



AN ANALYSIS OF OBSERVED ANGIOSPERMIC AIRBORNE POLLEN OF SUMMER SEASON BASED UPON THEIR MODE OF POLLINATION IN FIROZABAD DISTRICT OF UTTAR PRADESH

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ABSTRACT:

A floristic survey in Firozabad district was carried out from three selected sites which are 15-20 km away from each other. The main objective behind the field study was to find out angiospermic species which may shed large number of pollen in the atmosphere and to note their specific pollination period and mode of pollination which was useful criterion in the identification of atmospheric pollen. We studied variations in concentration of airborne pollen and other particles of biological origin which are collectively known as Primary Biological Aerosol Particles (PBAP) in those three sites. During the annual cycle the frequency of pollen in the air was different in different seasons. It might be due to local climatological influence on flowering of plants. The lowest concentration of pollen was observed in winter season. On the basis of mode of pollination in winter season 65.99% anemophilous, 27.82% entomophilous and 3.58% amphiphilous species were found. Maximum plants bloom, during spring and rainy season followed by summer and winter season.

Keywords :- Amphiphilous, anemophilous, entomophilous, pollen, pollination.

INTRODUCTION :

The study of structural and applied aspects of pollen is termed as 'PALYNOLOGY'. It is classified into fundamental and applied categories and 'AEROBIOLOGY' which is the study of biological materials present in the air, (Erdtman, 1952) comes in applied category. Both these well defined branches now commonly known as 'AEROPALYNOLOGY' and is open the focus of study owing to their direct bearing with human health, crop production and economic welfare. Most recent aeropalynological works have been carried out in logos (South west nigeria) (Adeniyi *et al* 2014). The biological particles or materials or bio aerosols, emitted from vegetation and by other living organisms are also known as Primary biological aerosol particles (PBAP) which include pollen grains, fungal spores, bacteria, viruses, cell fragments and protozoans (Despres *et al.*2012) and they

are ubiquitous in the atmosphere (Gregory 1961, Womack *et al.* 2010). The main research interest regarding PBAP have been directed to their effects on humans, animals and agriculture, their potential as agents of biological warfare (Lim *et al.* 2005). Geographical variations are also responsible for pollen abundance (Latorre and Bianchi 1991).

METHODOLOGY :

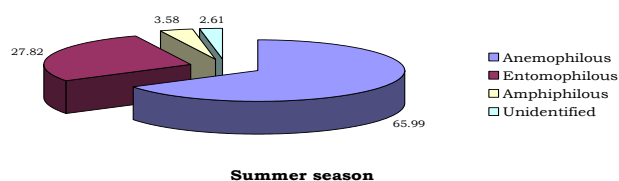
For pollen and spore trap three sites viz., Shikohabad, Firozabad and Jasrana were selected, which are semi-urban, urban and rural respectively and are 15-20 kms away from each other. Pollen sampling was conducted with the help of modified Durham Gravitational sampler which was placed 6.5-8.5 m above ground level. Two microscopic slides, coated with stained adhesive glycerine jelly were exposed daily for 24 hrs. These slides, contained trapped dust particles, pollen grains, fungal spores, hyphal

fragments, insect scales, epidermal hairs, microscopic vegetative fragments and other miscellaneous particles. The pollen grains and spores so trapped were identified on the basis of their morphological characters and by comparing these with reference slides. Pollen count and frequency of different pollens have been calculated by following the procedure of Mansour and Hameed (2005).

OBSERVATIONS :

The Firozabad district experiences four different seasons. Different categories of seasonal vegetation grown in ponds, on waste lands, roadsides, on railway tracks etc. Aerobiota of Firozabad district in summer season consisted 20.91% pollen, 14.42% fungal spores, 27.53% other bioparticles and 0.52% unidentified objects during research period at the temperature between 31°C to 43°C. Seasonal vegetation includes the herbs and under-shrubs of the rainy, winter and summer seasons growing in different habitats of the district. Seeds of several annual herbs start germinating in the month of March. At This time temperature gradually rises and continues to do so till the end of June. These months are dry and plants showing xerophytic characteristics such as thorns, wooly tomentum or stellate hairs, thick cuticle etc. come up and grow. A few summer annuals are- *Alhagi pseudalhagi*, *Alternanthera pungens*, *Boerhaavia diffusa*, *Citrullus lanatus*, *Dichanthium annulatum*, *Echinops echinatus*, *Glinus lotoides*, *Gomphrena globosa* and *Heliotropium eichwaldi*. During summer months of April, May and June, principal cucurbits are grown. The common ones are- *Citrullus* sp. (Tarbooz, tinda), *Cucumis* sp. (Kharbooz, kakri, khira), *Cucurbita maxima* (Sitaphal), *C. pepo* (Kaddu), *Lagenaria siceraria* (Lauki), *Luffa acutangula* (Kali torai), *L. cylindrica* (Ghia torai), *Momordica charantia* (Karela), *Trichosanthes*

