HOST PLANT RANGE AND MORPHOMETRICS DESCRIPTIONS OF AN EMERGING INSECT PEST OF CASHEW, *Plocaederus ferrugineus* L. (Coleoptera: Cerambycidae) IN NIGERIA: A PRELIMINARY REPORT

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Accepted for publication: 20 May 2009

ABSTRACT

Asogwa, E.U., Anikwe, J.C., Ndubuaku, T.C.N., Okelana, F.A. and Hammed, L.A. 2009. *Host plant range and morphometrics descriptions of an emerging insect pest of cashew,* plocaederus ferrugineus l. *(coleoptera: cerambycidae) in nigeria: a preliminary report.* Int. J. Sustain. Crop Prod. 4(3):27-32.

A 2.5 hectare cashew germplasm plot (S/GP) within Cocoa Research Institute of Nigeria, Ibadan was assessed between 2006 to 2007 to identify the host plant range and to describe the morphology of the various life stages of an emerging insect pest of cashew, *Plocaederus ferrugineus* in Nigeria. The cashew trunk and root borer, *Plocaederus ferrugineus* is fast becoming the most dreaded insect pest of cashew plantations in Nigeria as its infestation results in "sudden death" of mature cashew trees within few weeks. The rate of infestation of the borer on cashew and all tree stands/shrubs within S/GP and adjacent plots were recorded. Measurements of the morphometric characteristics of the various life stages of the borer collected from infested cut down trunks and excavated roots were carried out with a pair of caliper. Fewer stands of cashew were affected by the trunk and root borer resulting in an infestation rate of 36.3%. Only *Spondias mombin* was found to be riddled with borers out of all the other 24 species of trees and shrubs found within S/GP. 89.6% of the *S. mombin* assessed came down with different levels of attack by the borer, which differed significantly ($P < 0.05$) from 36.3% infestation rate on cashew. The larva (grub) has a mean body length of 2.72mm, while an average pupal length of 3.66mm was recorded. The adult *P. ferrugineus* is a medium sized dark grey beetle, 2.91cm long and 0.92cm wide at the base of the abdomen. They have longer antennae (3.58cm), which is significantly longer ($P < 0.05$) than their body (2.91cm).

Key words: Infestation, larvae, pupae, borer, adults, damages, germplasm

INTRODUCTION

The commercial cashew plantations started in Nigeria in the early 1950s with the establishment of first commercial plantations at Oghe, Oji and Mbala by the defunct Eastern Nigeria Development Corporation (ENDC) and Iwo, Eruwa and Upper Ogun by the defunct Western Nigeria Development Corporation (WNDC). From these locations, the planting of the crop spread to other parts of Nigeria particularly the Central and Northern States of Nigeria (Ohler, 1967; 1979; Venkataramah, 1976; Togun, 1977). The introduction of Brazilian cashew biotype with improved and desirable nut and kernel quality characteristics by CRIN has further increased the crops spread and popularity in Nigeria (Hammed *et al*., 2007).

The cashew apple is sweet and when fully ripe, the juice is rich in vitamin C and sugars. It contains 7 - 9 % of reducing sugars, 11-12% of soluble solids and about 0.5% of tannic acid (Opeke, 1987). In most cashew producing nations, it is eaten raw. It is a good raw material for soft drink industry. There have also been reports of jam and jelly production from the pulp following juice extraction (Ohler, 1979). The apple was also found to contain high moisture (80%) and marginal nutrient contents - protein 0.35%; ether extracts 1.8% and total ash 1.9% (Egbe and Sobamiwa, 1989). The cashew nut shell liquid (CNSL), is used widely in brake linings of motor vehicles, paints, varnishes and laminated products (Murthy and Sivasambari, 1985). It is also used as a plywood adhesive (Akaranta *et al*., 1996) and as a material for increased the tensile properties, as flame retardants of natural rubber (Menon, 1997) and as a long-life, highly bioactive, antifowling coating for marine vessels (Panda and Panda, 1991). CNSL and other extracts from the shell are larvicidal (Carrara *et al*., 1984; Evans and Raj, 1988) molluscicidal (Casadei *et al.*, 1984; Kubo *et al*., 1986) and antifungal and antibacterial (Echendu, 1991; Weerasena *et al*., 1993).

