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SEASONAL FLUCTUATIONS OF AIRBORNE POLLEN GRAINS COUNT AND ITS CORRELATION WITH CLIMATIC FACTORS FROM KHAIRPUR; SINDH, PAKISTAN

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Abstract

This is the first aerobiological survey of Khairpur, Sindh. The survey was conducted from January-December, 2011 using Burkard's Seven Days Volumetric Spore trap. A total of 4559 pollen/m^3 were recorded belonging to 33 plant families and 41 pollen types The major pollen types were Poaceae (13.84%), Amaranthaceae/Chenopodiaceae (10.40%), *Cyperus rotundus* (7.61%); *Prosopis juliflora* (6.19%), *Brassica campestris* (4.91%), *Typha angustifolia* (4.89%), *Tamarix indica* (4.43%), *Eucalyptus globules* (4.28%), *Conocarpus erectus* (3.73%), Asteraceae (3.01%), *Guaicum officinale* (2.94%), *Azadirachta indica* (2.74%), Malvaceae (2.15%) and *Phoenix dactylifera* (1.84%) constituting more than 70% of total pollen catch. The highest pollen grains concentration was observed in May-2011 with 880 pollen/m^3 count while second highest pollen concentration was detected in September 2011 with 682 pollen/m^3. The lowest count was found in December-2011.Climatic factors like wind speed, average temperature,humidity and rainfall were correlated with the pollen counts. Different pollen types showed significant positive correlation with average temperature while negative correlation with humidity and wind speed.

Introduction

Airborne pollen are sometimes responsible for causing allergic rhinitis and asthma when come in contact with human respiratory tract (D'Amato *et al.,* 1998, Leuschner *et al*., 2000, Patz & Kovats, 2002, Garcia-Mozo *et al*., 2006, 2007, Mandal *et al*., 2008). These airborne pollens are the most important inhalant allergens, and they are able to bring out type-I hypersensitive reaction such as asthma, rhinitis, and hay fever (Cookson, 1999).

During the recent past aerobiological studies have established great awareness due to their ample application in allergology, forestry, agriculture and horticulture (Sahney & Chaurasia, 2008). Advancement in aerobiological study has recognized which pollen cause allergy and hypersensitivity and how pollen frequencies differ throughout the year resulting in the establishment of pollen calendars in many cities (Recio *et al*., 1998, Dopazo *et al*., 2000). The pollen grains that are released by wind pollinated plants constitute a major part of the air flora of a particular region (Peng & Su-Hwa, 1996, Lacey & Jonathan, 2006). The manner of atmospheric pollen increase in concentration can influence the intensity and prevalence of contact to allergens as a result of sensitized persons with wind pollinated plant species and posing a high risk of exposure than insect pollinated species (Smart *et al*., 1979, Jimenez *et al*., 1994).

Pollen when present in high concentrations might cause allergy (Ribeiro *et al.*, 2008). Pollen allergy considerably affects people in several parts of the world. In many countries about 20% populations are affected from pollen allergy. Many investigations have been conducted to recognize allergenic pollen species and the allergy-causing components present in the pollen (Weerd *et al*., 2002).

Pollen grains present in the air mainly represent local vegetation of the region (Chaturvedi & Datta, 1995). Nature and period of the pollination during the year vary because pollen differs from area to area; depend on the weather and flora (D'Amato & Liccardi, 1994). The presence of pollen grains in the air is affected by climatic factors such as rainfall, humidity, temperature and wind. Positive correlation was found between temperature and pollen concentration in the air and negative correlation of pollen concentration with humidity and rainfall (Alwadie, 2008). In the rainy season lower counts of pollen is observed because rain mostly sweeps pollen from the air (Hong *et al*., 1986). Meteorological conditions also affect the dispersal mechanism of pollen (Burge, 2002, Jato, 2002, Rodriguez-Rajo *et al*., 2003). High pollen count is seen in hot, dry and windy days. In the spring season usually tree pollen dominates in the air and in autumn herbaceous plants pollen are in abundance (Chaturvedi & Datta. 1995).

Studies related to airborne allergenic pollen have been carried out in many countries (Koivikko *et al*., 1986, Dutta, 1989, Caramiello *et al*., 1990, Newnham *et al*., 1995, Bicakci *et al*., 2004, Weryszko-Chmielewska & Piotrowska, 2004, Gioulekas *et al*., 2004, Huang *et al*., 2008). No aerobiological data is available on allergenic pollen from Khairpur, Sindh. This is the first airborne pollen survey conducted in Khairpur, Sindh. The objective of this investigation was to identify the overall pollen types; their concentrations; diurnal patterns; and seasonal variations.

