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DIVERSITY AND DISTRIBUTION OF WHITEFLIES IN SOUTHWESTERN NIGERIA

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ABSTRACT

Whiteflies (Aleyrodidae) are major pests of crops in southwestern Nigeria, yet there is scanty information on diversity and distribution of these economic species. Therefore, a study of diversity and distribution of whitefly fauna was carried out in southwestern Nigeria in wet and dry seasons, between May 2007 and June 2012. Whiteflies were collected on crops and ornamental plants from 22 sampling sites, within the six states. *Aleurodicus dispersus* Russel (Aleurodicinae) was the most distributed species of whiteflies on crops and ornamental plants. It was recorded in all the sampling sites and on 45 different families of plants in the region. Whiteflies were most diverse in the rainforest zone than any other zone in the region. The cosmopolitan Aleurocanthus woglumi Ashby (Aleyrodinae) infested plants in the family Rutaceae more than any other species of whiteflies in the region. Citrus species was observed to host larger population of whiteflies than any other crop in the study area. Plant family, Euphorbiaceae, hosted the largest number of whiteflies (14 out of 35 whitefly species).

Key Words: Diversity, Euphorbiaceae, host-plant, rainforest

RÉSUMÉ

Les mouches blanches (Aleyrodidae) sont les pestes majeures des cultures au Sud-Ouest du Nigeria, déjà, il y a très peu d'information sur la diversité et la distribution de cette espèce. Une étude de diversité et de distribution des mouches blanches a alors été réalisée dans le Sud-Ouest du Nigeria en saisons sèches et humides, entre Mai 2007 et Juin 2012. Les mouches blanches étaient collectées sur les cultures et plantes ornementales dans 22 sites d'échantillonnage, répartis dans six Etats au Nigeria. *Aleurodicus dispersus* Russel (Aleurodicinae) était la plus répandue des espèces collectées. Cette espèce a été observée dans tous les sites d'échantillonnage et ceci sur 45 différentes familles de plantes. On a noté plus de diversité dans les mouches blanches dans la zone de forêt que dans n'importe quelle autre zone de la région. La mouche cosmopolite *Aleurocanthus woglumi* Ashby (Aleyrodinae) avait été retrouvée plus sur les plantes de la famille des Rutaceae que n'importe quelle autre espèce de mouche blanche de la région. Les espèces Citrus ont abrité plus de mouches blanches que toutes les autres cultures et plantes de la zone d'étude. Les Euphorbiaceae ont abrité le plus grand nombre d'espèces de mouches blanches (14 des 35 espèces de mouches blanches).

Mots Clés: Diversité, Euphorbiaceae, plante hôte, forêt humide

INTRODUCTION

There is increasing interest in assessing the diversity of insects and their relatives, because these groups dominate terrestrial and freshwater ecosystems and are valuable indicators of their health. Insects are extremely diverse and important to ecosystems (Finnamore, 1996). They have permeated the diverse and essential natural processes that sustain biological systems, making up over 75% of known species of animals. Indeed, our present ecosystems would not function without insects (Wiggins *et al.*, 1991). Study of diversity is very important in almost

every aspect of life because human survival depends directly or indirectly on it (David *et al.,* 1997). This is, especially so at ecosystem level because natural diversity in ecosystems provides essential economic benefits and services to human society - such as food, clothing, shelter, fuel and medicines - as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development (William, 2000). Diversity study when properly carried out is expected to produce detailed information on the number of species of organisms under consideration present within the study area. Other information pertaining to habitat, host plants, species occurrence and distribution, predator or prey of the organism will also be provided. It can also determine which species are endemic and which ones have been introduced. Moreover, systematic data such as species distribution, classifications, phylogenetic and observational data can be generated from a good diversity study (Jennifer *et al.,* 2000).

Research on diversity is also essential for biological control and integrated pest management. Lack of this knowledge, on the other hands, has delayed a biological control programmes and in some instances such as whiteflies that occur in the United States, and are part of the *Bemisia tabaci* complex.

Considerable confusion centers around the status of the sweet-potato whitefly (known as type A), which has occurred in the United States for nearly 100 years, and the silverleaf whitely (type B), which appears to have been introduced (Perring *et al*., 1993). Some specialists believe that the silverleaf taxon is a separate species from the sweet-potato whitefly (Perring *et al.,* 1993) and have described it as *Bemisia argentifolii* (Bellows *et al*., 1994); while others contend that it is the same species (Campbell *et al*., 1993). This distinction is important because it is unclear where the silverleaf whitefly is native to and therefore, where to search for effective natural enemies. If the *Bemisia* fauna in parts of the world were already known through diversity studies, biological control community could implement its programmes with little delay, and farmers could avoid loss of millions of dollars in damage.

