Agricultural Journal 3 (4): 258-262, 2008
ISSN: 1816-9155

Occurrence of Storage Pests of Kolanuts Across the Kola Growing Belt of Nigeria

E.U. Asogwa, T.C.N. Ndubuaku and I.U. Mokwunye
Kola Research Programme, Cocoa Research Institute of Nigeria, Ibadan, Nigeria

Abstract: Studies were carried out on the distribution and frequency of occurrence of kola weevils *Balanogastris kolae* and *Sophorhinus* sp. across the kola belts of Nigeria. Kola pods and cured kolanuts were randomly sampled from 3 States and assessed using parameters such as percentage of nut infestation, mean number of emerged larvae and adult weevils per treatment, mean number of weevil exit holes on the nuts and mean number of nuts with colour changes. Generally, it was observed that the weevil distribution cuts across all the States where kola is produced, but at different levels of infestation. The mean numbers of weevils (both *Balanogastris kolae* and *Sophorhinus* sp.) sampled at the various locations were not significantly different ($p>0.05$), however, *Balanogastris kolae* were significantly ($p<0.05$) more abundant than *Sophorhinus* sp. A weevil infestation level of 100% was recorded after 3 months of storage of nuts selected from kola pods from the different zones as compared to the highest infestation level of 21.7% recorded for procured cured nuts. The low infestation level on cured kolanuts further confirms the fact that kola farmers and vendors still subject the nuts to chemical treatment for the control of kola weevils. There is therefore, an urgent need for an alternative means of protecting kolanuts from the weevils to be proffered and transferred to kola farmers and merchants.

Key words: *Cola acuminata*, *Cola nitida*, *Balanogastris kolae*, *Sophorhinus* sp., treatments, exit holes

INTRODUCTION

Cola acuminata and *Cola nitida* (Schott and Endl) are the only edible species of kola grown on commercial scale in Nigeria (Jacob, 1973). 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 determines the quality and price of nuts offered for sale in the market.

Cola acuminata and *Cola nitida* are important economic crops in the forest areas of West and Central Africa (Eijnatten, 1969; Oladokun, 1982). 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 (*C. nitida*) 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, first, 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 (Eijnatten, 1969).

The problems posed by storage pest of kola, most especially the kola weevils (*Balanogastris kolae* and *Sophorhinus* sp.) are of immediate importance to the little production often achieved by kola farmers. Generally, it is the most serious post-harvest problem of kolanut, 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 have been recorded in cases of late harvest and in storage (Daramola, 1973). 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.

This study was therefore designed to reassess the distribution and frequency of occurrence of these very important pests of kola (*Balanogastris kolae* and *Sophorhinus* sp.) within the kola producing belts of Nigeria with a view of formulating standard integrated packages for their control.

MATERIALS AND METHODS

Collection of kola pods: Random samples of matured or fallen kola pods (*Cola nitida*) were procured from kola

Corresponding Author: E.U. Asogwa, Kola Research Programme, Cocoa Research Institute of Nigeria, Ibadan, Nigeria

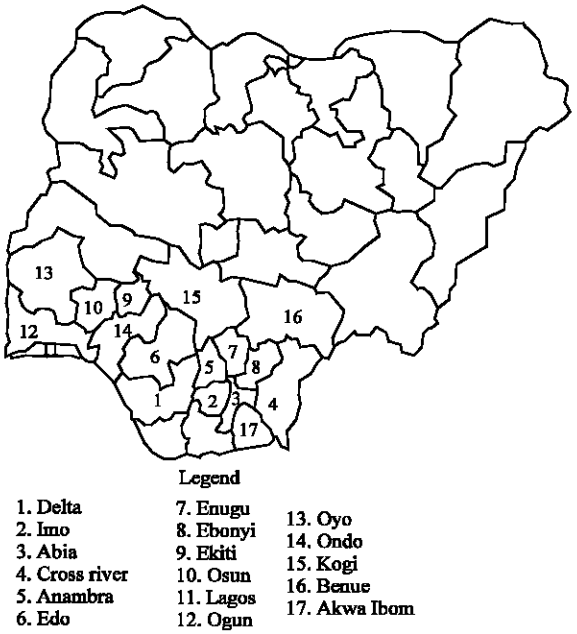

Fig. 1: Map showing the distribution of kola production in Nigeria

Table 1: Various locations from where the kolanut pods and nuts were procured from

