

**THE SORGHUM SHOOT FLY, *ATHERIGONA SOCCATA* RONDANI
(DIPTERA: MUSCIDAE) ATTACKING SOME GRAMINEOUS
FORAGE CROPS IN EGYPT.**

EL-SERWY, S. A.

Plant Protection Research Institute, ARC, Egypt

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Abstract

The sorghum shoot fly, *Atherigona soccata* Rondani, attacks sorghum ratoon (*Sorghum bicolor* (L.) Moench) at Sids and Al-Aiat with *Atherigona humeralis* (Wiedemann) on Sudan grass (*Sorghum vulgare* var. *sudanense* Hitch.) and *Atherigona bedfordi* Emden (new record) on Barnyard grass (*Echinochloa crus-galli* (L.) P. Beauv) at Al-Aiat in Middle Egypt. The shoot flies were generally active during the year and passing from crop to crop. It infested ratoon of sorghum plants left in the field after harvest reaching about 12% at Sids in 2002. Infestation was lower (about 5%) on Barnyard and Sudan grasses at Al-Aiat in 2002-2003 and 2003. Larvae peaked by early January on Barnyard grass and at early and late July as well as the third week of August on Sudan grass at Al-Aiat. Two peaks were attained by the third week of November and the second half of December on infested sorghum ratoon at Sids. Flies emerged from infested plants of the forage crops during the most months in the year. Flies reared from larvae infested Barnyard and Sudan grasses peaked on late January, July and August and December. Larval parasitism was higher (about 61%) on Barnyard and lower (about 9%) on Sudan grass at Al-Aiat. While pupal parasitism was (about 6%) on Sudan grass and reach the lowest rate (about 1%) on both larvae and pupae on sorghum ratoon at Sids. Three hymenopterous larval parasitoids i. e. *Neotrichoporoides* sp. near *nyemitawus* Rohwer, *Pediobius* sp. and *Prigalio* sp. (Eulophidae), two pupal parasitoids i. e. *Callitula* sp. (Ptromalidae) and *Dacnusa* sp. (Braconidae) and one undetermined hyperparasitoid belongs to Cynipidae had emerged. These species are newly recorded on *A. soccata* in Egypt. The first and the second species were abundant on larvae infested sorghum ratoon or Barnyard grass at Al-Aiat and on sorghum ratoon or Sudan grass at Sids and Al-Aiat. Plowing sorghum fields and collecting stubbles could be useful as a cultural control method for decreasing the population size of the sorghum shoot fly.

INTRODUCTION

The sorghum shoot fly, *Atherigona soccata* Rondani, attacks forage sorghum (*Sorghum bicolor* (L.) Moench) in the governorates of Aswan (at Aswan), Beni-Suef (at Sids), Behira (at Hosh Issa) and Giza (at Al-Aiat). Also, infested Barnyard and Sudan grasses (*Echinochloa crus-galli* (L.) P. Beauv & *Sorghum vulgare* var. *sudanense* Hitch.) at the last site. Two authors contributed to biology and ecology of *Atherigona humeralis* (Wiedemann) and *Atherigona soccata* Rondani on sorghum at Sohag in

Upper Egypt (Awadallah & Mohamad, 1984 and Salman, 1995). The shoot fly *A. soccata* is a key pest of sorghum in Asia, the Middle East and East Africa and some 40 species of host plants are known for this species (Young & Teetes, 1977 and Pont & Magpayo, 1995). Generations ranged between 5-6 in Italy and the mature larvae or pupae overwintering in the tillers of the plants left in the field after harvest (Bene, 1986).

The present work aimed to study incidence of infestation, emergence and parasitism of the shoot fly *A. soccata* on sorghum ratoon as well as Barnyard and Sudan grasses in Middle Egypt.

MATERIALS AND METHODS

A sorghum field contained stubbles left after harvest was chosen at Sids Agric. Res. Sta., Beni-Suef governorate in 1998. Eight samples were collected weekly from November 17th to January 5th in 1998- 1999 season. Two fields planted with Barnyard and Sudan grasses at Al-Aiat were chosen for sampling. Four samples of Barnyard grass crop were collected at weekly intervals from December 25th, 2002 to January 15th, 2003. After cuttings, seven samples were taken at biweekly intervals from April 17th to November 30th, 2003, except sampling of July were collected weekly. While twelve samples of Sudan grass were weekly obtained from June 19th till September 4th in 2003. A uniform sample size of 1000 ratoons or plants were collected randomly.

