

IDENTIFICATION AND QUANTIFICATION OF AIRBORNE POLLEN FROM HYDERABAD: TANDO-JAM, SINDH

ANJUM PARVEEN*, MUNEEBA KHAN AND SHAISTA ZEB

Centre for Plant Conservation, Department of Botany, University of Karachi, Karachi, Pakistan

*Corresponding author's e-mail: anjum_tahir@hotmail.com

Abstract

An investigation of airborne pollen grains from Hyderabad: Tando-Jam, Sindh has been carried out by Burkard's Seven Day Recording Volumetric Spore Trap. From August 2008 to July 2009. A total of 4665 pollen grains/m³ have been recorded. In this survey about 27 pollen grain types are recognized. These pollen types are *Acacia/Albizia*, *Amaranthaceae*, *Asteraceae*, *Azadirachta indica*, *Brassica campestris*, *Callistemon citrinus*, *Cyperus*, *Daucus carota*, *Delonix regia*, *Ephedra ciliata*, *Eucalyptus globulus*, *Gramineae*, *Guaiacum officinale*, *Leucaena leucocephala*, *Mangifera indica*, *Moringa oleifera*, *Morus alba/Casuarina equisetifolia*, *Parkinsonia aculeata*, *Prosopis juliflora*, *Ricinus communis*, *Rumex dentatus*, *Syzygium cumini*, *Tamarix*, *Thuja* and *Typha angustifolia*. The highest concentration of pollen grains were contributed by Grasses i.e. 1304 pollen grains/m³ followed by *Amaranthaceae/Chenopodiaceae* 754 pollen grains/m³, *Cyperus* 408 pollen grains/m³, *Eucalyptus* 379 pollen grains/m³, *Typha angustifolia* 257 pollen grains/m³, *Guaiacum officinale* 229 pollen grains/m³, *Brassica campestris* 154 pollen grains/ and *Leucaena leucocephala* 105 pollen grains/m³. Maximum pollen concentration was observed in the month of April-2009 i.e., 969 pollen grains/m³. The second highest peak value of pollen count was observed in the month of October-2008 i.e. 862 pollen grains/m³. The lowest concentration of pollen grains was found in January i.e., 82 pollen grains/m³.

Introduction

Pollen grains are considered to be one of the most important allergen bodies found in air. Pollen of various plant species are reported to cause respiratory allergies and bronchial asthma. These allergenic particles contain proteins and glycoproteins that are released on coming in contact with human respiratory tract and elicit allergic reactions in the body. Aerobiological studies can be utilized to forecast daily pollen and spore counts on electronic media (Carinanos *et al.*, 2000). The pollen grains released by wind pollinated plant constitute a major part of the air flora (Lacey & Jonathan, 2006).

Investigation of airborne pollen grains of populated city is very important (Bilisik *et al.*, 2008). Pollen calendar of a particular area gives us information about the time period of pollen grains which are present in the air with higher and lower concentrations along with the seasonal variation and annual periodicity. Data obtained by such calendars can be used by the clinicians for the correlation of the occurrence of airborne allergenic pollen grains with symptoms of patient suffering allergy. This helps in accurate diagnosis and manage the treatment of patients suffering from allergy (Hasnain *et al.*, 2005).

Hyderabad is the second largest city in the Sindh province and the fourth biggest city of Pakistan. The city of Hyderabad is the largest bangle producer in the world and serves as a transit between the rural and the urban Sindh. Tando-Jam is a town of Hyderabad city. It is situated at 25°25'60N 68°31'60E and is about 20 km away from Hyderabad. Tando-Jam houses a large number of federal and provincial agricultural institutes. Land of Tando-Jam is very fertile where wheat, cotton, vegetables and fruits are grown specially guavas and mangoes of Tando-Jam are famous.

There is no record of allergenic pollen from Hyderabad, Tando-Jam. However, preliminary studies of

atmospheric pollen of Karachi have been carried out by Kazmi *et al.*, (1984) in Karachi, similarly Perveen *et al.*, (2007) and Waqar *et al.*, (2010) conducted aerobiological studies of Karachi and adjacent area in relation to allergy. The purpose of present study is to identify and quantify airborne pollen from Hyderabad; Tando-Jam, Sindh.