Introduction to the study area: Khairpur is located in northern Sindh at 27°32′N 68°46′E coordinates. On the north, it shares its boundaries with Shikarpur and Sukkur; on the east with India; on the south with Nawabshahh and Sangharr; and on the west with Larkana and Naushahro Feroz. The estimated population of Khairpur, Pakistan is 1, 24,602 in 2010 according to the GeoNames and geographical database. The city is situated along the Khairpur East Canal, (18 km) south of the Indus River. Khairpur city is famous for its dates. Weather is hot during the summer and cold in winter. Humidity level in the area is usually low.

Materials and Methods

Sampling was carried out for the period of one year from January 2011-December 2011 by using Burkard's 7-Days Volumetric Spore Trap. The machine was installed about 15 meters above the ground level; on the roof of Botanical Garden of Shah Abdul Latif University campus, Khairpur. The data was collected for one year and was studied according to the guide lines of the manual by Lacey & West, (2006).Pollen grains were counted by using the light microscope at 40x magnification. The raw values were converted into standard counts i.e., pollen/m^3. Means values were calculated for daily and monthly counts. For the purpose of reference permanent slides of pollen were also prepared by standard method outlined by Erdthman, (1952). Meteorological data of one year (January 2011-December 2011) including various parameters like average temperature, wind speed, humidity, and precipitation (rain fall), was obtained from Pakistan Meteorological Department.

Results

During the study period from January 2011-December-2011, a total of 4559 pollen/m^3 were captured belonging to 41 pollen types, in which most dominant pollen types were *Acacia nilotica/Albizia lebbeck*, Amaranthaceae/ Chenopodiaceae, Asteraceae, *Azadirachta indica*, *Brassica campestris*, *Casuarina equisetifolia*, *Conocarpus erectus*, *Cyperus rotundus*, *Daucus carota*, *Delonix regia*, *Ephedra procera*, *Eucalyptus globulus*, *Guaicum officinale*, *Heliotropium* Malvaceae, *Leucaena leucocephala*, *Mangifera indica*, *Moringa oleifera*, *Morus alba*, *Phoenix dactylifera*, Poaceae, *Prosopis juliflora*, *Ricinus communis*, *Rumex crispus*, *Tamarix indica* and *Typha angustifolia* (Table 1). Poaceae pollen showed highest concentration i.e., 13.84% (631pollen/m^3) of the total pollen count. Second highest pollen concentration was of Amaranthaceae with 10.39% (474pollen/m^3) followed by *Cyperus rotundus* 7.61% (347 pollen/m^3); *Prosopis juliflora:* 6.18% (282 pollen/m^3); *Brassica campestris:* 4.19% (224 pollen/m^3); *Typha angustifolia:* 4.89% (223 pollen/m^3); *Tamarix indica:* 4.43% (202 pollen/m^3); *Eucalyptus globulus:* 4.27 % (195 pollen/m^3) etc.

Seasonal variation: The aerobiological data of Khairpur revealed that the highest concentration of airborne pollen was recorded in the month of May-2011 i.e., 880 pollen/m^3 (Fig. 1). Second highest peak of pollen count was observed in the month of September 2011 i.e., 682 pollen/m^3. Lowest pollen count was recorded in the month December-2011 i.e., 115 pollen/m^3. Our data showed that in May-2011 major pollen grains were contributed by Amaranthaceae/Chenopodiaceae, followed by Poaceae; *Brassica campestris*; *Cyperus rotundus* (Table 1).

Pollen grains of Poaceae were recorded throughout the year (Table 1), with the highest pollen season observed in April-2011 (111 pollen grains/m^3) and the lowest pollen concentration was observed in the month of December-2011. Amaranthaceae/ Chenopodiaceae-type pollen grains were also captured throughout the year showing peak pollen count in the month of May- 2011 (113 pollen/m^3) and lowest pollen count was recorded in months December-2011. The month of May-2011 was also the highest pollinating month of other captured pollen types including *Brassica campestris*; *Cyperus rotundus*; *Eucalyptus globulus*; *Guaicum officinale*; and *Typha angustifolia*. The highest concentration of *Prosopis juliflora* pollen grains was recorded in the month of April 2011 and lowest pollen count in March. *Tamarix indica* pollen count was highest in the month of October-2011 and lowest in the month of December-2011. *Conocarpus erectus* showed maximum pollen count in the month of July-2011 and lowest pollen concentration in November-2011. Asteraceae pollen type was observed with the highest pollen concentration in September-2011. *Azadirachta indica* pollen type showed highest concentration of pollen grains in the month of February-2011 and lowest concentration in the month of July-2011.

