J. of Plant Protection and Pathology, Mansoura Univ., Vol. 15 (3): 97 - 107, 2024

Journal of Plant Protection and Pathology

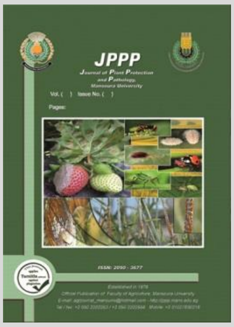
Journal homepage & Available online at: www.jppp.journals.ekb.eg

The Role of Predatory Insects in Regulating the Population of the Main Insect Pests Attacking Eggplant *(Solanum melanogena* L) Crop under Open Field Conditions

Cross Mark

Ata, T. E.*

Plant Protection Department, Faculty of Agriculture, Damietta University, Egypt.



ABSTRACT

The experiments were conducted to study the role of predatory insects in regulating the population of the main insect pests that attacking eggplant (*Solanum melanogena* L.) crop under open field conditions. The results showed the presence of nine predators belonging to four orders: Order Copleoptrea; *Coccinella undecimpunctata* (Linnaeus); *Exochomus nigromaculatus* (Goeze); *Scymnus* sp.; and, *Hippodamia convergens* (Family: Coccinillidae), Order Heteroptera; *Orius* spp. (Family: Anthocoridae) and *Nesidiocoris tenuis* (Family: Miridae) Order Diptera; *Aphidoletes aphidimyza* (Rondani) (Family: Cecidomyiidae) and *Syrphus* sp. (Family: Syrphidae) and finally, Order Nuroptera; *Chrysoperla carnea* (Stephens) (Family: Chrysopidae). The highly average numbers and ratios of the insect predators associated with eggplant insect pests were recorded by *Syrphus* sp. and presented by 92.2 individuals (14%). *A. aphidimyza*, *C. undecimpunctata* and *E. nigromaculatus* recorded 86.7, 83.5 and 80.9 individuals respectively, and presented by 13%, 13% and 12%, respectively. While, *Orius* sp. and *C. carnea* recorded the smaller numbers and represented by 54.6 individuals (8%) and 51.9 individuals (8%) during the study season.

***Keywords*:** Eggplant, predatory insects, insect pests, biotic and abiotic factors.

INTRODUCTION

In order to lessen the effects of chemical residues and insecticide-induced pest resistance, biological control programs have made substantial use of natural enemies in recent decades (Bale *et al.*, 2008). Insect predators are widely distributed and recognized as important natural enemies of insect pests in biological control and integrated pest management programs because they feed on a wide range of pests, including aphids, scale insects, mealy bugs, spider mites, and the larvae of certain species of Thysanoptera, Lepidoptera, and Coleoptera (Ceryngier and Hodek, 1996).

Predaceous coccinellids are significant biocontrol agents because they prey on a variety of phytophagous insect pests, such as aphids, scale insects, mealy bugs, mites, white flies, thrips, etc. (Omkar and Pervez, 2002). Among the most significant biological control agents are Coccinellids (Ceryngier and Hodek, 1996). Of all the coleopteran predators of soft scales, this group is the most prevalent and well-studied. Most of them are specialized feeders that only eat specific kinds of insects, mites, or fungus hyphae and spores. Nonetheless, pollen, sap, honeydew, nectar, green leaves, and even fresh manure can be added by the predatory species to their diet (Hodek, 1967). Insect prey can include a variety of Homopter as well as coleopteran larvae, which includes the larvae of other coccinellid species.

With 42,300 documented species worldwide, Heteroptera, sometimes known as real bugs, are a highly varied insect taxon that are divided into seven infraorders and 75–89 families (Henry 2009, Schuh and Slater 1995). The mouthparts, which developed as sucking stylts for the intake of liquid food and the injection of salivary gland secretions, are among their distinguishing characteristics; restricted diets are frequently noted. The majority of species are phytophagous; some only consume specific plant species, genera, or families, while others are polyphagous, consuming hundreds or even thousands of different host plants. Numerous species are carnivorous, some are employed as biocontrol agents against agricultural pests, and some are of significant economic relevance in agriculture or-less frequently-forestry (Schaefer and Panizzi 2000).

The Miridae, or plant bugs, are the most species-rich family within Heteroptera, with over 10,000 documented species (Henry 2009), of which 1036 are found in Europe (Aukema and Rieger 1995-2006). According to Wheeler (2001), plant bugs can range in size from small to enormous, soft-bodied, drab to vividly colored, phytophagous, zoo phytophagous, and predatory. Certain species are employed in biological management efforts, while others are regarded as significant agricultural pests (Kirby *et al.*, 2009). In the Mediterranean region, the mirid bug is a significant natural adversary of whiteflies. This family's omnivorous species are important natural enemies of a number of pests, including whiteflies, in greenhouse crops and solanaceous fields (Albajes and Alomar, 1999). According to Sanchez and Lacasa (2008), its population trends mirrored those of whiteflies, suggesting that it may play a part in biological control. In the absence of prey, this predator that consumes only plants does not appear to have much chance of finishing its growth (Urbaneja *et al.*, 2005). Nonetheless, *N. tenuis* adults or nymphs that were confined on a tomato shoot began to form necrotic rings on the stem; however, the damage was deemed insignificant, and these rings quickly vanished (Arnó *et al.*, 2006).

* **Corresponding author.**
E-mail address: drtarekata@du.edu.eg
DOI: 10.21608/jppp.2024.276292.1225

Native predators in Europe are the *Orius* spp. (van Lenteren, 1997). Aphids are among the soft-bodied arthropods that *Orius* spp. (Heteroptera: Anthocoridae) can eat (Reitz *et al*., 2006). *Orius albidipennis* Reuter, one of the genus's prevalent predators in many parts of Iran, has been noted to have the potential to act as a biocontrol agent, particularly in greenhouse environments (Rajabpour *et al*., 2011; Salehi *et al*., 2016).

The huge family of Diptera known as Syrphidae, or hover flies, is most famous for its amazing imitation of wasps and bees. The family has a wide range of eating preferences, however the Syrphinae subfamily is a significant predator of aphids and other Homoptera (Chambers, 1988), as well as chrysomelid leaf beetles on occasion (Rank & Smiley, 1994). After bees, flies are typically the second most significant visitors to flowers (Larson *et al*., 2001).

For over forty years, the predatory gall midge, *Aphidoletes aphidimyza* (Rondani) (Diptera: Cecidomyiidae), has been utilized as an efficient biological control agent in greenhouses. (Harris 1973; Markkula 1963). After biting and paralyzing the aphids, the larvae, or predatory stage, move over a leaf and sucke out their bodily fluid. Neonatal larvae locate close prey (~3 mm) by using olfactory and visual cues; they starve to death if they are more than 63 mm from food (Lucas and Brodeur 2001; Wilbert 1973).

One of the most prevalent arthropod predators is the common green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), which feeds on a variety of soft-bodied insects such as aphids, scales, whiteflies, mites, and eggs and neonates of lepidopteron insects (McEwen *et al.* 2001). Information on I.P.M. programs seems to benefit from the usage of *C. carnea* (Aziza *et al*., 2007).

Therefore, the goal of the current research is to study the role of predatory insects in decreasing the populations of the main insect pests that attack eggplant crops in open fields.

MATERIALS AND METHODS

On a private farm in the Kafr-Saad region of Damietta Governorate, Egypt, one feddan was planted with eggplant (*Solanum melongena* L.) Eggplant Black Beauty verity was used for the purpose of the current study. The farm is located at 31.359427°N 31.686452°E. On May 1st, 2021, during the summer planting season, Eggplant seedlings, forty-five days old were transplanted, leaving half a meter between each plant and a meter between rows. Throughout the whole production period, all recommended agricultural practices were adhered to, with the exception of using pesticides. The experiment area was split into four identical plots, each measuring 1050 m^2.

After two weeks of transplanting at weekly intervals until the end of harvest, the numbers of both insect predators and the main insect pests attacking eggplant that are considered prey for the insect predators were counted and recorded.

Five randomly chosen plants were chosen to symbolize each plot's four corners and center. Five leaves were selected from each plant to symbolize the lower, middle, and upper tiers of each plant. After being collected, the leaves were placed in paper bags and brought into the lab to be examined under a stereoscopic microscope. Next, the population density of the previously described predatory insects and insect pests was ascertained.