State	Location (Towns)*
Abia	Ariam and Ndioro
Akwa-Ibom	Ikot-ekpene and Ikot-inang
Anambra	Onitsha and Awka
Benue	Otukpo and Gboko
Cross-River	Ajassor and Ogoja
Delta	Umunede and Agbor
Ebonyi	Nkalagu and Abakaliki
Edo	Uhumora and Ohosu
Ekiti	Ikare and Ado
Enugu	Obollo-Afor and Ogbede
Imo	Emekuku and Amusari
Kogi	Okene and Ejule
Lagos	Epe and Ikorodu
Ogun	Ogumakin and Mamu
Ondo	Ile-Oluji and Ala
Osun	Iwo and Oshogbo
Oyo	Idi-Ayunre and Moniya

*Random samples of kola pods and nuts were procured from 5 different kola farmers or vendors in each location

farmers across the kola belt, which cuts across the States in South West, South East, South South and North Central geopolitical zones of Nigeria (Fig. 1 and Table 1). A total of 10 pods were procured from two locations within each state.

Collection of kola nuts: Random samples of 60 cured kolanuts (*Cola nitida*) without blemish were procured from kolanut retail vendors from 2 locations in each State across the kola belt of Nigeria (Fig. 1 and Table 1).

Pre-processing assessment of the pods: The pods were carefully cut to extract the fresh kolanuts. Each of the ten pods served as a replicate and were subsequently subjected to the following assessments:

- Total number of nuts in each pods.
- Total number of nuts with their cotyledons infested with weevils.
- Total number of larvae per pod.
- Total number of adult weevils per pod.
- Total number of weevil exit holes on the nuts per pod.

Primary processing of the extracted nuts: The seed coat or testa of the nuts from each pod was removed by soaking the nuts in water for 24 h to enhance rottening, after which the nuts were skinned and rinsed in fresh water. The soaking and washing was done differently for each pod. The rinsed nuts were collected differently in flat baskets through which excess water drained off before they were cured in the laboratory (temperature 28±3°C and relative humidity 75±5%, respectively) for a period of 72 h, during which considerable sweating that reduces the moisture content of the nuts takes place.

Storage of the processed fresh nuts: Random sample of 6 nuts were selected from each processed kola pod and stored differently in black light gauge polythene bags of dimension 42.5×21.0 cm for 3 months, under laboratory conditions of temperature and relative humidity 28±3°C and 75±5%, respectively. A space of 20 cm was maintained between replicates.

Storage of the procured cured nuts: The procured cured nuts from each State were stored in ten replicates of 6 nuts per polythene bag for the same duration, under laboratory conditions of temperature and relative humidity 28±3°C and 75±5%, respectively. A space of 20 cm was maintained between replicates.

Post storage assessment of the nuts: After 3 months of storage, the kolanuts in each poly-bag were observed carefully to access the following parameters:

- Total number of nuts with sign of weevil infestation.
- Total number of larvae per treatment.
- Total number of adult weevils per treatment.
- Total number of weevil exit holes per treatment.

Data analysis: The resulting data were subjected to the analysis of variance and significant means were separated at 5% level using the Tukey's Honestly Significance Difference (HSD).

