



Short communication

Airborne pollen flora of Jabalpur – the central India

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Abstract

The fortnightly aerobiological survey of pollen grains at five different sites at two different heights (ground level and at 10 m) was carried out at Jabalpur city during January to December, 1996. Air sampling was done for 30 minutes at each sampling point by using a Rotorod air sampler. A total of 84 pollen types belonging to 34 families of Angiospermae and one family of Gymnospermae were identified. The maximum mean concentration ($1.04/\text{m}^3$ air) of pollen was contributed by Asteraceae followed by Amaranthaceae/Chenopodiaceae ($0.77/\text{m}^3$ air) and the minimum ($0.001/\text{m}^3$ air) by Cucurbitaceae, Convolvulaceae and Sapotaceae. Maximum numbers of pollen grains were contributed by herb species (62.07%) followed by shrubs (18.47%) and trees (14.96%). A small fraction, i.e., 4.50% of total pollen flora remained unidentified. Morphological analysis revealed maximum concentration ($1.81/\text{m}^3$) of triporate pollen grains. There was a significant difference in the pollen concentration at ground level and at 10 m height. The ratio observed was 1.7 : 1.0. There was non-significant negative correlation ($r = -0.196$) between mean pollen concentration and mean atmospheric temperature. May, the hottest month, showed minimum mean pollen concentration ($1.65/\text{m}^3$ air), whereas October, with moderate temperature, the maximum ($10.86/\text{m}^3$ air).

1. Introduction

Pollen grains are male reproductive units and are released into the air in huge amounts for the purpose of pollination. During their dispersal they come into contact with human beings and cause a number of allergic manifestations such as bronchial asthma, hay fever, naso-bronchial allergy, conjunctivitis, contact dermatitis, etc. Allergy due to pollen grains is symptomised by breathlessness, running and itching of nose and eyes and is termed "Pollinosis". The high incidence of respiratory allergy is one of the major health problems of our country. Previous surveys conducted by different workers revealed that respiratory allergy is quite common in Jabalpur (Triptipal, 1981; Tiwari, 1987). The most common causative agents are airborne pollen grains. The density and diversity of atmospheric pollen flora are affected by

climatic conditions i.e. temperature, relative humidity, wind velocity and rainfall.

Jabalpur city is situated at $23^\circ-10'N$ and $79^\circ-57'E$ at a height of 402 m Mean Sea Level (Figure 1). It has a tropical climate with five different seasons viz., **spring** (February–March), **summer** (April–15th June), **rainy** (16th June–15th September), **autumn** (16th September–November) and **winter** (December–January). Jabalpur city and its suburb has luxuriant vegetation. Forests occupy an area of 2321.13 sq. km. in the district. The forests of Jabalpur district are dry tropical forest and are divided into (A) northern tropical dry deciduous forest (Group 4B) and (B) southern tropical dry deciduous forest (Group 4A) (Champion and Seth, 1968).



Figure 1. Simple outline map of India showing the geographical position of Jabalpur.