Statistical analysis

One-way analysis of variance (ANOVA) in the SPSS program was used to determine the impact of various predatory insects on the population abundance of the tested insect pests.

RESULTS AND DISCUSSION

Surveying the insect species infesting eggplant and their associated predatory insects.

The insect pest species:

The obtained results presented in Table (1) and Fig. (1) showed that the eggplant crop (*Solanum melanogena* L.) (Family: Solanaceae) attacked by many insect pests, the most abundant insect species were the onion thrips, *Thrips tabaci* L. (Thripidae: Thysanoptera); cotton and tomato whitefly, *Bemisia tabaci* (Genn.) (Aleyrodidae: Hemiptera); leafhoppers *Empoasca* spp. (Cicadellidae: Hemiptera); cotton aphid, *Aphis gossypii* (Glover) (Aphididae: Hemiptera); vegetable leafminer, *Liriomyza sativae* (Blanchard) (Agromyzidae: Diptera) and the cotton mealybug, *Phenacococcus solenopsis* Tinsley (Pseudococcidae: Hemiptera). The onion thrips, *T. tabaci* recorded the highest number and ratio and presented by 1805.7 individuals (50%). While, *B. tabaci* came in the second category and presented by 734.2 individuals (20%), whereas, *P. solenopsis* was the smallest and represented by 101.6 individuals (12.68%) during the study season.

Table 1. survey and occurrence of predators associated with eggplant insect pests during summer planting season.

Predator orders	Insect	*L. sativa*	*T. tabaci*	*B. tabaci*	*Aphis* spp.	*Empoasca* spp.	*P. solenopsis*
Coleoptrea	*C. undecimpunctata*	-	+	+	+	+	+
	E. nigromaculatus	-	-	-	+	-	+
	Scymnus sp.	-	+	-	+	+	+
	H. convergens	-	-	+	+	+	+
Heteroptera	*N. tenuis*	-	+	+	+	+	-
	Orius sp.	-	+	+	+	+	+
Diptera	*Syrphus* sp.	-	+	+	+	+	-
	A. aphidimyza	-	-	+	+	-	-
Nuroptera	*Chrysopa carnea*	-	+	+	+	+	+

The symbol (+) indicates that the predator feeds on the insect, while the symbol (-) indicates that the predator does not feed on the insect.

The predatory insect species:

As shown in Table (1) and Fig. (1) There are nine predators associated with the insect pests attacking eggplant crop, these predators belonging to four orders i.e. Copleoptrea Order; eleven spotted beetle, *Coccinella undecimpunctata* (Linnaeus, 1758); exochomus beetle, *Exochomus nigromaculatus* (Goeze, 1777); Lady beetles, *Scymnus* sp.; and convergent ladybug, *Hippodamia convergens* (Family: Coccinillidae), Heteroptera Order; the anthocorids pirate, bugs *Orius* spp. (Family: Anthocoridae) and mired bug, *Nesidiocoris tenuis* (Family: Miridae) Diptera Order; the aphidophagous gall midge , *Aphidoletes aphidimyza* (Rondani) (Family:

Cecidomyiidae) and syrphid fly , *Syrphus* sp. (Family: Syrphidae) and Nuroptera Order; green lacewings , *Chrysoperla* (=*Chrysopa*) *carnea* (Stephens). With regard to eggplant insect pests, *Syrphus* sp. reported the highly numbers and ratios of predatory insects and presented by 92.2 individuals (14%) followed by *A. aphidimyza*, *C. undecimpunctata* and *E. nigromaculatus* recorded 86.7, 83.5 and 80.9 individuals respectively, and presented by 13%, 13% and 12%, respectively. While, *Orius* sp. and *C. carnea* recorded the smaller numbers and represented by 54.6 individuals (8%) and 51.9 individuals (8%) during the study season.

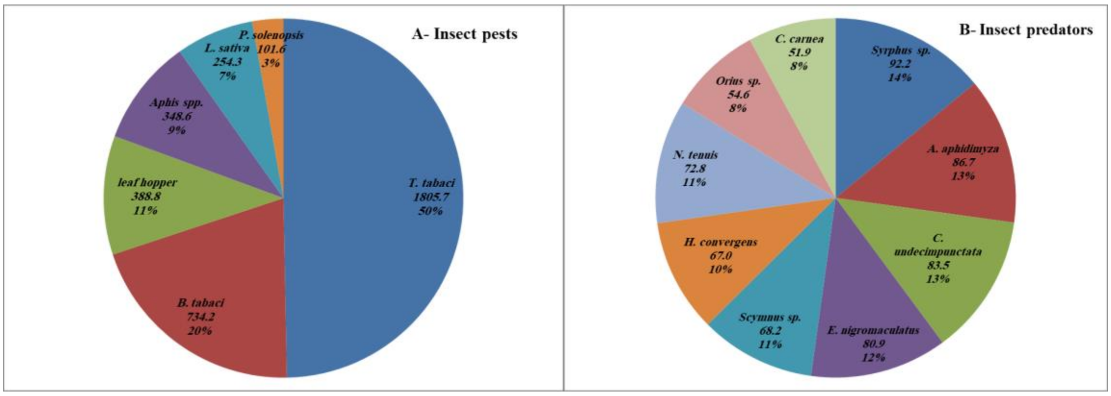


Fig. 1. Average numbers and their ratios (%) of the eggplant insect pests (A) and predator (B) species during 2021 at Kafr-Saad region Damietta Governorate.

Population density of predatory insects associated with eggplant insect pests at Kafr-Saad area in Damietta Governorate:

A- Coleopteran predators:

Data illustrated in Fig. (2 and 3) showed the seasonal activity of the predatory insects belonging to order Coleoptera and family Coccinellidae associated with eggplant insect pests during summer planting season of 2021. Four Coccinellid species were recorded, *Coccinella undecimpunctata*, *Exochomus nigromaculatus*, *Scymnus* sp., and *Hippodamia convergens.* The most abundant species was *C. undecimpunctata* that represented with (83.5 individuals) followed by *Exochomus nigromaculatus, Scymnus* sp. and *Hippodamia convergens* that represented with 80.9, 68.2 and 67.0 individuals respectively Fig. (2).

Three peaks were recorded for *C. undecimpunctata, E. nigromaculatus* and *H. convergens,* the first peak recorded in 10th of June for *C. undecimpunctat* & *E. nigromaculatus* and in 17th of June 2021 for *H. convergens* (6.8, 7.2 and 5.6 indiv. /sample), the second one in 8th of July (8.2, 7.4 and 6.8 indiv. /sample) for the three predator species, *C. undecimpunctat*, *E. nigromaculatus* and *H. convergens* respectively. While the last peak in 5th of August (8.0, 7.4 and 6.2 indiv. /sample). On the other hand *Scymnus* sp. has two peaks recorded in 15th Jul. and 5th of August (6.6 and 8.6 indiv. /sample) respectively Fig. (3).

B- Heteropteran predators:

Data illustrated in Fig. (2 and 3) Showed the seasonal activity of the predatory insects belonging to order Heteroptera, family: Miridae, *Nesidiocoris tenuis* and family: Anthocoridae, *Orius* sp. and that associated with eggplant insect pests during summer planting season of 2021. The seasonal average number of *N. tenuis* and *Orius* sp. recorded 72.8 and 54.6 indiv. /sample) Fig. (2).

Three peaks were recorded for *N. tenuis* and two peaks for *Orius* sp., the first peak recorded in 10th of June (8.2 indiv./sample) for *N. tenuis*, the second one in 8th of July (9.2 and 7.6 indiv. /sample) for *N. tenuis* and *Orius* sp., the last peak was observed in 5th of August (6.3 and 5.2 indiv. /sample) for *N. tenuis* and *Orius* sp. Fig. (3).

C- Dipteran predators:

Data illustrated in Fig. (2 and 3) Showed the seasonal activity of the predatory insects belonging to order Diptera, family: Syrphidae, *Syrphus* sp. and family: Cecidomyiidae, *Aphidoletes aphidimyza* that associated with eggplant insect pests during summer planting season of 2021. The seasonal average number of *Syrphus* sp. recorded 92.2 indiv. /sample) while, *A. aphidimyza* 86.7 indiv. /sample) Fig. (2).

