CSCanada
Advances in Natural Science
Vol. 7, No. 2, 2014, pp. 33-39
DOI: 10.3968/4788

ISSN 1715-7862 [PRINT]
ISSN 1715-7870 [ONLINE]
www.cscanada.net
www.cscanada.org

A Faunistic Description of Endemic Arthropods Associated With Sesame

Henry O. Sintim[a],*; Ivy V. Yeboah-Badu[a]; Clement Akotsen-Mensah[b]; Kwame D. Ansah[a]

[a]Department of General Agriculture, School of Applied Science & Technology, Sunyani Polytechnic, Sunyani, Ghana.
[b]Forest & Horticultural Crops Research Center, Kade, Institute of Agricultural Research, College of Agriculture and Consumer Sciences, University of Ghana. Legon, Ghana.
*Corresponding author.

Received 12 February 2014; accepted 26 May 2014
Published online 30 June 2014

Abstract

Sesame (*Sesamum indicum* L.) Pedaliaceae is produced mainly in developing countries where abundant and inexpensive labour is available and usually by small holders. It is cultivated for its edible seeds which is high in nutritious fatty acids. In Africa sesame has in recent years been promoted to diversify agricultural production especially in the Sahel region. It has the potential to become an important field crop in Ghana especially in the drier regions. Unavailable field data on constraints to sesame production including its insect pests may be the reason for its non-commercial cultivation in Ghana. A preliminary survey of arthropods associated with sesame, was conducted in the transitional zone of Ghana during the 2009 growing season. In order to achieve maximum natural infestation, no conscious control measure was adopted. A wide spectrum of arthropods including chewers, suckers, pollinators, scavengers and predators were found. In all 60 insect species and 11 spiders were collected and identified at least to family level. It appears that, Araneae, Coleopterans, Hemipterans, Hymenopterans, Lepidopterans and Orthopterans may be important. These arthropods recorded on sesame in Ghana have several implications for the future. This includes several scenarios where these endemic insects will prefer sesame in a host shift situation; the beneficial populations could be exploited and incorporated as field banker crops in local farming systems, sesame could be used as a trap crop or it could be adopted as an attractor for insect pollinators in tree crop plantations. The description, incidence and dynamics of these important insects and spiders of sesame are discussed.

Key words: Exotic crops; Sesame; Endemic arthropods; Ghana

Sintim, H. O., Yeboah-Badu, I. V., Akotsen-Mensah, C. & Ansah, D. K. (2014). A Faunistic Description of Endemic Arthropods Associated With Sesame. *Advances in Natural Science*, *7*(2), 33-39. Available from: http://www.cscanada.net/index.php/ans/article/view/4788
DOI: http://dx.doi.org/10.3968/4788

INTRODUCTION

Sesame (*Sesamum indicum* L.) is a broadleaf crop that belongs to the Pedaliaceae plant family which has bell-shaped flowers and opposite leaves (Martin & Leonard, 1967). It is a hardy crop with nearly 3,000 commercial varieties around the world which are able to withstand a variety of climatic, soil, and growing conditions, and produce seed varieties of several different sizes and colors. Most of its production occurs in developing countries (Desai, 2004) where it is usually grown by small holders (Ram et al., 1990; Ashri, 2007).

Sesame has mainly been grown in countries where abundant and inexpensive labour is available (Schrodter & Rawson, 1984) for which Ghana could be a candidate. It is primarily grown in tropical to temperate zones from 40°S to 40°N latitude (Ashri, 1989; Bedigian & Harlan, 1986). It is productive under high temperature and can grow on residual moisture at the end of a rainy season. It hardly shed its leaves during its vegetative phenology but terminates and self-defoliates after podding. It is cultivated for its edible seeds (Weiss, 2000) and oil which is high in nutritious fatty acids (Shyu & Hwang, 2002; Biswas et al., 2001) or recently as a biofuel candidate (Saydut et al., 2008). When sesame was introduced to the United States from Africa in the latter parts of the 1800s,

it was said to be among the most valuable acquisitions the United States had ever made (Betts, 1999) because there was no believe there existed so perfect a substitute for olive oil. The highest producing countries are found in Asia (FAOSTAT-Sesame, 2000) perhaps due to its relatively diverse uses in these regions. In Africa sesame has in recent years been promoted to diversify agricultural production in the Sahel region (Hess & Dodo, 2004).

