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Aeropalynological Investigation of the University of Ilorin, Ilorin, Nigeria

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ABSTRACT: Hay fever allergy could either be from pollen or fungi spores. Using the Hirst model of pollen trap, pollen buckets were constructed; with pollen trap solutions inside them, they were placed in specific locations in the University of Ilorin for four months (December 2012/January 2013 to March/April 2013). Using acetolysis reaction, pollens and spores were recovered from the trap solution and were analyzed and identified in the microscope. Pollen/spore were counted and compared with meteorological parameters i.e. rainfall, sunshine, wind speed, humidity, and temperature. It was observed that pollen/spore concentrations were influenced by these meteorological factors. Hence there is need for us to always determine the amount of these pollen/spore concentrations all year round as it will help to predict the vegetation of a given area as well as helping hay fever sufferers manage their allergies effectively. ©JASEM

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Introduction

Palynology is the study of dust, strew, sprinkle or particles that are strewn. A classic palynologist analyses particulate sample collected from air, water, or any deposits including sediments of any age. The condition and identification of those particles, organic and inorganic, give the palynologist clues to life, the environment and the energetic conditions that produced them. The term is sometimes narrowly used to refer to a subset of the discipline which is defined as "the study of microscopic objects of macromolecular organic composition (i.e. compounds of carbon, hydrogen, nitrogen and oxygen), not capable of dissolution in hydrochloric or hydrofluoric acids (Sarjeant 2002). The study of these particulates in the air is referred to as aeropalynology. In March 2010, a strange harmattan dust covered the whole of Nigeria and raised issues bordering on changing weather conditions and its consequence on public health. Adeonipekun and John (2011) investigated this cream coloured dust and found out that pollen grains of Guinea/Sudan savanna vegetation species were dominant. This, together with the abundant diatom frustules recorded, further supports a Saharan desert source for the strange dust. Apart from the published work of Adekanmbi and Ogundipe (2010) in the southwest Nigeria and most recently Adeonipekun and John (2011), there is no other aeropalynological work in this area (Ilorin) to serve as a basis for aeropalynological study. Even the Adekanmbi and Ogundipe (2010) work only identified most of the recovered palynomorphs mainly to family level thus not creating the needed basic data for comparative pollen analysis. The work of Adeonipekun and John (2011) also was carried out on the dust deposited on a car bonnet over a month. The sample used was not directly collected from the air with an aerofloral sampler. However, in the southeast Nigeria, works of Agwu and Osibe (1992), Agwu (2001), Agwu *et al*. (2004), Njokuocha and Osayi (2005) and Njokuocha (2006) have created a rich data base for comparison and research in aeropalynology. These works have not only shown the richness of the aerospora, but have also provided basic data for the twelve months of the year in the Nsukka area as well as re-affirming also the contributions of allochthonous sources for the recovered aeropalynomorphs. The works of Adetunji *et al*. (1979) and Adedokun *et al*. (1989) on the mineralogy of harmattan dust in Nigeria have confirmed a Saharan source for the harmattan dust and affirmed its significance on the agriculture, health and micro-climate of West Africa and beyond.

Medical palynological and aeropalynological studies however are scarce in Nigeria and little or no known aeropollen data is available for the Ilorin metropolis. Thus the aim of this project research is to identify the concentrations of air borne pollen/fungal spores and the effect of some meteorological parameters in its concentration at the University of Ilorin, Ilorin, Nigeria.

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MATERIALS AND METHODS

Study areas: The study was carried out in four (4) selected areas at the University of Ilorin, Ilorin, Nigeria namely Jalala (Junior Staff Quarters), Senior Staff Quarters Unilorin Primary School and Unilorin secondary School.

*Construction of pollen trap***:** A pollen trap was constructed consisting of the following, a four liter transparent bucket and a 25cmx25cm wire mesh. The bucket was filled with 175L of water, 800mL of formaldehyde, 14g of phenol and 1.63L of glycerol. The wire mesh was placed on top of the bucket and fastened with the aid of a wire.

The pollen trap was placed in a hole 30cm deep at each sites of the study. The pollen trap was left for a month and was replaced with another pollen trap solution consecutively for a period of four months starting from December 7th 2012 to April 7th 2013. The recovered palynomorphs were identified after acetolysis reaction has being carried out on the pollen tap solution. Meteorological parameters data such as temperature, rainfall, wind speed, humidity, and sunshine were obtained from the Lower River Niger Basin, Ilorin station from the Meteorological and Hydrological Department from Dec 2012 – Apr 2013. The percentage abundance of the species and the monthly pollen/spore count were compared with the meteorological parameters and data.