The dense populations of *Aleurodicus dispersus* Russell producing ample honey dew and sooty mould led to abandonment of some cassava fields and the removal of some ornamental trees in Benin Republic of West Africa (Neuenschwander, 1994). Alegbejo (2000) reported that whiteflies, especially *Bemisia tabaci* Gennadius transmit at least 21 viruses in Nigeria and cause yield losses ranging from 15 to 100 percent. It has been observed that infestation of plants by whiteflies in southwestern Nigeria is high and needs to be controlled (Banjo, 2010). Productivity and product quality of both crops and ornamental plants in the region is low due to whitefly infestation.

An important issue in biodiversity studies is the understanding of what drives the variation in species diversity and composition (Holyoak *et al*., 2005; Hore and Uniyal, 2008). The interest is not in knowing the exact number, but rather how the diversity and composition vary among sites. The gap created by the paucity of data on the diversity, number of species, distribution and host plants of whiteflies in South-western Nigeria is a major constraint to the management of the pest. Past surveys of whiteflies in Nigeria were often limited to certain agricultural plants like cassava, tobacco and citrus (Bale *et al.,* 2008), hence this study covered all whitefly infested crops and ornamental plants in the region.

MATERIALS AND METHODS

This study was carried out in southwestern Nigeria, which is between longitudes 002°492 E and 006°202 E of the Greenwich Meridian, and latitudes 06°002 N and 08°502 N of the Equator. The study area comprised of three ecological zones, namely, the Mangrove forest zone, the rainforest zone and the Derived savannah zone (Fig. 1). Twenty two representative towns were selected as sampling sites within the six states, namely Lagos, Ogun, Oyo, Osun, Ekiti and Ondo (Fig. 2). Since the distribution of whiteflies is mainly influenced by the host plants and the factors affecting the host plants within their environment, the selection of the study area was based on the type of vegetation in southwestern Nigeria (Mangrove, Rainforest and Derived Savannah). It was done in a way that towns with similar vegetation were not severally repeated. Towns with similar ecological pattern, but

