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AEROBIOLOGICAL STUDY FROM THE SPIDER WEBS OF PAKHAL WILDLIFE SANCTUARY, WARANGAL DISTRICT, TELANGANA STATE, INDIA

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ABSTRACT
An aerobiological investigation was carried out at Pakhal wildlife Sanctuary, Warangal district, Telangana state to know the incidence and effects of aero biota by using palynological data collected from the spider webs during winter season. Four spider web samples were collected from Pakhal wildlife Sanctuary and processed by using Erdtman's acetolysis technique and recorded 30 pollen grains along with fungal spores belong to 18 families. In this study the following allergenic pollen viz., *Parthenium hysterophorus, Ageratum conyzoides, Peltophorum pterocarpum, Prosopis julifera, Eucalyptus globulus, Xanthium strumarium, Abutilon indicum, Syzygium cumini, Azadirachta indica* and Poaceae pollen and some fungal spore like *Alternaria* sp., *Curvularia* sp., *Torula* sp. were also recorded. The dominance of fungal spores is due to the unhygienic and interference of anthropogenic activities around Pakhal Lake. These are the indications of humid climatic conditions. The present study is useful not only to know the incidence of pollen or aeroallergens and also know the effects of allergenic diseases like allergy, asthma and hay fever or seasonal rhinitis to the human beings and also the wild life in Pakhal wildlife Sanctuary.

INTRODUCTION

Aeropalynology is an applied branch of Science that deals with the study of spore, pollen and fungal spores present in the atmosphere, which transports to different places through air. Gregory (1973) proposed the term "Air-spora" to describe airborne pollen grains and fungal spores, the composition of which varies from place to place. Spider webs are known to be potential natural traps (Xiao Yan Song *et al*. 2007) for airborne spores and pollen grains, fungal spores, small leaves, flower and insect parts of a particular geographical area (Bera *et al.,* 2002, Reddy *et al.*, 2009 and More *et al.*, 2013). Pollen grains found in the atmosphere are widely known to cause allergenic diseases like hay-fever, asthma and eczema (Nair 1963, Mandal and Chandra 1979). The allergic diseases are a severe problem for the community as well as for the national economy (Cookson 1999, Sharma *et al.*, 2009). Allergic diseases such as asthma and seasonal rhinitis affect the human population in polluted and industrialised cities and are a product of immediate hypersensitivity responses to innocuous components in the environment (Eder *et al.,* 2006 and Pawankar *et al.*, 2011). ICPA (India coordinated project on aeroallergens) carried out a survey in India reported that about 20-30% of population suffer from allergic rhinitis and 15% of asthma (Anonymous 2000 and Chhabra *et al.*, 1998). Pollen grains and fungal spores, which are released into the atmosphere, are a major source of airborne allergens and significant cause of these diseases (De Weerd *et al.,* 2002, Avinash, 2008 and Singh and Mathur 2012). Therefore, monitoring of aerospora released and transported in the air regionally is required to determine the prevalence of various pollen types and to identify seasonal variations over time (Hose *et al.,* 2002). Such measures can support the public sector and health sector in the prevention and control of respiratory diseases caused by exposure to airborne allergens (Smith *et al.*, 2014).

The present study deals with an aeropalynological investigation of Pakhal wildlife Sanctuary, Warangal district, Telangana state by using palynological data collected from the spider webs during winter season. In situ webs were collected from Pakhal wildlife Sanctuary, Warangal district including surrounded areas of Pakhal Lake. The main aim objective of the present investigation is to monitor the air quality regarding the bio pollutants or aeroallergens and to know the qualitative and quantitative dispersal of pollen and fungal spores in the atmosphere with help of spider webs.

MATERIALS AND METHODS

Study area

Warangal district located on the eastern part of Deccan Plateau at 18° 0' N longitude and 79° 58' E latitudes on the banks of the Godavari River with an elevation of about 289 m above the sea level. Warangal located in the semi-arid region of Telangana state with a predominantly hot and dry climate

with annual rainfall ranges from 500-550 mm and temperature is around 15 to 42^{0}C. Pakhal Lake is situated at a distance of about 50 kms to the east of Warangal city and with Narsampet which about 12 km away, which is enveloped by the scenic forested hills, which spreads over an area of 30 km^2. The Pakhal wildlife Sanctuary lies on the 17^0 58' N longitude and 79^0 27' E latitudes of Warangal district in the north eastern region of the state of Telangana, India. (Fig. 1). It is a dense forest shelter for a variety of flora consists of mixed forests, bamboo and teak forests.

