

A preliminary survey of airborne pollen in Madras City

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Abstract

The atmospheric pollen of Madras city was surveyed during a 1-year period (January–December 1995) with a vertical cylinder trap. A total of 32 pollen types were identified, among which nine were present throughout the year. These belonged to Poaceae, *Casuarina equisetifolia* Foster and Foster f., *Prosopis juliflora* (SW.) DC., *Acalypha indica* L., *Parthenium hysterophorus* L., Cyperaceae, *Cocos nucifera* L., Amaranthaceae, and *Typha angustata* Borry and Chaub. Among the identified pollen, 61.05% belonged to trees, 21.01% to grasses, 11.65% to herbs and 6.27% to shrubs. Anemophilous pollen contributed about 52.87% to the total while entomophilous and amphiphilous pollen contributed 38.89 and 8.22%, respectively. Pollen belonging to Poaceae were found to be most predominant in the air of Madras city followed by *Casuarina equisetifolia* and *Prosopis juliflora*. © 1998 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

Among various types of biological particles present in the air, pollen and fungal spores play an important role in causing various kinds of allergic disorders like asthma, allergic rhinitis, etc. Although fungal spores exceed pollen in a given volume of air, the volume concentration of the pollen may actually be larger (Susan Isaac, 1996). The routine monitoring of pollen in the atmosphere is therefore of great help in the diagnosis and treatment of pollen allergies as well as subsequent patient care. The airborne pollen of several cities in India are well documented (Chanda and Mandal, 1980a,b; Singh and Babu, 1981a,b; Janaki Bai and Subba Reddi, 1982, 1983; Nair et al., 1986; Singh et al., 1987; Agashe and Abraham, 1988; Gopi et al., 1990; Prakash Kumar et al., 1993; Satheesh et al., 1993a,b; Agashe et al., 1994).

However aeropalynological data for Madras, which is one of the four metropoliton cities of India, are lacking. Hence it was felt worthwhile to make a survey of pollen in the atmosphere of Madras city. This study was designed to identify airborne pollen types and monitoring their seasonal frequencies leading to the preparation of a pollen calendar.

2. Description of the sampling site

The survey was carried out in the city of Madras which is the capital of Tamil Nadu. The city covers 170 km² area and is situated 13° 8'N 80° 19'E and 30 m above MSL on the east coast of India. The metropolis has about 55 lakhs population.

Madras has a typical humid tropical climate with overlapping seasons. The winter (December–January) is mild with mean day temperatures around 28°C and night temperatures varying between 19–20°C. The period between March and May is the typical summer

