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## Atmospheric concentration of pollen grains at human height

PUSHPA MALIK, A. B. SINGH, C. R. BABU and S. V. GANGAL

Malik, P., Singh, A. B., Babu, C. R. & Gangal, S. V. 1991. Atmospheric concentration of pollen grains at human height. – Grana 30: 129–135, 1991. Odense, September 1991. ISSN 0017-3134.

An atmospheric survey at human height (1.5–1.8 ft) was carried out from February 1988 to January 1990, in four different ecozones of the Delhi metropolis. The samples were collected by using Burkard Personal Volumetric Sampler at weekly intervals. The sampler was operating for 15 min three times a day (07, 14, 20 hrs). Altogether, 84 pollen types were identified. Some of the dominant pollen types recorded were Poaceae (25.1%), Chenop/Amaranthaceae (14.5%) and *Ricinus communis* (12.3%) followed by *Morus*, *Cannabis*, *Prosopis*, *Parthenium* and *Artemisia*. Weekly variations were recorded for the total number of pollen of different types in different months. Two major pollen seasons 1. February – April and 2. August – October were observed, although pollen was recorded throughout the year. Significant variation in total and individual pollen concentration was recorded from different inhabited areas in the same urban locality. Any definite daily pattern in the occurrence of pollen was not recorded. The concentration at lower height was also poor.

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Aerial surveys of pollen and fungal spores are considered as an essential aspect of the study of the respiratory allergic diseases. Continuous monitoring of the qualitative and quantitative composition of airborne pollen is of paramount importance in pollinosis (Newmark 1968, Solomon 1983, Lewis et al. 1984, D'Amato & Lobefalo 1989). In India, the seriousness of allergic diseases began to be appreciated in the sixties as more than 10% of the population were estimated to suffer from major allergic disorders (Vishwanathan 1964). Delhi, being the garden city of India, has lots of exotic plants in different inhabited areas. Studies on the atmospheric pollen of the Delhi region were initiated by Shivpuri and his associates (Shivpuri et al. 1960, Dua & Shivpuri 1962, Singh & Babu 1982).

However, the above mentioned studies were of qualitative nature based on gravitational methods. The data were collected by installing the samplers at 10–15 m height (Kasliwal et al. 1959, Dua & Shivpuri 1962, Mittre & Khandelwal 1973, Tripathi et al. 1978, Tilak & Vishwe 1980, Chanda & Mandal 1980, Singh & Babu 1982 a, b). The sampling method used in the current investigation has thus provided the exact exposure load to which people are subjected to airborne pollen inhalation. The data was collected at

weekly intervals from different zones for limited period because of practical convenience. Since most of the people are exposed to various pollen prevailing at lower height (1.5–1.8 m), it was considered appropriate to find out the common pollen types present at this height in different inhabited areas of Delhi metropolis, as an aid for diagnosis and treatment of allergic disorders.

### MATERIALS AND METHODS

The atmospheric survey was carried out for two consecutive years from February 1988 to January 1990, using the Burkard personal volumetric sampler. The sampler was operated at human height (1.5–1.8 m) three times a day, (07, 14, 20 hrs), for 15 min, at weekly intervals. Delhi was arbitrarily divided into four zones, north, south, east and west. The samples were collected from each zone to get better representation of atmospheric pollen. North zone is densely populated and is characterised by a secondary forest of thorny type growing on Delhi ridge, which is an extension of Aravalli hills. South zone constitutes, a posh locality with lot of exotic and avenue trees in the parks and along road sides. West zone is sparsely populated and includes industrial and agricultural sites and vacant lots. East zone is characterised by swampy areas of the banks of the Yamuna, beside orchard gardens and agricultural fields. The zone is densely populated with pockets of slums.

