aerobiology

MDPI

Article

Airborne Pollen and Spores of the University of Ibadan Campus, Ibadan, Southwest Nigeria

Muyideen Olumide Akasoro [1,*], Margaret Adebisi Sowunmi [2] and Peter Adegbenga Adeonipekun [1]

[1] Laboratory of Palynology and Palaeobotany, Department of Botany, Faculty of Life Sciences, University of Lagos, Lagos 101017, Nigeria; aadeonipekun@unilag.edu.ng
[2] Department of Archaeology and Anthropology, Faculty of Science, University of Ibadan, Ibadan 200005, Nigeria; bisisowunmi@hotmail.com
* Correspondence: akasoromuyideen.unilag@gmail.com

Abstract

The study of airborne pollen and spores in regions, communities, and campuses has gained importance in Nigeria in recent times. Aerospora sampling was carried out from November 2012 to February 2013 on the University of Ibadan campus Watch Tower. The Tower is the tallest building on campus, standing at 35 m. An Aero sampler was used to collect aeropalynomorphs monthly at the site. The recovered residues were acetolysed and studied microscopically. Meteorological data for this location were obtained from the Nigerian Meteorological Agency (NiMet) for the prevailing weather conditions. Statistical analysis using the Pearson Correlation Coefficient was used to evaluate the relationship between airborne pollen and spores and meteorological parameters. A variety of palynomorphs, characteristic of rainforest, secondary/open forest, savanna, and freshwater vegetation types, were recovered. The dominant ones belonged to the Arecaceae, Anacardiaceae, Amaranthaceae, Euphorbiaceae, Moraceae, and Poaceae families, as well as fungal spores. Pollen counts with meteorological data revealed variations in palynomorph types and concentrations that reflected the influence of the aerosampler location, weather parameters, and the degree of human activities on the floral composition. This work is the first aerosampling on the University of Ibadan campus and a contribution to the aeropalynological data of campuses across Southwest Nigeria.

Keywords: aeropalynology; pollen and spores; weather parameters; health; Ibadan; Southwest Nigeria

1. Introduction

Palynology, as defined by [1], is the study of modern and fossil pollen, spores, phytoplankton, chitinozoans, and other organic-walled acid-resistant microstructures, collectively called palynomorphs. Aeropalynology is a branch of palynology that deals with the study of pollen grains and spores found freely in the atmosphere [2,3]. The pioneering work of [2] on aeropalynology and its connection to allergies, particularly hay fever, is pivotal to the current research in palynology. Airborne palynomorphs, including pollen and fungal spores, are significant triggers for respiratory allergic diseases. Their concentrations vary seasonally depending on flowering and climatic conditions [4]. Nigeria experiences wet and dry climatic seasons. There are eight vegetation zones associated with this climatic condition, from the southernmost to the Northernmost part. These are mangrove forests, Freshwater swamp forests, Lowland rainforests, derived savanna, Guinea savanna, Sudan

Check for updates

Received: 9 February 2026
Revised: 8 April 2026
Accepted: 24 April 2026
Published: 18 May 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

savanna, Sahel savanna, and Montane forests [5]. Interestingly, airborne pollen and spores recorded across zones are a typical representation of the climatic conditions associated with these vegetation zones. Thus, the transition from the rainy season to the dry Harmattan season drastically alters the atmospheric load of these aeropalynomorphs. The airborne pollen grains and spores recovered by [6–23] were found to depend on several factors, particularly vegetation cover and prevailing weather conditions at the time of recovery, such as atmospheric humidity, rainfall, temperature, wind velocity, and wind direction. These works have contributed to knowledge of the prevalent aeropalynomorphs in the studied areas during a specific period in Nigeria. Some of these studies were carried out in the campuses of the University of Nigeria, Nsukka [7], and the University of Lagos [9,13,14], and in different vegetation zones, ranging from the Southwestern [10,12,17,20–24] through Southeastern [6–8,11] to the Southernmost part [15], as well as from the Northern part of Nigeria [16].

From these studies, the predominant aeropalynomorphs were pollen from Poaceae, *Elaeis guineensis* Jacq. (Arecaceae), *Casuarina equisetifolia* L. (Casuarinaceae), *Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg., (Euphorbiaceae), *Milicia excelsa* (Welw.) C. C. Berg, (Moraceae), Amaranthaceae and Combretaceae/Melastomataceae, Asteraceae, and spores of the fungi of *Alternaria*, *Cladosporium*, and *Aspergillus* spp.

Adeonipekun and John [10], in their palynological study of haze dust collected on the bonnet of the car of one of the authors in March 2010 in Ayetoro-Itele area of Ogun State, recorded an abundance of pollen grains and spores with a high proportion of pollen from *Vitex* cf. *doniana* Sweet. and *Isoberlinia doka* Craib & Stapf, which are Southern Guinea savanna and derived savanna trees, along with freshwater diatoms of the Sahara desert. They [10] rightly inferred that the dust was harmattan-borne, blown a distance south by the North East Trade Winds. A comparative study carried out a year later to confirm the results of [10] revealed that the harmattan storm was indeed due to the North East Trade Winds, due to the absence of *Vitex* cf. *doniana* Sweet., *Isoberlinia doka* Craib & Stapf, and *Parinari* spp. (Southern Guinea/Sudan savanna) pollen grains in the subsequent year [12].

