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Occurence and species diversity of kola weevils across different ecological zones of Southwestern Nigeria

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ABSTRACT

Kola weevil species were surveyed in different ecological zones of South-western Nigeria and the adult kola weevils together with their progenies were monitored and assessed in the laboratory at ambient temperature of 27±2^{0}C and relative humidity of 70±5% using Completely Randomised Design in four replicates. The fresh nuts were allowed to dry on a wire mesh before they were wrapped in plantain leaves prior to storage in baskets. Data were collected on damage characteristics at 30 days interval. The result showed that Balanogastris kolae were significantly higher in mean number of exit holes (71.37), weight of frass (10.13) and nut damage (80.14) compared to Sophrorhinus spp. The higher number of B. kolae (63.54) observed relatively to few Sophrorhinus spp indicates abundance of B. kolae in Nigeria. These insect pests are implicated as field-to-store pests and are widely distributed across the kola growing belt of Southern Nigeria.

Keywords: Survey; Kola weevils; *Sophrorhinus* spp; *Balanogastris kolae;* Damage characteristics

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INTRODUCTION

Cola acuminata and *Cola nitida* (Schott & Endlicher) are the only edible species of kola grown on commercial scale in Nigeria [4]. The cotyledons of the nuts are red, pink or white in colour, which are often observed amongst nuts extracted from the same pod. The colour of the nuts in addition to other parameters such as size, flavour and storage quality determine the quality and price of nuts offerred for sale in the market.

C. acuminata and *C. nitida* are important economic crops in the forest areas of West and Central Africa [3,10]. The cultivation of kola in Nigeria is ecologically limited to the rain forest zones of the South and riverine areas of the Savannah region. The cultivation of *C. nitida* in Nigeria began sometime in the 19th century. The "goro nut" was observed to be "growing plentifully in the Otta bush" by 1854 while its cultivation was noted in Egba Division in 1902 and in Labochi and environs in 1901. From Agege, *C. nitida* cultivation presumably spread to the forest areas following, firstly, the course of the railway line into Abeokuta, Ibadan and Offa, replacing the local *C. acuminata* and penetrating, later, along streams and river banks into the Guinea Savannah and present South South and Eastern States [3]. Unfortunately, kola still remains the only indigenous African cash crop that has not attracted international sympathy. It is sometimes referred to as an "orphan crop" as most countries outside Africa and even Africans to an extent shy away from its production and improvement.

The problems posed by storage pests of kola, most especially the kola weevils (*Balanogastris kolae* and *Sophrorhinus* spp) are of immediate importance to the little production often achieved by kola farmers. Generally, it is the most serious post-harvest problem of kola nuts, which farmers and kola traders seek to solve. The kola weevils, identified as field-to-store pests of kola are capable of causing between 30-70% damage on the stored nuts,

while 100% damage has been recorded in cases of late harvest and in storage [5]. Several workers reported the losses recorded in the case of kola nuts picked from the floor of the plantations after they have dropped in Guinea, Ivory coast and Nigeria [1,5]. The recorded species are; *S. duvenoyi* Rouzet, *S. insperatus* Faust, *S. kolae* Haustache, *S. pujoli* Hoffman, *S. divareti* Hoffman, *S. schedli* Voss and *S. gbanjaensis* (sp. nov.). Genetic variations may result into development of resistance against the commonly used insecticides. Therefore, this study was carried out to determine the weevil pest species diversity and abundance of kola nut weevils in kola growing zones of Southwestern, Nigeria. This study was also designed to assess the damage characteristics of these very important pests of kola (*Balanogastris kolae* and *Sophrorhinus* spp) under the ambient conditions, which could be of help in formulating standard integrated packages for their control.