Sesame is grown and documented in most African countries but information on the cultivation or use of sesame in Ghana is not available and it is considered as an exotic crop. Local farmers grow sesame through trial and error approach. There is no systematic or well-defined research or production program and that makes sesame cultivation unattractive. For now it is grown as an adventure crop in some parts of Ghana either for its edible leaves or seeds. It has the potential to become an important field crop in Ghana especially in the drier regions. Several countries such as Germany, China, India Turkey and also Ghana have reports of ethnobotanical uses of sesame against health problems including, cancer, cold and colic (Beckstrom-Sternberg et al., 1994; Morris, 2002).

The pests that attack sesame plants have the potential to limit its economic production (Brigham, & Young, 1983). These pests need some review which may help circumvent future issues as sesame production expands in new environments. Historically, crop pests cause cosmetic damage in the early years of crop introduction but become more serious as production expands. Insects among pests are reported to cause the most damage to sesame (Ssekabembe et al., 2001) which is one of the major constraints in sesame production. A plethora of endemic insects have been documented on sesame from all the growing areas. In Bangladesh scientists working on sesame listed 29 insect species infesting sesame at various stages of plant growth (Biswas et al., 2001) whilst other workers in India collected and identified 65 insect species (Ahuja & Bakhetia, 1995). Being an exotic crop in Ghana, sesame could attract or host endemic insects known to be associated with other crops in Ghana. We therefore set up this survey to document the field arthropod dynamics of sesame as a prelude to the possible introduction and commercialization of sesame in Ghana.

1. MATERIALS AND METHODS

1.1 Site location

The study was carried out in the transitional zone of Ghana during the major rainy season of 2009. The area lies (latitude 9.42°N, Longitude 0.55°W and 180m altitude) in the Brong Ahafo Region of Ghana. It has a bimodal rainfall regime consisting of a major dry season (November - February) and a major wet season (April-July). Agriculture and forestry are the mainstay of the populace in this region. Farmers grow cereals, vegetables, tuber or root crops, plantain and tobacco interspersed within national forest reserves.

1.2 Trial Establishment

Three sites each measuring $10m^2$ spaced randomly within a ten hectare farm were labeled, cultivated into sesame plots and used as the sites for insect monitoring. Three sesame cultivars with maturity periods of 14 weeks were obtained from the Faculty of Horticulture, Chiba University, Japan was grown and monitored till harvest on the three $10m^2$ sites by manual drilling. This was later thinned to 10cm within rows. The varieties were alternated in the rows which were spaced, 40cm apart. Varietal effect however was not an option under consideration at this stage.

1.3 Insect Incidence and Abundance

The relative incidence and abundance of insects were monitored at weekly intervals during June to August 2009 of a growing season. Random samples of 75 plants were tagged from each site. These, the alternate plants and the immediate neighbourhood were thoroughly inspected for arthropods. The number or presence of each arthropod species found was identified and counted. Specimens or photographs of collected arthropods were confirmed with other scientists at the University of Ghana, Forest & Horticultural Crops Research Center.

2. RESULT ANALYSES AND DISCUSSION

Table 1
Arthropod Dynamics on Sesame During the 2009 Major Cropping Season in Ghana

Identified arthropod order and species / family	Number of species recorded										
	June 2009				July 2009				August 2009		
	6th	13th	20th	27th	4th	11th	18th	25th	1st	8th	15th-29th
ORTHOPTERA *Zonocerus variegatus*.; *Locusta migratoria; Abisares* sp.; *Melanoplus* sp.; *Attractomorpha* sp.; *Zabalius* sp.	0	5	6	5	4	2	3	3	4	3	3
LEPIDOPTERA *Agrostis* sp.; *Trichoplusia ni*; Geometridae; Sphingidae; Yponeumotidae; Pterophoridae	1	1	1	2	1	3	1	1	1	3	2
HEMIPTERA *Coenomorpha* sp.; *Leptocorisa* sp.; *Dysdercus* sp.; *Nezara viridula; Bemisia tabacci* ; *Anoplocnemis curvipes; Megacopta* sp.; *Geocoris* sp.; Acanthosomatidae; Reduviidae; Aphididae; Ciccadelidae	0	0	1	2	2	4	5	5	10	6	1

