



Indoor and outdoor aeromycological survey in Burdwan, West Bengal, India

Soma Chakraborty, Sukanta Kumar Sen & Kashinath Bhattacharya*

Department of Botany, Visva-Bharati University, P.O. Santiniketan, West Bengal, Pin-731235, India

(*author for correspondence, e-mail: genusr@vbharat.ernet.in; fax: +91 03463 52672)

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Abstract

A comparative survey of airborne fungal spores in five indoor and five outdoor environments in Burdwan, West Bengal, India, was carried out for a period of two years using rotorod samplers and sedimentation plates (culture plate). A total of 29 spore types were identified, of which three were Phycomycetous (*Mucor*, *Rhizopus*, *Syncephalastrum*), one Ascomycetous (*Chaetomium*), one Basidiomycetous (*Ganoderma*) and the remainder were Fungi Imperfecti. The results revealed lowest count during summer and maximum during the rainy season. *Aspergillus* was quite abundant in all the environments surveyed. The predominance of *Aspergillus*, *Curvularia*, *Alternaria*, *Cladosporium*, *Drechslera*, *Fusarium* in all the surveyed environments has been attributed to their ability to grow in various substrata. The occurrence of *Cladosporium* in the winter months suggest that it is sensitive to high temperature. All spore types were common in both environments except *Bispora*, *Cercospora*, *Papularia*, *Spegazzinia*, *Trichothecium* in the outdoor sites. A correlation has been made between the volumetric composition of airspora and the incidence of seasonal mold allergy.

1. Introduction

The importance of mold allergy has long been realised (Bernton, 1930) but there have been few studies in India (Agarwal et al., 1969; Vittal and Glory, 1985; Mishra and Jamil, 1991). A few preliminary aeromycological investigations have been done in West Bengal, (Barat and Das, 1963; Santra and Chanda, 1989; Chakravorty and Sinha, 1985; Raha and Bhattacharya, 1992 etc), however there has been no systematic volumetric studies of the airmycoflora there. In the present investigation an attempt has been made to assess the quantitative and qualitative estimation of indoor and outdoor airspora at ten selected sites of Burdwan, a densely populated industrialised township in West Bengal. Fungal contaminants in the air are suspected to be the major health problem in the township.

2. Materials and methods

A systematic survey of airborne fungi was carried out for a period of two years (March 1991 to February 1993) in Burdwan town, located about 100 km north-east of Calcutta. The indoor environments studied included processed rice mill (Chira mill), hospital ward, indoor market, residential area, storage place and the outdoor environments included forest, outdoor market, populated area, railway station and rice field.

Air was sampled volumetrically using a Rotorod sampler and qualitatively using sedimentation culture plates. The Rotorod sampler (Perkins, 1957) was placed 1m. above ground level in vertical position in each site. The sampler was operated for 30 minutes between 1 and 2 pm at fortnightly intervals. The sampling time was selected because most of the fungal

spore exhibited peak concentration between 1 and 2 pm. However, some basidiospores and ascospores showed their higher prevalence between 7 and 8 am and remain suspended in the air for 5 to 6 hours. In the present survey, the rotorod was operated with the aim of monitoring spores which show both morning and midday release patterns. The sampler was powered by a 6v battery giving a rotation speed of 2500 rpm. After sampling, the cello tape strips bearing the spore catch were removed and remounted on clean glass slides using 'DPX' as mountant. Spores were then identified to generic level where possible and those that could not be identified, were grouped as "others" or "indeterminate". As spores belonging to *Aspergillus* and *Penicillium* could not be separated visually when trapped by the rotorod sampler, they were counted and grouped under a single category "*Aspergilli*".

The counts were converted to concentration m^{-3} of air by multiplying with an appropriate conversion factor (4) as suggested in the guide book of The British Aerobiology Federation (1995).

In the present survey work sedimentation culture plate method was adopted due to the non-availability of other active samplers like 'Anderson'.