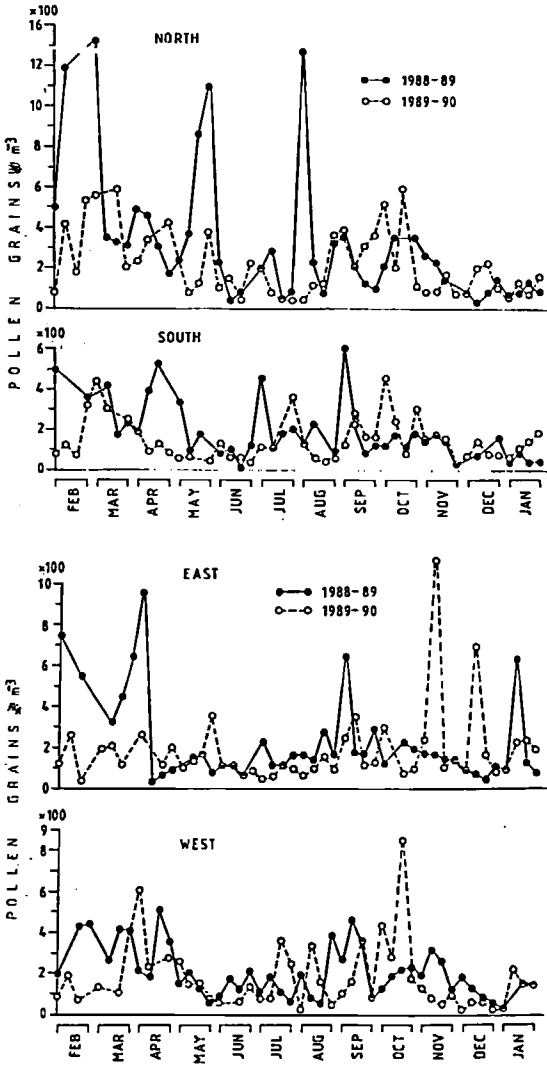


Fig. 1. Total weekly concentration of recorded pollen types at human height from north, south, east and west zones of Delhi during 1988-89 and 1989-90.

**RESULTS**

The periodical, seasonal and annual variations of total and eight dominant types are analysed below in detail.

**Weekly concentration**

The concentrations of total pollen types obtained as a result of the weekly samplings, from the different zones in Delhi are illustrated in Fig. 1.

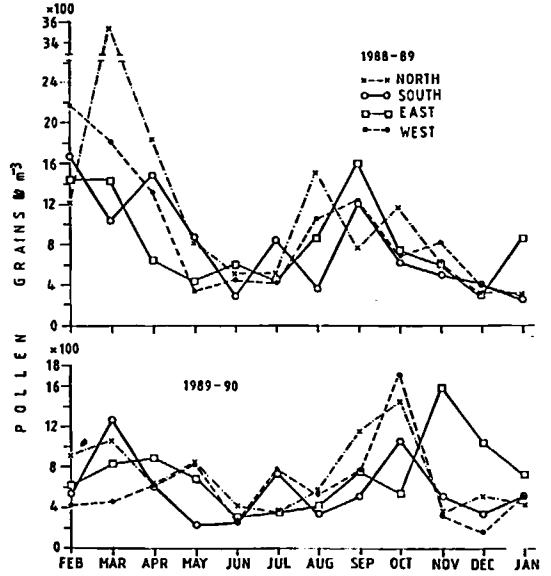


Fig. 2. Total seasonal concentration of airborne pollen in the different zones of Delhi (1988-89 and 1989-90).

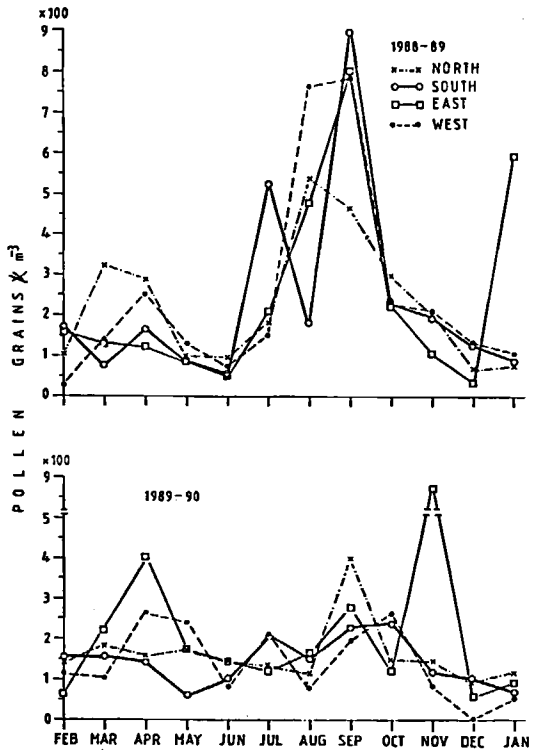


Fig. 3. Seasonal variations of Poaceae pollen in the different zones of Delhi (1988-89 and 1989-90).

