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## Atmospheric concentration of Aerospora of Balrampur

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### Abstract

Study of aerobioparticles using Tilak Air Sampler was carried out at Balrampur (U.P.) from January, 2012 to December, 2012. A total of 80 bioparticles were identified. The following forms were recorded as dominant; *Alternaria* (16.65%), *Cladosporium* (12.12%), *Drechslera* (11.05%), *Curvularia* (6.42%), Lichens (5.79%), *Epicoccum* (5.11%), *Aspergilli* (5.11%) and Smut spore (4.17%) to the total airspora. The total number of bioparticles trapped on the cellotape was 2,00,184/m<sup>3</sup> of air. The identification was done up to generic level.

**Keywords:** Aerospora, Tilak Air sampler, Balrampur

### Introduction

The science of aerobiology has emerged as a specialized branch covering almost all the aspects of aerobiological investigations including biological, medical, veterinary, palynology, mellitopalynology, allergology, entomology, plant and animal pathology, phytogeography and microbiology. This fascinating interdisciplinary branch of science has its origin by the pioneering experiments of Spallazini and the work of Pasteur (1861) <sup>[1]</sup>, Tyndall (1881) <sup>[2]</sup> who used the methods of aerobiologists in disapproving the theory of spontaneous generation and developed the germ theory of disease.

The study area Balrampur is situated near the Indo-Nepal border. It is an important town of Tarai belt of eastern Uttar Pradesh near the foothills of the Himalayas.

Out of the total 80 components, 69 spore types of fungi were identified up to generic level while the remaining were identified and kept into separate groups such as algae, crystals, epidermal hairs, hyphal fragments, insect parts, insect scales, lichen, pollen grains, protozoan cysts, xylem fibre and unidentified spores. Out of 69 spore types, majority belonged to Deuteromycetes followed by Ascomycetes, Basidiomycetes and Phycomycetes. Deuteromycetes spore types dominate the airspora by contributing the highest percentage. The present study of aerobiological particles, contributed in understanding the composition and components of airspora of Balrampur. This information in forthcoming period will be helpful in establishing disease forecasting system for valuable crop plants in this area.

### Materials and methods

The Air monitoring was carried out by operating continuous volumetric Tilak Air Sampler (Tilak and Kulkarni 1970) <sup>[3]</sup>. The apparatus runs on electric power supply (AC-230 volt) and provides continuous sampling of air for 8 days. The apparatus was kept at a constant height of one meter above the ground level. The apparatus was protected from rain by placing it in a wire cage roofed with tin shade. Air was sampled at the rate of 5 liters/minute and the transparent cellotape coated with adhesive petroleum jelly was changed after a week. The exposed tape was cut into 16 equal parts and each part representing 12 hours trace area of a day and night accordingly. The pieces of cellotape were mounted on slides using glycerine jelly as a mountant. Glycerine jelly as a mountant has the best optical properties for visual examination. The experiments were conducted for a period of one year from January, 2012 to December, 2012. The number of spores, thus scanned were identified by the reference slides, fungal collections, visual identifications and from reference books (Gregory 1961, Ellis 1971, 1976, Sarbhoy, 1983 and Tilak 1982, 1989, 2009 and 2010) <sup>[4-11]</sup>.

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**Table 1:** Monthly Concentration of Aero-Bioparticles present/m<sup>3</sup> of air along with % contribution to the total airspora (from January 2012 to December 2012) by 'Tilak Air Sampler'

