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Diversity of Oil Palm Epiphytes in Rainforest and Guinea Savanna Locations in Nigeria

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ABSTRACT

This study investigates the diversity of oil palm epiphytes in rainforest (Ifaki-Ekiti, Ekiti State, Nigeria) and guinea savanna locations (Anyigba, Kogi State, Nigeria). Sampling of epiphytes associated with Oil Palm trees were carried out in each of the two locations. In each location, Five Oil Palm plantations were visited and sampling plot of 50m by 50m was laid out in each plantation. Epiphytes found growing on Oil Palm trees were observed, collected and identified. A total of 14 epiphytes belonging to 11 families were sampled in the two locations. While 5 epiphytes were obtained in Anyigba, the guinea savanna location, 11 were obtained in Ifaki-Ekiti, the rainforest location. 2 of the identified epiphytes were bryophytes and 3 were pteridophytes while 9 were angiosperms. Two of the identified pteridophytes in this study were common to the two locations thus an IS value of 0.25 was obtained in this study. The epiphytic species density and diversity of the rainforest location were higher than those of the derived guinea savanna location. *Nephrolepis bisserata* was the most common oil palm epiphyte in both the derived savanna and rainforest locations. The species has a relative frequency of 32.3% and 27.6% respectively. While the results obtained from the savanna location revealed the presence of some vascular plants of *Ficus* spp., *A. conyzoides* and *C. odorata* were the prominent epiphytic vascular plants sampled in the rainforest location. Features responsible for the ecological success of these epiphytes were discussed.

KEYWORDS: Diversity, Oil palm, epiphytes, rainforest, guinea savanna

INTRODUCTION

The dependence on phorophytes for support constitutes an important pre-requisite for the ecological success of epiphytes. Other requirements, according to Hietz (1999), included the density of porofit, microclimate, the distance from the seed source, the type and size of the tree, the type and history of the disorder, epiphytic population dynamics of trees and sepiphytes physiology. The epiphytes are non-parasitic but derive only physical support from the phorophytes, also known as hosts (Adeleye *et al.,* 2017). They derived their moisture and nutrients from the air, rain and sometimes debris, which accumulate on the phorophyte. They may also develop roots primarily for attachment and some other specialized structure such as scales, succulent leaves and stems to hold moisture (Akinsoji, 2005).

Elaeis guineensis is a species of palm, commonly called African oil palm or macaw-fat (Wikipedia 2019), and a member of the family Arecaceae. It is a native of West Africa, but it is extensively cultivated in Africa, Southeast Asia, tropical America, Malaysia, Nigeria, Indonesia, Ivory Coast and

Brazil (Singh *et al.*, 2005). All components of this plant namely; fronds, leaves, trunk, stem and roots are used for several purposes ranging from palm oil, broom, planks, soaps, palm kernel cake etc. (Ogieva, 2003). Adelekan *et al.* (2002) observed that palm oil is the principal source of most edible oil consumed in Nigeria.

Most oil palm species cultivated in Nigeria were the wild type that possessed rough barks that easily accumulate dusts and moistures thus provide habitats to enormous number of vascular epiphytic growth. Suzanti, *et al*. (2016) asserted that diversity of epiphytes abounds in the canopy of Oil Palm tree. However, a limited number of studies have been documented on the vascular epiphytic flora in Nigeria. Studies recorded include those of Akinsoji (1990, 1991 and 2005) in Olokemeji and Gambari forest reserves and Gashaka-Gumti National Park respectively; Oloyede *et al.* (2014) documented the composition and distribution of epiphytes in relation to climatic factor in Obafemi Awolowo University, Ile Ife, Nigeria and that of Adeleye *et al.* (2017) conducted in the Lekki Conservation Centre, Lagos, though Enuofu, (1994), documented the pteridophytes in the same Lekki Conservation Centre, Lagos Nigeria.

Consequent on the above, the study being reported here aimed at the investigation on the diversity of oil palm epiphytes in rainforest and guinea savanna locations in Nigeria.

