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COMPARATIVE ASSESSMENT AND PREFERENTIAL HOST-PLANT OF *CYLAS PUNCTICOLLIS* BOH. [COLEOPTERA:Brentidae] Damage Potential on *Gossypium Hirsutum* L. And *Ipomoea* Spp. At Sangere, Nigeria

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ABSTRACT: *The damage potential and preferential host of Cylas puncticollis Boh. were studied on cotton, Gossypium hirsutum L.; sweet potato; Ipomoea batatas and wild potato weed, Ipomoea eriocarpa on the field in screen cages and potted experiment in 2003-2006 at Sangere, Yola. Two varieties of cotton, SAMCOT 8 and AFCOTT-BENIN seeds were sown in 2003-2005 infested with 5 pairs of C. puncticollis in a completely randomized block design in three replications. Results obtained showed that caged (protected) gave higher yield in g/plant on SAMCOT 8 (43.67, 50.00 and 52.33) and AFCOTT-BENIN (50.33, 46.67 and 52.33) from 2003-2005 respectively. While caged and artificially infested gave lower yield of (38.80, 40.33 and 43.00) and (39.67, 34.33 and 38.00) for SAMCOT 8 and AFCOTT-BENIN respectively. Percentage reduction in yield was higher on AFCOTT-BENIN (21.17, 25.57and 26.80) compared to SAMCOT 8 (12.93, 19.10, 17.80) in same years respectively. Average number of fruiting bodies formed per plant when artificially infested with C. puncticollis on AFCOTT-BENIN (3.33/plant) compared with SAMCOT 8 (2.33/plant). However, the potted experiment carried out in 2006, showed that, I. batatas had yield loss of up to 95.93% and cotton bolls were not developed to maturity (bolls did not form lints).The leaves of cotton were not damaged by the weevils, but sweet potato damaged leaves was 46.95% which was less compared to I. eriocarpa with 54.90 %, but there was no significant difference at p=0.05.The weevils preferred Ipomoea leaves and the fruiting bodies of cotton.*

KEYWORDS: *Gossypium*, *Ipomoea eriocarpa*, Sweet potato, Fruiting bodies, Percentage, *Cylas*

INTRODUCTION

David Jnr. (1969) suggested that the naturally designed structure of the cotton plant (nectaries, blooms and bolls) is a favourable attraction to insects. A lot of research on the insect pests of cotton and their assessment on its damage have been documented by several workers (Hargreaves, 1948; Lyon 1970; Hill and Waller, 1988; Matthews, 1989; Onu, 1990; Anon., 1996 and CAB International, 2003). However none of these earlier researchers ever mentioned *Cylas puncticollis* as an insect pest of cotton. No literature even in their check lists ever mentioned *Cylas* as a minor pest of cotton prior to the present investigations except the recent findings by same researchers during the course of these investigations (Malgwi, 2007; Malgwi and Onu, 2010; Malgwi, 2010; Malgwi *et al*., 2011). It was considered to be a pest of sweet potato only (Chalfant, *et al*., 1990; Jansson and Raman, 1991). *Cylas* is such a

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versatile pest in the field that even small populations will greatly affect the quantity and quality of sweet potato roots formed (Proshold, 1983). An average of three to four larvae is able to develop in 20 cm of the vine above ground level. Larvae usually tunnel through the soft pith, and rarely in the vascular bundles (Proshold, 1983). Tissue reaction to *Cylas* attack shows conspicuously as stem swellings. The swollen tissues in the stem become fibrous and harden making it impossible for the larvae to tunnel through such tissues. Only a small number of larvae are therefore able to survive in stem because of these conditions, resulting in reduction in population growth even when the initial population is estimated to be high (Allard *et al*., 1991).

Adult *Cylas* on the other hand prefers the epidermis of vines and leaves, leaving oval patches on petioles, young vines and leaves. This eventually causes the leaf to shrivel, wilt and die. *Cylas* spp when feeding on the leaves prefers the lower leaf surfaces, whereas in the roots, adult prefers the periderm than the roots inner core (Nottingham *et al*., 1987 and 1998). The adult feeding on the tubers creates numerous small holes that measures about the length of the feeders head. This is clearly distinguished from the oviposition sites by their greater depths and the absence of faecal plugs (Allard *et al*., 1991; Capinera, 1998 and Parker *et al*., 2000).

