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Pollen calendar of Agra city with special reference to allergenic significance

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Abstract: *The pollen calendar of Agra was recorded with special reference to allergenic significance. Pollen grains of 35 species belonging to 23 angiosperm families have been identified out of a total catch of 24,220/m³ of air annually. High occurrence of pollen grains in air belonged to Asteraceae (5222/m³) and Parthenium hysterophorus contributed the maximum (17.91%) of the total airspora. Higher counts of pollen were found in ecozones surrounded by agricultural fields, parks and gardens. The skin prick tests for the clinical investigation were made. Patients of bronchial asthma with rhinitis (62.30%) were maximum followed by bronchial asthma (25.61%) and allergic rhinitis (12.07%). Maximum number of patients had symptoms between the age group of 31-40 years and male were more sensitive than females. Maximum sensitivity was caused by Amaranthus spinosus, followed by P. arthenium, P. hysterophorus, Chenopodium album, Cynodon dactylon and Cassia occidentalis.*

Key words: *Pollen calendar, Agra city, Allergenic significance.*

Introduction

Aerobiological studies have gained unique importance in recent years. Spores and pollen are chief aeromicrobial components, which have been of utmost importance due to their phytopathogenic and allergic effects. Pollen spectra of the atmosphere are useful for the selection of proper antigen during desensitization treatment of respiratory allergy in human beings (Kasliwal and Solomon, 1959). A document titled "Pollen Calendar" of different states, India (Annonymous, 1992) provides information on air borne pollen allergens and their precise season in the atmosphere pollen calendar of Allahabad (Chaturvedi, 1993), Delhi (Singh and Babu, 1982; Singh, 1996) and Gwalior (Jain and Gupta, 1999) provide a ready reference for allergenically significant plants.

Agra, the city of Taj is the ultimate destination of tourists world over. Everyday, so many people from various parts of India and abroad visit the city. The present study will be useful for those who are sensitive to pollen allergy so that they can plan accordingly their tour and can escape from the incidence of allergy. The present paper deals with the pollen calendar of Agra city with special reference to allergenic significance.

Materials and Methods

The aerobiological investigations were done with the help of Rotorod Sampler during the period between "2000-2002". The fortnightly trips for floristic survey were made in seven different ecogeographical zones of Agra city including those where the aerobiological devices were kept for pollen trapping (Fig. 1 and Table 1). The plants with frequent occurrences were identified and their flowering periods and mode of pollination were recorded.

Identification of airborne pollen was done by comparing them with the corresponding pollen in the reference collections made during extensive and periodic field trips to various parts of the city and the adjoining areas covering various seasons of the year. Reference slides of acetolysed pollen were prepared by the method suggested by Erdtman (1969). Number and distribution of apertures and various patterns of ornamentation of exine were the chief characters employed for the identification of atmospheric pollen, as confirmed from standard literature for pollen identification by Erdtman (1952); Faegri and Iverson (1964); Tilak (1989).

Skin prick test: The skin prick test for the clinical investigation was done in collaboration with Allergist Dr. Varun Chaudhary, Allergic clinic, Varun Market, Bypass Road, Agra. Results of the skin prick test reactions have been analyzed on the basis of different age group of patients, age of onset of disease and associated allergic symptoms.

Results and Discussion

The floristic survey of Agra city revealed quite variable spectra, comprising of trees, shrubs, weeds and grasses (Sharma and Dhakre, 1995). The dominant families of herbs and shrubs are Papilionaceae, Poaceae, Asteraceae, Cyperaceae, Acanthaceae, Convolvulaceae, Euphorbiaceae, Amaranthaceae, Scrophulariaceae, Malvaceae, Boraginaceae and Labiatae. On the other hand, Anacardiaceae, Bignoniaceae, Bombacaceae, Meliaceae, Moraceae, Myrtaceae, Salvadoraceae and Ulmaceae are dominant families of woody trees. The flowering period of 155 plants belonging to 58 families of Agra has been presented in view of their significance in aeropalynology (Chauhan and Singh, 2002). Airborne pollen grains are synchronized with the flowering period of plants of a locality.