Sr. No.	Name of Aero-Bio particles	JAN 2012	FEB 2012	MAR 2012	APR 2012	MAY 2012	JUN 2012	JUL 2012	AUG 2012	SEP 2012	OCT 2012	NOV 2012	DEC 2012	Total Air Spora	% contribution of total airspora
1	Alternaria	770	2002	12054	4186	3836	4074	1498	1218	826	1414	1190	280	33348	16.659
2	Albugo	00	00	00	00	00	00	00	00	00	84	70	28	182	0.091
3	Aspergilli	168	350	1748	2562	2240	1120	140	280	406	308	784	140	10246	5.118
4	Arthrinium	00	00	00	00	00	00	00	00	00	14	42	14	70	0.035
5	Ascotricha	00	00	00	00	00	00	00	00	00	00	00	70	70	0.035
6	Beltraniella	00	00	00	00	70	28	00	14	00	00	00	00	112	0.056
7	Beltrania	00	00	00	00	42	154	00	42	28	56	00	00	322	0.161
8	Botryodiplodia	00	00	00	00	00	00	00	00	70	28	00	00	98	0.049
9	Bactrodesmium	00	00	00	00	28	00	00	14	00	00	00	00	42	0.021
10	Bispora	28	14	140	42	154	28	00	00	14	84	252	70	826	0.413
11	Cercospora	70	00	00	182	56	00	70	168	42	350	84	98	1120	0.559
12	Codinaea	00	00	00	00	00	00	28	56	00	00	00	00	84	0.042
13	Cladosporium	2940	2800	2240	1624	308	112	1078	672	2002	4704	4382	1400	24262	12.120
14	Corynespora	00	00	28	616	14	798	42	14	42	00	00	28	1582	0.790
15	Curvularia	448	392	238	1120	714	1526	1876	1078	2730	1736	770	224	12852	6.420
16	Cordella	00	00	00	00	28	70	00	00	00	00	00	00	98	0.049
17	Cordana	42	00	00	00	00	00	00	00	00	00	00	28	70	0.035
18	Cunnighamella	00	00	00	00	00	00	14	42	28	14	28	00	126	0.063
19	Drechslera	2870	822	1260	1336	1792	1904	1652	1442	3500	2310	1638	1596	22122	11.051
20	Deightoniella	14	28	140	00	00	00	154	00	00	14	00	00	350	0.175
21	Diplodia	00	00	00	00	00	00	00	00	00	28	42	00	84	0.042
22	Didymospharia	00	00	00	00	00	00	00	00	28	14	00	00	112	0.056
23	Dictyoathrinium	00	00	00	00	00	00	00	00	42	28	42	00	112	0.056
24	Epicocum	952	1414	5530	770	294	560	00	28	56	308	336	00	10248	5.119
25	Excipularia	56	00	00	00	00	00	28	00	00	00	14	84	182	0.091
26	Erysiphe	28	00	00	00	00	42	28	00	70	00	00	154	322	0.161
27	Exosporium	14	56	00	168	28	294	42	252	14	294	700	28	1890	0.944
28	Fusarium	14	00	00	00	00	00	00	28	168	112	126	14	462	0.231
29	Fusariella	00	00	00	00	00	00	00	42	252	140	56	00	504	0.252
30	Helminthosporium	00	00	00	00	00	00	00	14	168	126	28	00	336	0.168
31	Heterosporium	00	00	00	00	00	00	00	00	14	42	70	00	126	0.063
32	Haplosporella	00	42	182	00	00	14	00	00	140	448	112	28	966	0.483
33	Harknessia	00	00	00	00	00	00	00	00	00	56	28	00	84	0.042
34	Hypoxylon	00	28	56	00	00	00	42	00	28	14	00	00	168	0.084
35	Hysterium	70	28	14	42	00	70	112	00	14	00	56	00	406	0.203
36	Hirudinaria	28	00	00	00	00	00	00	00	00	14	42	00	84	0.042
37	Lacellinopsis	70	42	140	14	00	00	00	14	56	112	350	196	994	0.497
38	Mitteriella	00	00	00	00	00	00	00	00	14	28	00	84	126	0.063
39	Melanospora	00	00	00	00	14	56	196	364	00	00	112	84	826	0.413
40	Memnoniella	00	42	14	00	00	00	14	00	00	154	140	00	364	0.182
41	Melanographium	84	14	14	00	00	00	28	00	00	00	28	28	196	0.098
42	Nigrospora	1008	798	1120	980	574	14	182	238	826	952	700	350	7742	3.867
43	Oidium	00	14	70	00	00	00	70	84	00	00	112	126	476	0.238
44	Phaeotrichoconis	00	00	14	14	00	00	00	00	00	00	56	00	84	0.042
45	Periconia	84	28	28	126	420	14	14	28	42	238	112	140	1274	0.636
46	Pleospora	00	00	42	00	00	00	434	00	00	140	14	00	630	0.315
47	Pithomyces	140	28	56	28	00	00	42	00	14	350	322	70	1050	0.525
48	Pseudotorula	00	42	84	00	00	00	00	42	00	00	14	00	182	0.091
49	Phyllachora	00	00	00	00	00	00	28	00	28	00	00	00	56	0.028
50	Rust Spores	672	448	1036	378	434	00	00	42	84	224	700	504	4522	2.259
51	Rhizopus	00	00	00	14	00	00	00	14	00	182	112	00	322	0.161
52	Scopulariopsis	70	14	00	00	00	00	00	00	00	00	00	28	112	0.056
53	Sirodesmium	28	42	14	00	00	00	00	14	28	42	28	42	238	0.119
54	Sclerospora	00	00	00	00	00	00	00	14	42	56	00	00	112	0.056
55	Sporormia	170	238	182	42	14	00	00	210	28	42	154	308	1388	0.693
56	Sordaria	00	00	00	00	00	28	350	238	294	56	00	00	966	0.483
57	Sporidesmium	56	28	28	42	14	00	00	42	28	56	84	112	490	0.245
58	Smut Spores	994	826	1050	1792	490	210	980	294	210	84	448	980	8358	4.175
59	Stachybotrys	56	14	28	56	84	00	00	112	42	140	42	182	756	0.378
60	Spegazzinia	42	00	28	14	210	126	00	28	28	98	70	00	644	0.322
61	Sclerotium	308	14	70	00	00	00	00	00	00	294	84	252	1022	0.511
62	Tetraploa	42	14	00	196	56	00	14	28	14	84	168	00	616	0.308
63	Torula	210	168	196	98	154	504	392	14	28	98	392	182	2436	1.217
64	Tetracoccosporium	182	28	70	224	154	00	14	56	28	168	140	84	1148	0.573
65	Trichothecium	126	112	14	00	00	00	224	154	56	42	00	00	728	0.364
66	Trichoderma	00	00	00	00	00	00	00	00	00	14	42	00	56	0.028
67	Trichoconis	56	14	28	00	00	00	00	00	00	14	70	00	182	0.091
68	Ulocladium	00	00	00	00	00	00	00	00	00	00	98	28	126	0.063