Frass is deposited in the tunnels as the feeding progresses, and in response to these, the roots produce terpene phytoloxins/toxic sesquiterpenes which is bitter in taste rendering the storage root tubers unfit for human consumption (Akazawa *et al*., 1960; Allard *et al*., 1991 and Smit, 1997). In Uganda, record losses of up to 73% have been reported by Smit (1997). Capinera (1998) in his estimates reported losses ranging from 5 – 97% in areas where the weevil occurred depending upon the intensity of *interaction*.

However, there is no detail description of *C. puncticollis* damage on cotton documented anywhere in literature, nor its comparison of its damage on sweet potato, except what is reported in this study and same researchers earlier mentioned (Malgwi, 2010; Malgwi and Onu, 2010; Malgwi *et al*., 2011; Malgwi and Onu, 2013). Therefore, the present study was aimed at establishing the damage potential on cotton and comparing assessment studies of the damages produced by *Cylas* on cotton, sweet potato and their relatives as a result of artificial infestations during the rainy season on the field and in plastic pots in screen cages.

MATERIALS AND METHODS

The experiments were conducted at Sangere village where the Federal University of Technology, Yola is located which is approximately 32 kms away from the hot-spot zone of *Cylas* at Ngurore. This is because functional laboratory facilities, screen houses and security were not available at Ngurore. Artificial cages were often vanderlized by nearby villagers. The choice of Sangere therefore provided the much needed security and neutrality for this research.

Damage Potential of *C. puncticollis* on Cotton in Screen Cages on the field

Two varieties of cotton, SAMCOT 8 and AFCOTT-BENIN (seeds collected at AFCOTT) were sown each year on the 5th of July in 2003– 2005, on a plot size of 3 x 4m (12 m^2) with a buffer zone of 1.5 m between each plot. Plant spacing was 0.5 m x 1m (intra- and inter-row spacing). All agronomic practices of land preparation as regards ploughing, ridging, planting,

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fertilizer applications, thinning and regular weeding was carried out. Healthy plant stands of uniform sizes were selected and caged 8 weeks after sowing (WAS). One plant per cage was selected as shown in Plate 1, adapting the methods of Sharma *et al*. (1992) and Malgwi (1997). Screen cages measuring 1.5m x 1.0m x1.0m with their bases covered with fine meshed muslin cloth were used. Loose sag of the muslin cloth and a rope tie around the cotton plant was used to prevent insects from entering or escaping after caging (Plate 2). At square formation, 10 *C. puncticollis* (5 males and 5 females) were collected from their hot-spot zones at Ngurore and introduced into the cages, while in the control, no insect was introduced. Three other plants were also tagged on 3 plots which served as replications.

Twenty eight (28) days after *Cylas* introduction, the cages were examined to determine the number of insects alive. At harvest the weights of seed-cotton were recorded for the three different treatments (caged and infested, caged and uninfested and open to all insects). The percentage reduction in seed-cotton yield was also calculated. The damage potential on the two cotton varieties artificially infested was determined and ranked on a scale of 1 – 4, similar to Adamu *et al.* (2000) and Malgwi and Onu (2004), where 1 = low damage of 0 – 10% yield reduction, 2 = moderately low damage of 11 – 20% reduction, 3 = moderately high causing 21 – 30% reduction in yield and 4 = high causing 31% and above yield reduction. The data were analysed by Analysis of Variance (ANOVA) using SAS (2002) [12] Software Version 8 (2) and Student-Newman-Keuls (SNK) was used to separate the means at $p = 0.05$ test for variables.