Sampling Method

Four Spider web samples were collected from in and around Pakhal wildlife Sanctuary and Pakhal Lake during winter season i.e. December, 2014. These spider webs were collected from the trees and bushes by rolling the end of the stick. The methodology of spider webs was adopted from Bera *et al.,* 2002. For the extraction of pollen and spores, samples were first treated with conc. hydrochloric acid (HCL) to dissolve the meshes instantly. After that, the superfluous materials were removed with the help of 150 sized Sieve mesh, then washed several times with distilled water to remove acid content by centrifuging and decantation. And the filtrate was treated with 10 ml conc. hydrofluoric acid (HF) and kept for two days to dissolve silica, and then washed with distilled water by centrifugation. Then residue was treated with acetolysis mixture, i.e. acetic anhydride and con. Sulphuric acid (H_2SO4) in the ratio of 9:1 (Erdtman 1943; 1969). Then the solution was placed in a boiling (100°C) water bath for 15-20 mins. After centrifugation and decantation, samples were prepared in 50% glycerine solution for observation. For the analysis of aerospora 3 slides were prepared for each sample. Light photomicrography was carried out using Olympus microscope. The prepared slides were presented in the Palaeobotany & Palynology Research Laboratory, Department of Botany, University College of Science, Saifabad, Hyderabad.

RESULTS AND DISCUSSION

The aero biota consists of pollen grains, fungal spores and cuticles, insect remains like wings, scales, epidermal scales and trichomes. A total of about 30 pollen grains along with fungal spores were encountered Viz., Poaceae type (15.62%), *Prosopis julifera* (15.5%), *Parthenium hysterophorus* (8.41%), *Tectona grandis* (7.82%), *Ageratum conyzoides* (6.62%), *Leucaena leucocephala* (5%), *Xanthium strumarium* (2.85%), *Sida cordifolia* (2.14%), *Abutilon indicum* (2%), *Tridax procumbens* (1.79%), *Peltophorum pterocarpum* and *Sapindus emarginatus* (1.72% each), *Eucalyptus globulus* (1.67%), *Amaranthus* sp. (1.53%), *Celosia* sp. (1.48%), *Tamarindus indica* (1.15%), *Psidium guajava* (1%), *Syzygium cumini* (0.96%), *Albizia lebbeck* (0.82%), *Acacia nilotica* (0.77%), *Cieba pentandra* (0.61%), *Cardiospermum* sp. (0.58%), *Azadirachta indica* (0.44%), *Rangia repens* (0.37%), where as fungal spores viz., *Alternaria* sp. (7%), *Curvularia* sp. (3.88%), *Torula* sp. (2.71%), *Nigrospora* sp. (0.3%), Ascospores (2.23%), microtharious fungi and trichomes like epidermal and insect scales were also recorded (Fig. 2).

The predominant pollen are Poaceae pollen, *Prosopis julifera, Tectona grandis, Parthenium hysterophorus, Ageratum conyzoides, Leucaena leucocephala, Xanthium strumarium* and *Sida cordifolia* and the fungal spores like *Alternaria, Curvularia* sp., *Torula* sp., *Pitheum* sp. and Ascospores are also recorded. And other significant types are *Amaranthus* sp., *Celosia* sp., *Abutilon indicum, Tridax procumbens*, *Peltophorum pterocarpum, Sapindus emarginatus, Eucalyptus globulus* and *Tamarindus indica*. In this study the following allergenic pollen viz., *Parthenium hysterophorus, Ageratum conyzoides, Peltophorum pterocarpum, Prosopis julifera, Eucalyptus globulus, Xanthium strumarium, Abutilon indicum, Syzygium cumini, Azadirachta indica* and Poaceae pollen and some fungal spore like *Alternaria* sp., *Curvularia* sp., *Torula* sp., *Nigrospora* sp., Ascospores were also recorded.

Table 1: Airborne aerospora recorded from the Spider webs of Pakhal wildlife Sanctuary, Warangal district, Telangana Sate.

