SHORT COMMUNICATION

Survey of Parasitoids on Lepidopterous Stem Borers Attacking Maize and Sorghum in Some Localities of Ethiopia

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Abstract

Surveys were carried out for three consecutive years (1996/97-1998/99) to study the natural percent parasitism of indigenous parasitoids associated with stem borers attacking maize and sorghum in west, north and central Ethiopia. At all sites and localities, maize and/or sorghum fields were inspected for the presence of larvae and pupae of stem borers (*Busseola fusca* Fuller and *Chilo partellus* Swinhoe) and their parasitoids. The major parasitoids encountered were *Apanteles sesamaie* (Cameron)(=*Cotesia*); *Bracon hebetor* (Say); *Bracon sesamiae* (Cameron); *Procerochasmias nigromaculatus* (Cameron) (Ichntumonidae) and a *Sarchophaga sp*. (from order Diptera). An unidentified predaceous ant was also recorded. The surveys revealed the different percent parasitism depending upon the environmental conditions of the localities and availability of the hosts. This paper attempts to describe the natural percent parasitism and the potential of the above-mentioned parasitoids in various locations of the country. The survey showed that *Apanteles spp*. is the dominant parasitoid group that attacks stem borers. Among the *Apanteles* parasitoid groups *A.sesamiae* (Cam) was found to be wide spread in all surveyed areas. Preliminary laboratory observations on *A.sesamiae* (Cam) also showed that its percent parasitism ranges from 20-60 %. The number of adult parasitoids emerging from one host larva depends on the instar parasitized and varied with environmental conditions of the localities and availability of host.. Roughly 60 and above adult parasitoides can emerge from a single parasitized larva. The most suitable larval stage for egg deposition was 4th to 6th instar. Both field and preliminary laboratory observations on percent parasitism suggest that *A.sesamiae* (Cam) is widespread and important for use in developing biological control program of maize and sorghum stem borers.

Introduction

Maize stalk borers are the most important group of pests of maize and sorghum causing considerable yield loss in Ethiopia. The major species of stem borers found in Ethiopia are *Busseola fusca*, *Chilo partellus* and *Sesamia calamistis*, the former one being the dominant species in mid and highland areas (1160-2500m) (Assefa 1985). The larvae feed on stem, leaf and panicle or cob of sorghum and maize. Depending on the level of infestation, losses due to these insect pests could reach up to 100% in Ethiopia (Assefa, 1988a & 1988b). Although there are several potent chemical pesticides for stem borer control, their high cost cannot be easily afforded by the majority of small-scale farmers. Hence, the principal option left to tackle these pests is through the use of cultural practices such as adjusting planting dates and burning of stalks. In recent times, it has become apparent that the intelligent integration of various control options is indispensable to obtain sustainable pest control. In this respect, the use of natural enemies in the control of stem borers plays an important role.

Surveys conducted to determine the species composition of native natural enemies revealed the existence of several parasitoids attacking stem borers. Assefa (1981) reported four larval and two pupal parasitoids of *B. fusca*. *Apanteles sesamiae* (Cam.) was found to be widespread in all areas surveyed. At Alemaya, five *Hymenopteran* parasitoids attacking larvae and pupae of *B. fusca* were recorded (Kasahun *et.al* 1994). Similarly, four species of parasitoids that belong to the family *Braconidae* were recorded from larvae of *B. fusca* collected from Ambo, Bako and Dedessa (Mulugeta *et al* 1994). Nevertheless, there is no information as to the contribution and potential of these natural enemies in the regulation of stem borers. In this paper, an attempt has been made to quantify the natural field percent parasitism, species composition and show their relative importance as natural regulators of maize stalk borers.

Materials and Methods

Field survey and laboratory rearing

Roadside inspections were made in different localities at a regular interval of 10-20 km in maize and sorghum fields. At each site, samples were taken from farmers' plots following a "Z" pattern. At all sites and localities fields were inspected for the presence of stem borers and their parasitoids. A total of 10-15 infested stalks were gathered and dissected to collect larvae of stem borers, parasitoid cocoons, pupae and any other natural enemies. Besides, different parts of maize and sorghum (stalks, cobs, heads) were checked at their flowering, ripening and maturity stages. In some places with stubble was also checked. Larvae and pupae of stem borers, parasitoid cocoons, pupae and larvae were collected from those surveyed areas and kept in wooden frame cloth cages. The collected specimens were reared in the laboratory in petri dishes. The relative importance of parasitoids of maize stem borer was determined at each locality by taking counts of cocoons, larvae, pupae and adults for each group of parasitoids. Those having relatively high counts were considered as the principal parasitoids for that particular locality.