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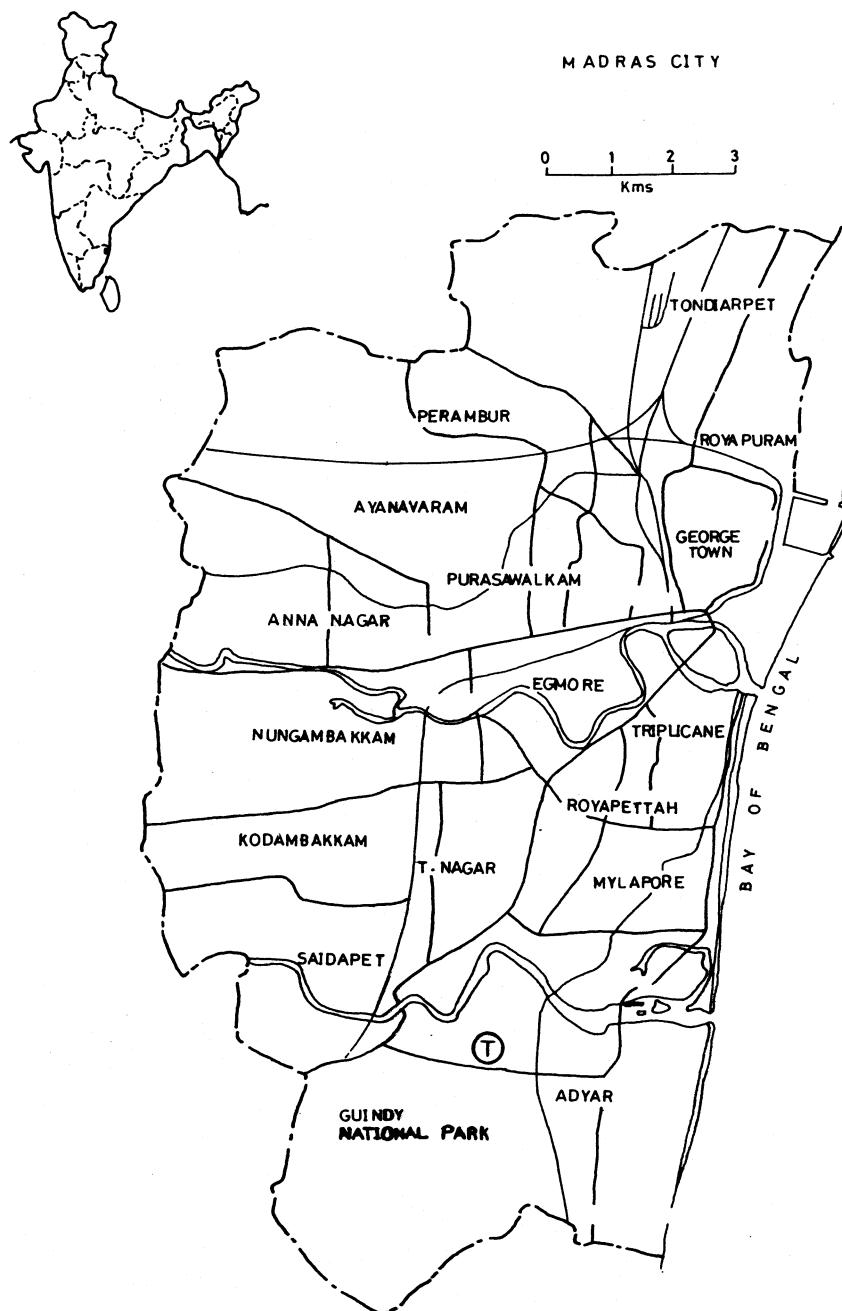


Fig. 1. Map of Madras City showing location of trap (T).

season and the maximum temperature goes up to 45°C , the month of May being the hottest. The daily mean temperature during this season will be around 35°C with high relative humidity and turbulent winds. The South-West monsoon season starts from June and continues up to September and the daily mean temperature during this period varies between $28\text{--}30^{\circ}\text{C}$. The city receives its first rainfall during August–September depending on the South-West monsoon. The months of October and November constitute the retreating North-East monsoon season during which the city receives maximum rainfall under the influence of frequent cy-

clonic storms due to low pressure depression in Bay of Bengal. The daily mean temperature varies between 26 and 28°C .

The Guindy Campus of the Madras University where the cylinder trap was located is bounded on the North, West and East by residential areas and South by Guindy National park which is less than a kilometre from the trapping site (Fig. 1). The National park covers an area of 270.57 ha of the South-West corner of Madras City and the vegetation in the park is mixed dry deciduous scrub jungle. This forest comprises nearly 200 species of trees, shrubs, climbers, herbs and

grasses which are mostly indigenous. During summer the entire vegetation looks dry due to the deciduous nature of the vegetation but turns into green immediately after the monsoon.

The dominant plant species in the National Park are *Albizia lebbeck* (L.) Benth., *Azadirachta indica* Adr.Juss., *Borassus flabellifer* L., *Cassia* sp., *Citrus* sp., *Delonix regia* (Hook.) Raf., *Dodonaea viscosa* Linn., *Feronia elephantum* Corr. Serr., *Lannea coromandelica* (Houtt.) Merr., *Mangifera indica* L., *Mimusops elengi* L., *Morinda tinctoria* Roxb., *Parthenium hysterophorus* L., *Santalum album* L., *Syzygium cumini* (L.) Skeels., *Tamarindus indica* L., *Toddalia asiatica* (L.) Lam. and several species of grasses.

