African Journal of Agricultural Research Vol. 3 (3), pp. 205-214, March 2008
Available online at http://www.academicjournals.org/AJAR
ISSN 1991-637X © 2008 Academic Journals

Full Length Research Paper

Survey of insect species associated with cashew (*Anacardium occidentale* Linn.) and their distribution in Ghana

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Accepted 29 February, 2008

Knowledge of the insect complex associated with any crop is essential for developing pest control strategies for the crop. Literature on cashew insects is lacking in Ghana. Field surveys were conducted from July 2003 to October 2005, to collect and identify the insect fauna on cashew. The surveys were conducted in 13 major cashew growing areas within ten districts of the Northern, Upper West, Brong-Ahafo and Eastern Regions of Ghana. Pyrethroids knock down and visual examination methods were used. A total of 170 insect species were collected. Eighty nine species of the total collection were identified to family level, 57 of which were identified to at least the generic level.

Key words: Survey, insect species, distribution, cashew, Ghana.

INTRODUCTION

Cashew was introduced into Ghana by the Government in the 1960s for afforestation in the savannah, coastal savannah and forest-savannah transition zones in Greater Accra, Eastern, Volta and Brong-Ahafo regions (Anon, 2005). Its cultivation was also considered essential for tree cover in eroded areas where land reclamation programmes were under way to prevent further erosion. Large scale cultivation of the crop started in 1991 and by 1997, the area under cashew cultivation nation-wide was 12,500 ha. Between 2000 and 2004, incentives were provided to farmers in the form of loans and improved planting materials to establish new and rehabilitate old plantations. Consequently, there was a marked increase in acreage from 18,000 ha to 51,831 ha, with a corresponding rise in nut yield from 3,600 MT to 25,915 MT (Anon 2005).

Cashew is potentially a great socio-economic crop to Ghana. The commodity of commercial importance is the nut, which contains 47% fat, 21% protein and 22% carbohydrate, vitamins, especially thiamine (Ohler, 1979). Cashew nut proteins are complete, having all the essential amino acids, and a kilogramme of the nut yields about 6000 calories compared to 3600 from cereals, 1800 from meat and 650 from fresh citrus fruit (Nambiar et al., 1990). As majority of the fatty acids present in the nuts are unsaturated, they are easy to digest, and can therefore, be consumed safely by young and old alike (Nambiar et al. 1990). A liquid obtained from the shell of the nut, the cashew nut shell liquid (CNSL), is used widely in brake linings of motor vehicles, paints, varnishes and laminated products (Murthy and Sivasamban, 1985). It is also used as a plywood adhesive (Akaranta et al., 1996) and a low-cost replacement for phenol in resole resins (Mahanwar and Kale, 1996), as a component to increase the tensile properties, as flame retardants of natural rubber (Menon, 1997) and as a long-life, highly bioactive, antifouling 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; Laurens et al. 1997), and antifungal and antibacterial (Echendu, 1991; Kubo et al., 1993; Weerasena et al., 1993).

The cashew tree is infested by numerous insect pests elsewhere at different stages of its growth (Eguagie, 1972; Pillai et al., 1976; Devasahayam and Nayar, 1986; Malipatil and Houston, 1990; Xianli and Van Der Geest

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Figure 1. Cashew insect species survey sites.

1990). There is, however, very little information on the insect species associated with the tree in Ghana, other than brief studies by Boakye (1995). This paper reports on the insect species occurring on cashew trees in the Northern, Brong-Ahafo, Upper West and Eastern Regions of Ghana, emphasizing their distribution, time of occurrence, stage of crop development infested and the role of the various species of insects.

MATERIALS AND METHODS

The study was conducted from July 2003 to October 2005 in 13 major cashew growing areas randomly selected within ten districts of the Northern, Upper West, Brong-Ahafo and Eastern Regions of Ghana (Figure 1).

Insect samples were taken from the various developmental stages of the crop, that is, seeds, nursery seedlings, transplanted seedlings, pre-fruiting stage and the mature trees including inflorescence and fruits. Two methods were used for the sampling: pyrethroid knockdown and visual examination.