Materials and Methods

Sampling site: Hyderabad city lies between 25.367 °N latitude and 68.367 °E longitude and is located on the east bank of the river Indus of Sindh. Tando-Jam is about at a distance of 20 km away from Hyderabad. Vegetation of Tando-Jam is very rich. The flora in Tando Jam is dominated by trees and shrubs. Some of the trees and shrubs are cultivated for the ornamental purpose in avenues and parks while others are in agriculture fields most common trees in the area are *Azadirachta indica*, *Eucalyptus globulus*, *Cordia myxa*, *Ficus elastica*, *Parkinsonia aculeata*, *Moringa oleifera*, *Bauhinia variegata*, *Delonix regia*, *Guaiacum officinale*, *Albizia lebbbeck*, *Peltophorum pterocarpum*, *Acacia nilotica* and *Prosopis juliflora*. Fruit yielding trees are also cultivated such as *Punica granatum* (Pomegranate), *Carica papaya* (Papaya), *Mangifera indica* (Mango), *Musa* (Banana), *Psidium guajava* (Apple Guava), *Tamarindus indica*. The abundant shrubs in this locality are *Hibiscus- rosa-sinensis*, *Rosa indica*, *Bougainvillea glabra*, *Nerium indicum*, *Ixora coccinea*, *Ocimum basilicum*, *Ziziphus nummularia*, *Parkinsonia aculeata*, and *Tamarix indica*. The herbaceous plants are *Achyranthes aspera*, *Aerva javanica*, *Amaranthus viridis*, *Typha angustifolia*, *Celosia argentea*, *Cyperus rotundus*, *Digera muricata* and various members of poaceae.

Pollen sampling: Pollen and spores were collected by Burkard's 7-Day recording volumetric spore trap for one

year from August 2008-July 2009. The machine was installed on the roof of the Department of Plant Protection, Agricultural University, Tando-Jam at a height of 10 meters. The pollen trap had the airflow rate of 10 liters per minute. The Melinex tape for catching pollen grains was replaced after every week at 12 p.m. Readings of the daily pollen count were taken for each hour at 40x magnification of objective and 10x magnification of eye piece under light microscope. Counting methods were standardized according to the British Aerobiology Federation (1995). A daily average of pollen grains per cubic meter of air was expressed. Those counts were converted into mean monthly counts and then total annual pollen counts were determined.

Results

In this survey 4665 pollen grains/m³ were trapped belonging to 27 pollen types viz. *Acacia/Albizia*, *Amaranthaceae*, *Asteraceae*, *Azadirachta indica*, *Brassica campestris*, *Callistemon citrinus*, *Cyperus*, *Daucus carota*, *Delonix regia*, *Ephedra ciliata*, *Eucalyptus globulus*, Grass, *Guaiaacum officinale*, *Leucaena leucocephala*, *Mangifera indica*, *Moringa oleifera*, *Morus alba/Casuarina equisetifolia*, *Parkinsonia aculeata*, *Prosopis juliflora*, *Ricinus communis*, *Rumex dentatus*, *Syzygium cumini*, *Tamarix indica*, *Thuja orientalis* and *Typha angustifolia*. The mean annual pollen catch of all the pollen types and their monthly trend is represented in Table 1 and Fig. 1a and 1b.

Table 1. Mean monthly airborne pollen grains concentration/m³ of the captured pollen types from Hyderabad: Tando-Jam, Sindh.

Name of species	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Total
<i>Acacia/Albizia</i>	0	0	3	4	2	1	2	3	8	7	6	0	36
<i>Amaranthaceae</i>	0	154	282	54	17	1	65	45	64	42	30	0	754
<i>Asteraceae</i>	0	0	3	3	6	0	0	1	5	1	4	0	23
<i>Azadirachta indica</i>	0	1	8	13	0	0	26	10	35	0	4	0	97
<i>Brassica campestris</i>	0	20	15	14	6	1	56	18	8	15	1	0	154
<i>Callistemon citrinus</i>	0	4	2	0	0	0	0	29	0	0	0	0	35
<i>Cyperus</i>	37	57	114	26	3	0	12	29	64	23	25	18	408
<i>Daucus carota</i>	0	0	0	0	0	0	2	0	0	15	1	0	18
<i>Delonix regia</i>	0	0	0	0	0	0	1	0	0	1	0	0	2
<i>Eucalyptus</i>	0	16	9	9	13	7	24	37	253	5	6	0	379
<i>Ephedra ciliata</i>	0	0	0	0	0	0	0	1	0	4	0	0	5
Grass	49	135	269	44	22	22	91	114	197	60	212	89	1304
<i>Guaiaacum officinale</i>	0	24	39	30	5	5	11	27	27	40	21	0	229
<i>Leucaena leucocephala</i>	0	0	0	0	1	33	42	11	0	11	7	0	105
<i>Mangifera indica</i>	0	0	0	0	0	0	0	4	11	0	0	0	15
<i>Moringa oleifera</i>	0	0	12	9	27	0	2	10	3	0	3	0	66
<i>Morus alba/Casuarina equisetifolia</i>	0	0	3	3	22	9	0	0	3	1	0	0	41
<i>Parkinsonia aculeata</i>	15	11	8	0	0	0	0	18	24	0	0	0	76
<i>Prosopis juliflora</i>	0	13	9	10	0	0	0	16	37	1	3	0	89
<i>Ricinus communis</i>	0	0	0	0	0	0	20	4	5	0	0	0	29
<i>Rumex dentatus</i>	0	0	0	0	0	0	48	0	5	0	0	0	53
<i>Syzygium cumini</i>	4	1	3	1	3	0	2	4	8	0	0	0	26
<i>Tamarix indica</i>	0	1	14	4	2	0	0	5	5	0	16	0	47
<i>Thuja orientalis</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Typha angustifolia</i>	0	64	20	21	0	0	0	22	106	7	17	0	257
Damaged/Unidentified	4	63	46	31	9	3	47	67	101	8	26	0	416
Total pollen grains	109	566	862	276	138	82	457	475	969	241	383	107	4665