Diurnal Pollen pattern: Diurnal patterns were constructed to identify highest pollen count at a specific time of the day. These patterns were constructed based on mean daily pollen count for the whole year. Most of the pollen types encountered in this study did not show any sharp peak of pollen count rather the pollen grains counts were almost uniformly distributed in 24 hours. Other pollen types showed a diurnal pattern viz., Amaranthaceae/Chenopodiaceae pollen type has an after mid day maxima at 1 pm with peak pollen count of 50 pollen grains/m^3 (Fig. 2); Asteraceae pollen type showed exact mid day maxima at12pm (16 pollen grains/m^3) (Fig. 3). *Conocarpus erectus* showed a sharp after mid day pollen peak at 1 pm (39 pollen grains/m^3) (Fig. 4). *Guaicum officinale* showed near mid day maxima at 11am (20 pollen grains/m^3) (Fig. 5). Malvaceae pollen type showed two maxima points first is at 9 am (14 pollen grains/m^3) and second at 11 am (15 pollen grains/m^3) (Fig. 6). *Moringa* pollen type also showed two peak values at 6am and 3pm with same pollen count of 13pollen grains/m^3 (Fig. 7). *Phoenix* pollen grain type showed sharp peak at 3 pm and 8pm with a pollen count of 11 pollen grains/m^3 and 10 pollen grains/m^3 respectively (Fig. 8). Poaceae pollen type showed a noon maxima from 1 pm to 3pm (Fig. 9). *Prosopis juliflora* showed near mid day maxima at 11am (Fig. 10). *Tamarix indica* pollen type showed almost mid day maxima at 11am (21 pollen grains/m^3) and night maxima at 8 pm (18 pollen grains/m^3) (Fig. 11).

Statistical analysis: Pearson Chi-square test was performed by using SPSS software to determine the correlation of meteorological factors. Average temperature, wind speed, humidity, and precipitation were correlated with pollen counts (Table 2). Statistical analysis revealed positive correlation of *Azadirachta indica* (p-value 0.05); *Eucalyptus globulus* (p-value 0.02); Malvaceae (p-value 0.05); *Melilotus alba* (p-value 0.03); and *Rumex crispus* (p-value 0.02) with the average temperature; whereas, *Rosa indica* (p-value -0.01) and *Tamarix indica* (p-value -0.03) showed a negative correlation with the temperature. *Scirpus tuberosus* showed a positive correlation with humidity (p-value 0.05). Total pollen count showed significant negative correlation with humidity with a p value -0.03. Pollen grains of *Azadirachta indica*, *Brassica campestris*, and *Syzygium cumini* showed a positive correlation with average precipitation with p-value 0.03, 0.02, and 0.02 respectively (p-value-0.02). *Phyllanthus amarus* pollen showed a positive correlation with wind speed (p-value 0.03) while *Conocarpus erectus*, *Delonix regia*, and *Leucaena leucocephala* showed negative correlation.

Table 1. Pollen grains concentrations of various pollen types from Khairpur, Sindh for the year of 2011.