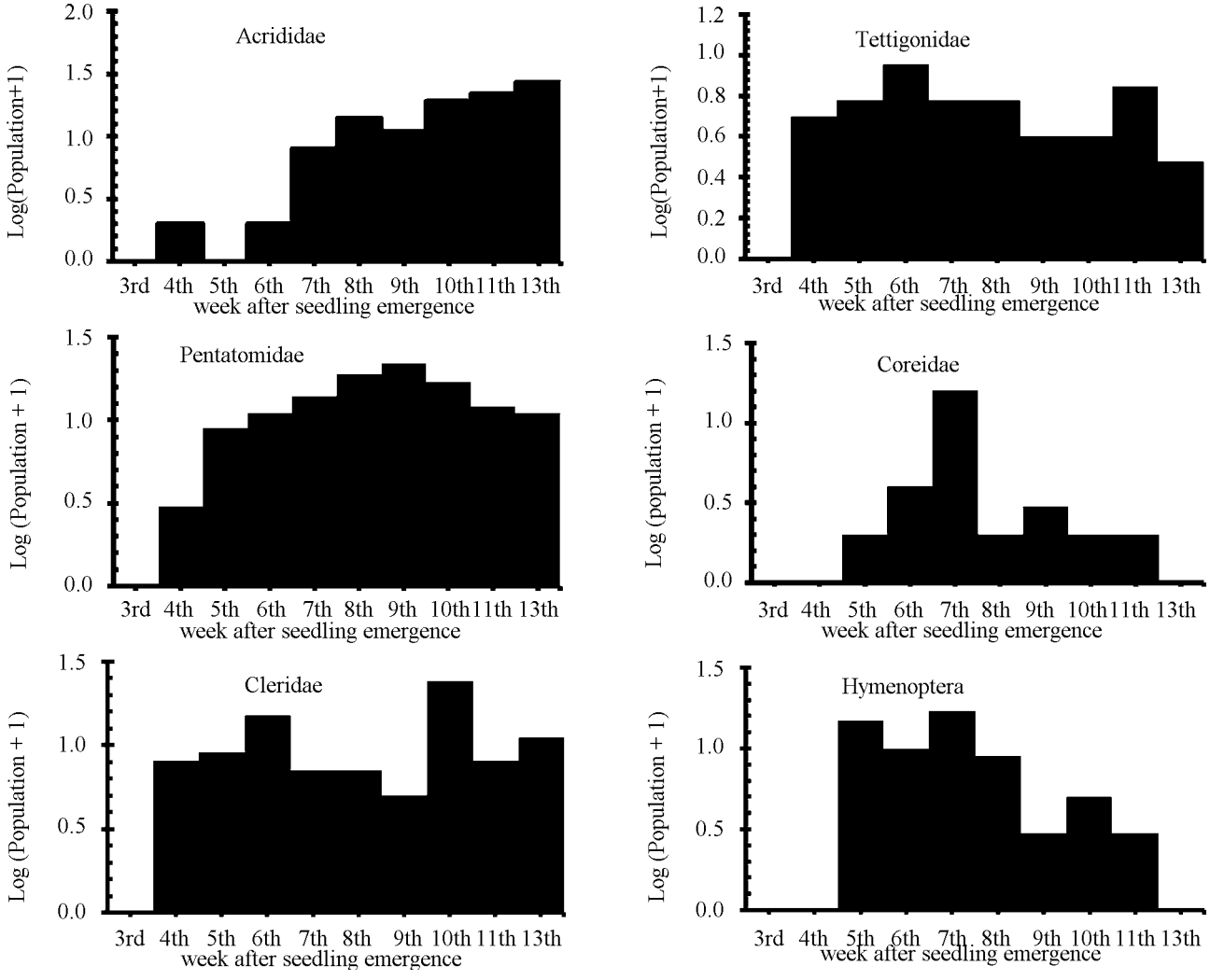
To be continued

Continued

Identified arthropod order and species / family	Number of species recorded										
	June 2009				July 2009				August 2009		
	6th	13th	20th	27th	4th	11th	18th	25th	1st	8th	15th-29th
DIPTERA *Sarcophaga* sp.; Tephritidae; Muscidae; Asilidae Sciaridae; Calliphoridae Mycetophilidae	0	2	2	1	1	1	4	4	2	2	1
HYMENOPTERA *Xylocopa pubescence; Xylocopa* sp.; *Halictus* sp.; *Anthidium* sp.; *Apis* sp.; *Oecophyla* sp.; *Dolichomutilla* sp. *Eumenes* spp.; *Camponotus* sp. Sphecidae; Braconidae	1	1	1	4	4	9	5	4	5	3	0
COLEOPTERA *Pharostynus cluteus; Ootheca mutabilis; Nisotra uniformis; Aphtona* sp.; *Lycus* sp.; *Pachnoda* sp.; *Longitarus* sp.; *Cheilomenes propinqua; Henosepilachna eleterii*; Cleridae; Scarabaeidae; Chrysomelidae	0	1	2	5	3	5	6	2	4	2	4
MANTODEA *Sphodromantis* sp.; *Pseudocreobotra* sp.	0	1	1	0	2	2	1	2	1	2	2
ARANEAE	0	1	1	3	0	1	2	1	2	2	1

Note. Insects were sampled once a week on 75 randomly selected plant stands and the immediate neighbourhood on three experimental plots which were 100-200 m apart