An aeropalynological study of the University of Lagos campus by [9] revealed the prevalence of pollen of Poaceae, Asteraceae, Mimosaceae, *Elaeis guineensis*, and *Alchornea cordifolia*. The abundance of airborne palynomorphs in the recovery was attributed to climatic conditions, especially rainfall, on the university campus. In another three-month aeropalynological study at the University of Lagos campus, from April to June 2014, though at a different site [13], also reported similar results. Poaceae, Cyperaceae, Mimosaceae, *Elaeis guineensis*, and *Alchornea cordifolia* were the dominant pollen within the campus. Despite the availability of aerospora data at some university campuses and many cities in Nigeria, there are no published aerospora data for the University of Ibadan campus, Ibadan, the largest city in West Africa. The only known aeropalynological study in Ibadan was the combined approach of demography, meteorology, and aeropalynology of Ibadan metropolis by [23].

This study, therefore, aimed to ascertain the atmospheric pollen grains and spores, and the factors influencing their occurrence and distribution within the University of Ibadan campus, Ibadan, Southwest Nigeria. Results from this research will constitute an important addition to Nigeria's aerospora data.

2. Materials and Methods

2.1. The Study Site

The University of Ibadan campus (Figure 1) is adorned with tall trees, shrubs, and herbs, including *Terminalia superba* Engl. & Diels, *Triplochiton scleroxylon* K.Schum., *Plumeria* spp. L., Poaceae, Asteraceae, *Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg., *Delonix*

regia (Bojer ex Hook.) Raf., *Tricholepidozia pulcherrima* (Steph.) E. D. Cooper, *Hura crepitans* L., *Milicia excelsa* (Welw.) C. C. Berg, *Azadirachta indica* A.Juss., *Elaeis guineensis* Jacq. *Cola millenii* K. Schum., *Pinus caribaea* Morelet, *Morinda lucida* Benth., *Polyalthia longifolia* (Sonn.) Benth. & Hook.f. ex Thwaites., *Tectona grandis* L.f., *Cassia* spp. L., and *Bombax buonopozense* P. Beauv. etc. The vegetation of the study area lies within rainforest ecozones (Figure 2). The area has an equatorial climate with two seasons, the tropical dry and wet seasons. The dry season is from November to March, while the wet season extends from April through to the end of October. The average daily temperature ranges from 25 °C (77.0 °F) to 35 °C (95.0 °F) while the mean maximum and minimum temperatures are 26.46 °C and 21.42 °C, respectively. The mean annual rainfall is estimated to be 1420.06 mm, and the relative humidity is 74.58%.

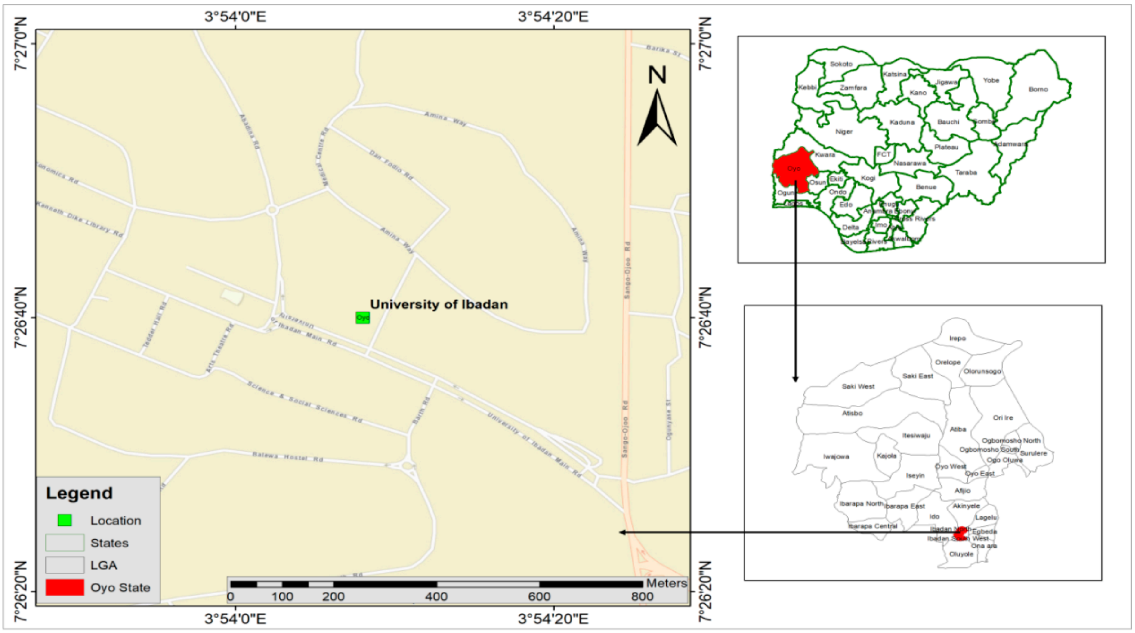


Figure 1. Map of Nigeria (**Upper Right** hand side); Oyo State (**Lower right**); The location of the University of Ibadan (**Left side**), Oyo State.

