SURVEY OF LARVAL PARASITOIDS OF COTTON BOLLWORMS IN UGANDA

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INTRODUCTION

The American bollworm (ABW), *Helicoverpa armigera* Hubner., the spiny bollworms (SBW), *Earias insulana* Boisd. and *E. biplaga* Wlk., (Lepidoptera: Noctuidae) and the pink bollworm (PBW), *Pectinophora gossypiella* Saunds. (Lepidoptera: Gelechiidae) are the major cotton bollworms not only in Uganda (El-Heneidy *et al.*, 1996) but also in many other African countries (Greathead 1966). They attack various crops including cotton, legumes, maize, sorghum, sunflower, tobacco and some vegetable crops. Damage is frequently localized on the reproductive parts of these crops. Detailed studies on their biology and control in Africa were mainly on cotton.

Biological control is a major component of Integrated Pest Management (IPM) which seeks to maximize the contribution of naturally occurring parasitoids, predators and pathogens for suppressing pest populations. Certain characteristics of these bollworm species e.g. the migratory ability of adults, aggressiveness of ABW and SBW larvae and the fact that they are concealed within the fruiting parts during most of their development, may make them difficult targets for biological control agents. However a large number of parasitoids have been recorded on them in Africa, particularly on ABW in East- and Southern Africa (Greathead 1966; Van den Berg 1993). Nevertheless, the impact of parasitoids on bollworm populations in cotton has declined during the last decades with the escalating use of insecticides.

No studies have been conducted in Uganda on the natural enemies of cotton pests since the surveys of Coaker (1959), Greathead (1966) and Nyiira (1970). This survey was conducted as a part of the IPM sub-component of the IFAD/WORLD BANK Project "Small-holder Cotton Rehabilitation Project" in Uganda. The objective was to up date the records of indigenous parasitoid species attacking bollworms in cotton agro-ecosystems in Uganda.

MATERIAL AND METHODS

Larvae of three cotton bollworms; ABW, SBW and PBW were collected extensively from untreated cotton fields located at each of Namulonge and Serere Agricultural and Animal Production Research Institutes, NAARI and SAARI, which represent two different cotton agro-ecosystems in the wet and dry regions of Uganda, respectively during two cotton growing seasons 1994/95 and 1995/96. Surrounding crops were sorghum, maize, cassava, soybean, beans and finger millet. Larvae were collected and reared individually in glass vials under laboratory conditions. Parasitoids recovered were sent to the British Museum of Natural History (BMNH) in London for identification. Seasonal abundance of the identified species was recorded.

RESULTS AND DISCUSSION

The following species are parasitoids of major bollworms larvae attacking cotton fields in Uganda:

Fam: Braconidae (identified by T. Huddleston)

Agathidinae

An unidentified species belonging to subfamily Agathidinae was recorded only on the larvae of ABW at NAARI. Identification beyond subfamily was not possible.

***Agathis bruesi* Shendefelt.**

Recorded on the larvae of SBW at both NAARI and SAARI. The genus was previously recorded on SBW larvae in Uganda (Greathead 1966). Replacement name for *aciclatus* Brues (not Ashmead). Peyrelongue and Bournier (1974) recorded the *Agathis* sp. on the SBW in Madagascar.

***Aleiodes* sp. (Rogadinae):**

Recorded on the larvae of SBW at NAARI. The genus was previously recorded on ABW larvae in Uganda (Nyiira 1970). Very little taxonomic work has been done on the African species in this genus. Replacement name for *Rogas*. One species of the genus (as *Rogas*) has been recorded from *Earias insulana* in India.

***Apanteles* sp.**

Recorded on the larvae of ABW and SBW at both NAARI and SAARI. The genus was previously recorded on ABW larvae in Uganda, Tanzania and Egypt in cotton and other crops (Coaker, 1959; Nyiira, 1970; El-Dakroury *et al.*, 1979 and Nyambo, 1990).

***Bracon kirkpatricki* Wilkinson (Braconinae):**

Recorded on the larvae of PBW at NAARI and SAARI late in the cotton season. Taylor (1936) recorded the species on PBW in Uganda. A frequently reared parasitoid of BPW and has been recorded from most of the East African countries. It has been introduced into North America, Central America and Egypt (Kirkpatrick, 1927).

***Bracon* sp. (Braconinae):**

Recorded on the larvae of PBW at NAARI and SAARI late in the cotton season. The genus and species are widely distributed in Africa.

