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INSECT PESTS OF SUGAR HONEY LEAF, *Stevia rebaudiana* BERTONI AND ASSOCIATED NATURAL ENEMIES IN EGYPT

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ABSTRACT

The current study was carried out during 2010/2011 and 2011/2012 seasons at the Experimental Farm of Sakha Agricultural Research Station for surveying insect pests of *Stevia* plants and associated with natural enemies, monitoring population size of major insect pests and identify arthropods trapped in spider webs. Data indicated that 20 species of insect pests, belonging to 15 families and 9 orders. 17 species of hymenopterous belonging to ten families. 17 species of predatory insects belonging to 9 families and 6 orders. 16 spider species belonging to ten families (Order: Araneae). The greatest population size in three successive cuts were; *Bemisia tabaci* (Genn.), *Thrips tabaci* Lind. and *Empoasca* spp. webs of some spider families were examined to find out the arthropods trapped inside. It was found that these webs contained 93.48%insect pests and mites, 6.52% insect predators and parasitoids. This show that the spider webs captured mainly the harmful arthropods.

INTRODUCTION

Sugar honey leaf, *Stevia rebaudiana* Bertoni (Family: Compositae), is a non-caloric natural-source alternative to artificially produced sugar substitutes. It is used as a sweetener, medicine, cosmetic ingredient, pickling agent, dentifrice, a flavor in cereals, breads, juices, candies, yoghurt and ice cream (Heikal *et al.*, 2008). Phillips (1988) reported that *Stevia* contains eight glycoside compounds, and Stevioside is the most abundant one. The extracts of these compounds may be up to 300 times sweeter than sugar (Tanaka, 1997). The total market values of *Stevia* sweetener in Japan is estimated to be around 2-3 billion yen/year (Megeji *et al.*, 2005). The crop has been cultivated allover the world, e.g. Brazil, Korea, Mexico, USA, Indonesia, Tanzania and Canada (Fors, 1995).

Aphids, whiteflies, mites, thrips, mealy bugs and cutworms are the dominant insects in *Stevia* fields allover the world (Thomas, 2000; Midmore and Rank, 2002 and Anonymous, 2010). Midmore and Rank (2002) reported that insect do not appear to be a problem *Stevia* has shown clear aphid resistance, the sweet taste being a possible deterrent to insects. Aphids, grasshopper and bugs are the dominant insect pests in *Stevia* fields (Anonymous, 2004). Megeji *et al.* (2005) indicated that insects like aphids, whiteflies, mealy bugs and red spider mite were observed in the experimental field, but without much harm to the crop. Fields grown with *Stevia* are not known to have serious insect pest problems and are often reported as exhibiting insect-repellent qualities (Anonymous, 2010). But, aphids, thrips and white flies can become a serious problem on *Stevia* in greenhouses,

which could significantly impact transplant production. *Stevia* plants are vulnerable hosts to insects and diseases (Anonymous, 2010).

In Egypt, Ministry of Agriculture and Land Reclamation is planning to expand the cultivated *Stevia* area in the coming decades to reduce imports and, if possible, to achieve self-sufficiency of sugar. The total area cultivated with *Stevia* reached 5000 feddans sponsored by the private companies such as *Stevia* International Company for Agricultural and Industrial Projects (Behira) and Glyco Medical Industries.

In Egypt, there are many research papers about the effect of different agricultural practices on quantity and quality of *Stevia* (Allam *et al.*, 2001; Attia, 2005 and Nassar *et al.*, 2006). But, as the author awares, this is the first investigation about the insects associated with *Stevia* in Egypt, and this is the first investigation about the natural enemies in allover the world.

The current study was carried out at the Experimental Farm of Sakha Agricultural Research Station during 2010/2011 and 2011/2012 seasons to investigate the following items:

1. Survey insect pests on *Stevia* plants and their associated insect parasitoids, predators and true spiders.
2. Monitor population size of major insect pests.
3. Identify arthropods (mainly insect pests) trapped in spider webs.

MATERIALS AND METHDOS

The current investigation was carried out at the Experimental Farm of Sakha Agricultural Research Station during 2010/2011 and 2011/2012 seasons. The experimental *Stevia* plants field (about ¼ feddan) was sown with "Spanti" cultivar during the first half of September 2010 until the first half of March 2012. The field received all recommended cultural practices, but without any pesticides used.