RESULTS

Table 2 shows the result of a pre-processing assessment of kola pods collected from different locations across the kola belts of Nigeria. Ogun and Ondo States had the highest mean number of nuts (9.4) in the pods collected, while others like Abia, Ebonyi, Enugu and Akwa-Ibom States had the lowest mean number of nuts per pod (7.7, 7.8, 7.9 and 7.9, respectively). Generally, weevils at varying degrees infested all the nuts in the pods collected from the various States. It was observed that Ondo, Cross-River, Osun and Oyo States had a fresh nut weevil infestation of 99, 97.6, 97.6 and 96.4%, respectively, while States like Enugu, Ebonyi, Benue and Kogi had a relative high infestation level of 70.9, 75.7, 76.7 and 77.9%, respectively. Apart from Cross-River, Ondo and Ogun States with the highest mean number of larvae infestation found on the pods (28.4, 27.9 and 25.7), most locations in the South West zones recorded relatively high mean number of larvae as well.

The mean number of adult *B. kolae* collected from pods across all the zones were relatively low and ranged between 2.2 for Cross-River to 0.2 for Enugu. Adult *Sophrorhinus* sp. were found in very few locations unlike adult *B. kolae* that was widely distributed across the States. Meanwhile, there was no exit hole found on the nuts collected from the pods across all the States, indicating no direct emergence of adult weevils from the nuts at that point (Table 2). The weevils are field to store pest of kolanuts and at that point of assessment most of the weevils were yet to complete their life cycles, which was the reason for the low number of adults and no exit holes recorded.

Table 3 shows the post storage assessment of nuts selected from the kola pods collected from different locations across the kola belts of Nigeria. From the result, it was observed that after 3 months of storage, kola weevils resulting to an infestation level of 100%, infested all the nuts selected from the kola pods. There was however a 0% larvae emergence from the nuts. The mean numbers of adult *B. kolae* found varied between 19.5 at Cross-River to 10.6 at Enugu State, while that of *Sophrorhinus* sp. were very few with Cross-River and Oyo States recording the highest mean number of 1.4 and 1.3, respectively. The mean number of exit holes on nuts recorded for the various treatments ranged from 20.9 (Cross-River) to 11.3 (Ebonyi State). Apparently, adult weevils had laid eggs on the nuts selected from the kola pods in the field and within the 3 months storage period, 2-3 generations of the weevils were produced. This therefore, accounted for the relatively high number of adult *B. kolae* and exit holes recorded after the storage period. The higher mean number of *B. kolae* observed when compared to a relatively few *Sophrorhinus* sp. indicates an abundance of *B. kolae* in Nigeria. This may probably be due to environmental factors or differences in the biology of the various weevil species, however further studies need to be carried out to confirm this.

Table 4 shows a varying degree of weevil infestation on procured cured kolanuts after 3 months storage. There was relatively low infestation level of the weevils, which ranged from 21.7 (Cross-River State) to 3.3% for Ebonyi and Enugu States. There were no larvae found on the nuts, while adult emergence was between 0.7 (Cross-River) to 0.0 (Ebonyi and Enugu States). No adult *Sophrorhinus* sp. was recorded for all the locations

Table 2: Varying degree of weevil infestation on kola pods from different locations across the kola belt of Nigeria during pre-processing assessment of the pods