***Cardiochiles variegatus* Szepligeti (Cardiochilinae).**

Recorded on the larvae of ABW at NAARI and SAARI. It is a new record on ABW in Uganda. Different *Cardiochiles* species were previously recorded in Uganda (Coaker, 1959, Greathead, 1966 and Nyiira, 1970). The species has been collected from Senegal, Gambia, Niger, Nigeria and Tanzania on *Helicoverpa* sp. and some from pyralid pests of cotton and maize (Huddleston, 1988 and Bhatnagar, 1988). Nyambo (1990) also recorded the species on ABW on the weed, *Cleome* sp. in Tanzania.

***Dolichogenidea aethiopica* Wilkinson (Migrogasterinae):**

Recorded frequently on the larvae of ABW and SBW only at NAARI. This species was recorded in Uganda as *Apanteles aethiopica* Wilkinson, in 1931. It is widespread in Africa, found in Sierra Leone, Cote d'Ivoire, Sudan, Somalia, Kenya,

Tanzania, Uganda and South Africa. It attacks more than 13 host species of Noctuidae, Pyralidae and Saturniidae (Walker, 1994).

Euphorinae:

An unidentified species belonging to the subfamily Euphorinae was recorded on the larvae of SBW only at NAARI. Identification beyond subfamily was not possible.

***Meteorus laphygmarum* Brues (Euphorinae)**

Recorded on the larvae of ABW only at SAARI. The species was previously recorded on ABW larvae in Uganda from cotton (Coaker, 1959). A solitary parasitoid of larval Lepidoptera, also recorded from *Laphigma exigua* and *L. exempta*. It is widely distributed in Africa.

***Protomocroplitis fasciipennis* Gahan (Migrogasterinae).**

Recorded frequently on the larvae of SBW only at NAARI. It is a new record on SBW in Uganda and may be in East Africa.

Fam: Elasmidae (identified by Z. Boucek)

***Elasmus? johnstoni* Ferriere:**

Recorded on the larvae of PBW only at SAARI. This species was previously recorded from Uganda on the false codling moth, *Cryptophebia leucotreta* Neyr. in cotton (Le Palley, 1959). The identified specimens were slightly different from the typical *E. johnstoni* (hence the question mark). This species is known from *P. gossypiella* (PBW). SBW has been recorded as an alternative host of the parasitoid. The species is also a facultative hyper-parasitoid (Van den Berg *et al.*, 1988).

Fam: Eulophidae (identified by J.S. Noyes)

***Pediobius near foveolatus* (Crawford):**

Recorded on the larvae of ABW only at NAARI. It is a new record on ABW in Africa (Van den Berg, 1993). This is a large genus, with many species recorded from Africa. The identified specimens are different from *P. foveolatus* in the Museum's collection in a number of characters, and it may be undescribed species. *P. near foveolatus* is a parasitoid of the larvae of Epilachninae (Coccinellidae). The host

range of *Pediobius* is wide and includes Orthoptera, Hemiptera, and many species of Lepidoptera, Coleoptera, Diptera and Hymenoptera (Kerrich, 1973).

Fam: Eupelmidae (identified by Z. Boucek)

***Eupelmus* sp.**

Recorded on the larvae of PBW only at SAARI. It is a new record in Uganda and belongs to a group close to *E. urozonus* Dalman. It may be a hyper-parasite.

Fam: Fitigidae (idenfified by N.D.M. Fergusson)

***Anacharoides* sp.**

Recorded on the larvae of SBW only at NAARI. It was not possible to identify the specimens to species. It is a new record on SBW in Uganda and East Africa. The genus is known only from Africa. Not much is known about the genus. It is most likely to be a parasitoid of Diptera.

Fam: Ichneumonidae (Identified by D.G. Notton)

***Charops ater* Szepligeti:**

Recorded on the larvae of ABW at both NAARI and SAARI. The genus was previously recorded on ABW in Uganda and Tanzania on cotton and other crops (Coaker, 1959; Nyiira, 1970 and Nuambo, 1990).

***Diplazon laetatorius* F.**

Recorded on the larvae of ABW and SBW at both NAARI and SAARI. A common, cosmopolitan, parthenogenetic parasitoid of Syrphidae (Diptera).

***Netelia* sp. (Tryphoninae):**

Recorded on the larvae of ABW and SBW only at SAARI. The genus was previously recorded on ABW larvae in Uganda on cotton (Coaker, 1959 and Nyiira, 1970). *Netelia* species are common external parasitoids of more or less exposed lepidopterous larvae. The subgenus *Netelia* includes 75% of the species and is worldwide in distribution. Unfortunately there is no recent revision of the Ethiopian species, so it was difficult to be identify to species.