In Nigeria, cashew, like most tree crops hosts a wide range of pests and diseases. Insect pests infest its various parts including roots, stem, branches, flowers, inflorescence and the psuedo-apples (Eguagie, 1972; 1973; 1974), but only a few of these insect species cause economic damage to this crop (Omole, 1972). The occurrence of *Dysdercus superstitious* (cotton stainer), and *Leptoglosus membranaceus* as new pests of cashew (Olunloyo, 1989), and the recent observations of "sudden death" of mature cashew trees due to infestation by *Plocaederus ferrugineus* (Asogwa *et al*., 2008), was an indication of a continuous increase in the number and species of insects infesting cashew plantation with time in Nigeria.

This work therefore is an attempt to identify the host plant range and to describe the morphorlogy of the various life stages of an emerging insect pest of cashew, *Plocaederus ferrugineus* in Nigeria.

MATERIALS AND METHODS

Survey of cashew plots: An assessment of cashew germplasm plot (S/GP), which is a 2.5 hectare cashew plot within CRIN headquarters, was carried out to determine the intensity of infestation by the trunk and root borer, *P. ferrugineus*. The layout design of the germplasm experimental plots was a Randomized Complete Block Design with 5 blocks of 0.5 ha each. All other tree/shrub stands (over 23 species) found within the vicinity and adjacent plots were closely observed for any signs of infestation by the borer. The identity of each tree was confirmed at the herbarium of the Forestry Research Institute of Nigeria (FRIN), Ibadan (Table 1).

Removal of affected cashew trees and the alternate hosts: The few affected cashew stands were carefully cut down with a saw machine and the stump and root extension carefully exhumed. All the trees and shrubs that exhibited similar infestation symptoms in the 2.5 hectare cashew germplasm plot were cut down and excavated. The total number of the different trunk and the roots excavated were recorded before they were taken to the laboratory for further assessment.

Morphometrics characteristics of the various stages of the pest: The excavated cashew and *Spondias mombin* stumps were carefully dissected to expose the various developmental stages of the insects (larvae, pupae and adults), which were collected and assessed. Twenty random samples of each of the developmental stages were selected and used for this study. The adults and larvae were gently killed by placing them in a kilnerjar bottles containing an absorbent cotton wool soaked in ethyl acetate at the bottom. Measurement of morphometric characteristics such as, body length, antennal length, head capsule length, head capsule width, thorax length, thorax width, abdominal length, abdominal width, last abdominal sternum width, elytra length, elytra width, membranous wing length and width was carried out with a pair of caliper.

RESULTS

Table 1 shows the infestation rate of *Plocaederus ferrugineus* on the various trees/shrubs within the cashew germplasm plots. Observations revealed that fewer stands of cashew were affected by the trunk and root borer resulting in an infestation rate of 36.3%. Out of the 24 species of trees and shrubs found within the germplasm plots, only *Spondias mombin* was found to be riddled with borers. 89.6% of the *S. mombin* assessed came down with different levels of attack by the borer, which was significantly different ($P < 0.05$) from their infestation rate on cashew.

Table 1. The infestation rate of *Plocaederus ferrugineus* on the various trees/shrubs within the cashew germplasm plots