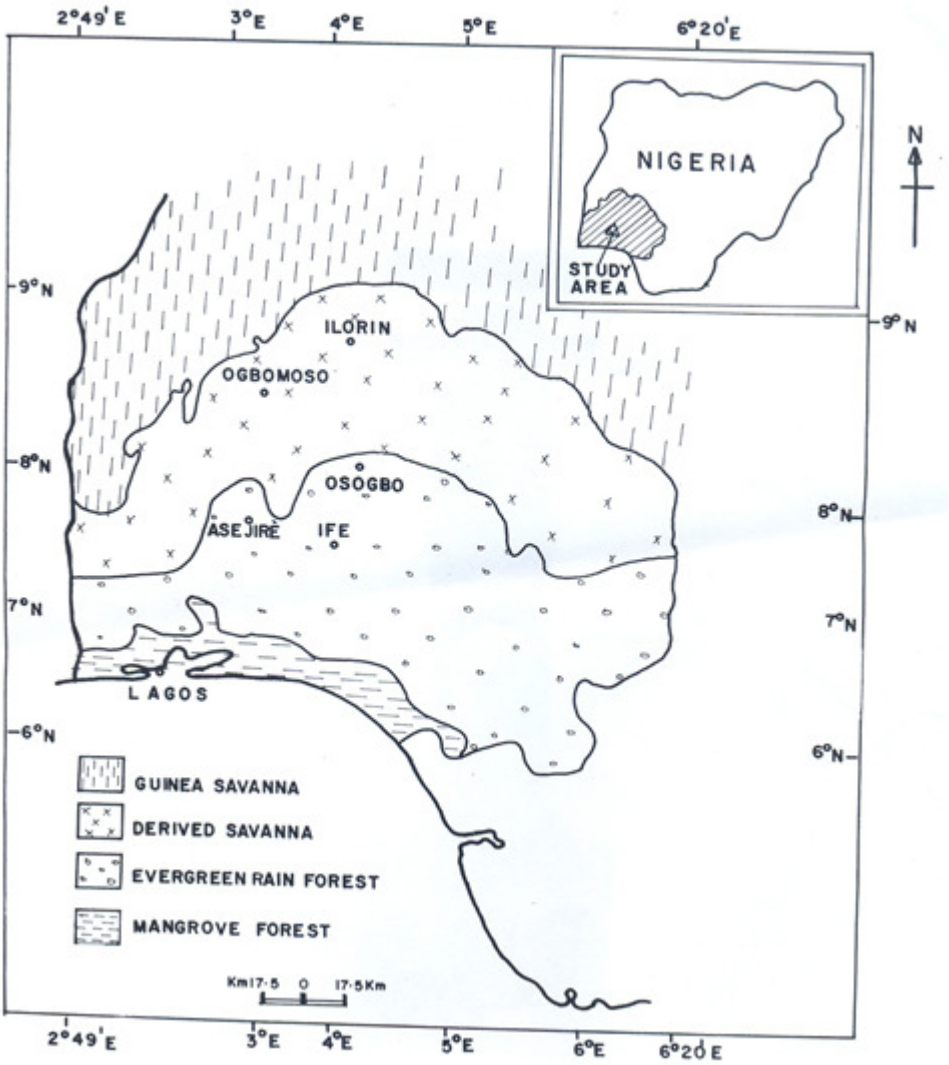

Figure 1. Different vegetational zones in the study area in Nigeria.

different types of ornamental plants were repeated. For example, Ile-Ife and Modakeke have similar ecological patterns, but different types of ornamental plants. The presence of Obafemi Awolowo University and its Teaching Hospital increased the number of the varieties of ornamental plants in Ile-Ife above that of Modakeke, despite the fact that they had similar ecological and vegetation pattern. The same thing was noticed in the varieties of ornamental plants in some towns within the study area and their immediate surrounding towns.

Field collection. Black sooty mould deposited on the upper leaf surfaces on the field is the first striking feature signalling the presence of whitefly to the collector (Plate 1). However, sooty mould can also be produced by aphids, scale insects and mealy bugs. In order to ascertain that the sooty mould produced was from whitefly, we had to look out for whiteflies dense populations on the undersides of the leaves of host plants (Plate 2). Sooty mould can also be found on fruits like citrus in southwestern Nigeria (Plate 3). Field survey of whiteflies was carried out between 2007