anguina (Chachinda), *T. dioica* (Parwal). During the summer season, the pollen types of 59 species have been recovered in the air. Their frequency greatly varies from 0.16% (*Moringa oleifera*) to 22.43% (*Parthenium hysterophorus*), and 22.38% (*Cynodon dactylon*; Table 1; Fig. 2). A moderate number of pollen of arboreal species such as those of *Cassia*, *Aegle*, *Psidium* and *Mangifera* have also been observed. Out of the total 59 pollen types, 3 types of grasses, 27 of non-arboreal (herbs) and 29 of arboreal (shrubs and trees) have been identified. Of these 42 are entomophilous, 09 anemophilous and 08 are of amphiphilous categories from the point of view of pollination mechanism (Table 2).



DISCUSSION :

Based on the Pollination Calendar, lowest number of anemophilous pollen types have been observed during summer season and the lowest. As the dry season progresses from May to mid of July, the representation of pollen of herbs decreases and that of trees taxa like *Cassia fistula*, *Dalbergia sissoo* and *Mangifera indica* etc. increases significantly. All in all, the pollen of *Parthenium hysterophorus* occur in highest number followed by those of *Cynodon dactylon*. In summer season, the pollen load is maintained in the atmosphere itself. Thus, the drier state of the atmosphere is helpful in maintaining pollen concentration in the atmosphere by easy dissemination and distribution. Temperature seems to be the main controlling factor at the start of grass pollen season and also when peak values are reached. Pollen distribution/frequency of *Parthenium hysterophorus* showed a significant correlation with the temperature at 1% level of

significance whereas the pollen frequency of *Cynodon dactylon* shows insignificant correlation at 1% level although it has long period of low count and a short period of peak values. In the late summer, pollen concentrations begin to decrease due to scarcity of flowering plants.

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Table 1: Pollen frequency of different plants during summer season (May, June and July) of three different sites