Sl. No	Family	Genus
1.	Mimosaceae	*Acacia nilotica* (L.) P.J.H.Hurter & Mabb.,*Albizia lebbeck* (L.) Benth., *Prosopis julifera* (Sw.) DC.*Leucaena leucocephala* (Lam.) de Wit
2.	Caesalpinaceae	*Peltophorum pterocarpum* (DC.) K. Heyne.,*Tamarindus indica* L.
3.	Asteraceae	*Ageratum conyzoides* L.,*Xanthium strumarium* L.,*Tridax procumbens* L.
4.	Verbenaceae	*Tectona grandis* L.f.
5.	Bombacaceae	*Cieba pentandra* (L.) Gaertn.
6.	Acanthaceae	*Rangia repens* L.
7.	Sapindaceae	*Sapindus emarginatus* L.*Cardiospermum* sp.
8.	Amaranthaceae	*Amaranthus* sp., *Celosia* sp.,
9.	Arecaceae	*Borassus* sp.
10.	Meliaceae	*Azadirachta indica* A.Juss.
11.	Malvaceae	*Abutilon indicum* (Link) Sweet.,*Sida cordifolia* L.
12.	Poaceae	Graminae pollen
13.	Myrtaceae	*Eucalyptus globulus* Labill.,*Syzygium cumini* (L.) Skeels. *Psidium guajava* L.
14.	Convolvulaceae	*Jacquemontia paniculata* (N. L. Burman) Hallier f.
15.	Pleosporaceae	*Alternaria alternata (Fr.) Keissel.,A. brassicicola (Fr.) Keissel.,Curvularia lunata (Walker)Boedijn.*
16.	Saccharomycetaceae	*Torula* sp.
17.	Montagnulaceae	*Pithomyces* sp.
18.	Trichosphaeriaceae	*Nigrospora* sp.

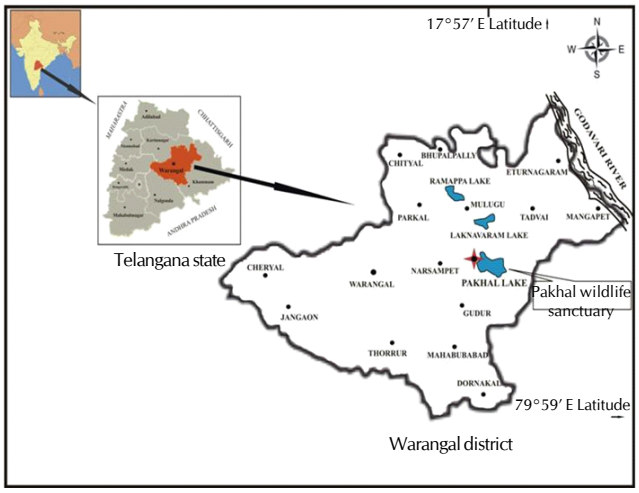


Figure 1: Map showing the location of Pakhal wildlife sanctuary, Warangal district, Telangana state

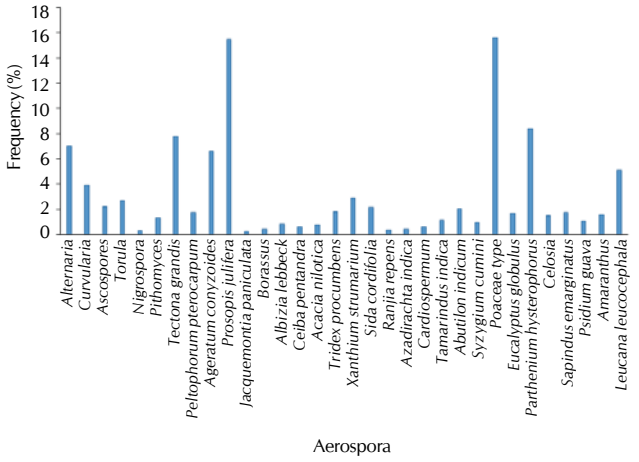


Figure 2: Pollen-fungal spectra of the PWSSW (Pakhal wildlife sanctuary - Spider web) samples from Pakhal wildlife sanctuary, Warangal district