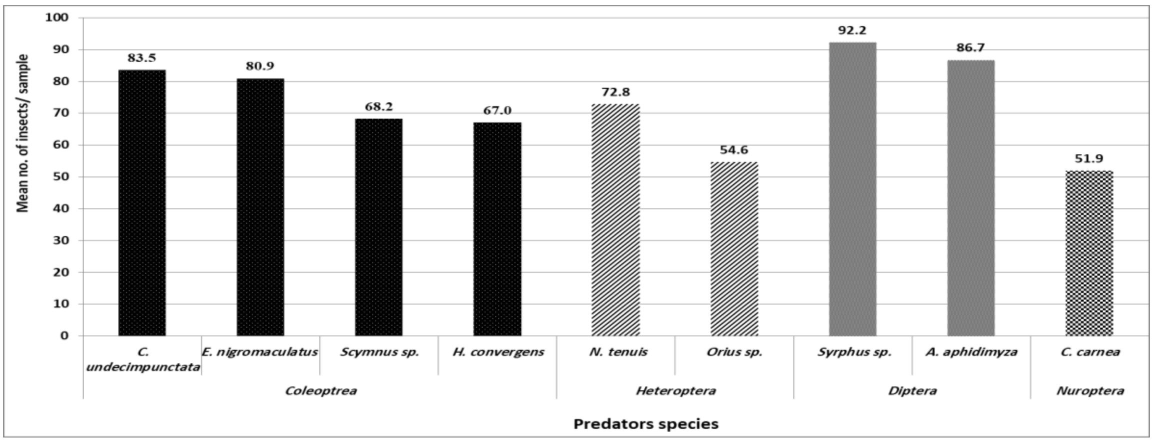


Fig. 2. Seasonal average numbers of predatory insects associated with eggplant insect pests during 2021 at Kafr-Sassd Damietta Governorate.

Fig. 3. Weekly average numbers of predatory insects associated with eggplant insect pests during 2021 at Kafr-Sassd Damietta Governorate.

Three peaks were recorded for *Syrphus* sp. and *A. aphidimyza*, the first peak recorded in 10th of June and in 17th of June for *Syrphus* sp. and *A. aphidimyza* with (6.2 and 11.0 indiv./sample), the second one in 8th of July (10.2 and 9.2 indiv./ sample), the last peak was observed in 5th of August (9.4 and 8.0 indiv. /sample) for *Syrphus* sp. and *A. aphidimyza* Fig. (3).

D- Nuropteran predators:

Data illustrated in Fig. (2 and 3) showed the seasonal average number and activity of the predatory insects belonging to order Nuroptera, family: Chrysopidae, *Chrysopa carnea* that associated with eggplant insect pests during summer planting season of 2021. The seasonal average number of *C. carnea* recorded 51.9 indiv. /sample) Fig. (2).

Three peaks were recorded for *C. carnea* the first peak recorded in 10th of June (4.8 indiv. /sample), the second one in 8th of July (5.1 indiv. /sample), the last peak was observed in 5th of August (5.8 indiv. /sample) Fig. (3).

Ants (Hymenoptera: Formicidae), *C. carnea* (Steph.) (Neuroptera: Chrysopidae), *C. undecimpunctata* L. (Coleoptera: Coccinellidae), *Orius* sp. (Hemiptera:

Anthocoridae), *Paederus alfierii* Koch. (Coleoptera: Staphylinidae), *Scymnus* spp. (Coleoptera: Coccinellidae), and *Syrphus* sp. (Diptera: Syrphidae) are the main predators associated with okra plant insect pests. In the course of the study, true spiders (unidentified species) were also observed by EIKhawas and EL-Mowafy (2005).

Influence of the predatory insects on the population density of eggplant insect pests:

1- The influence of predatory insects on population density of *L. sativa*:

The data presented in Fig. (4) showed weekly average numbers of *L. sativa* larvae on eggplant leaves during 2021 at Kafr-Saad region, Damietta Governorate. It is also proven from reference that the eggplant leaf miner was not subjected to predation by any of the predators observed during the experiments.

There are no recorded predatory insects that feed on this insect, only a number of insect parasites have been recorded that reduce the population of this pest. Numerous species of Liriomyza, which mine leaves, have the potential to be significant pests of tomatoes. These include *L. trifolii* (Burgess), which is known as serpentine leave miner, *L. sativae* Blanchard, which is known for vegetables, and *L. bryoniae* (Kalt.), which is known for tomatoes. Naturally occurring parasites can generally control leafminer populations at non-damaging levels when combined with selective insecticide usage, since leafminers are indirect pests with a relatively high threshold for damage (Kotze and Dennill, 1996). According to Liu *et al.* (2009), Eulophids in the genus Diglyphus and Brachonids in the genus Opius and Dacnusa are the most prevalent hymenopteran parasites of Liriomyza species. Oatman and Kennedy (1976), classic study showed that methomyl's negative effects on parasites might be used to generate populations of L. sativae.

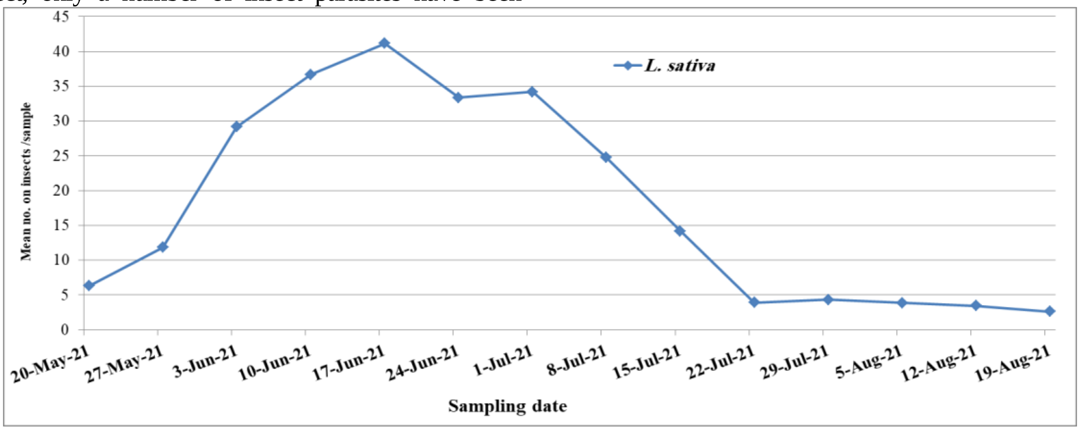


Fig. 4. Weekly average numbers of *L. sativa* larvae on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

L. sativae natural enemies seem to be the families Eulophidae and Braconidae and their near hymenopterous parasitic wasps, which are very small hymenopterous parasitic wasps, commonly referred to as the Parasitica. These insects are found all over the world, and like all Agromyzidae, *L. sativae* is maintained in low, balanced numbers by its natural enemies Waterhouse and Norris (1987).

2- The influence of predatory insects on population density of *T. tabaci*:

The data presented in Fig. (5) and Table (2) showed the relationship between *T. tabaci* and associated predatory insects, where there are six predators that feed on nymphs and adults of *T. tabaci* and these predators are *C. undecimpunctata*, *Scymnus* sp., *N. tenuis*, *Orius* sp., *Syrphus* sp. and *C. carnea.*

Statistical analysis showed the relationship between the average numbers of *T. tabaci* and associated predators on eggplant (Table 2). The simple correlation analysis showed that the relation between the populations activity of *T. tabaci* and *C. undecimpunctata* is positive but non-significant (r. = 0.091), this means that the predators prefer to feed on this insect. While the relation between the population activity of *T. tabaci* and the predatory insects, *Scymnus* sp., *N. tenuis*, *Orius* sp., *Syrphus* sp. and *C. carnea* were negative and non-significant, with correlation coefficient values (r.) were -0.543, -0.007, -0.034, -0.309 and -0.220 respectively this means that the predators does not prefer to feed on this insect.

The influence of different predators on *T. tabaci* population could be seen by the results of partial regression values in (Table 2) these results showed that there are non-significant negative relation between *T. tabaci* and the two predators, *Scymnus* sp. and *Orius* sp. while non-significant positive relation were found with the other predators.