Pollen Grains	May 08 and May 09			June 08 and June 09			July 08 and July 09			Total	Percentage
	SH	FZ	JA	SH	FZ	JA	SH	FZ	JA		
<i>Acacia nilotica</i> (L.) Willd. ex Del subsp.	2	--	4	--	--	4	2	3	6	21	0.38
<i>Achyranthes aspera</i> L.	--	13	17	--	--	10	9	11	12	72	1.30
<i>Aegle marmelos</i> (L.) Corr.	13	12	18	9	--	6	--	9	12	79	1.40
<i>Alangium salviifolium</i> (L. f.) Wang.	4	--	6	--	--	9	5	3	--	27	0.49
<i>Althaea rosea</i> (L.) Cav.	3	2	4	--	--	2	3	--	3	17	0.30
<i>Argemone mexicana</i> L.	11	9	13	--	2	--	--	--	2	37	0.67
<i>Azadirachta indica</i> A. Juss.	--	2	4	--	--	--	--	--	5	11	0.20
<i>Bergera koenigii</i> L.	3	--	--	2	1	4	--	--	2	12	0.20
<i>Capparis decidua</i> (Forsk.) Edgew.	4	--	--	--	--	2	--	--	5	11	0.20
<i>Carica papaya</i> L.	6	9	9	3	--	5	--	--	8	40	0.70
<i>Carthamus tinctorius</i> L.	--	5	--	2	1	--	--	--	4	12	0.20
<i>Cassia</i> sp. L.	24	28	31	12	21	19	26	28	22	211	3.80
<i>Chromolena odorata</i> (L.) King & Robin	4	2	2	--	--	3	1	--	6	18	0.30
<i>Citrullus lanatus</i> (Thunb.) Mansf.	7	9	13	9	9	11	6	5	7	76	1.30
<i>Clerodendrum inerme</i> (L.) Gaertn.	3	4	4	6	--	5	--	--	3	25	0.45
<i>Coccinia grandis</i> (L.) Voigt.	--	6	9	11	10	13	7	3	10	69	1.20
<i>Coriandrum sativum</i> L.	5	2	13	--	--	9	6	5	11	51	0.93
<i>Croton bonplandianum</i> Baill.	10	8	13	2	6	8	13	11	18	89	1.63
<i>Cucumis sativus</i> L.	6	5	9	--	--	8	4	7	11	50	0.90
<i>Cucurbita maxima</i> Duch.	--	--	--	2	1	4	--	--	7	14	0.25
<i>Cynodon dactylon</i> (L.) Pers.	132	128	140	129	135	148	140	136	130	1218	22.38
<i>Cyperus rotundus</i> L.	42	33	39	47	49	39	42	46	43	380	6.98
<i>Dalbergia sissoo</i> Roxb.	10	8	11	--	--	9	--	--	6	44	0.80
<i>Dichanthium annulatum</i> (Forssk.) Stapf	38	43	48	--	--	26	--	--	30	185	3.30
<i>Digitaria setigera</i> Roth apud Roem. & Schult.	26	17	22	13	9	19	13	19	9	147	2.70
<i>Eclipta prostrata</i> (L.) L.	16	14	--	--	6	3	--	--	6	45	0.80
<i>Euphorbia hirta</i> L.	19	14	13	--	--	11	--	--	13	70	1.28
<i>Gomphrena globosa</i> L.	--	--	6	4	--	--	5	--	7	22	0.40
<i>Hamelia patens</i> Jacq.	9	3	6	2	--	1	--	--	4	25	0.45
<i>Helianthus annuus</i> L.	5	3	7	--	3	--	2	4	--	24	0.44
<i>Hibiscus rosa-sinensis</i> L.	4	--	--	3	--	--	--	--	5	12	0.20
<i>Indigofera linifolia</i> Retz.	7	6	11	5	3	6	--	--	6	44	0.80
<i>Lagenaria siceraria</i> (Molina) Standley	6	5	6	--	3	8	2	6	8	44	0.80
<i>Lathyrus odoratus</i> L.	--	--	4	4	--	5	--	--	--	13	0.23
<i>Lawsonia inermis</i> L.	2	--	--	--	4	--	3	6	7	22	0.40
<i>Limonia acidissima</i> L.	9	6	11	7	5	10	--	4	--	52	0.90
<i>Lindenbergia indica</i> (L.) Vatke	8	2	9	1	--	5	--	--	3	28	0.50
<i>Luffa acutangula</i> (L.) Roxb.	--	--	--	6	5	9	11	8	13	52	0.95





<i>Mangifera indica</i> L.	9	8	11	--	2	4	6	11	17	68	1.24
<i>Melia azedarach</i> L.	3	4	6	1	--	--	7	2	5	28	0.50
<i>Moringa oleifera</i> Lamk.	--	--	--	--	--	--	--	6	3	9	0.16
<i>Parthenium hysterophorus</i> L.	131	134	132	139	132	141	136	149	127	1221	22.43
<i>Plumeria rubra</i> L.	4	2	--	2	--	--	--	--	1	9	0.16
<i>Portulaca oleracea</i> L.	5	--	--	--	--	--	3	2	4	14	0.25
<i>Prosopis juliflora</i> (Sw.) DC.	6	3	2	2	4	9	--	--	6	32	0.58
<i>Psidium guajava</i> L.	34	32	35	22	24	29	22	29	22	249	4.50
<i>Punica granatum</i> L.	--	--	8	--	--	--	3	--	6	17	0.30
<i>Ranunculus sceleratus</i> L.	4	--	5	--	--	--	2	--	--	11	0.20
<i>Raphanus sativus</i> L.	3	6	9	4	--	3	--	--	7	32	0.58
<i>Solanum</i> sp. L.	9	4	6	--	--	5	4	--	3	31	0.56
<i>Sphaeranthus indicus</i> L.	6	8	5	2	1	--	--	--	7	29	0.50
<i>Syzygium cumini</i> (L.) Skeels	8	6	7	9	11	13	--	--	4	58	1.06
<i>Tabernaemontana divaricata</i> (L.) R. Br. ex. Roem. & Schult.	--	-	--	--	6	2	--	--	6	14	0.25
<i>Tecoma undulata</i> G. Don	5	4	--	--	--	--	3	2	--	14	0.25
<i>Thevetia peruviana</i> (Pers.) K. Schum.	2	4	3	2	--	--	--	--	5	16	0.29
<i>Trianthema portulacastrum</i> L.	9	6	5	--	2	7	3	2	--	34	1.70
<i>Tribulus terrestris</i> L.	--	--	--	4	2	1	--	--	5	12	0.20
<i>Withania somnifera</i> (L.) Dunal	6	3	7	2	--	--	--	--	3	21	0.38
<i>Xanthium strumarium</i> L.	--	--	--	1	6	3	--	--	2	12	0.20
Unidentified and damaged pollens	22	19	10	10	9	13	22	16	21	142	2.60
Total	704	641	753	479	472	651	511	533	698	5442	100%
Percentage	12.94	11.78	13.84	8.80	8.67	11.96	9.39	9.79	12.83	100%	