A total of 35 types of pollen grains belonging to 23 angiospermic families were identified during the study period i.e. 2000-2002 out of the total catch of 24,220/m³ of air (Table 2). Among the 23 contributing families high occurrence of pollen grains in air belonged to Asteraceae (5222/m³) followed by

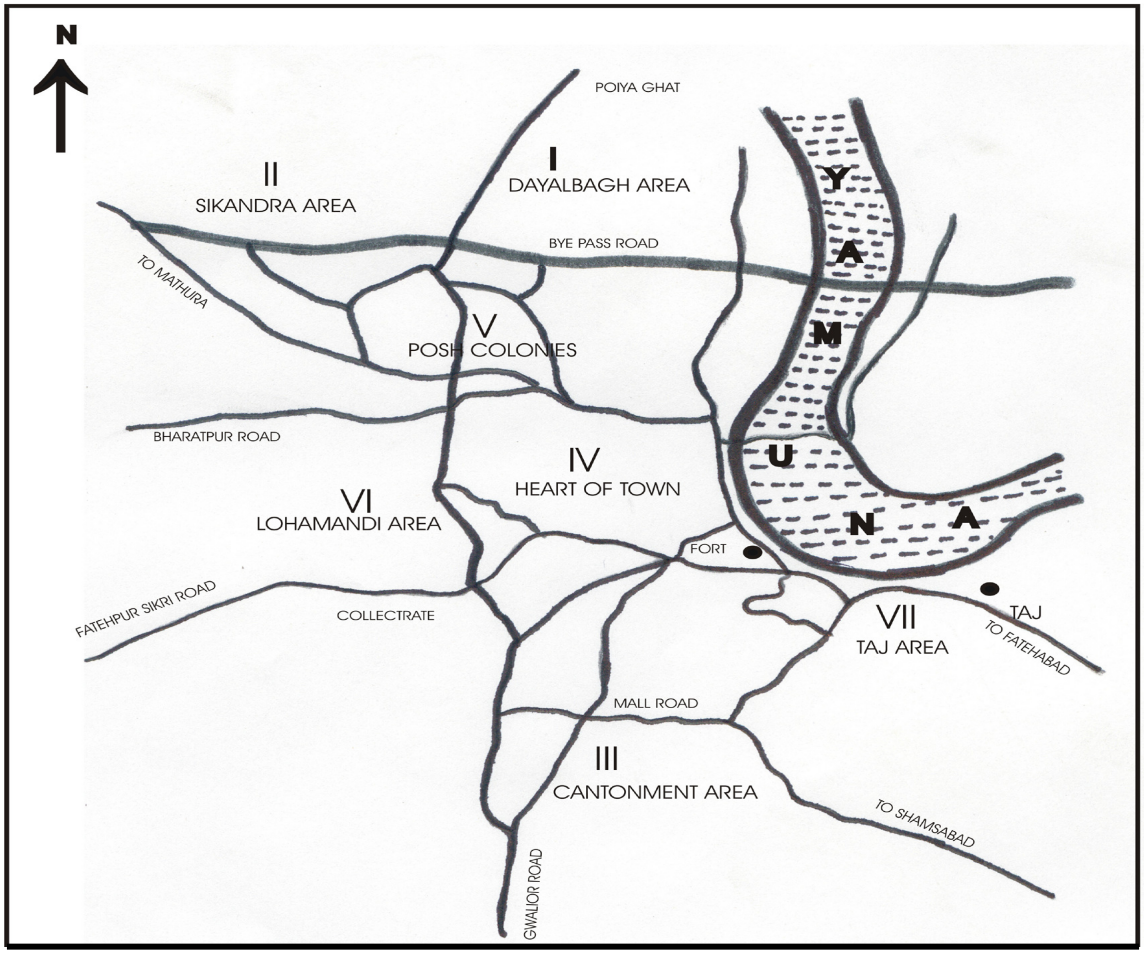

Fig. 1: Ecogeographical zones of Agra city.

Table – 1: Ecogeographical zones of Agra city.

No.	Zones	Area	% Contribution of total airspora
I	Dayalbagh area	DEI Deemed University, Poyia Ghat, Open fields and Residential part.	23.57
II	Sikandra	Outskirt of city, a mixture of residential area and vast open field.	17.5
III	Contonment area	Mall road, Agra Cantt Railway station, Airforce station, Madhu Nagar, Arjun Nagar and Sadar Bazar.	15.67
IV	Heart of Town	Kinari Bazar, Daresi, Kala Mahal, Ghatia, Belanganj and Chipitila.	14.50
V	Posh colonies	Lajpat Kunj, Nehru Nagar, New Agra, Surya Nagar, Professor Colony and Kamla Nagar	13.72
VI	Lohamandi area	Lohamandi, Shahganj, Jagdishpura, Jaipur House and Saket Colony.	13.01
VII	Taj area	Taj Mahal, Red Fort, Shahahan Garden, Motilal Nehru Park and Taj Ganj.	23.02