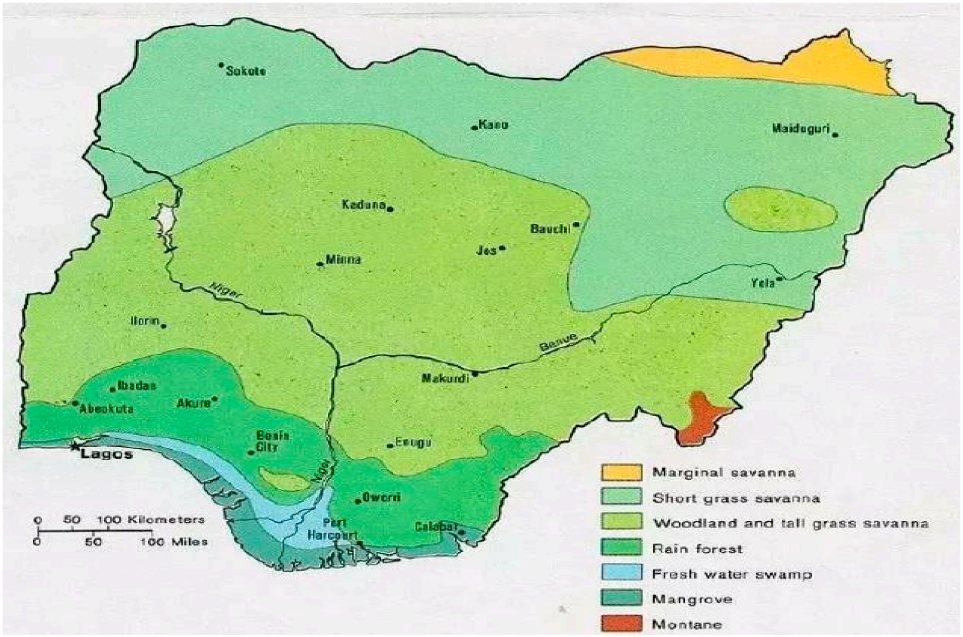


Figure 2. Vegetation Map of Nigeria (Adapted from 5).

Airborne pollen and spores were collected from the tallest structure on the University of Ibadan campus, Ibadan, Oyo State. The tallest structure is the clock tower, which is known as the Watch Tower and forms part of the main Administrative block of the University (Figure 3). The pollen sampler was placed on the topmost part of the Tower, which lies at 7°26′40″ N and 3°54′8″ E at a height of 35 m from the ground (253.8 m above sea level). The period for collecting airborne pollen and spores was during the dry season, from November 2012 through to February 2013. The pollen collector was recovered and changed monthly for four months.



Figure 3. University of Ibadan Tower (Pollen sampler was placed on the topmost open roof, 35 m from ground level).

Vegetation Reconnaissance

A vegetation reconnaissance of the sampled area was undertaken before and during the study. Notable arboreal species were *Delonix regia* (Bojer ex Hook.) Raf., *Terminalia*

superba Engl. & Diels, *Triplochiton scleroxylon* K. Schum., *Plumeria* spp. L., *Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg., *Hura crepitans* L., *Milicia excelsa* (Welw.) C. C. Berg, *Azadirachta indica* A.Juss., *Elaeis guineensis* Jacq., *Cola millenii* K.Schum., *Pinus caribaea* Morelet, and *Polyalthia longifolia* (Sonn.) Thwaites, *Tectona grandis* L.f., *Cassia* spp. L., *Bombax buonopozense* P. Beauv., *Albizia lebbeck* (L.) Benth., *Thevetia peruviana* (Pers.) K.Schum. The herbaceous and shrubby species are represented by *Tridax procumbens* (L.) L., *Gomphrena celosioides* Mart., *Acalypha* spp. L., *Duranta repens* L., *Murraya paniculata* (L.) Jack, *Ixora coccinea* L., and *Chromolaena odorata* (L.) R.M. King & H.Rob.

2.2. Pollen Sampler

An improvised 'Pollen sampler-Tauber-type' [25] made of a cylindrical tin 30 cm high and 15 cm wide was placed at the topmost part of the Tower (Figure 3) to recover palynomorphs every month. The sampler was changed once a month. The height was chosen following the [2] method. A mixture of chemicals, consisting of 50 mL glycerol, 10 mL formaldehyde, and 5 mL phenol, was poured into the sampler following the methods used by [9,11].

2.3. Palynomorph Analysis

The palynomorph analysis was carried out in the Palynology Laboratory, Department of Archaeology and Anthropology, University of Ibadan, Ibadan, Nigeria. The content of the sampler was washed with distilled water and poured into four 15 mL centrifuge tubes; usually, four tubes were used for each sample. The contents of the tubes were centrifuged for 20 min at 4000 rpm, and the supernatant was decanted. A second rinsing with distilled water was carried out by combining the residue in the four centrifuge tubes into one tube, thoroughly mixing with an electric mixer, centrifuging, and decanting. The third rinsing with distilled water also followed the same processes. Dark residues (sediments and some charred particles) were observed. 10 mL of glacial acetic acid was added to the residues in the centrifuge tubes, mixed, centrifuged for 10 min, and decanted.

The residues were subjected to the acetolysis technique of [3,26], which consists of the mixture of nine parts of glacial Acetic anhydride and one part of Tetraoxosulphate (VI) acid. The resulting acetolysis mixture was added to the residues and boiled for 10 min in a water bath in the fume cupboard. The mixtures were centrifuged at 4000 rpm for 15 min and decanted. This was washed with distilled water three times. 50% glycerol was added to the residues, centrifuged at 4000 rpm for 20 min, and the supernatant was decanted and allowed to settle. A known volume of 100% glycerol was added to the residues, mixed, and the final volume was made up to 2 mL. They were transferred into labeled vials according to locations and collection period. Then 10 µL were taken and mounted on slides, gently covered with cover slips, and sealed with translucent nail polish. Two slides were made for each sample collection for microscopic studies. The microscopic analysis of recovered palynomorphs was carried out by viewing and counting the entire slide using an Olympus CH 30 microscope, and photomicrographs of some of the recovered palynomorphs were taken at ×400 and ×1000 magnifications with a digital camera DCM 500 attached to the microscope.