FZ-Firozabad, **JA**-Jasrana, **SH**-Shikohabad.

Table 2 : Aero pollen calendar of summer season.

Sl. No.	Pollen Grains	Family	Local Name	Habit	Mp	D/M
1.	<i>Acacia nilotica</i> (L.) Willd. ex Del subsp.	Mimosaceae	Desi babool	Tree	En	D(Po)
2.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Latjeera, Apamarg	Herb	En	D(Mo)
3.	<i>Aegle marmelos</i> (L.) Corr.	Rutaceae	Bel	Tree	En	D(Po)
4.	<i>Alangium salviifolium</i> (L. f.) Wang.	Alangiaceae	Akorha	Tree	En	D(Ga)
5.	<i>Althaea rosea</i> (L.) Cav.	Malvaceae	Gulkhera	Herb	En	D(Po)
6.	<i>Argemone mexicana</i> L.	Papaveraceae	Satyanashi	Herb	En	D(Po)
7.	<i>Azadirachta indica</i> A Juss.	Meliaceae	Neem	Tree	Am	
8.	<i>Bergera koenigii</i> L.	Rutaceae	Meetha neem	Shrub	En	D(Po)
9.	<i>Capparis decidua</i> (Forssk.) Edgew.	Capparaceae	Kareel	Shrub	En	D(Po)
10.	<i>Carica papaya</i> L.	Caricaceae	Papita	Tree	En	D(Po)
11.	<i>Carthamus tinctorius</i> L.	Asteraceae	Kusum	Shrub	Am	D(Ga)
12.	<i>Cassia</i> sp. L.	Caesalpiniaceae	Amaltas	Tree	En	D(Po)
13.	<i>Chromolaena odorata</i> (L.) King & Robin	Asteraceae	--	Shrub	Am	D(Ga)
14.	<i>Citrullus lanatus</i> (Thunb.) Mansf.	Cucurbitaceae	Tarbooj	Herb	En	D(Po)
15.	<i>Clerodendrum inerme</i> (L.) Gaertn.	Verbenaceae	Lanjai	Shrub	En	D(Ga)
16.	<i>Coccinia grandis</i> (L.) Voigt.	Cucurbitaceae	Kundru	Shrub	En	D(Po)
17.	<i>Coriandrum sativum</i> L.	Apiaceae	Dhaniya	Herb	En	D(Po)
18.	<i>Croton bonplandianum</i> Baill.	Euphorbiaceae	Kala bhangra	Herb	An	D(Mo)
19.	<i>Cucumis sativus</i> L.	Cucurbitaceae	Khira	Herb	En	D(Po)
20.	<i>Cucurbita maxima</i> Duch.	Cucurbitaceae	Sitaphal	Herb	En	D(Po)
21.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Doob ghas, Durva	Grass	An	M
22.	<i>Cyperus rotundus</i> L.	Cyperaceae	Motha, Nagarmotha	Herb	An	M
23.	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	Shisham	Tree	En	D(Po)
24.	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Poaceae	Zarga, Apang	Grass	An	M
25.	<i>Digitaria setigera</i> Roth apud Roem. & Schult.	Poaceae	Kiwai	Grass	An	M
26.	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	Mochkand	Herb	En	D(Ga)
27.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Lal dudhi	Herb	An	D(Mo)
28.	<i>Gomphrena globosa</i> L.	Amaranthaceae	Bachelor's button	Herb	En	D(Mo)
29.	<i>Hamelia patens</i> Jacq.	Rubiaceae	Scarlet bush	Shrub	En	D(Ga)
30.	<i>Helianthus annuus</i> L.	Asteraceae	Surajmukhi	Herb	En	D(Ga)
31.	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Gurhal	Shrub	En	D(Po)