The Guindy Campus of Madras University covers 16.84 ha and the vegetation consists of *Albizia lebbeck*, *Borassus flabellifer*, *Cassia* sp., *Delonix regia*, *Feronia elephantum*, *Lannea coromandelica*, *Mangifera indica*,

Table 1

Airborne pollen types and their percentage occurrence during a 1-year sampling period

Name of the plant/family	Total (16622)	%
<i>Acalypha indica</i> L.	487	2.92
<i>Allophylus serratus</i> (Roxb.) Kurz.	19	0.11
<i>Alternanthera</i> sp.	10	0.06
Amaranthaceae	360	2.16
Asteraceae	113	0.67
<i>Azadirachta indica</i> Adr. Juss.	305	1.83
<i>Bauhinia purpurea</i> L.	79	0.47
<i>Borassus flabellifer</i> L.	169	1.01
<i>Cassia siamea</i> Lam.	215	1.29
<i>Casuarina equisetifolia</i> Foster and Foster f.	3092	18.60
<i>Cocos nucifera</i> L.	401	2.41
<i>Croton bonplandianus</i> Baillon	29	0.17
Cyperaceae	416	2.50
<i>Dodonaea viscosa</i> Linn.	203	1.22
<i>Eucalyptus tereticornis</i> Smith	112	0.67
<i>Feronia elephantum</i> Corr. Serr.	1719	10.34
<i>Ixora</i> sp.	17	0.10
<i>Kigelia pinnata</i> DC.	565	3.39
<i>Lannea coromandelica</i> (Houtt.) Merr.	169	1.01
Mimosaceae (polyads only)	58	0.34
<i>Parthenium hysterophorus</i> L.	477	2.86
<i>Peltophorum pterocarpum</i> (DC.) Backer ex K. Heyne	121	0.72
<i>Phyllanthus emblica</i> L.	27	0.16
<i>Plecosperrum spinosum</i> Trecul.	52	0.31
Poaceae	3360	20.21
<i>Prosopis juliflora</i> (Sw.) Dc.	2498	15.02
<i>Pterolobium hexapetalum</i> (Roth) Santapau and Wagh	10	0.06
<i>Ricinus communis</i> L.	68	0.40
<i>Syzygium cumini</i> (L.) Skeels	213	1.28
<i>Tinospora cordifolia</i> (Willd.) Hook. f and Thomson	177	1.06
<i>Typha angustata</i> Bory and Chaub	322	1.93
<i>Ziziphus oenoplea</i> (L.) Miller	123	0.73
Unidentified	636	3.82

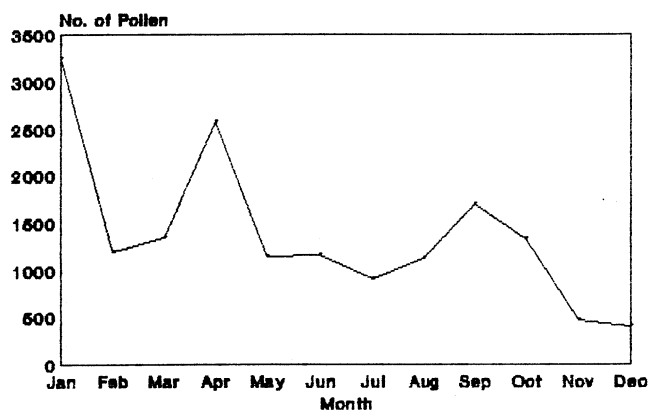


Fig. 2. Monthly variations in total airborne pollen.

Parthenium hysterophorus, *Prosopis juliflora*, *Syzygium cumini*, *Tamarindus indica* and some other weeds and grasses.

3. Materials and methods

Air sampling was carried out for 1 year beginning from January 1995 to December 1995 using a vertical cylinder trap installed at a height of about 18 m above ground level on the terrace of the life science building in the Guindy Campus of Madras University. A 1.8 × 1.8-cm vaseline coated cellophane strip wound on a 5-mm glass rod and clamped vertically under a protective shield was used as the trapping surface. The cylinders were changed at 24-h intervals. After a 24-h exposure the cellophane strip was removed and mounted on a microslide using glycerine jelly prestained with basic fuchsin. The entire area of the strip was scanned microscopically. The pollen were identified with the help of pollen reference slides and published literature. The nomenclature adopted by Mathew (1991) is followed in citing plant names.