For laboratory observations, adult parasitoids that emerged from cocoons and pupal parasitoids that emerged from pupae were collected and put in modified glass rearing cages, or in petri dishes to establish colonies of parasitoids. The collected stem borer larvae were maintained by supplying fresh pieces of maize stalk. Adult parasitoids and stem borer moths were provided with sugar solution (20 %) and flowers. In the preliminary laboratory observation unsexed adults of *A.sesamiae* (Cam) and laboratory reared normal larvae of *B.fusca* were used.

Results

Mortality of stem borers and percent parasitism

The relative importance and the percent parasitism of indigenous parasitoids associated with stem borers were determined in west, north and central Ethiopia (Table 5). In 1996/97, the main roadside areas surveyed were Bako-Anno, Bako-Jere, Bako-Toke, Ambo-Mutulu-Addisalem, Debresina-Sirinka, Southeast Tigiray–North Wollo - South Gonder, East Gojam – North Shewa routes. As shown in Table 3, the field percent parasitism of stem borers in these localities varied. The lowest percent parasitism ranged from 0.0- 14.3 % with a mean of 5.25 % in Bako-Anno routes, while the highest percent parasitism ranged from 0.0- 46.7 % with a mean of 26.3 % in Ambo-Mutulu routes. The maximum percent parasitism was recorded in the areas of Ambo-Mutulu (mean 26.3), Debrsina-Sirinka (mean 15.35) and Dejen-Debrelibanose (mean 12.86) routes (Table 1 & 2). In 1997/98-crop season, the maximum percent parasitism recorded were in the areas of Nekemte-Gambella route (mean 23.74) and Jima- Walkite route (mean 20.85). Few maize fields from Nura-Era (Upper Awash agro-industries field No. B40, B39 and B19) were assessed and the average field percent parasitism recorded ranged from 6.2 % to 9.5 % (Table 2). The stem borer percent parasitism by different parasitoids recorded in Nura-era Farm were found very low compared with other localities. This may be due to the regular or continuous application of chemical pesticides against different insect pests.

During the survey some larvae of stem borers were found dead due to mechanical and unidentified insect diseases. Pupal mortality was recorded to be very low when compared with mortality of larvae of stem borers in all inspected localities except in the areas of Abay George and Bako.

The preliminary laboratory observation also showed that larvae of *B.fusca* were successfully parasitized by *A.sesamiae* (Cam) and produced a number of cocoons and adult parasitoid. The number of adults emerged from one-host larvae depended on the stage of the instar parasitized and varied with environmental conditions of the localities and availability of the host. In this case, roughly 60 and more adult *A.sesamiae* parasitoids were emerged from *B.fusca*. The most suitable larval stage for egg depositions was 4^{th} to 6^{th} instar. Field percent parasitism recorded from different localities also indicated the potential and importance of the widespread parasitoids, *A.sesamiae* (Cam).

Species composition of stem borers and recorded parasitoids

Larval parasitoids collected and recovered in association with stem borers during the survey work included Braconidae: *Bracon sesamiae* (Cameron); *Cotesia sesamiae* (Cam); *Apanteles sp. near leavigatus* (Ratz); *Apanteles sp. vitripentis* group; *Apanteles sp.; Apanteles sp. (ater* group). *Trypoxylon viduum Arnoid* and *Bracon hebetor* (Say). From Diptera, *Sarcophaga sp* were also recovered in association with *B.fusca* larvae. In some localities of Bure (Illubabor) predaceous ants were also observed feeding on larvae of stem borers on damaged cobs and stems of maize crops. Furthermore, *Procerochasmias nigromaculatus* (Cameron) (Ichneumonidae) and *Pediobius furvus (Gahan)* (Eulophidae) were also recorded from stem borer pupae in very few areas. The identification of the parasitoids was mainly carried out by reference to specimens previously identified and using available identification keys. The key for identification of stem borer parasitoids was provided for primary parasitoids of stem borers that are most likely to be encountered when collecting stem borers from the field. The reference specimens used were previously identified in CAB (England) and USSR Zoology Institute.

The most abundant and widespread group of parasitoids that was encountered and recorded was *A.sesamiae*. Parasitoid wasps (Ichneumonidae) were also recorded as primary mortality factors of stem borer pupae in some surveyed areas (Table 1&2). At the same time, stem borers attacking maize and sorghum were considered and 3 species (*Busseola fusca, Chilo partellus and Sesamia calamistis*) were encountered in different localities. *Busseola fusca* was mainly found at higher and intermediate altitudes while *Chilo partellus* was recorded in lower altitude and in warmer areas of the surveyed localities. *Sesamia calamistis* was also recorded but very scattered and limited to intermediate altitudes.

Discussion

The survey results indicated the existence of large numbers of parasitoids associated with stem borers of sorghum and maize. The present study has also shown that there was a difference in population and distribution of these parasitoids in similar altitudes but different locations. Such variations could probably be explained by the difference in weather conditions and availability of alternate hosts. Tables 1 and 2 show field percent parasitism of stem borers by different parasitoids and predaeceous ants at different altitudes and localities. All inspected routes showed some level of parasitism except in Gedo-shambu route, because this area grows mainly barley, wheat and other small cereals rather than sorghum and maize. But, few maize plots have been checked and no infested maize stalks were found.