A broad range of insect species both beneficial and those injurious to sesame were collected from the crop and identified (Table 1). The species included those that are known to be pests in sesame in traditional growing areas such as leaf feeding beetles, pod suckers, whiteflies and the pod feeders of which many are regarded as a serious threat to sesame because of their destructiveness and extensive host range. Predatory spiders were also collected.



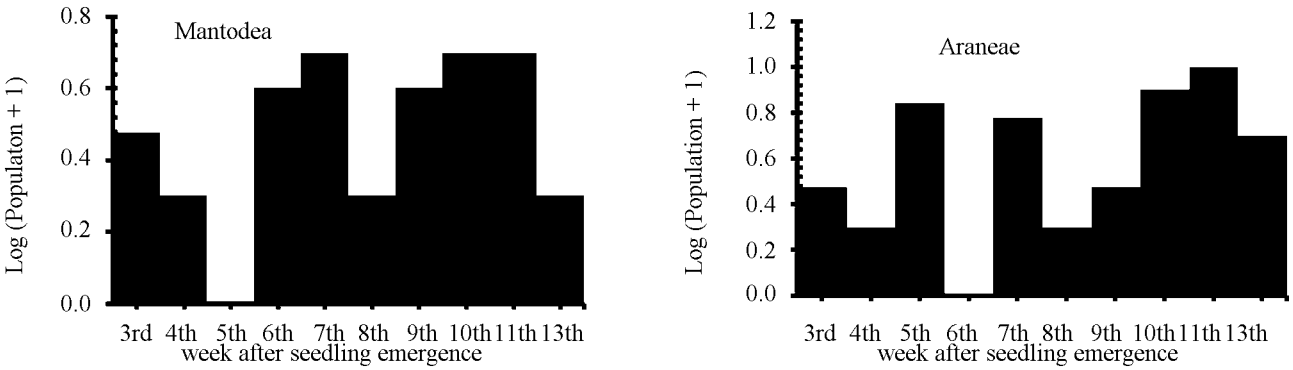


Figure 1
Population Trends of the Major Arthropods During the Phenology of Sesame

The first insect recorded on sesame was the cutworm (Lepidoptera) (Table 1). Seedling loss was suspected to be cutworm (*Agrotis* sp.) damage. This caterpillar characteristically cuts the seedlings at the ground level. The experiment was conducted during the major growing season and cutworms from nearby crops or bushes invaded the sesame seedling during the first week of June 2009.