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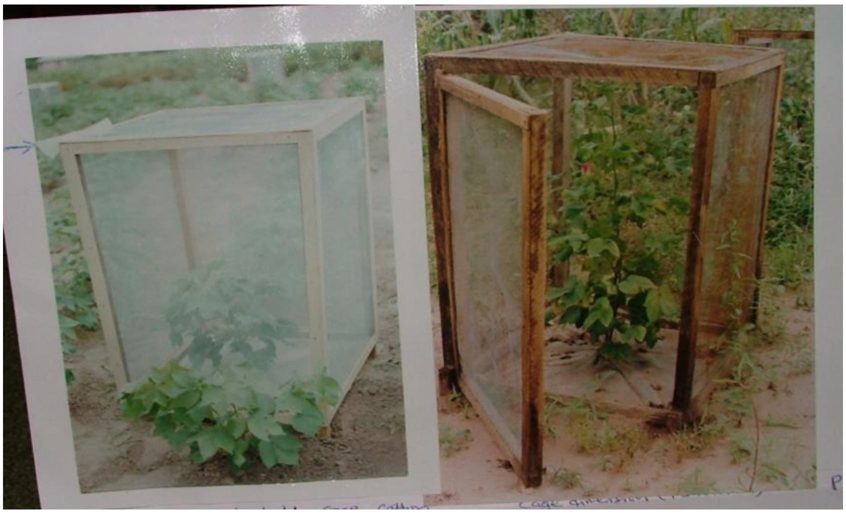

Plate 1: Cage used on the field to infest *C. puncticollis* with (left) an opening for infestation on top (right) open door to check for other insects that could enter the cage unknowingly

Plate 2: Showing how the cotton plant is fastened with a rope sagged in a musilin cloth to prevent insects from escaping after

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Damage Assessment of *Cylas puncticollis* on Cotton and Sweet Potato in Plastic Pots in Screen Cages

The same experiment as in 1.1 was conducted for cotton using same varieties (SAMCOT 8 and AFCOTT-BENIN) in 2006 in a screen cage of 30 mesh/square inch, but in plastic pots of 10 litres capacity perforated at the bottom. The plastic pots were filled to ⅔ capacity with soil sample collected on the farm. They were kept well watered for 10 days in order to remove all germinated weed seeds and insects, before cotton was sown. Cotton was sown on the 5th of July, 2006(because cotton takes longer period before it matures), while the potato cutting was sown on the 5th of September, 2006(that is when farmers transplant their stem cuttings in the experimental locality). The cotton seedlings were thinned to 2 per stand after 2 weeks of sowing and later to one plant/stand at 4 weeks after sowing (WAS) and this was followed by application of NPK fertilizer (20:10:10) at the rate of 10gms/pot. The plants were watered when necessary. Cotton plants were infested with adult *C. puncticollis* at the onset of bract formation with 10 weevils collected on the field. The number of bracts, buds and bolls formed was recorded in both infested and uninfested cages. The percentages of the above parameters were calculated for each against uninfested cotton.

The damage assessment was rated on a scale of 1-5, where 1 = Low damage causing 0 – 10% yield reduction, 2 = moderately low damage causing 11 – 20% yield reduction, 3 = moderately high, causing 21 – 30% yield reduction and 4 = High causing 31 - 40% and 5 = Very high causing 41and above yield reduction.

Cylas spp. collected in the field were also introduced on sweet potato at 4 and 7 weeks after planting. The stem cuttings were infested, while the control was not infested. The leaf damaged area was calculated against uninfested, and also the wild potato variety *Ipomoea eriocarpa* which was collected on the field was compared with unperforated leaves collected on the same field, as stated below, similar to Balogun (2005):

$$\text{Loss in weight (\%)} = \frac{\text{Weight of fresh undamaged leaf (g)} - \text{weight of fresh damaged leaf (g)}}{\text{Weight of fresh undamaged leaf (g)}} \times 100$$

The data were all subjected to Analysis of Variance (ANOVA) using SAS (2002) [12] Software Version 8 (2) and Student-Newman-Keuls (SNK) was used to separate the means at p = 0.05 test for variables.

RESULTS

Damage Potential of *C. puncticollis* on Cotton in Screen Cages on the Field

The results obtained are shown in Tables 1, 2 and Figures 1 and 2 for 2003, 2004, and 2005. Analysis indicated a significant difference in seed-cotton yield in infested and uninfested cotton for the two varieties (SAMCOT 8 and AFCOTT-BENIN) studied. In Table 1 and Figure 1, AFCOTT-BENIN yielded higher throughout the 3 years of investigation Damage

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observed in terms of yield reduction (%) for artificially infested cotton on the field and in cages were lower, than the artificially infested cotton in plastic pots in screen cages. The range was 18 – 28% seed-cotton yield reduction for SAMCOT 8, and 25 – 35% seed-cotton yield reduction for AFCOTT-BENIN, respectively. However, there was no significant difference between seed-cotton yields of SAMCOT 8 and AFCOTT-BENIN varieties when they were open to all insects in the field. It ranged between 55 – 61% (Figure 1). Typical damage inflicted by *Cylas* showed perforated squares, showing shot holes earlier shown on Plate 3. The bracts and developoing bolls were also nibbled round the developing bolls. The bracts later became flarred (Plate 4) and the developing bracts became mummified. Heavily damaged buds and bracts usually dropped off.