Two petridishes, one containing 2% malt agar and another containing potato dextrose agar supplemented with streptomycin (100 U/ml) as an antibacterial agent (Plant Pathologist's Pocket Book, 1968), placed at 1m height and were exposed at each site for 3–4 minutes. The exposed petridishes were then incubated at 28–30 °C for 3–4 days and then the developing colonies were counted, identified and subcultured for further studies.

The total spore concentration values as expressed in rotorod result and total No. of colonies as mentioned in the result of sedimentation culture plate are the sum of concentrations for the two years of collection.

The pure cultures of the fungi to be tested were grown in petridishes containing potato dextrose agar medium. The individual fungus was cultured separately for 4 weeks at 22 °C temperature. Fungal spores together with a few mycelial fragments were dusted on a clean wax paper and weighed. The antigenic extracts of the spores were prepared by the standard techniques of Sheldon et al. (1967) and Shivpuri (1962). The dried spores were defatted with solvent ether and then extracted in phosphate buffer (pH 7.5) and diluted in 1:50 ratio for skin test. Before the skin test, the sterility of antigenic extract was confirmed. The skin tests were performed year round at

the Allergy Unit of the Institute of Child Health, Calcutta, both on adult respiratory allergic patients and healthy non-allergic persons. A control test was also performed with sterile buffer saline. The results were analysed according to Stytiš et al. (1982). Fungal allergens frequently produced 1^+ reaction may be due to the presence of histamine releasing substance in the extract giving false reaction (Shivpuri, 1962). Therefore, in the present study only markedly 2^+ to 4^+ reactions were taken into consideration.

3. Results

A total of 19 different spore types in addition to 'Aspergilli' were recorded in rotorod catches (Tables 1 and 2). Among these one belong to ascospore type (*Chaetomium*) and one to basidiospore type (*Ganoderma*) while the remainder were spores of Fungi Imperfecti.

Using sedimentation plates, 21 spore types were recorded (Tables 3 and 4); which included three Phycomycetous type (*Mucor*, *Rhizopus*, *Syncephalastrum*) and the rest 18 belong to Fungi Imperfecti.

For better interpretation, the whole survey period has been divided into three seasons: Summer (March–June), Rainy (July–October) and Winter (November–February).

Indoor environment

A. Summer season

a. By Rotorod sampling (Table 1)

In the summer months 'Aspergilli' showed their dominance with a range of 1012–1400 spores m^{-3} followed by *Cladosporium* (216–664 spores m^{-3}), *Curvularia* (228–524 spores m^{-3}) and *Alternaria* (80–168 spores m^{-3}). The others showed their restricted distribution. The concentration of unidentified spore types varied from 40–120 spores m^{-3} .

b. By sedimentation plates (Table 3)

In the summer months *Aspergillus* (45.10–56.8%) was the most dominant constituent, followed by *Curvularia* (9.0–25.75%), *Rhizopus* (5.3–15.44%) and *Alternaria* (2.09–6.57%) at all the sites. The remaining spores were common to most places but absent in one or more sites. The unidentified types varied from 0.8–3.8 percent.

Table 1. Concentrations (spores/m³) of different indoor spore types collected by rotorod sampling.