*Pollen and spore isolation and identification***:** Acetolysis reaction according to Erdtman (1960) destroys and extracts everything except for the extine, the highly resistant outer shell of the pollen that bears characteristic morphological features used in pollen identification. The extracted pollen was infiltrated with suitable mounting medium for light microscopy. This technique has been used for high resolution 3D imaging of the pollen.

All processing done in a15ml polypropylene conical tube acetolysis reaction was done in the following steps: 6ml of suspended mixture of formaldehyde, phenol, water, and glycerol was obtained and poured in a centrifuge tube; 8ml of water was added to the suspended mixture. The mixture of water and suspension was shaken thoroughly, and centrifuged at 3000 revolutions per minute (rpm) for 15min. It was decanted and 10 ml of Glacial Acetic acid was added. It was centrifuged for the second time at 3000rpm for 10min. Acetolysis mixture was prepared i.e. 9ml of acetic anhydride and 1ml of sulphuric acid. 5ml of this solution was added to the already decanted Glacial Acetic mixture, boiled for about 2 mins at 80-90^{o}C. It was again centrifuged at 3000rpm for 10 mins. It was decanted and washed with distilled water three times; centrifuging at each interval of washing. The residue liquid was stored in the centrifuge tube for subsequent microscopic observations.

Microscopic Analysis: About 10-15 microliters of the washed acetolysed liquid was collected from tube using the micropipette. It was placed on a 25.4x76.2mm microscopic slide. A mountant was added to it to prevent easy dry up of the liquid. Mountant used was glycerol. The cover slide was placed on top of the liquid on the slide. A nail polish was used to seal the edges of the coverslip so as to prevent loss of sample liquid as a result of rapid dry out of the liquid. Thirty-two slides were prepared for each month of study and were viewed under the optical light microscope and were later identified.

Statistical Analysis: All the data gotten were reported and analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT). The computer software package SPSS 16.0 for windows was used for this analysis. The probability value of 0.05 was used as a bench mark for significant difference between the parameters.

RESULTS

The December/January microscopic analysis reveals total pollen/spore count of 277 belonging to 20 plant families and four fungi families with family Apocynaceae being the most dominant and *Aspergillus spp* being the most dominant in the fungi families. Other plant families were found in lower amount in the atmosphere. These include families like Cyperaceae, Fabaceae, Poaceae, Liliaceae, Orchindaceae, Alismataceae, Lentibulariaceae, Holaragacea etc. Four species of the fungal family were also identified and these includes; *Aspergillus*, *Penicillium*, *Cladiosporium* and *Alternaria* (Table 1).

In the January/Feburary microscopic analysis a total spore and pollen count of 340 were identified and these belong to19 plant families and three fungi families; namely Trichocomaceae, Davidellaceae, and Pleospoaraceae of which the *Caldiosporium spp* was the most dominant spore. The most dominant plant family was the Poaceae family, followed by the Polypodiaceae, Solanaceae and Cyperaceae families. Other families include the Brassicaceae, Annonaceae, Commelinaceae, and the Orchidaceae families (Table 2).

Table 1: Pollen and spore analysis in December 2012 and January 2013 for Jalala area of the University of Ilorin, Ilorin, Nigeria

S/N	Scientific name	Family	Nature of pollen aperture	Frequency of pollen/spore
1	*Celosia argentia*	Amaranthaceae	Periporate	2
2	*Desmodium paniculatum*	Fabaceae	Tricolpate	2
3	*Asystasia gagentica*	Acanthaceae	Tricolporate	5
4	*Phlebodium aurebum*	Polypodiaceae	Monolete	1
5	*Utricularia foliosa*	Lentibulariaceae	Polycolporoidate	1
6	*Taxodium distichum*	Taxodiaceae	Monoporate	10
7	*Alstonia boonei (de wild)*	Apocynaceae	Tricolporate	7
8	*Salvinia minima*	Salviniaceae	Trilete	2
9	*Physalis pubescens*	Solanaceae	Tricolporate	1
10	*Phoenix reclinata*	Aracaceae(palmae)	Monosulcate	8
11	*Solanum americanum*	Solanaceae	Tricolporate-syncolporate	3
12	*Gomphrena celosioides*	Amaranthaceae	Inaperturate	1
13	*Asystasia vogeliana*	Acanthaceae	Tricolporate	2
14	*Cladium mariseus*	Cyperaceae	Ulcerate	2
15	*Sagittaria latifolia*	Alismataceae	Ulcerate	1
16	*Sabal palmetto*	Arecaceae	Monosulcate	7
17	*Eragrostis elliottis*	Poaceae(Graminea)	Monoporate	5
18	Sagittaria lancifolia	Alismataceae	Ulcerate	1
19	*Crinum americanum*	Liliaceae	Monosulcate	3
20	*Alternanthera spp*	Amaranthaceae	Inaperturate	1
21	*Thevetia neriifolia*	Apocynaceae	Tricolporate	7
22	*Justicia elegantusa*	Acanthaceae	Diporate	9
23	*Allamanda cathartica*	Apocynaceae	Tricolporate	5
24	*Saururus cernuus*	Saururaceae	Monosulcate	8
25	*Schinus terebinthifolius*	Anacardiaceae	Tricolporate	4
26	T*richopilia maculate*	Orchindaceae	Inaperturate	1
27	*Justicia pectoralis*	Acanthaceae	Diporate	3
28	*Astrocaryum standleyanum*	Palmae	Panporate	6
29	*Onicidium ampliatum*	Orchidaceae	Inaperturate	1
30	*Aritolochia pilosa*	Apocynaceae	Tricolporate	7
31	*Meschites trifida*	Apocynaceae	Inaperturate	1
32	*Chamaedorea wenlandiana*	Aracaceae	Trilete	5
33	*Pennicilium spp*	Trichocomaceae	Fungal spore	36
34	*Aspergillus spp*	Trichocomaceae	Fungal spore	26
35	*Alternaria spp*	Pleosporaceae	Fungal spore	21
36	*Cladosporium spp*	Davidellaceae	Fungal spore	38
37	Undefined spores	-	-	38