2. Materials and methods

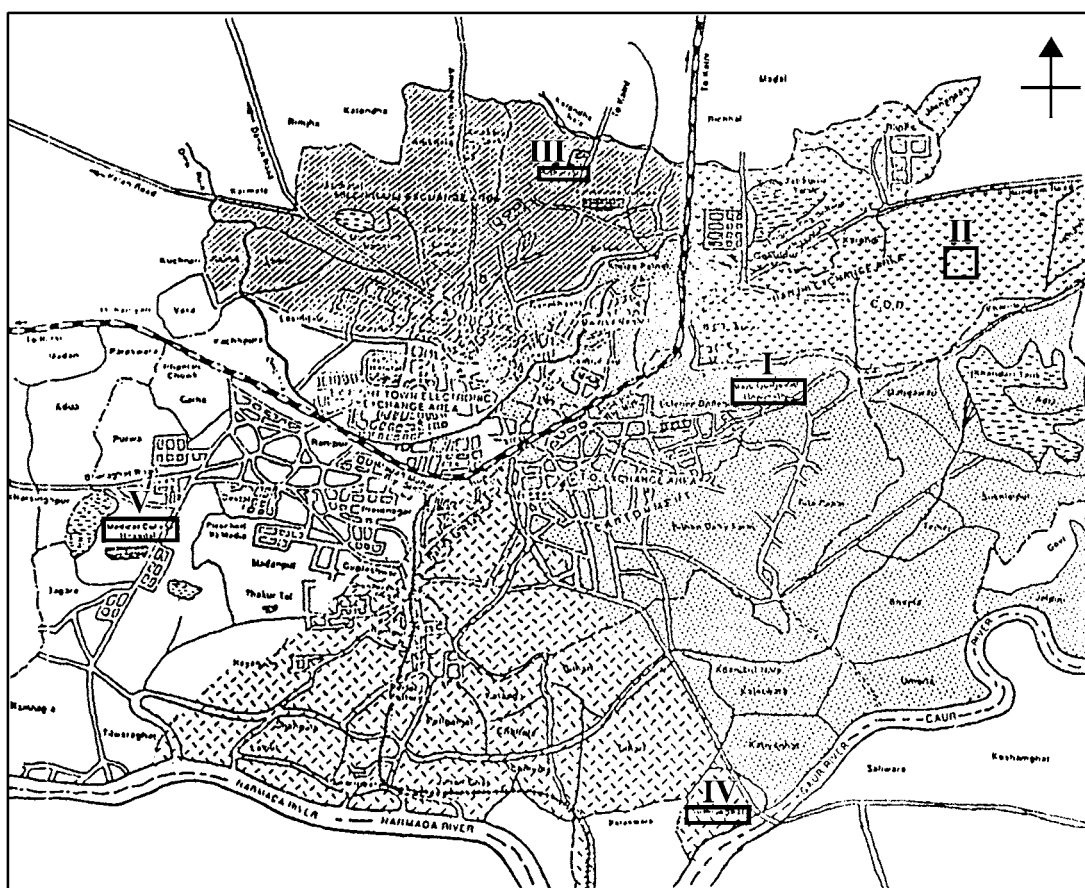
Fortnightly air sampling was carried out during January to December, 1996 by using Tilak's Rotorod air sampler (Tilak, 1987). The five sites (Figure 2) selected for air sampling were: Site – I (Rani Durgavati University campus), Site – II (Ranjhi market), Site – III (National Research Centre of Weed Science), Site – IV (Gour river farm house) and Site – V (S. C. Bose Medical College campus) having different morphometry, vegetational pattern and dwellings. Two samples (each of 30 minutes duration) were taken from each site, i.e., one at ground level and the other at a height of 10 m during the period between 09.00 hrs to 17.00 hrs (Indian standard time) of the same date. After mounting in safranin mixed glycerine jelly, the slides were scanned under light microscope at a magnification of 450 x. Identification of trapped pollen grains was done by comparing with standard pollen slides and with the help of literature.

(Erdtman, 1952, 1957; Nair, 1970). The flowering period and availability of the plants in the particular locality were also considered to distinguish morphologically similar pollen grains.

Pollen concentration (no./m³) was calculated by multiplying conversion factor, i.e., (0.3024) with pollen count. The meteorological data were recorded from the Department of Meteorology, Adhartal, Jabalpur (M.P.) which is located near site – III (National Research Centre of Weed Science, Jabalpur).

3. Results and discussion

During the whole year of air sampling, a total of 240 samples were collected. These samples revealed 84 types of pollen grains of which 35 are well known allergens (Table 1). The overall pollen flora belonged to 34 families of Angiosperm and one (Coniferae) of Gymnosperm. Out of 34 families of Angiosperm, 30



Site I – Rani Durgavati University, Pachpedi
 Site II – Ranji Market
 Site III – National Research Centre of Weed Science, Adhartal
 Site IV – Gour River Farm House, Barela
 Site V – S. C. Bose Medical College

Figure 2. Map of Jabalpur city showing the position of each of the five sampling sites.

belonged to dicotyledons (17 Polypetalae, 8 Gamopetalae and 5 Monochlamydeae) and 4 to monocotyledons (1 Coronarieae, 1 Nudiflorae and 2 Glumaceae) (Table 2).

