Distribution and Abundance of Airborne Palynomorphs in Aku, Enugu State, Nigeria

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Abstract

A study of airborne palynomorphs of Aku was carried out with the use of tauber pollen sampler from October to December, 2004. A total of 3,390 palynomorphs was recorded with the breakdown as follows: October, 1248; November, 1156 and December, 1526. Out of the counted palynomorphs, pollen grains constituted 2,125.The count of 736 pollen in October was followed by a decrease to 545 in November and a further increase to 844 in December. The pollen grains belonged to 20 families of flowering plants (17 dicotyledons and 3 monocotyledons) consisting of 20 genera. The result revealed dominance of wooded shrub grassland/woodland vegetation sub-type, relics of tropical lowland rainforest and secondary grassland. The taxa of both tropical lowland rainforest and secondary Grassland decreased from October to November and increased again in December. Fungi were the major spore contributors to the atmosphere and were dominated by the spores of Spadicoides, Curvularia, Dreschlera/Helminthosporium and Nigrospora. Pollen grains were next to fungi in total abundance and were dominated by the pollen of; Elaeis guineensis Jacq, Poaceae, Milicia excelsa Wild C.C. Berg, Irvingia wombolu Vermoesen, Syzygium guineense Engl. and Ageratum conyzoides L. December had a high influx of charred gramineae cuticles indicative of increased burning activities in the area. Fungal spores recorded per month had an inverse relationship with the monthly rainfall and relative humidity.

Keywords: Distribution, Abundance, Airborne spore, Palynomorphs, Aku

Introduction

The characteristics of pollen grains and spores have contributed immensely to their usefulness in accessing the vegetation of an area. They are more widely distributed than any other parts of a plant, because of their small sizes and aerodynamic properties (Sowunmi, 1975). The amount of pollen and spores in the air vary depending on whether the air is dry or moist. Their quantities are greater on dry windy days than on wet rainy days. In time, the loss of height and velocity result in spores being precipitated on all surfaces such as field, roads, forest, roof-tops, lakes, seas or even on human beings and vehicles (Sowunmi, 1975).

In deed, it is on the account of their remarkable resistance that spores have been found in rocks estimated to be about 36 million years old and even date further back. Their inability to be destroyed during the digestive processes in the gastro intestinal tract of animals coupled with their great diversity of patterns shown on their resistant walls contribute immensely to their usefulness in palynological studies.

Palynological study of airborne pollen grains and spores has been considered important in the reconstruction of the vegetation of an area. This is attributed to the principle that the pollen and spores released into the atmosphere represent the plant vegetation around the area of study (Agwu, 1997), though variable pollen grains and spores are introduced into an area through long distant transport.

Variation in the abundance of pollen grains in the atmosphere from year to year have been reported by Hyde (1952) as well as Davies and Smith (1973). These variations could be related to variations in the flowering intensity and pollen productivity due to climatic variations.

According to Lyon *et al*. (1984), palynomorphs concentrations measured in the atmosphere are the result of wide range of inter-related environmental and biological factors.

Materials and Methods

Study area: Aku town is the largest community in Igbo-Etiti L.G.A in Enugu state,

Nigeria. It is bounded on the East by Ukehe, Ikolo and Affa;on the West by Obimo, Nkpologwu and Adada River; on the North by Lejja and Ozalla and on the south by Akpugo, Udueme and Adada River.

Aku is generally characterized by a derived Savanna (Keay *et al*., 1964), which is located between the true Guinea Savanna in the north and the tropical rainforest belt in the south of Nigeria. It forms a part of the mosaic of Lowland Rainforest and Secondary Grassland (White,1983) which stretches east to west across the country with its widest north-south extension located in the Nsukka plateau area.

According to Phil-Eze (1994), the vegetatin of Aku is modified into Wooded Shrub Grassland/Woodland vegetation sub-type, the vegetation is associated with numerous species of grasses and shrubs such as *Protea madiensis, Baphia pubescens, Lannea welwitshii* and *Hymenocardia acida.* Trees of regular occurrence include *Daniella oliveri, Parkia biglobosa, Prosopis africana, Acioa bateri, Syzygium guineense, Eugenia nodiflora and Vitex doniana* (Phil-Eze,1994; Agwu,1997).

The climate of Aku is tropical with mean monthly temperature oscillating between 24^0C and 29^0C and with a range of about 10^0C during the year. The climate is characterized by alternating wet season (May - October) and dry season (November-April). The dry season is accentuated in its dryness caused by the dust bearing harmattan wind (NE) from December to January. The major winds during the dry and wet seasons are the NE trades and the SW monsoon respectively. The Inter-tropical Discontinuity (I.T.D.) fluctuates in its position within the West Africa region from the coastal margins at 4^0 N to about 8^0 N latitude during the dry season (Inyang, 1978). The period of investigation (October to December) is characterized by low rainfall (Table 1).