However the February/March 2013 microscopic analysis reveals a slight difference in the pollen, fungal spores (palynomorphs) in the atmosphere. Although persistent families like the Poaceae, Fabaceae, and the Taxodiaceae were present in the atmosphere, however there was a slow fall in their concentrations. The most dominant family was the Cyperaceae. In total, 12 families of plant species and 4 Fungi families were identified. A total of 229 spore/pollen count was recorded (Table 3).

Finally in the March/April 2013 results, pollen/spore concentrations in the atmosphere decrease significantly. Eight plant families and 4 fungal species were identified. A total pollen/spore count was 234 with Cyperaceae being the most dominant in the plant family and Pleosporaceae family being the dominant fungal spore (Table 4).

Table 2: Pollen and spore analysis in January and February 2013 for Jalala area of the University of Ilorin, Ilorin, Nigeria

S/N	Scientific name	Family	Nature of pollen aperture	Frequency of pollen/spore
1	*Allamanda cathartica*	Apocynaceae	Periporate	3
2	*Asystasia vogeliana*	Acanthaceae	Tricolporate	5
3	*Tournefortia angustiflora*	Boraginaceae	Trilete	2
4	*Diplazium grandifolium*	Polypodiaceae	Monocolporate	6
5	*Cassia obtusifolia*	Fabaceae	Tricolporoidate	9
6	*Eleocharis cellulose*	Cyperaceae	Ulcerate	7
7	*Axonopus compressus*	Cyperaceae	Monoporate	19
8	*Coryanthes manculata*	Orchidaceae	Inaperturate	8
9	*Anacardium occidentalis*	Acanthaceae	Tricolporate	9
10	*Mormodes unlata*	Orchidaceae	Aporate	6
11	*Rhynchospora cephalotes*	Commelinaceae	Monocolpate	9
12	*Matelea trianae*	Asclepiadaceae	Vesculate	5
13	*Sagittaria latifolia*	Alismataceae	Ulcerate	2
14	*Commelina diffusa*	Commelinaceae	Monosulcate	4
15	*Saururus cernuus*	Saururaceae	Monosulcate	3
16	*Thelypetris balbis*	Polypodiaceae	Monolete	22
17	*Trichomanes godmanii*	Cyantheaceae	Trilete	7
18	*Descurainta pinnata*	Brassicaceae	Trilete	8
19	*Solanum americanum*	Solanaceae	Tricolporate-syncolporate	3
20	*Aritolochia pilosa*	Rubiaceae	Tricolporate	20
21	*Ichanthus pallens*	Poaceae	Monoporate	9
22	*Orthoclada laxa*	Poaceae	Monoporate	13
23	*Paspalidium paniculatum*	Poaceae	Monoporate	9
24	*Leptochloa virgate*	Poaceae	Monoporate	5
25	*Lasiacis procerrima*	Poaceae	Monoporate	6
26	*Paspalum conjugatum*	Poaceae	Monoporate	5
27	*Acer rubrum*	Aceraceae	Inaperturate	7
28	*Thelypteris incise*	Polypodiaceae	Monolete	4
29	*Capsicum annuum*	Solanaceae	Inaperturate	2
30	*Geonoma procumbens*	Aceraceae	Trilete	9
31	*Aspidosperma cruenta*	Apocynaceae	Syncolporate	8
32	*Desmopsis panamensis*	Annonaceace	Inaperturate	4
33	*Alternaria spp*	Pleosporaceae	Fungal spore	27
34	*Caldosprium spp*	Davidellaceae	Fungal spore	29
35	*Aspergillus spp*	Trichocomaceae	Fungal spore	13
36	*Penicillium spp*	Trichocomaceae	Fungal spore	10
37	Undefined spores	-	-	35

