Journal of Ecology and the Natural Environment Vol. 4(12), pp. 314-320, September 2012
Available online at http://www.academicjournals.org/JENE
DOI: 10.5897/JENE12.031
ISSN 2006 - 9847©2012 Academic Journals

Full Length Research Paper

Comparative Aeropalynology of Ota, Nigeria

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Accepted 3 July, 2012

The aeropalynological sampling of March 2011 was carried out at Ayetoro-Itele, Ota, southwest Nigeria. This was done to create a basis for comparison with March 2010 aerofloral data and verify conclusions made there with respect to its strange haze dust. An improvised aerofloral sampler made up of a food flask base, plastic cylinder, 5 µm mesh sieve and sieve-clamp was mounted on a 2 m stand beside the position of the previous year (March 2010) data collection. Chemo-palynological treatment of the recovered sediment and microscopic analysis of its residue revealed a predominance of the aeroflora by Poaceae and Cheno/Am. There was no record of *Vitex* cf. *doniana*, *Isoberlinia doka* and *Parinari* spp – the Guinea/Sudan savanna vegetation species that dominated the previous year's month. Almost all the pollen recovered was dry climate indicators unlike the 2010 data that recorded relatively high proportion of wet indicator pollen. Fungal elements and diatom species are of higher diversity but of lower population thus reflecting the autochthonous source of the sediment. These findings further support the conclusion that the haze dust of March 2010 was as a result of late harmattan triggered by an unknown event that brought the savanna pollen dominating its data.

Key words: Aeropalynology, harmattan, pollen and spores, fungal elements, diatom frustules.

INTRODUCTION

In March 2010, a strange harmattan dust covered the whole of Nigeria and raised issues bothering 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 to serve as a basis for aeropalynological study. Even the Adekanmbi and Ogundipe's (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.

Although Adeonipekun and John (2011) indicated a Saharan source for the strange dust, the need to further investigate the aeropalynoflora of the same period of the following year is imperative. This will re-affirm the conclusions on the March 2010 record that the northward movement of the position of the ITD was delayed and that the northeast trade winds suddenly re-appeared with an upsurge thus bringing the Saharan dust along. It will also provide aeropalynological data base for future

Figure 1. Aerofloral sampler on a 2 m high stand.

research on climate and allergy in the southwestern part of Nigeria.

MATERIALS AND METHODS

An aerofloral sampler *Gbenga-2* (Figure 1) was constructed with a 5 cm diameter plastic cylinder with 15 cm height. Five micron sized mesh sieve was used in covering the base of the plastic cylinder with the aid of a band-like clamp. This setup was dipped inside an open 7 cm diameter and 10 cm high food flask (Figures 2 and 3).

Fifteen milliliters of formaldehyde was added to 20 ml glycerol and 10 ml of distilled water in the plastic cylinder of the aerofloral sampler. The 5 µm mesh sieve prevented aeropalynomorphs and other aero-particles equivalent to or larger than 5 µm from escaping into the food flask below while the upper end of the cylinder is open. The mixture in the cylinder was monitored every week to assess its volume if there was a need to top it with glycerol and formaldehyde particularly on wet days when rain water diluted the mixture.

The aerofloral sampler was kept in a wooden container to prevent it from being blown-off by wind on a 2 m high stand beside the spot where the 2010 March haze dust was collected at Ayetoro-Itele (Coordinates: N 06° 36.391′ ; E 03° 13.389′) Ota, Ogun State, a border town to Lagos State, southwest Nigeria. Details of the regional and immediate vegetation types' composition and climate of the area are given in Adeonipekun and John (2011).

Laboratory work

Upon the removal of the plastic cylinder, the suspending mixture of formaldehyde and glycerol escaped through the 5 µm sieve and the sediment was carefully washed in plastic vials with formaldehyde. Standard palynological preparation technique was adopted where the sediment was acetolyzed with nine parts Acetic Anhydride and one part tetraoxosulphate VI acid (H_2SO_4) mixture (Erdtman, 1969). The sediment in the acetolysis mixture was boiled for 10 min and allowed to cool. The resulting residue was washed with distilled water and stored in a vial with known volume of glycerine (0.2 ml). Residue and glycerine volume then became 0.35 ml. Residue volume was found to be 0.15 ml (150 µl).