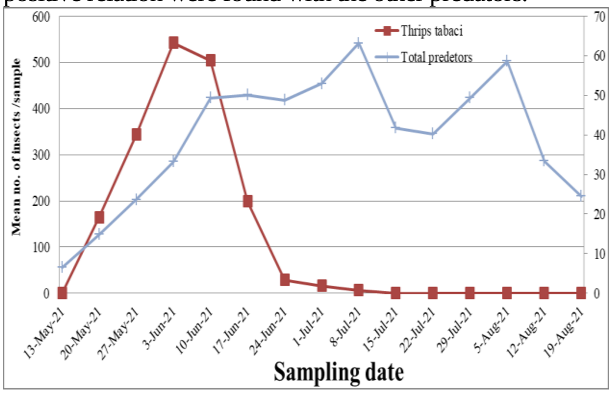


Fig. 5. weekly average numbers of *T. tabaci* and associated predators on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

This means that the decline in *T. tabaci* numbers may be due to the increase in numbers of predatory insects that feed on nymphs and adults of *T. tabaci*.

It could be observed also from (Table 2) that the explained variance of predatory insects affecting *T. tabaci* population activity was 63.1% from the effect of all factors affecting the population.

According to Satti and Mahgoub (2018), the four predatory insects linked to *T. tabaci* were observed on onion, rocket, and tomato that are recognized as hosts for the species.

These predators include *C. undecimpunctata*, *C. carnea* and *H. variegata*, as well as the syrphid fly (*Xanthogramma aegyptium* Wied.). The most common species was *C. carnea*, which was followed by *C. undecimpunctata*. They reached their peak in late winter (from March to April), coinciding with the growth of onion thrips on onion plants. Predators of thrips from other regions have previously recorded encounters with *C. carnea* and *C. undeci*mpunctata (Awadalla *et al*. 2011, Fok *et al*. 2014, Habib *et al*. 1980 and Rueda 1995). The findings also demonstrated a close relationship and coincidence between the predators' occurrence, seasonal build-up, and peak populations on the examined host plants and those of their prey hosts (*T. tabaci*).

Table 2. Simple correlation coefficient, partial regression values and explained variance (E.V.) between the weekly mean numbers of *T. tabaci* and the predatory insects on eggplant crop during 2021.

Order	Predator	Simple correlation analysis		Multiple partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
Coleoptrea	*C. undecimpunctata*	0.091	0.746	77.13	0.283	2.28	0.139	63.1%
	Scymnus sp.	-0.543	0.037	-135.82	0.107			
Heteroptera	*N. tenuis*	-0.007	0.981	5.17	0.904			
	Orius sp.	-0.034	0.904	-82.64	0.414			
Diptera	*Syrphus* sp.	-0.309	0.263	47.2	0.659			
Nuroptera	*C. carnea*	-0.220	0.430	80.24	0.401			

2- The influence of predatory insects on population density of *B. tabaci*:

The data presented in Fig. 5 and Table 3 showed the relationship between *B. tabaci* and associated predatory insects, where there are seven predators that feed on immature stages (eggs and nymphs) of *B. tabaci* and these predators are *C. undecimpunctata*, *H. convergens*, *N. tenuis*, *Orius* sp., *Syrphus* sp., *A. aphidimyza* and *C. carnea*.

From (Fig. 6), it is clear that an increase in the numbers of whitefly *B. tabaci* in the beginning season is followed by an increase in the numbers of associated predators, also, fluctuations in whitefly population and associated predators were appeared during the growing season.

Statistical analysis showed the relationship between the average numbers of *B. tabaci* and all of associated predators, *C. undecimpunctata*, *H. convergens*, *N. tenuis*, *Orius* sp., *Syrphus* sp., *A. aphidimyza* and *C. carnea* were positive and significant, with correlation coefficient values r. =-0.551, 0.761, 0.578, 0.474, 0.595, 0.636 and 0.754 respectively, this means that the predators prefer to feed on this insect.

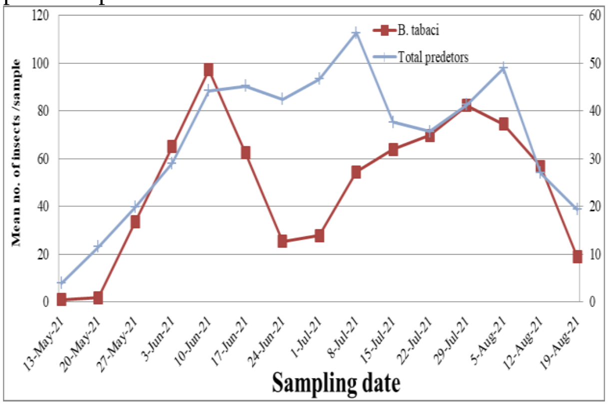


Fig. 6. weekly average numbers of *B. tabaci* and associated predators on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

Table 3. Simple correlation coefficient, partial regression values and explained variance (E.V.) between the weekly mean numbers of *B. tabaci* and the predatory insects on eggplant crop during 2021.

Predator orders	Predator	Simple correlation analysis		Multiple partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
Coleoptrea	*C. undecimpunctata*	0.551	0.033	-1.055	0.901	4.21	0.039	80.8%
	H. convergens	0.761	0.001	17.290	0.054			
Heteroptera	*N. tenuis*	0.578	0.024	-0.058	0.991			
	Orius sp.	0.474	0.074	6.44	0.613			
Diptera	*Syrphus* sp.	0.595	0.019	-19.35	0.122			
	A. aphidimyza	0.636	0.011	-7.549	0.263			
Nuroptera	*C. carnea*	0.754	0.001	31.01	0.075			

The influence of different predators on *B. tabaci* population could be seen by the results of partial regression values in (Table 3) these results showed that there are non-significant negative relation between *B. tabaci* and four predators, *C. undecimpunctata*, *N. tenuis*, *Syrphus* sp. and *A. aphidimyza*, while non-significant positive relation was found with *Orius* sp. and *C. carnea* on the other hand *H. convergens* these relation was significantly positive.

This means that the decline in *B. tabaci* numbers may be due to the increase in numbers of predatory insects that feed on eggs and nymphs of this insect.

It could be observed also from (Table 3) that the explained variance of predatory insects affecting *B. tabaci* population activity was 80.8% from the effect of all factors affecting the population.

Even though hundreds of predators have been known to attack *B. tabaci*, the most frequent ones are as follows: lacewings (*C. carnea* and *C. pallens*), bugs (*Orius laevigatus*, *Macrolophus caliginosus*, and *Nesidiocoris tenuis*), and mites (*Amblyseius swirskii* and *Euseius ovalis*) Al-Zyoud (2014). Compared to parasitoids and diseases, predators have a greater potential to manage *B. tabaci* and are crucial in managing pest populations (Jazzar and Hammad, 2004 and Gerling *et al.*, 2001). It has been documented that *B. tabaci* is a prey item for hundreds of predators. The most frequent predators of *B. tabaci* are lacewings (Neuroptera: Chrysopidae) (Khan and Wan, 2008a,b), true bugs (Hemiptera: Anthocoridae and Miridae) (Gerling *et al.*, 2001; Calvo *et al.*, 2009), ladybird beetles (Coleoptera: Coccinellidae) (Heinz and Parrella, 1994; Al-Zyoud, 2007, 2008, 2013; Al-Zyoud *et al.*, 2007, 2013; Sharma and Joshi, 2010), and mites (Acarina: Phytoseiidae) (Nomikou *et al.*, 2003). However, in many impacted cropping systems around the world, the potential of the biological control of *B. tabaci* by predators represents a critical tactic that has largely gone unmet (Naranjo, 2001). Gerling *et al.* (2001) cataloged 114 arthropod predators from 9 orders and 31 families based on lists that had been published. As the research has advanced, the list has expanded. Predation by sucking predators, such as bugs, and chewing predators, such as beetles, accounted for approximately 36% and 31% of all *B. tabaci* juvenile mortality, respectively, according to data from 14 cohorts studied over a three-year period in cotton fields (Naranjo, 2001). Every year, *Syrphus ribesii* produces two generations. The larvae overwinter as fully fed among decaying leaves, and in May, they pupate. Nectar and pollen are the adult food sources (Sundby 1967).

3- The influence of predatory insects on population density of *A. gossypii*:

The data presented in Fig. 7 and Table 4 showed the relationship between *A. gossypii* and associated predatory insects. *C. undecimpunctata, E. nigromaculatus, Scymnus* sp., *H. convergens, N. tenuis, Orius* sp., *Syrphus* sp., *A. aphidimyza*, and *C. carnea* that feed on different stages of *A. gossypii*.