Quantitative and qualitative analyses of the recovered residues were carried out. The percentage abundance of each species was estimated. Identification of recovered palynomorphs was done with the aid of albums of photomicrographs, a reference slide collection of more than 4000 pollen types in the Palynology Laboratory of the Department of Archaeology and Anthropology, University of Ibadan, as well as published works of [9,10,27,28].

2.4. Weather Data

Meteorological data, consisting of atmospheric temperature, wind speed, rainfall, and relative humidity, were obtained from the Nigerian Meteorological Agency (NiMet) in Oyo State to complement the palynological findings.

3. Results

A variety of palynomorphs, characteristic of rainforest, secondary/open forest, savanna and freshwater vegetation types were recovered (Table 1). From the pollen analysis, a total number of 1195 palynomorphs were counted and studied from the slides belonging to 31 families (Table 2). Out of these, 30 palynomorphs were identified to species level, 16 to genus level, while others were only identified to the family level. The palynomorphs that could not be identified were grouped as pollen-spores indeterminate.

Table 1. Meteorological parameters and palynomorphs of the study area.

	Temperature (°C)	Rainfall (mm)	Wind (km/h)	Rel. Hum (%)	Pollen Grains	Fungal Spores	Pteridophyte Spores
November	28	54.9	91	82	263	59	42
December	28.7	0	104.8	71	334	212	12
January	28.9	3.3	120.9	61	129	65	37
February	29.5	64.4	147.7	73	101	32	21

Table 2. Palynomorphs recovered in the month of November, 2012.

Family	Species	Qty
Arecaceae	*Elaeis guineensis* Jacq.	14
Asteraceae	*Tridax procumbens* L.	4
Asteraceae		2
Amaranthaceae		9
Anacardiaceae	*Spondias mombin* L.	3
Anacardiaceae		12
Bignoniaceae		1
Combretaceae/Melastomataceae	Combret/Melastom	1
Cyperaceae	*Cyperus* sp.	1
Euphorbiaceae	*Alchornea* cf. *cordifolia* Schumach. & Thonn.	62
Meliaceae	*Azadirachta indica* A.Juss.	1
Fabaceae	*Peltophorum pterocarpum* (DC.) K. Heyne	1
Moraceae	cf. *Milicia excelsa* (Welw) C.C.Berg.	27
Casuarinaceae	*Casuarina* sp.	14
Poaceae	*Zea mays* L.	30
Poaceae		33
Rubiaceae	*Borreria* sp. *Morinda lucida* Benth.	1
Sapindaceae	*Paullinia pinnata* L.	1
Solanaceae		4

Table 2. *Cont.*

Family	Species	Qty
Fungal spores	Cf. *Cladosporium* sp.	32
	Cf. *Alternaria* sp.	27
Total	20	322

The dominant aeropalynomorphs were fungal spores of *Alternaria* sp. and *Cladosporium* sp., the pollen from Poaceae (*Zea mays*), Euphorbiaceae (*Alchornea cordifolia*), and Arecaceae (*Elaeis guineensis*), Anacardiaceae, Amaranthaceae, and Moraceae (*Milicia excelsa*) (Table 3, Figure 4). The monthly variations in the recovery of palynomorphs showed that the highest number of airborne palynomorphs was collected in December, while the lowest number was in February (Table 4).

Table 3. Dominant taxa in the recovered aeropalynomorphs.

Family\Month	November	December	January	February
Arecaceae	14	45	-	-
Euphorbiaceae	62	92	9	12
Poaceae	63	73	11	7
Fungal spores	59	224	102	38
Moraceae	27	-	44	-

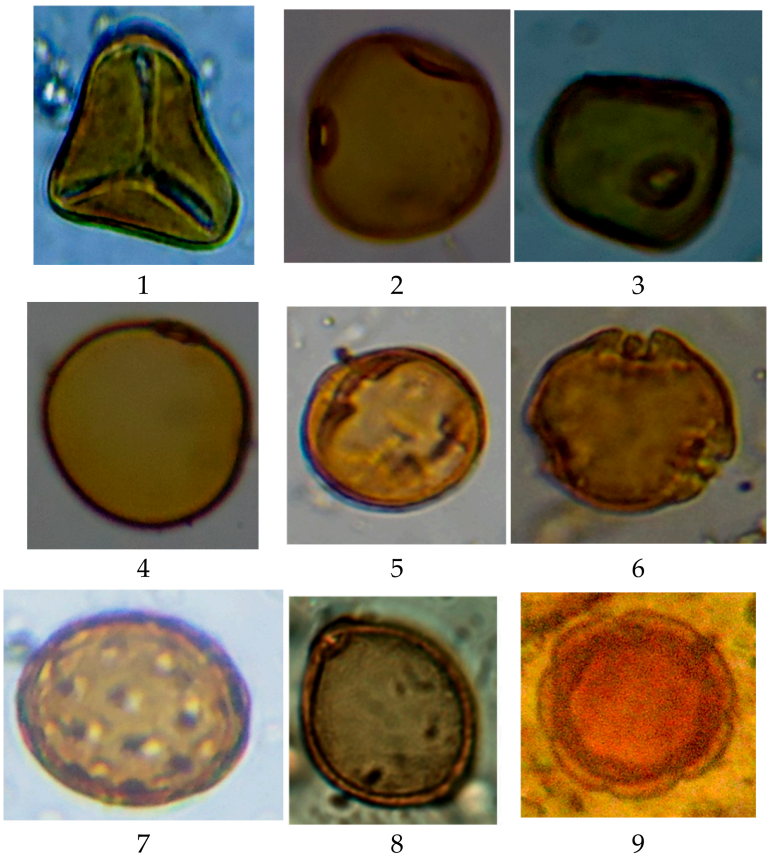


Figure 4. Legend. 1. *Elaeis guineensis*; 2–4. *Zea mays*; 5. *Alchornea cordifolia* (equatorial view). 6. *A. cordifolia* (polar view); 7. Amaranthaceae; 8. *Milicia excelsa*; 9. *Borreria* sp. (Magnification ×400).

