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ROLE OF PREDATORY ANTS (HYMENOPTERA: FORMICIDAE) AS A BIOLOGICAL CONTROL AGENT TO SUGAR BEET PESTS

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ABSTRACT

Formicid species (order: Hymenoptera) occurring in the Egyptian sugar beet fields at the Experimental Farm of Sakha Agricultural Research Station, were surveyed during 2011/2012 and 2012/2013 seasons. Identified specimens revealed the occurrence of seven formicid species belonging to three subfamilies, *i.e.* Dolichoderinae (one specie), Formicinae (two species) and Myrmicinae (four species). The majority of devoured prey by formicid species were insect pests, mites and snails (93.44%). Fortunately, the natural enemies were preyed by ants constituted only 6.56% of the total prey. The major insect pests were Collembola, dipterous, cicadellids, *Scrobipalpa ocellatella* Boyd., *Thrips tabaci* Lind., *Cassida vittata* Vill. and aphids with 21.31, 18.03,14.75,11.48, 3.28, 3.28 and 3.28%, respectively. Application of insecticides proved to be hazardous to these beneficial formicids. Reduction in formicid populations in treated plots with chlorpyrifos-methyl after twenty-four hours, one week and two weeks were 85.06, 64.52 and 58.33%, respectively. Finally, the current investigation shows the importance of ants as a biocontrol agent, which indicates to the necessity to avoid or minimize the insecticidal applications.

Key words: Biological control, Formicidae, sugar beet, pests, chlorpyrifos-methyl.

INTRODUCTION

Ants (Hymenoptera: Formicidae) are the most efficient and numerous of all predaceous insects. Over the centuries, predaceous ants have been used allover the world to control a wide variety of insect pests. Ants are very effective biological control agents for several reasons, colonies contain large numbers of ants that consume large quantities of prey and their predation is not limited to a particular prey species or stage (Paulson and Burts, 1993). Capinera (2001) indicated that various species of Formicidae are important predators to sugar beet root aphids, *Pemphigus betae* Doane and *Pemphigus populivenae* Fitch (Homoptera: Aphididae). Many predatory ant species have been found to cause significant reduction in agricultural insect pests and damage in annual and orchard crops (Van Mele and Cuc, 2001). Vogt *et al.* (2001) indicated that percent damaged peanut pods on plants grown within *Solenopsis invicta* Buren mounds were significantly (approximately three times) lower than those on plants grown without mounds in peanut fields. Diaz *et al.* (2004) showed that although *S. invicta* may increase populations of *Aphis gossypii* Glover, early in the growing cotton season, it is an important predator of bollworm, *Helicoverpa zea* (Boddie) and beet armyworm, *Spodoptera exigua* (Hubner) eggs later in the season. Agarwal *et al.* (2007) demonstrated that in ephemeral and annual cropping agroecosystems, predatory ants are important natural enemies of lepidopteran pests playing a significant role in plant protection. They suggested that predatory ant assemblages in annual cropping systems can contribute to sustainability in insect pest management.

In Egypt, Tawfik (1997) reported that predatory ants are important predators of lepidopteran pests in maize fields. *Cardiocondyla* sp. on

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larvae of *Ostrinia nubilalis* L., as well as *Paratrechina* sp., and *Pheidole* sp. on larvae of sugar cane borers. Bazazo (2005) showed that Formicidae constituted 75-81% out of the total insect predators captured by pit-fall traps in sugar beet fields.

In spite of rich literature on predaceous insects, very little is known about Formicidae occurring in Egyptian sugarbeet fields. Therefore, the current study was carried out in sugar beet fields to survey and identify different species of Formicidae, identify various prey of Formicidae and find out the adverse effect of chlorpyrifos-methyl (Kensban 50% EC) on the population of formicids.

MATERIALS AND METHODS

The current investigation was carried out at Sugar Beet Research Program located at Sakha Agricultural Research Station, and laboratory of Sugar Crops Research Department (Sakha), during 2011/2012 and 2012/2013 seasons. Sugar beet was sown with different cultivars on mid-October in the two seasons.

Identification of Various Species of Formicidae and Their Prey

A fine brush was used to catch formicids and their prey from sugar beet plants and the soil surface (mounds and plant bottoms), every two weeks (two hours for each sample from 10.0 a.m. to 12.0 a.m.), after thinning of sugar beet plants till harvest (from the 15th of November to the 15th of April during both 2011/12 and 2012/13 seasons). Collected formicids and their prey, *i.e.* twenty-two samples in the two investigating seasons were introduced by a fine brush into glass vials containing 70% ethyl alcohol and some drops of glycerine, and kept for examination and identification by using a stereoscope (4.8-56.0 X magnification). The specimens were identified by Prof. Dr. Ahmed S. Hendawy and Prof. Dr. Salah El-Azab, Plant Protection Research Institute, Agricultural Research Center, Giza.