From (Fig. 7), it is clear that an increase in the numbers of *A. gossypii* in the beginning season is followed by an increase in the numbers of associated predators, also, fluctuations in *A. gossypii* population and associated predators were appeared during the growing season.

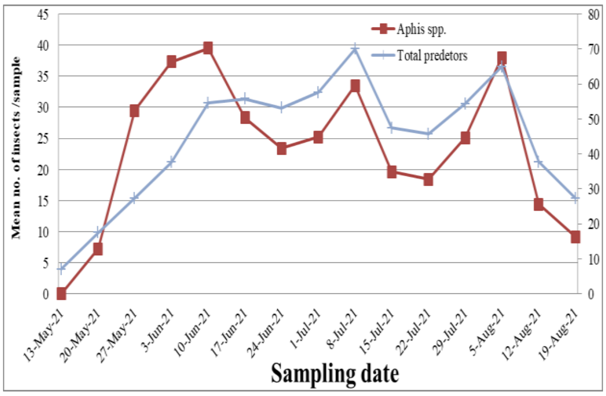


Fig. 7. Weekly average numbers of *A. gossypii* and associated predators on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

Statistical analysis showed the relationship between the average numbers of *A. gossypii* and all of associated predators, *C. undecimpunctata, E. nigromaculatus, H. convergens N. tenuis, Orius* sp., *Syrphus* sp., *A. aphidimyza* and *C. carnea* were positive and highly significant, with correlation coefficient values r. = 0.826, 0.858, 0.757, 0.694, 0.734, 0.607, 0.676 and 0.626 respectively, except *Scymnus* sp. (r. = 0.348) was non-significant this means that the predators prefer to feed on this insect.

Table 4. Simple correlation coefficient, partial regression values and explained variance (E.V.) between the weekly mean numbers of *A. gosspii* and the predatory insects on eggplant crop during 2021.

Predator orders	Predator	Simple correlation analysis		Multiple partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
Coleoptrea	*C. undecimpunctata*	0.826	0.000	-1.471	0.874	3.00	0.120	84.4 %
	E. nigromaculatus	0.858	0.000	4.437	0.480			
	Scymnus sp.	0.348	0.203	-0.683	0.907			
	H. convergens	0.757	0.001	4.033	0.298			
Heteroptera	*N. tenuis*	0.694	0.004	0.145	0.963			
	Orius sp.	0.734	0.002	3.993	0.667			
Diptera	*Syrphus* sp.	0.607	0.016	-4.160	0.693			
	A. aphidimyza	0.676	0.006	-2.177	0.574			
Nuroptera	*C. carnea*	0.626	0.012	5.808	0.425			

The influence of different predators on *A. gossypii* population could be seen by the results of partial regression values in (Table 4) these results showed that there are non-significant negative relation between *A. gossypii* and four predators, *C. undecimpunctata, Scymnus* sp., *Syrphus* sp. and *A. aphidimyza,* while non-significant positive relation was found with *E. nigromaculatus, H. convergens, N. tenuis, Orius* sp. and *C. carnea*.

This means that the decline in *A. gossypii* numbers may be due to the increase in numbers of predatory insects that feed on nymphs and adults of this insect.

It could be observed also from (Table 4) that the explained variance of predatory insects affecting *A. gossypii* population activity was 84.4% from the effect of all factors affecting the population.

A. gossypii, B. tabaci, and *Empoasca* spp. were the main piercing sucking insect pests and the predators that were connected with them during the summer crop of okra plants. The most prevalent pest species was the cotton aphid, *A. gossypii*, which was followed by *B. tabaci* and *Empoasca* spp. The most prevalent predators that were linked to the main insect pests that were harming okra plants were ants and *C. carnea*. It is necessary to expand and improve the biocontrol agents' inherent function in okra crops. It also showed that, in conjunction with other safe techniques, the three predators, *C. camea, Scymnus* spp., and *C. undecimpunctata* may play a promising role in the planning of Integrated Pest Management (I.P.M.) strategies to prevent pollution in the surrounding area EIKhawas and EL-Mowafy (2005).

4- The influence of predatory insects on population density of *Empoasca* spp:

The data presented in Fig. 7 and Table 4 showed the relationship between *A. gossypii* and associated predatory insects. *C. undecimpunctata, Scymnus* sp., *H. convergens, N. tenuis, Orius* sp., *Syrphus* sp. and *C. carnea* that feed on nymphs and adults of *Empoasca* spp.

From (Fig. 8), it is clear that an increase in the numbers of *Empoasca* spp. in the beginning season is followed by an increase in the numbers of associated predators, also, fluctuations in *Empoasca* spp. population and associated predators were appeared during the growing season.

Statistical analysis showed the relationship between the average numbers of *Empoasca* spp. and all of associated predators, were positive and significant for *C. undecimpunctata, H. convergens* and *C. carnea* with correlation coefficient values r. = 0.602, 0.644 and 0.572 respectively, while this relation were non-significant positive in the case of *Scymnus* sp. *N. tenuis, Orius* sp. and *Syrphus* sp. with correlation coefficient values r. = 0.313, 0.442, 0.450 and 0.408 respectively, this means that the predators prefer to feed on this insect.

The influence of different predators on *Empoasca* spp. population could be seen by the results of partial regression values in (Table 5) these results showed that there are non-significant negative relation between *Empoasca* spp. and four predators, *Scymnus* sp., *N. tenuis*, *Orius* sp. and *Syrphus* sp., while non-significant positive relation was found with *C. undecimpunctata* whereas these relation was significantly positive with *H. convergens* and *C. carnea*.

This means that the decline in *Empoasca* spp. numbers may be due to the increase in numbers of predatory insects that feed on nymphs and adults of this insect.

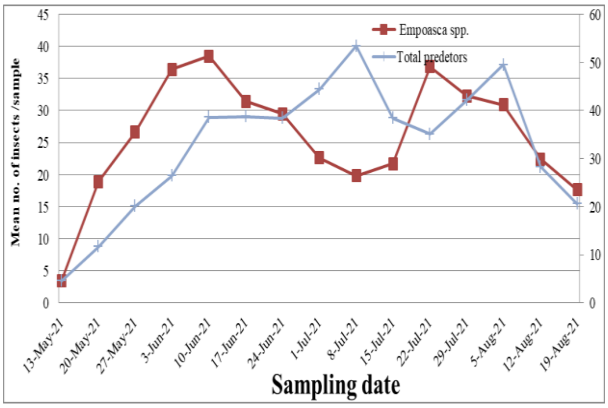


Fig. 8. Weekly average numbers of *Empoasca* spp. and associated predators on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

Table 5. Simple correlation coefficient, partial regression values and explained variance (E.V.) between the weekly mean numbers of *Empoasca* spp. and the predatory insects on eggplant crop during 2021.

Predator orders	Predator	Simple correlation analysis		Multiple partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
Coleoptrea	*C. undecimpunctata*	0.602	0.017	1.299	0.642	3.85	0.048	79.4 %
	Scymnus sp.	0.313	0.256	-4.068	0.209			
	H. convergens	0.644	0.01	5.739	0.052			
Heteroptera	*N. tenuis*	0.442	0.099	-2.852	0.134			
	Orius sp.	0.450	0.092	-0.374	0.922			
Diptera	*Syrphus* sp.	0.408	0.132	-1.685	0.684			
Nuroptera	*C. carnea*	0.572	0.026	8.555	0.044			

It could be observed also from (Table 5) that the explained variance of predatory insects affecting *Empoasca* spp. population activity was 79.4 % from the effect of all factors affecting the population.

Steer clear of broad-spectrum pesticides while trying to boost the effectiveness of natural enemies. The efficiency with which generalist predators like ladybird beetles and green lacewings may catch leafhopper nymphs and adults is remarkable. Leafhoppers can be effectively suppressed by parasitoids such *Stethynium triclavatum* Enock and *Anagrus flaveolus* Waterhouse (Subba Rao 1968; Parker *et al.* 1995). *A. gossypii*, *B. tabaci*, and *Empoasca* spp. were the main piercing sucking insect pests and the predators that were connected with them during the summer crop of okra plants. The most prevalent pest species was the cotton aphid, *A. gossypii*, which was followed by *B. tabaci* and *Empoasca* spp. The most prevalent predators that were linked to the main insect pests that were harming okra plants were ants and *C. carnea*. It is necessary to expand and improve the biocontrol agents' inherent function in okra crops. It also showed that, in conjunction with other safe techniques, the three predators, *C. camea*, *Scymnus* spp., and *C. undecimpunctata* may play a promising role in the planning of Integrated Pest Management (I.P.M.) strategies to prevent pollution in the surrounding area EIKhawas and EL-Mowafy (2005).