Name of species	Jan.11	Feb. 11	Mar. 11	April 11	May 11	June 11	July 11	Aug. 11	Sept. 11	Oct. 11	Nov. 11	Dec. 11	Total
Acacia nilotica / Albizia lebbeck	17	0	8	2	11	0	0	0	0	0	0	3	41
Amaranthaceae/Chenopodiaceae	31	21	25	36	113	27	28	26	106	31	20	10	474
Asteraceae	20	11	17	2	0	0	6	14	23	15	20	9	137
Azadirachta indica	0	30	17	14	28	9	4	0	17	6	0	0	125
Bougainvillea glabra	11	5	2	0	0	0	0	2	15	0	0	0	35
Brassica campestris	28	19	19	12	79	0	0	8	33	12	9	5	224
Callistemon citrinus	0	11	8	0	11	0	0	0	0	0	0	0	30
Cassia fistula	0	0	6	6	0	9	10	0	0	0	0	0	31
Casuarina equisetifolia	20	18	2	0	0	0	0	0	0	0	0	2	42
Cleome viscosa	17	0	0	0	15	0	0	6	10	10	0	3	61
Clerodendrum inerme	0	0	0	0	0	16	0	0	0	10	0	7	33
Conocarpus erectus	0	12	0	0	34	11	51	14	27	15	6	0	170
Cyperus rotundus	37	25	19	40	55	45	0	22	41	52	11	0	347
Cupressaceae	0	0	0	0	0	0	0	0	0	0	7	9	16
Daucus carota	9	0	0	4	11	2	0	0	0	0	0	3	29
Delonix regia	0	0	0	0	0	7	8	10	6	14	0	0	45
Ephedra procera	0	0	0	0	11	4	0	0	0	0	0	12	27
Eucalyptus globulus	34	0	25	0	38	0	22	12	27	37	0	0	195
Guaicum officinale	0	14	10	12	43	0	6	14	12	23	0	0	134
Heliotropium ophioglossum	0	0	8	4	11	0	0	0	19	6	0	5	53
Malvaceae	9	2	6	0	28	0	0	0	15	21	17	0	98
Leucaena leucocephala	0	0	0	0	0	13	4	0	27	14	0	0	58
Mangifera indica	14	7	6	4	19	0	0	0	0	0	0	0	50
Melilotus alba	0	7	4	10	0	0	0	8	12	14	0	3	58
Moringa oleifera	17	5	14	6	17	0	0	0	0	0	0	0	59
Morus alba	6	4	0	0	0	0	0	0	0	8	9	0	27
Parkinsonia aculeata	0	9	2	18	15	11	0	0	0	0	0	0	55
Phoenix dactylifera	11	11	6	8	15	0	0	8	15	0	0	10	84
Phyllanthus amarus	0	0	0	0	0	0	0	0	21	14	0	0	35
Pinus roxburghii	6	2	0	0	0	0	0	4	0	0	0	0	12
Poaceae	68	35	46	111	96	36	34	28	58	89	18	12	631
Prosopis juliflora	0	23	17	55	45	22	18	22	43	37	0	0	282
Ricinus communis	0	0	4	6	17	0	0	12	19	19	0	0	77
Rosa indica	11	0	0	0	23	0	0	0	17	0	0	0	51
Rumex crispus	0	0	8	0	0	0	0	0	14	0	9	0	31
Scirpus tuberosus	0	11	19	18	30	0	0	0	41	25	0	0	144
Syzygium cumini	0	5	2	0	0	0	0	0	0	0	0	0	7
Tamarindus indica	0	0	4	6	23	0	12	0	0	0	0	0	45
Tamarix indica	17	9	15	26	30	0	0	10	31	54	0	10	202
Typha angustifolia	23	14	21	18	47	16	0	22	27	35	0	0	223
Ziziphus nummularia	11	0	4	2	0	0	0	0	0	0	0	2	19
Unidentified	7	5	3	0	15	7	0	5	8	4	0	10	64
Total	**424**	**315**	**347**	**420**	**880**	**235**	**203**	**247**	**682**	**565**	**126**	**115**	**4559**

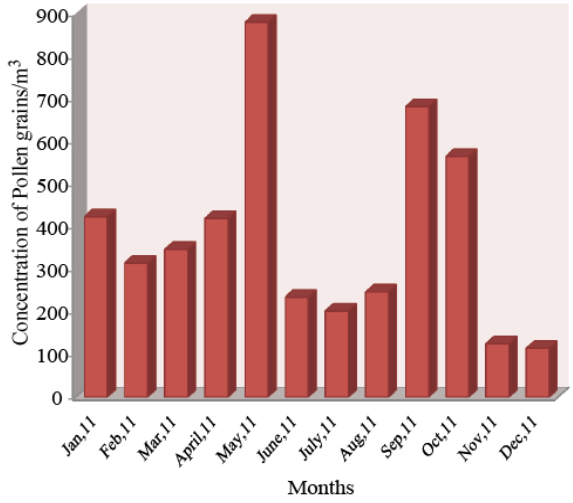

Fig. 1. Monthly variation of total pollen count of Khairpur, Sindh for the year of 2011.

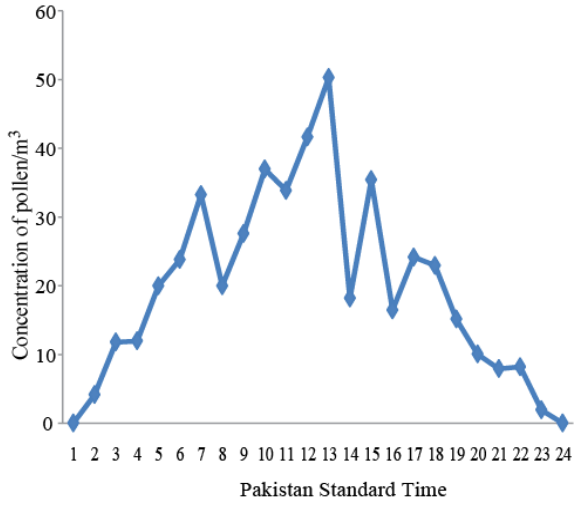

Fig. 2. Diurnal pattern of Amaranthaceae/Chenopodiaceae pollen/m^3.