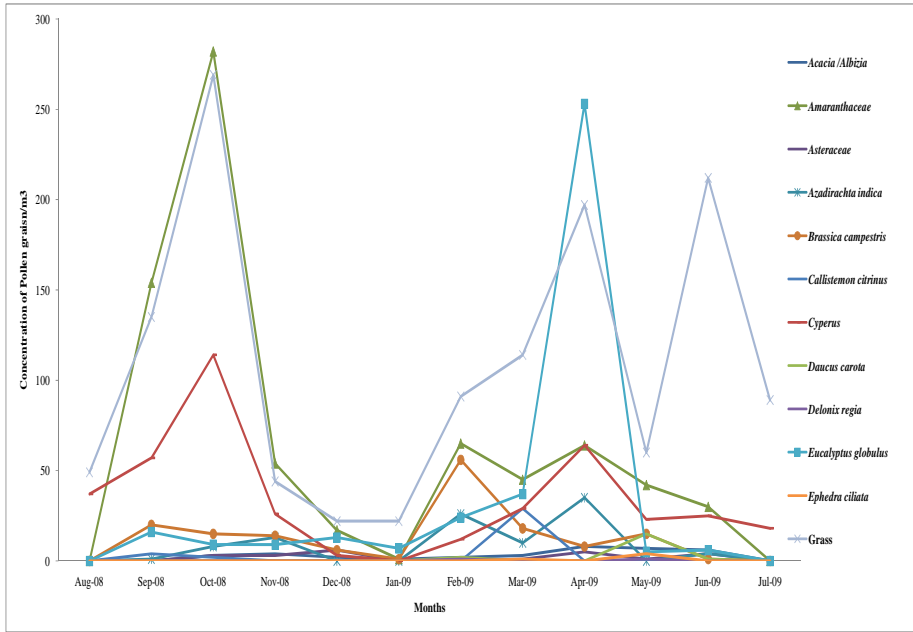


Fig. 1a. Seasonal variation of airborne pollen grains concentration from Hyderabad: Tando-Jam, Sindh.

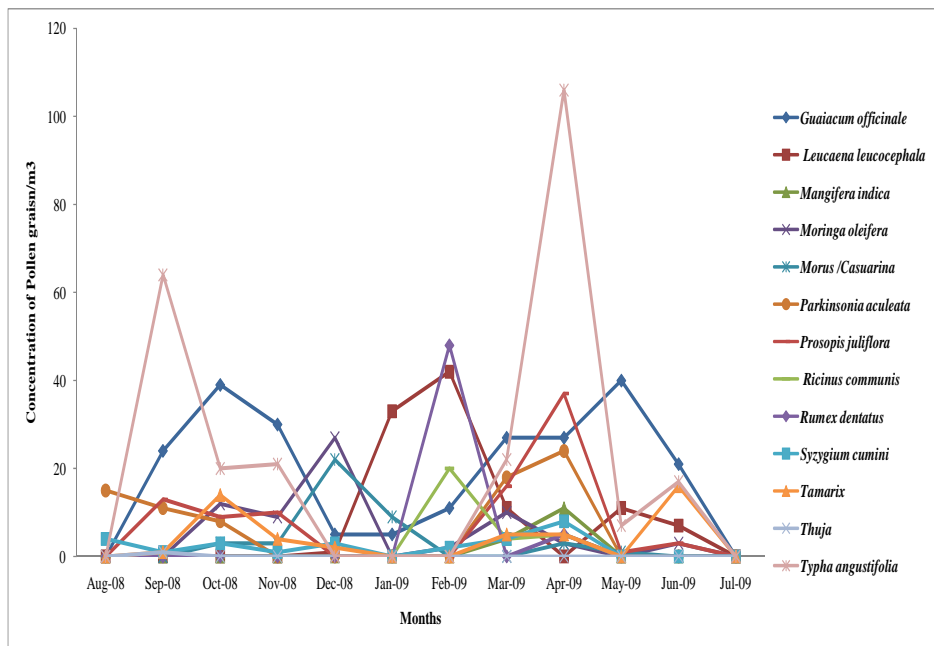


Fig. 1b. Seasonal variation of airborne pollen grains concentration from Hyderabad: Tando-Jam, Sindh.