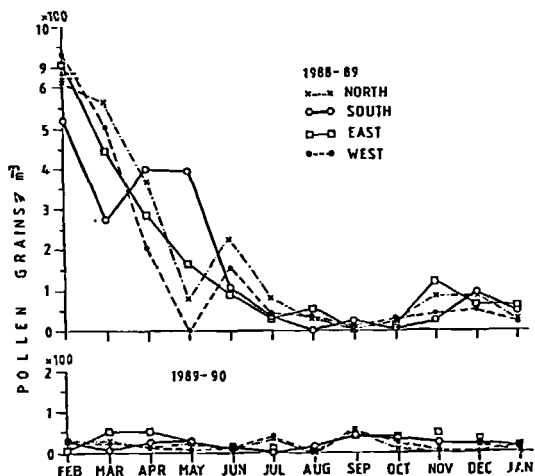


Fig. 4. Seasonal variations of the *Ricinus* pollen obtained in the different zones of Delhi 1988-89 and 1989-90.

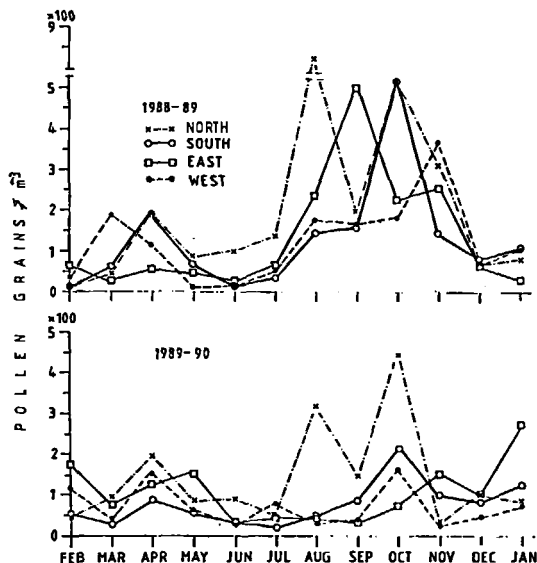


Fig. 5. Seasonal variations of the *Cheno/Amaranthaceae* pollen recorded during 1988-89 and 1989-90 in Delhi.

**Seasonal variation**

Altogether 84 pollen types were identified. Of these 41, belonged to trees and 42 to herbs. Grasses were identified together as Poaceae.

Two main pollen seasons are observed: 1. February-April, and 2. August-October, although pollen grains were caught in varying frequencies throughout the year (Fig. 2). The seasonal variation in the pollen concentration of Poaceae is illustrated in Fig. 3. The major grass pollen season is in the period from July to October, preceded by a minor peak in March-April. The airborne pollen concentration of *Ricinus* reveals a peak season from November to March (Fig. 4). The major pollen season for *Cheno/Amaranthaceae* is July-December (Fig. 5). In May and June the airborne pollen concentration was generally low.

*Morus* pollen shows a short season during February-March (Fig. 6). *Cannabis* pollen has a peak from February to May, although it was observed in almost all of the months (Fig. 6) with zonal variations. An unusual peak of 280 pollen grains  $m^{-3}$  was observed in August 1989, from the west zone. *Artemisia* shows two pollen periods, one in February-April, and another in September-November. In 1989-90, a high concentration was recorded from all the zones with varying frequencies in October.

The two major pollen seasons for *Prosopis* are in March-April, and in September-November (Fig. 7). The concentration of *Parthenium* pollen grains was

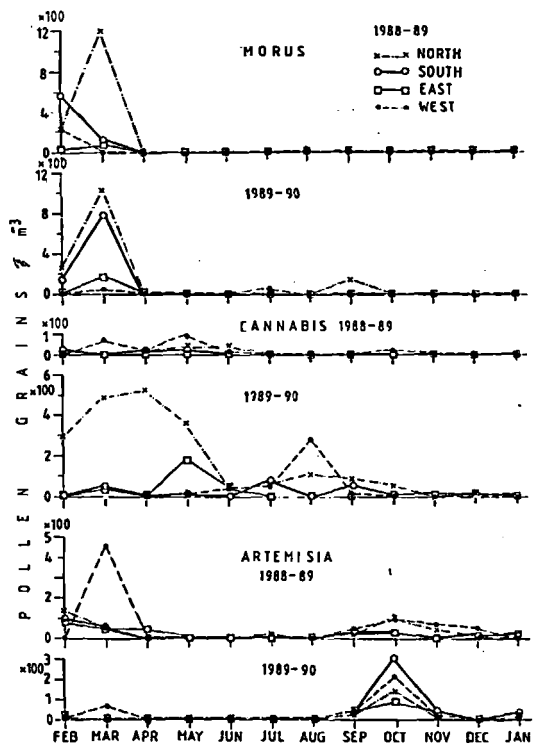


Fig. 6. Seasonal variations of *Morus*, *Cannabis* and *Artemisia* pollen recorded from different zones in Delhi during 1988-89 and 1989-90.

