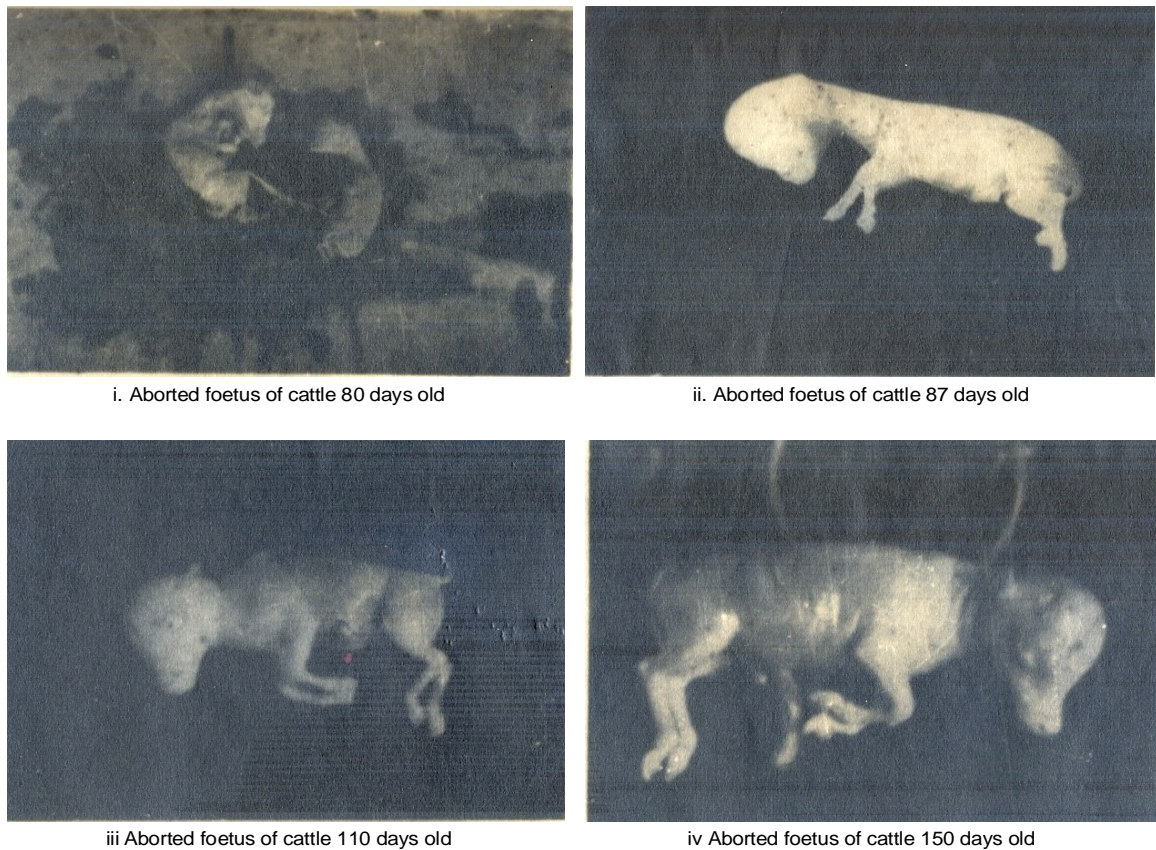


Fig 3(i-iv). Abortion of cattle foetus due to mycotic infection

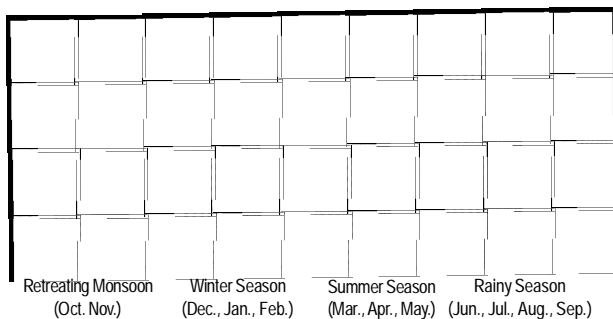


Fig. 4: Seasonwise distribution of fungal airspora trapped from Indoor environment of the Manipur State Museum building using Burkard Personal Volumetric Air Sampling Method (1st October, 2002 to 30th September, 2004)

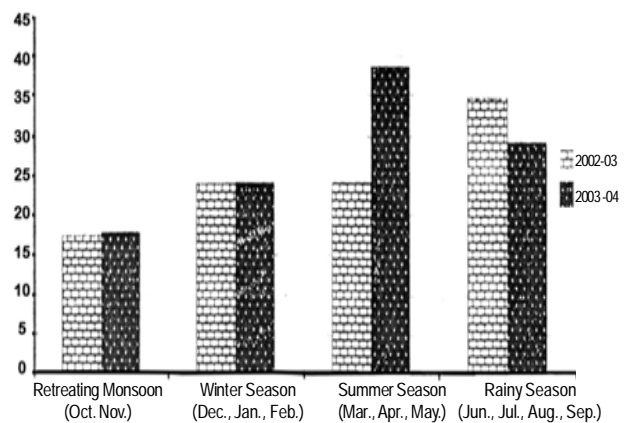


Fig. 5: Seasonwise distribution of fungal airspora trapped from Indoor environment of the Manipur State Archives building using Burkard Personal Volumetric Air Sampling Method (1st October, 2002 to 30th September, 2004).