Among dicotyledons, maximum mean number ($1.32/\text{m}^3$ air) of pollen was contributed by Gamopetalae followed by Polypetalae ($1.01/\text{m}^3$ air). The lowest concentration i.e., $0.84/\text{m}^3$ air was of Monochlamydeae, this may be due to poor density and diversity of plants and the monochlamydeous condition of flowers. The highest mean pollen concentration was contributed by Asteraceae ($1.04/\text{m}^3$ air) followed by Amaranthaceae/Chenopodiaceae ($0.77/\text{m}^3$ air) and the least by Cucurbitaceae, Sapotaceae and Convolvulaceae (each $0.001/\text{m}^3$ air) (Table 3). There was a significant difference in the pollen concentration at

ground level and at 10 m height as t_{cal} i.e., 4.26 is greater than 2.72 i.e., t_{table} at $\alpha = 0.01$ & 11 d.f. The ratio observed was 1.7 : 1.0. The highest concentration of Asteraceae pollen is because of high density of *Parthenium hysterophorus*, which flowers throughout the year and produces an enormous amount of pollen grains. Anemophilous mode of pollination is also one of the factors which accounts for its higher concentration. The same result was also observed by previous workers (Sudha and Agashe, 1996; Oommachan et al., 1996). The second highest pollen concentration of Amaranthaceae/Chenopodiaceae might be due to abundance of plants of these families and anemophilous mode of pollination. Pollen grains of *Amaranthus* sp. and *Chenopodium* sp. can not be distinguished due to their similar morphology, shape and

Table 1. Monthly count of different pollen types in twenty air samples taken from five sites (ground level and 10 m height) during January to December, 1996

