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Coexistence of Pests and the Associated Predators Inhabiting Soybean, *Glycine Max* L. Merr. in Assiut City, Egypt

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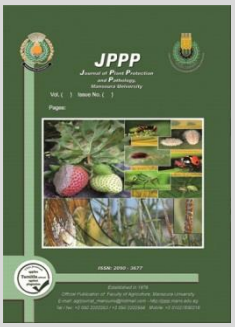

ABSTRACT

Soybean plants are afflicted by many pest species. The current study was conducted at Assiut experimental farm in the 2022 and 2023 seasons. The results showed twenty-six species of insect pests pertaining to ten orders and eighteen families were collected from the soybean crop in Assiut city at different stages of growth. This study revealed that a total of 15 species of pests were found in soybean plants. Whitefly, *Bemisia tabaci* was the most dominant of these pests at all, followed by *thrips tabaci* (Lindeman), plant bug (*Phytocoris* spp.), and jassid, *Empoasca* spp., then come *Aphis gosspyii* (Glover), *Myzus persicae*, and *Nazara viridula* (Linné), while, *Eysarcoris inconspicuous* (Westwood) and *Nysius graminicola* (koienati) were the least economically important for this crop. Eleven predator species pertaining to five orders and seven families were found to feed on soybean insects. Among them, six are significant; these are specifically *Campylomma impicta* (Meyer) *Coccinella undecimpunctata* (Linnaeus), *Chrysoperla carnea* (Stephens), *Cydonia* spp. and *Orius* spp., in addition to true spiders. An essential part in managing insect pests of soybeans is played by these natural enemies. In all cases the dominance degrees of pests were higher than those of the predators. Through these results, it is clear that natural enemies can be included into an integrated pest management program under the weather condition of Assiut city.

Keywords: Soybean, Natural enemies, Management, Whitefly, Predators

INTRODUCTION

Soybeans are a type of legume and contain many important nutrients such as fiber, vitamins, minerals and antioxidants (Khan *et al*., 2021; Otie *et al*., 2021 and Bhatt *et al*. 2022). *Glycine max* (L.) Merr. , or soybean, is one of the most important leguminous crops in Egypt and the rest of the globe. Many piercing-sucking insects attack soybeans; the most significant ones are the green stink bug, *Nezara viridula* L., whiteflies, *Bemisia tabaci* (Genn.), leafhoppers, and aphids, *Aphis* spp. (Abd-ElSamad *et al*., 2011; Khattab *et al*., 2012; Eissa, 2018; Rahayu *et al*., 2018; Musser *et al*., 2020; Tetila *et al*., 2020; Carnevalli *et al*., 2022 and Kezar *et al*., 2023). Pests of soybeans can strike at any stage of growth, from seedling to harvest, and they can be especially harmful from flowering to plant maturity. The insects decrease both soybean yields and quality. Soybean pests harm plants both directly by feeding them and creating an opening for other pathogens to attack (Heinrichs and Muniappan, 2018). They also cause indirect harm by spreading viruses and other diseases (Iqbal *et al*., 2008).

The abundance and geographic range of different predator groups are also affected. In many agroecosystems, arthropod predators-spiders and insect predators the common natural enemies that can act as biocontrol agents for soybean pests (Bueno, *et al*., 2012).They aid in decreasing various pests and are frequently the most numerous and diverse natural enemies (Pekár, 2013). Throughout their lives, predators usually consume a variety of prey species, and they can exhibit predation at any stage of their development immature, adult, or both (Ademokoya *et al*., 2022). There are about twenty insect orders in which predators are widely dispersed. The orders Coleoptera, Diptera, Hemiptera, Hymenoptera, and Neuroptera are the home to most predatory insects commonly used in pest management operations (Capinera, 2008). To design an effective management program for these pests under Assiut conditions, the current study aims to study the pests and related predators that inhabit soybean plants and to determine their abundance and levels of dominance.

