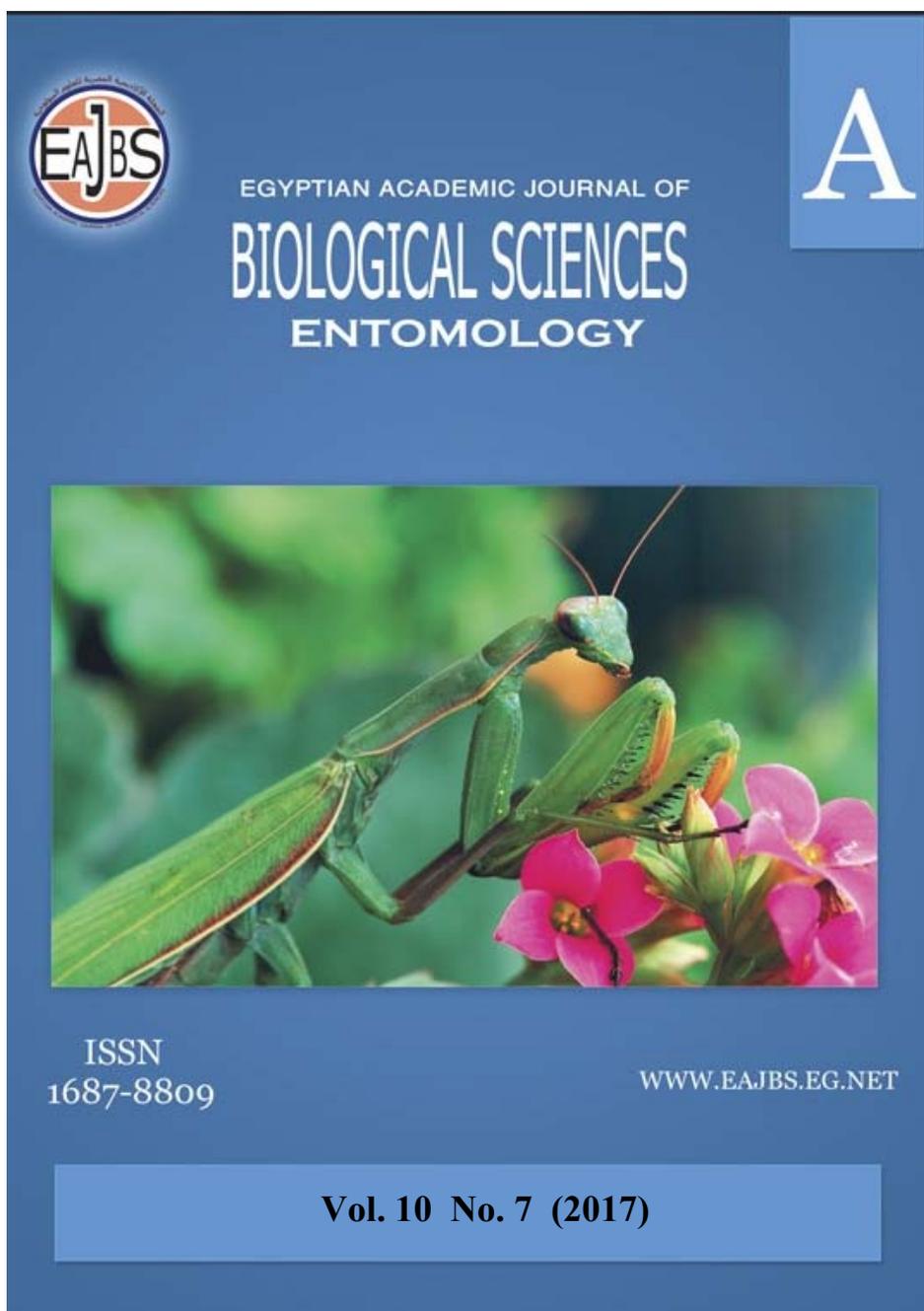


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## Survey and Population Fluctuations of Arthropod Pests and Natural Enemies in Okra Plantations at Kafr El-Sheikh Governorate

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### ABSTRACT

Survey and population fluctuations of arthropod pests and natural enemies associated with okra, *Abelmoschus esculentus* L. were conducted during 2015 and 2016 seasons at El-Riad district, Kafr El-Sheikh Governorate. The investigation revealed the presence of 23 arthropod species belonging to 17 families and 8 orders. Spiders were the most dominant predators and the population densities of spiders peaked in June, July, August, September and October. The survey of spiders on okra, achieved by pitfall traps and hand catch, revealed the occurrence of 12 families; Araneidae, Clubionidae, Dytinidae, Dysderidae, Eutichuridae, Gnaphosidae, Linyphiidae, Lycosidae, Philodromidae, Salticidae, Tetragnathidae, and Theridiidae, with lycosids being the most abundant. The following ranks were occupied by Araneidae and Philodromidae. The remaining families were slightly represented; Dysderidae, Clubionidae and Eutichuridae. The spider population was greatest collected by pitfall traps, and then, hand catch. Fifteen parasitoid species were detected, as belonging to 13 families using pitfall traps. Water pan traps captured 25 parasitoid species, belonging to 13 families, with *Trichopria* spp. being the most abundant parasitoid.

### INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench is an important vegetable crop in Egypt. Okra is a commercial vegetable crop with considerable area under cultivation in Africa and Asia (Benchasri 2012). Okra plays an important role in the human diet by supplying fats, proteins, carbohydrates, minerals and vitamins. The composition of okra pods per 100 g edible portion (81% of the product as purchased, ends trimmed) is: water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fats 0.20 g, fibers 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg,  $\beta$ -carotene 185.00  $\mu$ g, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. (Gopalan, *et al.* 2007, Varmudy 2011).

Insect pests are important limiting factors in okra plantations. As high as seventy two species of insects have been recorded on okra (Srinivasa and Rajendran, 2003). It is attacked by several insect pests which affect the yield quantitatively and qualitatively (Shahid, *et al.* 2012, Benchasri, 2013; Singh, *et al.*, 2013; Khajuria, *et al.*, 2014; Khan, *et al.*, 2015 and El-Fakharany 2016). Fallahzadeha, *et al.* (2014) found that most of hosts of cotton mealy bug, *Phenacoccus solenopsis* Tinsley

belong to families Solanaceae, Mulvaceae and Cucurbitaceae.

Insect predators and parasitoids were detected at variable levels, attacking mainly insect pests on okra (Barahoei, *et al.*, 2011, Abdalla and Bilal, 2012, Saljoqi, *et al.*, 2013, Khan, *et al.*, 2015, Rakhshani *et al.*, 2015 and El-Fakharany 2016).

Spiders are among the most abundant and species-rich groups of predators in arable fields and they can play an important role in natural pest control (Hendawy and El-Fakharany, 2012 and 2015; Khan, *et al.*, 2015 and El-Fakharany 2016). Species abundance of spider communities in agricultural and horticultural ecosystems can be as high as in undisturbed natural ecosystems. About 13 spider species in vegetables were recorded (Rajeswaran, *et al.*, 2005).

The objective of this study was to survey pests and natural enemies (insect predators, spiders and parasitoids) in okra plantation, and monitor the population fluctuations of the main pest species and predators were evaluated.

## MATERIALS AND METHODS

The present study was undertaken in 2015 and 2016 seasons, at El-Riad district, Kafr El-Sheikh Governorate and at Biological Control Laboratory of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh. Okra seeds were sown on April 30<sup>th</sup>, in both seasons with cv. white velvet. An area of about 1/2 feddan was divided into four equal plots (considered as four replicates), no pesticides were applied. Inspection started 30 days after sowing, and continued weekly till the end of the crop season.

### **Survey and population fluctuations of arthropods associated with okra plantation:**

Arthropods were surveyed in okra plantations to studying population fluctuations of pests and associated natural enemies. Arthropods were recorded on 10 leaves /replicate in the field. The same samples were transferred to the laboratory to count the number of eggs and immatures of whitefly, and eggs, & mobile stages of *Tetranychus* sp. using binocular. Each Inspection of cotton mealybug, *P. solenopsis*. consisted of randomly selected 10 twigs (10 cm and 3 leaves each) from the top of the plant. Thus inspection was consisted 10 twigs and 30 leaves. Beneficial arthropods were also counted on 10 plants/ replicate in the field.

### **Survey of pests, predators and parasitoids from okra field by pitfall and water pan traps:**

#### **Water pan traps:**

Six blue plastic plates, 30 cm in diameter and 8 cm deep, were set on ground between okra plants without covers and filled with water to 5 cm height. Formalin 3% was used as preservative plus some drops of detergent added to break the surface tension. Traps were diagonally embedded on rows in an area of about 1/2 feddan in plantations. Sampling was undertaken at 7-day intervals. The traps were set continuously and weekly emptied. The trapped insects were sieved through a fine screen textile and transferred to glass tubs contain ethanol (75%), counted and classified.

#### **Hand-catching:**

Spiders occurring on foliage were collected by hand-catch (For collecting spiders by hand we wear soft rubber hand gloves for catching them).

#### **Pitfall traps:**

Six pitfall traps (9 cm diameter and 12 cm height) were fixed into the ground, 5 m a part. Each trap was provided with water to a height of 8 cm. In addition, the trap

was provided with 3% formalin and a detergent. Ground-active arthropods were collected by these traps. The traps were emptied once a week and the catches were transferred to ethanol (75%), counted and classified.

**RESULTS AND DISCUSSION**

**Survey and population density of arthropods in okra:**

Table (1) showed that lists of the arthropods found on okra plantation during 2015 and 2016 seasons. Data revealed the presence of 23 arthropod species, 17 families and 8 orders. These pests were *Jacobiasca lybica* (Bergevin and Zamon), *Aphis gossypii* Glover, *Bemisia tabaci* Genn., *Nezara viridula* (L), *Phenacoccus solenopsis* Tinsley, *Oxycarenum hyalinipennis* (Costa), and *Tetranychus* sp. on okra plants, while *Earias insulana* Boisduval, *Helicoverpa armigera* (Hübner), *Pectinophora gossypiella* Saunders and *Oxycarenum hyalinipennis* Coster in fruits okra.