Table 4. Total monthly variations in abundance of aeropalynomorphs.

Month	November 2012	December 2012	January 2013	February 2013	Total
Aeropalynomorphs (Qty)	322	546	194	133	1195

4. Discussion

Plant species are known to exhibit high diversity in Tropical rainforests. This is reflected in the types and variety of recovered palynomorphs in aeropalynological studies from the tropics. Variations were recorded in the recovered aeropalynomorphs for this location during the study month (Tables 2 and 5–7). The most abundant pollen grains recovered were those from Asteraceae (*Tridax procumbens*, *Chromolaena odorata*, *Ageratum conyzoides*), Arecaceae (*Elaeis guineensis*), Euphorbiaceae (*Alchornea cordifolia*), Amaranthaceae, and Poaceae (Table 3, Figure 4). These plants were also recorded during the vegetation reconnaissance of the study area. Thus, their recovery in the samples was due to the tall tree species, herbs, and shrubs in this location, most of which were noticeable for flowering during the study. This agrees with the views of [9,12], whose works showed the abundance of these palynomorphs within the same vegetation zone. The work of [23] also reported similar recovery from three (3) different locations in Ibadan. In their separate regional investigations [7,9,23], they also affirmed a strong influence of local vegetation on the pollen types recovered in their samplings, such as *Alchornea cordifolia* and *Elaeis guineensis*. The effect of the height of the pollen sampler had also been noted by [8]. This confirms that, depending on the aims, especially for climatic and agricultural studies, samplers must be placed at considerable heights to have a comprehensive picture of palynomorphs in the air. Most of the pollen grains recovered are wind–dispersed. This showed that, as is to be expected, wind-borne pollen grains are more abundant in the atmosphere than insect-dispersed pollen grains. Insect-dispersed pollen grains, such as those of *Delonix regia* and *Ixora* sp., were discovered to be very low in the study. These plants have abundant flowers and are high pollen producers. Hence, their presence in the air might be due to their being dropped in transit by their pollinators (birds and insects). They are both ornamental plants with flamboyant flowers that attract pollinators.

Table 5. Palynomorphs recovered in December 2012.

Family	Palynomorphs	Qty
Arecaceae	*Elaeis guineensis* Jacq.	45
Asteraceae	*Tridax procumbens* L.	1
	Chromolaena odorata (L.) R.M.King & H.Rob.	7
	Vernonia sp.	1
Asteraceae		4
Amaranthaceae		9
Anacardiaceae	*Spondias mombin* L.	3
Fabaceae	*Cassia* sp.	4
Celastraceae	*Cassine* sp.	1
Combretaceae/Melastomataceae	Combret/Melastom	7
Euphorbiaceae	*Alchornea cordifolia* Schumach. & Thonn.	81
	Mallotus subulatus Müll.Arg.	6
	Phyllanthus sp.	3
	Tetrorchidium didymostemon (Baill.) Pax & K.Hoffm.	2

Table 5. *Cont.*

Family	Palynomorphs	Qty
Malvaceae	*Sida* cf. *acuta* Burm.f. *Grewia* sp.	2 1
Moraceae		20
Myrtaceae	*Psidium guajava* L.	1
Casuarinaceae	*Casuarina* sp.	1
Poaceae	*Zea mays* L.	1
Poaceae		72
Pteridophyte	*Monolete* sp. *Trilete* sp. *Tetrad spores*	1 7 2
Rosaceae		1
Rubiaceae	*Borreria* sp. *Ixora* sp	2 4
Solanaceae		3
Ulmaceae		25
Fungal spores	Cf. *Cladosporium* sp. Cf. *Alternaria* sp. Spores	144 68 12
	Epiphytic fern	5
Total		546

Table 6. Palynomorphs recovered in January 2013.

Family	Species	Qty
Arecaceae	*Elaeis guineensis* Jacq.	6
Asteraceae	*Ageratum conyzoides* L.	2
Anacardiaceae	*Spondias mombin* L.	1
Fabaceae	*Cassia* sp.	1
Combretaceae/Melastomataceae	Combret/Melastom	5
Cyperaceae	*Cyperus* sp.	2
Euphorbiaceae	*Alchornea* cf. *cordifolia* Schumach. & Thonn. *Mallotus* cf. *subulatus* Müll.Arg.	2 7
Euphorbiaceae		1
Moraceae	 *Bosqueia* sp.	40 4
Casuarinaceae	*Casuarina* sp.	3
Poaceae		11
Pteridophyte	Pteridophyte spores	1
Rubiaceae	*Ixora* sp.	3
Rubiaceae		2
	Epiphytic fern	1

Table 6. *Cont.*

Family	Species	Qty
Fungal spores	Cf. *Cladosporium* sp.	45
	Cf. *Alternaria* sp.	20
	Spores Indeterminate	37
		194

Table 7. Palynomorphs recovered in February 2013.