In the study year (August 2008–July 2009) grass pollen type showed highest percentage i.e., 28.0% (1304 pollen grains/m³) of the total pollen count (Table 2). The second highest pollen percentage was contributed by Amaranthaceae with 16.2% (754 pollen grains/m³) followed by *Cyperus* 8.7% (408 pollen grains/m³), *Eucalyptus globulus* 8.1% (379 pollen grains/m³), *Typha angustifolia* 5.5% (257 pollen grains/m³), *Guaiacum officinale* 4.9% (229 pollen grains/m³), *Brassica campestris* 3.3% (154 pollen grains/m³), *Leucaena leucocephala* 2.3% (105 pollen grains/m³), *Azadirachta indica* 2.1% (97 pollen grains/m³), *Prosopis juliflora* 1.9% (89 pollen grains/m³), *Parkinsonia aculeata* 1.6% (76 pollen grains/m³), *Moringa oleifera* 1.4% (66 pollen grains/m³), *Rumex dentatus* 1.1% (53 pollen grains/m³), *Tamarix indica* 1.0% (47 pollen grains/m³), *Morus alba/Casuarina equisetifolia* 0.9% (41 pollen grains/m³), *Acacia /Albizia* 0.8% (36 pollen grains/m³), *Callistemon citrinus* 0.8% (36 pollen grains/m³), *Ricinus communis* 0.6% (29 pollen grains/m³), *Syzygium cumini* 0.6% (26 pollen grains/m³), Asteraceae 0.5% (23 pollen grains/m³), *Daucus carota* 0.4% (18 pollen grains/m³), *Mangifera indica* 0.3% (15 pollen grains/m³), *Ephedra ciliata* 0.1%

(5 pollen grains/m³), *Delonix regia* 0.04% (2 pollen grains/m³) and *Thuja occidentalis* 0.02% (1 pollen grain/m³). Damaged/Unidentified pollen were 405 pollen grains/m³.

Seasonal periodicity: Our data revealed that the highest pollen concentration was recorded in the month of April-2009 i.e. 969 pollen grains/m³ (Table 1). During this month produced major pollen grain contribution was done by *Eucalyptus globulus* (253 Pollen grains/m³), Grass (197 Pollen grains /m³), *Typha angustifolia* (106 Pollen grains/m³), *Cyperus rotundus* (64 Pollen grains /m³), Amaranthaceae (64 Pollen grains/m³), *Prosopis juliflora* (37 Pollen grains/m³) and *Azadirachta indica* (35 Pollen grains/m³). The second peak value of pollen grains concentration was observed in the month of October-2008 i.e. 862 pollen grains/m³. In this month Amaranthaceae pollen grains dominated and showed 282 pollen grains/m³. Other types with noteworthy amount of pollen grains were of grasses (269 pollen grains/m³) and *Cyperus* (114 pollen grains/m³). The lowest value of pollen grains concentration was found in January i.e. 82 pollen grains/m³.

Table 2. Percentage of the captured pollen types from Hyderabad: Tando-Jam, Sindh.

Name of species	Total pollen grains/m ³	Percentage
<i>Acacia /Albizia</i>	36	0.8
Amaranthaceae	754	16.2
Asteraceae	23	0.5
<i>Azadirachta indica</i>	97	2.1
<i>Brassica campestris</i>	154	3.3
<i>Callistemon citrinus</i>	35	0.8
<i>Cyperus</i>	408	8.7
<i>Daucus carota</i>	18	0.4
<i>Delonix regia</i>	2	0.04
<i>Eucalyptus globulus</i>	379	8.1
<i>Ephedra ciliata</i>	5	0.1
Grass	1304	28.0
<i>Guaiacum officinale</i>	229	4.9
<i>Leucaena leucocephala</i>	105	2.3
<i>Mangifera indica</i>	15	0.3
<i>Moringa oleifera</i>	66	1.4
<i>Morus alba/Casuarina equisetifolia</i>	41	0.9
<i>Parkinsonia aculeata</i>	76	1.6
<i>Prosopis juliflora</i>	89	1.9
<i>Ricinus communis</i>	29	0.6
<i>Rumex dentatus</i>	53	1.1
<i>Syzygium cumini</i>	26	0.6
<i>Tamarix indica</i>	47	1.0
<i>Thuja occidentalis</i>	1	0.02
<i>Typha angustifolia</i>	257	5.5
Damaged/Unidentified	416	8.9
Total pollen grains	4665	100.0