1. Survey of insect pests, and their associated insect parasitoids, predators and true spiders:

Arthropods were surveyed from September 2010 to March 2012. Weekly examinations were conducted by three methods:

a) Sweep net : (50 double strokes per examination):

Just before sweeping, a cotton piece saturated with chloroform was introduced into the trap to anesthetize the trapped arthropods. After collection, the catch was emptied into glass jars, and transferred to the laboratory for identification.

b) Hand collection (glass test tubes):

Some arthropods, particularly true spiders, were trapped using glass test tubes, as the spiders move quickly away from collecting techniques to hide in the soil, or under plant litters.

c) Visual record:

Some arthropods, particularly eggs of *Chrysoperla,* were visually recorded.

2.Monitoring population size of major insect pests:

Major insect pests were monitored from September 2010 to November 2011. Weekly examination were conducted by sweep net (50 double strokes per examination) during three successive cuts.

3.Identify arthropods trapped in spider webs:

Spider spin their webs to capture arthropods for feeding upon. These webs were found to be constructed on the soil and on plants. In each sample, the webs with its contents were carefully picked up using a brush, and introduced into glass vials containing 70% ethyl alcohol for preservation till identification. Twelve samples (15 webs/sample/month) were collected from the beginning of November 2010 up to October 2011.

RESULTS AND DISCUSSION

1.Survey of insect pests, parasitoids, predators, spiders and monitor population size of major insect pests:

1.1.Survey insect pests:

The survey revealed the occurrence of 20 insect species, belonging to 15 families and 9 orders (Table 1). Homoptera was represented by seven species and Lepidoptera was represented by four species, the third rank was that of Orthoptera and Diptera were represented by two species. Collembola, Coleoptera, Hemiptera, Hymenoptera and Thysanoptera were each represented by one species.

Table (1):Survey of insect pests inhabiting *Stevia* fields at the Experimental Farm of Sakha Agricultural Research Station, during 2010/2011 and 2011/2012 seasons.

Order	Family	Genera/species	No.
Collembola	Entomobryidae	*Lepidocertinus insertus* Hand.	1
Coleoptera	Phalacridae	Unidentified	1
Diptera	Agromyzidae	*Liriomyza trifolii* Backer	2
	Tephrittidae	Unidentified	
Hemiptera	Pentatomidae	*Nezar viridula* L.	1
Homoptera	Aleyrodidae	*Bemisia tabaci* (Genn)	1
	Cicadellidae	*Empoasca lybica* de Berg *Empoasca decipiens* (Paoli)	2
	Aphididae	*Aphis gossypii* (Glover) *Myzus persicae* (Sulzer)	2
	Delphacidae	*Sogatella sp.*	1
	Pseudococcidae	*Planococcus sp.*	1
Hymenoptera	Eurytomidae	Unidentified	1
Lepidoptera	Noctuidae	*Agrotis ipsilon* (Huf.) *Syngrapha circumflexa* L. *Phytometra gamma* L. *Phytometra ni* L.	4
Orthoptera	Acrididae	*Acrida sp.*	1
	Gryllotalpidae	*Gryllotalpa gryllotalpa* L.	1
Thysanoptera	Thripidae	*Thrips tabaci* Lind	1
Total 9	15	*20*	20

These results are in agreement with those obtained by many authors in allover the world, e.g. Thomas, 2000, Midmore and Rank, 2002, Anonymous, 2004, Megeji *et al.*, 2005 and Anonymous, 2010.

1.2.Monitor population size of major insect pests:

Data presented in Table (2) show the population size of major insect pests inhabiting the three successive *Stevia* cuts. The greatest population sizes were those of *Bemisia tabaci* (30.86, 30.31 and 31.28%), *Thrips tabaci* (26.23, 21.76 and 20.76%), and *Empoasca* spp. (21.60, 21.76 and 20.51%), out of total surveyed insect pests, respectively. Moderate population sizes in three cuts were those of *Nezara viridula* (7.10, 9.07 and 9.23%), aphids (6.79, 5.95 and 6.41%) and *Planococcus sp.* (6.17, 7.25 and 6.66%), respectively. Low population size were recorded for Collembola (1.23, 3.88 and 5.12%), respectively. Regardless of cuts, the same trend obtained, as *B. tabaci, T. tabaci* and *Empoasca* spp. were the most occurring while Collembola was the least.

Table (2): Population size of major insect pests attacking *Stevia* plants in three successive cuts, 2010/2011 and 2011/2012 seasons, using sweep net method.