Some field collected dead larvae had symptoms of fungal and bacterial diseases, but it was not possible to establish that they are the cause for the death of these larvae. However, Kassahun and Assefa (1994) suggested that such unidentified fungal and bacterial pathogens that were associated with stem borers were probably responsible for some of the larval mortality. In this case also, if proper identification of the pathogens and bioassays are carried out it is possible that they could be the cause of death of those stem borer larvae.

Except a few parasitoids, some still require more detailed studies to clarify their status. For example, *Sarcophaga* spp. reported earlier by

Kassahun and Assefa (1994) from eastern part of Ethiopia were associated with stem borers. In their report they did not indicate whether these *Sarcophaga* spp. are primary parasitoids of *Busseola fusca* or not. However, Mohyuddin and Greathead (1970) reported and considered them as larval parasitoids on moribund larvae. During the survey, the *Sarcophaga* spp. were also recovered from larvae of *B. fusca* at Kilinto (Ambo) but only occurs in small numbers. It is also difficult to ascertain the status of these species since sufficient information is not available.

Table 1. Level of field parasitism of maize and sorghum stem borers by different parasitoids at different localities in Ethiopia

Location	Altitude (m)	Parasitism (%)	Stem borer (host)	Parasitoids recorded
1.Bako-Anno route				
Shute	1800	0.0		-
Annbekanissa	1930	6.7	*B. fusca*	*Procerochasmias nigromaculatus* (Cameron)
Annogambella	1835	0.0		-
Hongobo	1800	14.3	*B.fusca*	*Procerochasmias nigromaculatus* (Cameron)
2.Bako-Jere route				
Gobudambi	1800	0.0		-
Muridanbi	1900	0.0		-
Jagi	1775	15.4	*B. fusca*	*A. sesamiae* (Cameron)
Bachkinbi	1800	7.7	*B. fusca*	*Apanteles sp. ater group*
3.Backo-Toke route				
Ijaji	1800	9.1	*B. fusca*	*Apanteles sp. nr. Leavigatus*
Gedo	2200	0.0		-
Wagidikortu	2100	0.0		-
Libangamo	2300	12.5	*B. fusca*	*Apanteles sp. .vitripentis group*
Tokekombolcha	2400	0.0		-
Tokeirensa	2450	0.0		-
Laygnawmeti	2450	15.4	*B. fusca*	*A.sesamiae* (Cam.)
4.Ambo- Mutulu route				
Melkadera	2450	0.0		-
Birbirsanadogoma	2100	25.0	*B. fusca*	*A.sesamaie*(Cam) & *Trypoxylon viduum Arnoid*
Kilinto	2050	40.9	*B. fusca*	*A.sesamaie* (Cam), *Sarcophaga sp. & Trypoxylon viduum*
Farisy	2150	33.3	*B. fusca*	*Apantels sp. nr.leavigatus & A.sesamiae* (Cam)
Koraballa	2250	46.7	*B. Fusca*	*A.sesamiae* (Cam) & *P. nigromaculatus*
Addisalem	2300	11.5	*B. fusca*	*Apanteles sp. & Bracon hebetor*(Say)
5.Debresina-Sirinka route				
Chirameda-debresina	1660	30.0	*B. fusca, C. partelus*	*A.sesamaie*(Cam)
Karajejba-dogoma	1200	8.3	*C. partelus*	*A.sesamiae* (Cam) & *Apanteles sp.vitripentis group*
Godanachele	1400	7.1	*B. fusca*	*A.sesamiae* (Cam)
Medhine	1525	14.2	*C. partelus , B. fusca*	*A.sesamiae*(Cam)
Kurtamba	1900	23.5	*B. fusca*	*A.sesamiae* (Cam)
Haik	1850	17.6	*C. partelus, B. fusca*	*A.sesamiae*(Cam)
Chaffee	1675	25.0	*B. fusca, C. prtelus*	*Apanteles sp & pediobius sp.*
Chisabay	1550	14.3	*C. partelus*	*A.sesamiae*(Cam)