Airborne palynomorphs sampling: Tauber pollen traps were used to collect the airborne palynomorphs from the area of study. The trap was set in two locations in the area. Tauber (1977) procedure was employed in the collection of the palynomorphs. Each trap was buried in the ground with collar about 5 cm above the ground level. 50 ml of glycerol, 10 ml of formaldehyde and 5 ml of phenol were poured into each trap. The mixture was changed monthly and the collected recipient was taken to the laboratory for analysis of the palynomorphs. The study lasted for the period of three months.

Each sample was sieved through 200 µ-mesh copper wire gauze to filter off large organic and inorganic particles. The samples were then centrifuged at 2000 revolutions per minute (rpm) for three minutes. The supernatant was decanted and the residue retained. The residues (ppt) were washed with glacial acetic acid and centrifuged in order to recover the polliniferous residue, which were subsequently acetolysed and re-centrifuged. The acetolysing agent is a mixture of concentrated tetraoxosulphate (VI) acid and acetic anhydride in the ratio, 1:9 (Erdtman, 1934). Three ml of the acetolysis mixture was added into each of the residues. This was followed by heating in a water bath for 5 minutes at 100^{oc}. The samples were each washed with glacial acetic acid and three times with distilled water. Each wash was followed by centrifugation and decanting in order to recover the polliniferous residue. The acetolysed samples were each transferred into specimen (vial) tubes and 5ml glycerol/alcohol was added and stored for analysis. Two ml of each sample were placed on a microscopic slide and covered carefully with a 22mm x 22mm cover slip. The mount was then sealed off around the edges with nail varnish to avoid desiccation and movement of the cover slip. The slides were each examined microscopically and the palynomorphs identified and counted with the use of “Leica Gallen” 11 1508KX Microscope at x400 magnification. The x100 magnification (oil immersion) was used for the detailed morphological study of pollen grains and spores. Measurements were carried out with the aid of ocular micrometer.

The identification of pollen grains and spores was based on literature (Maley, 1970; Sowunmi, 1973; Ybert, 1979; Boneffille and Riollet, 1980; Agwu and Akanbi, 1985; Hurtado and Riegler-Goihman, 1986; Agwu and Ahize, 1987) and on reference collection of modern pollen grains of Nigeria stored in the palynology research unit, Department of Botany, University of Nigeria, and Nsukka. The pollen grains captured in the course of this study were separated into their different phytoecological groups. These include: Lowland rainforest, Savanna and Human Impact.

Results

A total of 3,390 palynomorphs were recorded with the breakdown as follows: October,1248; November,1156 and December ,1526. Out of the counted palynomorphs, pollen grains constituted 2125.

Table 1: Airborne palynomorphs trapped at aku in October, November and December, 2004.

Phytoecological Indicator Species	October		November		December	
	1	2	1	2	1	2
Tropical Lowland Rainforest (TLR) Taxa						
Amaranthaceae/chenopodiaceae	60	5	0	0	0	0
Alchornea cordifolia	10	0	0	0	0	35
Cassia spp	1	25	0	0	0	10
Cyperus sp	10	10	0	0	0	10
Elaeis guineensis	55	230	95	205	95	225
Ficus spp	0	0	0	0	5	0
Gloriosa superba	0	0	5	0	0	0
Lannea acida	0	10	0	0	0	0
Microdesmis	0	1	0	0	0	0
Milicia excelsa	0	0	1	0	1	25
Olax viridis	1	10	0	0	0	0
Phyllanthus amarus	2	0	0	0	0	0
Phycnanthus angolensis	0	25	0	0	0	0
Irvingia wombolu	10	5	0	0	15	15
Sub-total Trop. Rainforest	**149**	**321**	**101**	**205**	**116**	**311**
Savanna						
Poaceae	105	95	200	10	200	190
Syzygium guinensis	42	1	0	0	0	0
Combretaceae/ melastomaceae	1	0	0	0	0	0
Acacia sp	0	1	0	0	0	0
Eugenia nodiflora	0	0	0	0	6	0
Sub-total Savanna	**148**	**97**	**200**	**10**	**206**	**90**
Human Impact						
Ageratum conyzoides	15	0	15	0	15	0
Casuarina equisetifolia	1	0	1	2	0	1
Chromolaena odoraata	3	2	6	5	3	2
Total	**316**	**420**	**323**	**222**	**340**	**504**
Algal cyst/cells	15	0	0	0	0	0
Fungal spore	257	235	410	136	360	190
Chared Gramineae Epidermis	5	0	42	23	60	72
Pteridophytic (fern) spore	0	3	30	35	66	99

The count of 736 pollen in October was followed by a decrease to 545 in November and an increase to 844 in December. The pollen grains belonged to 20 families of flowering plants (17 dicotyledons and 3 monocotyledons) consisting of 20 genera.

