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RESEARCH ARTICLE

STUDY ON AIRBORNE POLLEN IN THE ATMOSPHERE OF BANGALORE CITY

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Abstract

The atmospheric pollen of Jnana Bharathi campus, Bangalore University was surveyed during one year period from January 2011 to December 2011 using a vertical cylinder trap. A total of 28 pollen types were identified, among which 7 were present throughout the year. These belonged to Poaceae, Tridax sp., Eucalyptus sp., Parthenium hysterophorus, Cocus nucifera, Croton sparsiflorus and Mimosa pudica. The most predominant Pollen was Parthenium hysterophorus (23.87%) followed by Poaceae (16.19%), Mimosa Pudica (11.31%), Delonix regia (8.77%) and Eucalyptus spp. (7.58%) were found in the atmosphere of Bangalore city. Maximum pollen concentration was observed in the month of May (880/m^3) followed by April (552/m3) and minimum in June (163/m^3). The total pollens as well as individual pollen types displayed distinct seasonal periodicity in their incidence. The present study will provide preliminary but useful data to the allergologists for effective diagnosis and treatment of local population suffering from pollen hypersensitivity.

Introduction

The respiratory system is the target organ of various bio particles and chemical pollutants present in the air. The bio particles include pollen, fungal spores, mites, insect debris etc. Among these, pollen grains are the earliest known allergens and a major cause of allergies historically known as "hay fever"(Leuschner et al., 2000; Garecia Mozo et al., 2006), The incidence of these diseases is usually observed during the pollination of wind pollinating plant species(Bicakci & Akyalcin, 2000; Altintas et al., 2004). Climatic conditions play an important role in the release and dissemination of airborne pollen grains in our environment (Lata owa et al., 2005). Flower blooming and pollination are linked to temperature and wind(Gioulekas et al., 2004; Erkara, 2008). Airborne pollen grains monitoring has become an essential field for the medical community (Levetin et al., 2000; Weryszko-Chmielewska et al., 2001) as pollen calendars are proved to be serve as a supportive tool to take such steps which would help in prevention of allergies(Green et al., 2002).The airborne pollen grains data are also utilized by numerous botanists, ecologist, mycologists and plant pathologists for other purposes.

The concentration of airborne pollen grains varies not only from place to place, but also within the same area due to both environmental and anthropogenic reasons. In order to identify the dominant pollen allergens, aerobiological survey has been conducted in Jnana Bharathi campus during one year period from January 2011 to December 2011 and find out the dominant pollen allergens. The data collected will help in establishing a correlation between pollen allergens in the air and symptoms of hypersensitive patients, thus achieving effective management of allergic disorders. This study was designed to identify airborne pollen types and monitoring their seasonal frequencies leading to the preparation of a pollen calendar as shown in Fig-2.

Bangalore lies in the southeast of the South Indian state of Karnataka. It is in the heart of the Mysore Plateau (a region of the larger Precambrian Deccan Plateau) at an average elevation of 900 m (2,953 ft). It is located

at 12.97°N 77.56°E and covers an area of 741 km^2 (286 sq mi). The City is growing very fast on account of rapid industrialization and due to various other favorable factors. The City is abounded with large number of parks, private and public gardens, containing wild, exotic, cultivated, and indigenous plants. Most of the city roads are well laid out and studded with avenue trees. It is on account of these qualities that the city is called as the Garden City of India. However the atmosphere of Bangalore City has bio pollutants such as pollen and spores released by the plants growing in and around the City. Some of these bio pollutants have been found to be very harmful, causing allergic disorders in a large population. It is intended, therefore to survey the air spread of Bangalore City and detect the pollen allergens and exploit the scope of immunotherapy in allergic patients.

Materials and Methods

Sampling site and time

The Department of Environmental Science building selected for this investigation was situated at Jnana Bharathi campus in Bangalore University, India. Air sampling was carried out for a one year period from January 2011 to December 2011.

Collection of samples

A vertical cylinder trap sampler was installed at a height of 18 meters above the ground level on the terrace. Vaseline coated 1.8 x 1.8 cm 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 hour intervals.

Treatment of samples

After 24 hours exposure the cellophane strip was removed and mounted on a micro slide using glycerin jelly pre stained with basic fuchsin. The entire area of the strip was scanned microscopically. The identification of pollen types was done with the help of reference slides prepared directly from known plants. Continuous observation of the flowering periods of plants in the vicinity has made it possible to access the major contributing sources of each type of pollen appearing on the sample slides. Beside this, pollen atlases available on the internet and published literature were also consulted(Erdtman, 1952; Walker & Doyle, 1976).