Spores	Chira mill			Hospital ward			Indoor market			Storage place			Residential area		
	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
Ascomycetes															
<i>Chaetomium</i>	–	–	–	–	–	–	88	120	–	–	232	–	–	–	–
Basidiomycetes															
<i>Ganoderma</i>	–	–	–	–	–	–	–	180	92	–	92	100	–	–	–
Fungi imperfecti															
<i>Alternaria</i>	112	168	212	80	356	156	112	824	292	168	248	320	152	144	152
<i>Aspergilli</i>	1260	1664	1060	1184	1596	940	1012	1444	840	1400	1664	1100	1032	1564	816
<i>Cladosporium</i>	664	540	872	572	760	920	216	424	864	372	372	636	316	356	780
<i>Corynespora</i>	–	176	120	–	–	–	–	–	–	–	–	–	–	–	–
<i>Curvularia</i>	432	388	228	364	300	216	228	336	183	296	644	212	524	712	388
<i>Drechslera</i>	88	200	296	40	108	424	32	196	60	–	–	–	16	116	48
<i>Epicoccum</i>	–	–	–	–	–	–	–	–	–	152	–	100	–	–	–
<i>Fusarium</i>	64	100	360	144	200	80	–	–	–	–	–	–	172	172	36
<i>Nigrospora</i>	–	–	–	60	172	12	84	172	–	–	–	–	–	144	8
<i>Periconia</i>	–	–	–	–	–	–	8	280	92	48	–	196	8	56	80
<i>Phaeotrichoconis</i>	–	–	–	–	–	–	–	72	120	–	–	–	–	–	–
<i>Pithomyces</i>	–	–	–	–	176	12	–	–	–	–	–	–	24	128	100
<i>Tetraploa</i>	–	76	108	–	–	–	–	–	–	–	48	152	–	–	–
Unidentified	120	80	20	72	–	20	112	112	124	100	100	128	40	116	–
Total	2740	3392	3276	2516	3668	2780	1892	4160	2672	2536	3400	2944	2284	3508	2408

S = Summer, R = Rain, W = Winter.

B. Rainy season

a. By Rotorod sampling (Table 1)

‘Aspergilli’ also recorded the highest concentration (1444–1664 spores m⁻³) like the summer season, followed by *Cladosporium* (356–760 spores m⁻³), *Curvularia* (300–712 spores m⁻³) and *Alternaria* (144–824 spores m⁻³). The distribution of *Ganoderma*, *Chaetomium*, *Corynespora* and *Phaeotrichoconis*, etc. were restricted. The unidentified types contributed to 80–116 spores m⁻³.

b. By sedimentation plates (Table 3)

In this season *Aspergillus* also showed peak concentration (39.02–50.56%) at all sites, followed by

Alternaria (4.50–22.74%), *Curvularia* (8.14–21.57%) and *Rhizopus* (7.76–18.48%). Besides these, some others occurred in low concentration in selected sites.

C. Winter season

a. By Rotorod sampling (Table 1)

In winter season ‘Aspergilli’ again occupied the highest position (816–1100 spores m⁻³) closely followed by *Cladosporium* (636–920 spores m⁻³), *Curvularia* (188–388 spores m⁻³) and *Alternaria* (152–320 spores m⁻³). These four types were found at all the sites. Other spore types showed their restricted distribution.

Table 2. Concentrations (spores/m³) of different outdoor spore types collected by rotorod sampling.

Spores	Forest			Outdoor market			Populated area			Railway station			Rice field		
	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
Ascomycetes															
<i>Chaetomium</i>	24	352	36	–	–	–	–	–	–	–	–	–	–	–	–
Basidiomycetes															
<i>Ganoderma</i>	–	248	152	116	320	–	–	–	–	–	344	72	–	256	144
Fungi imperfecti															
<i>Alternaria</i>	432	776	220	428	788	276	416	896	304	416	788	216	408	756	196
<i>Aspergilli</i>	1160	1620	884	796	1160	232	1112	1552	872	1120	1308	240	852	1232	120
<i>Bispora</i>	–	–	–	–	–	–	–	–	–	–	–	–	72	256	208
<i>Cercospora</i>	–	–	–	–	140	80	–	184	140	–	92	112	–	–	–
<i>Cladosporium</i>	344	708	1416	796	792	1362	420	656	1404	344	640	1512	916	544	1520
<i>Corynespora</i>	68	412	96	–	384	152	100	396	168	92	368	148	–	–	–
<i>Curvularia</i>	1124	1520	508	860	1376	528	1084	1364	512	1068	1500	496	952	1504	464
<i>Drechslera</i>	–	–	–	–	–	–	136	324	140	32	336	356	–	316	208
<i>Fusarium</i>	176	232	208	204	160	56	164	312	136	200	224	304	220	276	144
<i>Helminthosporium</i>	–	–	–	–	–	–	–	–	–	–	–	–	36	212	288
<i>Nigrospora</i>	56	368	124	164	440	96	–	–	–	60	360	56	108	480	88
<i>Papularia</i>	–	–	–	32	216	212	–	–	–	–	–	–	–	–	–
<i>Periconia</i>	36	168	32	36	172	24	124	144	268	32	136	84	–	–	–
<i>Phaeotrichoconis</i>	16	168	248	–	–	–	72	240	200	–	–	–	–	256	264
<i>Speggazinia</i>	–	–	–	–	–	–	–	–	–	–	112	124	–	–	–
<i>Tetraploa</i>	–	108	88	32	224	316	–	–	–	48	72	136	–	96	128
Unidentified	100	44	40	120	144	80	100	72	124	92	80	60	76	100	96
Total	3536	6724	4052	3584	6316	3420	3728	6140	4268	3504	6330	3916	3640	6284	3868