Effect of Chlorpyrifos-Methyl on the Populations of Formicidae

The current experiment aimed to disclose the effect of using chlorpyrifos-methyl (Kensban 50% EC) the recommended insecticide for controlling some sugar beet insect pests. At sugar beet plantation sown on mid-October, the tested insecticide was used at the rate of 1000 ml/fad., on 30 March, 2013, using knapsack sprayer (20 liters). Two plots were assigned for the experiment, each of about 130 m^2. Each plot was divided into three replicates each of 42 m^2. Formicids inhabiting ten sugar beet plants in each replicate were visually counted just before insecticide treatment. Twenty four hours, one week and two weeks after insecticide application, reduction percentage in formicid populations were calculated according to Henderson and Tilton (1955) formula:

$$\text{Reduction \%} = 1 - \left[\frac{\text{No. of formicids in treated plots after spray}}{\text{No. of formicids in treated plots before spray}} \times \frac{\text{No. of formicids in check plots before spray}}{\text{No. of formicids in check plots after spray}}\right] x100$$

RESULTS AND DISCUSSION

Survey and Identification of Formicid Species

Seven ant species were recorded belonging to three subfamilies (Table 1). Myrmicinae subfamily had the majority of species, having four ones. Two species were found belonging to subfamily Formicinae, while only one specie was belonging to Dolichoderinae subfamily.

Bazazo (2005) reported that formicid species constituted 75-81% out of the total insect predators caught by pit-fall traps in sugar beet fields.

Formicid Species Composition

Table 2 shows that each of *Camponotus thoracicus, Camponotus* sp., *Cataglyphis bicolor, Tetramorium brevicoryne, Tetramorium depressiceps, Solenopsis latro* and *Solenopsis* sp., constituted 4.17% from the total number of formicid species followed by *Tapinoma simrothi* and *Tapinoma* sp. (1.67%). Very low percentage (0.83%) was detected for *Monomorium pharaonis*.

Agarwal *et al.* (2007) suggested that predatory ant species assemblages in annual cropping systems can contribute to sustainability in insect pest management.

Table 1. Survey of formicid species at the experimental farm of Sakha agricultural research station during 2011/12 and 2012/13 seasons

Subfamily	Species	No.
Dolichoderinae	*Tapinoma simrothi* Krausse	1
Formicinae	*Camponotus thoracicus* (Fab.) *Cataglyphis bicolor* L.	2
Myrmicinae	*Monomorium pharaonis* L. *Solenopsis latro* Forel *Tetramorium brevicoryne* Brondroit *Tetramorium depressiceps* Menozzi	4
Total		7

Table 2. Formicid species composition in sugar beet fields during 2011/12 and 2012/13 seasons

Genera/species	No.*	(%)
Camponotus thoracicus	5	4.17
***Camponotus* sp.**	5	4.17
Cataglyphis bicolor	5	4.17
Tetramorium brevicoryne	5	4.17
Tetramorium depressiceps	5	4.17
Solenopsis latro	5	4.17
***Solenopsis* sp.**	5	4.17
Tapinoma simrothi	2	1.67
***Tapinoma* sp.**	2	1.67
Monomorium pharaonis	1	0.83
Unidentified	80	66.67
Total	120	

*Total number of formicids (22 samples x 2 hours in two seasons)

Numbers of Various Prey of Formicidae

The total number of prey fed by formicid species were 61 individuals (Table 3) including insect pests, mites, snails, Araneae (true spiders) and parasitoids. The majority of attacked prey were insect pests, mites and snails (93.44%). Fortunately, the natural enemies, Araneae and parasitoids constituted only 6.56% of the total number of prey. The major insect pests were; Collembola, dipterous, cicadellids, sugar beet moth *Scrobipalpa ocellatella, Thrips tabaci,* tortoise beetle *Cassida vittata* and aphids with 21.31, 18.03,14.75, 11.48, 3.28, 3.28 and 3.28%, respectively.

Ali *et al.* (1984) investigated prey items of *Solenopsis invicta* in sugarcane fields. Most of prey items were Diptera larvae (13%), Heteroceridae larvae (12%), Aphididae (8%), Cicadellidae (3%), Collembola (3%), Coleoptera (3%) and others (58%).

Adverse Effect of Insecticide Application on Formicid Population

Data in Table 4 show the adverse effect of chlorpyrifos-methyl on formicid populations. Reductions in formicid numbers in treated plots compared to those untreated after twenty four hours, one week and two weeks were 85.06, 64.52 and 58.33%, respectively.