Titi	1550	5.2	*C. partelus*	*A.sesamiae* (Cam)
Sirinka	1850	8.3	*C. partelus*	*A.sesamiae* (Cam) & *Apanteles sp. ater group*
6.Tigray-Wollo route				
Shehet	1400	8.3	*C. partelus*	*A.sesamiae* (Cam)
Alemseged	2000	0.0	*B. fusca*	-
Maineben	1900	13.2	*B. fusca*	*A.sesamiae* (Cam)
Hiwane	2000	17.9	*C. partelus* , *B. fusca*	*A.sesamiae* (Cam)
Mohoni (machew area)	1750	11.4	*C. partelus*	*A.sesamiae* (Cam)
Cheeho (Cherecher)	1650	9.5	*C. partelus*	*A.sesamiae* (Cam)
Ayiwargibar	1650	20.0	*C. partelus*	*A.sesamiae* (Cam)
Guya (Kufto area)	1450	12.4	*C. partelus*	*Apanteles sp.*
7.Wollo- Gonder route				
Kobo	1450	18.9	*C. partelus*	*Apanteles sp.*
Hormat	1450	0.0	*C. partelus*	-
Kukubarobit	1500	14.4	*C. partelus*, *B. fusca*	*A.sesamiae* (Cam)
Gobiye (Kebele 021)	1650	9.1	*C. partelus*	*A.sesamiae* (Cam)
Dorogibir	1550	16.7	*C. partelus*	*A.sesamiae* (Cam)
Godoberi	1750	0.0	*B. fusca*	-
Bekuloangach (Laygaint)	2700	8.8	*B. fusca*	*Apanteles sp.*
Sinkomedianalem	1950	0.0	*B. fusca*	-
8.E. Gojam- N.Shewa route				
Dejen	2300	14.3	*B. fusca*	*Apanteles sp.*
Nawer	1900	33.3	*B. fusca*	*A.sesamiae* (Cam) & *P. nigromaculatus*
Filiklik	1750	16.7	*B. fusca*	*A.sesamiae* (Cam) & *Pediobius furvus(Gahan)*
Kuyu	2500	0.0	*B. fusca*	-
Workuabayi (Debrelibanos)	2000	0.0	*B. fusca*	-

Pediobius furvus (Gahan) was recorded in drier areas of Chaffee, Chisabalima and Filiklik (Abay gorge) areas. The adult parasitoids were found emerging from pupae of *Busseola fusca* (Fuller) and *Chilo partellus* (Swinhoe). *Pediobius furvus* (Gahan) was earlier reported by Kassahun and Assefa (1994) from the eastern part of Ethiopia. Tsedeke (1991) also included the same species in the list of entomophagous arthropods of Ethiopia. *Trypoxylon viduum* Arnoid was recorded from larvae of *Busseola fusca* in Ambo and Guder areas in 1979. The specimens are currently available in the collection of Ambo Plant Protection Research Center.

The above recorded natural enemies are of considerable importance in reducing or containing pest populations if they are conserved and handled in a proper manner. In some areas many of the parasitoids are unable to survive in sites where pesticides are regularly applied. The survey results and information obtained on the natural enemy complex of stem borers confirm and quantify the contribution of these natural enemies in reducing stem borer populations. The field percent parasitism by these parasitoids recorded at different localities indicated their potential use in biological control. Therefore, special consideration should be given to parasitoids found abundant and adapted themselves to different agro-ecologies.

Conclusion

In Ethiopia, interest and efforts on the use of parasitoids and conservation of indigenous natural enemies have been ignored and overwhelmed by the interest to use insecticides. Thus, this survey study has provided information that would be useful in the overall understanding of the potential of different parasitoids for integrated stem borer management.

Table 2. Level of field percent parasitism of maize and sorghum stem borers by different parasitoids and predaceous ants at different localities in Ethiopia .

Location	Altitude	Parasitism (%)	Stem borer (host)	Parasitoids recorded
9.Nura era enterprise				
Field B40	-	9.5	*B. fusca*	*A.sesamiae* (Cam) & *P. nigromaculatus*
Field B39	-	7.1	*B fusca*	*Bracon sesamiae* (Cam)& *P. nigromaculatus*
Field B19	-	6.25	*B. fusca*	*A.sesamiae* (Cam.) and *Pediobius furvus* (Gahan)
10.Gedo- shambu route				
Fincha-shambu	-	0.0		-
Horoguduru	-	0.0		-
11.Nekemte-Gambella route				
Nekemte-Badele	1800-2000	22.4	*B. fusca*	*A.sesamiae* (Cam), *Trypoxylon sp.* & unidentified ants
Gambella Abobo	510-540	19.4	*C. partelus*	*A.sesamiae*(Cam) & *P. nigromaculatus*
Abobo-Cholo	//	29.4	*C. partelus*	*A.sesamiae*(Cam)
12.Jima-Walkite route				
Merew-Kerssa	1780-2080	20.0	*B. fusca*	*A.sesamiae* (Cam)
Gandaburka –Asendabo	//	30.0	*B. fusca*	*A.sesamiae* (Cam)
Assendabo-Sokoru	//	16.7	*B. fusca*	*A.sesamiae* (Cam)
Sokoru- Walkite	-	16.7	*B. fusca*, *C. partelus*	*A.sesamiae* (Cam)

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