Microscopic analysis

Twenty microlitres of residue was dropped on a microslide and covered with a coverslip. Nail polish was used to seal the edges of the coverslip. Two slides were prepared and studied. The slides were scanned for analysis. Photomicrographs of most important palynomorphs were taken (Plates 1, 2 and 3).

RESULTS

The microscopic analysis reveals that a total of 305 sporomorphs belonging to 17 plant families, are represented in the collection. Most of the pollen grains recovered are dry condition indicators found within the vicinity of the experimental site. Poaceae pollen dominate to being over-represented in the studied aeroflora with 230 grains. Also of relative high proportion is Cheno/Am pollen and charred Poaceae cuticles. Cyperaceae pollen is also well represented. There was no record of *Parinari* species, *Isoberlinia doka* and *Vitex* cf. *doniana*, all of which are of Guinea/Sudan savanna vegetation types recorded the previous year. There was also not much of wet condition indicating sporomorphs except two pteridophytic spores (Tables 1 and 2.)

It is also important to report the recovery of fungal mycelium and conidia along with hyphae and spores. Diatom frustules of genera *Aulacasiera* and *Navicula* dominate the diatom flora along with other undetermined genera.

DISCUSSION

Dominance of Poaceae pollen in the aeroflora is not unexpected because *Panicum maximum* in particular along with *Elusine indica* and *Axonopus* sp. flourished around the experimental area. This scenario agrees with the high proportion of charred Poaceae cuticles that resulted from bush burning synonymous with dry season in Nigeria. Characteristic open vegetation herbs - Cheno/Am, *Vernonia* sp. and Compositae - were also recovered abundantly, indicating dry and open vegetation during the study month. Further credence to the dry condition of this month is the absence of wet weather condition indicating pollen except *Elaeis guineensis* – an open secondary forest vegetation species and pteridophytic spores (Table 1).

Figure 2. Aerofloral sampler on display (a), and dismantled (b) showing the sieve-clamped cylinder and the basal flask.

Figure 3. Components of the aerofloral sampler – flask base, plastic cylinder, 5 µ sieve and sieve clamp.