69	Virgatospora	00	00	00	00	00	00	00	14	28	42	00	00	84	0.042
70	Algae	224	98	126	84	168	112	224	84	42	140	280	238	1820	0.909
71	Crystals	630	00	00	00	00	00	00	00	112	00	308	896	1946	0.972
72	Epidermal Hair	546	154	532	238	14	00	42	14	56	70	532	252	2450	1.224
73	Hyphal Fragment	252	210	1092	546	322	00	238	42	252	980	728	1036	5698	2.846
74	Insect Part	42	28	70	28	14	00	00	42	14	28	00	14	280	0.140
75	Insect Scale	364	434	616	308	252	00	182	210	196	1092	616	350	4620	2.308
76	Lichen(Usnea)	840	774	2520	2604	558	112	84	14	00	14	2660	1428	11608	5.799
77	Pollen Grains	434	280	588	504	518	28	42	70	238	336	560	378	3976	1.986
78	Protozoan Cyst	700	434	112	378	112	14	238	204	238	28	168	112	2738	1.368
79	Unidentified	224	56	392	224	112	140	140	70	70	448	322	154	2352	1.175
80	Xylem Fibre	00	112	28	56	00	14	00	00	00	98	00	14	322	0.161
	<b>Grand Total</b>	<b>17166</b>	<b>13538</b>	<b>34032</b>	<b>21636</b>	<b>14292</b>	<b>12166</b>	<b>10976</b>	<b>8282</b>	<b>13818</b>	<b>19684</b>	<b>21658</b>	<b>12936</b>	<b>200184</b>	<b>100</b>