On each sampling date, plants were visually examined and classed as infested and non-infested. The characteristics of infestation were dead hearts and decaying stems. To rear larvae, infested plants were placed in plastic bags where the full-grown larvae were collected and counted daily, consequently placed in a petri dish until pupation. The obtained pupae were transferred in a new petri dish. Emerged adults of the shoot flies, other dipterous flies, parasites and hyperparasites were collected, identified and counted. Finally, dried stems with pupae were dissected and dead pupae were recorded.

To survey the *Atherigona* species and its parasitoids, sorghum ratoons; Bermuda grass, (*Cynodon dactylon* L.) and wheat (*Triticum aestivum* L.) plants showing dead heart symptoms were collected from Al- Aiat region in 2002 and 2003. Similar rearing and counting methods were followed.

RESULTS AND DISCUSSION

1- Incidence of infestation and abundance of larvae:

Data in Table 1 show that sorghum ratoon showing dead heart symptoms appeared in a low rate of 7% by mid November and peaked a week later at Sids in

1998. Then, it declined on early December, but increased gradually to reach its maximum on the third week and drastically lowers to 3.5% at early January in 1999. On Barnyard grass crop, infested plants average was 6.5% on late December and increased to 8% in the next week, but declined to 5% on mid January at Al-Aiat in 2002-2003 season (Table 2). However on Barnyard grass ratoons, infestation lowers to 3% at mid April and early May and increased twice on mid July reaching 8% a week later. The lowest rates ranged between 2%- 3% at early and late November. On Sudan grass, infestation started at mid June and continued till early September reached 7.7%, 5% and 6% on early and late July as well as the third week of August at Al-Aiat in 2003 (Table 3). Larvae followed the same pattern of infestation and the greater number of larvae coincides with the infestation peaks. One, two and three peaks were attained at early January; the third week of November and the second half of December as well as early & late July and the third week of August on Barnyard grass, sorghum ratoon and Sudan grass, respectively.

Previous results refer to dead hearts on sorghum ratoon crop were higher (12.4%) at Sids compared to 5% and 4.5% on Barnyard and Sudan grasses at Al-Aiat. However, larvae peaked at early January on Barnyard grass and by the third week of November and the second half of December on sorghum ratoon at Sids. Whereas three peaks were attained at early and late July as well as the third week of August on Sudan grass. These greater numbers occupied with the higher dead heart plants on each forage crop. The obtained infestation levels on sorghum ratoon crop were relatively lower than those recorded on the first sorghum crop by *A. humeralis* or *A. soccata* at Sohag by (Awadalla & Mohamed, 1984 and Salman, 1995). The incidence of *A. soccata* was greater (66%) in the first sorghum crop than the ratoon crop (Ochonda Ogola *et al.*, 2004).

2- Emergence of shoot flies:

Emerged shoot flies were represented 63%, 91.3% and 84.3% of the total number of collected healthy larvae (pupated) reared from sorghum ratoon at Sids as well as Barnyard and Sudan grasses at Al-Aiat, respectively (Tables 1, 2 and 3).

Distribution emergencies of shoot flies from sorghum ratoon at Sids during 1998- 1999 and from Barnyard and Sudan grasses at Al-Aiat in 2003-2004 and 2003 are illustrated in (Figs. 1 and 2).

The shoot flies reared from sorghum ratoon emerged from late November till mid February and peaked by mid December and late January at Sids in 1998-1999 season (Fig. 1). On the first Barnyard grass crop, emergence period lasted from the third week of January to February and peaked at late January 2003 (Fig. 2). Whereas flies reared from growth ratoons after cuttings emerged on late April and from the

third week of July to early August as well as during late November- early January and peaked on late July and December in 2003- 2004, respectively. The shoot flies reared from Sudan grass emerged from early July till mid September and peaked by late July and August at Al-Aiat in 2003 (Fig. 2).