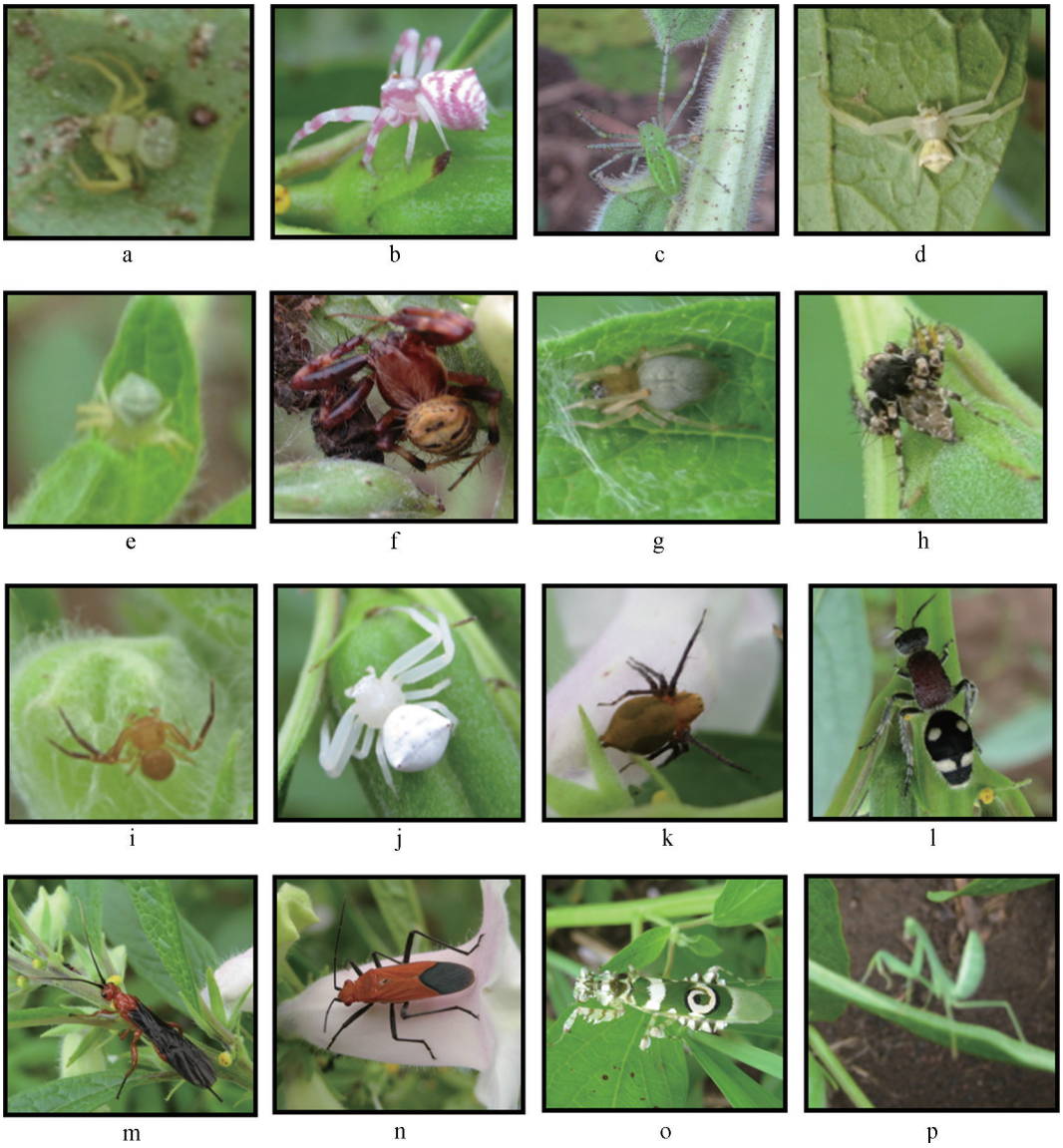


Figure 2
The Major Predators Associated With Sesame Crop During a Growing Season
(a - k: Araneae; l: Dolichomutilla, m - n: Hemiptera, o - p: Mantodea)

In the third week of plant growth, the arthropods sampled were spiders and mantids (Figure 1). The Mantodea recorded included *Sphodromantis* sp. and the rare *Pseudocreobotra wahlbergi*. Araneae species that were recorded (Figure 2) were highly sporadic. Out of the eleven Araneae species identified, the incidences of nine were for only one sampling week. The other two species were recorded for two or three consecutive sampling weeks. Two predatory Coccinelidae (Table 1) were recorded during the vegetative or podding stage.