MATERIALS AND METHODS

Samples of mature or fallen kola pods (*Cola nitida*) without visible blemish were procured from farmers from locations in each local government area of different states across the Southwestern geo-political zones of Nigeria. The pods were carefully cut to extract the fresh kola nuts. The seed coat or testa of the nuts from each pod was removed by soaking the nuts in water for 24 hours to enhance rottening, after which the nuts were skinned and rinsed in fresh water. The soaking and washing was done separately for each location. The rinsed nuts were collected separately in flat baskets through which excess water drained off before they were cured in the laboratory (temperature 28$\pm$ 3^0C and relative humidity 75+ 5% respectively) for a period of 72 hours, during which considerable "sweating" that reduces the moisture content of the nuts took place. The fresh nuts were further allowed to dry on a wire mesh before they were wrapped in plantain leaves prior to storage in baskets.The experiment was laid out in a Completely Randomised Design using four replicates. The total emergents of larvae were counted at 14 days interval for twelve weeks. Consequently, the kola nuts were separated into different baskets to facilitate individual count of the insects and other parameters taken. After 3 months of storage, the kola nuts in each basket were observed carefully to assess the following parameters at 30 days interval: Total number of *Balanogastris kolae*, total number of *Sophrorhinus* spp, total number of adult exit holes per treatment for each of the weevil, weight of frass for each of the weevil per treatment and nut damage for each of the weevil per treatment. The resulting data were subjected to the analysis of variance and significant means were separated at 5% level using the Tukey's Honest Significance Difference (HSD).

RESULTS AND DISCUSSION

Table 1 Different locatons where random samples of kola pods and nuts were procured

S/N	STATE	L. G. A	LOCATION (TOWNS)
1	Ondo	Ifedore North-East	Owena
2	Ondo	Akoko South West	Okemoro
3	Ondo	Akoko South West	Oka Akoko
4	Ondo	Akoko South West	Akungba Akoko
5	Ondo	Idanre North East	Idanre
6	Ondo	Ile-Oluji Oke-Igbo	Bamikemo
7	Osun	Ife South	Orefidiya (Idi-obi)
8	Osun	Ife South	Ologiri
9	Osun	Odo Otin	Okuku
10	Osun	Atakumosa East	Ikoro maja
11	Ogun	Obafemi Owode	Ogunmakin
12	Ogun	Sagamu	Ode lemo
13	Oyo	Oluyole	Ibadan (CRIN HQ, Idi-Ayunre)

Table 1 shows the locations of purchase of samples of of a pre-processed kola pods and nuts across the Southwestern of Nigeria. More locations were visited in Ondo State (6), followed closely by Osun state (4), two locations in Ogun States while only one location was visited in Oyo State. Ondo state is amongst the leading kola producing states in Nigeria. [10] reported that *Cola* spp. are important economic crops in the forest areas of West and Central Africa. These States are the kola belts known for growing of kola in different ecological zones of Southwestern, Nigeria. *Balanogastris kolae* and *Sophrorhinus* spp have a wide geographical distribution in the kola belt and in fact all kola trees in Africa are believed to be infested [1,10]. This is in tandem with the species diversity and abundance of insect pests associated with *C. nitida* surveyed in different States of Southwestern, Nigeria. Generally, weevils at varying stages of development were encountered in all the nuts in the pods collected from the various States. It was observed that locations in each local government area of different States had a fresh nut weevil infestation.

Table 2	Incidence of developmental stages of kola weevils at various locations			
	Balanogastris kolae		***Sophrorhinus* spp**	
Locations	No. of larvae	No. of adult	No. of larvae	No. of adult
Bamikemo	60.20a	80.20a	0.50d	20.50^{d}
Ibadan CRIN- HQ	58.38^{a}	78.38^{a}	0.75^{cd}	20.75^{cd}
Ogunmakin	58.08^{a}	78.08^{a}	4.25^{abc}	24.25^{abc}
Okuku	57.90^{a}	77.90^{a}	4.00^{abcd}	24.00^{abcd}
Okemoro	56.75^{a}	76.75^{a}	2.50^{abcd}	22.50^{abcd}
Ikoro maja	43.90^{b}	63.90^{b}	2.50^{abcd}	23.50^{abcd}
Ologiri	43.90^{b}	63.90^{b}	3.50^{abcd}	22.50^{abcd}
Orefidiya	23.90^{c}	43.90^{c}	1.75^{bcd}	21.75^{bcd}
Ode lemo	16.40^{c}	36.40^{c}	1.25^{bcd}	21.25^{bcd}
Owena	16.40^{c}	36.40^{c}	4.75^{ab}	24.75^{ab}
Oka Akoko	16.40^{c}	36.40^{c}	6.00^{a}	20.50^{d}
Akungba- Akoko	16.00^{c}	36.00^{c}	1.35^{bcd}	21.00^{bcd}
Idanre	16.00^{c}	36.00^{c}	0.50^{d}	26.00^{a}
Total	484.21	744.21	33.6	293.25
Mean	37.25	57.25	2.59	22.56