Insect pests	1st cut		2nd cut		3rd cut		Total	
	No*	%	No*	%	No*	%	No	%
Bemisia tabaci	100	30.86	117	30.31	122	31.28	339	30.86
Thrips tabaci	85	26.23	84	21.76	81	20.76	250	22.72
Empoasca spp.	70	21.60	84	21.76	80	20.51	234	21.27
Nezara viridula	23	7.10	35	9.07	36	9.23	94	8.54
Aphids	22	6.79	23	5.95	25	6.41	70	6.36
Planococcus sp.	20	6.17	28	7.25	26	6.66	74	6.72
Collembola	4	1.23	15	3.88	20	5.12	39	3.54
Total	324	-	386	-	390	-	1100	

*** Number of insects collected in (8 samples x 50 double strokes)**

1.3.Parasitoids:

The survey revealed the occurrence of 17 hymenopterous parasitoid species, belonging to ten families (Table 3). Each of Braconidae and Trichogrammatidae was represented by three species. Two species were found belonging to each of Aphelinidae, Mymaridae and Scelionidae. Families: Bethylidae, Ceraphronidae, Encyrtidae, Eulophidae and Pteromalidae were each represented by only one species.

1.4.Insect predators:

Table (4) reveals the occurrence of 17 species of predatory insects, belonging to nine families and six orders. Four species belonged to Coccinellidae. Two species were found belonging to each of Carabidae. Staphylinidae, Mantidae, Syrphidae, Formicidae. One species belong to each of Anthocoridae, Reduviidae and Chrysopidae.

1.5.Spiders (Order: Araneae):

The spider species inhabiting *Stevia* fields are listed in Table (5). Sixteen spider species are belonging to 10 families (Order: Araneae). Araneidae and Linyphiidae were each represented by three species. The second rank of family occurrence was that of Lycosidae and Salticidae, as

each represented by two species. Each of Dictynidae, Oonopiidae, Philodromidae, Pholcidae, Theridiidae and Thomisidae was represented by one species.

Table (3): Survey of hymenopterous parasitoids associated with *Stevia* insect pests at the Experimental Farm of Sakha Agricultural Research Station, during 2010/2011 and 2011/2012 seasons.

Family	Genera/species	No.
Aphelinidae	*Encarsia Formosa* (Gahn) *Etremocerus mundus* (Mercet)	2
Bethylidae	*Goniuzus sp.*	1
Braconidae	*Apanteles sp.* *Bracon sp.* *Cotesia sp.*	3
Ceraphronidae	*Ceraphron sp.*	1
Encyrtidae	*Mecroterus sp.*	1
Eulophidae	*Tetrastichus sp.*	1
Mymaridae	*Anagrus atomus* L. *Gonatocerus sp.*	2
Scelionidae	*Telonomus sp.* *Trissolcus sp.*	2
Trichogrammatidae	*Trichogramma evanescens* (Ashmead) *Oligosita sp.* *Paracentrobia sp.*	3
Pteromalidae	*Pteromalus* sp.	1
Total 10	17	17

Table (4): Survey of predatory insects associated with *Stevia* insect pests at the experimental Farm of Sakha Agricultural Research Station, during 2010/2011 and 2011/2012 seasons.

Order	Family	Genera/species	No.
Coleoptera	Carabidae	*Bemidian mixtum* Schaum *Tachys sp.*	2
	Coccinellidae	*Coccinella undecimpunctata* L. *Rhizobus litura* Fab. *Scymnus interruptus* Goeze *Stethorus gilviforns* (Muls).	4
	Staphylinidae	*Paederus alfierii* (L.) *Philonthus sp.*	2
Dictyoptera	Mantidae	*Sphodromantis bioculata* Sauss *Callidomantis savignyi* L.	2
Diptera	Syrphidae	*Syrphus corollae* L. *Allogrpta sp.*	2
Hemiptera	Anthocoridae	*Orius livigtos* L.	1
	Reduviidae	*Reduvius sp.*	1
Hymenoptera	Formicidae	Solenopsis sp. Monomorium sp.	2
Neuroptera	Chrysopidae	Chrysoperla carnea Steph.	1
Total 6	9	17	17

Table (5): Survey of spiders, (Order: Araneae) associated with *Stevia* insect pests at the Experimental Farm of Sakha Agricultural Research Station during 2010/2011 and 2011/2012 seasons.

Family	Genera/species	No.
Araneidae	*Araneus sp.* *Argiope trifasciata* Forscal *Singa albobivittata* Dicaporiacco	3
Dictynidae	*Dictyna sp.*	1
Linyphiidae	*Bathyphantes sp.* *Erigone sp.* *Lepthyphantes sp.*	3
Lycosidae	*Lycosa sp.* *Pardosa sp.*	2
Oonopiidae	Unidentified	1
Philodromidae	*Thanatus albini* (Audouin)	1
Pholcidae	*Pholcus phalangioides* (Fuesslin)	1
Salticidae	*Plexippus paykulli* (Savigny) *Ballus sp.*	2
Theridiidae	*Theridion sp.*	1
Thomisidae	*Thomisius sp.*	1
Total 10	16	16

In the USA, Australia and China, spiders are effectively used in biocontrol programs. In China, particularly Hubei province, the use of chemical insecticides was reduced by 70-90% because of existing spiders in the fields (Rajeswaran *et al.*, 2005).