Results

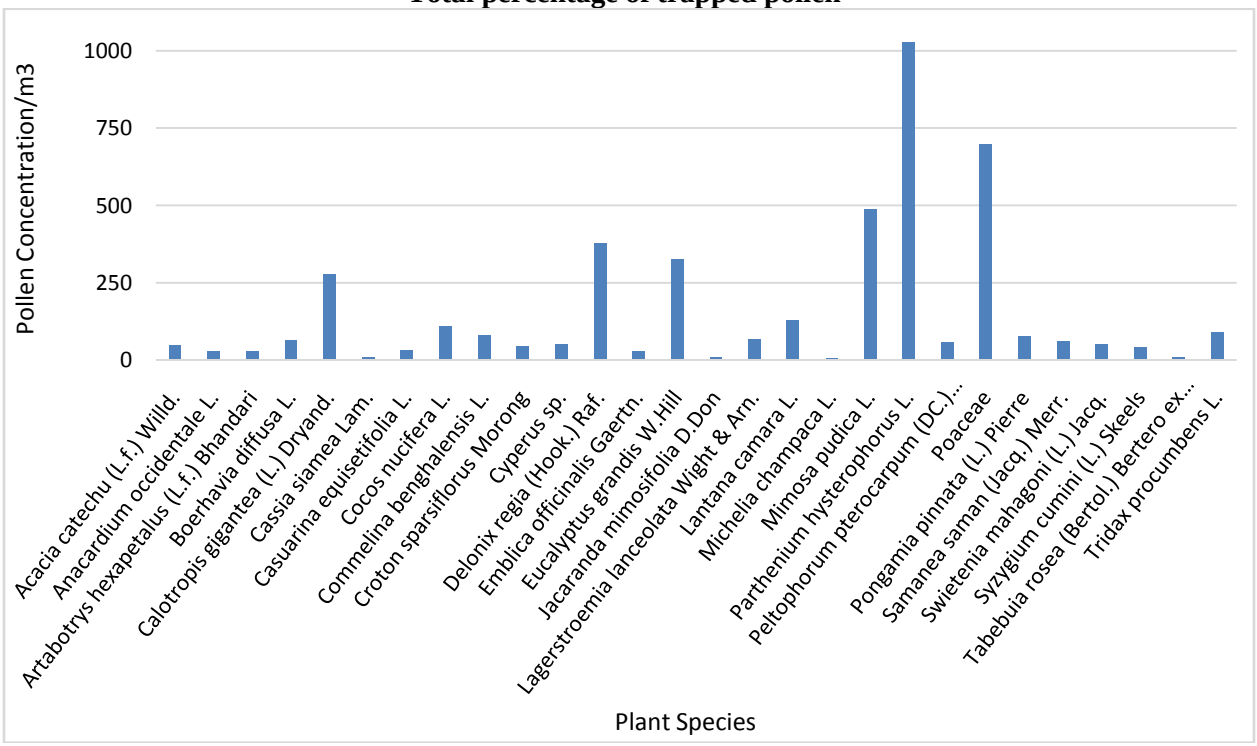
A total of 28 pollen types were trapped as a result of 365 samples collected during one year of the survey period. Depending on their morphological features they were identified up to family, genus or species level as reported in Table 1. Pollen of grasses could not be identified up to generic level and thus were included under Poaceae family. A small fraction (1.1 %) of pollen flora remained unidentified because of their distorted nature.

Table 1. Season wise Pollens identified from the atmosphere of Bangalore city

Sl. No	Species	Family	Season
1	Acacia catechu (L.f.) Willd.	Fabaceae	June-September
2	Anacardium occidentale L.	Anacardiaceae	February-April
3	Artabotrys hexapetalus (L.f.) Bhandari	Moraceae	December-February
4	Boerhavia diffusa L.	Nyctaginaceae	Throughout the year
5	Calotropis gigantea (L.) Dryand.	Asclepiadaceae	Throughout the year
6	Cassia siamea Lam.	Caesalpiniaceae	April–June
7	Casuarina equisetifolia L.	Casuarinaceae	Throughout the year
8	CocosnuciferaL.	Arecaceae	Throughout the year
9	Commelinabenghalensis L.	Commelinaceae	March-April
10	Croton sparsiflorus Morong	Euphorbiaceae	July–October
11	Cyperus sp.	Cyperaceae	July–December
12	Delonix regia (Hook.) Raf.	Fabaceae	March-July
13	Emblica officinalis Gaertn.	Euphorbiaceae	March–April
14	Eucalyptus grandis W.Hill	Euphorbiaceae	March–April