	% Infestation and mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	Infestation (%)	Larvae**	*B. kolae* **	*S.* sp.**	Exit** holes
Abia	7.7	7.1	92.2	13.9^{ef}	0.7^{bc}	0.1^{ab}	0.0^{a}
Akwa-Ibom	7.9	7.2	91.2	15.6^{def}	0.9^{abc}	0.3^{ab}	0.0^{a}
Anambra	8.3	6.9	83.1	14.0^{ef}	0.3^{c}	0.0^{b}	0.0^{a}
Benue	8.6	6.6	76.7	13.5^{ef}	0.7^{bc}	0.0^{b}	0.0^{a}
Cross-River	8.4	8.2	97.6	28.4^{a}	2.2^{a}	0.7^{ab}	0.0^{a}
Delta	8.5	7.9	92.9	20.7^{bcd}	0.7^{bc}	0.3^{ab}	0.0^{a}
Ebonyi	7.8	5.9	75.7	11.2^{ef}	0.3^{c}	0.0^{b}	0.3^{a}
Edo	8.7	7.3	84.0	16.0^{cde}	0.6^{bc}	0.3^{ab}	0.0^{a}
Ekiti	8.8	7.3	82.9	15.7^{de}	0.4^{bc}	0.0^{b}	0.0^{a}
Enugu	7.9	5.6	70.9	10.2^{f}	0.2^{c}	0.0^{b}	0.0^{a}
Imo	8.3	6.8	82.0	11.5^{ef}	0.3^{c}	0.0^{b}	0.0^{a}
Kogi	8.1	6.3	77.9	13.2^{ef}	0.3^{c}	0.0^{b}	0.0^{a}
Lagos	9.1	8.9	97.9	23.2^{ab}	1.2^{abc}	0.4^{ab}	0.0^{a}
Ogun	9.4	8.9	94.8	25.7^{ab}	1.5^{abc}	0.7^{ab}	0.0^{a}
Ondo	9.4	9.3	99.0	27.9^{a}	1.7^{ab}	0.7^{ab}	0.0^{a}
Osun	8.6	8.4	97.6	23.1^{ab}	1.3^{abc}	0.6^{ab}	0.0^{a}
Oyo	8.2	7.9	96.4	21.2^{bc}	1.4^{abc}	0.8^{a}	0.0^{a}

*Each value represents mean of ten replicates; **Means followed by the same superscript are not significantly different ($p>0.05$) using Tukey's test

Table 3: Varying degree of weevil infestation on kolanuts selected from fresh pods from different locations after 3 months storage

	% Infestation and mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	Infestation (%)	Larvae**	*B. kolae* **	*S.* sp.**	Exit** holes
Abia	6.0	6.0	100	0.0^{a}	15.5^{ab}	1.0^{abc}	16.3^{abcd}
Akwa-Ibom	6.0	6.0	100	0.0^{a}	12.1^{bcd}	0.6^{abcd}	12.8^{bcde}
Anambra	6.0	6.0	100	0.0^{a}	14.6^{bc}	0.0^{d}	14.8^{bcde}
Benue	6.0	6.0	100	0.0^{a}	13.8^{bcd}	0.0^{d}	15.1^{bcde}
Cross-River	6.0	6.0	100	0.0^{a}	19.5^{a}	1.4^{ab}	20.9^{a}
Delta	6.0	6.0	100	0.0^{a}	15.9^{ab}	0.6^{abcd}	16.7^{abc}
Ebonyi	6.0	6.0	100	0.0^{a}	10.2^{dc}	0.0^{d}	11.3^{e}
Edo	6.0	6.0	100	0.0^{a}	14.9^{abc}	0.6^{abcd}	14.9^{bcde}
Ekiti	6.0	6.0	100	0.0^{a}	14.1^{bcd}	0.0^{d}	15.0^{bcde}
Enugu	6.0	6.0	100	0.0^{a}	10.6^{dc}	0.0^{d}	11.9^{de}
Imo	6.0	6.0	100	0.0^{a}	13.5^{bcd}	0.3^{cd}	14.7^{bcde}
Kogi	6.0	6.0	100	0.0^{a}	12.2^{bcd}	0.0^{d}	12.5^{cde}
Lagos	6.0	6.0	100	0.0^{a}	16.7^{ab}	1.1^{abc}	17.3^{ab}
Ogun	6.0	6.0	100	0.0^{a}	16.5^{ab}	1.5^{a}	17.5^{ab}
Ondo	6.0	6.0	100	0.0^{a}	16.1^{ab}	1.1^{abc}	16.9^{abc}
Osun	6.0	6.0	100	0.0^{a}	13.5^{bcd}	1.0^{abc}	13.7^{bcde}
Oyo	6.0	6.0	100	0.0^{a}	15.5^{ab}	1.3^{ab}	16.0^{bcde}