MATERIALS AND METHODS

The Study Areas

A rainforest location close to the Ifaki-Ekiti Campus of the Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria and a guinea savannah location situated at the campus of Kogi State University, Anyigba, Kogi State, Nigeria were used for this study.

Ifaki-Ekiti is situated on Latitude 7°.79′ North, Longitude 5°.25′ East and 457 meters elevation above the sea level (Anon. 2019a). Two climatic sessions prevailed, a rainy season between March and October and a dry season between November and February (Kayode 2004). The town which is situated at the Ido-Osi Local Government Area of Ekiti State has a population of 9,185 who are mostly engaged in farming activities.

Anyigba is situated on Latitude 7° 36′ North, Longitude 7° 12′ East and between 270 and 390 metres above sea level (Awosusi and Oriye 2015). The town lies within tropical hinterland with seasonal climate. Rainy season occur between April through October and the peak is September. Anyigba which is situated in Dekina Local Government Area of Kogi State area is populated by people involved in farming activities.

Methods

Sampling of epiphytes associated with Oil Palm trees were carried out in each of the two locations stated above. In each location, Five Oil Palm plantations were visited and sampling plot of 50m by 50m was laid out in each plantation. Epiphytes found growing on Oil Palm trees in the plots were observed, collected and identified. The collected plant samples were then taken to the Herbarium of the Department of Plant Science and Biotechnology, Ekiti State University for proper scientific identification.

The relative frequency of occurrence of each epiphyte in each sampled site was determined as:
Relative frequency = Frequency of the Species / Total Frequencies of all the species x 100
Where:
Frequency = Number of occurrence of the species / Total number of Oil Palm sampled

The Index of Similarity (IS) between the sampled sites was determined as:
$IS = 2C / A + B \times 100$

Where:
A = Number of epiphytes present in one location
B = Number of epiphytes present in the second location, and,
C = Number of epiphytes common to both locations

RESULTS AND DISCUSSION

The results obtained revealed the presence of epiphytes in both locations; the rainforest and derived savanna locations. The epiphytes do not have direct connections with the ground as previously observed by Madison (1977). Epiphytism is an interaction between plants in which the epiphytic plant obtains nutrients directly from atmospheric moisture, without emitting haustorium structures on the phorophyte (Bennet 1986). Epiphytism favours the capture of light irradiation, limiting, at the same time, the availability of water for plants (Benzing 1986, 1990).

A total of 14 epiphytes belonging to 11 families were sampled in the two locations (Table 1). While 5 epiphytes were obtained in Anyigba, 11 were obtained in Ifaki-Ekiti. This observation tends to suggest that epiphytes are more diverse in the rainforest than the derived savanna. Previous assertion by Anon. (2017) revealed that the combination of high atmospheric humidity and intense sunlight throughout the year allows the rainforest to become so ridiculously rich in diversity. Also in this vegetation, Anon. (2019b) asserted that fewer ecological obstacles to higher biodiversity abounds. Thus the plants in this vegetation have the greatest access to consistent energy, water, and carbon.

Table 2 revealed that 2 of the identified epiphytes were bryophytes and 3 were pteridophytes while 9 of the identified epiphytes were vascular plants (angiosperms). Two of the identified pteridophytes in this study (Table 2) were common to the two locations. Thus the IS value of 0.25 was obtained in this study. The species density and diversity of the rainforest vegetation were higher than those of the derived savanna. Anon. (2019c) asserted that the tropical rainforest biome has four main characteristics that included very high annual rainfall, high average temperatures, nutrient-poor soil, and high levels of biodiversity (species richness).

Also the results obtained revealed that most of the epiphytes sampled in the rainforest location were herb species thus lending credence to the previous assertion of Richards (1996) that the rain forest epiphytes were mainly small plants although a few grow to several meters high.

