LEAFHOPPERS AND THEIR ASSOCIATED PARASITOIDS IN SUGAR BEET FIELDS

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Abstract

Sugar beet plants are subject to attack by many insects, of which are several species of leafhoppers. Leafhoppers directly injure sugar beet plants by sucking large amounts of sap, and indirectly by transmitting virus diseases. Parasitoids of leafhoppers infesting sugar beet plants have received little attention in Egypt. The current investigation was carried out at locations in Kafr El-Sheikh and Gharbia Governorates, as well as at Sakha Agricultural Research Station during 2004/05 and 2005/06 seasons to survey parasitoids of leafhopper eggs and nymphs. Also, the population fluctuations of the leafhopper, *Empoasca decipiens* Paoli adults and the egg-parasitoid, *Anagrus* spp. were monitored. The survey of leafhoppers, using sweeping net and vacuum machine, revealed the occurrence of 13 species; *Cofana* sp., *Nephotettix apicalis* (Motsch.), *Recilia* sp., *Balclutha* spp., *Cicadulina bipunctata* (Melichar), *Macrosteles* sp., *Exitianus capicola* (Stal.), *Circulifer tenellus* (Baker), *Orosius albicinctus* Distant, *Hecalus* sp., *Empoasca decipiens* Paoli, *Empoasca lybica* de Berg and *Asymmetrasca decedens* (Paoli). Nymphs of *Nephotettix* sp and *Cicadulina* sp. were found to be parasitized by *Pipuncules* sp. and *Tomosvaryella* sp.(Pipunculidae: Diptera). Five egg-parasitoids were detected from the host eggs of *Empoasca decipiens*, four species; *Anagrus* sp., *A. atomus* Linnaeus, *A. empoascae* Dozier, *Erythmelus* sp.are belonging to family Mymaridae, and one species; *Oligosita* sp. belonging to family Tricogrammatidae. Population flactuations of *E. decipiens* and its egg-parasitoid, *Anagrus* spp. were monitored using yellow sticky traps at Kafr El-Sheikh and Gharbia locations. The insect pest exhibited four peaks of occurrence (on 15 Oct., 15 Jan., 15 Mar and 1 May) accompanied by three peaks of the parasitoid (on 1 Nov.,1 Feb and 1 Apr.). At Gharbia locations, three peaks were detected for the insect pest (on 15 Nov., 15 Mar. and 1 May) associated with two peaks for the parasitoid (on 1 Dec. and 1 Apr.). This study shows that sugar beet fields are rich in parasitoid species attacking leafhoppers which are still minor pests in such fields. Consequently, too much restrictions should be imposed upon the application of insecticides to conserve these important natural enemies, otherwise the minor pets could become major ones.

INTRODUCTION

Sugar beet plants are liable to be attacked by more than 150 species of insects and mites, 40-50 of these species can cause economic damage (Lang 1987). These species have been recorded by several investigators in Egypt and other countries (Lang 1971, Blickenstaff 1976, Abo Saied Ahmed 1987, Lang 1987, Shalaby 2001, Bazazo 2005).

The surveyed insects from sugar beet fields were found belonging to a wide range of insect orders, from which is Homoptera. From the homopterous insects, leafhoppers were surveyed worldwide attacking sugar beet plants (Reynolds *et al.* 1967, Lang 1971, Abo-Saied Ahmed 1987, Shalaby 2001 and Bazazo 2005).

Leafhoppers cause direct injury to plants by sucking large amounts of sap, and thus reduce or destroy leaf chlorophyll content. In severe cases, the leafhopper species can build up enormous populations in short time producing a typical feeding damage symptom known as "hopperburn". On the other hand, indirect damage may occur when the insect species act as vectors of some diseases (Staples *et al.* 1970 and Lang 1987). In many locations, sugar beet growers are getting worried about the infestations with leafhoppers, and tend to use insecticides regardless of insect economic importance. To avoid the misuse of insecticides, integrated pest management (IPM) programs should be considered. Biological control is usually an essential component of IPM.

Studies concerning natural enemies of leafhoppers in Egypt were found few. El-Kifl *et al.* (1974) recorded *Anagrus* spp. parasitizing jassids attacking leguminous crops.

Hendawy (2001) surveyed *Anagrus* spp., *Oligosita* sp. and *Tomosvaryella* sp. as parasitoids of rice leafhoppers and plant hoppers. Triapitsyn and Beardsley (2000) indicated that several species of *Anagrus* were successfully used in biological control programs.

The current study was undertaken during 2004/05 and 2005/06 seasons at the experimental farm of Sugar Beet Research Program, Sakha Agricultural Research Station. Also, sugar beet fields in Gharbia Governorate were considered. The study aimed to survey leafhoppers and their parasitoids occurring in sugar beet fields. Also, population fluctuations of most dominant leafhoppers and parasitoids were monitored.