S = Summer, R = Rain, W = Winter.

b. By sedimentation plates (Table 3)

In this season *Cladosporium* showed its dominance (28.94–35.38%) followed by *Aspergillus* (18.0–31.54%), *Curvularia* (7.55–16.53%), *Alternaria* (0.81–8.36%) and *Rhizopus* (5.12–7.84%) at all the sites. The other spore types were restricted in their distribution.

Outdoor environment

A. Summer season

a. By Rotorod sampling (Table 2)

In the outdoor environment, very similar composition to the indoor environment was recorded. Here, ‘Asper-

gilli’ contributed 796–1160 spores m⁻³ followed by *Curvularia* (860–1124 spores m⁻³), *Cladosporium* (344–916 spores m⁻³), *Alternaria* (408–432 spores m⁻³), *Fusarium* (164–220 spores m⁻³), etc. The other spore types were restricted in their occurrence.

b. By sedimentation plate (Table 4)

In the sedimentation plate *Curvularia* occupied the peak dominant position (29.57–37.23%) followed by *Aspergillus* (18.54–23.38%), *Alternaria* (10.3–20.36%), *Cladosporium* (4.61–7.14%). The other spore types were sporadic in their occurrence. The percentage of unidentified spore types were 1.65–4.51 percent.

Table 3. Seasonal percentage contribution of different indoor spore types using sedimentation culture plates.

Spores	Chira mill			Hospital ward			Indoor market			Storage place			Residential area		
	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
Phycomycetes															
<i>Mucor</i>	–	–	6.39	–	–	–	–	3.17	0.90	–	–	–	–	–	–
<i>Rhizopus</i>	15.44	15.65	5.58	10.19	14.18	5.28	5.38	8.44	6.44	5.89	7.76	6.27	11.27	18.48	7.87
<i>Syncephalastrum</i>	–	–	–	–	–	–	–	1.58	1.35	0.28	0.80	2.29	–	–	–
Fungi Imperfecti															
<i>Alternaria</i>	2.14	4.50	0.81	2.09	10.46	6.00	6.57	22.74	8.36	3.30	4.73	–	4.98	7.80	8.00
<i>Aspergillus</i>	45.10	50.56	25.46	52.41	49.53	18.00	56.80	39.02	23.72	47.05	47.27	31.54	55.26	41.41	20.96
<i>Aureobasidium</i>	–	2.92	3.48	–	–	–	–	–	–	–	–	–	–	–	–
<i>Cladosporium</i>	4.43	–	30.23	8.88	–	35.38	3.28	–	34.35	2.44	–	28.94	3.73	2.77	33.67
<i>Curvularia</i>	13.14	11.82	7.55	12.54	8.37	8.03	10.16	8.14	7.68	25.75	21.57	16.53	9.0	17.28	10.41
<i>Drechslera</i>	2.59	7.09	9.30	–	–	–	–	–	–	0.57	5.54	1.22	–	–	–
<i>Fusarium</i>	–	–	–	4.70	5.81	4.19	3.43	5.36	2.48	6.33	3.32	1.22	3.22	3.84	4.57
<i>Helminthosporium</i>	–	–	–	5.09	0.46	4.19	8.07	0.79	3.61	–	–	–	6.92	0.48	3.30
<i>Nigrospora</i>	5.81	6.19	3.83	–	–	–	–	–	–	2.73	5.24	2.75	–	–	–
<i>Penicillium</i>	5.96	–	4.06	–	–	–	–	3.97	6.55	1.72	3.22	8.11	1.38	–	5.46
<i>Periconia</i>	–	–	–	0.78	8.48	5.00	5.38	3.67	4.51	–	–	–	0.69	4.68	4.44
<i>Scopulariopsis</i>	–	–	–	–	0.93	1.16	–	–	–	–	–	–	–	–	–
<i>Verticillium</i>	–	–	–	1.83	–	6.00	–	–	–	–	–	–	–	–	–
Unidentified	5.35	1.23	3.25	1.43	1.75	4.07	0.89	3.07	–	3.88	0.50	1.07	3.46	3.60	1.27
Total No. of Spores	654	888	860	765	860	859	669	1007	885	695	992	653	722	833	787