Seasonal trend was determined for each pollen type in order to identify their major pollen releasing months. During the study different pollen types showed different peak of pollen grain counts in different parts of the year. *Acacia/Albizia*: 8 pollen grains/m³ in April-2009; *Amaranthaceae*: 282 pollen grains/m³ in October-2008; *Asteraceae*: 6 pollen grains/m³ in December-2008; *Azadirachta indica*: 35 pollen grains/m³ in May-2009; *Brassica campestris*: 56 pollen grains/m³ in February-2009; *Callistemon citrinus*: 29 pollen grains/m³ in March-2009; *Cyperus rotundus*: 114 pollen grains/m³ in October-2008; *Daucus carota*: 15 pollen grains/m³ in May-2009; *Eucalyptus*: 253 pollen grains/m³ in April-2009; *Ephedra*: 4 pollen grains/m³ in May-2009; Grass pollen grains showed two peak seasons of pollen release i.e. 269 pollen grains/m³ in October-2008 and 212 pollen grains/m³ in June-2009; similarly *Guaiacum officinale* also showed two peak seasons of pollen release i.e., 39 pollen grains/m³ in October-2008 and 40 pollen grains/m³ in May-2009; *Leucaena leucocephala*: 42 pollen grains/m³ in February-2009; *Mangifera indica*: 11 pollen grains/m³ in April; *Moringa oleifera*: 27 pollen grains/m³ in December-2008; *Morus alba/Casuarina equisetifolia*: 22 in December-2008; *Parkinsonia aculeata*: 24 pollen grains/m³ in April-2009; *Prosopis juliflora*: 37 pollen grains/m³ in April-2009; *Ricinus communis*: 20 pollen grains/m³ in February-2009; *Rumex dentatus*: 48 pollen

grains/m³ in February-2009; *Syzygium cumini*: 8 pollen grains/m³ in April-2009; *Tamarix*: 14 pollen grains/m³ in October-2008 and 16 pollen grains/m³ in June-2009; *Typha angustifolia*: 64 pollen grains/m³ in September-2009 and 106 pollen grains/m³ in April-2009.

Diurnal pattern: Diurnal pattern of those pollen types having a total annual pollen count more than 75 pollen grains/m³ was constructed and has been represented in Fig. 2-12. For the calculation of the diurnal pattern of encountering pollen grain types in the present study, mean hourly values for the whole year were determined. The taxa which showed a high difference of maximum and minimum concentration at a specific day time were: *Cyperus*: Peak pollen grain concentration of 34 pollen grains/m³ at 5 a.m. and 28 pollen grains/m³ at 4 p.m. (Fig. 2); Grasses: 104 pollen grains/m³ at 4 p.m. (Fig. 3); *Leucaena leucocephala*: 17 pollen grains/m³ at 4 p.m. (Fig. 4); *Parkinsonia aculeata*: 15 pollen grains/m³ at 9 a.m. (Fig. 5). A homogenous pattern of pollen release (very less difference between the minimum and maximum readings) throughout the day was observed in the case of *Amaranthaceae* (Fig. 6), *Azadirachta indica* (Fig. 7), *Brassica campestris* (Fig. 8), *Eucalyptus globulus* (Fig. 9), *Guaiacum officinale* (Fig. 10), *Prosopis juliflora* (Fig. 11) and *Typha angustifolia* (Fig. 12).

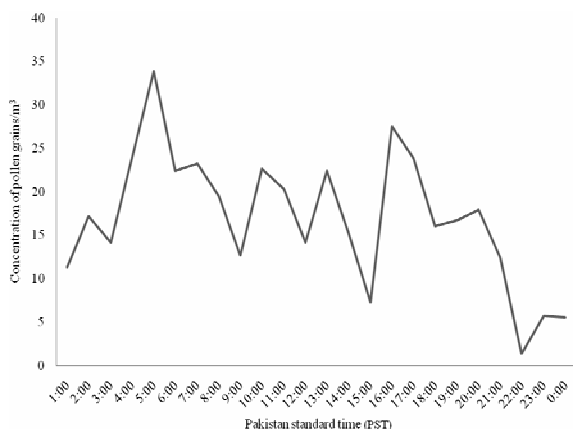


Fig. 2. Diurnal pattern of *Cyperus* pollen grains/m³.