Pyrethroid-knockdown method was used to determine insect species distribution and their relative abundance on mature cashew tree (4 years and above). A one-hectare cashew plot of different ages was demarcated out of 4.0 ha at the CRIG sub-station at Bole ($2^{o}30'$NW; $9^{o}2'$N) in the Northern region and farmers' farms at the other selected localities. With the exception of the CRIG plantation at Bole in which the trees were the Brazilian dwarf type and evenly distributed at a planting distance of 10 x 10 m triangular, the rest had planting distances ranging from 7 x 7 m to 12 x 12 m and the types were mixed. Each month, 10 trees were randomly selected from each field and sprayed thoroughly with 0.45% solution of Karate (lambda cyhalothrin) 2.5EC (a synthetic pyrethroid), using a *solo*-motorized mist blower. The sprayed trees were vigorously shaken 30 – 60 min later and all insects that dropped on a 5 x 5 m white cloth spread underneath the trees were collected for counting and identification.

Twenty-five trees were randomly selected from another 1-ha plot of cashew at Bole and 30 panicles (inflorescence) and 30 fruits (young and mature apples and nuts) were selected per tree and observed for insect species and their damage each month. By means of a 2 m ladder, the 30 panicles and 30 fruits were first examined in situ on each tree and later plucked by hand. Each sample was then carefully examined and teased out for the presence of insects and their damage. All developmental stages of insects (eggs, larvae, nymphs, pupae and adults) were recorded. Panicles and fruits (apples and nuts) were considered damaged when there were symptoms of brownish and watery lesions, necrotic lesions, dieback and fruit deformation with scars. In addi-

Figure 2. Adult *Helopeltis schoutedeni*.

Figure 3. Adult *Pseudotheraptus devastans*

tion, 100 randomly selected trees were tagged in each location and their stems, branches and twigs were inspected monthly for fresh entry and exit points of stem and twig borers. Fresh entry points on two trees at each location were covered with nylon net, the open ends of which were tied tightly and left in the field to trap the emerging adult borers. The emergent insects were killed using ethyl acetate, for identification. Additional 50 nuts were randomly sampled per site, kept in a 5000 ml container in the laboratory and observed weekly for storage insects.

Observations on transplanted seedlings and the pre-fruiting phases were restricted to the CRIG nurseries and plantations at Bole, where the various developmental stages of the crop (nursery seedlings, transplanted seedlings, pre-fruiting phases: 1st, 2nd and 3rd years) were growing concurrently. One-hectare cashew plot was subdivided into 10 equal subplots. From each subplot, five plants of each developmental stage, were selected randomly (total of 50 trees), and assessed by visual examination up to hand-height (about 2 m high). The procedure was repeated monthly for 28 months, from July 2003 to October 2005.

To study insect species and damage on nursery seedlings, 500 cashews seeds/nuts were sown in poly bags measuring 7 x 10 cm and arranged in groups of fifty. Nursed seeds were watered and observed until seedling emergence (about 12 - 14 days after sowing). Inspection of seedlings for insects and their damage began a day after seedling emergence. Leaves and stems were carefully examined on daily basis and insects found and their damage recorded. Adult specimens were oven-dried at 80°C for 48 h and preserved with naphthalene balls for identification preservation. Insects of the Order Hemiptera, Diptera and Hymenoptera were preserved with 10% formaldehyde and immature insects in 70% ethyl alcohol. These methods are similar to those described by Dwomoh (2003).

RESULTS

In this survey 170 insect species were recorded comprising 31 Hemiptera, 60 Coleoptera, 31 Hymenoptera, 5 Dictyoptera, 13 Orthoptera, 17 Lepidoptera, 5 Odonata, 4 Homoptera, 3 Diptera and 1 Thysanoptera. A little over half of the total collections, eighty nine, were identified to family level out of which 57 were identified to at least the generic level. The other 81 specimens were only classified to Order and comprised 10 Hemiptera, 14 Lepidoptera, 27 Coleoptera, two Dictyoptera, five Odonata and 23 Hymenoptera. The identified specimens, their spatial and temporal distributions, the developmental stage of crop infested and the damage caused are presented in Table 1.