Characteristically, the plants of the Tropical Lowland Rainforest 1209 (56.8%) and savanna 845 (39.7%) dominated, while the greater aspect of indicators of Human Impact 71(3.5%) was influenced by *Casuarina equisetifolia*, Asteraceae sub. family Tubuliflorae complex.

The major contributors from the Tropical Lowland Rainforest were *Alchornea cordifolia* (Schum and Thonn.)Mull.Arg*., Cassia spp, Elaeis guineensis* Jacq*., Ficus spp, Gloriosa superba* L*., Lannea acida*` , *Milicia excelsa* Wild C.C. and *Phyllanthus amarus (*Baill). Mull.Arg.(Table 2). *The* oil palm *Elaeis guineensis* Jacq.flowers throughout the sampling period but more during the month of December. Savanna spectrum was dominated by Poaceae, *Syzygium guineense* Engl*., Acacia spp*. and Combretaceae /Melastomataceae.

Fungal spores constituted 1,588 of the 3,930 palynomorphs counted, their number increased progressively throughout the months. The most prevalent fungal spores encountered were *Curvularia, Nigrospora, Spadicoides, Helminthosporium/Dreschlera* that attained their peaks in December.A total of 202 pieces of charred gramineae cuticle were recorded. They were lower for October (5), increased in November (65) and had their peak in December. Algal cysts occurred sparsely throughout the period of sampling.

Discussion

The vegetation of Aku is characterized by numerous species of grasses (e.g. *Andropogon tectorum, Laudetia arundinalia,*

Panicum maximum, Schizacharum brevifolium etc), shrubs and trees, indicating the presence of Wooded Shrub Grassland /Woodland vegetation sub-type (Phil-Eze, 1994).

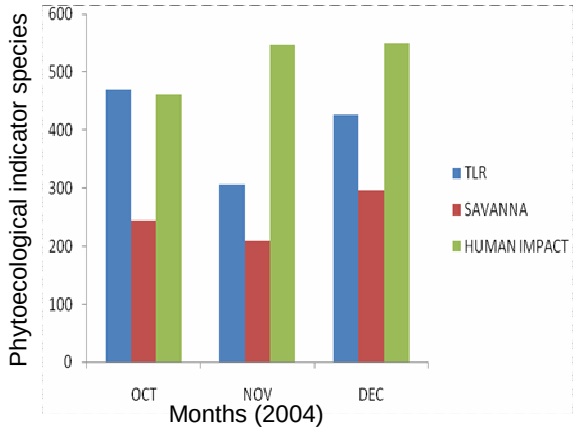

Fig.1: Monthly record of the atmospheric pollen content of the phytoecological indicator species in Aku from October to December, 2004.

December was the period characterized by high influx of pollen from the surrounding vegetations at different rate into the atmosphere and were qualitatively dominated by the pollen of entomophilous plants (Agwu and Ahize,1987; Njokuocha and Osayi,2004). Pollen transported by the NE wind (harmattan wind) in addition to the main flowering season of most trees, shrubs and wild herbaceous plants of the Savanna contributed to the increase in the airborne pollen recorded in December. Very low rainfall (1.52),coupled with the direction and turbulent action of the wind also led to the higher quantity of pollen and spores in December than the previous two months (Vincens *et al*.2002).

It is important to note that throughout the study period, pollen of dicotyledonous families dominated in number as compared to the pollen of monocotyledonous families. This was as a result of the dominance of dicotyledonous plants in the vegetation.

The decrease in abundance of the pollen grains recorded in the months of October and November (Fig. 1) was as a result of the high monthly rainfall in October (149.12mm). This support the view of Barnes *et al*. (2006), which stated that airborne pollen grains declined sharply after a strong rainfall.

It was observed that pollen belonging to Human impact was dominant throughout the sampling period, followed by those of Tropical Rainforest taxa and the least was those of Savanna plants (Table 1 and Fig.1).

Conclusion: The study of airborne palynomorphs revealed the dominance of Wooded Shrub Grassland/Woodland vegetation, relics of Tropical Lowland Rainforest and secondary Grassland.

The atmospheric pollen content (APC) reflected the flora of the vegetation in flower from October – December 2004. The dominance of pollen produced by plants of the tropical lowland rainforest, mosaic of lowland rainforest and secondary Grassland characteristic of the Aku vegetation, confirmed their source area as being mainly the flora of Aku.

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