Three *Atherigona* species: *A. soccata* Rondani, *A. humeralis* (Wied.) and *Atherigona bedfordi* Emden (new record) were identified. The first species emerged in huge numbers from pupae sampling from the three forage crops at both regions. However, the second and the third species were emerged in a few numbers from Sudan grass and Bermuda grass, *Cynodon dactylon* L., as well as Barnyard grass and wheat, *Triticum aestivum* L., at Al-Aiat in 2003.

Afore mentioned results indicate that the shoot flies reared from infested plants of the forage crops were emerged during the most months in the year and passing from crop to crop. At Al- Aiat, emergence period of *A. soccata* reared from Barnyard grass lasted from the third week of January till early January in 2003- 2004. Four peaks were attained by late January and December (on Barnyard grass), August (on Sudan grass) and July on both host plants. On sorghum, *A. soccata* adults were active during (August-September) in Upper Volta, Sengal and India (Bonzi & Gahukar, 1983; Gahukar, 1987 and Gujrati *et al.*, 1988). However, adults emerged from March-October with two main peaks of activity (March-April) and (August- September) and have ten field generations annually in Upper Egypt (Salman, 1995).

Generally, chloropid larvae often accompanied the shoot fly larvae. Five species i. e. *Oscinella nartshukiana* Boschovski, *Anatrichus pygmaeus* Lamb, *Aphanotrigonum subfasciella* Collin, *Scolioptthalmus trapezoides* Becker and *Stenophthalmus ocellatus* Becker (Chloropidae) and one *Silba virescens* Macqart synom of *S. aristella* (Bezzi.) (Lonchaeidae) were emerged. The first three species are newly recorded in Egypt. All species were emerged from the three infested forage crops, except the first two species on Sudan grass, the second species on Barnyard grass and the third and the fifth species as well as the lonchaeid species on sorghum ratoon at Al-Aiat. Two species were emerged in huge numbers *A. subfasciella* from infested sorghum ratoon (1998-1999) at Sids and Sudan grass (2003) at Al-Aiat and *S. trapezoides* from sorghum ratoon and Barnyard grass (2003-2004) at Al-Aiat. Dr Deeming, suspected that the absence of *O. nartshukiana* and *A. pygmaeus* from Sudan grass is due to the unsuccessful competition with large population of *A. subfasciella* (Personal communication). These species may be preferred the shoots already damaged by shoot fly larvae. Such result agrees with those on *A. soccata* on guinea corn, *Sorghum bicolor* L., and on *A. tritici* sp. n. on wheat, *Triticum aestivum* L., (Deeming, 1971 and El-Serwy, 2000).

3-Parasitism:

Larval parasitism was higher on larvae infested Barnyard grass (61.2%) than Sudan grass (8.5%) at the same region or sorghum ratoon 1.1% at Sids (Tables 1, 2 and 3).

Rate of 65% was recorded at late December and peaked by early January, but decreased after two weeks on larvae infested Barnyard grass at Al- Aiat during 2002-2003 (Table 2). Parasitism fluctuated on larvae reared from Barnyard grass ratoon crop. It was (66.7%) on mid April and reached 100 by early May, but declined to 15.8% at mid July and reaches the lowest rate 10% a week later while no parasitic activity was observed until the end of November in 2003. On larvae infested Sudan grass, parasitism lasted from early July till the third week of August and peaked on mid August at Al-Aiat in 2003 (Table 3). Rate of 3.8% was found by mid November and lowered to 2.2% till early December on larvae infested sorghum ratoon at Sids (Table 1).

Pupal parasitism were 5.8% and 0.9% on pupae developed from larvae infested Sudan grass and sorghum ratoon at Al- Aiat and Sids (Tables 2 and 3). Parasitism started in a rate of 9.5% at early July and peaked by the third week of August on Sudan grass (Table 3). Rate of 2.1% was recorded on mid November and reached 4.5% at early December on sorghum ratoon (Table 1). No parasitic activity was found on pupae obtained from Barnyard grass (Table 2).