04). The incidence of fungal airspora were maximum in rainy season followed by winter season, summer season and retreating monsoon respectively. The tribal showcase of Manipur state museum was never free from fungal airspora (Fig. 4).(Singh and Singh, 2016ab).

INDOOR FUNGAL AIRSPORA OF MANIPUR STATE ARCHIVE BUILDING

Indoor fungal airspora of Manipur state archive building was studied using Burkard personal volumetric air sampler. A total of 26,505 spores in 2002-03 and 27,740 spores in 2003-04 fungal

airspora were recorded. It was studied using Burkard personal volumetric air sampler. The most dominant airspora types were Aspergilli-Penicilli group (18.79% in 2002-03 and 17.25% in 2003-04) followed by *Cladosporium* (7.50% in 2002-03 and 9.83% in 2003-04). The maximum fungal airspora were recorded during rainy season followed by summer season, inter season and re-

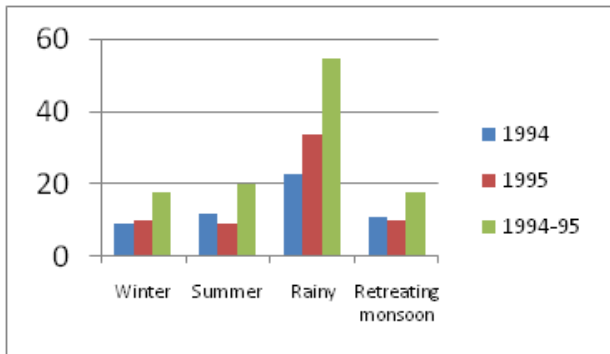


Fig. 6a : Seasonal variation of indoor fungal airspora in the Manipur University library

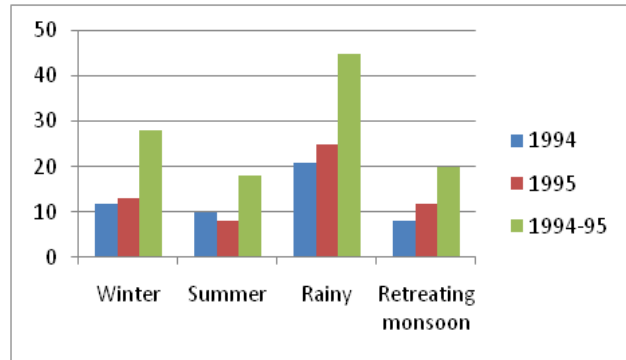


Fig 9 : Seasonal variation of indoor fungal airspora of a Rice mill building.

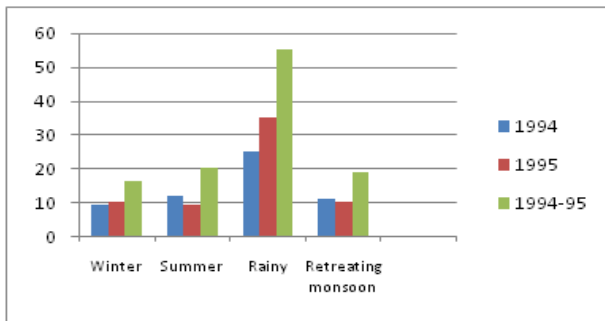


Fig. 6b : Seasonal variation of indoor fungal airspora of State Central library

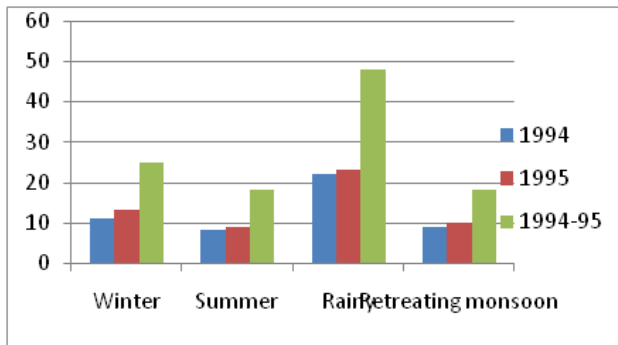


Fig 7 : Seasonwise variation of total indoor fungal airspora of bakery for 1994, 1995 and sum of 1994 and 1995.