Table 1: Damage caused by *C. puncticollis* Boh. on cotton plants on its yield for 3 years cropping season.

Treatment	2003		2004 Yields g/plant		2005	
	SAMCOT 8	AFCOTT-BENIN	SAMCOT 8	AFCOTT-BENIN	SAMCOT 8	AFCOTT-BENIN
Caged and protected (control)	43.67a	50.33a	50.00a	46.67a	52.33a	52.33a
Caged and artificially infested	38.00a	39.67b	40.33b	34.33b	43.00b	38.00b
Open to all insect pests (unprotected)	21.33b	20.33c	21.33c	20.00c	25.33c	21.67c
Mean	34.33	36.78	37.22	33.67	40.22	37.22
C.V (%)	7.33	3.63	4.05	10.05	7.71	6.17

Means within the same column followed by different letters are significantly different at P<0.5 Student-Newman-Keuls (SNK) test for variables.

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Table 2: Percentage yield reduction on cotton caused by *C. puncticollis* and its damage rating (summary of three years at Sangere).

Treatment	2003		2004		2005	
	SAMCOT 8	AFCOTT-BENIN	SAMCOT 8	AFCOTT-BENIN	SAMCOT 8	AFCOTT-BENIN
Caged and artificially infested	12.93^{b} (2)	21.17^{b} (3)	19.1^{b} (2)	25.57^{b} (3)	17.80^{b} (2)	26.80^{b} (3)
*Open to all pests on field	50.80^{a} (5)	59.57^{a} (5)	57.47^{a} (5)	57.23^{a} (5)	51.30^{a} (5)	58.16^{a} (5)
Mean	31.86^{b}	40.36^{a}	38.28^{b}	41.40^{a}	34.55^{a}	42.48^{a}
C.V (%)	15.15	3.90	9.87	9.96	16.32	1.99

Means within the same column followed by different letters are significantly different at P<0.5 Student-Newman-Keuls (SNK) test for variables, with means for each year in a low

Figures in parenthesis are the damage rating of *C. puncticollis* on a scale of 1 – 5, where 1 = Low damage of 0 – 10% yield reduction 2 = moderately low damage of 11 – 20% yield reduction; 3 = moderately high causing 21 – 30% yield reduction and 4 = high causing 31 – 40 % yield reduction, and 5 = very high, causing 41% and above yield reduction.
* Other insect pests other than *C. puncticollis* contributed to its reduction in yield, on the open field (unprotected and unsprayed).

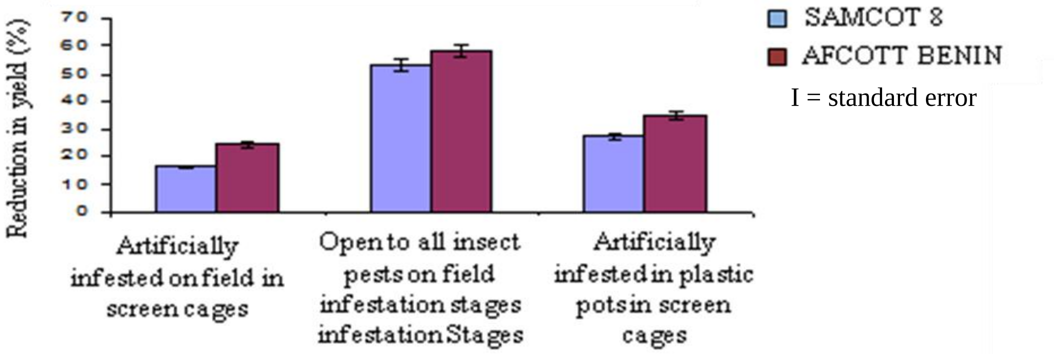

Figure 1: Reduction in yield/plant (%) on artificial infested plant with *C. puncticollis* for the three years at Sangere, Adamawa State, Nigeria.