S. No.	Pollen types of various plants	Flowering period (▲)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total count	% Out of grand total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	<i>Acacia</i> sp.*	8–12	1	–	1	–	–	–	2	–	–	–	3	1	8	0.19
2	<i>Achyranthus aspera</i>	11–2	–	–	5	–	–	–	–	–	–	7	19	8	39	0.93
3	<i>Acacia auriculiformis</i> *	3–6	–	–	–	–	–	–	–	–	3	4	–	–	7	0.17
4	<i>Ageratum conyzoides</i> *	9–3	10	5	–	–	–	–	–	–	–	–	–	–	15	0.36
5	<i>Ailanthus excelsa</i> *	1–3	1	73	10	–	–	–	–	–	–	–	–	–	84	2.01
6	<i>Alternanthera sessilis</i>	1–12	69	–	–	11	–	–	–	–	–	3	6	10	99	2.37
7	<i>Allium cepa</i>	11–3	–	3	–	1	1	–	–	–	–	–	–	–	5	0.12
8	<i>Amaranthus/Chenopodium</i> *	8–1	3	12	30	5	3	4	–	1	15	244	126	31	474	11.33
9	<i>Antigonon leptopus</i>	10–12	–	–	–	–	–	–	–	–	–	–	13	–	13	0.31
10	<i>Argemone mexicana</i> *	2–6	–	6	11	6	3	2	–	–	–	–	2	2	32	0.76
11	<i>Avena sterilis</i> *	1–4	–	–	–	–	–	–	–	–	–	–	8	–	8	0.19
12	<i>Azadirachta indica</i> *	3–5	–	–	7	10	2	–	–	–	–	–	–	–	19	0.45
13	<i>Barlaria cristata</i>	10–2	–	–	–	–	–	–	–	–	–	–	–	2	2	0.05
14	<i>Basella alba</i>	10–12	–	–	–	–	–	–	–	–	–	3	–	2	5	0.12
15	<i>Bauhinia purpurea</i>	9–11	–	–	–	–	–	–	–	–	–	–	3	1	4	0.09
16	<i>Bombax ceiba</i> *	2–3	–	26	11	1	–	–	–	–	–	–	–	–	38	0.91
17	<i>Bougainvillea glabra</i>	1–12	–	–	–	–	–	–	–	–	–	–	3	–	3	0.07
18	<i>Butea monosperma</i>	2–4	–	1	3	–	–	–	–	–	–	–	–	–	4	0.09
19	<i>Carica papaya</i>	1–12	2	8	–	–	2	1	1	2	1	7	3	1	28	0.67
20	<i>Callistemon lanceolatus</i>	10–12	–	–	5	–	2	–	–	–	–	–	–	2	9	0.22
21	<i>Capparis</i> sp.	1–6	–	–	–	12	–	–	–	–	–	–	–	–	12	0.29
22	<i>Cassia fistula</i> *	4–7	–	–	–	–	1	–	–	–	–	–	–	–	1	0.02
23	<i>Cassia siamea</i> *	1–12	–	–	–	–	–	–	–	–	5	–	18	–	23	0.55
24	<i>Cassia tora</i> *	8–12	–	–	–	–	–	–	–	–	2	2	–	–	4	0.09
25	<i>Cestrum nocturnum</i>	8–11	3	–	–	–	–	–	–	–	–	–	2	–	5	0.12
26	<i>Ceiba pentandra</i> *	1–3	–	–	3	–	–	–	–	–	–	–	–	–	3	0.07
27	<i>Crotalaria juncea</i>	11–1	–	–	–	–	–	–	–	–	–	–	1	–	1	0.02
28	<i>Cyperus triceps</i> *	9–12	–	–	–	–	–	–	–	3	–	–	–	–	3	0.07
29	Cyperaceae*		–	–	–	–	–	–	–	4	3	81	123	42	253	6.05
30	<i>Cucumis</i> sp.	6–10	–	–	–	1	–	–	–	–	–	–	–	–	1	0.02
31	<i>Cynodon dactylon</i> *	1–12	1	4	–	–	–	–	–	–	–	8	19	16	48	1.15
32	<i>Datura metel</i>	11–4	3	1	1	–	–	–	–	–	–	–	–	–	5	0.12
33	<i>Delonix regia</i> *	3–6	–	–	–	–	3	–	1	–	–	–	–	–	4	0.09
34	<i>Dichanthium annulatum</i> *	10–1	–	2	–	–	–	–	–	–	–	–	–	–	2	0.05
35	<i>Dodonea viscosa</i> *	11–12, 1–2	–	88	6	2	–	–	–	–	–	–	–	–	96	2.29
36	<i>Eucalyptus</i> sp.*	1–4	3	22	–	1	–	1	–	–	–	2	12	10	51	1.22
37	<i>Emblica officinalis</i>	7–10	–	–	–	2	–	–	–	–	–	–	–	–	2	0.05
38	<i>Fimbristylis dichotoma</i> *	9–11	–	–	–	–	–	–	24	277	20	9	–	–	330	7.89
39	<i>Gomphrena celosioides</i>	5–9	–	–	–	–	–	–	–	–	–	–	3	–	3	0.07
40	<i>Helianthus annuus</i>	7–9	–	–	–	1	1	1	–	–	–	–	–	–	3	0.07
41	<i>Heteropogon contortus</i> *	10–12	1	8	–	–	–	–	–	–	–	–	–	–	9	0.21
42	<i>Holoptelea integrifolia</i> *	1–4	–	–	3	–	–	–	–	–	–	–	–	–	3	0.07
43	<i>Indigofera trifoliata</i>	10–12	–	–	–	–	–	–	–	–	–	1	–	–	1	0.02
44	<i>Ipomoea fistulosa</i> *	12–3	–	–	1	–	–	–	–	–	–	–	–	–	1	0.02
45	<i>Lantana indica</i>	9–1	1	6	–	5	–	1	7	–	–	115	8	2	145	3.47