Three hymenopterous larval parasitoids species i.e. *Neotrichoporoids* sp. near *nyemitawus* Rohwer, *Pediobus* sp. and *Pnigalio* sp. (Eulophidae), two hymenopterous pupal parasitoids *Dacnusa* sp. (Braconidae) and *Callitula* sp. (Pteromalidae) and one undetermined hyperparasitoid belongs to Cynipidae had emerged. These species are newly recorded on *A. soccata* in Egypt. The first and the second species were abundant on larvae reared on sorghum ratoon and Barnyard grass at Al-Aiat and on sorghum ratoon (at Sids) or Sudan grass (at Al-Aiat), respectively. Both species were parasitised on larvae infested Barnyard and Sudan grasses, whereas *Pnigalio* sp. was recorded on larvae infested sorghum ratoon at Sids. However, the first pupal parasitoid was found on Sudan grass at Al-Aiat, and with second species on (sorghum ratoon) at Sids. Both species were found on *A. soccata*, but *Opius* sp. probably replaced by *Callitula* sp. on *A. humeralis* infested Bermuda grass, *Cynodon dactylon* L. grown at Al-Aiat. Larval and pupal parasitism were 45% and 25% during January–November. Five and two pupal and larval parasitoids were recorded on *A. tritici* sp. n. and *A. humeralis* infested wheat and Bermuda grass at Sids (El-Serwy, 2000).

It is clearly that the most important parasitoid was *N. nyemitawus* on *A. soccata* in Egypt. Parasitism by this species and *Opius* sp. are quietly high during the post-

rainy season and is greater on sorghum-cowpea crops than where is the sole crop (Singh and Sharma, 2002).

In conclusion the sorghum shoot fly *A. soccata* is the principle pest of the gramineous forage crops: sorghum, Barnyard and Sudan grasses in Egypt. Two *Atherigona* species: *A. humeralis* and *Atherigona bedfordi* were also infested both grasses. Flies were active during the year and passing from crop to crop. It infested ratoon of sorghum plant left in the field after harvest to reach about 12% at Sids in 1998- 1999, opposed to about 5% on the other two grasses at Al-Aiat during 2002-2003 season. The higher infestation rates nearly occupied with the larval peaks at early January on Barnyard grass and by the third week of November and the second half of December on sorghum ratoon at Sids. However, three peaks were attained at early and late July as well as the third week of August on Sudan grass at Al-Aiat. Peaks of *A. soccata* larvae occurred during May, June and September in Kenya (Ogwaro, 1979). Generally, the shoot flies emergence period lasted from early January to late December and peaked on late January, July and August and December. *A. soccata* adults emerged during March- October with two main peaks of activity by March & April as well as August & September on sorghum in Upper Egypt (Salman, 1995). Thus reflecting that the shoot flies reared from the alternative hosts sorghum ratoon crop and Barnyard grass considered the main source of new infestation to the first sorghum crop. More than 60% of larvae on barnyard grass were parasitised by *N. nyemitawus* at Al-Aiat, opposed to about 1% on sorghum ratoon at Sids. Sorghum ratoon considered a main source of the new infestation. Plowing fields after harvest and collecting stubbles must be followed as a cultural control method for decreasing the population size of the sorghum shoot fly.

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Table 1. Percent of infested sorghum ratoon and number of collected larvae and pupae of the sorghum shoot fly *A. soccata* at Sids in 1998- 1999.

Sampling date		Infested ratoon %	Total no. of collected larvae	No. of parasitised larvae	Total no. of collected pupae	No. of parasitised pupae	Parasitism %		
Month	Day						Larvae	Pupae	Total
November	17	7	53	2	47	1	3.8	2.1	3.0
	24	16.1	91	2	74	1	2.2	1.4	1.8
December	1	11.1	46	1	22	1	2.2	4.5	2.9
	8	13.4	77	0	56	0	0	0	0
	15	14.4	75	0	15	0	0	0	0
	22	18.6	82	0	56	0	0	0	0
	29	15.1	82	1	49	0	0	0	0
January	5	3.5	14	0	8	0	0	0	0
Total			520	6	327	3			
General mean		12.4	65	0.8	40.9	0.4	11.1	0.9	1.0

Table 2. Percent of infested plants of the Barnyard grass, *Echinochloa crus-galli* and number of collected larvae as well as emerged flies and parasitism of the sorghum shoot fly *A. soccata* at Al-Aiat in 2002-2003.