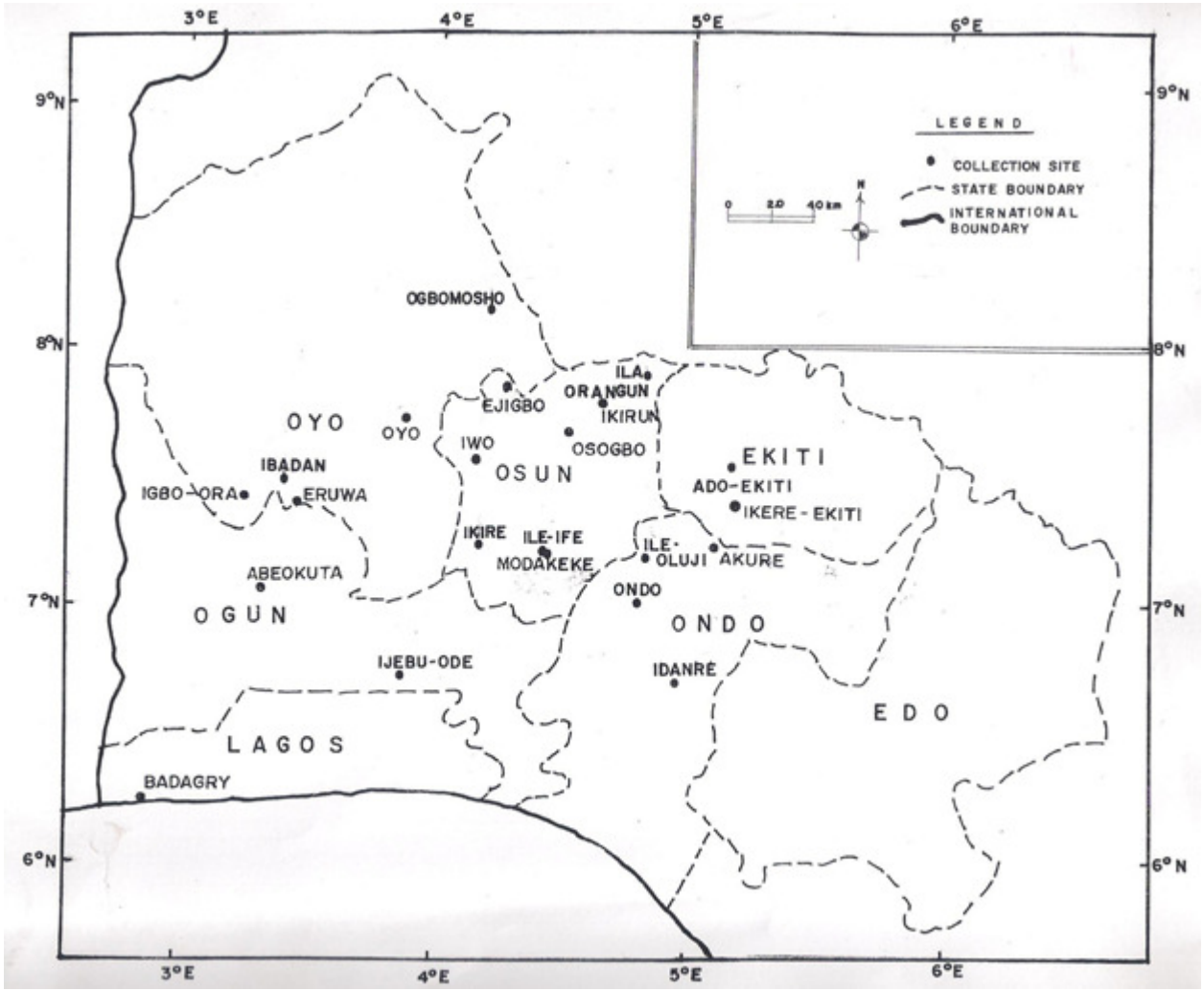

Figure 2. Map of study area showing localities where specimens were collected in this study.

Plate 1. Black sooty mould on *Citrus reticulata*.

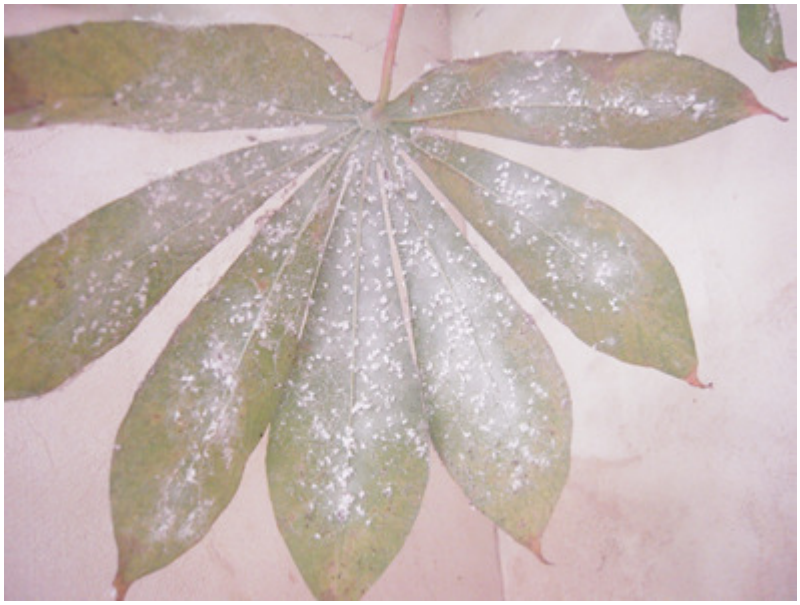

Plate 2. Dense population of whiteflies on the underside of *Manihot esculenta* leaf.

Plate 3. Black sooty mould of whiteflies covering fruits and leaves of *Citrus sinensis*.

and 2012 using visual search technique for adult insects and their various instars attached to the underside of leaves. The whole leaf with the puparia attached was detached and placed in an envelope and kept dry in the laboratory cabinet until required for preparation, or at times pieces of leaf with puparia attached were placed and stored in 95% ethanol prior to treatment. Collected specimens were identified using Martin (1987) and Hodges and Evans (2005) guides.

Data were analysed using Palaeontological statistics software package (PAST). Non-parametric t-test was carried out on the whitefly populations in the study area. Host plants were identified in the herbaria of the Forestry Research Institute of Nigeria, Ibadan; Natural History Museum and Botany Department of Obafemi Awolowo University, Ile-Ife, Nigeria.

RESULTS

Diversity and distribution. The occurrence of whiteflies in the three ecological zones is presented in Table 1. The Rainforest zone had the highest number of whitefly species, with 32 species belonging to Subfamily Aleyrodinae, and three species belonging to Subfamily Aleyrodicinae. *Aleurolobus niloticus* and *Siphoninus phillyreae* were not recorded in the zone. Eighteen whitefly species were present in the Derived savannah, indicating that whiteflies in this zone are less diverse compared with the Rainforest zone. Five were recorded in the Mangrove Forest. This zone had lower whitefly species diversity than the Rainforest and the Derived Savannah zone.