Most of the insects damaged the crop by sucking sap, defoliation, branch girdling, stem and twig boring and fruit and nut boring. Some were apparently harmless. A few beneficial species were also recorded either as pollinators or predators (Table 1).

The most devastating species belonged to the Order Hemiptera and included one Miridae, *Helopeltis schoutedeni* Reuter (Figure 2); five Coreidae, *Pseudotheraptus devastans* Dist. (Figure 3), *Anoplocnemis curvipes* F. (Figure 4), *Homoecerus pallens* F., *Clavigralla shadabi* Dolling and *Clavigralla tomentosicollis* Stal. They also included four Pentatomidae, that is; *Piezodorus rubrofasciatus* F., *Aspavia armigera* (F.), *Nezara viridula Linn*. and *Atelocera* sp., as well as one each of Pyrrhocoridae, *Dysdercus superstitiosus* F. and Alydidae, *Riptortus dentipes* F.

Others were the stem and twig girdler, *Analeptes trifasciata* F. (Coleoptera: Cerambycidae) (Figure 5) and the stem borer, *Apate telebrans* Pall. (Coleoptera: Bostrychidae) (Figure 6) as well as the apple chewers, *Diplognatha gagates* (Forst.) (Coleoptera: Cetoniidae), *Pachnoda cordata* (Figure 7) (Drury) (Coleoptera: Cetoniidae) and *Pachnoda marginata* (Drury) (Coleoptera: Cetoniidae).

In terms of prevalence and damage, *H. schoutedeni* was the most prevalent and destructive. It was present all year round and in all the localities surveyed, infesting nursery seedlings, transplanted seedlings, establishment

Figure 4. Male (arrowed) and female. *Anoplocnemis curvipes* copulating

Figure 6. Male (arrowed) and female *Apate telebrans*

Figure 5. Male (arrowed) and female. *Analeptes trifasciata* copulating

Figure 7. Adult *Pachnoda cordata*

phase of the plant and mature trees. Both nymphs and adults were found feeding on growing tips, foliar and floral flush, apples and nuts. Attack on foliar and floral shoots resulted in dieback and, in severe cases, entire foliar and floral flushes were shrivelled. Severely damaged shoots sometimes exuded colourless resin from the point of feeding.

Among the beetles, the branch girdler, *Analeptes trifasciata* was the most common and destructive. The adults were found on mature trees from January to April at Bole, Damongo, Tabiasi and Drobo. *A. trifasciata* was also found on cashew in the Afram plains, Ga districts and some parts of the Central region. They fed on the branches of the cashew tree, leaving rings around them and cutting through phloem tissues. The branches eventually dry and break off. The stem borer, *Apate telebrans* occurred on cashew from September to January in all the localities surveyed. The larvae bored into tree trunks and twigs of mature trees. The prominent apple eaters identified, *Diplognatha gagates* (Coleoptera: Cetoniidae), *Pachnoda cordata* (Coleoptera: Cetoniidae), *Pachnoda marginata* (Coleoptera: Cetoniidae) occurred in all localities from January to April, when there were abundant young and mature apples in the field. Adult beetles fed on the apples creating wounds at the point of feeding, which predisposed the apples to secondary infestation by *Drosophila* sp. and infection by unidentified fungi and bacteria.

DISCUSSION

This study is the first most widespread survey of cashew insects in Ghana. While testing the efficacy of some che-

Table 1. Insect species associated with cashew, time of occurrence, plant part attacked and nature of damage in Ghana. 2003 -2005.