4. Results

Altogether 16622 pollen grains were trapped during the 1-year sampling period. Of these, 15986 grains constituting 96.17% of the total pollen trapped were identified and assigned to 32 different pollen types. The remaining 636 (3.82%) grains were included under unidentified category. Pollen of Poaceae were most abundant and accounted for 20.21% of the total followed by *Casuarina equisetifolia* (18.60%). The next in the order of abundance were *Prosopis juliflora* (15.02%), *Feronia elephantum* (10.34%), *Kigelia pinnata* (3.39%), *Acalypha indica* (2.92%), *Parthenium hysterophorus* (2.86%), *Cyperaceae* (2.50%) *Cocos nucifera* (2.41%), *Amaranthaceae* (2.16%). The remaining types con-

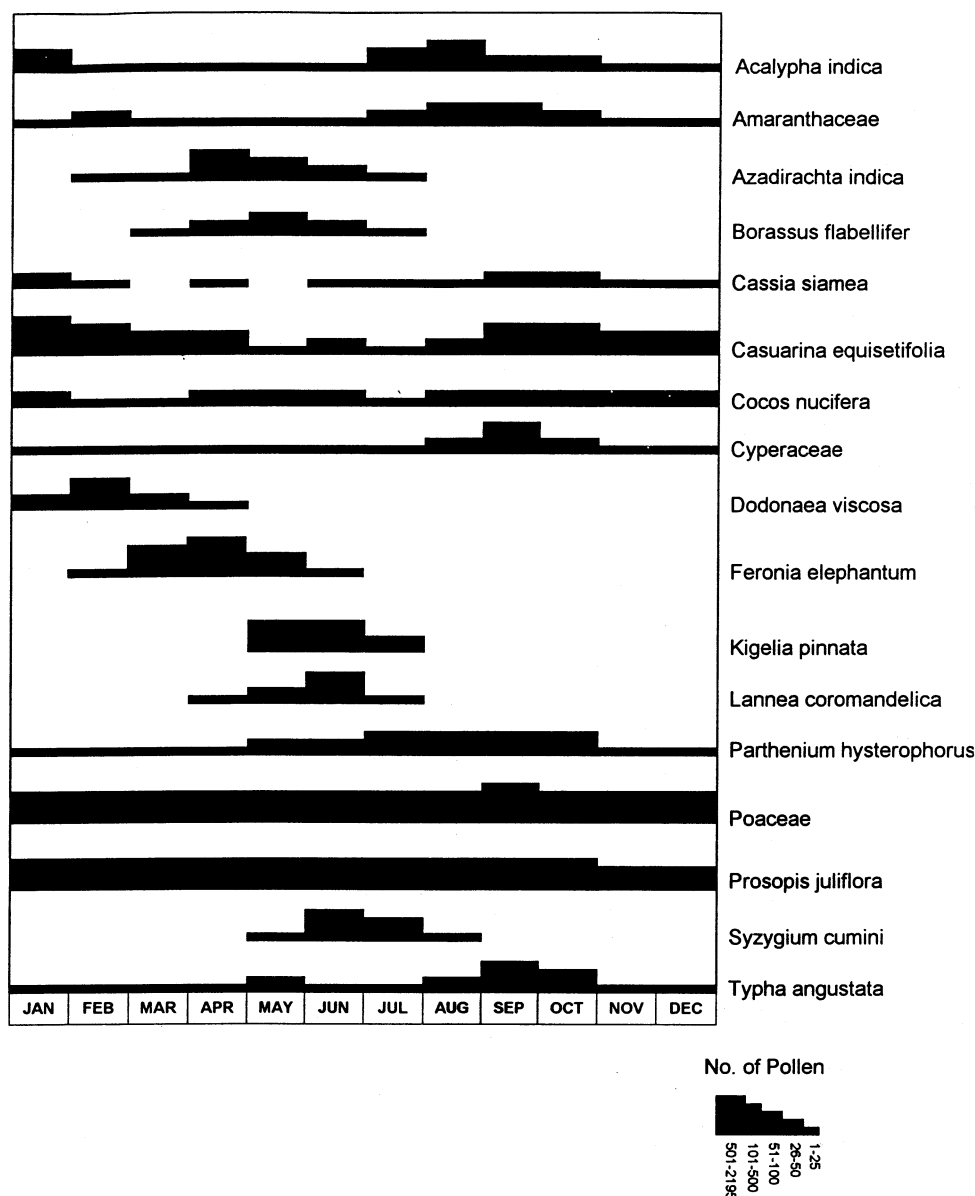


Fig. 3. Seasonal incidence (pollen calendar) of some common airborne pollen.

tributed less than 2.0% each (Table 1). Among these *P. juliflora*, *K. pinnata* and *P. hysterophorus* are exotic while *F. elephantum* and *A. indica* are native plants.

In Madras City two major pollen seasons were observed during the months of January–April and August–October (Fig. 2). The highest peak incidence was recorded during January (3246 pollen) followed by April (2571 pollen). The main contributors to the pollen peak is *Casuarina equisetifolia* in January and *Feronia elephantum* in April. The minimum number of pollen grains were obtained during November and December (Fig. 2).

Pollen of Poaceae showed higher incidence during August–October and minimum during December. Both for *Casuarina equisetifolia* and *Prosopis juliflora* the

peak was observed in January. Pollen of *Feronia elephantum* was present during February–June. The major peak was noticed in April. *Kigelia pinnata* pollen were found only during 3 months, i.e. from May to July (Fig. 3).

5. Discussion

Of the 32 pollen types identified, nine were recorded throughout the year. These were Poaceae, *Casuarina equisetifolia*, *Prosopis juliflora*, *Acalypha indica*, *Parthenium hysterophorus*, Cyperaceae, *Cocos nucifera*, Amaranthaceae, *Typha angustata*. Among the identified pollen, trees (61.05%) were found to be the main con-