Family	Species	Qty
Arecaceae	*Elaeis guineensis* Jacq.	3
Asteraceae	*Tridax procumbens* L.	1
	Chromolaena odorata (L.) R.M.King & H.Rob.	1
Anacardiaceae	*Spondias mombin* L.	1
	Mangifera indica L.	1
		1
Fabaceae	*Cassia* sp.	3
	Piptadeniastrum africanum (Hook.f.) Brenan	1
		1
Combretaceae/Melastomataceae	Combret/Melastom	3
Euphorbiaceae	*Alchornea* cf. *cordifolia* Schumach. & Thonn.	7
	Mallotus cf. *subulatus* Müll.Arg.	2
	Phyllanthus sp.	3
Moraceae	cf. *Milicia excelsa* (Welw.) C. C. Berg	2
Casuarinaceae	*Casuarina* sp.	1
Poaceae		7
Rubiaceae		4
Sapotaceae		3
	Chrysophyllum sp.	2
Malvaceae	*Cola* sp.	2
Ulmaceae	*Celtis* sp.	2
Fungal spores	cf. *Cladosporium* sp.	43
	cf. *Alternaria* sp.	15
	Spores indeterminate	21
	Pollen indeterminate	3
Total		133

The presence of pollen grains of *Alchornea cordifolia*, *Azadirachta indica*, *Morinda lucida*, *Zea mays*, *Psidium guajava*, *Vernonia amygdalina*, Amaranthaceae, Asteraceae, and *Elaeis guineensis* is noteworthy. They indicate open vegetation resulting from bush clearance and farming, which is a result of human impact on the environment [23]. These species are either preserved for their economic values or are common weeds associated with farming activities [6,7,23,29]. Various parts of most of these species are consumed raw, used as medicine, or cooked as food. For instance, the leaves of *Vernonia amygdalina* have antioxidant and anti-inflammatory properties [30], while various parts of the plant species of *Azadirachta indica* are known for their therapeutic roles in disease prevention and treatment [31]. *Zea mays* is also consumed as food by humans.

The abundance of fungal spores (*Alternaria* sp. and *Cladosporium* sp.) recovered is worthy of attention. Some of these spores may be lurking in their natural habitat on the university campus. However, the University has various Halls of residence, flats or houses where students and staff live as well as farm sites. The abundance of these spores in the air probably indicated the level of waste being generated in the environment, or from farm wastes, while showing the risk the inhabitants expose themselves to from poor waste management. Some of the recovered pollen grains, such as *Alchornea cordifolia*, *Azadirachta indica*, *Zea mays*, *Delonix regia*, *Amaranthus hybridus*, *Cocos nucifera*, *Catharanthus roseus*, and *Carica papaya*, have been recorded to be allergenic [18,19,32,33]. The allergenic constituents of some of these aeropalynomorphs pose health risks to residents [11] and have been linked to various cases of allergic symptoms in the Ibadan metropolis, including the University of Ibadan campus [23]. Catarrh, the most reported case and prevalent symptom of allergies, in the metropolis of Ibadan, has been reported by [23] to be a result of the presence of airborne pollen and spores in the area of study.

Comparing palynomorph counts with the weather parameters for the months of study (Table 1), temperature increased within a range, indicating an appreciable increase in heat intensity. There was an intermittent fluctuation in the rainfall patterns during the recoveries. This shows an irregular pattern of rainfall decrease and subsequent increase during the study months. When rain falls, most atmospheric components, both biological and chemical, are washed away by rain splash. This supported the view of [34], who described the physical removal of pollen grains by raindrops. Thus, the increase in heat intensity and the reduction in rainfall reduced atmospheric moisture content. It can be affirmed from this study that an increase in the intensity of the heat and in the dryness of the atmosphere is favourable for the flowering of plant species in the studied area. It is noteworthy that the submissions by [7,35] suggest that many plants in the tropics flower during periods of lesser rainfall, when the sun shines more brightly, and atmospheric humidity is lower, which supports this finding.

To evaluate the relationship between airborne palynomorphs and the prevailing weather conditions in the study area, a Pearson correlation coefficient (r) analysis was performed [36]. A strong negative correlation between pollen grains and wind speed (Table 8) was recorded. As wind speed increased, the pollen count decreased significantly. This might suggest that high winds during this period acted to disperse pollen concentration during the study. The negative relationship with wind speed, as evaluated, might indicate a dilution effect, in which higher wind velocities disperse more palynomorphs to another location, reducing the concentration captured by the pollen sampler [37]. A moderate-to-strong negative correlation of pollen with temperature was recorded, although pollen concentrations were higher in the drier months (November to December).

Table 8. Pearson Correlation Coefficient (r) between pollen and spores and meteorological data.

Aeropalynomorphs	Temperature (°C)	Rainfall (mm)	Wind Speed (km/h)	Rel. Humidity (%)
Pollen Grains	−0.681	−0.356	−0.814	+0.415
Fungal Spores	−0.201	−0.701	−0.430	−0.101
Pteridophyte Spores	−0.526	+0.247	−0.343	+0.139

These results suggest that during the study period, pollen and spore counts per cubic meter tended to decrease as wind speed and temperature increased, as observed by [38] in tropical savannah regions where peak flowering precedes the hottest months.

A strong negative correlation between fungal spores and rainfall was noted. Interestingly, for this specific four-month dry-season window, higher rainfall (in Nov and Feb)

coincided with lower fungal counts, while the driest month (Dec) saw the highest fungal spike. This suggests that during the transition into the dry season, fungal release may have been triggered by drying of substrates rather than by immediate moisture, a phenomenon characteristic of "dry-weather" spores such as *Cladosporium* and *Alternaria* [39]. The relationships between fungi and temperature, as well as relative humidity, showed very weak correlations, suggesting these were not the primary drivers of fungal fluctuations during this specific period [40]. Just like pollen, pteridophyte spores showed a moderate negative correlation with temperature. However, unlike pollen and fungi, pteridophytes showed a weak positive correlation with rain, reflecting their biological dependence on moisture for growth and spore dispersal [8].