5- The influence of predatory insects on population density of *P. solenopsis*:

The data presented in Fig. 7 and Table 4 showed the relationship between *A. gossypii* and associated predatory insects. *C. undecimpunctata*, *E. nigromaculatus*, *Scymnus* sp., *H. convergens*, *Orius* sp. and *C. carnea* that feed on nymphs and adults of *P. solenopsis*.

From (Fig. 9), it is clear that an increase in the numbers of *P. solenopsis* in the beginning season is followed by an increase in the numbers of associated predators, also, fluctuations in *P. solenopsis* population and associated predators were appeared during the growing season.

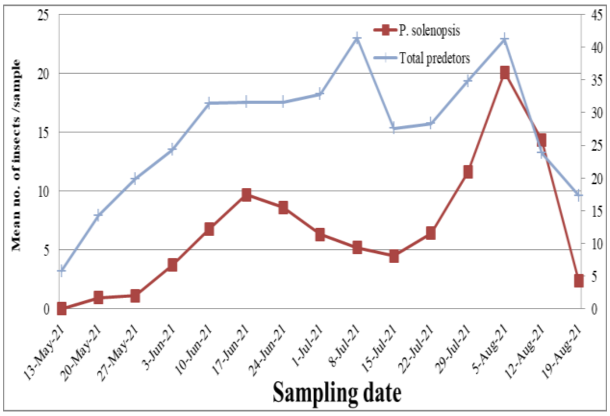


Fig. 9. weekly average numbers of *P. solenopsis* and associated predators on eggplant leaves during 2021at Kafr-Saad region Damietta Governorate.

Statistical analysis showed the relationship between the average numbers of *P. solenopsis* and all of associated predators, were positive and significant for *C. undecimpunctata*, *E. nigromaculatus*, *Scymnus* sp., *H. convergens* and *C. carnea* with correlation coefficient values r. = 0.566, 0.500, 0.752, 0.579 and 0.719 respectively, while this relation were non-significant positive in the case of *Orius* sp. with correlation coefficient values r. = 0.394 respectively, this means that the predators prefer to feed on this insect.

The influence of different predators on *P. solenopsis* population could be seen by the results of partial regression values in (Table 6) these results showed that there are non-significant negative relation between *P. solenopsis* and tow predators, *H. convergens* and *Orius* sp. while non-significant positive relation was found with three predators, *C. undecimpunctata*, *E. nigromaculatus* and *C. carnea*, whereas these relation was significantly positive with *Scymnus* sp.

Table 6. Simple correlation coefficient, partial regression values and explained variance (E.V.) between the weekly mean numbers of *P. solenopsis* and the predatory insects on eggplant crop during 2021.

Predator orders	Predator	Simple correlation analysis		Multiple partial regression analysis				
		r.	P.	b.	p.	"F"	Prob>F	E.V.
Coleoptrea	*C. undecimpunctata*	0.566	0.028	0.096	0.972	6.44	0.010	82.9 %
	E. nigromaculatus	0.500	0.058	2.644	0.200			
	Scymnus sp.	0.752	0.001	2.109	0.051			
	H. convergens	0.579	0.024	-1.159	0.391			
Heteroptera	*Orius* sp.	0.394	0.146	-1.533	0.250			
Nuroptera	*C. carnea*	0.719	0.002	0.797	0.567			

This means that the decline in *P. solenopsis* numbers may be due to the increase in numbers of predatory insects that feed on nymphs and adults of this insect.

It could be observed also from (Table 6) that the explained variance of predatory insects affecting *P. solenopsis* population activity was 82.9 % from the effect of all factors affecting the population.

According to research by Hameed *et al.* (2013), *C. undecimpunctata* is a potent biocontrol agent of the cotton mealybug *P. solenopsis* that can be utilized to successfully manage this infamous pest on cotton crops through integrated pest management programs. The adult female of *C. undecimpunctata* ingested more mealybugs during the course of its lifetime than the adult male. Of the Coccinellid species, coccids make up 36% of the prey (Hodek and Honek 2009).

CONCLUSION

The results showed that there are three predators: *C. undecimpunctata*, *Orius* sp. and *hrysopa carnea* played an important role in controlling the population of all pests recorded on eggplant, which are: *T. tabaci, B. tabaci, Aphis* spp., *Empoasca* spp. and *P. solenopsis*, with the exception of *L. sativa*, no predator has been recorded feeding on it. It was also clear from the results that there are four predators: *Scymnus* sp., *H. convergens, N. tenuis,* and *Syrphus* sp., it feeds on four of the insect pests recorded on eggplant. It was also clear from the results that there are two predators, *E. nigromaculatus* and *A. aphidimyza*, which feed on four of the insect pests recorded on eggplant.

The obtained results are supported by many authors; *A. gossypii*, *B. tabaci*, and *Empoasca* spp. were the main piercing sucking insect pests and the predators that were connected with them during the summer crop of okra plants. The most prevalent pest species was the cotton aphid, *A. gossypii*, which was followed by *B. tabaci* and *Empoasca* spp. The most prevalent predators that were linked to the main insect pests that were harming okra plants were ants and *C. carnea*. It is necessary to expand and improve the biocontrol agents' inherent function in okra crops. It also showed that, in conjunction with other safe techniques, the three predators, *C. camea*, *Scymnus* spp., and *C. undecimpunctata* may play a promising role in the planning of Integrated Pest Management (I.P.M.) strategies to prevent pollution in the surrounding area EIKhawas and EL-Mowafy (2005). *Orius laevigatus* (Fiber), the anthocorid bug, and *Macrolophus caliginosus* Wagner and *Nesidiocoris tenuis* (Reuter), the mirid bug, are both Hemiptera species that are predominantly polyphagous and rarely exhibit prey specificity (Fauvel, 1999). These insects feed on aphids, thrips, and mites, as well as aphids (Alvarado *et al.*, 1997), thrips (Riudavets and Castane, 1998), as well as mites (Venzon *et al.*, 2002). Numerous hemipterans can aid in the management of *B. tabaci* since they are common generalist predators of the pest (Arno *et al.*, 2008; Calvo *et al.*, 2009). As a generalist predator, *C. carnea* eats sucking pests, such as 510 whitefly nymphs (Gautam & Tasfaye, 2002) and 216–950 aphid nymphs and adults (Chang, 1998). Maintaining this predator and controlling the adult population that is immigrating are the keys to effective pest management (Karahroudi & Hatami, 2003). Due to the frequent and careless use of chemicals, which has resulted in the development of resistance and the loss of half the yield (Georghious and Lagunes, 1991), biological control is now the most important alternative. This is supported by the addition of *C. carnea* to the control of sucking pests, specifically the cotton whitefly *B. tabaci* (Mohyuddin *et al.*, 1997). Therefore, it is imperative that biological control-based IPM be supported by extensive evidence and recommendations.

REFERENCES

Albajes, R., and Alomar, Ò. (1999). Current and potential use of polyphagous predators. In Integrated pest and disease management in greenhouse crops. Dordrecht: Springer Netherlands. (pp. 265-275).

Alvarado, P., Balta, O. and Alomar, O. (1997). Efficiency of four heteroptera as predators of *Aphis gossypii* and *Macrosiphum euphorbiae* (Hom., Aphididae). Entomophaga 42: 215-228.

Al-Zyoud, F. (2007). Prey species preference of the predator *Serangium parcesetosum* Sicard (Col., Coccinellidae) and its interaction with another natural enemy. Pak. J. Biol. Sci. 10: 2159-2165.

Al-Zyoud, F. (2008). Biology and predation potential of the Indian ladybird *Serangium parcesetosum* on *Bemisia tabaci*. Jordan J. Agric. Sci. 4: 26-40.

Al-Zyoud, F. (2013). Evaluation of the predatory beetle *Serangium parcesetosum* Sicard (Col., Coccinellidae) release rate and time on the cotton whitefly *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae). Jordan J. Agric. Sci. 9: 321-335.