32.	<i>Indigofera linifolia</i> Retz.	Fabaceae	Neel	Herb	En	D(Po)
33.	<i>Lagenaria siceraria</i> (Molina) Standley	Cucurbitaceae	Lauki	Herb	En	D(Po)
34.	<i>Lathyrus odoratus</i> L.	Fabaceae	Jangli matar	Herb	En	D(Po)
35.	<i>Lawsonia inermis</i> L.	Lythraceae	Mehndi	Shrub	En	D(Po)
36.	<i>Limonia acidissima</i> L.	Rutaceae	Kaith	Tree	En	D(Po)
37.	<i>Lindenbergia indica</i> (L.) Vatke	Scrophulariaceae	--	Herb	Am	D(Ga)
38.	<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae	Torai	Herb	En	D(Po)
39.	<i>Mangifera indica</i> L.	Anacardiaceae	Aam	Tree	En	D(Po)
40.	<i>Melia azedarach</i> L.	Meliaceae	Bakain	Tree	En	D(Po)
41.	<i>Moringa oleifera</i> Lamk.	Moringaceae	Sahjan	Tree	En	D(Po)
42.	<i>Parthenium hysterophorus</i> L.	Asteraceae	Congress grass, Gajar ghas	Herb	An	D(Ga)
43.	<i>Plumeria rubra</i> L.	Apocynaceae	Lalchampa	Tree	En	D(Ga)
44.	<i>Portulaca oleracea</i> L.	Portulacaceae	Kulfa	Herb	En	D(Po)
45.	<i>Prosopis juliflora</i> (Sw.) DC.	Mimosaceae	Kabuli kikar	Tree	An	D(Po)
46.	<i>Psidium guajava</i> L.	Myrtaceae	Amrood	Tree	An	D(Po)
47.	<i>Punica granatum</i> L.	Punicaceae	Anar	Shrub	En	D(Po)
48.	<i>Ranunculus sceleratus</i> L.	Ranunculaceae	Jaldhania	Herb	En	D(Po)
49.	<i>Raphanus sativus</i> L.	Brassicaceae	Muli	Herb	Am	D(Po)
50.	<i>Solanum</i> sp. L.	Solanaceae	Makoi	Herb	Am	D(Ga)
51.	<i>Sphaeranthus indicus</i> L.	Asteraceae	Mundi	Herb	Am	D(Ga)
52.	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Jamun	Tree	En	D(Po)
53.	<i>Tabernaemontana divaricata</i> (L.) R. Br. ex. Roem. & Schult.	Apocynaceae	Chandni	Shrub	En	D(Ga)
54.	<i>Tecoma undulata</i> G. Don	Bignoniaceae	--	Shrub	En	D(Ga)
55.	<i>Thevetia peruviana</i> (Pers.) K. Schum.	Apocynaceae	Peeli kaner	Shrub	En	D(Ga)
56.	<i>Trianthema portulacastrum</i> L.	Aizoaceae	Santhi, Biskhanpar	Herb	Am	D(Po)
57.	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Gokhru	Herb	En	D(Po)
58.	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Asgand	Shrub	En	D(Mo)
59.	<i>Xanthium strumarium</i> L.	Asteraceae	Chhota gokhru	Herb	En	D(Ga)

Am-Amphiphilous, **An**-Anemophilous, **D**-Dicot, **En**-Entomophilous, **Ga**-Gamopetalae, **M**-Monocot, **Mo**-Monochlamydeae, **Mp**-Mode of pollination, **Po**-Polypetalae.

Total Pollen Types- **59**, Total Grasses- **03**, Total Herbs- **27**, Total Shrubs- **14**, Total Trees- **15**, Total Anemophilous- **09**, Total Entomophilous- **42**, Total Amphiphilous- **08**, Total Dicotyledons- **55**, Total Gymnosperms- **0**, Total Monocotyledons- **04**.