*Each value represents mean of ten replicates; **Means followed by the same superscript are not significantly different (p>0.05) using Tukey's test

Table 4: Varying degree of weevil infestation on cured kolanuts procured from different locations after 3 months of storage

	% Infestation and mean number infestation by various weevil stages*						
Locations	Total Nuts	Infested nuts	Infestation (%)	Larvae**	*B. kolae* **	*S.* sp.**	Exit** holes
Abia	6.0	0.9	15.0	0.0^{a}	0.4^{a}	0.0^{a}	0.8^{ab}
Akwa-Ibom	6.0	1.2	20.0	0.0^{a}	0.5^{a}	0.0^{a}	1.1^{ab}
Anambra	6.0	0.3	5.0	0.0^{a}	0.1^{a}	0.0^{a}	0.4^{b}
Benue	6.0	0.5	8.3	0.0^{a}	0.2^{a}	0.0^{a}	0.7^{ab}
Cross-River	6.0	1.3	21.7	0.0^{a}	0.7^{a}	0.0^{a}	1.7^{a}
Delta	6.0	1.0	16.7	0.0^{a}	0.4^{a}	0.0^{a}	1.1^{ab}
Ebonyi	6.0	0.2	3.3	0.0^{a}	0.0^{a}	0.0^{a}	0.2^{b}
do	6.0	1.0	16.7	0.0^{a}	0.4^{a}	0.0^{a}	1.0^{ab}
Ekiti	6.0	0.4	6.7	0.0^{a}	0.4^{a}	0.0^{a}	0.7^{ab}
Enugu	6.0	0.2	3.3	0.0^{a}	0.0^{a}	0.0^{a}	0.2^{b}
Imo	6.0	0.5	8.4	0.0^{a}	0.2^{a}	0.0^{a}	0.8^{ab}
Kogi	6.0	0.6	10.0	0.0^{a}	0.2^{a}	0.0^{a}	0.8^{ab}
Lagos	6.0	0.7	11.7	0.0^{a}	0.4^{a}	0.0^{a}	0.9^{ab}
Ogun	6.0	0.9	15.0	0.0^{a}	0.5^{a}	0.0^{a}	1.4^{ab}
Ondo	6.0	0.5	8.4	0.0^{a}	0.1^{a}	0.0^{a}	0.6^{ab}
Osun	6.0	0.7	11.7	0.0^{a}	0.3^{a}	0.0^{a}	0.8^{ab}
Oyo	6.0	0.7	11.7	0.0^{a}	0.4^{a}	0.0^{a}	0.8^{ab}

*Each value represents mean of ten replicates; **Means followed by the same superscript are not significantly different (p>0.05)

sampled across the kola belts. The very low infestation level and corresponding low weevil emergence from the procured cured nuts goes further to confirm the fact that kola farmers and vendors still subject the nuts to chemical treatment for the control of kola weevils.

DISCUSSION

The kola weevils (Family *Curculionidae*) have been identified as the most destructive insect pest of kolanut in West Africa (Daramola, 1973; 1978). The adult *B. kolae* is dark brown 3-4 long and 1.5-2 mm wide (Ivbijaro, 1976), while adult *S.* sp. measures 4-5.5 mm long (Daramola, 1975). Their mouthparts are adapted for piercing and puncturing the kolanuts to obtain food and for making ovipositional holes, thus resulting in considerable economic damage to the kolanuts (Gerald, 1967). From the results of this study, it is evident that kola weevils especially *B. kolae* are widely distributed across the kola growing belt of Nigeria at varying degrees and such infestation normally starts on the field. They are classified as field-to-store pest as their infestation is initiated in the field and persists in storage (Daramola and Ivbijaro, 1975).