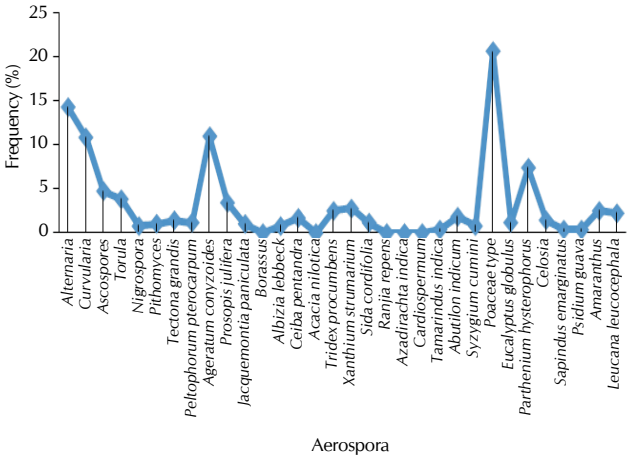


Figure 3: Pollen - fungal graphical figure of the PWSSW-1 spider web sample from Pakhal wildlife Sanctuary

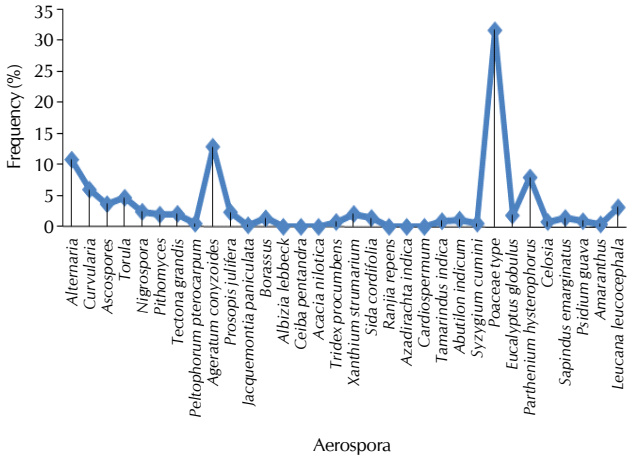


Figure 4: Pollen- fungal graphical figure of the PWSSW-2 spider web sample from Pakhal wildlife Sanctuary

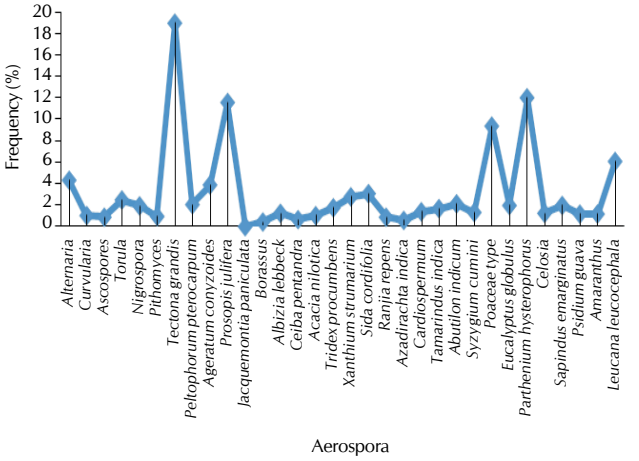


Figure 5: Pollen - fungal graphical figure of the PWSSW-3 spider web sample from Pakhal wildlife Sanctuary

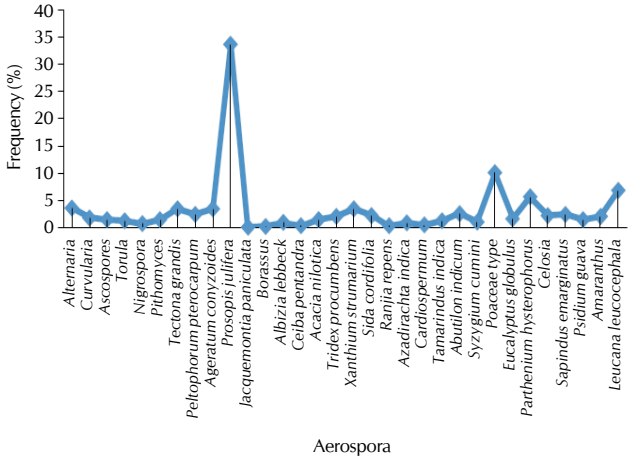


Figure 6: Pollen - fungal graphical figure of the PWSSW-4 spider web sample from Pakhal wildlife Sanctuary