15	Jacaranda mimosifolia D.Don	Bignoniaceae	March-July
16	Lagerstroemia lanceolata Wight &Arn.	Lythaceace	October-December
17	Lantana camara L.	Verbenaceae	Throughout the year
18	Michelia champaca L.	Magnoliaceae	February-April
19	Mimosa pudica L.	Fabaceae	Throughout the year
20	Parthenium hysterophorus L.	Asteraceae	Throughout the year
21	Peltophorum pterocarpum (DC.) K.Heyne	Fabaceae	February-July
22	Poaceae	Poaceae	Throughout the year
23	Pongamia pinnata (L.) Pierre	Papilionaceae	March–April
24	Samanea saman (Jacq.) Merr.	Fabaceae	March-April
25	Swietenia mahagoni (L.) Jacq.	Meliaceae	March-April
26	Syzygium cumini (L.) Skeels	Myrtaceae	March-May
27	Tabebuia rosea (Bertol.) Bertero ex A.DC.	Bignoniaceae	March-May
28	TridaxprocumbensL.	Asteraceae	Throughout the year

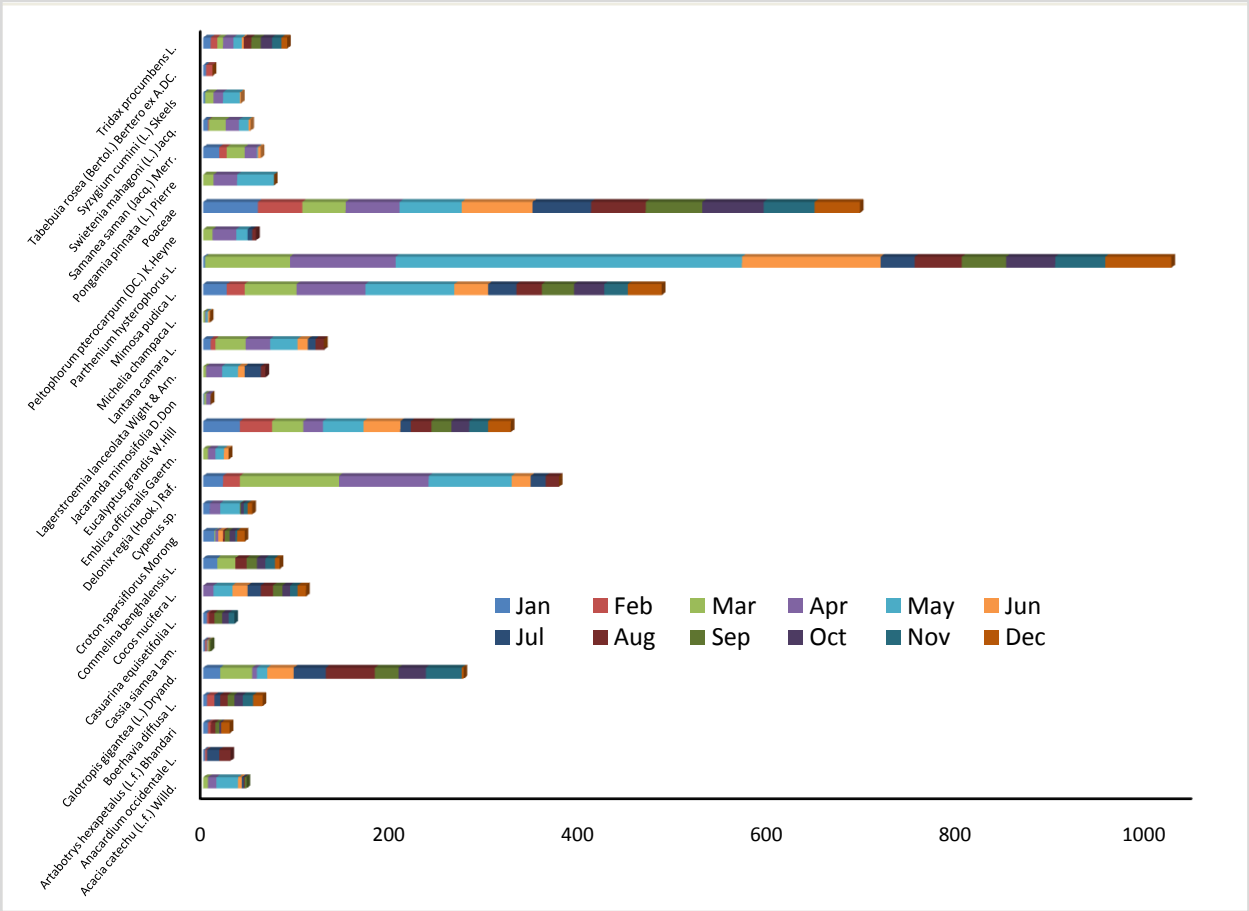
Fig. 1
Total percentage of trapped pollen