Figure 3 shows percentile distribution of Aleyrodinae in southwestern Nigeria. Four species were distributed within 24 percentiles. Sixteen species in Derived Savannah were distributed with 28 percentiles. Twenty nine species in Rainforest were distributed with 32 percentile in the region. Figure 4 shows the diversity of whitefly species in southwestern Nigeria. Rainforest has the highest diversity index (1), with a distribution range of 1. Derived Savannah had the highest distribution range of 2, with a diversity index of 0.5. Mangrove Forest had a diversity index of 0.1, and a distribution range of 1.1. The comparisons between Derived Savannah *versus* Mangrove and Rainforest *versus* Mangrove were significantly different ($P<0.05$). Only the comparison between Rainforest and Derived Savannah were not statistically different (Table 2).The result of paired comparison of Aleurodicinae using non-parametric t-test was presented in Table 3. The comparisons between derived savannah versus

TABLE1. Occurene of whiteflies in different ecological zones of southwestern Nigeria

Species of Aleyrodinae	Ecological zones		
	A	B	C
Acaudaleyrodes rachipora		X	X
Acaudaleyrodes tuberculata		X	X
Africaleurodes coffeacola		X	X
Africaleurodes loganiaceae		X	X
Aleurocanthus trispina		X	X
Aleurocanthus zizyphi		X	X
Aleurocanthus woglumi	X	X	X
Aleuroclava nigeriae		X	
Aleurocybotus indicus		X	
Aleurolobus niloticus			X
Aleuromarginatus tephrosiae		X	
Aleurothrixus floccosus		X	
Aleurotrachelus trachoides	X	X	X
Bemisia afer		X	X
Bemisia tabaci		X	X
Corbettia lonchocarpi		X	X
Dialeurodes citri		X	
Dialeurodes emarginata		X	X
Dialeurolonga africana		X	
Dialeurolonga hoyti		X	
Dialeurolonga lamtoensis		X	
Dialeuropora papillata		X	
Extensaleyrodes akureensis		X	
Neomaskellia bergii		X	X
Orstomaleyrodes fimbriae		X	X
Pealius ezeigwi		X	
Pealius fici		X	
Pogonaleyrodes zimmermanni		X	
Siphoninus phillyreae	X		X
Tetraleurodes andropogoni		X	
Trialeurodes ricini		X	
Sub total	3	29	16
Species of Aleurodicinae			
Aleurodicus cocois	X	X	
Aleurodicus dispersus	X	X	X
Metaleurodicus cardini			X
Paraleyrodes citri		X	
Sub total	2	3	2
Total	5	32	18

A= Mangrove Forest, B=Rainforest, C= Derived savannah

TABLE 2. Paired comparisons of Aleurodicinae in different Ecological zones of southwestern Nigeria

Paired comparisons	Derived savanah	Rainforest	Mangrove
Derived savanah	-	1.0	1.0
Rainforest	0.5	-	
Mangrove	0.56	1.0	-

TABLE 3. Paired comparisons of Aleyrodinae in different ecological zones of southwestern Nigeria

Paired comparisons	Derived savanah	Rainforest	Mangrove
Derived savanah	-	8.940	0.00024*
Rainforest	2.16	-	.0016*
Mangrove	0.00031*	0.0023*	-

* indicates probabilities that are significantly different (P<0.05)

mangrove and rainforest versus mangrove were significantly different (P<0.05). Only the comparison between rainforest and derived savannah were not statistically different (Table 3).

The occurrence of Aleyrodinae in southwestern Nigeria on 32 different families of plants is presented in Table 4. Euphorbiaceae and Fabaceae host the largest number of Aleyrodinae with twelve and thirteen species on them respectively. Amaranthacea, Araceae, Caricaceae, Dioscoreaceae, Loganiaceae, Papilionaceae, Piperaceae, Rosaceae, Rubiaceae, Tiliaceae and Zingiberaceae had the least number of Aleyrodinae recorded on them in the region. *Aleurocanthus woglumi* had the highest occurrence, and occurred on nineteen different plant familes in the region. *Acaudaleyrodes tuberculata, Africaleurodes loganiaceae, Aleurocybotus indicus, Aleuromarginatus tephrosiae, Corbettia lonchocarpi* and *Neomaskellia bergii* had the lowest occurrence as they occurred on only one plant family.

Table 5 shows the occurrence of southwestern Nigerian Aleurodicinae on thirty seven different

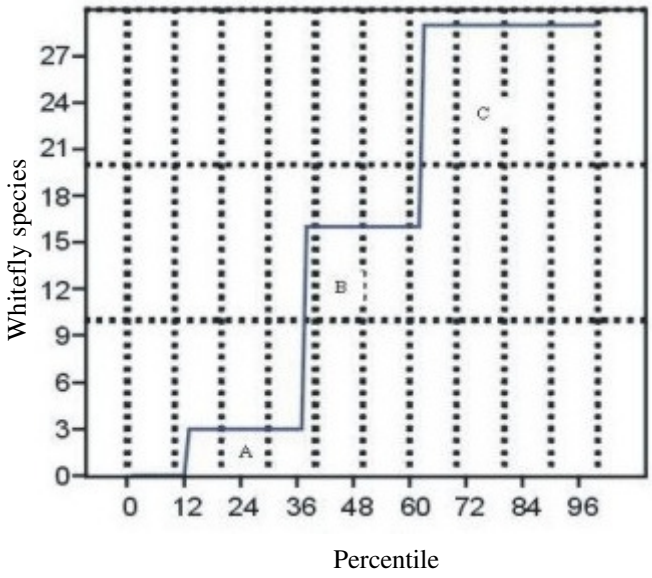

Figure 3. Percentile Distribution of Aleyrodinae species in southwestern Nigeria. A = Mangrove Forest, B = Derived savannah, C = Rainforest