Means followed by the same letter in each column are not significantly different (P>0.05) according to Tukey Honest Test

Table 3	Damage characteristics of kola weevils					
	Balanogastris kolae			***Sophrorhinus* spp.**		
Locations	No. of nut damage	No. of exit holes	Wt of frass(g)	No. of nut damage	No. of exit holes	Wt of frass (g)
Bamkemo	72.50^{ab}	76.00^{a}	16.75^{abc}	29.75^{ab}	36.00^{a}	2.00^{ab}
Ogunmakin	72.50^{ab}	81.75^{a}	20.50^{ab}	32.50^{ab}	37.75^{a}	3.00^{a}
Ibadan HQ	81.88^{a}	77.75^{a}	21.75^{a}	32.50^{ab}	41.75^{a}	2.00^{ab}
Okuku	69.75^{ab}	74.25^{a}	15.25^{bc}	29.75^{ab}	34.25^{a}	2.00^{ab}
Okemoro	69.75^{ab}	73.50^{a}	14.00^{c}	41.88^{a}	33.50^{a}	2.00^{ab}
Ikoro maja	65.00^{ab}	55.70^{b}	1.45^{d}	25.00^{ab}	15.70^{b}	0.50^{b}
Ologiri	65.00^{ab}	48.00^{b}	2.65^{d}	25.00^{ab}	15.70^{b}	1.00^{ab}
Orefidiya	65.00^{ab}	45.75^{b}	2.65^{d}	25.00^{ab}	8.00^{b}	1.00^{ab}
Akungba	65.00^{ab}	45.25^{b}	3.00^{d}	23.50^{ab}	5.25^{b}	0.25^{b}
Ode lemo	62.50^{ab}	45.25^{b}	3.98^{d}	22.50^{ab}	5.75^{b}	0.50^{b}
Owena	62.50^{ab}	45.25^{b}	0.90^{d}	22.50^{ab}	5.25^{b}	0.25^{b}
Oka Akoko	53.75^{b}	45.25^{b}	0.73^{d}	21.25^{b}	5.25^{b}	0.25^{b}
Idanre	61.25^{b}	45.25^{b}	0.73^{d}	13.75^{b}	5.25^{b}	0.25^{b}
Total	866.38	758.95	104.34	344.88	249.4	15
Mean	66.65	58.38	8.03	26.53	19.19	1.15

Means followed by the same letter in each column are not significantly different (P>0.05) according to Honest Tukey Test

The kola weevils have been identified as the most destructive insect pest of kola nuts in West Africa [5,9]. Their mouth parts are adapted for piercing and puncturing the kola nuts to obtain food and for making ovipositional holes, thus resulting in considerable economic damage to the kola nuts [2]. This is the fall-out of the post-storage assessment of nuts selected from the kola pods collected from different locations across the kola belts of Nigeria. Significantly higher number of larvae (60.20^{a}) was encountered from kola nuts collected in Bamikemo compared with other locations. The lowest were recorded in Idanre (16.00^{c}). Similarly, highest number of adult *B. kolae* were recorded in the same location (Bamikemo)(80.20^{a}) and the least in Idanre (36.00^{c}). This might be attributed to difference in climate, landscape or topography of the areas. The results also corroborated previous observation made by [1] that the geographical distribution of some of the weevils is widespread and all the kola trees in Africa are believed to be infested. A significant infestation of 70% and in some cases of late harvest, 100% damage has been reported in Cote D'Ivoire, Guinea and Nigeria [5,7]. However, the highest number of *Sophrorhinus* spp larvae (6.00^{a}) was recorded in kola nut collected in Oka-Akoko relative to other locations whereas the least was recorded in Bamikemo and Idanre, though the slight similarity in the topography of Oka Akoko and Idanre locations had no bearing on the results. Likewise, higher number of adult *Sophrorhinus* spp was recorded in kola nuts (26.00^{a}) collected from Idanre compared with other locations. Kola nuts collected from Oka Akoko and Bamikemo recorded the least (20.50^{a}) adult *Sophrorhinus* spp (Table 2).