tributors to atmospheric pollen followed by grasses (21.01%), herbs, (11.65%) and shrubs (6.27%). Predominance of tree pollen in the atmosphere of coastal Kerala was reported by Prakash Kumar et al., 1993. The predominance of tree pollen was also reported by Singh et al., (1987) for Dehra Dun although the type of tree flora are totally different from that of Madras.

Among the individual pollen types those of Poaceae were dominant as is the case with several other localities in India (Nair et al., 1986; Satheesh et al., 1993b). The second dominant type was *Casuarina equisetifolia*. This may be because of abundant plantation of *C. equisetifolia*, along the coast line under social forestry programme to meet the demand of fuel wood and as wind breaks and shelter belts to prevent soil erosion. The third position was occupied by *Prosopis juliflora*, which occurs in abundance in the wastelands of Madras city.

The incidence of anemophilous pollen in Madras City was higher (52.87%) when compared with entomophilous (38.89%) and amphiphilous pollen (8.22%). Similar observations were made by Janaki Bai and Subba Reddi (1982). This may be attributed to the continuous occurrence of large number of anemophilous pollen of *Casuarina equisetifolia*, Poaceae etc. in the air.

The pollen calendar of Madras City shows that there is no pollen free period. This is true of any tropical zone in the world, the reason being that the climate is less seasonal and is favourable for the growth of vegetation throughout or most part of the year (Ewusie, 1980). The pollen calendar also clearly shows the seasonal variation and occurrence of various types of pollen in the atmosphere (Fig. 3). The present study, although preliminary, shows that the atmosphere of Madras City has different kinds of pollen in varying quantities, the most dominant types being Poaceae, *Casuarina equisetifolia*, *Prosopis juliflora*, *Feronia elephantum*, *Kigelia pinnata*, *Acalypha indica*, etc. In addition to Poaceae (Kundu et al., 1985; Spieksma, 1990) the pollen of *Casuarina equisetifolia*, (Bucholtz et al., 1987; Agashe et al., 1994) *Prosopis juliflora*, (Spieksma, 1990), *Kigelia pinnata* (Jain and Datta, 1997) are found to be allergenically potent.