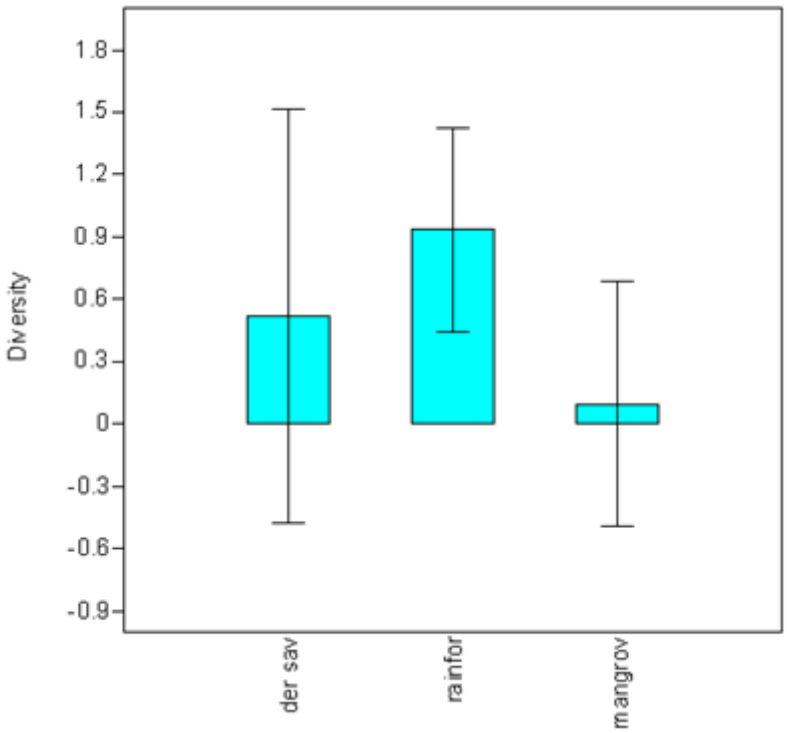

Figure 4. Diversity of Whitefly Species in southwestern Nigeria. rainfor = Rainforest, der sav = Derived savannah, mangrov = Mangrove forest

TABLE 4. Occurence of Aleyrodinae on host plants in southwestern Nigeria

Species of plant families	2	3	4	5	6	7	9	13	14	15	18	19	20	24	26	27	29
Acaudaleyrodes rachipora									X			X	X				X
Acaudaleyrodes tuberculata													X				
Africaleurodes coffeacola			X						X			X					
Africaleurodes loganiaceae																	
Aleurocanthus trispina									X							X	
Aleurocanthus zizyphi									X			X	X				X
Aleurocanthus woglumi		X	X	X		X		X	X			X	X		X	X	X
Aleuroclava nigeriae							X					X					
Aleurocybotus indicus																	
Aleurolobus niloticus	X			X													
Aleuromarginatus tephrosiae													X				
Aleurothrixus floccosus		X													X		
Aleurotrachelus trachoides					X					X	X				X		
Bemisia afer			X									X	X		X		
Bemisia tabaci				X								X	X		X		
Corbettia lonchocarpi																	
Dialeurodes citri													X				
Dialeurodes emarginata														X			
Dialeurolonga africana															X		X
Dialeurolonga hoyti												X					
Dialeurolonga lamtoensis												X					X
Dialeuropora papillata						X						X	X				
Extensaleyrodes akureensis																	
Neomaskellia bergii																	
Orstomaleyrodes fimbriae							X		X				X				
Pealius ezeigwi												X					
Pealius fici																	X
Pogonaleyrodes zimmermanni																	
Siphoninus phillyreae						X							X				

TABLE 4. Contd.