Scientific name	Family	Infestation rate (%)*
Anacardium occidentale	**Anacardiaceae**	**36.3^{b}**
Rothmannia longiflora	Rubiaceae	0^{c}
Blighia sapida	Sapindaceae	0^{c}
Alchornea cordifolia	Euphorbiaceae	0^{c}
Combretum sp	Combretaceae	0^{c}
Lecaniodiscus culpanioides	Combretaceae	0^{c}
Cola gigantea	Sterculiaceae	0^{c}
Ceiba petandra	Bombacaceae	0^{c}
Albizia zygia	Mimosoideae	0^{c}
Lonchocarpus sericeus	Papillionoides	0^{c}
Dialium guineense	Caesalpiniaceae	0^{c}
Antiaris africana	Moraceae	0^{c}
Gliricidia sepium	Papillionoides	0^{c}
Rauvolfia vomitoria	Apocynaceae	0^{c}
Milicia exelsa	Moraceae	0^{c}
Ficus exasperata	Moraceae	0^{c}
Sterculia tragacantha	Sterculiaceae	0^{c}
Baphia nitida	Papillionoides	0^{c}
Peltophorum pterocarpum	Caesalpiniodes	0^{c}
Pterocarpus osun	Papilliionoides	0^{c}
Cola millenii	Sterculiaceae	0^{c}
Spondias mombin	**Anacardiaceae**	**89.6^{a}**
Newbouldia laevis	Bignonaceae	0^{c}
Psidium guajava	Myrtaceae	0^{c}
Ricinodendron heudelotii	Euphorbiacea	0^{c}

*Rates with the same superscript are not significantly different ($P > 0.05$) by DMRT.

The mean body morphometric measurements of *Plocaederus ferrugineus* larvae were shown in Table 2. The larva (grub) of *P. ferrugineus*, has a curled whitish body with wrinkled skin and dark brown head capsule with a mean body length of 2.72mm. The width of the larvae tapers down from the anterior to the posterior end of the body with an anterior width of 0.74mm, which decreased to 0.58mm for both the mid point and posterior width. The larvae however were higher at the midpoint (0.49mm) when compared to the anterior height (0.45mm) and posterior height (0.43).

Table 2. Mean body morphometric measurements of *Plocaederus ferrugineus* larvae (mm)*

Parameters	Mean**	SD	SE	VAR
Length of body	2.724[a]	1.189	0.266	1.414
Height of anterior end	0.447[b]	0.162	0.036	0.026
Width of anterior end	0.735[b]	0.255	0.057	0.065
Height of posterior end	0.433[b]	0.131	0.029	0.017
Width of posterior end	0.582[b]	0.182	0.041	0.033
Height of mid point	0.489[b]	0.200	0.045	0.040
Width of mid point	0.582[b]	0.207	0.046	0.043

*Each value represents mean of 20 replicates
**Means with the same superscript are not significantly different (P > 0.05) by DMRT.

The mean body morphometric measurements of *Plocaederus ferrugineus* pupae were shown in Table 3. The pupa is a calcareous cocoon buried in the frass and soft wood tissue of the trunk/roots. An average pupal length of 3.66mm was recorded. However, the mean widths of the pupae at the anterior and posterior ends were not different as both measured 1.04mm. Also the height of the pupae at the anterior end (1.50mm) and posterior end (1.45mm) followed the same pattern as they were not significantly different.

Table 3. Mean body morphometric measurements of *Plocaederus ferrugineus* pupae (mm)*

Parameters	Mean**	SD	SE	VAR
Length of body	3.660[a]	0.469	0.105	0.220
Height of anterior end	1.499[b]	0.218	0.049	0.047
Width of anterior end	1.037[b]	0.219	0.049	0.048
Height of posterior end	1.452[b]	0.127	0.029	0.016
Width of posterior end	1.044[b]	0.208	0.047	0.043

*Each value represents mean of 20 replicates
**Means with the same superscript are not significantly different (P > 0.05) by DMRT.

The mean body morphometric measurements of adult *Plocaederus ferrugineus* were shown in Table 4. The adult *P. ferrugineus* is a medium sized dark grey beetle, 2.91cm long and 0.92cm wide at the base of the abdomen. They have longer antennae (3.58cm), which is significantly longer (P < 0.05) than their body (2.91cm). The head, thorax and the elytra are dark brown or almost black. Other morphometric parameters (length of head capsule, width of head capsule and width of elytra; length and width of thorax; width of abdomen, and width of membraneous wings) were found to overlap considerably. The lowest value of 0.22cm was recorded for the last abdominal sternum.