Insect Order/Family/Genus/Species	Location/Distribution	Period of occurrence	Parts attacked and damage caused
Anoplocnemis curvipes (F) (Hemiptera: Coreidae)	Bole, Sawla, Dawadawa, Jirapa, Tizza, Takpo, Wenchi, Drobo and Kintampo	August - April	Found on mature trees. Both adults and nymphs attack flushing shoots and developing apples and nuts by sucking juice from them. Damaged foliar, apples and nuts turn pale green in colour and wither. The withered foliar, apples and nuts turn brownish in colour but remain attached to the tree.
Pseudotheraptus devastans (Dist.) (Hemiptera: Coreidae)	Bole, Sawla, Jirapa, Tizza, Nimbaare, Takpo, Wenchi, Drobo and Somanya	January - April	Found on both young and mature trees. Adults suck sap and juice from shoots, young apples and nuts. Points of stylet insertion develop necrotic lesions. that appear as black, sunken, elongated spots on the epidermal tissue. Attacked apical meristems cease to grow and damaged young fruits abort.
Homoeocerus pallens (F) Hemiptera: Coreidae	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Takpo, Wenchi, Drobo, Kintampo and Somanya	October - April	Found on both young and mature trees. Attack and damage similar to those of *P. devastans*.
Clavigralla shadabi Dolling (Hemiptera: Coreidae)	Bole, Damongo, Tizza, Nimbaare, Tabiasi, Takpo, Wenchi, Drobo and Kintampo	October - March	Found on both young and mature trees. Adults feed on flushing shoots, water suckers (shoots developing from the base of the tree), apples and nuts. Severely damaged shoots and apples shrivel and wither.
Clavigralla tomentosicollis Stal. (Hemiptera: Coreidae)	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tabiasi, Takpo, Drobo and Kintampo	November - April	Found on both young and mature trees. Adult feeds on flushing shoots and nuts.
Piezodorus rubrofasciatus (Hemiptera : Pentatomidae)	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare, Tabiasi, Takpo and Drobo,	November - May	Found on both young and mature trees. Adults feed on flushing shoots. Severely damaged shoots exude colourless gum from the points of feeding.
Nezara viridula Linn. (Hemiptera: Pentatomidae)	Drobo, Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare, Tabiasi and Kintampo	December - May	Found on mature trees. Adults suck sap from young cashew nuts. Attacked nuts become dark green and further turn black and the nuts shrink and die. When attack on the nut is early, they abort.
Atelocera sp. (Hemiptera: Pentatomidae)	All localities	July - May	Found on mature trees. Nymphs and adults suck growing tips and flushing shoots.
Apate telebrans Pall. (Coleoptera: Bostrychidae)	All localities	September - January	Found on mature trees. Larva bores into tree trunks and twigs. Attacked twigs sometimes break off.
Diplognatha gagates (Forst.) (Coleoptera: Cetoniidae)	All localities	January - April	Found on mature trees. Adults feed on young and mature apples, predisposing them to secondary infestation by Drosophila sp. and infection by unidentified bacterium.
Pachnoda cordata (Drury) (Coleoptera: Cetoniidae)	All localities	January - April	Found on mature trees. Adults feed on young and mature apples, predisposing them to secondary infestation by Drosophila sp. and infection by unidentified bacterium.

Table 1. Contd.