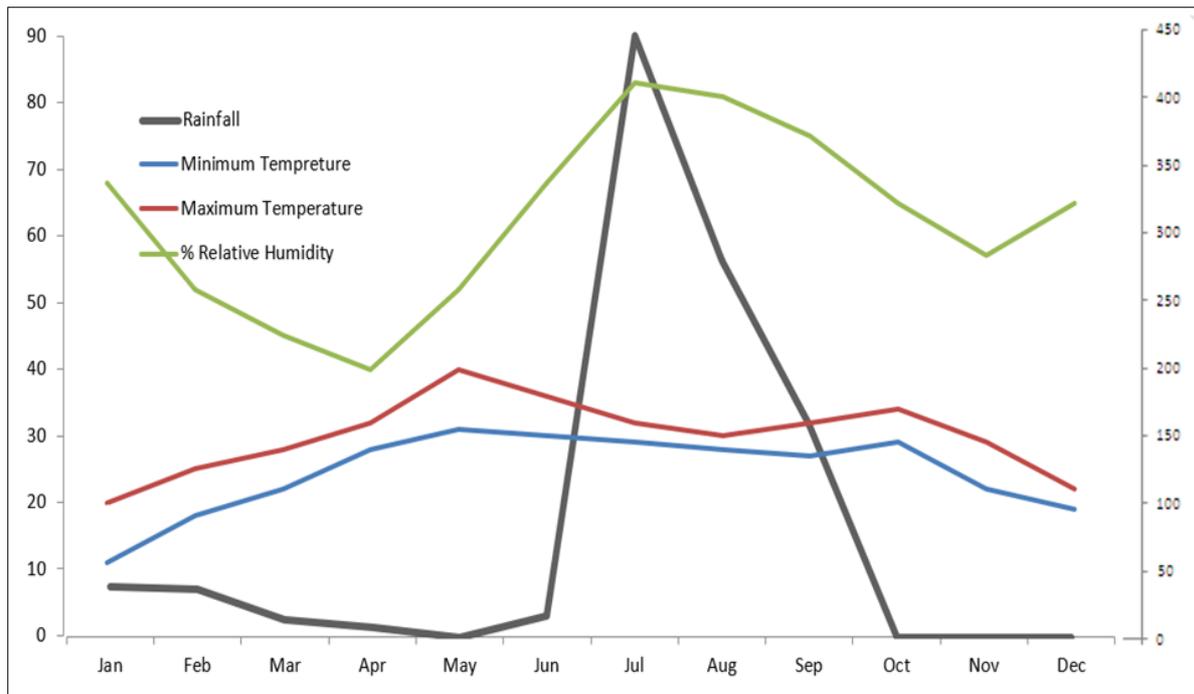


Fig 1: Showing Monthly Average Minimum Maximum Temperature, Relative Humidity & Rainfall from January-2012 to December-2012

### Results

The present study revealed that total number of airborne spores including pollen grains, algae protozoan cyst, insectscales, unidentified forms, lichens, crystals and hyphal fragments was 2,00,184/m<sup>3</sup> of air. In the present investigation, 69 types of fungi were identified in which maximum contribution was of *Alternaria* 33348/m<sup>3</sup> (16.65%) followed by *Cladosporium* 24262 spores/m<sup>3</sup> (12.12%), *Drechslera* 22122 spores/m<sup>3</sup> (11.05%), *Curvularia* 12852 spores/m<sup>3</sup> (6.42%), *Epicoccum* 10248 spores/m<sup>3</sup> (5.11%), *Aspergilli* 10246 spores/m<sup>3</sup> (5.11%) and Smut spore 8358 spores/m<sup>3</sup> (4.17%).