Poaceae (3234/m^3), Amaranthaceae (2828/m^3), Caesalipiniaceae (2128/m^3), Myrtaceae (1386/m^3), Verbenaceae (1372/ m^3) Brassicaceae (1092/m^3) and Nyctaginaceae (1022/m^3). On the other hand, other families e.g. Apocynaceae (924/m^3), Bignoniaceae (756/m^3), Anacardiaceae (700/m^3) Solanaceae (462/m^3), Meliaceae (448/m^3), Balsaminaceae (406/m^3), Papaveraceae (364/m^3), Malvaceae (350/m^3), Euphorbiaceae (308/m^3), Papilionaceae (294/m^3), Rubiaceae (280/m^3), Salvadoraceae (252/m^3), Liliaceae (56/m^3), Rhamnaceae and Cariaceae (28/m^3) also contributed to the air (Table 2 and Figs. 2 & 3). Pollen grains of Chenopodiaceae and Amaranthaceae are grouped together as Amaranth/Chenopodiaceae because of their stenopalynous nature. Similarly, grasses were identified as Poaceae. Poaceae, *Parthenium*, Amaranth/Chenopodiaceae, and *Cassia* were observed throughout the study period. Plants of *Parthenium*

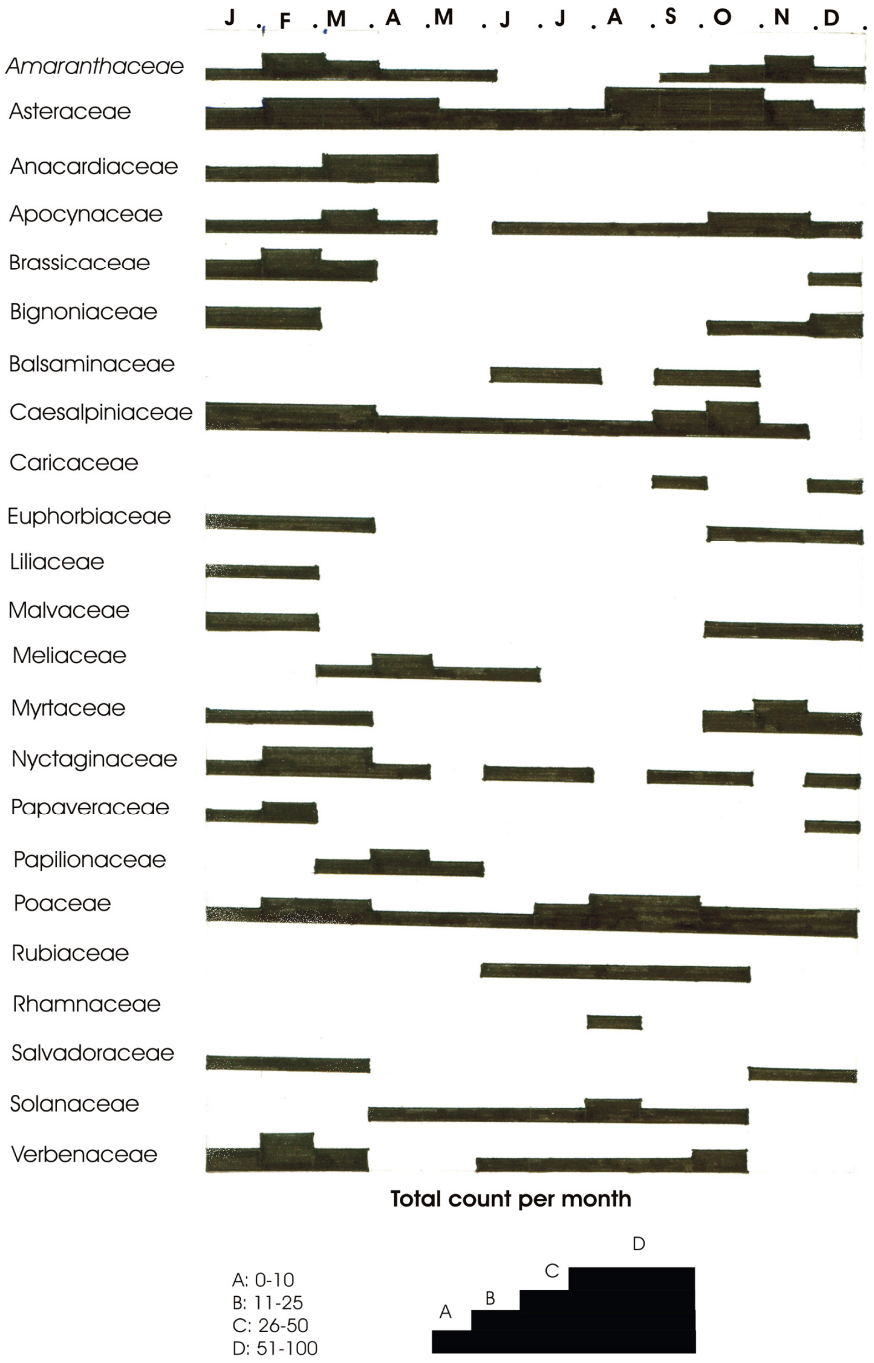

Fig. 2: Pollen calendar of Agra city, 2000-2002.