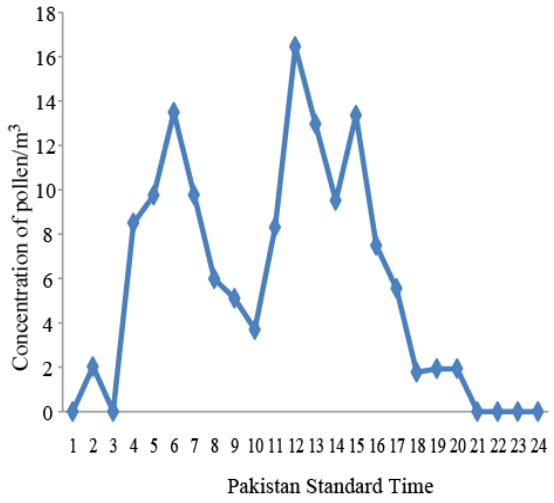

Fig. 3. Diurnal pattern of Astraceae pollen/m^3.

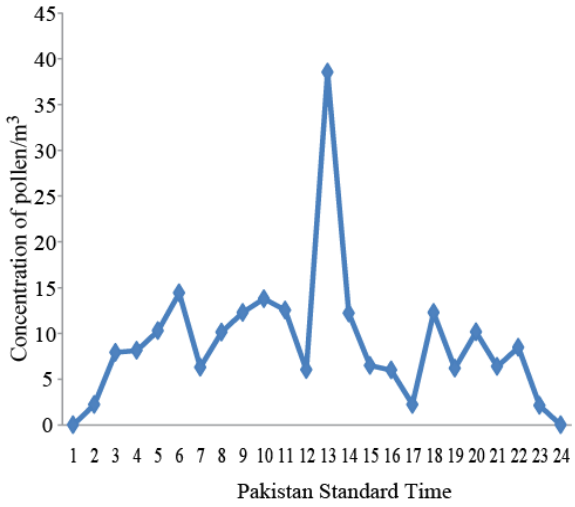

Fig. 4. Diurnal pattern of *Conocarpus erectus* pollen/m^3.

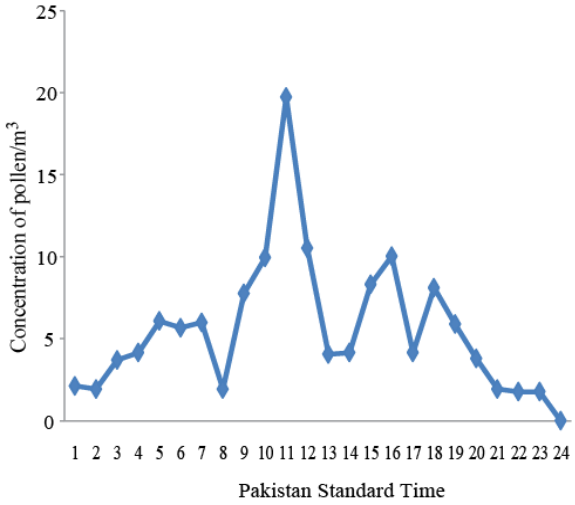

Fig. 5. Diurnal pattern of *Guaicum officinale* pollen/m^3.

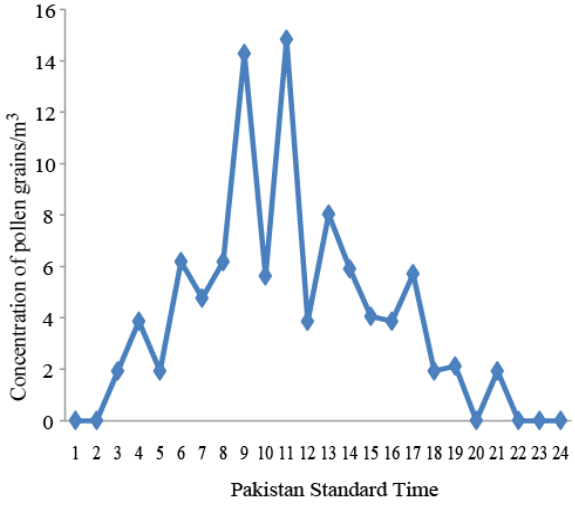

Fig. 6. Diurnal pattern of Malvaceae pollen/m^3.