The results also corroborates previous observation made by Alibert and Mallamaire (1955) 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 30-70% and in some cases of late harvest 100% has been reported in Cote D'Ivoire, Guinea and Nigeria (Groormanns and Pujol, 1955; Daramola, 1973; Daramola and Ivbijaro, 1975). According to Daramola and Taylor (1975), the havoc caused by this insect pest approximately claims 60% of the total kolanut production in Nigeria.

The farmers and kola vendors are in the habit of adding Gamalin 20 EC (Organochlorine insecticide that has been banned) and other synthetic insecticides to the water for soaking fresh *Cola acuminata* or *Cola nitida* during primary processing. They usually add between 10-20 mL to a bowl of water (20-30 L) for soaking a basket of fresh nuts depending on the size of the basket. The chemicals are readily available in the kola markets, where it is hawked freely in small quantities at affordable prices. The farmers have resorted to this practice to drastically reduce the menace of weevil infestation on stored kolanuts, as untreated nuts deteriorates within 3-4 weeks. Unfortunately this act is not desirable, as kolanut does not undergo any other formal processing before consumption. There is an urgent need for an alternative means of protecting kolanuts from the weevils to be proffered and transferred to kola farmers and merchants so as to save kola consumers of an impending calamity. The next phase of our study therefore, will focus on the aspects of alternative weevil control measures.

ACKNOWLEDGEMENT

We are very grateful to the Management and staff of Cocoa Research Institute of Nigeria for their support.

REFERENCES

Alibert, H. and A. Mallamaire, 1955. Les Characons de le noix de Cola on Afrique Moyens de les Combattre. Bull. Proc. Vouv. Gen. Afr. Occ. Franc. Dir Gen. Sugv. Econ. Insp. Gen. Agric., 92: 29-88.

Daramola, A.M., 1975. Secondary sexual characteristics of kola weevils, *Sorphrorhinus gbanjaensis* (Coleoptera: Curculionidae). Rev. dr. Zool. Et. Bot. Afrique, 89 (1): 211-216.

Daramola, A.M., 1973. The bionomics of kola weevils, *Sophrorhinus* sp. (Coleoptera: Curculionidae) Ph. D. Thesis. University of Ibadan, Nigeria, pp: 325.

Daramola, A.M., 1978. Insect pest of kola in Nigeria. No 3. CRIN, Ibadan. Res. Bull., pp: 33.

Daramola, A.M. and M.F. Ivbijaro, 1975. The distribution and ecology of kola weevils in Nigeria. Nig. J. Pl. Prot., 1 (1): 5-9.

Daramola, A.M. and T.A. Taylor, 1975. Studies on the re-infestation of kola in store by kola Weevil in S. Nigeria. Nig. J. Stored. Prod. Res., 11: 61-63.

Eijnatten, C.L.M. Van, 1969. Kola, its botany and cultivation. Commun. 59. Roy. Inst. Amsterdam, pp: 100.

Gerard, B.M., 1967. The control of *Balanogastris kolae* (Debr) and *Sorphrorhinus insperatus* (1st.) (Coleoptera: Curculionidae) in small samples of stored kolanut using phosphine. Bull. Ent. Soc. Nig., 1: 43-48.

Groormanns, C. and R. Pujol, 1955. Rescherches sur la Charancon de kola *Balanogastris kolae* Desbr. J. Agric. Trop. Applied, 2: 263-280.

Jacob, V.J., 1973. Yield characteristics, incompatibility and sterility studies in *Cola nitida* (vent) Schoot and Endlicher. Ph.D Thesis University of Ibadan, pp: 159 .

Ivbijaro, M.F., 1976. The feeding and oviposition behaviour of kola nut weevil, *Balanogastries kolae* (Desbr.) (Coleoptera: Curculionidae) on stored kola nuts (*Cola nitida*). Ghana. J. Agric. Sci., 9 (3): 155-159.

Oladokun, M.A.O., 1982. Morpho-physiological aspect of germination, rooting and seedling growth in kola (*Cola* sp.). Ph.D. Thesis, University of Ibadan, Nigeria, pp: 230.