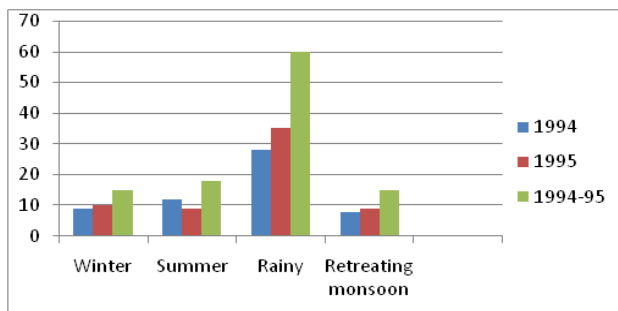


Fig 8 : Indoor fungal airspora of Manipur University ladies hostel kitchen

treating monsoon respectively. The indoor environment of Manipur state archive was never free from fungal airspora (Fig 5) (Singh and Singh, 2016 cd).

Environment

Effect of air temperature, relative humidity and rainfall on the prevalence of air borne spores.

The germination potential study of the air spores of Shillong and its suburbs (Meghalaya) was conducted from June 1974 to May 1976 by employing artificially made spider web made out of nylon fishing thread being wounded on a triangular iron wire frame to form a web of 2cm diameter at St. Edmunds college campus, Shillong. Thirty nine fungal species were isolated. The maximum germination of spores were in August which contributes 16.20% of the yearly total. The types isolated were *Aspergillus*, *Aurobasidium*, *Blastomyces*, *Botrytis*, *Cladosporium*, *Gliocladium*, *Monilia*, *Mucor*, *Penicillium*, *Scopulariopsis*, while rainfall, temperature and relative humidity recorded were being 20.5cm, 20.50c and 86% respectively. The lowest germination rate obtained in July which contributes 0.75% of the yearly total. When the maximum rain occurs (108.68 cm) in July while the temperature and relative humidity record was being 19.65°C and 95% respectively. The types isolated were *Aspergillus*, *Cladosporium*, *Drechslera*, *Gliocladium*, *Mucor* and *Rhizopus*. There was no significant difference in the maximum temperature but was highly significant difference in the rainfall.

INDOOR AEROMYCOLOGY OF CERTAIN WORKPLACE ENVIRONMENT

Monitoring of fungal airspora in Libraries (Site A and B) was carried out in Imphal area (Manipur) for 2 (two) consecutive year (Jan 1994 to Dec 1995) by employing Tilak air sampler. Thirty fungal spore

types were identified, out of which 23 belong to Deuteromycotina, 3 to Ascomycotina and 2 each to Basidiomycotina and Zygomycotina concentration during rainy season in both sites (A and B). Fig 6(a) and 6(b).

There was a fluctuation in airborne spores concentration in the indoor air of libraries, which were correlated with, apart from meteorological parameters, availability of substrates and air movement. The concentration of spores was higher at site B than that of site A.

Monitoring of indoor fungal airspora in bakery factory was carried out for two consecutive years (Jan 1994 to Dec 1995) by employing Tilak rotorod air sampler (Singh, 2007). Out of 29 fungal spore types identified, 25 belong to Deuteromycotina, 2 to Ascomycotina and 1 each to Basidiomycotina and Zygomycotina respectively. Concentration of various spore groups revealed the influence of, apart from meteorological parameters, availability substrates within the working environment. The highest concentration of spores was recorded during rainy season (Fig 7).

Monitoring of indoor fungal airspora of Manipur University Ladies Hostel kitchen for 2 years (Jan 1994 to Dec 1995) were carried out by employing the same type of air sampler. The study revealed 29 fungal types, out of which 24 belongs to Deuteromycotina, 2 to Ascomycotina and 1 each to Basidiomycotina and Zygomycotina and Mastigomycotina respectively. There was a fluctuation of airborne spore concentration in the indoor air of hostel kitchen as influenced by availability of substrate, air movement and meteorological factors (Fig 8).

Monitoring of fungal airspora in the rice mill building for consecutive years (Jan 1994 to Dec 1995) using the same type of air sampler revealed 30 fungal spore types, out of which, 23 belongs to Dueromycotina, 4 to Ascomycotina, 2 to Basidiomycotina and 1 to Zygomycotina. Seasonwise variations revealed the highest spore concentration during rainy season. Fluctuation of airborne spore concentration in the indoor air of rice mill was influenced by apart from meteorologi-

cal parameters, available substrates in the room and air movement. Higher concentration of spores was recorded in 1995 than that of 1994 (Fig 9).

CONCLUSION

Importance of airborne pollen grain, fungal spores, etc in North-East India to health, heritage and environment are recommended. Further, as a management practice more awareness activities are also recommended.

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