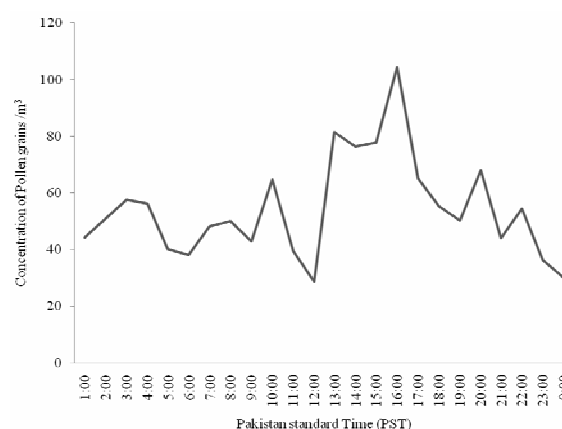


Fig. 3. Diurnal pattern of Grass pollen grains/m³.

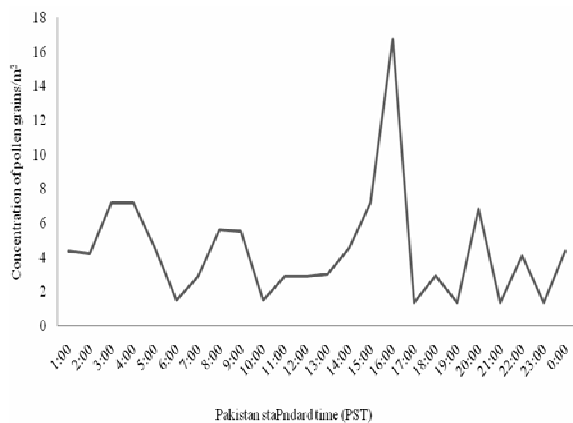


Fig. 4. Diurnal pattern of *Leucaena leucocephala* pollen grains/m³.

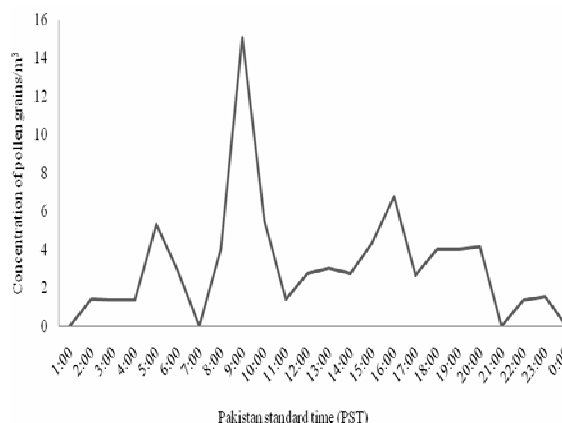


Fig. 5. Diurnal pattern of *Parkinsonia aculeata* pollen grains/m³.



Fig. 6. Diurnal pattern of *Amaranthaceae* pollen grains/m³.

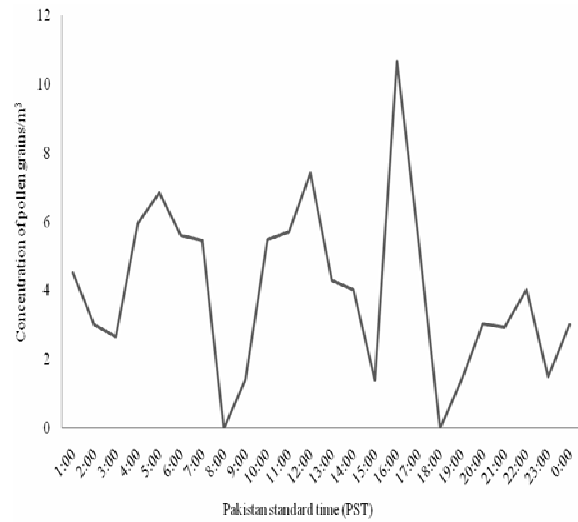


Fig. 7. Diurnal pattern of *Azadirachta indica* pollen grains/m³.

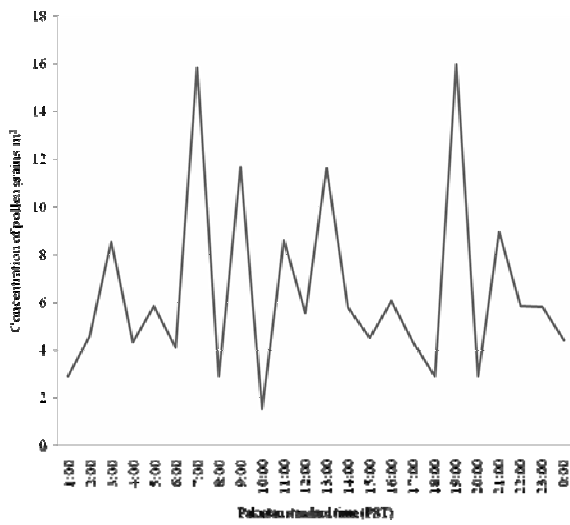


Fig. 8. Diurnal pattern of *Brassica campestris*.