Pachnoda marginata (Drury) (Coleoptera: Cetoniidae)	All localities	January - April	Found on mature trees. Adults feed on young and mature apples, predisposing them to secondary infestation by Drosophila sp. and infection by unidentified bacterium.
Philematium festivum F. (Coleoptera: Cerambycidae)	Bole, Damongo, Sawla, Nimbaare, Tabiasi and Takpo	November - March	Found on mature trees. Larvae bore into tree trunks and twigs. Attacked branches can break off.
Analeptes trifasciata F. (Coleoptera: Cerambycidae)	Bole, Damongo, Tabiasi and Drobo	November - March	Found on mature trees. Adults girdle tree trunks and branches in a V-shape. Only a small segment of the branch remains, which is unable to support its full weight and hence eventually breaks off.
Prosopocera lactators F. (Coleoptera: Cerambycidae)	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare and Tabiasi,	October - February	Found on mature trees. Larva bores into tree trunks and twigs
Zographus regalis Brown. (Coleoptera: Buprestidae)	Bole, Damongo and Tabiasi	November - March	Found on mature trees. Larva bores into tree trunks and twigs
Mylabris bifasciata Deg. Coleoptera : Meloidae	Bole	January - May	Found on mature trees. Adult feeds on inflorescence and tender foliage
Asbecesta cyanipennis Har. Coleoptera : Galerucidae	Bole, Drobo, Kintampo and Wenchi	June - July	Found on both young and mature trees. Foliage feeder
Chilomenes lunata F. Coleoptera: Coccinellidae	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare, Wenchi, Drobo, Kintampo and Somanya	October - February	Found on both young and mature trees. Larvae and adults prey on aphids and early nymphs of H. schoutedeni
Phaneroptera sparsa F. Orthoptera: Tettigoniidae	All localities	August - January	Found on both young and mature trees. Foliage feeder
Conocephalus longipennis L. Orthoptera: Tettigoniidae	Bole, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare, Tabiasi, Takpo, Wenchi and Drobo	August - January	Found on both young and mature trees. Foliage feeder
Anacridium sp. Orthoptera: Acrididae	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare and Tabiasi	October - December	Found on both young and mature trees. Foliage feeder
Polyspilota variegata Oliv. Orthoptera: Acrididae	Bole, Damongo, Sawla, Jirapa, Tizza, Tabiasi and Takpo,	October - December	Found on both young and mature trees. Foliage feeder
Atractomorpha aberrans K. Orthoptera: Acrididae	Bole, Damongo, Sawla, Jirapa, Tizza, Nimbaare, Tabiasi and Takpo,	October - February	Found on mature trees. Foliage feeder
Acrida turrita L Orthoptera: Acrididae	Sawla, Jirapa, Tizza, Tabiasi and Takpo,	November - December	Found on both young and mature trees. Foliage feeder
*Zonocerus variegatus (*L.) Orthoptera: Pyrgomorphidae	Wenchi, Bole, Drobo and Kintampo	December - April	Found on both young and mature trees. Foliage feeder
Pantelia horrenda Wlk. Orthoptera: Tetrigidae	Sawla, Jirapa, Tizza, Tabiasi and Takpo,	November - December	Found on both young and mature trees. Foliage feeder

Table 1. Contd.