Al-Zyoud, F., Ghabeish, I. and Al-Araj, S. (2013). Positive density-dependent prey mortality of *Bemisia tabaci* puparia due to the predatory coccinellid *Serangium parcesetosum* Sicard. J. Food Agric. Environ. 11: 417-420.

Al-Zyoud, F., Sengonca, C. and Abbadi, S. (2007). Evaluation of *Serangium parcesetosum* (Col.: Coccinellidae) for biological control of *Bemisia tabaci* under greenhouse conditions. J. Pest Sci. 80: 85-92.

Al-Zyoud, F.A. (2014). The most common predators of *Bemisia tabaci* (Genn.): Biology, predation, preferences, releases, alternative food resources, combined use, current efforts and future perspectives. Journal of Biological Control, 28(1), 1-16.

Arnó, J., Castañé, C., Riudavets, J., Roig, J., and Gabarra, R. (2006). Characterization of damage to tomato plants produced by the zoophytophagous predator *Nesidiocoris tenuis*. *Bulletin IOBC/wprs*, 29 (4): 249-254.

Arno, J., Roig, J. and Riudavets, J. (2008). Evaluation of *Orius majusculus* and *O. laevigatus* as predators of *Bemisia tabaci* and estimation of their prey preference. Biol. Cont. 44: 1-6.

Aukema, B. and Rieger, C. (1995-2006). Catalogue of the Heteroptera of the Palaearctic Region. Vols. 1-5. Amsterdam: The Netherlands Entomological Society. Vol. 1, 222 pp., Vol. 2, 361 pp., Vol. 3, 577 pp., Vol. 4, 346 pp., Vol. 5, 550 pp.

Awadalla, S.S., El-Naggar, M.E., Abdel-Baky, N.F. and Hamid, O.F. (2011). The insect pests attacking onion plants with special references to the onion thrips, *Thrips tabaci* Lind., at Mansoura region. *Journal of Plant Protection and Pathology*, Mansoura Univ., 2(1): 1-12.

Aziza, M. El-Gantiry, El-Arnaouty, S.A., Badawy, H.M. and Nevien, M. Gaber (2007). Biochemical variation in the life stages and populations of *Chrysoperla carnea* (Stephens) (Neuroptera : Chrysopidae) . Egypt J. Agric. Res., 85 (6): 2121-2138.

Bale, J.S., Van Lenteren, J.C. and Bigler, F. (2008). Biological control and sustainable food production. Phil. Trans. R. Soc. B., 363: 761-776.

Calvo, J., Bolckmans, K., Stansly, P.A. and Urbaneja, A. (2009). Predation by *Nesidiocoris tenuis* on *Bemisia tabaci* and injury to tomato. Bio. Cont. 54: 237-246.

Ceryngier, P. and Hodek, I. (1996). Enemies of the Coccinellidae. In: Hodek, I., Honk, A. (Eds.), Ecology of Coccinellidae. Kluwer Academic Publishers, Dordrecht, pp. 319-350.

Chambers, R.G. (1988). Applied production analysis: a dual approach. Cambridge University Press.

Chang, (1998). *Chrysoperla plurabund* larvae feed disproportionately on thrips in the field. Canadian Entomol., 130: 549-50.

EIKhawas, M. A. M., & EL-Mowafy, N. E. (2005). Survey of predators associated with major insect pests on okra plants, in Qalubia Governorate. *Journal of Plant Protection and Pathology*, *30*(2), 1105-1116.

Fauvel, G. (1999). Diversity of Heteroptera in agroecosystems: role of sustainability and bioindication. Agric. Ecosys. Environ. 74: 275-303.

Fok, E.J., Petersen J.D. and Nautt, B.A. (2014). Relationships between insect predator populations and their prey, *Thrips tabaci*, in onion fields grown in large-scale and small-scale cropping systems. *BioControl*, 59: 739–748. DOI 10.1007/s10526-014-9612-9.

Gautam, R.D. and Tesfaye, A. (2002). Potential of green lacewing, *Chrysoperla carnea* (Stephens) in crop pest management. New Agric., 13: 147-58.

Georghious, G.P. and Lagunes, T.A. (1991). The Occurrence of Resistance to Pesticides in Arthropods, p: 318. Food Agriculture Organization, United Nations, Rome.

Gerling, D., Alomar, O. and Arno, J. (2001). Biological control of *Bemisia tabaci* using predators and parasitoids. Crop Prot. 20: 779-799.

Habib, A., Rezk, N., Farghaly, H.T. and Ragab, Z.A. (1980). Seasonal abundance of some predators in cotton fields and its relation to certain pests. *Bulletin of the Entomological Society of Egypt*, 60: 191-196.

Hameed, A., Hafiz, M. S., Saghir, A., Iqbal, J., Karar, H., and Amin, A. (2013). Predatory potential and life history characteristics of eleven spotted beetle, *Coccinella undecimpunctata* L. reared on cotton mealybug, *Phenacoccus solenopsis* Tinsley. Pakistan Journal of Zoology, 45(6).

Harris, K.M. (1973) Aphidophagous Cecidomyiidae (Diptera): taxonomy, biology and assessments of field populations. B. Entomol. Res. 63:305-325.

Heinz, K.M. and Parrella, M.P. (1994). Poinsettia (*Euphorbia pulcherrima* Willd. Ex Koltz.) cultivar-mediated differences in performance of five natural enemies of *Bemisia argentifolii* Bellows and Perring, n. sp. (Hom., Aleyrodidae). Biol. Cont. 4: 305-318.

Henry, T.J. (2009) Biodiversity of Heteroptera. In Foottit RG, Adler PH (Eds) Insect Biodiversity: Science and Society. Chichester, UK: Wiley-Blackwell, 223-263.

Hodek, I. (1967). Bionomics and ecology of predaceous Coccinellidae. Annual Review of Entomology, 12(1), 79-104.

Hodek, I. and Honek, A., (2009). Scale insects, mealy bugs, whiteflies, and psyllids (Hemiptera: Sterrnorhyncha) as prey of ladybird. Biol. Contr., 51: 232-243.

IBM Corp. (2020). IBM SPSS Statistics for Windows (Version 27.0) [Computer software]. IBM Corp.

Jazzar, C., Hammad, E.A.F. (2004). Efficacy of multiple biocontrol agents against the sweetpotato whitefly, *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae) on tomato. J. Appl. Entomol. 128: 188-194.

Karahroudi, Z.R. and Hatami, B. (2003). Comparison of two method of releasing *C. carnea* (Steph) eggs against *A. gossypii* under greenhouse condition. J. Sci. Tech. of Agric. Nat. Resour., 7: 215-25.

Khan, I.A. and Wan, F.0.H. (2008a). Life history of *Chrysopa pallens* (Rambur) (Neur., Chrysopidae) on *Bemisia tabaci* (Genn.) (Hom., Aleyrodidae) biotype B prey. Sarhad J. Agric. 24: 635-640.

Khan, I.A. and Wan, F.0.H. (2008b). Prey consumption by *Chrysopa pallens* of un-parasitized and *Encarsia formosa* parasitized *Bemisia tabaci* biotype B prey. Sarhad J. Agric. 24: 641-648.

Kirby, P., Bantock, T. and Nau, B. (2009) *Dicyphus escalerae* Lindberg, 1934. HetNews 13: 7-8.

Kotze, D.J., and Dennill, G.B. (1996). The effect of *Liriomyza trifolii* (Burgess) (Dipt., Agromyzidae) on fruit production and growth of tomatoes, *Lycopersicon esculentum* (Mill)(Solanaceae). Journal of Applied Entomology, 120(1-5), 231-235.

Larson, B.M.H., Kevan, P.G. and Inouye, D.W. (2001). Flies and flowers: taxonomic diversity of anthophiles and pollinators. The Canadian Entomologist, 133(4), 439-465.

Liu, T.X., Kang Le., K.L., Heinz K.M. and Trumble, J. (2009). Biological control of *Liriomyza leafminers*: progress and perspective. CAB Reviews: Perspectives in Agriculture, Veterinary Science,Nutrition and Natural Resources 4: 1-16.

Lucas, E. and Brodeur, J. (2001) A fox in sheep's clothing: furtive predators benefit from the communal defense of their prey. Ecology 82 (11):3246-3250.