MATERIALS AND METHODS

The current study was conducted during the 2022 and 2023 seasons at Assiut University's experimental farm. A quarter of feddan (ca. 1,000 m^2) was divided into equal four plots. Seeds of soybean were normally planted in mid-May during both seasons. The study period was characterized by traditional agricultural practices and no chemical control was used. Manually removing weeds was done. As sampling methods, direct count and sweep-net techniques were used to survey pests and associated predators inhabiting soybean foliage.

a) **Direct count:** Ten randomly selected leaves were taken representing upper, middle and lower levels of plants each week in the morning and transferred into paper bags then moved to the lab for examination.
b) **Sweep net:** The sampling commenced once the plants reached a sufficient height for effective sweeping. Weekly, 25 sweeps were repeated four times (totaling one hundred). Every collected sample was put into labeled paper bags and transported to the laboratory. The

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specimens were anesthetized using chloroform and observed under a stereo microscope. The count of species and the number of individuals of each species were documented.

c) Using the formula of **facylate (1971**), the degrees of dominance (%) and abundance (%) of the identified pests and the related predators were determined.

The following formula was used to calculate the dominant degrees (D) for the detected species:

D = t/T x 100,

where

(t) = the total number of each species that was collected at that time.
(T) = the total number of species observed during the time of collection.

The following formula was used to compute the abundance degrees (A) for a species that was recorded throughout the sampling period.

A = n/N x 100,

where,

(n) = the total number of samples for which each species was found.
(N)= the total number of samples collected during the season.

RESULTS AND DISCUSSION

1. The obtained results presented in Table (1) show the insect pests inhabiting soybean crops and the associated predators in Assiut City during two consecutive growing seasons, 2022 and 2023. The results show that 26 different arthropod species pertaining to 10 orders and 18 families were present. Of the collected species, four are considered to be major pests causing significant damage, three are considered to cause moderate damage, eight are beneficial arthropods, and there are also several unidentified true spider species. The identified species listed in (Table 1) were classified as both: predators and pests.

Table 1. A list of insect pests and their predators associated with soybean in the Assiut City during two successive seasons of 2022 and 2023.

Order	Family	Scientific name	Common name	Pest stage	Sampling method
		Pests			
Diptera	Agromyxidae	*Agromyza pussilla* (Meigen)	Leaf miners	L	D.C.
Hemiptera	Pentatomidae	*Nezara veridula* (Linnaeus)	Green Stink Bug	N+A	D.C.& S.N.
		Eysarcoris inconspicuous (Westwood)	Whites potted stink bug	N+A	D.C.& S.N.
	Lygaeidae	*Nysius graminicola* (Kolenati)	Lygeid seed bug	N+A	D.C.& S.N.
	Miridae	*Phytocoris* spp.	Plant bug	N+A	D.C.& S.N.
Homoptera	Aleyrodidae	*Bemisia tabaci* (Gennadius)	Whitefly	N	D.C.& S.N.
	Aphidaidae	*Aphis gossypii* (Glover)	Cotton aphid	N+A	D.C.& S.N.
		Myzus persicae (Sulzer)	Green peach aphid	N+A	D.C.& S.N.
	Cicadellidae	*Empoasca* spp.	Leaf hoppers	N+A	D.C.& S.N.
Orthoptera	Acrididae	*Heteracris littoralis* (Rambur)	Grasshopper	N+A	D.C.& S.N.
	Gryllotalpidae	*Gryllotalpa gryllotalpa* (Linnaeus)	Mole cricket	N+A	D.C.
Lepidoptera	Noctuidae	*Agrotis ipsilon* (Hufnagel)	Cut worm	L	D.C.
		Spodoptera littoralis (Boisduval)	Cotton leaf worm	L	D.C.
Thysanoptera	Thripidae	*Thrips tabaci* (Lindeman)	Onion thrips	N+A	D.C.& S.N.
Acari	Tetranychidae	*Tetranychus urticae* (Koch)	Two-spotted spider mite	N+A	D.C
		Predators			
Coleoptera	Coccinellidae	*Coccinella undecimpunctata* (Linnaeus)	Eleven-spot ladybird	L+A	D.C.& S.N.
		Scymnus spp.	Scymnus lady beetles	L+A	D.C.& S.N.
		Cydonia spp.		L+A	D.C.& S.N.
Diptera	Syrphidae	*Syrphus corolla* (Fabricius)	Hover fly	L	D.C.& S.N.
Dermaptera	Labiduridae	*Labidura riparia* (Pallas)	Earwigs	N+A	D.C.& S.N.
Hemiptera-Heteroptera	Anthrocoridae	*Orius* sp	Flower bug	N+A	D.C.& S.N.
	Geocoridae	*Geocoris* sp.	Bigeyed bug	N+A	D.C.& S.N.
	Miridae	*Campylomma impicta* (Wagner)	Plant bug	N+A	D.C.& S.N.
		Cyrtopeltis tenuis (Reuter)	Mirid bug	N+A	D.C.& S.N.
	Nabidae	*Nabis* spp	Damsel bug	N+A	D.C.& S.N.
Neuroptera	Chrysopidae	*Chrysoperla carnea* (Stephens)	Lace wing	N+A	D.C.& S.N.
True spider		Unidentified			