Tables (3, 4 and 5) show that *Stevia* fields are rich in natural enemies; parasitoids, insect predators and spiders that should be conserved to keep the natural balance in the fields.

2.Identify arthropods (mainly insect pests) trapped in spider webs:

Web-weaver spiders trap their victims in the spun nets, and then, these victims become available prey to be fed upon.

The total numbers of arthropods collected in 180 webs of spiders were 92 individuals (Table 6), including insect pests, mites and even insect predators and parasitoids. The majority of collected arthropods were insect pests and mites (93.48%). Fortunately, the insect predators and parasitoids constituted only 5.42 and 1.10%, respectively of the total trapped arthropods. Most of trapped insect pests were *Bemisia tabaci* (16 nymphs and adults), followed by aphids (15 nymphs and adults), collembolan (13 nymphs and adults), *Thrips tabaci* (12 nymphs and adults) and *Liriomyza trifolii* (9 adults). Very few numbers of *Tetranychus sp., Acrida sp., Solenopsis sp.* and *Anagrus* were trapped in the webs ranging between one to five individuals. Nyffeler and Benz (1988) considered all arthropods found in webs of spider as prey, regardless if the spiders were observed feeding on them or not.

Table (6): Arthropods trapped in webs of spiders; Araneidae, Dictynidae, Linyphiidae, Pholcidae and Theridiidae constructed on the soil and on *Stevia* foliage, during 2010/11 and 2011/12 seasons.

Taxa	Stage	No.*	%
1. Pests:			
Bemisia tabaci	Nymph & adult	16	17.40
Cicadellidae	Nymph & adult	16	17.40
Aphids	Nymph & adult	15	16.30
Collembola	Nymph & adult	13	14.13
Thrips tabaci	Nymph & adult	12	13.04
Liriomyza trifolii	Adult	9	9.80
Tetranychus sp.	Nymph & adult	3	3.30
Acrida sp.	Nymph	2	2.17
Subtotal		86	93.48
2. Insect predators and parasitoids			
Solenopsis sp.	Adult	5	5.42
Anagrus sp.	Adult	1	1.10
Subtotal		6	6.52
Grand total		92	

*Numbers of arthropods collected in 180 webs (12 samples x 15 webs).

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الآفات الحشرية والأعداء الحيوية المصاحبة لها على نبات الإستيفيا فى مصر

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أجريت الدراسة بالمزرعة البحثية لمحطة البحوث الزراعية بسخا ، فى موسمى ٢٠١٠/٢٠١١ ، ٢٠١١/٢٠١٢م. جرى حصر الآفات الحشرية التى تصيب نبات الاستيفيا ، حيث تم تسجيل ٢٠ نوعا تنتمى إلى ١٥ عائلة و٩ رتب. كما سجل ١٧ نوعا من الطفيليات الحشرية تنتمى إلى ١٠ عائلات ، جميعها من رتبة غشائية الأجنحة. كما سجل ١٧ نوعا من المفترسات الحشرية تنتمى إلى ٩ عائلات و٦ رتب. أما بخصوص العناكب الحقيقية ، فلقد تم حصر ١٦ نوعا تنتمى إلى ١٠ عائلات. كانت الذبابة البيضاء ، التربس ثم نطاطات الأوراق أعلى الأنواع الحشرية تعدادا. ونظرا لأهمية العناكب الناسجة فى اصطياد الآفات الحشرية ، فلقد تم فحص محتويات شباك بعض العائلات، واتضح أن مفصليات الأرجل داخل هذه الشباك كانت من الآفات الحشرية والأكاروسية بنسبة ٩٣,٤٨% ، أما المفترسات والطفيليات الحشرية كانت نسبتها ضئيلة (٦,٥٢%) وهذا يوضح أهمية هذه الشباك فى إصطياد الآفات الحشرية الضارة بمحصول الاستيفيا موضع الدراسة. ونظرا لإصابة محصول الاستيفيا بالعديد من الآفات الحشرية ، كما ظهر من نتائج هذا البحث ، فإن الحاجة ماسة لإجراء مزيد من الدراسات لتوضيح مدى تأثير هذه الآفات الحشرية على المادة المحلية الموجودة بهذا المحصول الواعد والجديد والذى سوف يساهم بقوة فى تقليل الفجوة الغذائية للسكر.

قام بتحكيم البحث

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