S = Summer, R = Rain, W = Winter.

B. Rainy season

a. By Rotorod sampling (Table 2)

In the rainy season ‘*Aspergilli*’ again occupied the highest position (1160–1620 spores m^{-3}) followed by *Curvularia* (1364–1520 spores m^{-3}), *Alternaria* (756–896 spores m^{-3}), *Cladosporium* (544–792 spores m^{-3}), *Fusarium* (160–312 spores m^{-3}), etc.

b. By sedimentation plate (Table 4)

In the rainy season *Curvularia* (29.57–36.78%) also scored its highest position followed by *Alternaria* (11.66–19.80%), *Aspergillus* (14.53–19.86%), *Drechslera* (4.06–10.53%), etc.

C. Winter season

a. By Rotorod sampling (Table 2)

In the winter season *Cladosporium* (1368–1520 spores m^{-3}) was the predominant type followed by ‘*Aspergilli*’ (120–884 spores m^{-3}), *Curvularia* (464–528 spores m^{-3}), *Alternaria* (196–304 spores m^{-3}) and *Fusarium* (56–304 spores m^{-3}) at all sites. *Helminthosporium* and *Bispora* were recorded only from rice field. The occurrence of other restricted spore types were more or less similar in distribution to summer and rainy season. The unidentified types contributed 40–124 spores m^{-3} at all the sites.

Table 4. Seasonal percentage contribution of different outdoor spore types using sedimentation culture plates.