The first incidence of adult insect pests started from the 13th June which was four weeks after seedling emergence. These insects included grasshoppers, moths, flies and a beetle. The major Orthopterans were Acrididae and Tettigonidae (Figure 1). Others were the Pygormorphidae including *Attractomorpha* sp., *Zonocerus variegatus*, *Melanoplus* sp. and *Zabalius* sp. and these named species were the most consistent (Table 1). At the vegetative stage, Hemiptera and Coleoptera were the predominant insects recorded on sesame. The leaf chewing beetles were consistent and were recorded during nine consecutive weeks. The highest occurring was a Cleridae species (Figure 1) and also at least eight species of Chrysomelids.

The incidence of Lepidoptera species took place during the vegetative and podding stages. Most of which were adult moths and the sporadic caterpillars were inchworms or loopers. The Hemiptera incidence which was either pests or predators included *Coenomorpha* sp. and *Leptocorisa* sp., the dominant species. For these insects both nymphs and adults were recorded. Other sporadic Hemiptera was the Pentatomidae, Coreidae, Acanthosomatidae, Cicadellidae and Aphididae. The predatory Hemiptera was Lygaeidae and Reduviidae and were recorded mostly at the podding stage.

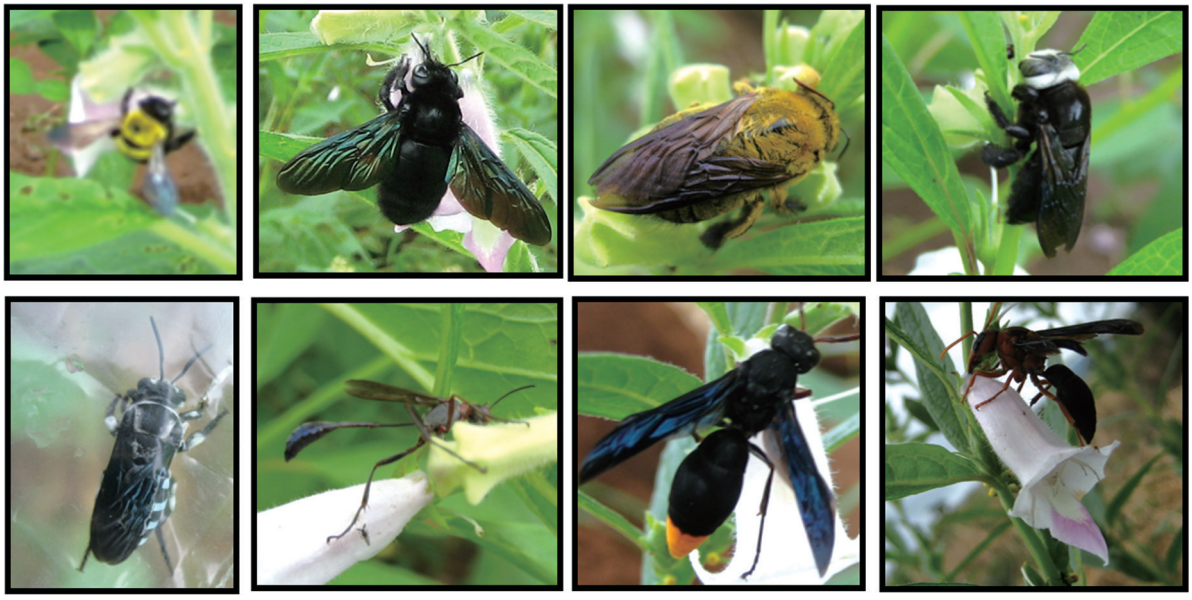


Figure 3
Pollinating Hymenoptera Associated With Sesame in Ghana

The Diptera recorded were Tephritidae, Calliphoridae, Muscidae and Mycetophilidae. These flies were recorded throughout the experimental period. Characteristic of pollinating hymenoptera, at least 14 species were recorded during the bloom stage of sesame (Table 1). Prominent among these were *Halictus* sp., *Anthidium* sp., *Apis* sp. and *Xylocopa* sp. (Figure 3). The others were Sphecids and Braconids. The true ants *Oecophylla* sp. were recorded consistently during the experiment and the velvet ant *Dolichomutilla* sp. which is considered a predator was recorded from the latter stages after podding. From Figure 1, five insect families: Acrididae, Tettigonidae, Coreidae, Pentatomidae, and Cleridae could be important pests of sesame. The Hymenoptera, Mantodea and Araneae could be a source of beneficial arthropods from sesame fields.