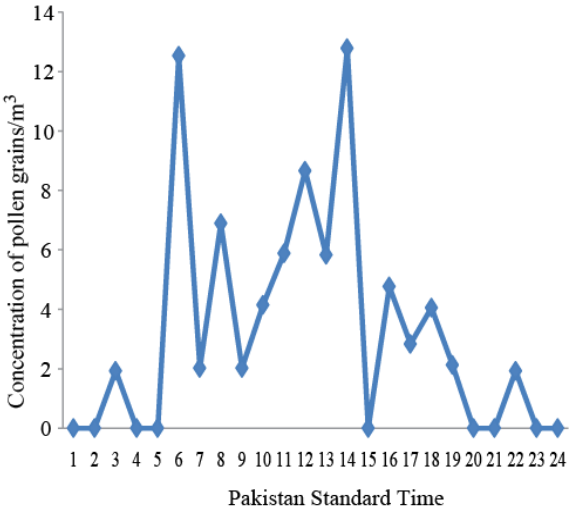

Fig. 7. Diurnal pattern of *Moringa olifera* pollen/m^3.

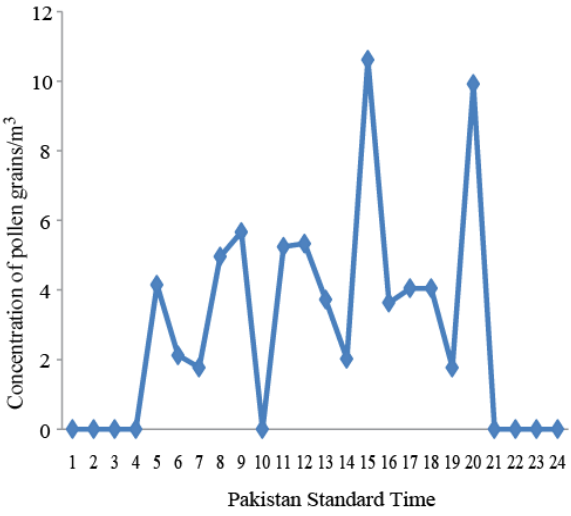

Fig. 8. Diurnal pattern of *Phoenix dactylifera* pollen/m^3.

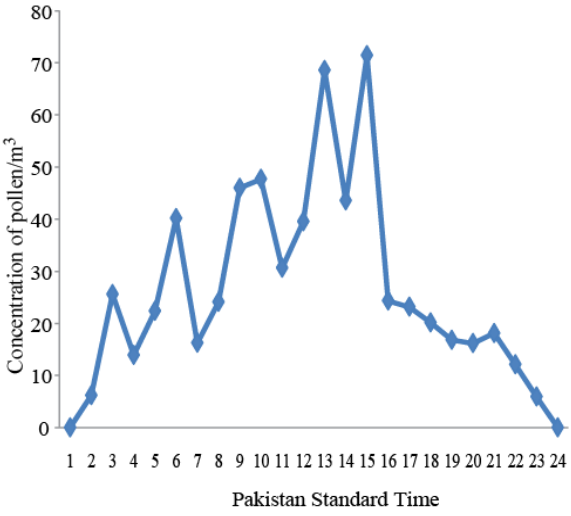

Fig. 9. Diurnal pattern of Poaceae pollen/m^3.

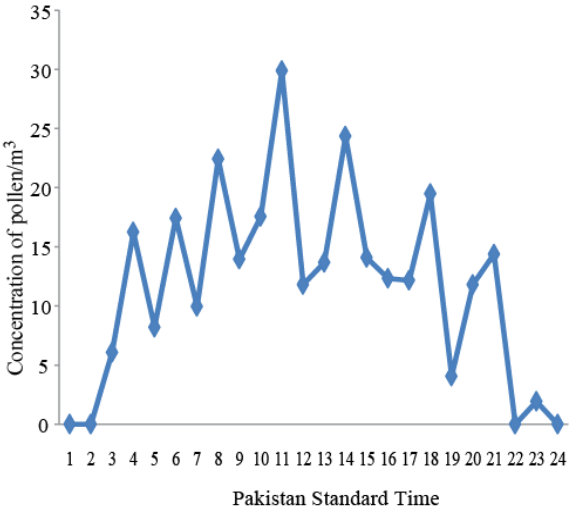

Fig. 10. Diurnal pattern of *Prosopis juliflora* pollen/m^3.