Damage ratings of 1-5 was determined where 1 = Low damage causing 0 – 10% yield reduction, 2 = moderately low damage causing 11 – 20% yield reduction, 3 = moderately high, causing 21 – 30% yield reduction and 4 = High causing 31 - 40% and 5 = Very high causing 41and above yield reduction.

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Table 3: Effect of artificial infestation of cotton by C. puncticollis on production of fruiting bodies and seed cotton yield.

Treatments	Average no. of fruiting bodies per plant			Seed-cotton weight (g/plant)
	Bracts	Buds	Bolls	
SAMCOT 8 infested	2.33c	2.00b	0.67c	18.46c
AFCOTT-BENIN infested	3.33b	2.67b	2.33b	26.61b
SAMCOT 8 uninfested	3.67b	2.67b	3.33a	25.78b
AFCOTT-BENIN uninfested	4.33a	5.33a	4.00a	40.71a
C.V (%)	8.45	21.70	21.39	9.21

Means within the same column followed by different letters are significantly different at P<0.05 Student-Newman-Keuls (SNK) test for variables.

The highest number of bracts formation was obtained in uninfested AFCOTT-BENIN (4.33) with *C. puncticollis* which indicates a significant difference from all the other treatments. Infested AFCOTT-BENIN had 3.33 bracts which was not significantly different from uninfested SAMCOT 8 with 3.67 bracts. The lowest bract number was recorded on SAMCOT 8 (2.33) infested with *C.puncticollis* in Table 3.

The same pattern was repeated as regards buds number where AFCOTT-BENIN has an average of 5.33, and the lowest infestation was SAMCOT 8 (2.0). The rest of the treatments didn't vary significantly from one another. For the bolls and seed-cotton weight obtained, it was also similar where AFCOTT-BENIN had 4 bolls/plant and yield of 40.71 (gm) seed-cotton weight. Infested SAMCOT 8 had average of less than 1 boll, seed-cotton weight of 18.46gm (Table 3). However not all the bracts and buds formed were able to sustain bolls development to maturity that is they did not form mature bolls that opened or produced healthy seed cotton. The seed-cotton weight for plastic potted cotton is shown in Figure 2. The (%) reduction in yield of seed-cotton was 32.2% rated on a scale of 1-5, where the damage rating of 4 was recorded within a range of 31 – 40%. On the overall, there was a significant difference in the weights of seed-cotton 22.56g in the infested cotton as against 33.35g in the uninfested.

However, in comparison of cotton artificially infested with *C.puncticollis* and sweet potato, when infested at 4 WAP and 7 WAP, the yield loss of up to 80% and 95%, respectively for sweet potato was obtained compared to 32.2% reduction in yield of seed cotton. The percentage damage on sweet potato far exceeds that of seed-cotton. There was significant difference between the two planting dates of sweet potato in yield loss due to *C. puncticollis* damage (Table 4). The extent of damage on sweet potato is shown on Plates 3 – 5.

Comparing damage caused by *C.puncticollis* on sweet potato foliage on the other hand with *I. eriocarpa* weed, (Table 5), there was no significant difference in area of leaves (foliage) percentage (%) reduction. Comparing the weight of undamaged *I. batatas* and *I. eriocarpa* leaves, that of *I. batatas* leaves was significantly higher than the damaged leaves of *I. batatas* and *I. eriocarpa* but not with undamaged *I. eriocarpa* (Figure 3 and Plates 3, 4 and 6), that is, no significant difference between damage *I. batatas* and undamaged *I. eriocarpa* leaf weight.

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Table 4: Damage potential of artificially infested sweetpotato with *Cylas puncticollis* Boh. at 2 stages.