MATERIALS AND METHODS

Experiments were conducted during seasons of 2004/05 and 2005/06, at fields of Kafr El-Sheikh and Gharbia Governorates. Kowmara sugar beet cultivar was sown

on three successive plantations; mid-August, mid-September and mid-October. Each plantation occupied an area of one feddan, where no pesticides were applied.

1. Survey of leafhoppers occurring in sugar beet fields:

Leafhoppers were biweekly counted in sugar beet fields using two sampling methods. For each sampling date, the sweeping net was used as 25 double strokes, and vacuum machine was operated for two minutes. The sampling procedure started by beginning of September, and continued till end of the season. The collected insects were placed in glass jars, and transferred to the laboratory. At examination, the insects were anesthetized to be easily examined using stereoscope microscope. The leafhoppers were separated, from the catch, and identified by specialists at plant Protection Research Institute.

2. Survey of parasitoids related to leafhopper nymphs:

Some of the collected leafhopper nymphs were observed to be parasitized. These nymphs were found belonging to *Nephotettix* and *Cicadulina* genera. The parasitized nymphs were separated from the normal ones, placed in glass tubes and provided with pieces of fresh sugar beet leaves till the emergence of parasitoids. The obtained parasitoids were preserved, and identified.

3. Survey of parasitoids of *Empoasca decipiens* eggs:

The dominant leafhopper species was found as *Empoasca decipiens*. So, the sweeping net was used for collecting insects. The catch was inspected, and the individuals belonging to *E. decipiens* were separated using an aspirator. The adults were placed in 30 x 30 x 40 cm screen cages having potted sugar beet plants upon which the leafhopper can feed. Two days later, the sugar beet plants having *E. decipiens* eggs were transferred to the field, and located with their pots among sugar beet plants for two days. Thus, the leafhopper eggs were exposed to the natural parasitoids in the field for about 48 hours. The pots of sugar beet plants were retransferred to the laboratory.

Thus, the sugar beet leaves may contain parasitized leafhopper eggs. Three days later, the sugar beet plants were pulled out from the pots with their roots attached. The roots were water washed, and wrapped with a piece of water saturated cotton and confined in a plastic bag to keep the roots moist. The sugar beet plants were placed in transparent plastic jars. Two days later, the jars were placed in the freezer for five minutes to anesthetize the probably emerging parasitoids, and then moved out the refrigerator. The sugar beet plants were shaken on a white paper for collecting the anesthetized parasitoids. This procedure was repeated seven times, and thus the experiment lasted for 14 days (7 collections x 2-day long). The collected parasitoids were mounted using Hoyer medium, and prepared for identification.

4. Population fluctuation of *Empoasca decipiens* nymphs and adults and the egg-parasitoid, *Anagrus* sp.:

To monitor the population fluctuations of the leafhopper and its egg-parasitoids, yellow sticky traps were used for trapping *Empoasca decipiens* nymphs and adults, and the egg-parasitoid, *Anagrus* sp. Biweekly samples were collected, examined and counted from locations in Kafr El-Sheikh and Gharbia Governorates.

RESULTS AND DISCUSSION

1. Survey of leafhoppers occurring in sugar beet fields:

Both sweeping net and vacuum machine were used to survey leafhopper species occurring in sugar beet fields at locations in Kafr El-Sheikh and Gharbia Governorates. Thirteen leafhopper species were surveyed from both locations (Table 1).

Out of the thirteen species, nine were surveyed from Kafr El-Sheikh locations, thus, *Cofana* sp. and *Recilia* sp. were absent. On the other hand, four species were absent at locations of Gharbia Governorates, i.e. *Exitianus capicola, Circulifer tenellus, Hecalus* sp. and *Asymmetrasca decedens*. The species, *Circulifer tenellus* was reported as vector of top curl virus of sugar beet plants. This species that was surveyed from Kafr El-Sheikh locations, but not from Gharbia, is considered of economic importance as the majority of sugar beet cultivated areas are located at Kafr El-Sheikh. Accordingly, top curl virus disease should be monitored, and control procedures should be applied, from which the management of insect vectors (Staples *et al.*, 1970 and Lang, 1987).

Table 1. Leafhopper species (Auchenorrhyncha-Cicadellidae) surveyed from sugar beet fields during 2004/05 and 2005/06 seasons.