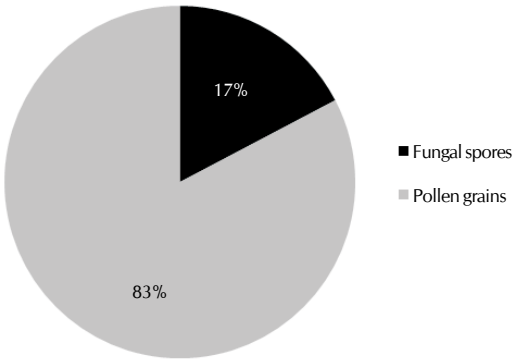
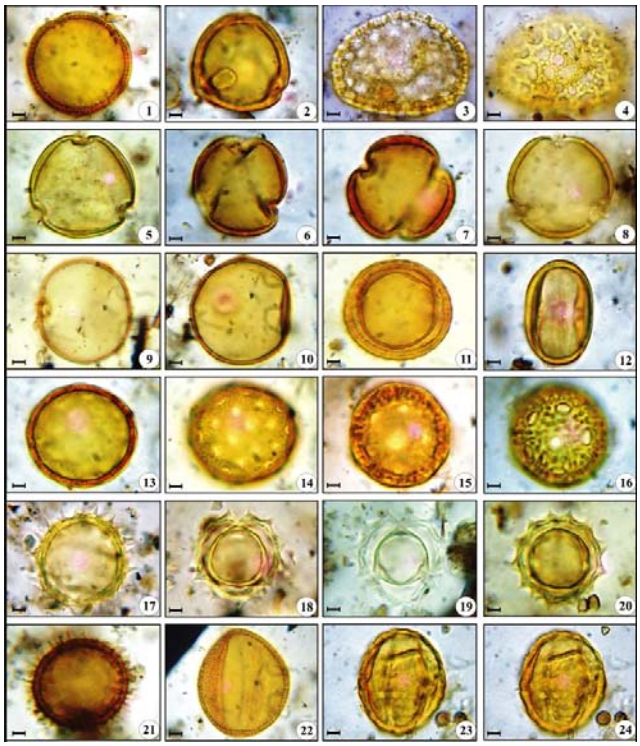


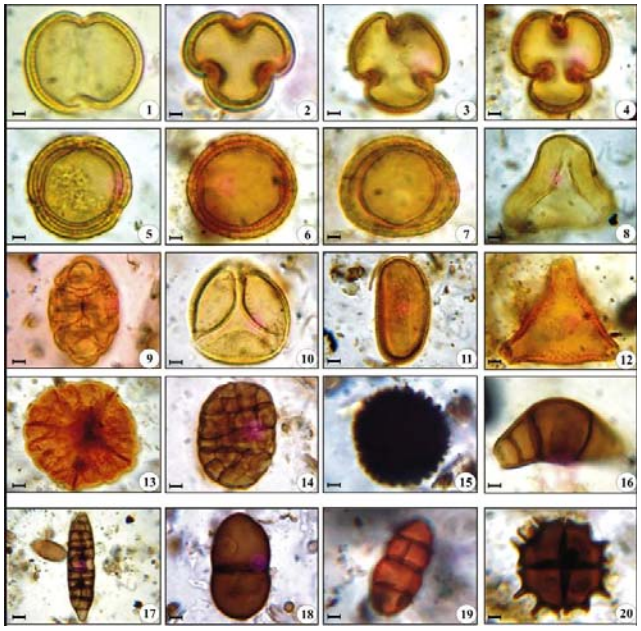
Figure 7: The frequency (%) of pollen and fungal spores of PWSSW samples



1. *Jacquemontia paniculata,* 2. *Eucalyptus globulus,* 3-4. *Cieba pentandra,* 5-8. *Leucaena leucocephala,* 6-7. *Prosopis julifera,* 9-10. Poaceae type, 11. *Xanthium strumarium*, 12. *Rangia repens*, 13-14. *Amaranthus* sp., 15-16. *Celosia* sp., 17. *Abutilon indicum*, 18-19. *Ageratum conyzoides,* 20. *Sida cordifolia*, 21-22. Unidentified, 23-24. *Borassus* sp.