Infestation stages	Weight of sweet potato roots (g)	Yield loss (%)
Uninfested (control)	53.83a	0.00a
Infested 4 WAP*	2.35b	95.93b
Infested 7 WAP*	10.27b	80.51c
Mean	22.15	58.81
C.V (%)	19.34	7.01

Means followed by the same letters in a column are not significant, while means with same letters are significant at P<0.05, using Student-Newman- Keul test for variables.
*WAP = weeks after planting

Table 5: Comparative Damage on wild and domesticated *Ipomoea* spp. leaves by *Cylas puncticollis*

Ipomoea leaf	Fresh weight of punctured leaves		Damage (%)
	Damaged (g)	Undamaged (g)	
I. batatas	0.96	1.84	46.95
I. eriocarpa	0.61	1.37	54.90
Mean	0.78	1.61	50.92
S.E. +	0.07NS	0.23NS	8.21NS
C.V. (%)	15.11	24.14	27.89

NS = Not significant

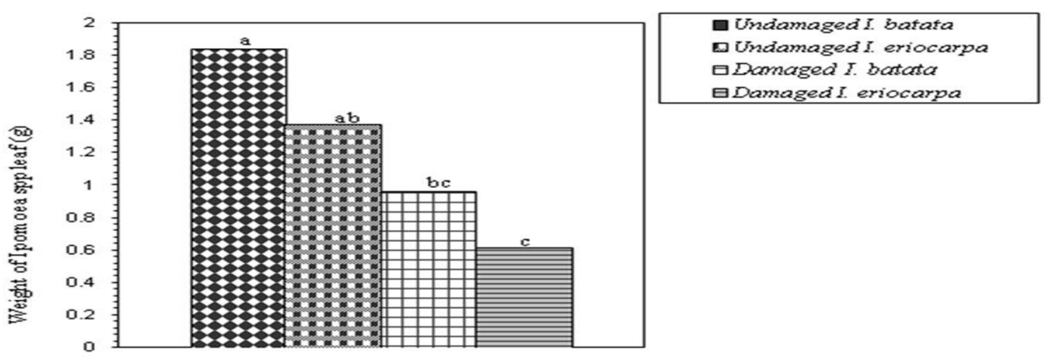

Figure 3: Damage potential of *C. puncticollis* on leaves of *Ipomoea* spp.

Means followed by the same letters are not significantly different at P<0.05
SNK (Student-Newman-Keuls) test for variables

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Plate 3: Root of sweet potato tubers infested at 4WAP* (left) and 7WAP harvested after 1st and 2nd leaves abscission, when new leaves started sprouting at 16WAP*

Plate 4: Damaged sweet potato tuber and leaves at harvest (24WAP*) showing 100% yield loss infected with fungi/bacteria (soft and dry rot)

Plate 5: Completely damaged SP* tuber artificially infested with *C. punticollis* showing plenty emergence holes, adult *Cylas* and fungal rot.

Plate 6: Damaged leaves of *Ipomoea eriocarpa* by *C. punticollis* on cotton farmers' field where maize is planted at the borders.

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DISCUSSION

Results obtained from the investigation indicated that, *Cylas puncticollis* is a potential economic pest, emerging as a serious threat to the formation and development of fruiting bodies in cotton and to the production of cotton. Fortunately, the damage varied with cotton varieties. The variety recommended for eastern zone (SAMCOT 8) though has a lower yield than the variety obtained from AFCOTT foreign company (AFCOTT- BENIN).

AFCOTT Company in Nigeria (is a foreign oil seed company of cotton and other oil seeds in Adamawa state, which acquires supplies of cotton seeds from local farmers and process vegetable oil). Where AFCOTT gets its seeds is not clear. Research has earlier indicated the presence of *Cylas puncticollis* in Nigeria before (Nwana, 1979; Hill and Waller, 1988; Anon., 1996; Smit and Huis, 1998; CAB International, 2003). However it was known to be a pest of sweet potato only and not of cotton. The presence of *Cylas puncticollis* in such concentration as observed at Ngurore where AFCOTT Company is located points to the fact that the pest probably had unknowingly become the pest of cotton somewhere (probably in countries that supplies AFCOTT) and thus imported by AFCOTT through the purchase and importation of seed-cotton. Its prevalence on other members of the malvaceae family indicates the possibility that, *Cylas puncticollis* is seriously exploiting the possibilities of increasing its host-range other than the sweet potato in Nigeria (Malgwi and Onu, 2013). In the present investigation, *C. puncticollis* proved to be a versatile pest on cotton, weeds and have been hibernating and diapausing in thrash and in cotton stem and even in ratoon cotton which suggested that once it establishes itself, eradication may be difficult locally as earlier reported by Malgwi (2011); Malgwi and Onu (2013). This poses a serious threat to the cotton industry in Nigeria since a bulk of cotton products, mostly come from local farmers who knows little about the bio-ecology of the weevils and other insects. The results obtained in the use of screened cages and plastic pots showed little or no difference from those obtained in the open field. This suggests that *Cylas puncticollis* has very high ecological aptitude adapting easily to its new habitat. This agrees with Smit (1997) that it is a versatile insect and can easily adapt to a wide range of soil or environmental conditions in the tropics. The question is, could it be possible that *C. punticollis* both appeared on cotton at the same time with the known cotton pest, *Anthonomus grandis* Boh in1843 in the USA? Or could there close resemblances and behaviour might have been overshadowed by the already identified *A. grandis* on cotton? Was this the reason why it was not recorded in literature before? Was it also possible that *Cylas* was brought to the cotton fields by flood waters from a sweet potato field elsewhere, and not actually brought in through the importation of seeds by AFCOTT? These are still the 1 million dollar questions that need answers.