Table 1. Continue

S. No.	Pollen types of various plants	Flowering period (▲)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total count	% Out of grand total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
46	<i>Lawsonia innermis</i> *	3-8	-	-	-	-	27	-	-	-	-	-	6	-	33	3.47
47	<i>Lagerstroemia speciosa</i> *	4-9	-	-	-	-	-	-	-	2	2	12	-	-	16	0.38
48	<i>Lycopersicon esculentum</i>	7-9	-	-	1	-	-	-	-	-	-	-	-	-	1	0.38
49	<i>Leucas aspera</i>	8-2	-	2	-	-	-	-	-	-	-	-	-	-	2	0.05
50	<i>Mangifera indica</i>	1-3	-	2	-	-	-	-	-	-	-	-	-	-	2	0.05
51	<i>Mimusops elengi</i>	3-7	-	-	-	-	1	-	-	-	-	-	-	-	1	0.02
52	Mimosaceae		1	1	11	1	-	-	-	-	-	-	-	-	14	0.33
53	<i>Moringa oliefera</i>	1-5, 10-12	5	9	1	5	1	-	-	-	-	-	-	-	21	0.5
54	<i>Nyctanthus arbotristis</i>	9-11	-	-	-	1	-	-	-	-	-	-	-	-	1	0.02
55	<i>Ocimum canum</i>	7-12	1	-	-	-	-	-	-	-	-	-	-	-	1	0.02
56	<i>Parthenium hysterophorus</i> *	1-12	2	-	101	236	15	63	67	85	72	15	67	39	762	18.22
57	<i>Pinus</i> spp.	1-5	-	-	-	-	-	4	-	-	-	-	-	-	4	0.1
58	<i>Peltophorum pterocarpum</i> *	3-5, 7-1	-	-	1	1	4	10	23	1	11	41	-	-	92	2.2
59	<i>Pithecellobium dulce</i>	12-3	-	-	4	-	-	-	-	-	-	-	-	-	4	0.1
60	<i>Prosopis cineraria</i> *	3-5	-	-	1	-	-	-	-	-	-	-	-	-	1	0.02
61	<i>Psidium guajava</i>	4-6	1	8	-	-	-	-	1	-	-	-	-	-	10	0.24
62	Poaceae*		38	39	21	27	3	-	15	21	47	111	85	19	426	10.18
63	<i>Parkinsonia aculeata</i>	11-12	-	4	1	-	-	-	-	-	-	-	-	-	5	0.12
64	<i>Polygonum glabrum</i>	9-3	-	-	-	-	-	-	-	-	-	-	11	1	12	0.29
65	<i>Quisqualis indica</i>	9-3	-	-	-	-	2	-	-	-	-	-	1	-	3	0.07
66	<i>Ricinus communis</i> *	1-3	-	1	-	-	-	-	-	-	2	-	-	-	3	0.07
67	<i>Rungia pectinata</i>	10-12	2	1	-	-	-	-	-	-	-	-	-	3	6	0.14
68	<i>Saraca indica</i>	5-7	-	-	1	-	-	-	-	-	-	-	-	-	1	0.02
69	<i>Solanum</i> sp.	11-6	-	2	-	-	-	-	-	-	-	-	-	-	2	0.05
70	<i>Spherranthus indicus</i>	11-2	-	-	-	-	-	-	1	-	-	-	-	-	1	0.02
71	<i>Syzygium cumini</i>	4-6	-	-	151	2	4	-	-	-	-	-	-	-	157	3.78
72	<i>Terminalia arjuna</i>	4-8	-	-	-	1	-	-	-	-	-	-	-	-	1	0.02
73	<i>Tectona grandis</i>	8-9	-	-	-	-	-	-	-	-	-	4	1	1	6	0.14
74	<i>Taberneomontana divaricata</i>	1-12	-	-	-	-	-	-	-	-	-	-	-	2	2	0.05
75	<i>Tephrosia purpurea</i>	9-11	-	-	-	-	-	-	-	-	-	-	2	-	2	0.05
76	<i>Trema orientalis</i>	7-9	-	-	-	-	-	-	-	1	-	10	6	-	17	0.41
77	<i>Tridax procumbens</i>	1-12	-	-	-	-	-	1	-	-	-	15	-	-	16	0.38
78	<i>Typha angustifolia</i> *	10-12	-	7	115	60	6	29	125	-	-	-	-	-	342	8.18
79	<i>Triticum aestivum</i> *	11-3	32	14	-	-	-	-	-	-	-	-	-	-	46	1.1
80	<i>Vitex negundo</i>	10-2	32	2	-	3	1	-	-	1	-	-	-	-	39	0.93
81	<i>Vernonia cineraria</i>	1-12	-	1	-	-	-	-	-	-	-	-	2	-	3	0.07
82	<i>Xanthium strumarium</i> *	9-10	-	-	-	-	-	-	-	-	-	-	14	13	27	0.65
83	Umbelliferae		-	-	-	-	-	-	-	-	-	-	-	3	3	0.07
84	<i>Zeamays</i> *	8-12	-	-	-	-	1	1	2	-	-	-	2	-	6	0.14
	Unidentified		5	18	21	12	26	22	11	13	14	24	10	11	187	4.47
	Total		217	376	527	407	109	140	280	41	197	718	579	222	4183	100
	Monthly mean pollen concentration (no./m ³ air)		3.28	5.68	7.97	6.15	1.65	2.12	4.23	6.21	2.98	10.86	8.75	3.36		