Sesame has been grown at several non-traditional locations including Missouri and Texas in the United States. There are even reports of sesame cultivation in Italy. In these locations sesame seemed almost uniquely distasteful to many leaf chewing insects and this was attributed to the use of insect resistant varieties. Through plant breeding, present varieties in the US for example have incorporated tolerance to all insects encountered since 1978. In other regions, however, sesame has been attacked on occasion by insects.

The range of insects found in the study was in agreement with that reported from other surveys conducted in traditional growing areas including Nigeria where about 32 insect pests have been reported to attack sesame causing varying levels of damage (Noniwu, 2009). In Japan scientists collected

several insects (ca. 10 families) of sesame (Sintim et al., 2010) where due to labour implications sesame growing is dwindling but in India sesame was reported to be infested by as many as 29 insect-pests belonging to 8 families including the leaf roller (capsule borer) which is a reported key pest (Gopinath et al., 2011). In Uganda 38 insect pest species were reported to infest sesame and the webworm and gall midge were considered the most crucial (Egonyu, 2005). In other reports from Bangladesh (Biswas et al., 2001) or Pakistan (Talpur et al., 2002) they indicated that insects of the five families; Pyralidae, Pentatomidae, Aphididae, Thripidae and Aleyrodidae constitute the important pests of field grown sesame. Again the 31 insect species identified in Egypt (Mahmoud, 2012) confirms that a fairly common spectrum of insects occur in sesame fields in all the growing areas but usually the beneficial insect populations are able to control the insect pests seen. The hymenopterans as usual formed the bulk of the pollinators during the bloom period (Mahmoud, 2012; Kamel, 1997).

Any assessment of new regions potential for sesame production would be aided by the knowledge of the insect fauna that is associated with this crop. The implications for these arthropods recorded on sesame in Ghana have several ramifications. This includes several scenarios where these endemic insects will prefer sesame in a host shift situation; the beneficial populations could be exploited and also used as a companion crop: as a field "banker crop" in local farming systems, as a trap crop or adopting sesame as an attractor for insect pollinators in tree crop plantations.

ACKNOWLEDGEMENTS

We extend our appreciation to the technical staff and students of Sunyani Polytechnic, the scientists at University of Ghana (Forest & Horticultural Crops Research Center, Kade) for the help in insect identification. The sesame seeds were a kind gift from Dr Toru Tashiro. I am grateful to Francis Barnes and Solace Sintim for editing the initial manuscript.

REFERENCES

Ahuja, D. B., & Bakhetia, D. R. C. (1995). Bioecology and management of insect pests of sesame—A review. *Journal of Insect Science, 8,* 1-19.

Ashri, A. (1989). Sesame. In G. Roebblen, R. K. Downey, & A. Ashri (Eds.), *Oil Crops of the World* (pp.375-387). New York, NY: McGraw-Hill.

Ashri, A. (2007). Sesame (*Sesamum indicum L.*). In R. J. Singh (Ed.), *Genetics resources, chromosome engineering, and crop improvement* (Volume 4, pp.231-289). Oilseed Crops. CRC Press, Boca Raton, FL, USA.

Beckstrom-Sternberg, S. M., Duke, J. A., & Wain, K. K. (1994). "*The ethnobotany database"* (Data version, July). Retrived from http://ars-genome.cornell.edu/cgi-bin/WebAce/webace?db= ethnobotdb

Bedigian, D., & Harlan, J. R. (1986). Evidence for the cultivation of sesame in the ancient world. *Economic Botany, 40,* 136-154.

Betts, E. M. (1999). *Thomas Jefferson's garden book* (1766–1824). Charlottesville, VA: Thomas Jefferson Memorial Foundation, Inc..