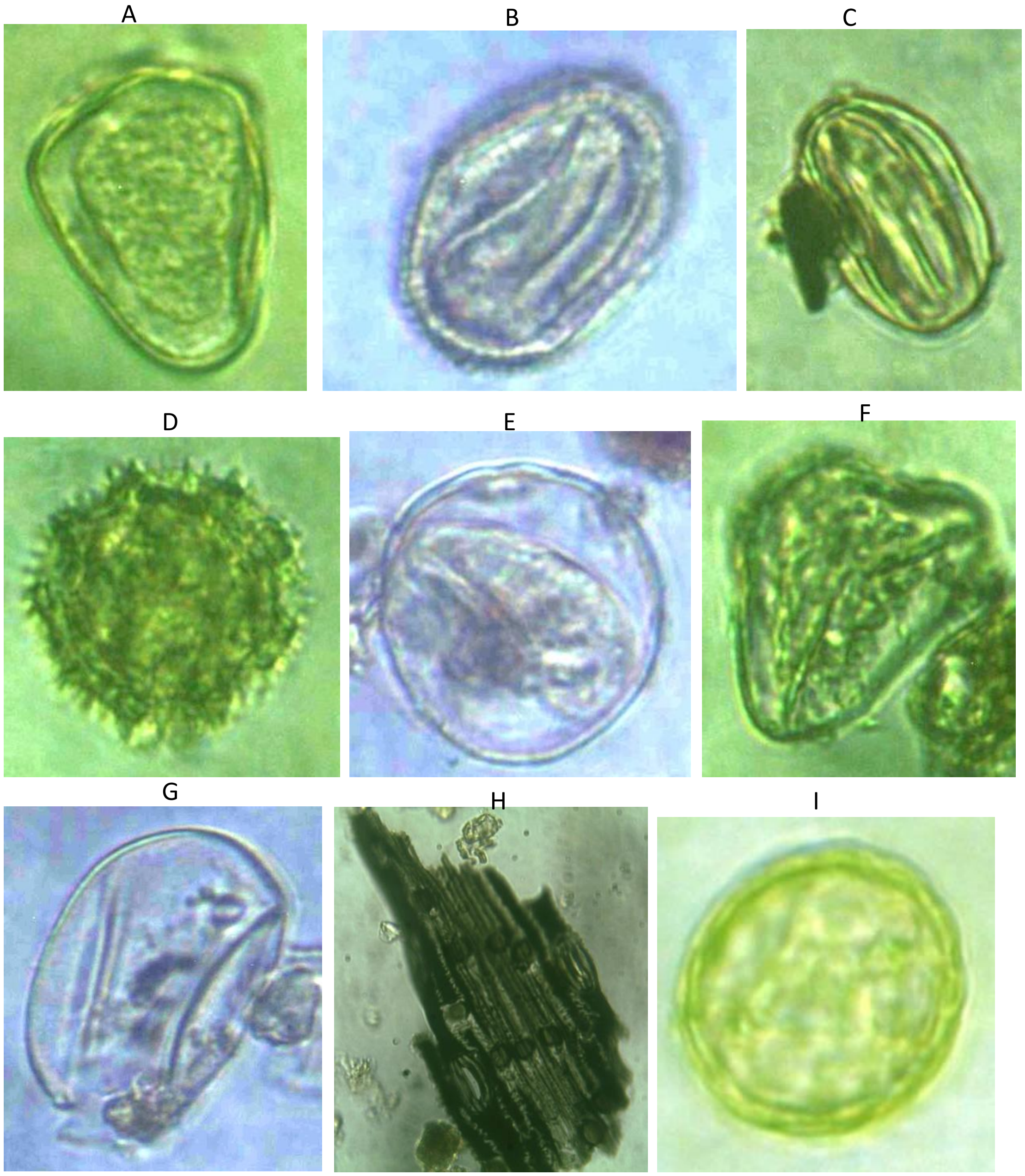

Plate 1. A-*Cyperus* sp.; B-*Asystacia gangetica*; C-*Dissotis* sp.; D-*Vernonia* sp.; E- Poaceae; F-*Elaeis guineensis*; G-Poacea; H-Charred Gramineae cuticle; I-Chenopod/Amaranth Magnification x400.

On the whole, the recovered palynomorphs are indicative of the prevailing dry weather where the vegetation is dry and open for most of the herbs to grow. Comparing with the 2010 data which contains lower proportion of Poaceae but high proportion of *Vitex* cf. *doniana* and *Isoberlinia doka* as well as fair occurrence of *Parinari* spp. along with lower proportion of charred Poaceae cuticles, the conclusion of Adeonipekun and John (2011) is given credence. Adeonipekun and John (2011) had asserted that the haze dust of 2010 March was still the harmattan borne by the Northeast Trade winds from the Sahara desert across the Guinea / Sudan savannas though it came in March instead of the traditional January/February period. The winds came back suddenly after the inter-tropical discontinuity (ITD) Zone had left its previous southernmost extent. Buttressing this further is the low abundance and high diversity of diatom frustules in the 2011 March data since they came from the surrounding dust with richer diversity as against the high abundance and low diversity in the 2010 data that came from a freshwater deposit source far away from the sampling site (Table 1).