*Indicates allergenic pollen (Prasad and Pramila, 1998).

(▲) Numerals 1-12 of flowering period represent corresponding months of the year starting from January to December.

Table 2. Pollen contribution of major taxonomic categories during 1996

Group – Dicotyledons			Monocotyledons			Gymnosperms		Unidentified
Class	Families	Mean Pollen conc./m ³ air	Series	Families	Mean Pollen conc./m ³ air	Family	Mean Pollen conc./m ³ air	Mean Pollen conc./m ³ air
Polypetalae	17	1.01	Coronarieae	1	0.01			
Gamopetalae	8	1.32	Nudiflorae	1	0.43	Coniferae	0.01	0.24
Monochlamydeae	5	0.84	Glumaceae	2	1.42			

Conc. = Concentration.

Table 3. Pollen concentration of different families in descending order (January to December, 1996)

S. No.	Family	Total No. of Pollens in 240 samples	Mean no. of pollens/sample	Mean pollen concentration/m ³ air
1	Asteraceae	827	3.44	1.040
2	Amaranthaceae/Chenopodiaceae	615	2.56	0.774
3	Cyperaceae	586	2.44	0.738
4	Poaceae	545	2.27	0.686
5	Typhaceae	342	1.42	0.429
6	Myrtaceae	227	0.94	0.284
7	Verbenaceae	190	0.79	0.239
8	Caesalpinaceae	134	0.55	0.166
9	Sapindaceae	96	0.40	0.121
10	Simoroubaceae	84	0.35	0.106
11	Papaveraceae	60	0.25	0.076
12	Lythraceae	49	0.20	0.060
13	Bombacaceae	41	0.17	0.051
14	Mimosaceae	34	0.14	0.042
15	Polygonaceae	25	0.10	0.030
16	Moringaceae	21	0.08	0.024
17	Ulmaceae	20	0.08	0.024
18	Meliaceae	19	0.07	0.021
19	Solanaceae	13	0.05	0.015
20	Capparidaceae	12	0.05	0.015
21	Acanthaceae	8	0.03	0.009
22	Fabaceae	8	0.03	0.009
23	Euphorbiaceae	5	0.02	0.006
24	Liliaceae	5	0.02	0.006
25	Basellaceae	5	0.02	0.006
26	Combretaceae	4	0.01	0.003
27	Coniferae	4	0.01	0.003
28	Nyctaginaceae	4	0.01	0.003
29	Lamiaceae	3	0.01	0.003
30	Umbelliferae	3	0.01	0.003
31	Apocynaceae	2	0.008	0.002
32	Anacardiaceae	2	0.008	0.002
33	Cucurbitaceae	1	0.004	0.001
34	Sapotaceae	1	0.004	0.001
35	Convolvulaceae	1	0.004	0.001
	Unidentified	187	0.77	0.233
Grand total		4183		