Table 1: Checklist of epiphytes sampled in oil palm trees in rainforest and guinea savanna locations in Nigeria

S. No.	Epiphytes	Family
1.	*Ageratum conyzoides*	Asteraceae
2.	*Chromolaena odorata*	Asteraceae
3.	*Comommelina africana*	Commelinaceae
4.	*Dryopteris filix-mas*	Dryopteridaceae
5.	*Ficus benghalensis*	Moraceae
6.	*Ficus elastica*	Moraceae
7.	*Ficus sur*	Moraceae
8.	*Lapportea aestuans*	Urticeaceae
9.	*Nephrolepis bisserata*	Nephrolepidaceae
10.	*Peperomia pellucida*	Piperaceae
11.	*Platycerium elephantotis*	Polypodiaceae
12.	*Solenostemon monostachus*	Lamiaceae
13.	*Thuidum gratum*	Thuidiaceae
14.	*Tortular ruralis*	Pottiaceae

Table 2: Classification of epiphytes sampled in oil palm trees in rainforest and guinea savanna locations in Nigeria

Classification		Status /Location*	
		Anyigba (G. savanna)	Ifaki-Ekiti (Rainforest)
Bryophytes			
	T. gratum	A	P
	T. ruralis	P	A
Pteridophytes			
	D. filix-mas	P	P
	N. bisserata	P	P
	P. elephantotis	A	P
Angiosperms			
	A. conyzoides	A	P
	C. odorata	A	P
	C. africana	A	P
	F. benghalensi	P	A
	F. elastica	P	A
	F. sur	A	P
	L. aestuans	A	P
	P. pellucida	A	P
	S. monostachus	A	P

Nephrolepis bisserata was the most common oil palm epiphyte in the derived savanna location (Table 3). It has a relative frequency of 32.3%. Epiphyte with the least occurrence in the location was *Dryopteris filix-mas.* It has a relative frequency of 2.0%. The ecological success of *Nephrolepis bisserata* could be attributed to its propagation by spores. Its sporangia produced spores by meiosis and release them into the air. Spores that land on a suitable substrate germinate and form a heart-shaped gametophyte, which is attached to the host by thin filamentous rhizoids. The inconspicuous gametophyte harbors both sex gametangia (Anon. 2019d). Anon (2011) asserted that *Nephrolepis bisserata,* like other fern that grow in semi-arid region, create special proteins that minimize the damage caused by being desiccated. When moisture returns, other proteins quickly set in to repair the damage caused by the drying. Some of these proteins are similar to those found in maturing seeds.

Also in the rainforest location, *Nephrolepis bisserata* (Table 4, relative frequency of 27.6%) was equally the most common oil palm epiphyte while the least was *Ficus capensis* (relative frequency of 1.5, Table 4). *Dryopteris filix-mas* was equally found in both rainforest and derived savanna locations used in this study. This fern, according to Anon (2018), thrives in partial or full shade and moist, rich, well-drained, slightly acidic soil. It can also tolerate short periods of afternoon sunlight. Previous study by Pittermann (2013) revealed that the gametophytes of ferns show a high degree of desiccation tolerance. Also the morphological attributes in the gametophytes may facilitate water retention in them thus enable them to survive in the derived savanna ecosystem examined in this study.

The ecological success of epiphytic bryophytes has been summarized by Lepp (2008) who opined that a bryophyte growing on the predominantly shady side of a tree trunk is protected from the full force of the sun. Additionally, the tree trunk concentrates some of the rain falling on the tree. During rainfall, some rain will fall directly on the trunk, some on the branches above, with some falling on the branches flowing down onto the trunk, so adding to the amount of water the trunk is exposed to. The benefits are greatly increased if the bark is rough and fissured. Such bark provides a much greater surface area (with numerous shaded micro-habitats) and slows down the flow of water, as well as providing numerous spots where a few droplets can be trapped, allowing any nearby bryophytes to benefit from the water over a longer period. The bark of oil palm trunk fits perfectly into this description.