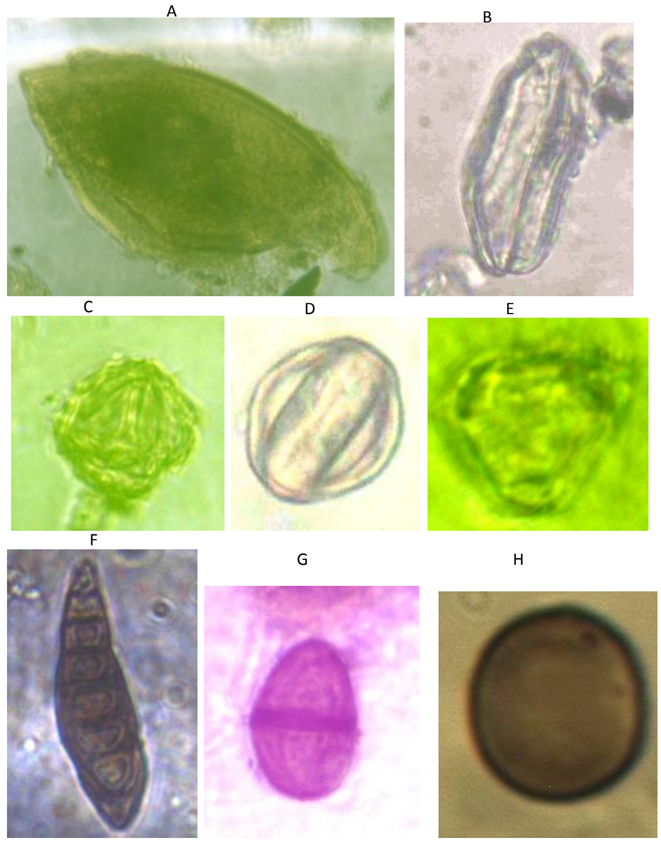

Plate 2. A- Palmae 1; B-cf, *Podococcus barteri*; C-Euphorbiaceae; D- *Dissotis* sp.; E- *Syzygium guineensis*; F-Fungal conidia; G-Fungal spore; H-Fungal spore. Magnification x400.

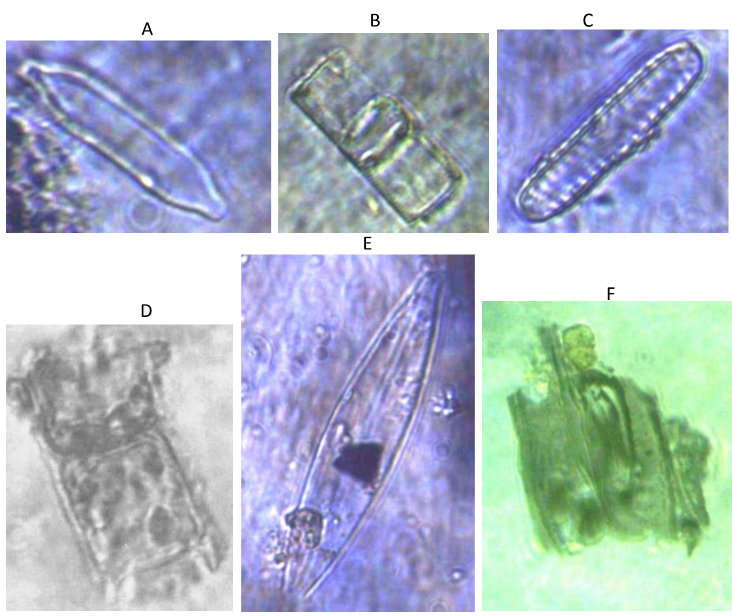

Plate 3. A-Diatom frustules Cf Synedra sp..; B-cf. *Aulacasiera* sp.; C-Cf Pinnularia; D- *Aulacasiera* sp.; E- Cf Frustulia; F- Charred Gramineae cuticle. Magnification x400.

Table 1. List of aeropalynomorphs recovered from the 2011 march study and their proportions.

S/N	Name	Family	Proportion (No. and percent)	Percent of composition excluding Poaceae
1.	Poaceae	Poaceae	230 (75%)	
2.	*Syzygium guineensis*	Myrtaceae	3 (1.0%)	4.0
3.	*Elaeis guineensis*	Palmae	2 (0.7%)	2.7
4.	Cheno/Am	Chenopodiaceae/Amaranthaceae	23 (7.5%)	31
5.	*Polygonum* sp.	Polygonaceae	1 (0.3%)	1.3
6.	*Cyperus* sp.	Cyperaceae	3 (1.0%)	4
7.	*Dissotis* sp.	Melastomaceae	5 (1.6%)	6.7
8.	*Vernonia* sp.	Compositae	2 (0.7%)	2.7
9.	Agavaceae	Agavaceae	3 (1.0%)	4
10.	*Euphorbia* sp. 1	Euphorbiaceae	2 (0.7%)	2.7
11.	*Euphorbia* sp. 2	Euphorbiaceae	4 (1.3%)	5.3
12.	cf. *Mallotus* sp.	Euphorbiaceae	7 (2.3%)	9.3
13.	Polyad	Caesalpinaceae	1 (0.3%)	1.3
14.	Papilionaceae	Papilionaceae	7 (2.3%)	9.3
15.	*Asystacia gangetica*	Acanthaceae	1 (0.3%)	1.3
16.	Cf. *Ipomoae* sp.	Convolvulaceae	1 (0.3%)	1.3
17.	*Citrus* sp.	Rutaceae	1 (0.3%)	1.3
18.	Pteridophytes	Pteridophyceae	5 (1.6%)	6.7
19.	cf. *Ocimum gratissimum*	Lamiaceae	2 (0.7%)	2.7
20.	Palmae 1	Palmae	1 (0.3%)	1.3
21	Cf. Podococcus barteri	Palmae	1 (0.3%)	1.3
22.	cf. *Alternaria* spores	-	7	
23.	Fungal mycelium	-	2	
24.	Fungal hyphae	-	10	
25.	Fungal spores	-	11	
26.	Fungal conidia	-	8	
27.	Charred Poaceae cuticles	Poaceae	13	
28.	*Aulacasiera* sp.	?	13	
29.	*Cf Synedra sp.*	?	4	
30.	Undetermined Diatom frustules	-	3	
31.	Undetermined Pollen	-	11	