Table 4. Descending order of different pollen morphotypes based on NPC system of classification

S. No.	Type of pollens	Total no. of pollens	Mean no. of pollens/sample	Mean pollen concentration (no. /m ³ air)	% out of grand total
A	(1) 3-Porate	1437	5.99	1.810	34.35
	(2) 3-Colpate	971	4.05	1.220	23.21
	(3) Polyporate	653	2.72	0.820	15.61
	(4) 1-Porate	545	2.27	0.690	13.02
	(5) 3-Colporate	202	0.84	0.250	4.83
	(6) 5-Porate	116	0.48	0.150	2.77
	(7) Polyad	34	0.14	0.043	0.81
	(8) 4-Colporate	19	0.08	0.020	0.45
	(9) Inaperturate	5	0.02	0.006	0.12
	(10) 1-Sulcate	5	0.02	0.006	0.12
	(11) 2-Colpate	3	0.01	0.004	0.07
	(12) 6-Porate	2	0.01	0.003	0.05
B	Winged	4	0.02	0.006	0.05
C	Unidentified	187	0.78	0.240	4.50

size (Prasad and Pramila, 1998; Singh, 1997). The least pollen concentrations of Convolvulaceae, Cucurbitaceae and Sapotaceae may be due to the large size and sticky nature of pollen grains and entomophilous mode of pollination.

Habitwise, analysis of pollen contribution shows maximum percentage of herbs (62.07%) followed by shrubs (18.47%) and trees (14.96%). A small fraction, i.e., 4.50% of airborne pollen flora remained unidentified. The percentage contributions are related to the pollen contribution made by the constituent species of each plant group. Herbaceous plant species belonged mainly to Asteraceae, Amaranthaceae/Chenopodiaceae, Poaceae, and Cyperaceae. These families contributed the highest pollen concentration as discussed above. The lower pollen contribution by shrubs and trees might be due to the low frequency of occurrence and short flowering period of the plants belonging to these groups. These results are similar to those reported by previous workers (Oommachan et al., 1996; Sudha and Agashe, 1996). The morphological analysis of the trapped grains on the basis of NPC system of pollen classification revealed maximum mean concentration of 3-porate grains (1.81/m³ air) and a minimum of 6-porate grains (0.003/m³ air). The concentration of winged pollen grains was 0.006/m³ air (Table 4).

There were two main pollen seasons (i) September to November and (ii) February to April. The seasonal

distribution of pollen seems to be related to the flowering periods of the plants. The maximum number of plants flower during these periods and release a huge amount of pollen grains in the air.

Incidence of *Prosopis cineraria* pollen in Jabalpur is quite interesting. During the floristic survey, this species was not encountered in the vicinity of Jabalpur city (Oommachan and Shrivastava, 1996). However, floristic survey as well as aerobiological survey of Bhopal district (about 400 km from Jabalpur) indicated the occurrence of this plant and pollen (Tripathi et al., 1978). Thus, it may be an example of long distance dispersal of pollen grains. The earlier findings proved that pollen may undergo long distance aerial transport (Salas, 1983).