Figure 8: Photographic plate with explanation of allergenic aerospora; all figures × 650

The aerospora recorded from the spider web PWSSW-1 reveals the dominance of pollen grains over fungal spores. Among the pollen grains, Poaceae type (20.6%), *Ageratum conyzoides* (10.96%), *Parthenium hysterophorus* (7.39%), *Prosopis julifera* (3.43%), *Xanthium strumarium* (2.77%) *Amaranthus* sp. and *Tridax procumbens* (2.5% each) and *Leucaena leucocephala* (2.24%) are the dominating taxa respectively and are totally encountered in good frequencies, whereas fungal spores *i.e.*, *Alternaria* sp., (14.26%), *Curvularia* sp. (10.83%), Ascospores (4.75%), *Torula* sp. (3.83%) are also



1. Unidentified pollen, 2-4. *Tectona grandis,* 5-8. *Leucaena leucocephala,* 5-7. *Xanthium strumarium,* 8, 11. Unidentified, 9. *Albizia lebbeck*, 10. *Prosopis julifera*, 12. *Cardiospermum* sp., 13. Trichome (Peltate scale), 14. Microthareous fungi, 15. *Nigrospora* sp., 16. *Curvularia lunata,* 17. *Alternaia* sp., 18. Rust spore, 19. *Pithomyces* sp., 20. Fungal spore (unidentified).

Figure 9: Photographic plate with explanation of allergenic aerospora; all figures × 650

recorded in abundant values. And other significant palynotaxa are *Abutilon indicum* (1.84%), *Ceiba pentandra* (1.71%), *Tectona grandis* (1.45%), *Peltophorum pterocarpum, Sida cordifolia* and *Eucalyptus globulus* (1.18% each), *Celosia* sp. (1.45%), *Jacquemontia paniculata* (1%) are present in low frequencies respectively. Others, viz. *Syzygium cumini* and *Albizia lebbeck* (0.79% each), *Tamarindus indica, Psidium guajava* and *Sapindus emarginatus* (0.39% each) are met with infrequently. And the fungal spores such as *Pithomyces* sp. (1%), *Nigrospora* sp. (0.78%) are also recorded with moderate values. Therefore it is noted that Poaceae type pollen (20.6%) are predominant than *Alternaria* sp. (14.26%) in PWSSW-1; (Fig. 3).

The aerosporal composition of PWSSW-2 also reveals that the pollen grains are dominant over fungal spores. Among the pollen grains, viz., Poaceae type (31.68%), *Ageratum conyzoides* (12.9%), *Parthenium hysterophorus* (7.95%), *Leucaena leucocephala* (3.12%) are recorded in abundant frequency. And other significant palynotaxa are *Prosopis julifera* (2.34%), *Tectona grandis* and *Xanthium strumarium* (2% each) *Sida cordifolia* and *Sapindus emarginatus* (1.43% each), *Borassus* sp. (1.37%), *Eucalyptus globulus* (1.25%), *Abutilon indicum* (1.17%); and others such as *Tamarindus indica* and *Psidium guajava* (0.91% each), *Tridax procumbens* (0.78%), *Peltophorum pterocarpum* and *Syzygium cumini* (0.52% each) and *Amaranthus* sp. (0.39%), *Jacquemontia paniculata* (0.25%) are recorded less than one frequency; Whereas the fungal spores, *Alternaria* sp. (10.82%); *Curvularia* sp. (5.99%), *Torula* sp. (4.69%), Ascospores (3.65%), *Nigrospora* sp. (2.41%) and *Pithomyces* sp. (1.95%) are

recorded in moderate values (Fig. 4)