5. Conclusions

The recovery of palynomorphs in this location was remarkable. These findings underscore the need for seasonal health alerts and improved waste-mitigation strategies in high-risk areas. The findings demonstrate a high concentration of airborne palynomorphs, which peaks during the onset of the Harmattan period. The Harmattan season poses the greatest risk to respiratory health due to high airborne pollen and spore loads. The study highlights that the clinical impact is location-dependent. This research is a pilot study. Thus, it needs to be followed up with studies in other locations to get a more comprehensive picture of the aeropalynomorphs in Ibadan city, as well as other seasons for the remaining year. The health risks associated with the abundant fungal spores and pollen in the study areas should be further evaluated. The variation in recovery was due to the weather patterns, the nature of local vegetation, and the intensity of human activities.

Future Research

Future studies should extend the sampling period to a full 12-month cycle. This would allow for a better understanding of the rainy season fungal peaks and provide the sample size necessary for higher statistical significance in Pearson correlations. Incorporating clinical tests, such as Skin Prick Tests (SPT) or ELISA for specific IgE, would help confirm which specific pollen or fungal taxa identified in this study are the primary drivers of the reported symptoms. Future aerobiological traps should be paired with $PM_{2.5}$ and PM_{10} sensors to distinguish between biological particles (such as pollen/spores) and environmental pollutants (including smoke/soot/dust).

Author Contributions: M.O.A.: Project conceptualization, visualisation, field and laboratory analysis, Data curation, Writing—original draft, M.A.S.: Project administration, Supervision, edited original draft, approved final draft. P.A.A.: Writing—review & editing, improved on, and approved final draft. All authors have read and agreed to the published version of the manuscript.

Funding: This research was not funded by any agency, organization, or financial institution.

Data Availability Statement: No new data were created or analyzed in this study.

Acknowledgments: The authors acknowledged the assistance of Opara P.C. and Emmanuel Nwagbara of the Palynology Laboratory in the Department of Archaeology and Anthropology, University of Ibadan, for their assistance during the laboratory analysis. The authors also thank Orijemie E.O. for his contribution during the pollen identification in this study.

Conflicts of Interest: The authors declare they have no conflicts of interest in this research study.

References

1. Traverse, A. *Paleopalynology*; Springer: Berlin/Heidelberg, Germany, 2007.
2. Wodehouse, R.P. *Pollen Grains, Their Structure, Identification and Significance in Science and Medicine*; Hafner Publishing Co.: New York, NY, USA, 1935.