Spores	Forest			Outdoor market			Populated area			Railway station			Rice field		
	S	R	W	S	R	W	S	R	W	S	R	W	S	R	W
Phycomycetes															
<i>Mucor</i>	–	–	–	–	–	–	–	4.58	1.11	1.89	4.78	1.34	–	–	–
<i>Rhizopus</i>	5.57	5.50	3.83	8.77	5.56	–	6.76	3.60	1.45	6.55	6.04	3.84	–	–	–
Fungi Imperfecti															
<i>Alternaria</i>	20.36	14.84	5.08	17.16	13.54	5.56	10.30	19.80	9.83	15.74	11.66	5.57	20.24	13.35	3.98
<i>Aspergillus</i>	20.36	19.49	10.73	18.54	19.86	12.04	23.38	41.53	7.37	22.01	16.86	11.25	20.93	18.34	12.47
<i>Aureobasidium</i>	–	–	–	–	–	–	0.92	6.14	10.16	–	–	–	–	–	–
<i>Bispora</i>	–	–	–	–	–	–	5.53	–	2.45	–	–	–	3.03	5.79	7.33
<i>Cladosporium</i>	5.05	–	36.43	5.76	–	39.75	4.61	–	39.44	7.14	–	35.0	5.78	–	41.29
<i>Corynespora</i>	–	–	–	0.50	4.21	4.32	1.53	2.04	5.58	0.29	4.02	3.46	0.55	4.18	1.04
<i>Curvularia</i>	31.60	33.30	13.03	29.57	29.57	14.21	37.23	36.78	11.17	33.96	34.31	11.34	34.02	31.77	11.74
<i>Drechslera</i>	–	7.54	5.65	2.75	4.06	7.41	3.23	10.53	5.25	–	8.64	7.5	–	7.32	6.49
<i>Fusarium</i>	6.60	3.89	4.60	7.76	6.62	–	–	–	–	3.79	6.29	4.23	9.50	4.50	4.29
<i>Helminthosporium</i>	–	–	–	–	–	–	–	–	–	–	–	–	1.23	3.29	7.96
<i>Nigrospora</i>	1.68	8.30	3.45	1.62	4.81	6.59	–	–	–	1.16	5.20	7.01	3.03	9.49	1.25
<i>Papularia</i>	–	–	–	1.00	6.17	5.97	–	–	–	–	–	–	–	–	–
<i>Penicillium</i>	3.65	2.88	1.34	4.26	4.81	1.95	2.46	0.87	4.91	–	–	–	–	–	–
<i>Pithomyces</i>	0.56	0.76	6.90	–	–	–	–	–	–	0.87	0.41	5.19	–	–	–
<i>Scopulariopsis</i>	–	2.37	4.21	–	–	–	–	–	–	–	–	–	–	–	–
<i>Trichothecium</i>	2.66	–	3.25	–	–	–	–	–	–	–	–	–	–	–	–
<i>Verticillium</i>	–	–	–	–	–	–	–	–	–	2.04	1.17	2.78	–	–	–
Unidentified	1.68	1.10	0.76	2.25	0.75	2.16	4.0	1.07	1.22	4.51	0.58	1.44	1.65	1.93	2.09
Total No. of Spores	712	1180	1043	798	1329	971	650	1025	895	686	1192	1040	726	1243	954

S = Summer, R = Rain, W = Winter.

b. By sedimentation plates (Table 4)

Cladosporium (35.0–41.29%) was also the predominant type followed by *Curvularia* (11.17–14.21%), *Aspergillus* (7.37–12.47%), *Alternaria* (3.98–9.83%), *Drechslera* (5.25–7.50%) at all the sites.

4. Discussion

In the present investigation, the rotorod sampling and sedimentation plates have been combined to give volumetric determination of the airspora, and specific identification of airborne fungi in different indoor

and outdoor sites, in an unexplored biozone of West Bengal. The microscopic assessment of stored collections allows only limited classification of spore types, while culturing allows specific identification of predominant types. There is no previous report on the volumetric airmycoflora survey in West Bengal, thus the present combination of volumetric and qualitative methods has complemented each other for a better interpretation of the results.

In the present investigation, the occurrence of airspora exhibited a distinct seasonal periodicity in their annual occurrence, perhaps due to differences in meteorological conditions (Figure 1). All the

Table 5. Results of skin-tests with fungal allergens.

Fungal antigen tested	No. of patients tested	Negative (%)	No. of Patients showing positive reactions				Intensity of reactions (%) 2+ to 4+
			1+	2+	3+	4+	
1 <i>Aspergillus niger</i>	P-90	34.44	30 (S = 5; R = 18; W = 7)	11 (S = 2; R = 6; W = 3)	11 (S = 4; R = 5; W = 2)	7 (S = 2; R = 3; W = 2)	32.22
	N-10	90.00	1 (R = 1)	—	—	—	
2 <i>Cladosporium cladosporioides</i>	P-72	63.88	13 (S = 2; R = 3; W = 8)	8 (S = 1; R = 3; W = 4)	4 (R = 1; W = 3)	1 (R = 1)	18.05
	N-10	100.00	—	—	—	—	
3 <i>Curvularia lunata</i>	P-112	73.21	12 (S = 3; R = 6; W = 3)	15 (S = 3; R = 8; W = 4)	3 (R = 2; W = 1)	—	16.07
	N-10	100.00	—	—	—	—	
4 <i>Alternaria alternata</i>	P-70	77.14	9 (S = 2; R = 4; W = 3)	6 (S = 1; R = 3; W = 2)	1 (R = 1)	—	10.00
	N-10	90.00	1 (R = 1)	—	—	—	
5 <i>Rhizopus nigricans</i>	P-55	81.81	6 (S = 2; R = 3; W = 1)	3 (R = 2; W = 1)	1 (R = 1)	—	7.27
	N-10	100.00	—	—	—	—	