Sampling date		Infested plants %	Total no. of collected larvae	No. of parasitised larvae	Larval parasitism %	Total no. of collected pupae	No. of parasitised pupae
Month	Day						
December	25	6.5	40	26	65.5	12	0
January	1	8.0	66	55	83.3	9	0
	8	6.0	26	19	73.1	5	0
	15	5.0	24	17	70.8	6	0
April	17	3.0	3	2	66.7	1	0
May	1	3.0	3	3	100	0	0
July	15	6.0	19	3	15.8	16	0
	22	8.0	11	1	10.0	10	0
	29	5.0	4	0	0	4	0
November	12	2.0	3	0	0	3	0
	30	3.0	7	0	0	7	0
Total			206	126		73	0
General mean		5.0	18.7	11.5	61.2	6.6	0

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Table 3. Percent of infested plants of Sudan grass, *Sorghum vulgare* var. *sudanense*, and number of collected larvae or pupae and parasitism of the sorghum shoot fly *A. soccata* at Al-Aiat in 2003.

Sampling date		Infested Plants %	Total no. of collected larvae	No. of parasitised larvae	Total no. of collected pupae	No. of parasitised pupae	Parasitism %		
Month	Day						Larvae	Pupae	Total
June	19	1.0	1	0	1	0	0	0	0
	26	2.0	7	0	7	0	0	0	0
July	3	4.2	3	0	2	0	0	0	0
	10	7.7	30	4	21	2	13.3	9.5	11.8
	17	5.1	25	0	3	1	0	4.2	4.2
	24	6.0	32	4	25	1	12.5	4.0	8.8
	31	5.0	36	4	34	2	11.1	5.9	8.6
August	7	5.5	8	1	7	0	12.5	0	12.5
	14	3.5	9	2	4	0	22.2	0	22.2
	21	6.0	32	1	24	3	3.1	12.5	7.1
	28	6.0	4	0	4	0	0	0	0
September	4	2.0	1	0	1	0	0	0	0
Total			188	16	154	9			
General mean		4.5	15.7	1.3	12.8	0.8	8.5	5.8	7.3

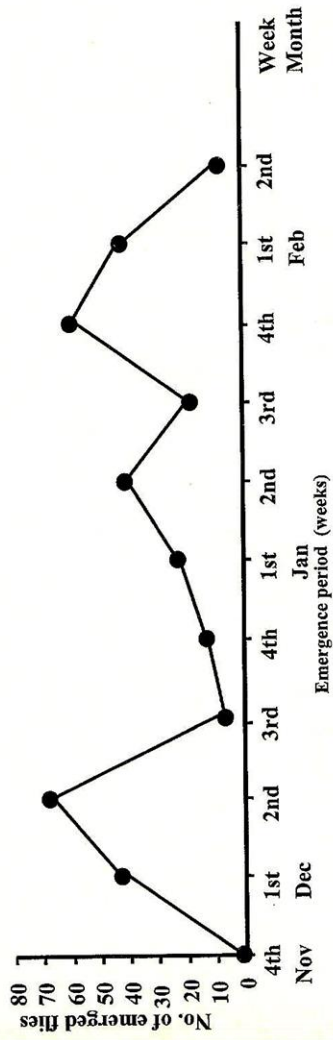


Fig. 1. Number of emerged *A. soccata* flies reared from sorghum raatoon at Sids in 1998- 1999 .