flower almost round the year with a good number of pollen grains.Dominance of these pollen types has also been reported from other parts of the country (Tripathi and Oommachan,1981; Seetharamaiah *et al*., 1981; Agashe and Abraham, 1988). This is because atmospheric concentration of pollen is essentially a function of the frequency, density, abundance of plants and their flowering behavior at a given locality. However, a number of entomophilous plants also liberate good amount of pollen in air. These include *Cassia* (1554), *Brassica* (1092), *Lantana* (672), *Bougainvillea* (784), *Mitragyna (*280) and *Carica* (28)/m^3 of air. However, pollen of anemophilous plant species outnumbered and dominated the entomophilous type. This could be attributed to the wind currents which are the carrier of pollen from one plant to another (Table 2).

The wind blown pollen is light and buoyant, thus can be easily blown by light breeze. Their rate of production is very

Table – 2: Airborne pollen of some plants of Agra city.

Plants(Pollen types)	Total pollen count per month	Yearly concentration No./m³ of air	% contribution to the total airspora
Amaranthaceae	202	2828	-
1. Achyranthus	12	168	0.69
2. Amaranth/chenopodiaceae	190	2660	10.98
Asteraceae	373	5222	-
3. Ageratum	20	280	1.15
4. Helianthus annuus	3	42	0.17
5. Parthenium hysterophorus	310	4340	17.91
6. Xanthium	40	560	2.31
Anacardiaceae			
7. Mangnifera indica	50	700	2.89
Apocynaceae			
8. Nerium indicum	66	924	3.81
Brassicaceae			
9. Brassica	78	1092	4.50
Balsaminaceae			
10. Impatiens	29	406	1.67
Bignoniaceae			
11. Tecoma	54	756	3.12
Caesalpiniaceae	152	2128	-
12. Bauhinia	3	42	0.17
13. Cassia	111	1554	6.41
14. Delonix	31	434	1.79
15. Parkinsonia	7	98	0.40
Caricaceae			
16. Carica	2	28	0.11
Euphorbiceae	22	308	-
17. *Croton*	17	238	0.98
18. *Ricinus*	5	70	0.28
Liliaceae			
19. *Allium*	4	56	0.23
Malvaceae	25	350	
20. *Hibiscus*	22	308	1.27
21. *Abutilon*	3	42	0.173
Meliaceae			
22. Azadirachta indica	32	448	1.84
23. Myrtaceae			
24. Eucalyptus	99	1386	5.72
Nyctaginaceae	73	1022	-
25. *Boerhaavia*	17	238	0.98
26. *Bougainvillea*	56	784	3.23
Papaveraceae			
27. *Argemone*	26	364	1.50
Papilionaceae			
28. *Dalbergia*	21	294	1.21
29. *Poaceae*	231	3234	13.35

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Rubiaceae			
30. *Mitragyna*	20	280	1.15
Rhamnaceae			
31. *Zizyphus*	2	28	0.11
Salvadoraceae			
32. *Salvadora oleoides*	18	252	1.04
Solanaceae	33	462	-
33. *Solanum nigrum*	26	364	1.50
34. *Withania*	7	98	0.40
Verbenaceae	98	1372	-
35. *Lantana*	48	672	2.77
36. *Clerodendron*	50	700	2.89
Unidentified	20	280	1.15
Total	1730	24220	

Table – 3: Age groups at the onset of symptoms and type of allergy.

Age in years	Rhinitis	Bronchial asthma with rhinitis	Bronchial asthma	Total
1-10	-	-	-	-
11-20	28	40	109	177
21-30	75	345	70	490
31-40	65	510	150	725
41-50	10	26	37	73
51-60	4	18	20	42
Total	182	939	386	1507
Percentage	12.07	62.30	25.61	

Table – 4: Results of the skin tests against various pollen allergic in patients.