Gryllus lucens (Wlk) Orthoptera: Gryllidae	Wenchi, Bole and Kintampo	June - August	Found on nursery seedlings. Nymphs and adults burrow in the ground and cut nursed seedlings at ground level
Acrocerops sp. Lepidoptera: Gracilariidae	All localities	May - November	Found on both young and mature trees. Larvae are leaf miners of tender foliage of both nursed seedlings and mature trees. Mining destroys epidermal layer of the lamina. Foliage later appears scotched.
Euchrysops malathana Boisd. Lepidoptera : Lycaenidae	Bole and Damongo	September - November	Found on both young and mature trees. Foliage and floral feeders
Sylepta derogata (F.) Lepidoptera : Pyralidae	Bole, Wenchi, Drobo and Kintampo	June - July	On nursery and transplanted seedlings. Leaf rollers/feeders
Drosophila melanogaster (Meigen) Diptera: Drosophilidae	All localities	February - April	Found on mature trees. Adult feeds on rotten apples
Sphodromantis lineola (Burm) Dictyoptera: Mantidae	All localities	January - December	Found on both young and mature trees. Predator of nymphs of flying insects including *H. schoutedeni* and *Dysdercus superstitiosus*
Tarachodes afzelii Roy. Dictyoptera: Mantidae	Bole, Damongo, Sawla, Dawadawa, Jirapa, Tizza, Nimbaare, Tabiasi and Takpo	January - December	Found on both young and mature trees. Predator of nymphs of flying insects including *H. schoutedeni* and *D. superstitiosus*
Amorphoscelis sp. Dictyoptera: Mantidae	All localities	January - December	Found on both young and mature trees. Predator of nymphs of flying insects including *H. schoutedeni* and *D. superstitiosus*
Stictococcus sp. Homoptera: Coccidae	All localities	December - May	Found on mature trees. Sap suckers. Live on young fruits and twigs. Found in close association with *O. longinoda, C. striatula* and *P. megacephala* that tend them.
Planococcoides njalensis (Laing) Homoptera: Pseudococcidae	All localities	January - December	Found on mature trees. Sap suckers. Live on young fruits and found in close association with *O. longinoda* and *C. striatula* that tend them.
Toxoptera aurantii (Boy.) Homoptera: Aphididae	All localities	February - April	Found on mature trees. Sap suckers. Live on young fruits and found in close association with *O. longinoda, C. striatula* and *C. olivieri* that tend them.
Aphis sp. Homoptera: Aphididae	All localities	July - April	Found on mature trees. Sap suckers. Live on terminal shoots and fruits and found in close association with *O. longinoda, C. striatula* and *C. olivieri* that tend them.
Pheidole megacephala F. Hymenoptera: Formicidae	All localities	January - December	Found on both young and mature trees. Predators and scavengers. Found in close association with some unidentified aphids and the scale insect, *Stictococcus* sp.
Crematogaster africana Mayr. Hymenoptera: Formicidae	All localities	January - December	Found on both young and mature trees. Predators and scavengers. Found in close association with some unidentified aphids and the scale insect, *Stictococcus* sp.
Crematogaster striatula Emery Hymenoptera: Formicidae	All localities	January - December	Found on mature trees. Predators and scavengers. Found in close association with the mealybug, *Planococcoides njalensis,* the scale insect, *Stictococcus* sp. and the aphid, *T. aurantii*

Table 1. Contd.

Oecophylla longinoda Latr. Hymenoptera: Formicidae	All localities	January - December	Found on mature trees. Predators and scavengers. Capture nymphs of *Helopeltis* and *Anoplocnemis* nymphs. Found in close association with the mealybug, *Planococcoides njalensis,* the scale insect, *Stictococcus* sp. and the aphid, *T. aurantii*.
Cataulacus guineensis F. Smith Hymenoptera: Formicidae	All localities	January - December	Found on mature trees. Mostly scavengers.
Polyrachis laboriosa Smith Hymenoptera: Formicidae	All localities	January - December	Found on mature trees. Mostly scavengers.
Camponotus olivieri F. Hymenoptera: Formicidae	All localities	January - December	Found on both young and mature trees. Honey dew harvesters. Found in close association with some unidentified aphids and the scale insect, *Stictococcus* sp.
Apis mellifera F. Hymenoptera: Apidae	All localities	December - April	Found on mature trees. Pollinators of cashew inflorescence
Selenothrips rubrocinctus (Giard) Thysanoptera : Thripidae	Wenchi, Drobo, Kintampo and Somanya	July - December	Found on both young and mature trees. Both nymphs and adults suck and scrape the abaxial surface of leaves, mainly along the main veins. Initial yellowish patches turn grey to give silvery appearance to the adaxial surfaces of leaves.

mical insecticides against *Helopeltis schoutedeni* and *Anoplocnemis curvipes* on cashew in Brong Ahafo region of Ghana, Boakye (1995) recorded some unidentified thrips, shield bugs, aphids, leafhoppers, blow flies and spittle bugs. These insects were also found in the present survey. In Nigeria, 141 species have been reported on cashew (Eguagie, 1972). In the present survey, 170 insect species were recorded, including *Helopeltis pallens, P. devastans, A. curvipes, D. superstitiosus, S. rubrocinctus, H. schoutedeni*, *A. trifasciata*, *R. dentipes* and the ants *Crematogaster* sp., *Polyrachis* sp., *Oecophylla* sp., which were also recorded in Nigeria, Cote d'Ivoire, Guinea Bissau and Guinea (Eguagie, 1972; Topper et al., 2001). This information suggests that cashew, which has become an important non-traditional crop in the West African sub-region, attracts a lot of potential insect pests. This can be dangerous to cashew plantation development in the West African states. Efforts should therefore, be made to curb the ravaging effect of these potential insect pests.