N=Nymph L=Larva D.C=Direct count S.N=Sweep net.

Pest

During the 2022–2023 seasons, fifteen species of insect pests pertaining to seven orders (Diptera, Hemiptera, Homoptera, Orthoptera, Lepidoptera, Thysanoptera and Acari) and twelve families (Agromyxidae, Aphididae, Aleyrodidae, Pentatomidae, Cicadellidae, Miridae, Thripidae, Acridiidae, Gryllotalpidae, Noctuidae, Tetranychidae and Lygaeidae) were collected to be inhabiting the soybean crop in Assiut City at various stages of growth **(Table 1)**. Out of these, seven species whitefly, *Bemisia tabaci* (Gennadius), jassid, *Empoasca* spp., *Nezara viridula* (L.), *M.persicae*, plant bug *Phytocoris* spp., *Aphis gosspyii* (Glover) and *thrips tabaci* (Lindeman) were deemed to be the main pests. While, *Eysarcuris inconspicuous* (herrich-schaeffer) and *Nysius graminicola (*koienati) were of less economic importance based on population densities Lepidoptera species were collected as larvae using sweeping nets or by direct observation on plants. They were classified in the family Noctuidae. In this order, only two species were found: *Agrotis ipsilon* (Rott.) and *Spodoptera littoralis* (Boisd.). Additionally, one species of Orthoptera was recorded during the study. This species, the mole cricket *Gryllotalpa gryllotalpa* L., belonging to the family Gryllotalpidae, was collected from the soil surface when attacking soybean seedlings. Nevertheless, this species was deemed to pose no significant threat to soybeans and did not cause any significant

harm to the crop. The order Hemiptera, Homoptera, Thysanoptera, and the red spider mite of Order Acari are among the collected and documented species of arthropods that puncture the tissue and absorb the sap of soybean plants.

Bemisia tabaci (Genn.), (Aleyrodidae) also known as the cotton whitefly, is a highly destructive pest that infests soybean plants throughout the season. Aphids, specifically *Aphis gossypii* Glover and *Myzus persicae* (Sulz.), were the most significant and dangerous pests. These aphid species (Aphididae) were gathered from the plants in early Mid-July and left there until harvest time. They consumed the leaves and the apical racemes. Comparatively moderate numbers of onion thrips, *Thrips tabaci* (Lind.) (Thripidae), plant bugs (*Phytocoris* sp.) (Miridae), and leafhoppers, *Empoasca disciplines* (Paoli.) (Cicadellidae) were collected using both the sweep net and direct count methods. The red spider mite *Tetranychus urticae* Koch (Tetranychidae: Acaria) was discovered in the laboratory after randomly selected soybean leaves were examined. This mite causes severe infestation on soybean leaves throughout the entire growing season.