Table 2. Comparison of 2010 and 2011 March aerofloral records.

S/N	March 2011 (This work)	March 2010 (Adeonipekun and John, 2011)
1.	Poaceae dominates	*Vitex* cf. *doniana* dominates
2.	*Isoberlinia doka* and *Vitex* cf. *doniana* absent	*Isoberlinia doka* and *Vitex* cf. *doniana* present
3.	*Parinari* spp. absent	*Parinari* spp. present
4.	Cheno/Am high proportion	Low proportion
5.	Higher proportion of Charred Poaceae cuticles	Low proportion
6.	Low to non-occurrence of *Citrus* sp.	High proportion of *Citrus* spp.
7.	*Cyperus* is high in proportion	*Cyperus* very low
8.	*Alchornea cordifolia* absent	*Alchornea cordifolia* present
9.	Diatom frustules have high diversity and low abundance	Diatom frustules have high abundance and low diversity
10.	Fungal mycelium and conidia along with hyphae and spores present	Only fungal hyphae and spores present
11.	A total of 300 pollen aerosampler captured	A total of 125 pollen from settled dust

The fungal elements recovered in the 2010 study were only spores and hyphae while in the 2011 data, mycelium, conidia, spores and hyphae were altogether recovered. This also indicate that the source of the aerospora was local that is, autochthonous where even mycelia were still intact while they must have been reduced to hyphae upon transportation over long distance from the savannas in the case of the 2010 data. Though Bringfelt et al. (1982) remarked that aeroallergens are capable of being transported to varying ecological settings from their sources as also observed in Adeonipekun and John (2011) however, the contribution of the local vegetation under normal climatic condition is greater as observed by Njokuocha (2006).

This work further confirms the important contribution of the local plant pollen in the aerofloral constituents of a place. Thus except there is a trigger on some climatic factors particularly the wind, the aeroflora of any particular place will contain local pollen in abundance while allochthonous pollen will be insignificant.

The March 2010 event may help in the explanation of transportation of palynomorphs across the sea. Ordinarily, aeropollen of distant ecological zones such as the Sudan and Sahel savannas sometimes recovered from offshore sediments do not get to the sedimentary basin by wind but mainly by fluvial action in the Niger Delta except there is a triggering climatic factor as recorded by Adeonipekun and John (2011). Adeonipekun and Olowokudejo (2012) had observed that there was no record of savanna pollen in the aeroflora at offshore sites in the eastern offshore Niger Delta even during the dry season sampled.

With the data presented for the 2011 March study, a reference data set has been generated which will be useful for future research in climate study and allergy in public health concerns.

Conclusion

The 2011 March data represents the normal aerofloral components of the studied area while the 2010 March event indicated more of allochthonously sourced components. This clear difference in the features of the aeropalynomorphs recovered from both 2010 and 2011 March studies which shows that the 2010 record was triggered by an event yet to be identified hence the fear expressed by the Nigerian public in March 2010 of a possible “acid rain”. A collaborative effort will be needed to unravel the triggering factor(s).

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