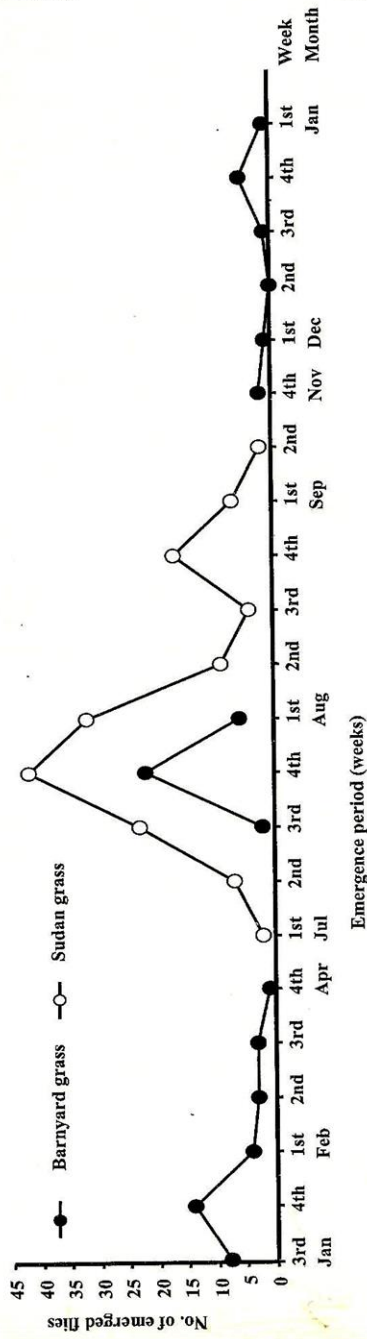


Fig. 2. Number of emerged *A. soccata* flies reared from Barnyard grass and Sudan grasses at Al-Aliat in 2003-2004.

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إصابة بعض محاصيل العلف النجيلية بذبابة البرعم الطرفي للذرة الرفيعة
Atherigona Sovvata Rondani
 في مصر

سمير عوض السروى

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الجيزة - مصر.

تهاجم ذبابة البرعم الطرفي خلفات الذرة الرفيعة *Atherigona soccata* Rondani في سدس والعياط بالإضافة إلي النوع (*Atherigona humeralis* (Wiedemann) على حشيشة السودان والنوع *Atherigona bedfordi* Emden (تسجيل جديد) على الذنبية في العياط بمصر الوسطى. وجد أن ذباب البرعم الطرفي ينشط بصفة عامة وينتقل من محصول إلي آخر خلال السنة، فتصاب الخلفات النامية على نباتات الذرة الرفيعة بعد حصادها حيث تصل نسبة الإصابة إلي حوالي ١٢% في موسم ١٩٩٨-١٩٩٩ في سدس. بينما تنخفض تلك النسبة إلي حوالي ٥% على حشيشة الذنبية والسودان خلال عامي ٢٠٠٢ و ٢٠٠٣ في العياط.

بلغت اليرقات ذروتها في أوائل يناير على الذنبية بينما بلغت ثلاثة ذرات في أوائل وأواخر يوليو ثم في الأسبوع الثالث من أغسطس على حشيشة السودان في حين سجلت أعلى أعدادها في الأسبوع الثالث من نوفمبر والنصف الثاني من ديسمبر على خلفات الذرة المصابة في سدس. وتخرج الكاملات من النباتات المصابة لمحاصيل العلف المختلفة خلال معظم أشهر السنة وتبلغ ذروتها في أواخر يناير، يوليو وأغسطس وديسمبر على حشيشة الذنبية والسودان.

سجلت أعلى معدلات التطفل البرقي (حوالي ٦١%) على نباتات الذنبية المصابة وأقلها (حوالي ٩%) على حشيشة السودان في العياط بينما بلغت على العذارى (حوالي ٦%) على حشيشة السودان وسجلت أديانها (١%) على كلا من اليرقات والعذارى على خلفات الذرة المصابة في سدس. خرجت ثلاثة طفيليات لليرقات من عشائرية الأجنحة هي *Neotrichoporoides* sp. و *Pediobius* sp. و *Prigalio* sp. من عائلة (Eulophidae) وطفيليان على العذارى هما *Cillitula* sp. من عائلة (Pteromalidae) و *Dacnusa* sp. من عائلة (Braconidae) وطفيلي ثانوي غير معرف ينتمي إلي عائلة Cynipidae. وهذه الأنواع تسجيل جديد على ذبابة *A. soccata* في مصر. وجد أن النوعان الأول والثاني هما الأكثر شيوعا على اليرقات التي تصيب خلفات الذرة والذنبية في العياط وكذلك خلفات الذرة وحشيشة السودان في كلا من سدس والعياط، على التوالي.

إن حراثة حقول ذرة العلف وجمع بقايا النباتات تعتبر أحد طرق المكافحة الزراعية الآمنة لخفض أعداد ذبابة البرعم الطرفي على ذرة العلف.