Fam: Tachinidae (identified by N. Wyatt)

***Linnaomya agilis* Curran:**

Recorded on the larvae of SBW only at NAARI. The genus previously recorded in Uganda on SBW larvae by Coaker (1959) and on ABW by Nyiira (1970). Greathead (1966) reported that *L. agilis* was also recorded on SBW in South Africa.

***Palexorista laxa* Curran:**

Recorded only on the larvae of ABW at NAARI. The species was previously recorded in Uganda on ABW larvae (Coaker, 1959). Widely distributed in Afro-tropical Region. According to Crosskey (1967) *H. armigera* is the only proven host of *P. laxa.* Data from Tanzania revealed a strong association of *P. laxa* with sorghum, compared with maize, cotton and the weed, *Cleome* sp. (Nyambo, 1988).

***Peribaea* sp.**

Recorded only on the larvae of SBW at both NAARI and SAARI. It is a new record on SBW in Uganda and possibly in East Africa.

Seasonal abundance of the parasitoids is summarized in table (1). Braconids dominated the other families, and *Aleides* sp., *Cardiochiles variegatus, Dolichogenidea aethiopica,* and *Protomocroplitis fasciipennis* were mostly abundant throughout the cotton season in the two areas. On the contrary species of the sub-families, Agathidinae and Euphorinae, and *Meteorus* sp. (Braconidae), *Pediobius* near *foveolatus* (Eulophidae) and *Anacharoides* sp. (Fitigidae), were rare throughout the season.

Twenty-one parasitoid species belong to seven families were recorded. Among the 21 species 11 species were braconids. Twelve of the 21 species, have previously been recorded in Uganda on the three bollworms, three at genus level and nine at species level. Nine species were new records not only in Uganda but also in East Africa. Out of the 21 species, 10, 11 and four were recorded on ABW, SBW and PBW, respectively. Four species emerged from both ABW and SBW. Seventeen and 12 species were found in the southern and eastern regions of Uganda, namely Namulonge and Serere Research Institutes, respectively. Eight species were found on the bollworms in both regions.

TABLE (I)

Relative seasonal abundance of bollworm parasitoids in cotton fields at NAARI and SAARI in Uganda during the 1994/95 and 1995/96 cotton seasons.

PARASITOID SPECIES	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Fam. : Braconidae						
Agathidinae	-	+	-	-	-	-
Agathis bruesi S.*	++	+	++	-	-	-
*Aleiodes** sp.	+	++	+	+	+	-
*Apanteles** sp.	-	++	+	+	-	-
*Bracon kirkpatricki** W.	-	-	-	-	+	+
*Bracon** sp.	-	-	-	-	+	+
Cardiochiles sp.	+	++	+	+	+	-
*Dolichogenidea** sp.	+	+	++	+	++	-
Euphorinae.	-	-	+	-	-	-
*Meteorus** sp.	-	+	-	-	-	-
Protomicroplitis sp.	+	+	+++	++	+	-
Fam. : Elasmidae						
*Elasmus** sp.	-	-	-	-	+	+
Fam. : Eulophidae						
Pediobius sp.	-	-	-	+	-	-
Fam. : Eupelmidae						
*Eupelmus** sp.	-	-	-	-	+	+
Fam. : Fitigidae						
Anacharoides sp.	+	-	-	-	-	-
Fam. : Ichneumonidae						
*Charops ater** S.	-	+	+	-	-	-
Diplazon sp.	-	+	+	-	-	-
*Netelia** sp.	-	-	+	+	-	-
Fam. : Tachinidae						
*Linnaomya** sp.	-	-	+	-	++	-
*Palexorista** sp.	-	+++	+	-	-	-
Peribaea sp.	-	-	+	+	-	-

* Species and/or genera previously recorded in Uganda.

\+ Rare ++ Few +++ Frequent

SUMMARY

A survey of larval parasitoids of the American bollworm (ABW), *Helicoverpa armigera* Hb., the spiny bollworms (SBW), *Earias insulana* Boisd. and *E. biplaga* Wlk., and the pink bollworm (PBW), *Pectinophora gossypiella* Saunds. was conducted in cotton agro-ecosystems in Uganda during cotton seasons 1994/95 and 1995/96. Identifications were made by the British Museum of Natural History in London. Twenty-one parasitoid species belonging to seven families were recorded during the survey. Eleven species were braconids. Of these 21 species, 12 have been recorded previously in Uganda, three at genus level and nine at species level, while 9 species were new records not only in Uganda but also in East Africa. Of the 21 species, 10, 11 and four were recorded on ABW, SBW and PBW, respectively. Four species were emerged from both ABW and SBW. Seventeen and 12 species were found in the southern and eastern regions of Uganda, Namulonge and Serer Research Institutes, respectively. Eight species were recorded on the pest in the two distinct regions. Relative abundance of the parasitoid species throughout the cotton season was recorded.