Prominent among the sap sucking bugs was the cashew mosquito, *H. schoutedeni*, which was prevalent throughout the year in all the localities surveyed and, observed on nursery seedlings, transplanted seedlings, establishing phase of the plant and mature trees. Several species of *Helopeltis* have been recorded on a vast number of plants in the tropical, oriental and Australian regions (Xianli and Van Der Geest, 1990; Stonedahl, 1991; Peng et al., 1995). In Ghana, two species, *H. bergrothi* on cocoa and *H. schoutedeni* on cashew were reported by Forsyth (1966) and Boakye (1995). This finding further confirms *Helopeltis* spp. as resident pests of cashew in most cashew growing communities in the world.

The survey identified a number of ant species on cashew some of which have earlier been recorded on the plant and other tree crops in Ghana (Forsyth, 1966). These include *Crematogaster striatula*, *Camponotus olivieri*, *Pheidole megacephala*, *Cataulacus guineensis*, *Polyrachis laboriosa*, *Oecophylla longinoda*, *Crematogaster striatula and Camponotus olivieri*. These ants were found tending the aphids, *Toxoptera aurantii* and *Aphis* sp., whilst in addition, *Pheidole megacephala* and *Oecophylla longinoda* tended *Planococcoides njalensis* and *Stictococcus* spp. *Cataulacus guineensis* and *Polyrachis laboriosa* were, however, not found in association with any Homoptera. The association of the ant species with the Homoptera might be due to their feeding habits. Way (1953) and Greenslade (1972) found most ant species to be active predators, scavengers and feeders of honeydew produced by several Homoptera species. Bigger (1981) reported that *Stictococcus sjostedti* and *Planococcoides njalensis* were the most common and most important honeydew sources for ants. It is interesting to note that although pseudococcids, coccids and aphids are sap sucking feeders they have never been identified as major pests of cashew (Barzman et al., 1996). Furthermore, Peng et al. (1999) found that *O. smaragdina* do not affect homopteran natural enemies during flowering and fruiting periods, resulting in very little

damage to the cashew crop. It is, therefore, possible that *O. longinoda* might also not affect homopteran natural enemies on cashew.

Some ant species particularly, *C. striatula*, *C. olivieri*, *C. guineensis* and *P. laboriosa* used crevices and hollows in cashew trees for nesting whilst *Pheidole megacephala* mostly made its nests in the soil at the base of the trees. *O. longinoda*, which weaves its nests with tender leaves, has long been recognized as a valuable or potentially valuable biological control agent especially against pest Hemiptera (Way and Khoo, 1992).

H. schoutedeni was the most prevalent insect pest encountered in the present study. It was present all year round and found in all the localities surveyed as well as on nursery seedlings, transplanted seedlings, establishing phase of the plant and mature trees. This confirms earlier findings by Boakye (1995).

Conclusion

The survey has revealed that a number (170) insect species occur on cashew in Ghana. A little over half of the total collections, eighty nine, were identified to family level out of which 57 were identified to at least the generic level. The remainder 81 species were classified only to the level of Order and comprised 10 species of Hemiptera, 14 of Lepidoptera, and 27 of Coleoptera. The others include two species of Dictyoptera, five of Odonata and 23 species of Hymenoptera. Most of the insects damaged the crop through sap sucking, defoliation, girdling, stem and twig boring and fruit and nut boring. Some were apparently harmless. A few beneficial species were also recorded either as pollinators or predators.

ACKNOWLEDGEMENT

This study forms part of the first author's PhD thesis at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Sincere acknowledgement is made to the entire Cocoa Research Institute of Ghana (CRIG) staff of the Entomology Division, Tafo and the Sub-station at Bole. This study was funded by CRIG and supported by Cashew Development project (Ministry of Food and Agriculture, Accra, Ghana).

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