Predators

As shown in Table (1), Eleven predator species pertaining to five orders(Hemiptera, Dermaptera, Coleoptera, Neuroptera and Diptera) and eight families (Miridae, Coccinellidae, Labiduridae, Geocoridae, Chrysopidae, Nabidae, Anthocoridae and Syrphidae) were found to feed on soybean insects. Among them, six are significant; these are specifically *Campylomma impicta* (Meyer) (Miridae) *Coccinella undecimpunctata* (L.), (Coccinellidae) *Chrysoperla carnea* (Stephens), (Chrysopidae) *Cydonia* spp . , (Coccinellidae) and *Orius* spp, (Anthocoridae) as well as unidentified true spiders. An essential part in managing insect pests of soybeans is played by these natural enemies. While *Cyrtopeltis tenuis* Reuter, *Nabis capsiformis Germar* ,and *Syrphus corolla* Fabricius were less in number compared to other species.

2-dominance (%) and abundance (%) degrees of pests and associated predators:

Insect pests

According to data in Table 2, *B. tabaci* appears to be the most significant economic pest in the 2022 season, as shown by the greatest values of dominance and abundance degrees (46.95 and 90, respectively). Followed by *Empoasca spp, Phytocoris spp* and *Thrips tabaci*, with dominance values of 11.7, 11.53 and 11.37 respectively and abundance values of 100,100 and 100, respectively. On the other hand, the high abundance (90, 80, and 70) and low dominance (6.75, 5.27, and 5.68) of *A. gosspyii, M. persicae,* and *N. virdula* suggested that these species would be economically significant if environmental conditions improved. In the meantime, the species *E. inconspicuous* and *N. graminicola*, which had low abundance and dominance values (30 and 20; and 00.41 and 0.33, respectively) are predicted to have minimal economic significance since they may have a modest effect as a pest in soybean plant. According to the data presented in Table 3, *Bemisia tabaci* is the most significant economic pest infesting soybean plants in the 2023 growing season. This is due to its high levels of abundance and dominance, which were recorded at 100% and 54.77, respectively. *A. gosspii, Emposca* spp., *M. persicae, N. viridula, phytocoris* spp., and *Thrips tabaci*, on the other hand, had low dominance degrees (6.52, 7.91, 5.70, 5.05, 8.56, and 10.59) and high abundance degrees (90, 100, 80, 90,100 and 70%), respectively, indicating that these species could be important economically if environmental conditions changed in their favor. In the meantime, it is expected that the species *E. inconspicuous* and *Nysius graminicola*, with low values of dominance and abundance (0.41 and 30%, and 0.49 and 30%, respectively), will have minimal economic significance. In general, based on table 4 it could be concluded that *B.tabaci* is the most significant economic pest infesting soybean crop as indicated by the highest values of abundance and dominance degrees. while *Empoasca spp, Phytocoris spp* and *Thrips tabaci* come in the second order as a significant economic pest. On the other hand, *A. gosspyii*, *N. viridula*, and *M. persicae*, had a low dominance degrees and high abundance degrees indicating that these species could be important economically if environmental conditions changed in their favor. While *E. inconspicuous* and *Nysius graminicola* had low effect on soybean crops. The findings are in line with research done by Kumari *et al*. (2020), Gupta (2021), Hemlata *et al.* (2022) and Kandil (2022) who discovered that the most significant pests on soybeans are *Bemisia tabaci* Genn., *Aphis gossypii* Glover, *Nezara viridula* L., and *Empoasca* app. (Munje *et al.* ,2022). Based on these investigations, whiteflies (*Bemisia tabaci*) and thrips (*Thrips tabaci*) are the main insect pests of soybean crops.

Table 2. dominance (%) and abundance (%) degrees of pests and the associated predators inhabiting soybean during the 2022 season in Assiut City.