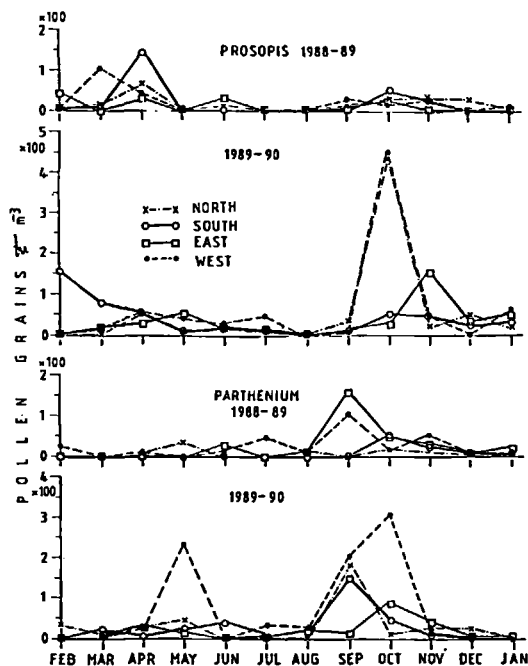


Fig. 7. Seasonal variations of *Prosopis* and *Parthenium* pollen in the different zones of Delhi during 1988-89 and 1989-90.

high in August-November (Fig. 7), and a smaller peak ( $234 \text{ m}^{-3}$ ) was observed from west zone in May 1989.

#### AVERAGE ANNUAL CONCENTRATION

The average annual concentration for the total number of pollen grains and for the seven dominant pollen types recorded from the different areas in Delhi at different times of the day are illustrated in Fig. 8.

The total pollen concentration in 1988-89 was higher in the morning ( $17.589 \text{ pollen m}^{-3}$ ), followed by afternoon ( $15.142 \text{ pollen m}^{-3}$ ) and evening ( $12.593 \text{ pollen m}^{-3}$ ), whereas in 1989-90 highest concentration was recorded in afternoon ( $13.587 \text{ pollen m}^{-3}$ ), followed by  $10.250 \text{ pollen m}^{-3}$  and  $9.693 \text{ pollen m}^{-3}$  in morning and evening, respectively (Fig. 8). Most of the dominant types had low catch in the evening as compared to the afternoon and morning. However, Poaceae pollen showed a concentration of  $1131 \text{ pollen m}^{-3}$  in the evening while  $822 \text{ pollen m}^{-3}$  in the morning. Total pollen as well as Chenopodiaceae, Poaceae, *Ricinus*, *Cannabis* and *Parthenium* exhibited low catch from the south com-

pared to the north, east and west zones (Fig. 8). *Parthenium* pollen was distinctly high in the afternoon in all the zones.

#### Relative concentration

The average percent contribution of the dominant pollen types from different ecozones of Delhi contributing more than 1% are illustrated in Table I. Poaceae is the dominating pollen type (25%) followed by Chenopodiaceae (14.5%) and *Ricinus* (12.3%). Other types are represented with 6.7% (*Morus*) to 1.3% (*Brassica*).

#### DISCUSSION

In the present investigation, in total 84 pollen types have been identified. Pollen of *Abies*, *Pinus*, *Mimosa*, Scrophulariaceae, *Tribulus terrestris*, *Primula* and *Pongamia* is observed for the first time in the Delhi atmosphere. But pollen of *Livistona*, *Lawsonia*, *Kigelia*, *Lagerstroemia* is not observed by us. The absence of these types could be due to the entomophilous nature of these taxa or to the sampling height adopted. Samples collected at weekly intervals reveals significant variations in total pollen concentrations from different inhabited areas. These variations are more prominent in 1988-89 from the north and south zones as compared to the east and west zones. However, in 1989-90, the fluctuations are not as sharp as in the previous year. Day to day fluctuations in the pollen concentration are reported by many workers (Kasliwal et al. 1959, Tripathi et al. 1978, Smart & Knox 1979, Singh & Babu 1980a, b, Spieksma et al. 1985, Galán et al. 1989). These periodical variations could be due to various climatic factors or different environmental settings in different areas.