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References

- Agashe SN, Bapat BN, Bapat HN, Elizabeth P. Aerobiology of *Casuarina* pollen and its significance as a potential aeroallergen. *Aerobiologia* 1994;10:123–8.
- Agashe SN, Abraham JN. Pollen calendar of Bangalore city. Part I. *Ind J Aerobiol* 1988;1:35–8.
- Bucholtz AG, Hensel AE, Lockey FR, Serbousek D, Wunderlin PR. Australian pine (*Casuarina equisetifolia*) pollen as an aeroallergen. *Ann Allergy* 1987;59:52–6.
- Chanda S, Mandal S. Grass pollen as dominant aeroallergen in west Bengal. *Asp Allergy Appl Immunol* 1980a;13:4–10.
- Chanda S, Mandal S. Incidence and phenology of airborne pollen in West Bengal with reference to respiratory allergies. *Proc. 5th. Int. Palynology Conf., Cambridge*, 1980b:76.
- Ewusie YJ. *Elements of Tropic Ecology*. London: Heinemann, 1980.
- Gopi TV, Prakash Kumar R, Ravindran P, Nair PKK. Comparative analysis of aerospora of two urban localities in Kerala. *Ind J Aerobiol* 1990;3(1-2):39–44.
- Isaac Susan. To what extent do airborne fungal spores contribute to respiratory disease and allergic reaction in humans? *Mycologist* 1996;10(1):31–2.
- Jain AK, Datta TR. Some aerobiological studies in relation to allergic incidences at Gwalior (India). In: Agashe SN, editor. *Aerobiology*. New Delhi: Oxford and IBH Publishing Company, 1997:59–68.
- Janaki Bai A, Subba Reddi C. Airborne pollen grains of Visakhapatnam. A combined field and air sampling study. *Proc Indian Acad Sci Plant Sci* 1982;91:329–50.
- Janaki Bai A, Subba Reddi C. Atmospheric pollen grains of Visakhapatnam. *Indian J Bot* 1983;6:173–5.
- Kundu S, Chanda S, Kundu I. Clinical investigation of some allergenic pollen grains from Calcutta. *Trans Bose Res Inst* 1985;48:21–8.
- Mathew KM. *An excursion flora of Central Tamilnadu, India*. New Delhi: Oxford and IBH Publishing Company, 1991:647.
- Nair PKK, Joshi AP, Gangal SV. Airborne pollen, spores and other plant materials of India—a survey. Lucknow, India: CSIR centre for Biochemicals and NBRI, 1986.
- Prakash Kumar R, Beevi VMH, Gopi TV, Nair PKK, Ravindran P. Comparative analysis of the pollen-spore spectra of six centres of the coastal belt of Kerala. *J Environ Biol* 1993;14:283–92.
- Satheesh R, Rao GR, Nair PKK. Aerial survey of pollen grains of two different altitudinal ecosystem of Tamil Nadu, India. A comparative study. *J Palynol* 1993a;29:11–27.
- Satheesh R, Rao GR, Nair PKK. A study on the incidence of pollen grains in the atmosphere of Trichirapalli, Tamil Nadu. *Acta Bot Indica* 1993b;25:74–7.
- Singh AB, Babu CR. Pollen types in the atmosphere of Delhi. *Phytomorphology* 1981a;30:180–9.
- Singh AB, Babu CR. Variations in the pollen spectra of Delhi region, India. *Grana* 1981b;20:191–5.
- Singh BP, Singh AB, Nair PKK, Gangal SV. Survey of airborne pollen and fungal spores at Dehra Dun, India. *Ann. Allergy* 1987;59:229–34.
- Spieksma FTHM. Allergenic plants in different countries. In: Polo Falagiani DVM, editor. *Pollinosis*. Boca Raton, FL: CRC press, 1990:19–38.