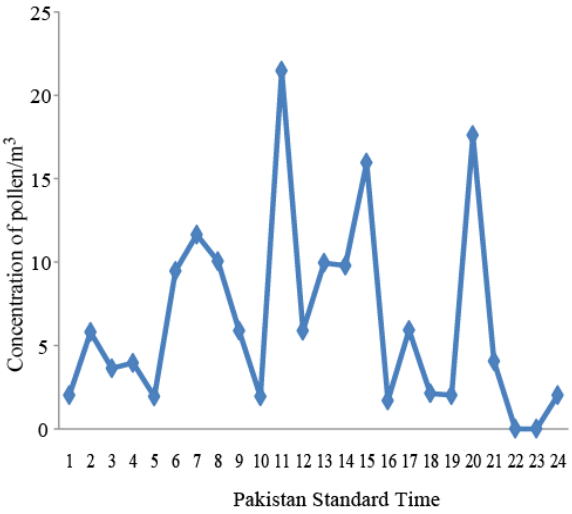

Fig. 11. Diurnal pattern of *Tamarix indica* pollen/m^3.

Discussion

In the present study Amranthaceae/Chenopodiaceae, Asteraceae, *Brassica campestris*, *Cyperus rotundus*, *Conocarpus erectus*, *Eucalyptus globules*, *Guaicum officinale*, Malvaceae, *Mangifera indica*, *Phoenix dactylifera*, Poaceae, *Prosopis juliflora*, *Typha angustifolia*, and *Tamarix indica* were abundant pollen types and representive of vegetation of Khairpur city. These pollen types have also been reported from other cities of Sindh (Waqar *et al.*, 2010; Perveen *et al*., 2007, 2012). *Phoenix dactylifera* pollen type is reported for the first time from Pakistan. *Pinus roxburghii* represent northern Pakistan flora. Those pollen grains might have been carried by the long distance travelling wind.

Poaceae pollen type was the most dominant pollen type. This trend was also observed in other parts of the world (Kazmi *et al*., 1984, Chakraborty *et al*., 1998, Garcia-Mozo *et al.*, 2006, Alwadie, 2008). Mandal *et al*., (2008) reported allergenicity to pollen grains from various species of grasses and sedge like *Cenchrus*

ciliaris, Cenchrus biflorus, Chloris barbata, Cynodon dactylon, Dicanthium annulatum, Dactyloctenium scindicum, Zea mays, Cyperaceae. Over the world, 40% allergic patients are sensitive to grass pollen allergy (Freidhoff *et al*., 1986, Andersson & Jonas, 2003). Amaranthaceae/ Chenopodiaceae was second dominated pollen type in Khairpur which was similar to Tandojam and Karachi aerobiological surveys of Pakistan (Perveen *et al*., 2007, 2012). There are reports of allergenic pollen by some members of Amaranthaceae family (Galan *et al*., 1989, Rodríguez-de La Cruz *et al*., 2012). *Prosopis juliflora* pollen grains are also reported to cause pollinosis (Shivpuri & Parkash, 1967, Dhyani *et al*., 2006). *Casuarina equisetifolia* pollen grains are reported to be allergenic by Singh & Kumar (2004).

Table 2. Correlation of captured air borne pollen grain types from Khairpur with meteorological conditions.