Leafhopper species	Occurrence	
	Kafr El-Sheikh	Gharbia
Cofana sp.	X	✓
Nephotettix apicalis (Motsch.)	✓	✓
Recilia (*Togacephala*) sp.	x	✓
Balclutha spp.	✓	✓
Cicadulia bipunctata (Melichar)	✓	✓
Macrosteles sp.	✓	✓
Exitianus capicola (Stal.)	✓	x
Circulifer tenellus (Baker)	✓	x
Orosius albicinctus Distant	✓	✓
Hecalus sp.	✓	x
Empoasca decipiens Paoli	✓	✓
Empoasca lybica de Berg	✓	✓
Asymmetrasca decedens (Paoli)	✓	x

2. Survey of parasitoids related to leafhopper nymphs:

Confining parasitized leafhopper nymphs in glass tubes revealed the occurrence of two parasitoid species, *Pipuncules* sp. and *Tomosvaryella* sp.,(Fig. 1,A) both are belonging to Family Pipunculidae and Order Diptera (Table 2). These two parasitoids were found emerging from nymphs of *Nephotettix* sp. and *Cicadulina* sp.

In rice fields *Tomosvaryella oryzaetora* (Koizumi) parasitized *Nephotettix* sp. (Barrion and Litsinger 1994) while *Tomosvaryella* sp. parasitized some Cicadellids (Hendawy 2001).

3. Survey of parasitoids of *Empoasca decipiens* eggs:

When the eggs of *Empoasca decipiens* were exposed to natural parasitism in the field, and later incubated and examined in the laboratory, five hymenopterous egg-parasitoids were collected (Table 2). Four species; *Anagrus* sp., *Anagrus atomus* Linnaeus, *Anagrus empoascae* Dozier and *Erythmelus* sp. are belonging to Family Mymaridae, and one species, *Oligosita* sp. is belonging to Family Trichogrammatidae. However, all species of Mymaridae and Trichogrammatidae are egg-parasitoids of leafhopper insects.

In this respect, Soyka (1950) identified several species of *Anagrus* in Egypt, but he did not define their hosts. El-Kifl *et.al* (1974) reported *Anagrus atomus* L., *Anagrus empoascae* Dozier, *Erythmelus* sp. and *Oligosita* sp. parasitizing jassids occurring on leguminous crops. Gibson (1993) and Huber(1986) noted that mymarids mostly parasitize eggs of homopteran insects, and their eggs are laid in concealed localities, such as plant tissues, under scales, or in the soil.

4. Population fluctuation of *Empoasca decipiens* nymphs and adults and the egg-parasitoid, *Anagrus* sp.:

Population of *Empoasca decipiens* and the egg-parasitoid, *Anagrus* sp. (Fig.1, B) were monitored using yellow sticky traps, at locations in Kafr El-Sheikh and Gharbia Governorates. Recording started at the beginning of September, 2005 and ended on 15 May (2006) (Table 3). At Kafr El-Sheikh, the first peak of *E. decipiens* (63 indiv./10 sticky traps) was detected on 15 October, the second (138 indiv.) on 15 January, the third and biggest one (184 indiv.) on 15 March, and the fourth (159 indiv.) on 1 May. The parasitoid exhibited three peaks of occurrence, the first (46 indiv./10 sticky traps) on 1 November, the second (43 indiv.) on 1 February, the third (48 indiv.) on 1 April. Thus, the peaks of the parassitoid came about one week later than the peaks of the host. The numbers of the host and parasitoid collected from Gharbia locations were usually less than those collected from Kafr El-Sheikh locations (Table 3). However, the first peak of *E. decepiens* was reported as 46 indiv./10 traps on 15 November, and followed by a peak for the parasitoid on 1 December (26 indiv.). The second peak of both host and parasitoid were detected on

15 March and 1 April, with numbers of 119 and 30 indiv., respectively. The greatest peak of the host occurred on 1 May (121 indiv./10 yellow sticky traps).

Thus, the egg-parasitoid, *Anagrus* sp. occurred in sugar beet fields throughout the season. This puts restrictions on the application of insecticides to conserve this parasitoid, as an important natural enemy.

Table 2. Parasitoids of eggs and nymphs of leafhoppers occurring in sugar beet fields; 2005/06 season.

Parasssitoid			Host & stage
Order	Family	Species	
Diptera	Pipunculidae	*Pipuncules* sp. *Tomosvaryella* sp.	*Nephtotettix* sp. & *Cicadulina* sp. (nymphs)
Hymenoptera	Mymaridae	*Anagrus* sp. *Anagrus atomus* Linnaeus *Anagrus empoascae* Dozier *Erythmelus* sp.	*Empoasca decipiens* (eggs)
	Trichogrammatidae	*Oligosita* sp.	