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REFERENCES

BHATNAGAR, V.S. (1988): The new records of *Cardiochiles* (Braconidae: Hymenoptera) on *Heliothis armigera* (Hb.) and *Reghuva albipunctella* de Joannis in the Sahel. IMP Project on Food Crops in the Sahel. *(FAO, Dakar, Senegal. Current - Science (India), vol. 57 (16): 904-905).*

Coaker, T.H. (1959): Investigations on *Heliothis armigera* (Hb.) in Uganda. *(Bull Ent Res., 50: 484-506).*

CORSSKEY, R.W. (1967): A revision of the Oriental species of *Palexorista* Townsend (Dipt.: Tachinidae Sturmiini). *(Bull. of British Museum (Natural History) Entomology, Supplement 21, 97 pp.).*

EL-DAKROURY, M.S.; M.S.T. ABBAS and A.H. EL-HENEIDY (1979): Biology of *Apanteles* sp. a parasite of the American cotton bollworm, *Heliothis armigera* Hb. in Egypt (Hymenoptera: Bracondiae). *(Agric. Res. Review, 57 (1): 119-124).*

EL-HENEIDY, A.H.; M.B. SEKAMATTE; N. MWAMBU and C. NYAMUTALE (1996): Integrated Pest Management Approach in Cotton Agro-ecosystem in Uganda. 1-Basic Field Data. *(African Crop Science Journal, in press).*

GREATHEAD, D.T. (1966): Memorandum of the parasites and possibilities of biological control of East Africa cotton boll worms. *(Commonwealth Inst. of Biological Control, East African Station, Kawanda, Uganda).*

HUDDLESTON, T.; S. WALKER and K. ANNETTE (1988): *Cardiochiles* (Hymenoptera: Braconidae), a parasitoid of lepidopterous larvae, in the Sahel of Africa, with review of the biology and host relationships of the genus. *(Bull. Ent. Res., 78: 435-461).*

KERRICH, (1973): A revision of the species of *Pediobius. (Bulletin of the British Museum (Natural History) (Entomology). 29: 115-199).*

KIRKPATRICK, T.V. (1927): Notes on a braconid parasite of the pink boll worm (*Platydera gossypiella* Saund.) in Kenya. *(Bull. Ent. Res., 18: 47-50).*

LE PALLEY, R.H. (1959): Agricultural Insects of East Africa. *(E.A.H.C., Nairobi, 10: 307 pp.).*

NYAMBO, B.T. (1988): Significance of Host-plant phonology in the dynamics and pest incidence of the cotton bollworm, *Heliothis armigera* Hubner

(Lepidoptera: Noctuidae), in Western Tanzania. *(Crop Protection 7: 161-167).*

NYAMBO, B.T. (1990): Effect of natural enemies on the cotton bollworm, *Heliothis armigera* Hubner (Lepidoptera: Noctuidae), in Western Tanzania. *(Tropical Pest Management, 36: 50-58).*

NYIIRA, Z.M. (1970): A note on the natural enemies of lepidopterous larvae in cotton bolls in Uganda. *(Annals of the Entomological Society of America, 63: 1461-1462).*

PEYRELONGUE, J. and J.P. BOURNIER (1974): (*Earias insulana* Boisd, (Lep. Noctuidae) and its parasites on *Abutilon asiaticum* L. in South-Western Region of Madagascar) *Earias insulana* Boisd, (Lep. Noctuidae) et ses parasites sur *Abutilon asiaticum* I. (Malvaceae) dans la region Sud-Ouest de Madagascar. *(Cotton-et-Fibres-Tropicales (France), v. 29 (2): 241-245).*

TAYLOR, T.H.C. (1936): Report on a year's investigation of *Platydera gossypiella* (pink bollworm) in Uganda (March, 1935 to April, 1936). *(Rep. Dep. Agric. Uganda for the year ended 30th June 1936, pt.2, pp. 19-39).*

VAN DEN BERG, H.; J.K. WAAGE and M.J.W. COCK (1988): Natural Enemies of *Helicoverpa armigera* in Africa. *(C.A.B. International, U.K.).*

VAN DEN BERG, H. (1993): Natural control of *Helicoverpa armigera* in small-holder crops in East Africa. *(Ph.D. Thesis Wageningen, The Netherlands 233pp,).*

WALKER, ANNETTE K. (1994): Species of Microgastrinae (hymenoptera: Braconidae) parasitizing lepidopterous cereal stem borers in Africa. *(Bull. Ent. Res., 84: 421-434).*