#### Seasonal periodicity

In general at human height, two peaks in the annual pollen concentration are observed, one in February-April another in August-October, although the pollen caught is varying in frequencies throughout the whole year. This is in agreement with earlier studies conducted in Delhi at higher heights (Singh 1986). Due to the poor vegetation the lowest pollen concentration is recorded in June.

Grass pollen were the main contributor in the total pollen catch with an average of 25%. Of this, 55% are found during the peak seasons. High con-

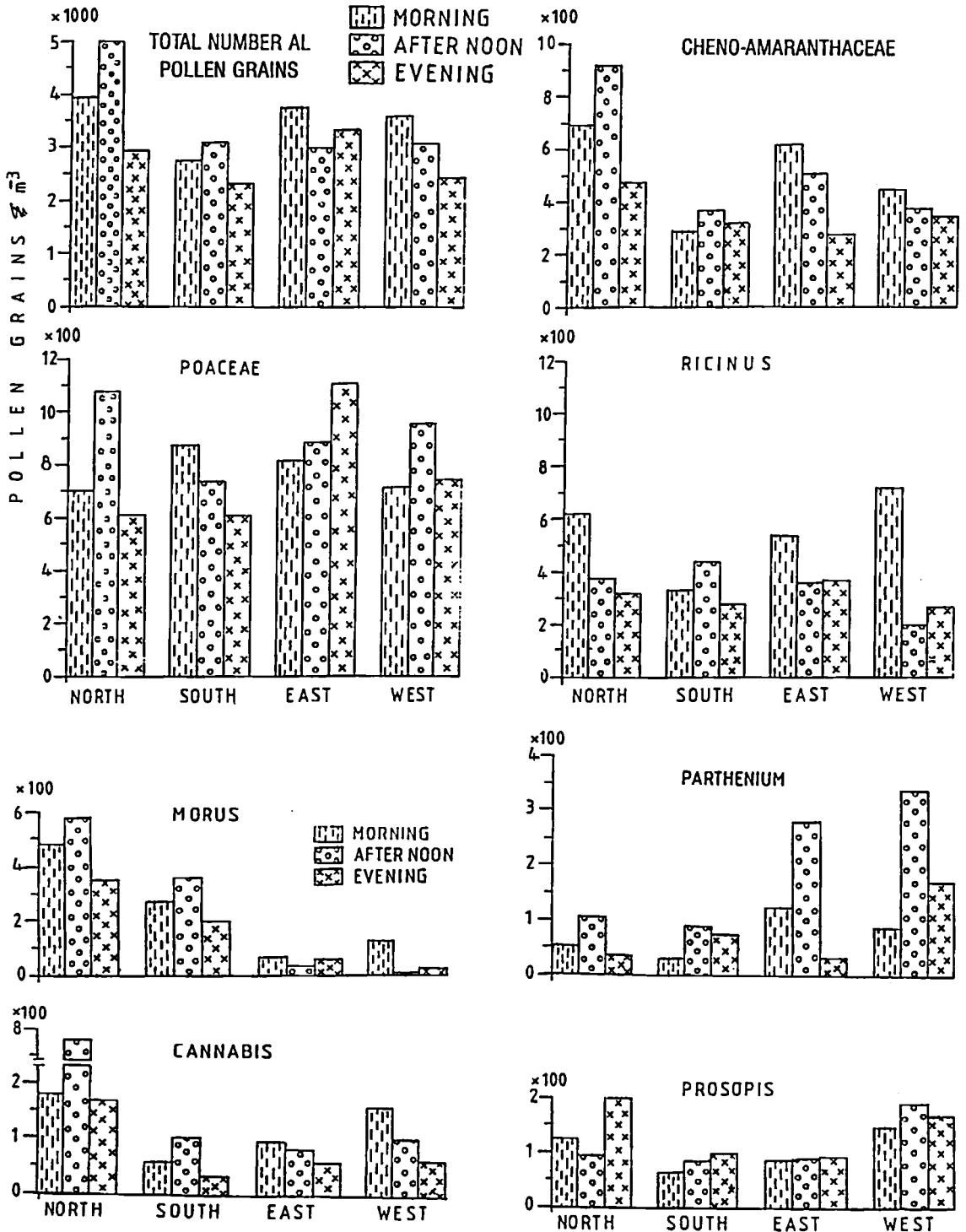


Fig. 8. Total average annual concentration of predominant pollen types from different zones in Delhi recorded at three times of the day.