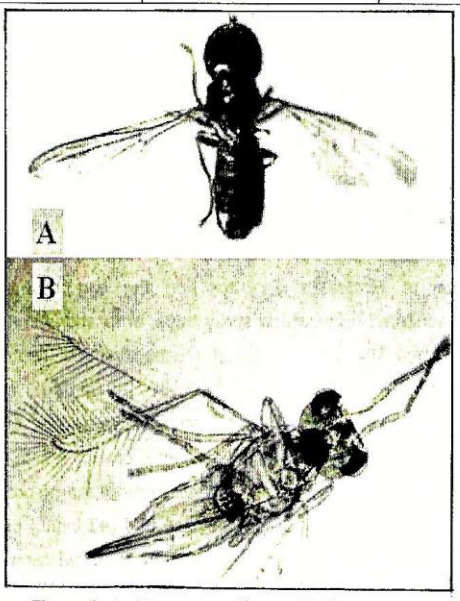

Figure 1: A. *Tomosvaryella* sp. , B. *Anagrus* sp.

Table 3. Population fluctuations of *Empoasca decipiens* nymphs and adults, and the egg-parasitoid, *Anagrus* sp./10 yellow sticky traps in sugar beet fields (2005/06 season).

Date		Kafr El-Sheikh		Gharbia	
		E. decipiens	*Anagrus* sp.	*E. decipiens*	*Anagrus* sp.
Sept.	1	23	4	15	3
	15	31	16	16	6
Oct.	1	91	16	19	12
	15	63	23	23	14
Nov.	1	22	46	36	14
	15	49	36	46	17
Dec.	1	70	13	28	26
	15	97	7	39	16
Jan.	1	101	10	61	5
	15	138	24	79	5
Feb.	1	97	43	83	18
	15	103	34	86	13
Mar.	1	121	29	90	24
	15	184	20	119	23
Apr.	1	129	48	89	30
	15	80	42	80	21
May	1	159	41	121	19
	15	126	36	116	16

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نطاطات الأوراق و الطفيليات المصاحبة لها في حقول بنجر السكر

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تتعرض نباتات بنجر السكر للإصابة بالعديد من الآفات الحشرية، و التي من بينها نطاطات الأوراق التي تتسبب في نوعين من الأضرار للنباتات، الأول مباشر عن طريق امتصاص العصارة، و الثاني غير مباشر بنقل الأمراض الفيروسية. و نظرا لأن الطفيليات التى تهاجم نطاطات الأوراق في حقول بنجر السكر، لم تحظ بالاهتمام الكافي في مصر، أجريت هذه الدراسة في عدة مناطق بمحافظتي كفر الشيخ و الغربية خلال موسمى ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/ ٢٠٠٦. استهدفت الدراسة حصر أنواع نطاطات الأوراق الموجودة في حقول بنجر السكر، و كذا الطفيليات المرتبطة بها.. علاوة علي دراسة تقلبات تعداد النطاط من النوع *Empoasca decipiens* (الأكثر انتشارا) و طفيل البيض *Anagrus* spp. المصاحب له.

أوضح الحصر وجود ١٣ نوعا من النطاطات هي :

Cofana sp., *Nephotettix apicalis* (Motsch.), *Recilia* sp., *Balclutha* spp., *Cicadulia bipunctata* (Melichar), *Macrosteles* sp., *Exitianus capicola* (Stal.), *Circulifer tenellus* (Baker), *Orosius albicinctus* Distant, *Hecalus* sp., *Empoasca decipiens* Paoli, *Empoasca lybica* de Berg , *Asymmetrasca decedens* (Paoli)

كما وجد أن حوريات النوعين *Nephotettix* sp. , *Cicadulina* sp. كانت عرضة للتطفل بكل من *Pipuncules* sp. , *Tomosvaryella* sp. التابعين لعائلة Pipunculidae: Diptera .و علاوة علي ذلك تم حصر خمسة أنواع من طفيليات البيض أربعة منها هي:

Anagrus sp., *A. atomus* L, *A. empoascae* Dozier, *Erythmelus* sp. تتبع عائلة Mymaridae و نوع واحد *Oligosita* sp. يتبع عائلة Trichogrammatidae .

عند دراسة تقلبات التعداد لكل من *Empoasca decipiens* و طفيل البيض *Anagrus* spp. المصاحب له باستخدام المصائد الصفراء اللاصقة ، ظهر أن للآفة أربع ذروات للتعداد في مناطق بمحافظة كفر الشيخ تصاحبها ثلاث ذروات للطفيل..وفي مناطق بمحافظة الغربية سجلت ثلاث ذروات للآفة مصحوبة بذروتين للطفيل.

توضح هذه الدراسة أن حقول بنجر السكر بها أنواع متعددة من الطفيليات التي تهاجم الأطوار المختلفة لنطاطات الأوراق. وعلي هذا يجب توخى الحذر الشديد عند استخدام المبيدات للحفاظ علي فاعلية هذه الأعداء الحيوية الهامة، حتى لا تتحول هذه النطاطات من آفات ثانوية إلي آفات رئيسية.