P = Patients; N = Normal non-allergic persons; S = Summer; R = Rainy season; W = Winter.

spore types were present in both environments except *Bispora*, *Cercospora*, *Papularia*, *Spegazzinia*, *Trichothecium* of outdoor sites. A definite difference in the composition of airspora of indoor and outdoor environment was noticed. The predominance of *Aspergillus*, *Curvularia*, *Alternaria*, *Rhizopus*, *Cladosporium*, *Drechslera*, *Penicillium* in indoor has been attributed to their ability to grow in many different substrata. Moreover, indoor airflora may have been diluted by the outside airflora entering through different inlets.

Seasonal differences in spore concentration were noticeable with lowest concentrations in the summer (March–June) and highest during the rainy season (July–October). The more frequent occurrence of fungal spores during the rainy season can be attributed to the moderate temperatures and high RH during this period, which favour fungal growth and sporulation, while fungi thrive less in the high temperature and dry condition of the summer period.

It has been found that environmental factors like rainfall, RH, temperature and wind speed (Figure 1) have a direct or indirect influence on the airspora. Few Phycomycetes like *Rhizopus* were isolated in the present survey. The moderately high temperature (25–35 °C) with high RH favoured spore release in

Rhizopus. A little rain with high RH in the atmosphere favoured the growth and sporulation of *Cladosporium* and consequently their concentration in the air increased when it was followed by dry condition. Our result is similar to the finding of Chakravorty and Nandi (1972) and Hjelmroos (1993). Moisture and humidity have a positive effect on sporulation of *Curvularia*, while dry weather and wind help spore liberation, consequently increasing the spore-load in the air, thus corroborating the findings of Meredith (1962, 1963). Abundance of *Curvularia* may also be due to its high saprophytic ability, colonising capacity over a variety of decaying substrates and its phytopathogenic nature. It was also found that high wind velocity during the summer decreases the atmospheric concentration of *Alternaria*. The result is consistent with the reports of Lopez and Salvaggio (1983). The release of *Chaetomium* and *Ganoderma* spores showed direct correlation with precipitation. An increase in the number of such spores in the air was observed with the onset of monsoon which gradually decreased with the beginning of winter, supporting the view of Ingold (1954), Tilak and Rao (1988).

The high incidence of 'Aspergilli' in the outdoor air (forest) may be due to deposition of logs near