Table I. The average contribution of dominant pollen types in different zones of Delhi (1988–89, 1989–90)

Name	%				
	North	South	East	West	Average
Poaceae	20.0	27.4	28.5	25.9	25.1
Cheno/Amaranthaceae	17.5	12.1	14.3	12.9	14.5
<i>Ricinus</i>	11.0	12.8	12.8	13.0	12.3
<i>Morus</i>	12.0	10.2	1.8	1.9	6.7
<i>Cannabis</i>	9.3	2.3	2.0	3.3	4.6
<i>Prosopis</i>	3.6	3.1	2.7	5.6	3.7
<i>Parthenium</i>	1.6	2.7	4.5	6.5	3.7
<i>Artemisia</i>	2.7	4.3	1.7	5.9	3.6
<i>Eucalyptus</i>	3.5	1.0	2.9	1.7	2.4
Brassicaceae	0.8	1.3	1.8	1.3	1.3

centrations of Poaceae are reported from Delhi and other parts of India (Dua & Shivpuri 1962, Singh & Babu 1980, Chanda & Mandal 1980, Ravindran et al. 1988), even by using the gravitational devices. As compared to previous year the concentration of *Ricinus* pollen declined considerably during 1989–90. This could be due to the poor vegetation of *Ricinus communis* in the fields because of the eradication of the road side communities. The high concentration in 1989–90, is also partly suspected to depend on a laboratory contamination. Pollen processed for antigenic preparation might have contributed to exposed slides while mounting in the laboratory. However, a high concentration is also reported by Shivpuri et al. (1960). Pollen grains of Chenopodiaceae and Amaranthaceae are grouped together as Cheno/Amaranthaceae because of their stenopalynous nature. The pollen contributes with 14.5% to the annual catch.

Pollen concentration of Cheno/Amaranthaceae, *Morus* and *Cannabis* are highest from the north zone. This could be due to extensive growth of these weeds along road sides and vacant lots. Extensive plantations of mulberry trees in the north compared to the east and west zones explains the higher concentration of this pollen type. *Artemisia* pollen shows two peak seasons at lower heights, in contrast to only one season (September–October) reported by other workers (Dua & Shivpuri 1962, Singh & Babu 1982). The sporadic presence of this pollen type could be due to their suspension in the

air for a longer period as some plants flower erratically after the main pollination season.

No definite pattern is seen for *Parthenium* and *Prosopis* pollen. *Parthenium* has recently invaded all the open places and grows extensively throughout the year. The concentration of this pollen in Delhi is very low as compared to Bangalore and Aurangabad (Agashe & Alfadil 1989, Tilak & Vishwe 1980). Low concentrations of *Prosopis* pollen are recorded as compared to earlier reports from Delhi (Dua & Shivpuri 1962, Singh & Babu 1982). Pollen of *Abies*, *Alnus*, *Betula*, *Pinus* and *Quercus* is observed sporadically in the air although not planted in the area except for some pine trees. This pollen is thought to have drifted from north Himalaya about 500 km away from Delhi.

#### Annual variation

The average pollen concentrations obtained as a result of sampling from the different zones in the morning, afternoon and evening, reveals certain degrees of variation. In 1988–89, the concentration was highest in the morning whereas in the latter year the concentration was high in the afternoon. Similarly, a definite pattern was not revealed with respect to dominant pollen types from the different zones. Poaceae pollen exhibited high concentrations in the afternoon from the north and west, whereas from the other two zones from morning and evening. Singh and Babu (1980b) reported a morning pattern for grass pollen from Delhi. Types such as *Artemisia* and *Ricinus* were more prevalent during morning hours. It is interesting to note that *Parthenium* pollen are observed in significantly high concentration in the afternoon from all the zones. The absence of any definite pattern in the concentration of the pollen recorded at three times of the day could be due to limited period and location of sampling.

In summary, two pollen seasons 1. February – April and 2. August – October were observed even at lower height with significant zonal variations even in the same urban locality. No definite pattern was obtained with different pollen types collected at three times of the day, and pollen catch was poor at human height.

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