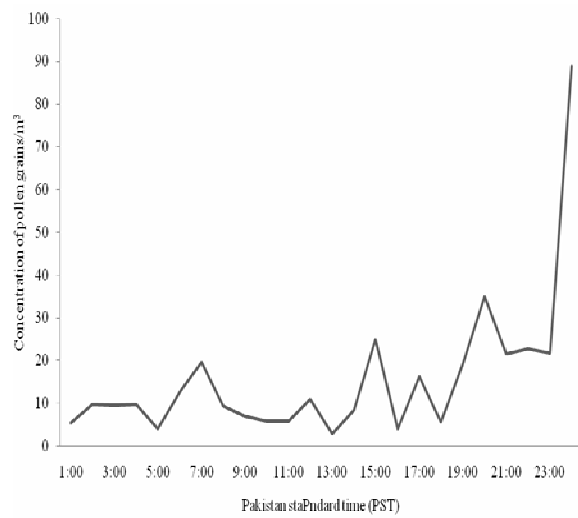


Fig. 9. Diurnal pattern of *Eucalyptus globules*.

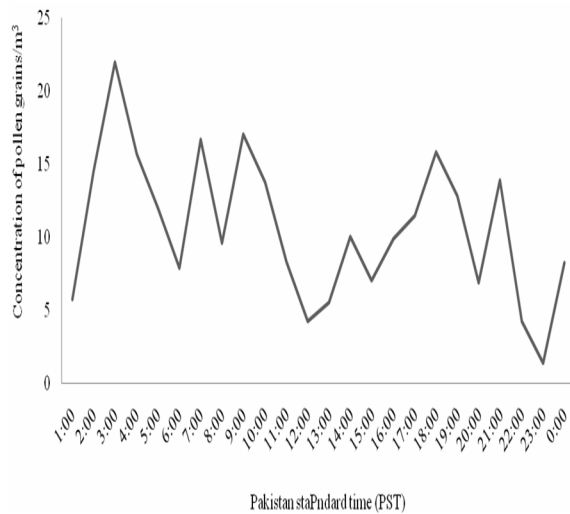


Fig. 10. Diurnal pattern of *Guaiacum officinale* pollen grains/m³.

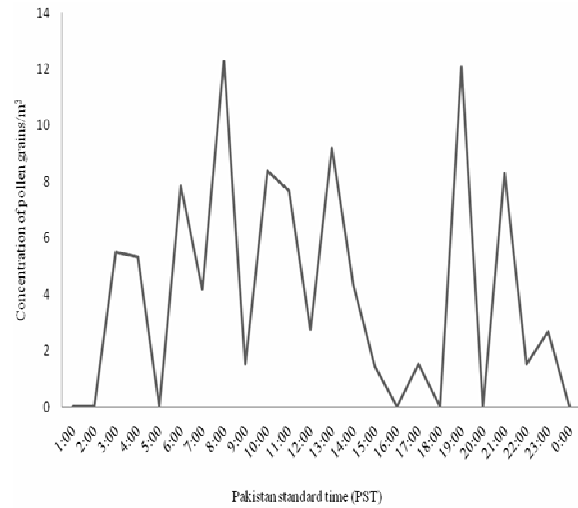


Fig. 11. Diurnal pattern of *Prosopis juliflora* pollen grains/m³.