Table 3: Pollen and spore analysis in February/March 2013 for Jalala area of the University of Ilorin, Ilorin, Nigeria

S/N	Scientific name	Family	Nature of pollen aperture	Frequency of pollen/spore
1	*Scetaria parviflora*	Poaceae	Monoporate	7
2	*Cladium mariscus*	Cyperaceae	Ulcerate	5
3	*Eleocharis cellulocosa*	Cyperaceae	Ulcerate	3
4	*Acrostichum danaeiflolium*	Pterdiaceae	Trilete	15
5	*Taxodium distichum*	Taxodiaceae	Monolete	11
6	*Phlebodium aureum*	Polypodiaceae	Monolete	2
7	*Cyerus haspan*	Cyeraceae	Ulcerate	1
8	*Boehmeria cylindrica*	Urticaceae	Diporate	34
9	*Typha latifolia*	Typhaceae	Monoulcerate	4
10	*Thelypteris kunthii*	Thelypteridaceae	Monolete	6
11	*Schoenoplectus taberaeamontani*	Cyperaceae	Ulcerate	10
12	*Vigna luteola*	Fabaceae	Triporate	27
13	*Rhychospora colorata*	Cyperaceae	Syncolporate	1
14	*Morella cerifera*	Myricaceae	Ulcerate	2
15	*Myriophyllum spp*	Holaragaceae	Stephanoporate	2
16	*Phragmites australis*	Poaceae	Monoporate	1
17	*Ilex cassine*	Aquifoliaceae	tricolporate	4
18	*Caladosporium*	Davidellaceae	Fugal spore	15
19	*Aspergillus spp*	Trichocomaceae	Fugal spore	10
20	*Penicillum spp*	Trichocomaceae	Fugal spore	18
21	*Alternaria spp*	Pleosporaceae	Fugal spore	17
22	Undefined spores			43

Table 4: Pollen and spore analysis in March/April 2013 for Jalala area of the University of Ilorin, Nigeria

S/N	Scientific name	Family	Nature of pollen aperture	Frequency of pollen/spore
1	*Axonopus compressus*	Cyperaceae	Monoporate	21
2	*Eleocharis cellulose*	Cyperaceae	Ulcerate	4
3	*Cassia obtusifolia*	Fabaceae	Triclporate	10
4	*Alamanda catherica*	Apocynaceae	Periporate	3
5	*Tournefortia grandifolium*	Boraginaceae	Trilete	3
6	*Matelea trianae*	Ascelpiadiacea	Vesulate	1
7	*Commelina diffusa*	Commelinaceae	Tricolporate	7
8	*Rhynchospora cephalotes*	Commelinacea	Monoporate	5
9	*Sagittaria latifolia*	Alismataceae	Ulcerate	9
10	*Asystatia gagentica*	Acanthaceae	Tricolporate	9
11	*Alstonia boonei*	Apocynaceae	Tricolporate	17
12	*Utricularia foliosa*	Lentibulariaceae	Polycolporate	1
13	*Phoenix reclinata*	Aracaceae	Monosulcate	5
14	*Justicia petoralis*	Acanthaceae	Diporate	5
15	*Celosia argentia*	Amaranthaceae	Periporate	9
16	*Cladium mariseus*	Cyperaceae	Ulcerate	3
17	*Salvinia minima*	Salvinaceae	Periporate	3
18	*Boehmeria cylindrical*	Utricaceae	Diporate	17
19	*Alternaria spp*	Pleosporaceae	Fugal spore	11
20	*Cladosporium spp*	Davidiellaceae	Fugal spore	29
21	*Aspergillus spp*	Trichocomaceae	Fungal spore	7
22	Undefined spores			21
23	Aritolochia pilosa	Apocyanceae	Monolete	15

DISCUSSION

The suspension of pollen grains in the atmosphere is a phenomenon that is inherent to the biological function of these particles, since the wind is the major mode of transportation of the pollens and spores of most flowering plants and fungi. It carries the grains from the anthers to the stigma of unisexual flowers, facilitating pollination (Charlesworth 1993) and often the pollen grains of these plants undergo various modifications (Crane 1986). One indirect consequence of this airborne transport is the appearance of allergic reactions in humans when pollen/fungi spore is inhaled and its proteins are released thereby forming antigens to which the immune system reacts, provoking allergic symptoms. As in many other biological processes, pollen/fungi spore dispersal is influenced by meteorological parameters like rainfall, sunshine, temperature and relative humidity. These may determine the timing of the flowering season and release of fungi spores by way of photoperiod, the rate of maturation of conidia, as well as the development of flower organs via their physiology, or by affecting the dynamics of the air

which the pollens and spores travel as passive elements (Ligthart *et al*. 1979; Benningnoff 1987).