Pollen contributes major forms among the air borne particles' in the atmosphere. In Rohtak city, contribution of tree pollen was quite high as compared to shrubs and herbs . The predominance of tree pollen was also reported from Dehradum (Singh et al., 1987) and Madras by Satheesh kumar and Vittal (Sivasubramani & Vittal, 1998). The airborne pollen is known to elicit allergy reaction among the susceptible individuals. The dispersal pollen will bring about the fertilization and also natural hybridization, sometimes the pollen also known to carry pollutants and the fungal spores among them. The continuous inhalation of large amounts of pollen brings about allergic reactions in the susceptible individuals. Some of the species present minor deviations, morphological and structural changes, reduction of the exine reticulation, changes in the number of pores or colpi, substance sedimentation, that appear as unspecific excrescences visible with an optical microscope. These small changes, as well as other exogenous factors,

are able to explain the yearly increase of the allergenic potential of the plants subjected to analysis. According to scientific research, documentation, these structural changes of the outer layer of the pollen lead to alteration of the quantity and quality of the secreted proteins and most of these proteins are proteolytic enzymes, which at modified concentrations irritate the mucosa they come in contact with, it explains the initiation of the allergic reactions.

Fig-2
Pollen Calendar of Bangalore 2011



Compilation of pollen calendar is the ultimate aim of an aerobiologist. Pollen calendars have great significance in pollen allergy as they serve as important guidelines to allergy practitioners with respect to the onset of allergenically significant pollen season, their peak and decline in the atmosphere. In this context a pollen calendar serves as a bridge between aerobiologists and allergists, as both are dependent on each other and get equally benefited. In Bangalore Asteraceae, Poaceae, Caesalpiniaceae,Mimoseceae, Fabaceae and Myrtaceae are important families from which dominant pollen are contributing to the pollen concentration in the atmosphere.

Earlier study has shown that the major pollen encountered in Karnataka is Parthenium hysterophorus, Amaranthus spinosus, Casuarina and Eucalyptus. Concentration of pollen goes up with an increase in temperature and humidity. Pollen from flowering trees are found more from January to April, grass pollens from July to November, weeds from November to January. According to a study, nearly 7.5% of children are allergic to pollen and fungi and 10% of the Indian population is allergic to pollens. The occurrence of pollen allergies changes significantly from season to season.

Clinical Studies

A survey was conducted around the study area with the help of a Questionnaire, which includes in depth history of symptoms, type of allergies, duration, diurnal variations of symptoms. The basic information about the pollen

allergy has been collected with the help of questionnaire, which categories on the basis of difference in Age. The questionnaire on the basis of pollen allergies were done for 58 people in Jnana Bharathi campus. In all 58 people suffering from various allergic disorders like rhinitis, sneezing, watery eyes and other nasobronchial allergies were selected for the study. During the study period the maximum number of patient exhibited several symptoms allergy between 21 to 30 years of age, followed by 31 to 40 years age group, than 41 to 50 and 11 to 20 years of age group. The total number of people suffering from Sneezing was (64%) which is maximum followed by Rhinitis (60%), Watery eyes (52%), Congestion (40%) and Bronchial Asthma (16%). Altogether 4297 pollen grains were trapped during one year sampling period, out of these, Parthenium hysterophorus were most abundant and accounted for 23.88% of the total followed by Poaceae (16.20%). The next in the order of abundance were Mimosa pudica (11.31%), Delonix regia (8.77%), Eucalyptus (7.59%), Lantana camara (2.98%) Cocos nucifera (2.54%), Tridax (2.07%). The remaining types contributed less than 2.0% each (Fig- 1).