Other types were Lichen 11608 fragments/m<sup>3</sup> (5.79%), Hyphal fragment 5698 fragments/m<sup>3</sup> (2.84%), Insect scales 4620 scale/m<sup>3</sup> (2.30%), Pollen grains 3976 pollen/m<sup>3</sup> (1.98%), Protozoan cyst 2738 cyst/m<sup>3</sup> (1.36%), Epidermal hair 2450 hair/m<sup>3</sup> (1.22%), Crystals 1946 crystal/m<sup>3</sup> (0.97%), Algae 1820 fragment/m<sup>3</sup> (0.90%), Xylem fibre 322 fibre/m<sup>3</sup> (0.16%) and Insect part 280 part/m<sup>3</sup> (0.14%) to the total airspora, as shown in the table. Apart from this, unidentified spores and dust particles were also trapped throughout the study tenure. In present investigation special emphasis was given to plant pathogens which occurred in the atmosphere. The allergenic spore types recorded during the study period were *Alternaria*, *Aspergilli*, *Cladosporium*, *Curvularia*, *Epicoccum*, *Fusarium*, *Helminthosporium*, *Nigrospora*, *Rhizopus*,

Rust spores, Smut spores, *Pithomyces*, *Periconia* and *Drechslera* as well as few pollen grains. A clinical implication of these spore types is reported in etiology of respiratory allergic disorders, in allergic diseases and allergic reactions to sensitive individuals (Agarwal and Shivpuri, 1974, Sheno and Ramalingam, 1976<sup>b</sup>)<sup>[12, 13]</sup>.

The present data is quite useful in disease forecasting services of a particular locality. The disease forecasting can be done on the basis of spore load present in the air.

### Discussion

The survey of outdoor aerobiological study was carried out in the campus of M.L.K. P.G. College, Balrampur from January, 2012 to December, 2012. The investigation of outdoor aerobioparticles was carried out using "Tilak Continuous Air Sampler". Monthly variation in the concentration of each spore was estimated as given in the table.

The different fungal spore types identified were classified into four groups of fungi – Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. The algal forms, crystals, epidermal hair, hyphal fragments, insect part, insect scale, Lichen, pollen grain, protozoan cyst, xylem fibre and unidentified spores were grouped under the heterogenous group called "other types".

The present investigation revealed the 80 types of components in

the airspora of which 69 belonged to fungal types and remaining 11 to the group "other types". Out of 69 fungal spores, 04 belonged to the group Phycomycetes, 10 to Ascomycetes, 02 to Basidiomycetes and remaining 53 to Deuteromycetes. The present investigation also revealed four bioparticles viz. *Arthrinium*, crystals, *Ulocadium* and *Virgatospora* as a new record to the airspora of this region.

Deuteromycetes contributed highest percentage 71.83% to the total airspora followed by other types 18.88%, Basidiomycetes 6.43%, Ascomycetes 2.47% and Phycomycetes (0.37%) respectively.

During the period of investigation, *Alternaria* spore type was the dominant type followed by *Cladosporium*, *Drechslera*, *Curvularia*, Lichens, *Epicoccum*, *Aspergilli* and smut spores.

Phycomycetes were represented by *Albugo*, *Cunninghamella*, *Rhizopus* and *Sclerospora*. The *Albugo* contributed 0.09%, *Cunninghamella* contributed 0.06%, *Rhizopus* contributed 0.16%, *Sclerospora* 0.05 % to the total airspora. The only occurrence of *Cunninghamella* spore was recorded by this sampler because these spores are of "Night spora" pattern.

The Ascomycetes spore types ranked 4<sup>th</sup> in the order of dominance. In all, 10 ascospore types were recorded during the period of investigation. The contribution of the total ascospores to the total aerospora was 2.47%. The presence and high degree of occurrence of many ascospore types also revealed the abundance of parasitic and saprophytic forms in the vicinity of sampling site.