Tetraleurodes andropogoni						X							X				
Trialeurodes ricini			X							X		X	X		X		
Total	1	2	4	3	1	4	2	1	6	2	1	12	13	1	7	2	6
	30	31	33	34	35	36	37	38	39	40	41	42	43	44	45		
Acaudaleyrodes rachipora		X							X					X			
Acaudaleyrodes tuberculata																	
Africaleurodes coffeacola								X			X						
Africaleurodes loganiaceae											X						
Aleurocanthus trispina																	
Aleurocanthus zizyphi		X					X										
Aleurocanthus woglumi	X	X				X		X	X	X	X		X				
Aleuroclava nigeriae		X															
Aleurocybotus indicus					X												
Aleurolobus niloticus																	
Aleuromarginatus tephrosiae																	
Aleurothrixus floccosus	X	X							X								
Aleurotrachelus trachoides		X								X	X			X			
Bemisia afer																	
Bemisia tabaci										X							
Corbettia lonchocarpi			X														
Dialeurodes citri								X	X								
Dialeurodes emarginata											X						
Dialeurolonga africana																	
Dialeurolonga hoyti								X									
Dialeurolonga lamtoensis																	
Dialeuropora papillata		X									X				X		
Extensaleyrodes akureensis																	
Neomaskellia bergii					X												
Orstomaleyrodes fimbriae													X				
Pealius ezeigwi											X						

TABLE 4. Contd.

Pealius fici															
Pogonaleyrodes zimmermanni								X							
Siphoninus phillyreae		X							X				X		
Tetraleurodes andropogoni					X										
Trialeurodes ricini		X		X								X			
Total	2	9	1	1	2	1	1	5	5	3	7	1	3	2	1

1=Acanthaceae 2=Amaranthaceae 3=Anacardiaceae 4=Annonaceae 5=Apocynaceae 6=Araceae 7=Arecaceae 8=Begnoniaceae
9=Bignoniaceae 10=Bombacaceae 11=Burseraceae 12=Caesalpiniaceae 13=Caricaceae 14=Combretaceae 15=Convolvulaceae 16=Compositae
17=Cucurbitaceae 18=Dioscoreaceae 19=Euphorbiaceae 20=Fabaceae 21=Labiatae 22=Liliaceae 23=Lobeliaceae 24=Loganiaceae
25=Magnoliaceae 26=Malvaceae 27=Meliaceae 28=Mimosaceae 29=Moraceae 30=Musaceae 31=Myrtaceae 32=Orchidaceae
33=Papilionaceae 34=Piperaceae 35=Poaceae 36=Punicaceae 37=Rosaceae 38=Rubiaceae 39=Rutaceae 40=Solanaceae
41=Sterculiaceae 42=Tiliaceae 43=Ulmaceae 44=Verbenaceae 45=Zingiberacea

plant families. Myrtaceae hosted the largest number of Aleurodicinae with three whitefly species occurring on it. Plant families Anarcadiaceae, Annonaceae, Apocynaceae, Arecaceae, Euphorbiaceae, Mimosaceae, Rutaceae, Solanaceae, and Sterculiaceae, each hosted two whitefly species in the region. *Aleurodicus dispersus* had highest occurrence, and occurred on thirty seven different plant familes in the region. *Paraleyrodes citri* had the lowest occurrence as it occurred on only one plant family.

DISCUSSION

The division of whiteflies into two different subfamilies (Aleyrodinae and Aleyrodicinae) was in accord with the findings of previous workers (Quaintance and Baker, 1913, Mound and Halsey, 1978; Martin, 1987). Out of a total of 32 species recorded in the Rainforest, 29 belonged to subfamily Aleyrodinae and three to subfamily Aleurodicinae. Eighteen whitefly species were present in the Derived savannah, indicating that this zone was less diverse compared with the Rainforest.

Three species in subfamily Aleyrodinae, *Aleurocanthus woglumi, Aleurotrachelus trachoides* and *Siphonninus phllyreae* were recorded in the Mangrove forest. Rainforest and Derived savannah zones were characterised by high species number; while Mangrove forest had a low number.

High temperature and nutritional quality of host plants in the Rainforest and Derived savannah may have contributed to the success of the pest in the zones (Tibor *et al.,* 2009). For instance, Byrne and Devonshire (1991) opined that agronomic practices and climatic factors contribute significantly to the occurrence of whiteflies as a major pest. In many other studies, high temperatures up to a maximum of 33 °C have been reported to favour whiteflies development (Butler *et al*., 1983; Powell and Bellows, 1992; Fishpool and Burban, 1994). However, high temperatures alone could not have caused the increase in whitefly population in the Rainforest and Derived savannah zones; a synergetic effect of high temperatures and rainfall may be responsible. This is in agreement with the work

TABLE 5. Occurence of Aleurodicinae on host plants in southwestern Nigeria

Aleurodicinae species	Plant families																			
Aleurodicinae species	1	2	3	4	5	6	7	8	10	11	12	13	14	16	15	17	18	19	21	22
Aleurodicus cocois			X	X			X											X		
Aleurodicus dispersus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metaleurodicus cardini					X															
Paraleyrodes citri																				
Total	1	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1