Species	Dominance		Abundance
	Mean number / 25 Sweep net	%	
Total	1781	100	100.00
Pests	1214	68.16	100.00
A.gosspyii	82	6.75	90.00
B.tabaci	570	46.95	90.00
E. inconspicuous	5	0.41	30.00
Empoasca spp.	142	11.70	100.00
M.persicae	64	5.27	80.00
N. viridula	69	5.68	70.00
Nyzus graminicola	4	0.33	20.00
Phytocoris spp	140	11.53	100.00
Thrips tabaci	138	11.37	100.00
Predators	567	31.84	100.00
campyloma impicta	173	30.51	100.00
coccinella undecimpunctata	105	18.52	60.00
Chrysoperla carnea	56	9.88	60.00
Cydonia spp	44	7.76	20.00
Cyrtopeltis	6	1.06	10.00
Nabis capsiformis Germar	2	0.35	80.00
Orius	77	13.58	30.00
Syrphus corolla	6	1.06	100.00
True spider	98	17.28	100.00

Associated predators:

Data in Table (2) show that *Campylomma impicta* was the most significant economic predator in the 2022 season, as indicated by its highest values of dominance and abundance (30.51 and 100%, respectively). In the second order were *C. undecimpunctata*, Orius spp., and true spiders, with respective to their dominance values (18.52, 13.58, and 17.28) and abundance values (100%, 80%, and 100%). However, *Chrysoperla carnea* and *Cydonia spp*. showed low dominance (9.88 and 7.76, respectively) and high abundance degrees (60% and 60%, respectively). These species might

have an impact if the environmental circumstances were altered in their favor. As a result of their low dominance (1.06, 0.35, and 1.06, respectively) and low abundance (20%, 10%, and 30%, respectively) relative to other predators of soybean pests, *Cyrtopeltis spp., Nabis capsiformis, and Syrphus corolla* were not economically significant.

Data in Table (3) indicates that during the 2023 season, *Campylomma impicta* and *C. undecimpunctata* were the most significant predators. This is supported by their maximum abundance values (90% and 100%, respectively) and dominance values (27.27 and 20.36, respectively). With dominance degrees of 13.45, and 15.64, respectively, and abundance rates of 80%, and 100%, respectively, *Chrysoperla carnea*, and real spiders ranked second in terms of economic importance.

Table 3. Dominance (%) and abundance (%) degrees of pests and the associated predators inhabiting soybean during the 2023 season in Assiut City.

Species	Dominance		Abundance
	Mean number/ 25 Sweep net	%	
Total	1777	100	100.00
Pests	1227	69.05	100.00
A.gosspyii	80	6.52	90.00
B.tabaci	672	54.77	100.00
E. inconspicuous	5	0.41	30.00
Empoasca spp.	97	7.91	100.00
M.persicae	70	5.70	80.00
N. viridula	62	5.05	90.00
Nyzus graminicola	6	0.49	30.00
Phytocoris spp	105	8.56	100.00
Thrips tabaci	130	10.59	70.00
Predators	550	30.95	90.00
campyloma impicta	150	27.27	100.00
coccinella undecimpunctata	112	20.36	80.00
Chrysoperla carnea	74	13.45	70.00
Cydonia spp	53	9.64	30.00
Cyrtopeltis	7	1.27	20.00
Nabis capsiformis Germar	3	0.55	90.00
Orius	57	10.36	40.00
Syrphus corolla	8	1.45	100.00
True spider	86	15.64	90.00

Despite having a high abundance of 70% and 90 % respectively and a low dominance of 9.64, and10.36 *Cydonia* spp., and *Orius* spp. will still be economically significant as a predator of soybean pests if environmental conditions alter. Comparing *Cyrtopeltis* spp., *Nabis capsiformis*, and *Syrphus corolla* to other predators of soybean pests, they were not economically relevant due to their low abundance (30%, 20%, and 40%, respectively) and low dominance (1.27, 0.55, and 1.45, respectively). In general, from Table (4), there were nine species of predators on soybean pests: *Campylomma impicta, C. undecimpunctata, Chrysoperla carnea, Orius spp., True Spider, Cydonia spp., Cyrtopeltis, Nabis capsiformis, and Syrphus corolla.* As the most significant economic predators on soybean pests, *Campylomma impicta and C. undecimpunctata* are ranked first. In second order are the true spider, *Orius spp., and Chrysoperla carnea*, while *Cydonia* species might be affected if the weather changed to their advantage. However, as predators on soybean pests, *Cyrtopeltis, Nabis capsiformis, and Syrphus corolla* had only a minor impact. Our results were consistent with those of Kandil (2022), who found that True spiders, *Paederus alfierii*, *C. undecimpunctata*, *Orius sp*., and *Chrysoperla carnea* were predators on soybean plants. El-Sarand (2018) discovered that during the two research seasons, *Chrysoperla carnea* dominated followed by *Paederus Alfierii*, *C. undecimpunctata*, real spiders, and *Scymnus* spp. Three predaceous insect species were detected on soybean plants, (Khattab, *et al*., 2019). These species are *Chrysoperla carnea* (Steph.), *Coccinella undecimpun ctata*, and *Orius* spp.