Biswas, G. C., Kabir, S. M. H., & Das, G. P. (2001). Insect pest of sesamum (*Sesamun indicum* Linn.) in Bangladesh, their succession and natural enemies. *Indian Journal of Entomology, 63*, 117-124.

Brigham, R. D., & Young, J. K. (1983). *Sesame performance tests at Lubbock*. Texas Agriculture Experimental Station Progress Report (No. 4131, p.6).

Desai, B. B. (2004). Seeds handbook: Biology, production, processing, and storage. *Science*, 787.

Egonyu, J. P., Kyamanywa, S., Anyanga, W., & Ssekabembe C. K. (2005). Review of pests and diseases of sesame in Uganda (pp.1411-1416). African Crop Science Conference Proceedings 7.

FAOSTAT-Sesame (2000, December 5). *Eleven-year global sesame seed production and productivity*. Retrived from http://ecoport.org

Gopinath, K. A., Venkateswarlu, B., Venkateswarlu, S., Yadav, S. K., Balloli, S. S., & Srinivasa, R. C., et al. (2011). *Organic sesame production* (p.34). Technical Bulletin, Central Research Institute for Dryland Agriculture, Santoshnagar, Hyderabad, Andhra Pradesh, India.

Hess, D. E., & Dodo, H. (2004). Potential for sesame to contribute to integrated control of *Striga hermonthica* in the West African Sahel. *Crop Protection*, *23*, 515-522.

Kamel, S. M. (1997). Occurrence and activity of hymenopterous insects on sesame flowers with special reference to their effect on crop production. *Annals of Agricultural Science, Moshtohor, 3,* 1713-1725.

Mahmoud, M. F. (2012). Insects associated with sesame (*Sesamum indicum* L.) and the impact of insect pollinators on crop production. *Pesticide Phytomedicine, 27,* 117-129.

Martin, J. H., & Leonard, W. H. (1967). Miscellaneous industrial crops. *Principles of field crop production* (pp.922-924). New York, NY: Macmillan.

Morris, J. B. (2002). Food, industrial, nutraceutical, and pharmaceutical uses of sesame genetic resources. In J. Janick & A. Whipkey (Eds.), *Trends in New Crops and New Uses* (pp.153-156). Alexandria, VA: ASHS Press.

Noniwu, G. O. (2009). *Package of practices for sesame production-Nigeria* (p.20). USAID Markets.

Park, S. J., & Kang, M. H. (2004). Functional properties of sesame seed. *Food Industry and Nutrition, 9,* 31-40.

Ram, R., Catlin, D., Romero, J., & Cowley, C. (1990). Sesame: New approaches for crop improvement. In J. Janick & J. E. Simon (Eds.), *Advances in new crops* (pp,225-228). Portland, OR: Timber Press .

Saydut, A., Duz, M. Z., Kaya, C., Kafadar, A. B., & Hamamci, C. (2008). Transesterified sesame (*Sesamum indicum* L.) seed oil as a biodiesel fuel. *Bioresource Technology, 99*, 6656-6660.

Schrodter, G. N., & Rawson, J. E. (1984). Herbicide evaluation studies in sesame. *Australian Weeds, 3*(2), 47-49.

Shyu, Y. S., & Hwang, L. S. (2002). Antioxidative activity of the crude extract of lignan glycosides from unroasted Burma black sesame meal. *Food Research International, 35*, 357-365.

Sintim, H. O., Tashiro, T., & Motoyama, N. (2010). Insect spectrum of a mixed cultivar sesame field. *Agricultura Tropica et Subtropica, 43*, 325-332.

Ssekabembe, C. K., Osiru, D. S. O., Ogenga-Latigo, M. W., Nantongo, S., & Okidi, J. (2001). *Some aspects of simsim production in northern and eastern Uganda* (Volume 5, pp689-697). African Crop Science Conference Proceedings.

Talpur, M. A., Khuhro, D. R., Rustamani, A. M., & Nizamani, I. A. (2002). Insect pests associated with sesame at Tando Jam. *Pakistan Journal of Applied Sciences*, *2*, 723-726.

Weiss, E. A. (2000). Sesame. In *Oilseed crops* (2nd ed., pp.282-340). London: Blackwell Science.