The concentration of pollen grains is affected by meteorological parameters such as temperature, relative humidity, rainfall, etc. (Table 5). The Karl Pearson coefficient of correlation was calculated between mean pollen concentration (mean of 10 samples of each sampling date) and mean atmospheric temperature of the respective dates. The computed value of the coefficient (r) for 24 sampling dates is equal to -0.196. The student's t test shows a non-significant negative correlation as the null hypothesis ($H_0: r = 0$ Vs $H_A: r \neq 0$) is accepted because $t_{cal} -0.938$ is lying in the region of acceptance i.e., between ± 2.074 ($t_{table} 0.05, 22$ d.f.) which means that pollen concentration decreases with

Table 5. Fortnightly mean pollen concentration and climatic conditions during January to December, 1996

Months	Survey Schedule	Total number of pollen in 10 samples	Mean number of pollen	Mean pollen concentration/ m ³ air	Mean Temperature (°C)	Mean relative humidity (%)	Rainfall of the sampling date (mm)
January	I	102	10.2	3.08	20.35	88.0	0.30
	II	115	11.5	3.48	14.95	39.5	0.00
February	I	148	14.8	4.47	17.65	82.5	0.00
	II	228	22.8	6.89	23.10	55.5	0.00
March	I	202	20.2	6.11	25.85	52.5	0.00
	II	325	32.5	9.83	25.90	28.5	0.00
April	I	182	18.2	5.50	29.15	45.0	0.00
	II	225	22.5	6.80	31.35	50.5	0.00
May	I	56	5.6	1.69	35.20	30.5	0.00
	II	53	5.3	1.60	35.25	19.5	0.00
June	I	76	7.6	2.30	32.55	49.0	0.00
	II	64	6.4	1.93	31.70	48.0	0.00
July	I	150	15	4.53	31.25	76.0	0.00
	II	130	13	3.93	27.50	91.5	2.20
August	I	303	30.3	9.16	23.80	95.0	5.10
	II	108	10.8	3.26	27.30	79.5	0.10
September	I	114	11.4	3.45	28.25	71.0	1.80
	II	83	8.3	2.51	29.85	62.5	6.30
October	I	247	24.7	7.47	25.15	55.0	0.00
	II	471	47.1	14.24	22.80	82.5	0.00
November	I	428	42.8	12.94	24.10	64.0	0.00
	II	151	15.1	4.57	20.50	59.0	0.00
December	I	114	11.4	3.45	13.20	60.5	0.00
	II	108	10.8	3.26	16.75	56.5	0.00
Grand total		4183					

increase in atmospheric temperature. The negative correlation is also evident as May (1.65/m³ air) and June (2.12/m³ air) showed the minimum mean pollen concentration due to maximum mean temperature, i.e., 41.49°C and 39.44°C, of the respective months. October (10.86/m³ air) and November (8.75/m³ air) showed the maximum mean pollen concentration under moderate temperature. Similar findings are also reported from Delhi and Lucknow (Dutta, 1989; Khandelwal, 1988).

Mean concentration of pollen grains was also correlated with the average relative humidity and the value of correlation coefficient (r) calculated for 24 sampling dates was equal to 0.229. Student's t test shows that there was no significant positive correlation between these two variables and the null hypothesis ($H_0: r = 0$ Vs $H_A: r \neq 0$) is accepted because t_{cal} 1.103 is lying between ± 2.074 (t_{table} 0.05, 22df).

The correlation coefficient (r) between mean pollen concentration, and rainfall of the respective sampling dates was found to be -0.065 . Student's t -test shows that rainfall did not show significant negative correlation with mean pollen concentration and the null hypothesis ($H_0: r = 0$ Vs $H_A: r \neq 0$) is accepted because t_{cal} -0.306 is lying between ± 2.074 (t_{table} 0.05, 22 df). The result shows that monthly mean pollen concentration was affected by rainfall viz. June–July (rainy period) which showed minimum pollen concentration as compared to October and November- the rain-free months having maximum pollen concentration. The rain decreased atmospheric pollen concentration by stopping the dispersal of pollens and by accelerating the process of deposition. On the contrary, the dry period facilitated pollen dispersal through the air. Feher and Jarai-Komlodi (1996) reported that there exists a significant difference in airborne pollen

concentration of ragweed (*Ambrosia elatior*) on days displaying different weather types. They found that most of the anticyclonic situations are favourable for pollination whereas all cyclonic situations are unfavourable, probably due to the precipitation by fronts.

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