Table 4. Dominance (%) and abundance (%) degrees of pests and the associated predators inhabiting soybean during the 2022 and 2023 seasons in Assiut City.

Species	Dominance		Abundance
	Mean number/ 25 Sweep net	%	
Total	3558	100.00	100.00
pests	2441	68.61	100.00
A.gosspyii	162	6.64	90.00
B.tabaci	1242	50.88	95.00
E. inconspicuous	10	0.41	30.00
Empoasca spp.	239	9.79	100.00
M.persicae	134	5.49	80.00
N. viridula	131	5.37	80.00
Nyzus graminicola	10	0.41	25.00
Phytocoris spp	245	10.04	100.00
Thrips tabaci	268	10.98	85.00
predators	1117	31.39	95.00
campyloma impicta	323	28.92	100.00
coccinella undecimpunctata	217	19.43	70.00
Chrysoperla carnea	130	11.64	65.00
Cydonia spp	97	8.68	25.00
Cyrtopeltis	13	1.16	15.00
Nabis capsiformis Germar	5	0.45	85.00
Orius	134	12.00	35.00
Syrphus corolla	14	1.25	100.00
True spider	184	16.47	95.00

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تواجد الآفات والمفترسات المصاحبة لها القاطنة فى محصول فول الصويا بأسيوط، مصر

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الملخص

تصيب العديد من أنواع الآفات نباتات فول الصويا. أجريت الدراسة الحالية بمزرعة كلية الزراعة جامعة أسيوط خلال موسمي 2022 و2023. أظهرت النتائج أنه تم جمع ستة وعشرين نوعًا من الآفات الحشرية تنتمي إلى عشر رتب وثمانية عشر عائلة من محصول فول الصويا في محافظة أسيوط في مراحل النمو المختلفة. وقد كشفت هذه الدراسة عن وجود 15 نوع من الآفات في نباتات فول الصويا، وكانت الذبابة البيضاء *Bemisia tabaci* هي الأكثر انتشارًا بين هذه الآفات، تليها حشرة التربس (Lindeman) *thrips tabaci*، *Phytocoris* spp.، والجاسيد *Empoasca* spp.، ثم (Glover) *Aphis gosspyii*، و*Myzus persicae*، في حين كانت *Eysarcoris inconspicuous*، و(Linné) *Nazara viridula* (Westwood) و(koienati) *Nysius graminicola* الأقل أهمية اقتصاديًا لمحصول فول الصويا. وقد وجد أن أحد عشر نوعًا من المفترسات التى تنتمي إلى خمس رتب وسبع عائلات تتغذى على حشرات فول الصويا. ومن بينها ستة أنواع مهمة؛ وهذه الأعداء الحيوية هي على وجه التحديد (Meyer) *Campylomma impicta* و (*Coccinella undecimpunctata* (Stephens) و *Chrysoperla carnea* و spp. *Cydonia* و spp. *Orius*، بالإضافة إلى العناكب الحقيقية. تلعب الأعداء الحيوية دورًا أساسيًا في مكافحة الآفات الحشرية لفول الصويا. في جميع الحالات كانت درجات سيطرة الآفات أعلى من درجات سيطرة المفترسات. ومن خلال هذه النتائج، يتضح أنه يمكن إدراج الأعداء الحيوية في برنامج مكافحة الآفات المتكامل في ظل الظروف الجوية لمحافظة أسيوط.