Discussion

Studies related to airborne allergenic pollen grains have been carried out in several countries (Koivikko *et al.*, 1986; Datta, 1989; Caramiello *et al.*, 1990; Newnham *et al.*, 1995; Moreno-Graua *et al.*, 1998; Peternel *et al.*, 2003; Bicakci *et al.*, 2004; Gioulekas *et al.*, 2004; Weryszko-Chmielewska & Piotrowska, 2004; Huang *et al.*, 2008). In the aerobiological study of Hyderabad; Tando-Jam, Sindh, we have recognized 27 pollen grain types in which grass pollen grain type was most abundant about 28% of the total pollen count. Over the world 40% allergic patients are sensitive to grass pollen allergy (Johnson & Marsh, 1965; Freidhoff *et al.*, 1986; Andersson & Jonas, 2003). Amaranthaceae pollen grains are second highest in the pollen count. Members of Amaranthaceae family are annual or perennial herbs and are widely distributed in Hyderabad, Tando-Jam. Most common members are found in the area are *Amaranthus viridis*, *Digera muricata* and *Salsola imbricata*. It has been reported that pollen of Amaranthaceae family plants is potent allergens (Galan *et al.*, 1989). Other herbaceous taxa reported in our study are Asteraceae, *Brassica*, *Cyperus*, *Daucus*, *Ricinus communis*, *Rumex dentatus* and *Typha*. Tree pollen types include *Acacia*, *Azadirachta*, *Callistemon citrinus*, *Eucalyptus globulus*, *Delonix regia*, *Guaiacum officinale*, *Leucaena leucocephala*, *Mangifera indica*, *Moringa oleifera*, *Morus alba/Casuarina equisetifolia*, *Parkinsonia aculeata*, *Prosopis juliflora*, *Syzygium cumini*, *Tamarix* and *Thuja*. *Azadirachta* and *Cyperaceae* are found to cause hypersensitive reactions in a skin prick test (Mandal *et al.*, 2008). *Acacia*, *Albizia lebbek*, *Alnus*, *Amaranthus*, *Azadirachta*, *Brassica*, *Casuarina equisetifolia*, *Chenopodium*, *Daucus carota*, grasses, *Morus*, *Prosopis juliflora*, and *Ricinus communis* are all classified as allergenic pollen producing plants (Al-Frayh *et al.*, 1999; Singh & Kumar, 2004).

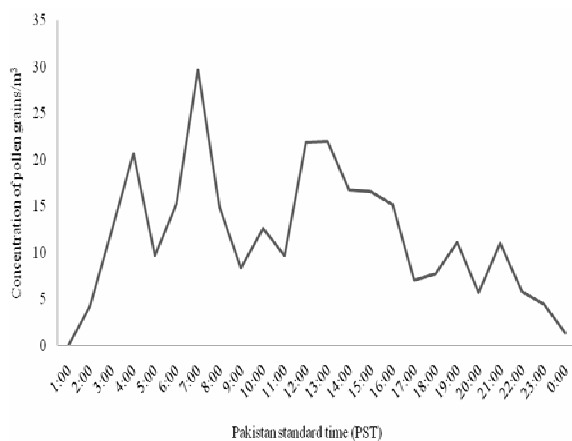


Fig. 12. Diurnal pattern of *Typha angustifolia* pollen grains/m³.

Our results of highest pollen grain counts in the month of April are similar to the results of Weryszko-Chmielewska *et al.*, (2004) and Bilisik *et al.*, (2008). In October-2008 another peak of pollen count was observed which is mainly due to the Amaranthaceae, *Cyperus* and grass pollen grains. According to a report high

concentration of *Amaranthus* pollen was found in October in various cities of Saudi Arabia having more or less similar climate (Hasnain *et al.*, 2007) as well as an elevated number of grass pollen grain is reported in October by Bilisik *et al.*, (2008) and Waqar *et al.*, (2010).

Concentration of pollen grains in the atmosphere varies throughout the day (Alcazar *et al.*, 1999). A diurnal pattern helps to understand the pattern in which the pollen grains are released and if there is any specific time of the day in which the pollen is present in higher quantity. Our data show *Cyperus* pollen type has an early morning maxima as well as a noon maxima, grass and *Leucaena leucocephala* has a noon maxima where as *Parkinsonia aculeata* has a mid morning maxima of 9 a.m. Amaranthaceae pollen grains were present throughout the daytime with no specific peak concentration in abundant amount. Not very sharp difference in the concentration and pattern was observed for the pollen grains of *Azadirachta*, *Brassica campestris*, *Eucalyptus globulus*, *Guaiacum officinale*, *Prosopis juliflora*, and *Typha angustifolia*.

Conclusion

During the study period (August 2008 to July 2009) major pollen types captured from Hyderabad; Tandojam are grass pollen type, amaranthaceae, *Cyperus* and *Guaiacum officinale*. Due to agricultural field in Tando-Jam *Brassica campestris*, *Daucus carota*, *Mangifera indica*, *Ricinus communis* and *Syzygium cumini* pollen types are also captured. The pollen count of airborne and allergy inducing plants like grasses, *Typha angustifolia*, *Eucalyptus globulus*, *Cyperus* and Amaranthaceae is high in certain parts of the year which may elicit anaphylactic attacks in hypersensitive individuals. Allergic people should be careful while working in fields in the months of February, March, April, September and October as in these months the pollen count is high in the investigated area.

Acknowledgements

The author is highly thankful to HEC for funding the project entitled "Identification and quantification of allergenic pollen from Sindh" and Department of Plant Protection, Agricultural University, Tandojam.

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(Received for publication 27 August 2011)