Paulson and Burts (1993) concluded that organophosphate and carbamate insecticides are highly toxic to formicids, and their residual effect can last for up to two weeks. Synthetic pyrethroids, also are toxic to formicids, but they are effective for only about a week.

Table 3. Prey of ants in sugar beet fields during 2011/12 and 2012/13 seasons

Group	Taxonomic categories	Stage	No.*	(%) out of total
Pests	**Collembola**	Adult	13	21.31
	***Lepidocyrtinus insertus* Hand**	Adult	5	8.20
	Unidentified species	Adult	8	13.11
	Diptera	Adult + Larva	11	18.03
	Ceciomyiidae	Adult	1	1.64
	Unidentified species	Larva	10	16.39
	Cicadellidae	Nymph	9	14.75
	***Scrobipalpa ocellatella,* Boyd.**	Larva	7	11.48
	Acari, *Tetranychus* sp.	Adult	5	8.20
	***Thrips tabaci* Lind.**	Adult	2	3.28
	***Cassida vittata* Vill.**	Larva	2	3.28
	Snails, *Monacha* sp.	Adult	2	3.28
	Aphids	Adult	2	3.28
	Pscoptera	Adult	1	1.64
	***Lixus junci* Boh.**	Larva	1	1.64
	***Agrotis ipsilon* (Huf.)**	Larva	1	1.64
	***Phytometra* sp.**	Larva	1	1.64
Subtotal			57	93.44
(Natural enemies)	**Linyphiidae (Araneae)**	Spiderling	2	3.28
Parasitoids	***Aphidius* sp. (Aphidiidae)**	Adult	1	1.64
Parasitoids	***Gelis* sp. (Ichneumonidae)**	Adult	1	1.64
Subtotal			4	6.56
Grand total			61	

* Total number of prey (22 samples x 2 hours in two seasons)

Table 4. Effect of insecticide application (chlorpyrifos-methyl) at the rate of 1000 ml/fad., on formicid populations in sugar beet fields, Kafr El-Sheikh region during 2013 season

Date of sampling (after spray)	No. of formicids/10 sugar beet plants				Reduction (%)
	Treated		Check		
	Total	Mean	Total	Mean	
24 hr	4	1.3	26	8.7	85.06
One week	10	3.3	28	9.3	64.52
Two weeks	15	5.0	36	12.0	58.33

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دور النمل المفترس (رتبة غشائية الأجنحة: عائلة فورميسيدي) كأحد عوامل المكافحة الحيوية لآفات بنجر السكر

كمال جابر إبراهيم بظاظو

قسم بحوث وقاية النبات - معهد بحوث المحاصيل السكرية - مركز البحوث الزراعية - مصر

هدفت الدراسة إلى حصر أنواع النمل المفترس فى حقول بنجر السكر المزروعة في محطة البحوث الزراعية بسخا خلال موسمي ٢٠١١/٢٠١٢ و٢٠١٢/٢٠١٣م، تم تعريف سبعة أنواع تنتمى إلى ثلاث تحت عائلات وهي دوليكوديريني (نوع واحد)، فورميسيني (نوعان) وميرميسيني (أربعة أنواع)، كما عرفت الفرائس المختلفة للنمل وكانت آفات حشرية ، وأكاروسات وقواقع بنسبة ٩٣,٤٤% والأعداء الحيوية بنسبة ٦,٥٦%، كانت معظم الفرائس من الآفات الحشرية هى كولمبولا، رتبة ثنائية الأجنحة ، نطاطات الأوراق ، يرقات فراشة البنجر، تربس البصل ، يرقات خنفساء البنجر والمن بنسبة ٢١,٣١ ، ١٨,٠٣ ، ١٤,٧٥ ، ١١,٤٨ ، ٣,٢٨ ، ٣,٢٨ و ٣,٢٨% على التوالى، كما أظهرت النتائج انخفاض أعداد النمل بشدة نتيجة استخدام المبيدات الكيماوية وكانت نسبة الخفض بعد ٢٤ ساعة ، أسبوع وأسبوعين من الرش بمبيد الكلوربيريفوس-ميثيل هى ٨٥,٠٦ ، ٦٤,٥٢ و ٥٨,٣٣% على التوالى، في النهاية يوضح هذا البحث أهمية النمل المفترس كأحد عوامل المكافحة الحيوية لآفات بنجر السكر وكذلك ضرورة تجنب أو تقليل استخدام المبيدات الحشرية للحفاظ على أعداد النمل فى الحقول.

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