Aleurodicinae species	23	25	26	27	28	29	30	31	32	33	35	38	39	40	41	42	44
Aleurodicus cocois					X			X						X	X		
Aleurodicus disperses	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metaleurodicus cardini								X									
Paraleyrodes citri													X				
Total	1	1	1	1	2	1	1	3	1	1	1	1	2	2	2	1	1

1= Acanthaceae 2= Amaranthaceae 3= Anacardiaceae 4= Annonaceae 5= Apocynaceae 6= Araceae 7=Arecaceae 8= Begnoniaceae
9= Bignoniaceae 10= Bombacaceae 11= Burseraceae 12= Caesalpiniaceae 13= Caricaceae 14= Combretaceae 15= Convolvulaceae 16= Compositae
17= Cucurbitaceae 18= Dioscoreaceae 19= Euphorbiaceae 20= Fabaceae 21= Labiatae 22= Liliaceae 23= Lobeliaceae 24= Loganiaceae
25= Magnoliaceae 26= Malvaceae 27= Meliaceae 28= Mimosaceae 29= Moraceae 30= Musaceae 31= Myrtaceae 32= Orchidaceae
33= Papilionaceae 34= Piperaceae 35= Poaceae 36= Punicaceae 37= Rosaceae 38= Rubiaceae 39= Rutaceae 40= Solanaceae
41= Sterculiaceae 42= Tiliaceae 43= Ulmaceae 44= Verbenaceae 45= Zingiberacea

of Leuschner (1978) and Dengel (1981) that recorded high population of whiteflies during high rainfall months in Togo, and they associated their observations with the flush of new leaves. The population of whiteflies was observed to increase during early and late rainfall season, and declined drastically as sporadic rainfall washed off the eggs and nymphs from the host leaves in between the early and late rainfall when the wetness is at optimum, and this is in accord with Banjo *et al*. (2004). The host plants with ability to produce auxiliary growth provided young leaves for the insects and, hence, caused a rise in population of whiteflies in the rainforest and derived savannah of the region.

The Rainforest has the highest diversity index of 1 with distribution range that is, relatively lower than the distribution range found in Derived savannah. Higher temperature and vegetation type in Derived savannah zone favours wide dispersal of Aleyrodidae (Sidney, 1946; Tibor *et al*., 2009). This zone is characterised by forest and grasses.

Leaf age may be a factor responsible for the wide distribution range of whiteflies in the Derived savannah. Most plants in this zone are not perennial like in the rainforest, they die out easily, especially in dry season and new ones emerge in the following wet season. This observation is supported by the works of Hussey and Gurney (1959) and Southwood and Reader (1976) who noticed decline in egg production with leaf age in many whitefly species. Fecundity is known to increase with leaf age (Lindsay and John, 2006). Savannah.

Plant varieties in the Mangrove were different from those of the other zones since they are resistant to whitefly attack. Resistant varieties of crop plants provide protection and insurance against insect damage.

Human activities in the Rainforest and Derived savannah zones could also contribute to the widespread of whiteflies in the region. The spread of some whiteflies species like *Aleurodicus dispersus* is connected with human activity and the risk of spread increases with frequency of movement (Asiwe *et al.*, 2002). Banjo (2010) pointed out that the spread of whiteflies was connected with human traffics.

Human activities, rainfall, high temperature and flush of new leaves are likely to account for the high percentage of whiteflies observed in Derived savannah and Rainforest zones. Rainforest had a diversity index of 1, with a distribution range of 1; whereas the Derived savannah had a diversity index of 0.5, with distribution range of 2; and the Mangrove forest zone had a diversity index of 0.1 with distribution range of 1. More than other factors, rainfall and temperature play a prominent role on the abundance and seasonal fluctuation of whitefly species and, in fact, regulating their population. Higher temperature in Derived savannah was accountable for its wide range, but less rainfall in this same zone is responsible for the fall in the diversity index compared with the Rainforest.

Bemisia has been regarded as a morphologically variable genus, with an exceptionally wide range of host plants, following the demonstration of the phenomenon of puparial plasticity by Mound (1963). This accounted for wide distribution of *B. tabaci* in southwestern Nigeria as observed in Table 1.

Bemisia tabaci is polyphagous and was recorded as pest of both crops and ornamental plants. This was in accordance with the findings of Mound (1963) that populations of *B. tabaci* move from one host to another and, thus generate host-induced morphological variation. Several such population biotypes have been recognised for some years. This prompted De Barro *et al.* (2005) to declare *B. argentifolii* to be a race of *B. tabaci* and, thus, its junior synonym. *Bemisia afer* have a great variation in shape, setae, dorsal and ventral structure. The caudal setae of specimens from southwestern Nigeria are as long as the caudal setae of *B. tabaci* and there is a variation within species on different hosts.

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