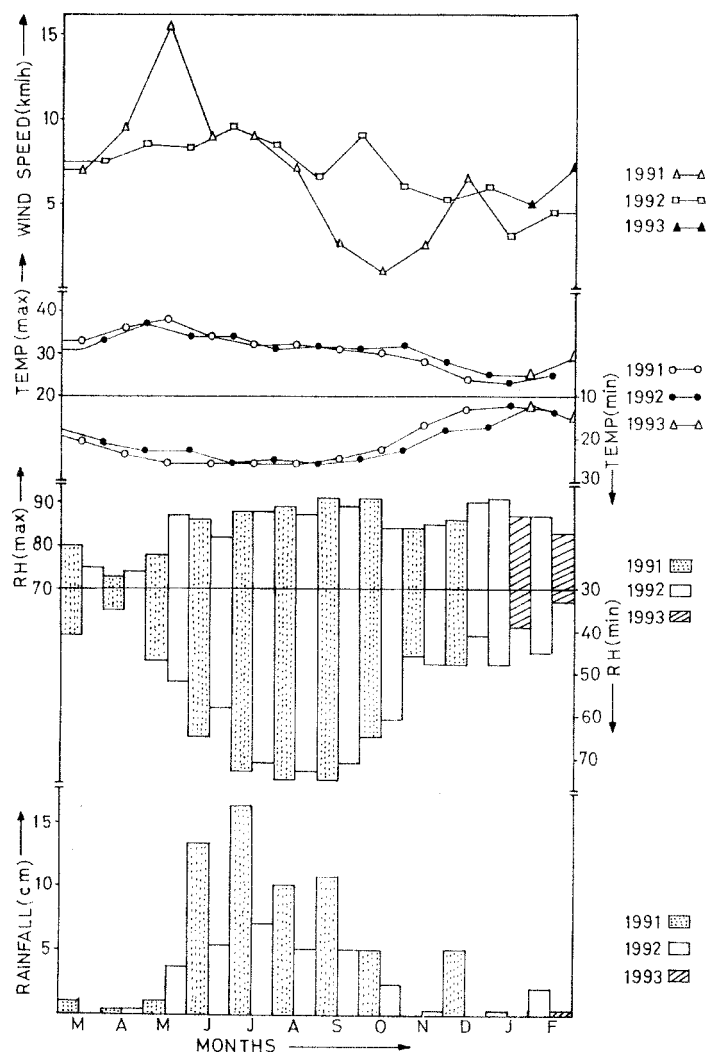


Figure 1. Meteorological data on monthly rainfall, relative humidity, temperature and wind speed from March 1991 to February 1993 at Burdwan.

sampling sites and its close proximity to rice fields which favoured the growth and sporulation of 'Aspergilli'. The occurrence of *Nigrospora* during post-monsoon and winter coincides with the period when rice crop was passing through heading and ripening phases. Our findings confirm the view of Sreeramulu and Vittal (1966).

Apart from the environmental factors, several other factors like vegetation, deposition and decomposition of litter, man-made operations and mechanical disturbance were found to be responsible for increased concentration of mold spores in the air. Vast areas of forests, decomposition of litter on the forest floors, grass lawn in and around Burdwan, probably acted

as suitable host for many parasitic and saprophytic fungi.

From the result of skin test (Table 5) it is evident that highest markedly positive reactions were exhibited by *Aspergillus niger* (32.22%). This was followed by *Cladosporium cladosporioides* (18.05%), *Curvularia lunata* (16.07%), *Alternaria alternata* (10.00%) and *Rhizopus nigricans* (7.27%).

In the present work *Aspergillus niger* exhibited maximum positive reactions in rainy season. *Cladosporium cladosporioides* also showed highly positive reaction, particularly in post-monsoon and winter months. Both *Curvularia lunata* and *Alternaria alternata* exhibited positive reactions and were found

to be more prevalent in the rainy season. *Rhizopus nigricans* showed comparatively less positive reactions to the patients.

From the skin sensitivity results, it may be concluded that the degree of incidence of mold allergy was directly related to the volumetric composition of airspora. The different frequency of skin positivity in patients may be due to the variations in the prevalence of aeroallergens. *Aspergillus* was found to be the most dominant fungal form, which exhibited maximum positive reaction. Similarly, a low incidence of *Rhizopus* recorded from indoor environments showed less positivity. Higher percentage of mold allergy in rainy season may be due to their higher prevalence, except for *Cladosporium*, which was more prevalent in winter months.

The allergenicity of *Alternaria*, *Cladosporium*, *Aspergillus*, *Ganoderma*, has also been proved by Vijay et al., 1989, 1991a, 1991b; Mishra and Jamil, 1991, and in other places.

Thus the present survey will be helpful to physicians in the diagnosis and therapy of patients suffering from mold allergy in this unexplored biozone of West Bengal where the local inhabitants frequently suffer from allergic diseases.

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