In Bangalore City two major pollen seasons were observed during the months of January-April and August- October (Table.1).The highest peak incidence was recorded during May (880pollen) followed by April (552 pollen). The main contributors to the pollen peak were Parthenium hysterophorus and Mimosa pudica in May. Poaceae in June. The minimum numbers of pollen grains were obtained during December and June. Pollen of Poaceae showed a higher incidence during August-October and minimum during December. Pollen of Delonix regia shows the peak in March. Pollen of Cocus nucifera ,Calotropis gigantea and Eucalyptus found throughout the year. Weed pollens of Tridax, Mimosa pudica was present throughout the year. Pongemia pinnata pollen was found only during 3 months, i.e. from March to May.

Discussion

Pollen contribution analysis has been performed in various parts of the world for certain specific, as well as other general pollen-producing species (Alba et al., 2000; Weryszko-Chmielewska et al., 2001; Giner, 2002; Guvensen & Ozturk, 2003)out of the 28 pollen types identified, seven were recorded throughout the year. These were Poaceae, Parthenium hysterophorus, Cocos nucifera ,Mimosa pudica, Tridex sp., Eucalyptus grandis, Croton sparsiflorus. For the month of April 2011, the pollen flora of the air was very rich because the avenue trees like Delonix reagia, Cassia sp, Fabaceae members like Peltophorum pterocaroum, Samania saman, were found to be flowering. This was evident from observation that for the whole month Peltophorum pterocarpum pollen numbered 56 followed by weeds. Parthenium hysterophorus, which flowered throughout the year amounted to 1026 in total. Poaceae had 696 pollen, Delonixregia 377, Legestroemia 66, Samania saman 61, Cyperaceae 52, Croton sp. 44,Lantana camara 128, Eucalyptus 326, Cocus nucifera 109. So it is evident that the tree pollens dominated over that of herbs.

On the whole the pollen grains were more abundant as compared to the fungal spores. In the month of May 2011, pollen grains of the weed, Parthenium hysterophorus amounted to 367 in number. Poaceae 66, Tridax sp. 89, Mimosa pudica 486 pollen were represented in air. It is evident that the flowering of Peltophorum pterocarpum was ending. Hence, the tree pollen content of the air had gone down, while the pollen of herbaceous plants remained consistent.

In the month of June2011, as the flowering period of avenue trees in Bangalore was coming to an end, the pollen of herbaceous plants dominated over the tree pollen. The Poaceae pollen has been reported among the dominant also by other workers (Celenk & Bicakei, 2005; Recio et al., 2006) Parthenium hysterophorus amounted 147, Poaceae 75, Lagerstroemia 7, Delonix regia 20, Croton 5,among the total catch. Poaceae pollen has been reported among the dominant types by other workers also. This clearly indicates that the flowering period of local plants has much to do with the pollen content in the air. The above data reveal that the pollen grains present in air correlated with the flowering period of the local flora. The pollen grains of weeds like Parthenium hysterophorus and grass are dominant and consistent.

In the present study pollen types of Myrtaceae, Parthenium, Delonix regia, Poaceae, Mimosa pudica, Lantana, Eucalyptus, Peltophorum pterocarpum were in clumps on the trap surface. These clumps had a little chance of getting inhaled. Hence the pollen of Poaceae, Parthenium hysterophorus, Delonix regia, and other anemophilous pollen stand important allergies both in number and volume. The maximum number of incidence of Nasobranchial allergy occurred in patients of the age of 20-39 years. In Bangalore Asteraceae, Poaceae, Fabaceae are important families from which dominant pollen are contribute to the pollen concentration in the atmosphere varies from year to year, season to season, day to day, and hour to hour, which is affected by the habit of the plant and distribution, ecology of the area, pollen, production and other factors.

The Questionnaire on the basis of pollen allergies were done for 58 people in JnanaBharati campus. In all 58 people suffering from various allergic disorders like rhinitis, Sneezing, Watery eyes and other nasobronchial allergies were selected for the study. During the study period maximum number of patient exhibited several symptoms of allergy between 21-30 years of age, followed by 31-40 years age group, than 41-50 and 11-20 years of age group. The total number of people suffering from Sneezing was (64%) which is maximum followed by Rhinitis (60%), Watery eyes (52%), Congestion (40%) and Bronchial Asthma (16%).This Questionnaire have clearly shown that the atmosphere of Bangalore contain the pollen grains causing nasobronchial allergies among the people in Bangalore.

The above data reveal that the pollen grains present in air correlate with the flowering period of the local flora. The pollen grains of weeds like Parthenium hysterophorus and grass are dominant and consistent. As far as clinical studies are concerned, further work has to be done in this field.

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