The aerosporal composition of PWSSW-3 reveals a high frequency of pollen grains viz., *Tectona grandis* (19%), *Prosopis julifera* (11.6%), *Parthenium hysterophorus* (12%), Poaceae type (9.4%), *Leucaena leucocephala* (6%), *Ageratum conyzoides* (3.89%), *Sida cordifolia* (3%), *Xanthium strumarium* (2.79%), *Abutilon indicum* (2.13%), *Peltophorum pterocarpum* (2%), *Eucalyptus globulus* and *Sapindus emarginatus* (1.98% each), *Tridax procumbens* (1.76%), *Tamarindus indica* (1.68%), *Cardiospermum* sp. (1.39%), *Syzygium cumini* (1.32%), *Celosia* sp. and *Albizia lebbeck* (1.24% each), *Ceiba pentandra* (0.66%), *Psidium guajava* and *Amaranthus* sp. (1.17%), *Acacia nilotica* (1%), *Ranjia repens* (0.88%), *Azadirachta indica* (0.58%), *Borassus* sp. (0.43%) were recorded in various percentages from sample no. 3, whereas fungal spores are, *Alternaria* sp. (4.33%), *Torula* sp. (2.49%), *Nigrospora* sp. (1.94%), *Curvularia* sp. (1%), *Pithomyces* sp. (0.95%) and Ascospores (0.88%) in which the pollen grains i.e. *Tectona grandis* (19%), *Prosopis julifera* (11.6%), *Parthenium hysterophorus* (12%) and Poaceae type (9.4%), were showed the dominance than other pollen grains and fungal spores; (Fig. 5).

The pollen-fungal spectra of the sample 4 (PWSSW-4) taken from the spider webs of Pakhal wildlife Sanctuary (Fig. 6) also reveal a high frequency of *Prosopis julifera* (33.57%), Poaceae type (10%), *Leucaena leucocephala* (6.77%), *Parthenium hysterophorus* (5.59%), *Alternaria* sp. (3.53%), *Tectona grandis, Xanthium strumarium* and *Ageratum conyzoides* (3.38% each), *Abutilon indicum* (2.5%), *Peltophorum pterocarpum* and *Sapindus emarginatus* (2.35% each), *Sida cordifolia* and *Celosia* sp. (2.13% each), *Tridax procumbens* and *Amaranthus* sp. (1.98% each), *Curvularia* sp (1.69%), *Eucalyptus globulus* (1.54%), *Psidium guajava, Acacia nilotica, Pithomyces* sp. and Ascospores (1.39% each), *Tamarindus indica* and *Torula* sp. (1.17% each), *Syzygium cumini* (0.95%), *Albizia lebbeck* (0.88%), *Azadirachta indica* (0.81%), *Nigrospora* sp. (0.65%), *Cardiospermum* sp. (0.44%), *Ceiba pentandra* and *Ranjia repens* (0.29% each), *Borassus* sp. (0.14%).

The qualitative and quantitative pollen and fungal spore analysis of spider webs reveals that pollen grains (83%) are dominant over fungal spores (17%); (Fig. 7). In which a total of 30 morphotypes were identified of which 26 were pollen grains of various families viz., Amaranthaceae, Arecaceae, Asteraceae, Acanthaceae, Bombacaceae, Caesalpinaceae, Malvaceae, Meliaceae, Mimosaceae, Myrtaceae, Poaceae, Convolvulaceae, Sapindaceae and Verbenaceae and 4 were fungal spores which belong to different families like, Pleosporaceae, Montagnulaceae, Saccharomycetaceae and Trichosphaeriaceae (Table. 1). Pollen grains viz., Poaceae type (15.62%) and *Prosopis julifera* (15.5%) were the dominant morphotypes in this area and followed by *Parthenium hysterophorus* (8.41%), *Tectona grandis* (7.82%) and fungal spore like *Alternaria* sp. (7%).

The important feature of pollen allergy depends on its floral variations in different seasons. The pollen allergy is due to dispersal of allergenic pollen in atmosphere. In present study *Parthenium hysterophorus, Prosopis julifera* and fungal spores were recorded in the spider web samples near Pakhal Lake which were proved as major causative agents for pollinosis like allergic rhinitis and asthma and also as indication for humid nature in the winter season due to fungal spores (Sivapuri and Parkash, 1967, Subbarao et al., 1985 and Avinash, 2007, 2008). The dominance of fungal spores is due to the unhygienic and interference of anthropogenic activities around Pakhal Lake. These are the indication of humid climatic conditions which causes asthma, hay fever (seasonal allergy) and contact dermatitis. Therefore the present study reveals that the palynoflora recorded from spider webs not only identify the local vegetation of area but also act as passive trap of airborne palynoflora or aeroallergens which causes various allergenic diseases to the human beings and also the wild life in Pakhal wildlife Sanctuary by airborne allergenic flora.

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