Table 4. Mean body morphometric measurements of adult *Plocaederus ferrugineus* (cm)*

Parameters	Mean**	SD	SE	VAR
Length of antennae	3.575[a]	0.653	0.146	0.426
Length of head capsule	0.590[g]	0.112	0.025	0.013
Width of head capsule	0.455[g]	0.132	0.029	0.017
Length of abdomen	1.235[e]	0.303	0.068	0.092
Width of abdomen	0.830[f]	0.169	0.378	0.289
Length of thorax	0.950[f]	0.100	0.022	0.010
Width of thorax	0.915[f]	0.127	0.028	0.016
Length of body	2.905[b]	0.369	0.083	0.136
Length of elytra	2.035[d]	0.173	0.386	0.030
Width of elytra	0.515[g]	0.081	0.018	0.007
Length of membraneous wing	2.540[c]	0.302	0.067	0.091
Width of membraneous wing	0.915[f]	0.150	0.033	0.022
Width of last abdominal sternum	0.220[h]	0.062	0.013	0.004

*Each value represents mean of 20 replicates of mixed adult males and females
**Means with the same superscript are not significantly different (P > 0.05) by DMRT.

DISCUSSIONS

Plocaederus ferrugineus, which is a serious pest has been reported in India (Abraham, 1958; Pillai *et al*., 1976; Bhaskara Rao, 1998 ; Mohapatra and Mohapatra, 2004) and Sri Lanka (Gerini, 1976), attacking trunks and roots of the cashew tree. Other related species are *P. consocium*, *P. obesus* and *Bactocera rufomaculata* (Abraham, 1958; Pillai *et al.*, 1976). When caught, the beetle makes an indignant squeaking sound by rubbing the prothorax and mesothorax together.

The establishment of cashew in South Western Nigeria does not often require clean weeding, but line weeding or cutting of traces at a recommended spacing between the lines. The belt of vegetation left is to provide the necessary microclimate for the transplants of cashew, especially when rain ceases. *S. mombin* was found not to be just an "alternate host" of the pest but could be referred to as the "preferred host plant", as over eighty nine percent (89.6%) of the assessed plants came down with different levels of attack by the borer, which was significantly different ($P < 0.05$) from their infestation rate on cashew. All the other plant species (trees and shrubs) within the vicinity of the germplasm plots were not infested with the borers.

The identification and knowledge of the location of the alternate hosts should facilitate the formulation of effective control strategies for the pest. For example, spot sprays of the insect on the alternate host plants may reduce its population in the environment. Also cutting down of such host plants within the vicinity will reduce or eliminate sources of reinfestation of cashew trees. Various authors have reported the presence and activities of other related borers in the same Order on tree crops. For example, Daramola (1978) and Ojo (1981) reported that the larvae of *Tragocephala castnia* Thoms. (Coleoptera: Cerambycidae) were found to bore into the stems of kola and cocoa trees. Ndubuaku (1989) reported *Phosphorus virescens* and *Phosphorus gabonator* (Coleoptera: Cerambycidae) as two species of stem borers affecting kola trees, which have been occasionally seen in cocoa farms.

Ecological studies often require reliable methods of segregating the sexes of the insect pest under investigation in the field. The morphological characters were usually assessed in some cases to separate the sexes. However, external physical observation of the last abdominal segment of beetles in the same order, like *Analeptes trifasciata* was the simplest and reliable means of segregating the sexes. The females were usually found to possess a mid ventral structure on their last abdominal sternum, which was absent in the males. However, this structural contrast needs a confirmatory test, which involves dissecting the adults and is therefore being used as a satisfactory criterion for segregating the sexes. This is yet to be done in the case of *P. ferrugineus* a new emerging insect pest of cashew in Nigeria. A mixed adult of both sexes was therefore used to carry out this preliminary study.

ACKNOWLEDGEMENT

The authors wish to thank the staff of Entomology Group, and the Management of Cocoa Research Institute of Nigeria for their support.

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