The ascospores types like *Didymosphaeria* and *Pleospora* appeared in the rainy months. This is true and got confirmed with the observation of Ingold (1965)<sup>[14]</sup> that there is an immediate impact of rainfall on the discharge of some of the ascospores types. The ascospores like *Sporomia*, *Pleospora*, *Melanospora* *Sordaria* etc. were recorded almost all the months, however their incidence was relatively high during August to October.

Only two spore types representing Basidiomycetes were recorded from air. These were rust spores (uredospores) and smut spores.

The rust spores contributed 2.25% whereas smut spores contributed 4.27% to the total airspora. The higher concentration of uredospores (Rust spores) was recorded from September to March whereas the higher smut spore catch was recorded in the month of July to April, as shown in the table. The probable source for the rust and smut spores was infected crop plants like wheat, sugarcane, grasses and many more wild plants.

The Deuteromycetes, a dominant group comprised 53 spore types with major contribution of 71.83% to the total airspora out of which one of the spore component, *Alternaria* constituted the bulk of 33348 spore/m<sup>3</sup> of air with highest percentage contribution 16.65% to the total airspora. The spores of *Alternaria* were trapped throughout the period of investigation with its maximum concentration in the ambient air from January 2012 to December, 2012 occurring as a common leaf spot disease causing pathogen on various crop plants like Potato, Radish, Cauliflower, Cabbage, Turnip, Mustard etc. and also as saprophyte on various substratum. In India, Kramer *et al.* (1959)<sup>[15]</sup> recorded 3.4%. *Alternaria* spores to the total catches. Tilak and Srinivasulu (1967)<sup>[16]</sup> recorded the occurrence of *Alternaria* in various months showing presence throughout the year. Sahney and Purwar (2007)<sup>[17]</sup> and Giri and Sawane (2010)<sup>[18]</sup> reported 11.42% and 5.69% spores to the total airspora.

*Cladosporium* was detected usually on decaying plant parts located in the garden as well as on the plants like *Dianthus*, *Musa*, *Colocasia* and on many grasses. The high humid conditions and

low temperature accounted for the maximum incidence of *Cladosporium* spores in the rainy and winter seasons.

In general, the spores of Deuteromycetes like *Alternaria*, *Aspergilli*, *Bispora*, *Cladosporium*, *Corynespora*, *Curvularia*, *Drechslera*, *Epicoccum*, *Fusarium*, *Haplosporella*, *Nigrospora*, *Oldium*, *Periconia*, *Pithomyces*, *Sporidesmium*, *Spegazzinia*, *Tetraploa*, *Tetracoccosporium* and *Trichothecium* were recorded throughout the period of investigation.

The parasitic and saprophytic forms also grew widely on wild plants near trapping site. All these parameters helped in increasing the spore concentration in the atmosphere of Balrampur.

Hyphal fragments were recorded throughout the period of investigation and contributed 2.84% to the total airspora. Protozoan cysts were also recorded throughout the year. It was 1.36% to the total airspora. Tilak and Srinivasulu (1967)<sup>[16]</sup> reported 7.5% protozoan cysts from Aurangabad.

The pollen grains were recorded throughout the year from January- 2012 to December-2012.

Meredith (1962)<sup>[19]</sup> in Jamaica, reported the well-defined maxima between 10:00 hrs. and 14:00 hrs.

He observed that pollens were abundant in dry weather and get reduced when there was considerable increase in humidity and precipitation.

Meredith (1961)<sup>[20]</sup> and Ingold (1965)<sup>[14]</sup> observed that the temperature had little effect on the concentration of various spore types whereas rainfall and relative humidity showed direct relationship with the spore concentration. In the present study the maximum bioparticle load was observed in the month of March that is 34032/m<sup>3</sup> whereas minimum load was found in the month of August that is 8282/m<sup>3</sup>. It was due to the fluctuation in temperature, relative humidity and rainfall in these months (as represented in figure). The concentration of aerobioparticles was least in the month of August because of high rainfall whereas maximum load in March was due to moderate temperature and humidity.

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