However, the high percentage of damage done to cotton resulting in huge loses in cotton yield (32.20%) as recorded in the present investigation suggest the fact that *Cylas puncticollis* Boh., has also become a major pest of cotton in Northern Nigeria. Although the pest status of *C. puncticollis* is yet to be determined, as compared to sweet potato that has been determined, the damage potential determined on cotton in this study poses a serious threat in terms of its damage percentage of above 10%.

It was necessary at this point to compare sweet potato with cotton damage. Since when *C. puncticollis* was artificially infested in cotton and sweet potato, the damage was rated giving

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32.2% on cotton as compared to sweet potato its major host giving yield reduction or loss of 81% and 96% depending on the time sweet potato was planted. This further prooved that *C. puncticollis* is a true pest of sweet potato as earlier recorded by researchers (Jansson and Raman, 1991; Smit, 1997; Capinera, 1998) as well as on cotton now. The pest preferred the young bracts, developing buds and bolls, it rarely punctures cotton leaves on observation. Only where *I. eriocarpa* was entwined on the field with cotton plant that a few punctures on the cotton leaves was observed where *C. puncticollis* were found. It could be that the foliage of *I. eriocarpa* is sweeter or preferred than cotton on which high gossypol content was found in literature not palatable to most insects (Mathhews, 1989). This has to be looked into to find out the preferential choice of *C. puncticollis* to foliage of *I. eriocarpa* and *I. batatas* than *G. hirsutum*. This is the reason why a comparison of foliage reduction in yield by weight was carried out between the two species of *Ipomoea* of which *I. eriocarpa* was abundant on cotton farm.

The weed, *I. eriocarpa* found on cotton field at Ngurore might have attracted *C. puncticollis* which could have been dispersed by run-off waters and flood from sweet potato farms, somewhere at Wurotalla where sweet potato is cultivated since the weevils could not fly long distances (Smit, 1997; Capinera, 1998 and Malgwi, 2007). However, the positive absence of *C. puncticollis* at Sangere far away from Ngurore where the weeds were also found and its presence at Gombi and Mubi where cotton was cultivated by farmers who obtained imputs at AFCOTT and are growing cotton for the industry suggests that, *C. puncticollis* must have been imported by AFCOTT unknowingly through the purchase of seed-cotton from the neighbouring country Cameroun via Mubi → Gombi → Ngurore (AFCOTT) (Malgwi *et al.*, 2011). This also suggests that plant guarantine from country to country or within a country will play a major role in controlling *C. puncticollis* as a component of IPM and which is a major finding in this research. However, this is a personal observation which has to be looked into since *C. puncticollis* was found on cotton at Mubi, Gombi, but not at Sangere where cotton is rarely cultivated (Malgwi, 2007 and Malgwi *et al.*, 2011).

The association of *I. eriocarpa* and *G. hirsutum* suggests that, *I. eriocarpa* on field increases the abundance of *C. puncticollis*, which gives a clue of reducing the weevil damage on cotton as an important component in developing an IPM programme for *C. puncticollis*, together with the other weeds, the weevils were found, which was earlier discussed (Malgwi and Onu, 2011).

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