From the results of this work, spore/pollen count and identification was recorded for the four month period of the study; in all pollen and spore count was most abundant in the Jan/Feb month of the analysis. Spore/pollen count values showed significant correlation with the meteorological parameters. Positive and statistically significant correlation was found between pollen/spore count and the mean temperature (min and max) of the months, wind speed, rainfall and sunshine while negative correlation was observed between the mean relative humidity and pollen/spore count. The amount of sunshine, rain or wind speed affects how much pollen/spore is released and how much the pollen/spore is spread around. On humid day, pollen/spore spreads slowly, during windy days, pollen/spore are transported over long distances (Gregory 1978). Wind speed is therefore recognized as being the most important factor (McDonald 1980). On rainy days, pollen may be cleared from the air, causing pollen levels to fall. People suffering from pollen and spore allergies look out for the counts whether daily or monthly concentrations to help them start and plan their day (McDonald 1980). The pollen/spore count tells us the amount of pollen in a certain sample of air in a given area.

In the Dec/Jan pollen/spore count, it was noted that pollen dispersal and concentration were not as dense as in the Jan/Feb pollen/spore count. This was attributed to the cold weather as we know anthesis occurs usually in the warm weather hence pollen dispersal was not very effective due to low temperature of the atmosphere. But the fungi spores where much more in abundance, that is to say the cold weather was not much of a factor in the dispersal of these fungi spores because most of these spores are produced from decaying organic matter. In line with this, most of the fungi spores identified are mostly parasitic. For example *Aspergillus spp* are a major cause of decay of agricultural crops in the field and in storage, and many species are also common in contaminated indoor environments. The *Cladiosporium spp* were found to be the most abundant of the entire fungi spore present. This is to say that mean temperature of 17.45^{o}C and 33.42^{o}C for both the minimum and maximum has an effect on the dispersal of pollen and not really significant in the dispersal of fungi spores. Also the amount of rainfall for Dec/Jan was very low with a total of 7.2mm hence pollen/spore dispersal was not inhibited by rainfall due to the relative concentrations of spores in the atmosphere. The relative humidity also played a role in the dispersal of spore having wet and dry humidity mean values of 17.97% and 19.22% respectively. One can say that pollen dispersal was affected indirectly in the airspora due to loss of water in the anther cell walls that facilitates anther mechanical breakage which releases the pollen (Nitius 2004). The moderate mean wind speed of 80.25km/h for the month of Dec/Jan explains the dispersal and concentration of spores better than all other meteorological parameters. At moderate wind speed, the pollen count in the atmosphere does not decrease, almost to an altitude of 1,000 m. According to Nitius (2004) during the day, when the cloud of pollen is brought up by the convection currents, no selection of pollen grains according to their size and mass takes place, but during the night, especially on a quiet one, larger and heavier grains descend significantly faster than smaller ones reducing the pollen concentration in the atmosphere. The wind is the passive fluid in which pollen and spores travel as passive elements (Ligthart *et al*. 1979; Benningnoff 1987). The relative high wind speed for the Dec/Jan period of study ensure the dispersal of the spores hence even though the temperature was relatively low there was still enough pollen to cause harm to hay fever suffers.

The Jan/Feb spore count was the highest record of 340 in the period of study. A mean minimum and max temperature of 20.42^{o}C and 34.23^{o}C respectively has no much significance on the pollen/spore distribution during the Dec/Jan period of study as pollen were in much denser concentrations than the fungi spores. The most dominant pollen was from the Poaceae family. The *Cladosporium spp* of the fungi spore was also in abundance but in lesser amounts as compared to the previous month of study. The increase in rainfall value can be infer to have reduced the concentration of the fungi spore as the rain cleanses the air but that is just an assumption however the mean sunshine hour of 6hrs 50min might be responsible for the increased pollen spore concentrations due to the fact that most plants undergo anthesis (i.e. the opening of flowers) and release pollen early in the morning. As the day gets warmer and more flowers open, pollen levels rise. On sunny days, the pollen count is highest in the early evening. The effect of the humidity on anther opening is also another factor to look out in the pollen abundance of the Jan/Feb period having wet and dry percentage humidity of 19.42 and 20.41 respectively. This may be as a result of the loss of water i.e. dry humidity, tension on the cell walls increases, anthers break up and pollen is released (Nitius 2004). The high wind speed mean of 113.625 KM/H of the Jan/Feb period of study is a major and more distinct factor of pollen/spore distribution. Fluctuations of pollen counts in the different locations of the Jala area of study may be affected by the grains brought from long dispersal and redisposition in the air currents.