Markkula, M. (1963) Studies on the pea aphid, *Acyrthosiphon pisum* Harris (Hom, Aphididae) with special reference to the difference in biology of the green and red forms. Ann. Agr. Fenn. 2:1-30.

McEwen, P.K., New, T.R.R. and Whittington, A. (2001). Lacewings in the crop management. Cambridge University Press. 546p, 14, 1806-1812.

Mohyuddin, A. I., Jilani, G., Khan, A. G., Hamza, A., Ahmed, I., and Mahmood, Z. (1997). Integrated pest management of major cotton pests by conservation, redistribution and augmentation of natural enemies in Pakistan. Pakistan J. Zool., 29: 293-298.

Naranjo, S.E. (2001). Conservation and evaluation of natural enemies in IPM systems for *Bemisia tabaci*. Crop Prot. 20: 835-852.

Nomikou, M., Janssen, A. and Sabelis, M.W. (2003). Phytoseiid predator of whitefly feeds on plant tissue. Exp. Appl. Acarol. 31: 27-36.

Oatman, E.R. and Kennedy, G.G. (1976). Methomyl induce outbreak of *Liriomyza sativae* on tomato. J. Econ. Entomol., 69: 667-668.

OMKAR and PERVEZ, A., (2002). New record of coccinellids from Uttar Pradesh .III. Journal of Advanced Zoology. 23(1): 63-65.

Parker, B.L., Talekar, N.S. and Skinner, M. (1995). Field guide: Insect pests of selected vegetables in tropical and subtropical Asia. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan, ROC. Publication no. 94-427. 170 p.

Rajabpour, A., Seraj A.A., Allahyari, H. and Shishehbor, P. (2011). Evaluation of *Orius laevigatus* Fiber (Heteroptera: Anthocoridae) for biological control of *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) on greenhouse cucumber in South of Iran. Asia Journal of Biological Science, 4: 457-467.

Rank, N. E. and Smiley, J. T. (1994). "Host-plant effects on *Parasyrphus melanderi* Curran (Diptera: Syrphidae) feeding on a willow leaf beetle *Chrysomela aeneicollis* Schaeffer (Coleoptera: Chrysomelidae)". Ecological Entomology. 19: 31–38.

Reitz, S. R., Funderburk, J.E. and Scot, M.W. (2006). Differential predation by the generalist predator *Orius insidiosus* on congeneric species of thrips that vary in size and behavior. Entomologia Experimentalis et Applicata, 119: 179-188.

Riudavets, J, and Castane, C. (1998). Identification and evaluation of native predators of *Frankliniella occidentalis* (Thysan., Thripidae) in the Mediterranean. Environ. Entomol. 27: 86-93.

Rueda, A. and Shelton, A.M. (1995) Onion thrips. In global crop pest. Cornell. International Institute for Food, Agriculture and Development, Cornell University.;http://www. nysaes.cornell.edu/ent/hortcrops/english/ thrips. html.

Salehi, Z., Yarahmadi, F. Rasekh, A. and Sohani, N.Z. (2016). Functional responses of *Orius albidipennis* Reuter (Hemiptera, Anthocoridae) to *Tuta absoluta* Meyrick (Lepidoptera, Gelechiidae) on two tomato cultivars with different leaf morphological characteristics. Entomologia Generalis, 36: 127-136.

Sanchez, J. A. and Lacasa, A. (2008): Impact of the Zoophytophagous Plant Bug *Nesidiocoris tenuis* (Heteroptera: Miridae) on tomato Yield. Journal of Economic Entomology, 101(6):864-870.

Satti, A.A. and Mahgoub, H.A.H. (2018). Population abundance of *Thrips tabaci* Lindeman and its associated predators on some crops at Shendi, River Nile State, Sudan.International Journal of Scientific Progress and Research (IJSPR), 54, (1):37-45.

Schaefer, C.W. and Panizzi, A.R. (2000) Heteroptera of Economic Importance. Boca Raton, Florida: CRC Press. 828 pp.

Schuh, R.T. and Slater, J.A. (1995) True bugs of the World (Hemiptera: Heteroptera). Ithaca: Cornell University Press. 336 pp.

Sharma, P.K. and Joshi, P.C. (2010). New records of coccinellid beetles (Coccinellidae: Coleoptera) from District Dehradun, (Uttarakhand). Indian New York Sci J. 3: 112-118.

Subba, Rao B.R., Parshad, B., Ram, A., Singh, R.P. and Srivastava, M.L. (1968). Distribution of *Empoasca devastans* and its egg parasites in the Indian Union. Entomologia Experimentalis et Applicata 11(2): 250-254.

Sundby, R.A. (1967). A comparative study of the efficiency of three predatory Insects *Coccinella septempunctata* L. (Coleoptera, Coccinellidae), *Chrysopa carnea* St. (Neuroptera, Chrysopidae) and *Syrphus ribesii* L. (Diptera, Syrphidae) at two different temperatures. Entomophaga, 11: (4) 395-404.

Urbaneja, A., Tapia, G. and Stansly, P. (2005): Influence of host plant and prey availability on developmental time and survivorship of *Nesidiocoris tenuis* (Het.: Miridae).- Biocontrol Science and Technology, 15: 513-518.

Van Lenteren, J.C. (1997). Benefits and risks of introducing exotic macro-biological control agents into. Europe.- Bulletin OEPP/EPPO, 27: 15-27.

Venzon, M., Janssen, A. and Sabelis, M.W. (2002). Prey preference and reproductive success of the generalist predator *Orius laevigatus*. Oikos 97: 116-124.

Waterhouse, D.F. and Norris, K.R. (1987). Biological control: Pacific prospects. viii + 454pp.

Wheeler, A.G. (2001) Biology of the Plant Bugs (Hemiptera: Miridae). Pests, Predators, Opportunists. Ithaca: Cornell University Press. 506 pp.

Wilbert, H. (1973) Zur Suchfkhigkeit der Eilarven von *Aphidoletes aphidimyza* (Diptera: Cecidomyiidae). Entomol Exp Appl 16:514-524.

دور الحشرات المفترسة في تنظيم مجاميع الآفات الحشرية الرئيسية التي تهاجم محصول الباذنجان تحت ظروف الحقل المفتوح

طارق السيد عطا

قسم وقاية النبات - كلية الزراعة - جامعة دمياط

الملخص

أجريت التجارب لدراسة دور المفترسات الحشرية في تنظيم مجاميع الآفات الحشرية الرئيسية التي تهاجم محصول الباذنجان (*Solanum melanogena* L.) تحت ظروف الحقل المفتوح. أظهرت النتائج وجود تسعة مفترسات تنتمي إلى أربع رتب هي: رتبة غمدية الأجنحة: حشرة أبو العيد ذو ألأحد عشر نقطة *Coccinella undecimpunctata* , حشرة أبو العيد إكسوكوموس *Exochomus nigromaculatus* , أبو العيد سكمنس *Scymnus* sp وأبو العيد هيبوديميا *Hippodamia convergens* من عائلة أبو العيد Coccinillidae, ومن رتبة متباينة الأجنحة حشرة بقة الأوريس *Orius* spp. عائلة Anthocoridae ومفترس بقة الطماطم *Nesidiocoris tenuis* من عائلة Miridae , ومن رتبة ثنائية الأجنحة، مفترس ذبابة المن *Aphidoletes aphidimyza* من عائلة Cecidomyiidae ومفترس ذبابة السرفس *Syrphus* sp. من عائلة Syrphidae وأخيراً رتبة شبكية الأجنحة، مفترس أسد المن *Chrysoperla carnea* من عائلة Chrysopida . تم تسجيل أعلى أعداد ونسب للحشرات المفترسة المرتبطة بأنواع آفات الباذنجان الحشرية بواسطة ذبابة السرفس *Syrphus* sp. ممثلةً بـ 92.2 فرداً (14%). سجلت ذبابة المن *A. aphidimyza* وأبو العيد ذو ألأحد عشر نقطة*C. undecimpunctata* و أبو العيد إكسوكوموس *E. nigromaculatus* 86.7 و83.5 و80.9 فردًا على التوالي، وبنسبة 13% و13% و12% على التوالي. بينما بقة الأوريس *Orius* sp. و أسد المن *C. carnea* سجلت أعدادًا أصغر ويمثلها 54.6 فردًا (8٪) و51.9 فردًا (8٪) خلال موسم الدراسة.