This explains a relatively few *Sophrorhinus* spp compared to abundance *B. kolae* in kola growing belt of Nigeria. The very low infestation level of adult *Sophrorhinus* spp might have been responsible for the corresponding low weevil emergence from the procured cured nuts. There were competitive interactions for food and space among the insect species populations associated with *C. nitida* from all the States. From the result, it was observed that after 3 months of storage, kola weevils resulting in an infestation level of 100%, infested all the nuts selected from the kola

pods. Apparently, adult weevils had laid eggs on the nuts selected from the kola pods in the field and within the 3 months storage period, two generations of the weevils were produced. Breeding was noted to continue throughout the year on left-over nuts and nuts produced between the main harvest seasons [6,11].

Table 3 showed that samples collected from Ibadan CRIN, Headquarters (HQ) (81.88^{a}) recorded significantly higher number of damaged kola nuts compared to other locations. While the least was recorded in Oka Akoko (53.75^{b}). The highest number of perforated nuts was recorded in samples collected from Ogunmakin (81.75^{b}) relative to other locations, whereas locations that recorded the lowest number of exit holes (45.25^{b}) included Idanre, Owena and Oka Akoko. The female laid its eggs 1 cm deep in the nuts or in the pods of the fruit through wounds and holes made by other insects such as *Ceratitis colae* Silv. or through cracks on the husk created when the follicles dehisce before harvest. Similarly, Ibadan CRIN HQ had significantly higher weight of frass from damaged nuts (21.73^{a}) in relation to other locations while Idanre and Owena (0.73^{d}) recorded the least frass. This is because incubation lasted for about 4-6days, larval stage takes 17-20 days and the larva feeds extensively reducing the kola to a brown powdery mass. The larvae feed inside the nut leaving tunnels filled with frass. Again, Okemoro recorded significantly higher number of damaged nuts by *Sophrorhinus* spp compared to other locations, while the samples collected from Idanre (13.75^{b}) was the least. Adult weevils also feed on the nuts. The damages caused destroy the nuts thereby lowering their market value [11]. Circular holes are made in the nuts by emerging adults. The number of exit holes in the samples collected from Ibadan CRIN HQ was the highest (41.75^{a}) relative to other locations with the least exit holes recorded in the samples collected from Oka Akoko (5.25^{b}). The total amount of frass recorded in the samples collected from Ogunmakin (3.00^{a}) was significantly higher than what obtained in other locations. Whereas the lowest quantity was obtained in the samples collected from Oka Akoko (0.25^{b}). There were competitive interactions for food and space among all the kola weevils populations associated with *C. nitida*. According to [8], the havoc caused by this insect pest approximately claims 60% of the total kola nut production in Nigeria. This therefore accounted for the relatively high number of adult *B. kolae* and exit holes recorded after the storage period. The evidence of the post storage assessment of nuts selected from the kola pods collected from different locations across the kola belts of Nigeria.

CONCLUSION

From the foregoing, it is evident that kola weevils especially *B. Kola* are widely distributed across the kola growing belt of Nigeria to varying degrees and such infestation normally starts on the field. Thus, they are classified as "field-to-store-pest" as their infestation is initiated in the field and persists in storage [7]. The higher mean number of *B. kolae* observed when compared to the relatively few *Sophrorhinus* spp indicates an abundance of *B. kolae* in Nigeria. The very low infestation level of adult *Sophrorhinus* spp and corresponding low weevil emergence from the procured cured nuts goes further to confirm the low fecundity of the insect pest. Meanwhile, there were varying degrees of exit holes found on the nuts collected, indicating direct emergence of adult weevils from the nuts across all the States. However, farmers have resorted to the use of chemical control to drastically reduce the menace of weevil infestation in stored kola nuts, as untreated nuts deteriorate within 3 to 4 weeks. Unfortunately this act is dangerous to consumers, as kola nut does not undergo any other further processing before consumption.

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