S. No.	Name of antigen tested	No. of patients showing positive reaction	Percentage
	Pollen allergens		
1	*Amanranthus spinosus*	623	16.39
2	*Argemone maxicana*	197	5.18
3	*Asphodelus tenuifolius*	55	1.44
4	*Brassica campestris*	187	4.92
5	*Cannabis sativa*	138	3.63
6	*Carica papaya*	78	2.05
7	*Cassia occidentalis*	244	6.42
8	*Cassia siamea*	180	4.73
9	*Chenopodium album*	332	8.73
10	*Chenopodium murale*	237	6.23
11	*Cynodon dactylon*	285	7.50
12	*Imperata cylindrica*	24	0.63
13	*Kigelia pinnata*	56	1.47
14	*Lantana camara*	165	4.34
15	*Morus alba*	82	2.15
16	*Pennisetum typhoides*	76	2.00
17	*Prospis juliflora*	92	2.42
18	*Parthenium hysterophrous*	334	9.05
19	*Ricinus communis*	178	4.68
20	*Salvadora persica*	40	1.05
21	*Sorghum vulgare*	68	1.78
22	*Xanthium strumarium*	129	3.39
	Total	3800	

high. The pollination in entomophilous plants depends upon the visit of insects like bees, flies, wasps, moths and beetles. Further, their pollen production is less, pollen are heavy and sticky and hence can not be blown by light breeze, but still they are present in air due to their detachment from the carrier (insect) during the flight.

Distribution of pollen in different ecogeographical zones: Ecogeographical zones I (Dayalbagh area) and VII (Taj area) showed maximum number of pollen grains (23.57 and 23.02% respectively). This is largely because these areas are open, semi-rural areas comprising mostly herbaceous plants, vast green land, gardens, parks surrounded by agricultural fields. Similarly, ecozones II (Sikandra area) and III (Cantonment area) also showed significant number of pollen grains (17.5 and 15.67% respectively). These areas also surrounded by open fields showing great deal of diversity in the vegetation. On the other hand, the ecozones IV (heart of town) and V (Posh colonies) showed comparatively lower count of pollen grains (14.5 and 13.72% respectively). This may be due to the mixture of residential area and trading complex. The zone VI (Lohamandi area) exhibited minimum number of pollen grains(13.01%) as it is thickly populated area with more or less no vegetation (Table 1).variation in the pollen concentration from different ecozones of the same urban township has also been reported by Oommachan *et al.* (1998) from Jabalpur and Malik *et al*. (1991) from Delhi.

Effect of climate: The role of weather conditions over the peak incidence in the atmosphere is also well established. The pollen grains were in highest concentration during February-April and August-October with temperature ranging between 20-30ºC. This may be because of their presence of pollen in air, although the pollen caught was varying in frequencies throughout the year. Lowest occurrence was found during May and June with high temperature and low relative humidity. Similar observations were reported earlier by Leuschner (1974). Sudha and Agashe (1996) also reported maximum airborne pollen concentration in October and November from Bangalore. Annual variations in pollen concentration due to climatic factors have also been studies by Al-Doory *et al.* (1982) and Jato *et al*. (1996). Rain also has a profound influence on the number of pollen in air by inhibiting anthesis or washing off effect. This accounts for the reduction in the number of pollen grains during rainy seasons and is similar to the findings of Hyde and Williams (1943), Gregory (1973) and Oommachan *et al.* (1988; 1996).

Allergenic significance of pollen

Skin prick test: During the study period 1507 patients were examined. Out of 1507 patients 909 were males and 598 were females. Maximum number of patients exihibited several symptoms between 31-40 years of age, followed by 21-30 years age group, than 11-20 and 41-50,51-60 years age group. No case was recorded in the age group of 0-10 years (Table 3). Jain *et al.* (1979) reported that the maximum incidence of Nasobranchial allergy due to Poaceae, *Amranthus* and *Parthenium* occurred in the patients of the age group of 20-39 years.

A total of 26 types of pollen antigens tested on patients, indicate that higher sensitivity was exhibited by *Amranthus spinosus* followed by *Parthenium hysterophrous*, *Chenopodium album, Cynodon dactylon* and *Cassia occidentalis*.(Table 4). Similar observations have also been recorded by Singh (1996) from Delhi. Jato *et al*. (1996) reported that Poaceae is an important source of allergenic pollen causing hay fever and asthama. Babu *et al.* (1979) reported that the concentration of the atmospheric pollen had no functional relationship with the symptamology of respiratory allergy, but the type of pollen appears to have some relationship with it.

Bronchial asthma with rhinitis (62.30) was maximum followed by bronchial asthma (25.61) and allergic rhinitis (12.07%) (Table 3).

In distribution of sex of different patients, the male dominated (60.31%) the female (39.68%). Generally, there was a peak of allergic disease of the respiratory tract in winter months than rainy and summer months (Table 5).

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