The Feb/March period of study records the lowest amounts of spore count of 229. This could be as a

result of the gradual change in the weather from the dry season to the early rainy season. Having a total rainfall of 40.7mm which is much higher when compared to the previous months of the study, the air is said to have being relatively wash free of spores. The minimum and maximum temperature of 23.84^{o}C and 35.52^{o}C could not explain the drop in the pollen concentration. However moderate wind speed of 94.96KM/H explained the reason why pollen/spore were still present although in moderate concentrations in the atmosphere. Wind current disperse pollen/spore randomly and at low speeds selects the pollen/spore. Heavier pollens/spores tend to fall back to the ground leaving only lighter ones in the air. The relative wet and dry humidity of 23.36% and 23.75% respectively could not explain pollen concentration drop due to the narrow significant differences at $p<0.05$ or $p= 0.05$.

The March/April result revealed a total spore count value of 234. There is a slight increase in this value in spite of the high amounts of rainfall of 106.7mm. This increase could be inferred from the relatively high mean sunshine value of 7hrs 10min which means flower opening was more due to the warm weather. The mean wind speed of 127.7KM/H which is the highest so far encourages dispersal and redisposition of spores. The mean min and max temperature of 23.90oC and 34.90oC as well as the percentage wet and dry of humidity of 23.30% and 24.45% played no significant role in spore count increments.

Conclusion: From the microscopic and statistical analysis of meteorological effect on pollen/fungi spore in the atmosphere, one can say truly that pollen/spore concentration is influenced by wind speed, rainfall, sunshine, humidity and temperatures. Hence hay fever sufferers should note the amounts of these parameters; in so doing allergies can be effectively managed. Pollen counts alone are unlikely to give an accurate indication of health risks for allergy or asthma sufferers, as pollen potency can vary widely. Hay fever sufferers can become sensitized by other, less allergenic, pollen species in advance of the main pollen season, which may increase the severity of the allergic reaction.

The pollen forecast and pollen calendar (which shows when different types of plant pollen that cause allergic reactions are present in the environment) also involve expert judgment on, and provide information about, the specific allergenic pollen types in the area of interest. Pharmaceutical organizations often use these forecasts not only by displaying it on their website but also to predict demand and supply of medication, such as histamine antagonists (commonly known as antihistamines), which alleviate some of the hay fever symptoms.

Understanding the potential increase in the health burden in relation to allergy will help health organizations and clinicians to plan for the future. There are already significant costs to the economy relating to allergic rhinitis in loss of productivity and days off work. Understanding how this financial burden may increase in the future is another area of potential interest. Further studies that will cover the twelve (12) months and even years should be carried out in the future to account for a more broad coverage of the area in question

In the Jalala areas pollen count was done in four different locations during the four month period of study a summary of these location and the relative occurrences of spore is highlighted in the table below

Table 5: Pollen and spore analysis for Primary School area

S/N	Scientific name	Family	Frequency of pollen/spore
1	*Celosia argentia*	Amaranthaceae	3
2	*Asystatia gagentica*	Acanthaceae	14
3	*Utricularia foliosa*	Lentibulariaceae	1
4	*Desmodium paniculatum*	Fabaceae	2
5	*Taxodium distichum*	Taxodiaceae	7
6	*Alternanthera spp*	Amaranthaceae	4
7	*Cladium mariseus*	Cyperaceae	5
8	*Crinum americanum*	Liliaceae	1
9	*Eragrostis elliotis*	Poaceae	2
10	*Sabal palmetto*	Arecaceae	3
11	*Anacardium occidentalis*	Acanthaceae	3
12	*Matelea trianae*	Ascelpiadiaceae	2
13	*Justicia petoralis*	Acanthaceae	2
14	*Aritolochia pilosa*	Apocyanceae	7
15	*Acrostichum danaeifolium*	Pteridiaceae	15
16	*Alamanda catherica*	Apocynaceae	5
17	*Tournefortia angustiflora*	Boraginaceae	2
18	*Cassia obtusifolia*	Fabaceae	7
19	*Axonopus compressus*	Cyperacea	10
20	*Thelypteris incise*	Polypodiaceae	1
21	*Desmopsis panamensis*	Annonaceae	2
22	*Leptochola virginata*	Poaceae	3
23	*Lasiacis procerrima*	Poaceae	5
24	*Geonoma procumbens*	Aceraceae	3
25	*Phargmites australis*	Poaceae	6
26	*Thelypteris kunthii*	Thelypteridaceae	6
27	*Morella certifera*	Myricaceae	2
28	*Phleobodium aureum*	Polypodiaceae	3
29	*Cyperus haspan*	Cyperaceae	6
30	*Coryanthes manculata*	Orchidaceae	4
31	*Descurainta pinnata*	Brassiceae	5
32	*Trichophilia manculata*	Orchidaceae	4
33	*Thevitia neriifolia*	Apocynaceae	4
34	*Chamaedorea wendlandiana*	Arecaceae	3
35	*Osmudia regalis*	Osmundaceae	6
36	*Justicia elegantusa*	Acanthaceae	5
37	*Saururus cernuus*	Saururaceae	4
38	*Cladosporuim spp*	Davidiellaceae	32
39	*Alternaria spp*	Pleosporaceae	34
40	Undefined spores		45