The results obtained from the savanna location revealed the presence of some vascular plants made up of *Ficus* spp. Fig plants are monoecious (hermaphrodite) or gynodioecious (hermaphrodite and female) (Armstrong and Disparti, 1998). Nearly half of fig species are gynodioecious, and therefore have some plants with inflorescences with long styled pistillate flowers, and other plants with staminate flowers mixed with short styled pistillate flowers (Friis and Balslev, 2005). The flowers are pollinated by very small wasps that crawl through the opening in search of a suitable place to lay eggs. The long flowers styles tend to prevent wasps from laying their eggs within the ovules, while the short styled flowers are accessible for egg laying (Valdeyron and Lloyd, 1979). This insect visitation might have been prominent in the transference of seeds of these plants to the oil palm canopy. The epiphytes in the rainforest location are more diverse with higher density than that of the savanna location. Also, more vascular plants were recorded. Schuettpelz and Trapnell (2006) had earlier asserted that the vast majority of vascular epiphytes occurred in the tropical rainforest. These vascular plants were dominated by herbaceous plants thus supporting the previous assertion of Richards (1996) that the rain forest epiphytes are mainly small plants although a few grow to several meters high.

Table 3: Occurrence of epiphytes on Elaeis *guineensis* in Anyigba, Kogi State

S. No.	Epiphytes	Occurrence	Frequency	Relative Frequency (%)
1.	*Dryopteris filix-mas*	5	0.05	2.02.0
2.	*Ficus benghalensis*	39	0.39	15.7
3.	*Ficus elastica*	55	0.55	22.2
4.	*Nephrolepis bisserata*	80	0.80	32.3
5.	*Tortular ruralis*	69	0.69	27.8

Table 4: Occurrence of epiphytes on Elaeis *guineensis* in Ifaki-Ekiti, Ekiti State

S. No.	Epiphytes	Occurrence	Frequency	Relative Frequency (%)
1.	*Ageratum conyzoides*	**33**	0.33	16.3
2.	*Chromolaena odorata*	**27**	0.27	13.3
3.	*Ficus capensis*	**3**	0.03	1.5
4.	*Lapportea aestuans*	**8**	0.08	3.9
5.	*Nephrolepis bisserata*	**56**	0.56	27.6
6.	*Nephrolepis cordifolia*	**5**	0.05	2.5
7.	*Pepperomia pellucida*	**10**	0.10	4.9
8.	*Platycerium elephantotis*	**5**	0.05	2.5
9.	*Solenostemon monostachys*	**6**	0.06	3.0
10.	*Thuidum gratum*	**50**	0.50	24.6

A. conyzoides and *C. odorata* were prominent among the vascular plants sampled in the rainforest location. These plants are invasive weeds. They are wide spread along roadsides and other disturbed areas. They grow in the proximity of habitation, thrive in any soils and are very common in disturbed sites and degraded areas. They invade forest, woodland, grassland, cultivated land, riparian zones, wetlands and coastal dunes. They both reproduced by seeds but while the seeds of *A. conyzoides* are dispersed on the hairs of livestock and wild animals, those of *C. odorata* are easily blown and dispersed by wind. However, both species complete their lifecycles (germination to flowering) within a short period of about two months thus enhancing their ecological success as epiphytes.

In conclusion the epiphytes were not parasitic yet field observation revealed that they harbor harmful insects and pests on the Oil palm tree. Similar observations were made in earlier studies such as Stuntz (2002), Wittman (2000) and Fayle *et al.* (2010). Also many of them dried up at the extreme of dry season and thus constituted combustible materials during burning. Kayode (2006) observed an increasing trend in burning activities in Nigeria vegetation especially during the period of farm preparations in the forest vegetation and during dry season in the savanna. These might be deleterious to the host plant- the oil palm tree. Thus while bush burning should be discouraged in the study areas, ecologically-friendly method of reducing epiphytes population should be evolved for use in oil palm plantations in the two locations used in this study.

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