Name of species	Temperature	Humidity	Precipitation (mm)	Wind speed
Acacia nilotica / Albizia lebbeck	-0.51	-0.24	-0.28	-0.39
Amaranthaceae/Chenopodiaceae	0.29	0.17	0.33	-0.22
Asteraceae	-0.47	0.58	0.45	-0.26
Azadirachta indica	0.05	-0.10	0.03	-0.38
Bougainvillea glabra	0.30	0.72	0.58	-0.13
Brassica campestris	-0.06	-0.10	0.02	-0.31
Callistemon citrinus	-0.15	-0.21	-0.12	-0.48
Cassia fistula	0.54	-0.28	-0.25	-0.20
Casuarina equisetifolia	-0.80	0.20	-0.10	-0.42
Cleome viscosa	-0.26	0.17	0.14	-0.19
Clerodendrum inerme	0.25	-0.23	-0.34	-0.27
Conocarpus erectus	0.62	0.24	0.23	-0.04
Cyperus rotundus	0.16	-0.12	-0.02	-0.30
Cupressaceae	-0.30	-0.19	-0.28	-0.40
Daucus carota	-0.25	-0.39	-0.38	-0.36
Delonix regia	0.55	0.34	0.35	-0.01
Ephedra procera	-0.02	-0.40	-0.33	-0.36
Eucalyptus globulus	0.02	0.07	0.10	-0.17
Guaicum officinale	0.29	-0.21	0.05	-0.27
Heliotropium ophioglossum	0.11	0.17	0.38	-0.21
Leucaena leucocephala	0.34	0.48	0.44	-0.01
Malvaceae	0.05	-0.13	-0.10	-0.28
Mangifera indica	-0.34	-0.29	-0.28	-0.41
Melilotus alba	0.03	0.26	0.45	-0.23
Moringa oleifera	-0.39	-0.34	-0.28	-0.43
Morus alba	-0.39	-0.05	-0.32	-0.36
Parkinsonia aculeata	0.23	-0.53	-0.35	-0.45
Phoenix dactylifera	-0.41	0.26	0.38	-0.30
Phyllanthus amarus	0.12	0.47	0.49	0.03
Pinus roxburghii	-0.53	0.42	0.25	-0.22
Poaceae	0.09	-0.40	-0.20	-0.30
Prosopis juliflora	0.48	-0.11	0.20	-0.26
Ricinus communis	0.34	0.19	-0.70	-0.31
Rosaceae	-0.01	0.16	0.21	-0.17
Rumex crispus	0.02	0.41	0.45	-0.22
Scirpus tuberosus	0.15	0.05	0.28	-0.25
Syzygium cumini	-0.38	0.11	0.02	-0.50
Tamarindus indica	0.40	-0.43	-0.25	-0.21
Tamarix indica	-0.03	-0.13	0.04	-0.26
Typha angustifolia	0.12	-0.05	0.14	-0.28
Ziziphus nummularia	-0.70	-0.06	-0.21	-0.39
Unidentified	-0.40	0.21	0.19	-0.29
Total pollen count	**0.12**	**-0.03**	**0.14**	**-0.27**

In the studied year of 2011, May has the peak pollinating season of plants with the highest pollen count. Same pattern of high incidence of pollen count in the month of May has also been reported by Bicakci *et al*., (2004) in Turkey and by Garcia-Mozo *et al*., (2006) in Spain. Rodríguez-de La Cruz *et al*., (2012) reported May as start of the pollinating season of Amaranthaceae/ Chenopodiaceae with peak concentration in August to September. Second highest concentration of pollen grains count was detected in the month of September in which maximum amount of pollen grains were contributed by Amaranthaceae/ Chenopodiaceae and Poaceae. In a similar type of study conducted in Karachi, the month September was declared the highest pollen count month. Poaceae and Amaranthaceae/ Chenopodiaceae were the main contributors in that month (Waqar *et al.,* 2010). In our study December was the lowest pollen count season. In a report from Allahabad, India winter season especially December was also reported to be the lowest pollen count season and pollen grains of most of the species were not recorded in that month (Sahney & Chaurasia, 2008).

The comparison of diurnal pattern of Khairpur airborne pollen data with other cities data has revealed that similar to Khairpur, in Tandojam, Poaceae pollen count is high in afternoon (Perveen *et al*., 2012). Another fifteen year study on airborne grass pollen release pattern in South West Spain has also reported high incidence of grass pollen between 1pm to 7pm with peak pollen count at 4pm. Our data has recorded peak pollen count of Poaceae pollen at 3pm. (Rodríguez *et al*., 2010). Amaranthaceae/Chenopodiaceae pollen peak hourly concentration was recorded in second half of the day which was similar to a study conducted in Spain (Rodríguez-de La Cruz *et al*., 2012).Most of the other species have shown their own specific pattern of average hourly pollen counts.

Our data of different pollen types show significantly correlation with average temperature, rain fall and wind while negative correlation with humidity. There are reports on the significant positive relation of pollen counts with temperature and negative with rain fall and humidity (Rodríguez-de La Cruz *et al*., 2012). Another study from India reported the similar type of observations that sunny, bright and rain-free days favor a high pollen catch. Such climatic conditions might be helpful for the high dispersal, discharge, and deposition of pollen (Singh & Babu, 1980). Pollen types of *Azadirachta indica*, *Eucalyptus globulus*, Malvaceae, *Melilotus alba*, and *Rumex crispus* were positively correlated with temperature. It is reported that Poaceae pollen counts significantly reduce during rainy season (*Green et al*., 2004) while our data showed *Cyperus rotundus* had a negative correlation with average rain fall. These was also a possible correlation of medium and long distant wind with pollen counts (Damialis *et al*., 2005) as in case of *Phyllanthus amarus* pollen from Khairpur.

Conclusion

Our results have shown that during aerobiological survey copious amount of pollen grains recorded in the study area. It is expected that the present study will provide useful data to the allergologists of Khairpur for selecting pollen allergens during calendar months of the year which will facilitate proper diagnosis and treatment.

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