Table 6: Pollen and spore analysis for Secondary School

S/N	Scientific name	Family	Frequency of pollen/spore
1	*Alsotonia boonei*	Apocynaceae	10
2	*Utricularia foliosa*	Lentibulariaceae	1
3	*Phoenix reclinata*	Arecaceae	3
4	*Gompherena celosioides*	Amaranthaceae	1
5	*Rhynchospora cephalotes*	Commelinaceae	14
6	*Axonopus compressus*	Cyperaceae	34
7	*Eleocharis cellulose*	Cyperaceae	8
8	*Cassia obtusifolia*	Fabaceae	6
9	*Alamanda catherica*	Apocynaceae	2
10	*Tournefortia grandifolium*	Boraginaceae	27
11	*Matelea trianae*	Ascelpiadiaceae	4
12	*Commelina diffusa*	Commelinaceae	3
13	*Sagittaria latifolia*	Alismataceae	1
14	*Taxodium distichum*	Taxodiaceae	11
15	*Alternanthera spp*	Amaranthaceae	3
16	*Cladium mariseus*	Cyperaceae	2
17	*Crinum americanum*	Liliaceae	2
18	*Eragrostis elliotis*	Poaceae	6
19	*Sabal palmetto*	Arecaceae	9
20	*Anacardium occidentalis*	Acanthaceae	3
21	*Thelypteris balisis*	Polypodiaceae	4
22	*Justicia petoralis*	Acanthaceae	2
23	*Phleobodium aureum*	Polypodiaceae	4
24	*Alternaria spp*	Pleosporaceae	10
25	*Cladosprium spp*	Davidellaceae	35
26	*Aspergillus spp*	Trichocomaceae	10
27	*Penicillium*	Trichocomaceae	18
28	Undefined spores		34

From the result of the analysis of variance carried out the location is significant with the F. value of 11.015, at 0.05 alpha level of significance, we reject the null hypothesis and conclude that there is a significant difference in pollen count across the locations in each month. The analysis also indicated that there is significant difference in the pollen count collected with F.value of 8.416, 0.05 alpha level of significance in the months.

Also the analysis of variance (ANOVA), there is significant difference in the effect of the metrological parameters namely humidity (dry and wet), temperature (min. and max.), rainfall, sunshine and wind speed on the amount of pollen count.