3. Erdtman, G. *Handbook of Palynology: Morphology, Taxonomy, Ecology: An Introduction to the Study of Pollen Grains and Spores*; Munksgaard: Copenhagen, Denmark, 1969.
4. Singh, A.B.; Mathur, C. An aerobiological perspective in allergy and asthma. *Asia Pac. Allergy* **2012**, *2*, 210–222. [CrossRef] [PubMed]
5. Akpan-Ebe, N.I. Reforestation in Nigeria: History, current practice and future perspectives. *Reforesta* **2017**, *3*, 105–115. [CrossRef]
6. Agwu, C.O.C.; Osibe, E.E. Airborne palynomorphs of Nsukka during the months of February–April 1990. *Niger. J. Bot.* **1992**, *5*, 177–185.
7. Agwu, C.O.C.; Njokuacha, R.C.; Mezue, O. The study of airborne pollen and spores circulating at "Head Level" in Nsukka environment. *Bio-Res.* **2004**, *2*, 7–14. [CrossRef]
8. Njokuocha, R.C. Airborne pollen grains in Nsukka, Nigeria. *Grana* **2006**, *45*, 73–80. [CrossRef]
9. Adekanmbi, O.; Ogundipe, O. Aeropalynological studies of the University of Lagos, Nigeria. *Not. Sci. Biol.* **2010**, *2*, 34–39. [CrossRef]
10. Adeonipekun, P.A.; John, M. Palynological investigation of haze dust in Ayetoro-Ota, south-west, Nigeria. *J. Ecol. Nat. Environ.* **2011**, *3*, 455–460. [CrossRef]
11. Adeonipekun, A.P.; Olowokudejo, J.D. Pollen rain at offshore locations in the eastern Niger delta, implications on geologic sedimentation, vegetation reconstruction, and allergy: A preliminary study. *Glob. J. Sci. Front. Res. Biol. Sci.* **2012**, *12*, 27–33.
12. Adeonipekun, P.A. Comparative aeropalynology of Ota, Nigeria. *J. Ecol. Nat. Environ.* **2012**, *4*, 314–320. [CrossRef]
13. Ajikah, L.; Ogundipe, O.T.; Bamgboye, O. Palynological survey of airborne pollen and spores in the University of Lagos, Akoka campus, South-western Nigeria. *Ife J. Sci.* **2015**, *17*, 643–655.
14. Ajikah, L.B.; Alebiosu, O.S.; Adekanmbi, O.H.; Oshinlaja, E.O.; Ogundipe, O.T. Aeropalynological investigation of three local governments in Lagos, South West Nigeria. *Niger. J. Bot.* **2017**, *30*, 107–118.
15. Adekanmbi, O.H.; Alebiosu, O.S.; Ajikah, L.B. A survey of atmospheric palynomorphs in relation to weather and vegetation at selected study sites in South Southern Nigeria. *Niger. J. Bot.* **2017**, *30*, 153–169.
16. Alebiosu, O.S.; Adekanmbi, O.H.; Nodza, G.I.; Ogundipe, O.T. Aeropalynological study of two selected locations in North-Central Nigeria. *Aerobiologia* **2017**, *34*, 187–202. [CrossRef]
17. Adeniyi, T.A.; Adeonipekun, P.A.; Olowokudejo, J.D.; Akande, S.I. Airborne pollen records of Shomolu Local Government Area in Lagos State. *Not. Sci. Biol.* **2014**, *6*, 428–432. [CrossRef]
18. Adeniyi, T.A.; Adeonipekun, P.A.; Olowokudejo, J.D.; Akande, S.I. Allergenicity of dominant aeropollen in Nigeria: Part I. *Curr. Allergy Clin. Immunol.* **2017**, *30*, 264–269.
19. Adeniyi, T.A.; Adeonipekun, P.A.; Olowokudejo, J.D.; Akande, S.I. Allergenicity of dominant aeropollen in Nigeria: Part II. *Curr. Allergy Clin. Immunol.* **2018**, *31*, 178–183.
20. Essien, B.C.; Ige, O.E. Comparative study of dominant aeropollen and allergy-related cases in Akoko Environment, Ondo State, Nigeria. *Eur. J. Med. Health Sci.* **2019**, *1*, 15–23. [CrossRef]
21. Ibigbami, T.; Adeonipekun, A. Comparative aeropalynology of two communities in Lagos State, Southwestern Nigeria. *Not. Sci. Biol.* **2020**, *12*, 729–740. [CrossRef]
22. Ajikah, L.B.; Neumann, F.H.; Alebiosu, O.S.; Ogundipe, O.T. Relevance of aerobiological studies in Nigeria: A two-year aerospora record of Lagos. *Aerobiologia* **2021**, *37*, 597–613. [CrossRef]
23. Akasoro, M.O.; Sowunmi, M.A.; Adeonipekun, P.A. Socio-demographics and health implications of airborne pollen and spores in Ibadan metropolis, Southwest Nigeria. *Impact Int. J. Publ.* **2025**, *1*, 486–511.
24. Ibigbami, T.I.; Adeonipekun, P.A.; Oluseyi, T.; Adeleye, M. Aeroflora and pollinosis in selected areas of Lagos, Nigeria. *Aerobiologia* **2022**, *38*, 567–580. [CrossRef]
25. Tauber, H. A static non-overload pollen collector. *New Phytol.* **1974**, *73*, 359–369. [CrossRef]
26. Faegri, K.; Iversen, J. *Textbook of Pollen Analysis*; John Wiley and Sons Ltd.: Hoboken, NJ, USA, 1989.
27. Sowunmi, M.A. Pollen of Nigerian Plants I: Woody species. *Grana* **1973**, *13*, 145–186. [CrossRef]
28. Sowunmi, M.A. Pollen of Nigerian Plants II: Woody Species. *Grana* **1995**, *34*, 120–141. [CrossRef]
29. Agwu, C.O.C. Modern pollen rain in Nsukka: An indicator of the vegetation of Nsukka plateau. *Würzburg. Geogr. Arb.* **1997**, *92*, 97–115.
30. Adedapo, A.A.; Aremu, O.J.; Oyegbemi, A.A. Anti-oxidant, anti-inflammatory and antinociceptive properties of the acetone leaf extract of *Vernonia amygdalina* in some laboratory animals. *Adv. Pharm. Bull.* **2014**, *4*, 591–598. [CrossRef]
31. Alzohara, M.A. Therapeutic role of *Azadirachta indica* (Neem) and its active constituents in disease prevention and treatment. *Evid. Based Complement. Altern. Med.* **2016**, *2016*, 7382506. [CrossRef] [PubMed]
32. Banik, S.; Chanda, S. Airborne pollen survey of Central Calcutta, India in relation to allergy. *Grana* **1992**, *31*, 73–75. [CrossRef]
33. Waqar, M.A.; Khan, M.; Saleem, A.; Muhammad Hasnain, S. Possible effects of cultivated plants in the development of allergy in population of Sindh, Pakistan. *J. Chem. Soc. Pak.* **2010**, *32*, 95–100.
34. McDonald, E.J. Collection and washout of airborne pollens and spores by raindrops. *Science* **1962**, *135*, 435–437. [CrossRef]

35. Agwu, C.O.C.; Okeke, G.I. Pollen analytical and thin-layer chromatographic study of honey from three savanna zones of Northern Nigeria. *Niger. J. Bot.* **1997**, *10*, 25–36.
36. Galán, C.; Ariatti, A.; Tormo, R.; Domínguez-Esmoris, E. Meteorological parameters and their influence on airborne pollen concentrations. *Aerobiologia* **2017**, *33*, 1–15.
37. Raynor, G.S.; Hayes, J.V.; Ogden, E.C. Mesoscale transport and dispersion of airborne pollens. *J. Appl. Meteorol. Climatol.* **1974**, *13*, 87–95. [CrossRef]
38. Agwu, C.O.C.; Njokuocha, R.C. Monitoring of airborne pollen and spores in Nsukka, Nigeria. *Niger. J. Bot.* **2004**, *17*, 107–114.
39. Troutt, C.; Levetin, E. Correlation of air-borne spore concentrations with meteorological variables of Tulsa, Oklahoma. *Int. J. Biometeorol.* **2001**, *45*, 102–110. [CrossRef]
40. Adhikari, A.; Sen, M.M.; Gupta-Bhattacharya, S.; Chanda, S. Volumetric assessment of airborne fungi in two sections of a rural indoor environment in West Bengal, India. *World Mycotoxin J.* **2004**, *7*, 89–95.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.