Table 7: Pollen and spore analysis for Junior Staff Quarters

S/N	Scientific name	Family	Frequency of occurrence
1	Lasiacis procerrima	Poaceae	1
2	Geonoma procumbens	Aceraceae	6
3	Phargmites australis	Poaceae	2
4	Celosia argentia	Amaranthaceae	8
5	Mormodes unlata	Orchidaceae	2
6	Salvinia minima	Salvinaceae	3
7	Boehimeria cylindrical	Utricaceae	7
8	Desmopsis panamensis	Annonaceae	1
9	Osmudia regalis	Osmundaceae	9
10	Justicia elegantusa	Acanthaceae	14
11	Saururus cernuus	Saururaceae	2
13	Justicia petoralis	Acanthaceae	2
14	Aritolochia pilosa	Rubiaceae	27
15	Ichanthus pallens	Poaceae	9
16	Orthoclada laxa	Poaceae	6
17	Paspalidium paniculatum	Poaceae	9
18	Leptochloa virgate	Poaceae	2
19	Aspidosperma cruenta	Apocynaceae	6
20	Paspalum conjugatum	Poaceae	6
21	Acer rubrum	Aceraceae	7
22	Thelypteris incise	Polypodiaceae	3
23	Capsicum annuum	Solanaceae	3
24	Cyperus haspan	Cyperaceae	17
25	Coryanthes manculata	Orchidaceae	2
26	Descurainta pinnata	Brassiceae	2
27	Trichophilia manculata	Orchidaceae	4
28	Thevitia neriifolia	Apocynaceae	3
29	Chamaedorea wendlandiana	Arecaceae	2
30	Desmopsis panamensis	Annonaceae	11
31	Aritolochia pilosa	Apocyanceae	8
32	Phargmites australis	Poaceae	3
33	Celosia argentia	Amaranthaceae	3
34	Mormodes unlata	Orchidaceae	4
35	Axonopus compressus	Cyperaceae	I6
36	Sagittaria latifolia	Alismataceae	1
37	Diplazium grandifolium	Polypodiaceae	6
38	Coryanthes manculata	Orchidaceae	2
39	Descurainta pinnata	Brassicaceae	1
40	Alamanda catherica	Apocynaceae	1
41	Anacardium occidentalis	Acanthaceae	3
42	Trichomanes godmanii	Cyntheaceae	4
43	Shoenoplectus tabaraemontani	Cyperaceae	3
44	Rhynospora colorata	Cyperaceae	3
45	Myriophyllum spp	Holaragaceae	8
46	Alternaria spp	Pleosporaceae	11
47	Caldosprium spp	Davidellaceae	35
48	Aspergillus spp	Trichocomaceae	17
49	Penicillium	Trichocomaceae	10
50	Undefined spores		27

Table 8: Pollen and spore analysis for Senior Staff Quarters

S/N	Scientific name	Family	Frequency of pollen/spore
1	*Alamanda catherica*	Apocynaceae	3
2	*Asyastasia vogeliana*	Acanthaceae	7
3	*Tournefortia gandifolium*	Boraginacea	1
4	*Cassia obtusifolia*	Fabaceae	6
5	*Eleocharis cellulose*	Cyperaceae	10
6	*Commelina diffusa*	Commelinaceae	8
7	*Trichomanes godmanii*	Cyatheceaceae	3
8	*Thelypteris balbis*	Polypodiaceae	4
9	*Solanum americanum*	Solanaceae	10
10	*Aspidosperma cruenta*	Apocynaceae	2
11	*Paspalum conjugatum*	Poaceae	2
12	*Celosia argentia*	Amarantaceae	15
13	*Geonoma procumbens*	Aceraceae	3
14	*Leptochloa virgate*	Poaceae	1
15	*Orthoclada laxa*	Poaceae	7
16	*Boehimeria cylindica*	Utricaceae	18
17	*Ilex cassine*	Aquifoliaceae	4
18	*Osmudia regalis*	Osmudaceae	3
19	*Alstonia boonei*	Apocynaceae	14
20	*Salvinia minima*	Salvinaceae	2
21	*Saururus cernuus*	Saururacaea	4
22	*Schinus terebinthifolius*	Anacardiaceae	4
23	*Justicia petoralis*	Acanthaceae	2
24	*Phoenix reclinata*	Aracaceae	4
25	*Onicidium amplicatum*	Orchidaceae	7
26	*Sagittaria latifolia*	Alismataceae	1
27	*Sabal palmetto*	Arecaceae	2
28	*Cladium mariseus*	Cyperaceae	3
29	*Taxodium distichum*	Taxodiaceae	3
30	*Alternanthera spp*	Amarantaceae	2
31	*Alternaria spp*	Pleosporaceae	8
32	*Caldosprium spp*	Davidellaceae	17
33	*Aspergillus spp*	Trichocomaceae	26
34	*Penicillium*	Trichocomaceae	16
35	Undefined spores		30

Table 9: Monthly effects of meteriological parameters on aeropalynomorphs concentration

Month	Dry humidity	Wet humidity	Minimum temperature	Maximum temperature	Rainfall	Sunshine	Wind speed
Dec. 2012 – Jan. 2013	19.2258[a]	17.9677[a]	17.4516[a]	33.4194[a]	7.7000[b]	8.2000[c]	41.4194[a]
Jan-Feb 2013	20.4194[b]	19.4135[b]	20.4194[b]	34.2258[b]	1.4000[a]	6.9000[a]	56.6452[b]
Feb-Mar 2013	23.7500[c]	23.3571[c]	23.8381[c]	35.5161[d]	40.7000[c]	6.7732[a]	95.0000[c]
Mar-Apr 2013	24.4516[d]	23.2903[c]	23.9032[c]	34.9032[c]	1.0670E2[d]	7.1339[b]	127.7097[d]
Total	21.9617	21.0072	21.4031	34.5161	39.1250	7.2518	80.1936

There is significant difference in the values of means in the column not followed by the same superscript

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