Table 1: Population density of pests and their associated predators in okra plantation at El-Riad district, Kafr El-Sheikh Governorate

Order	Family	Genus/species	Stage	No. of species		Occurrence %	
				2015	2016	2015	2016
Pests				Average No./40 leaves			
<b>Hemiptera</b>	Cicadellidae	<i>Jacobiasca lybica</i> (Bergevin and Zamon)	N,A	34.88	61.24	3.87	6.19
	Aphididae	<i>Aphis gossypii</i> Glover	N,A	679.44	804.76	75.32	81.29
	Aleyrodidae	<i>Bemisia tabaci</i> Genn.	E,N,A	72.16	43.12	8.0	4.36
	Psyllididae	<i>Nezara viridula</i> (L)	N,A	13.64	8.0	1.51	0.81
	Lygaeidae	<i>Oxycarenum hyalinipennis</i> (Costa)	N,A	14.4	9.80	1.60	0.99
	Pseudococcidae	<i>Phenacoccus solenopsis</i> Tinsley	N,A	19.24	18.60	2.13	1.88
<b>Acarina</b>	Tetranychidae	<i>Tetranychus</i> sp.	E,M	68.28	44.52	7.57	4.50
Total	-	-	-	902.04	990.04	100	100
Pests				Average No./100 fruits			
<b>Lepidoptera</b>	Nolidae	<i>Earias insulana</i> (Boisduval)	L	16.88	12.32	30.74	20.16
	Noctuidae	<i>Helicoverpa armigera</i> (Hübner)	L	3.52	4.36	6.41	7.13
	Gelechiidae	<i>Pectinophora gossypiella</i> Saunders	L	5.36	3.08	9.76	5.04
Hemiptera	Lygaeidae	<i>Oxycarenum hyalinipennis</i> (Costa)	N,A	29.16	41.36	53.10	67.67
Total	-	-	-	54.92	61.12	100	100
Predators				Average No./ 40 plants			
<b>Coleoptera</b>	Coccinellidae	<i>Coccinella undecimpunctata</i> L.	L,A	42.76	28.48	18.54	12.88
		<i>Cydonia vicina isis</i> cr.	A	2.6	1.92	1.13	0.87
		<i>Scymnus</i> spp.	L,A	41.44	31.64	17.97	14.30
		<i>Stethorus gilvifrons</i> Mulsant	E,L,A	33.36	30.20	14.46	13.65
<b>Hemiptera</b>	Anthocoridae	<i>Orius</i> sp.	N	24.24	16.48	0.94	0.85
<b>Neuroptera</b>	Chrysopidae	<i>Chrysoperla carnea</i> (Steph.)	E,L,A	14.88	12.8	10.51	7.45
<b>Diptera</b>	Cecidomyiidae	<i>Aphidoletes aphidimyza</i> Rondani	L	2.16	1.88	6.45	5.79
	Syrphidae	<i>Eupeodes corollae</i> (F.)	L, A	18.88	17.80	8.19	8.05
<b>Orthoptera</b>	Mantidae	<i>Sphodromantis viridis</i> Forskal	N,A	0.68	0.68	0.29	0.31
<b>Araneae</b>	Araneae	Spiders	S, A	49.64	79.32	21.52	35.86
Total	-	-	-	230.64	221.2	100	100

E = Egg, L=larva,P= pupa, N= nymph, A=adult, M= mobile stage, S= Spiderling

Ten species were predators; *Coccinella undecimpunctata* L., *Cydonia vicina isis* Crotch., *Scymnus* sp., *Stethorus gilvifrons* (Mulsant), *Chrysoperla carnea* Steph., *Aphidoletes aphidimyza* (Rondani), *Orius* spp., *Eupeodes corollae* (F.), *Sphodromantis viridis* (Forsk.) and Spiders. *Aphis gossypii* Glover constituted the greatest number. Population density of aphids per 40 leaves was 679.44 and 804.76 individuals forming about 75.32 and 81.29 % of the total pests in 2015 and 2016,

respectively. *N. viridula* was appeared in few numbers. Spiders constituted the greatest number, with 49.64 and 79.32 individuals per 40 plants forming about 21.52 and 35.86% of the total predators in 2015 and 2016 seasons, respectively. The next common species on okra plant was *C. undecimpunctata* and *Scymnus* spp. occupied the third rank, while, *S. viridis* was represented by few numbers recording 1.13 and 0.87% out of total predators in 2015 and 2016, respectively.

The collected insect pests by pitfall and water pan traps, in 2015 and 2016 seasons are listed in Table (2). 22 species, belonging to 14 families and five orders were surveyed. *A. gossypii* individuals was the most abundant (530 and 461 individuals/156 pitfall traps and water pan traps) in two the seasons, while the least occurring insect pest individuals were those of *Nephotettix* sp. and *Orosius* sp. (2 individuals/156 pitfall traps).

Table 2: List and abundance of insect pests and visitor collected from okra fields by pitfall and water pan traps at El-Riad district, Kafr El-Sheikh Governorate, in 2015 and 2016 seasons.

Order	Family	Genus/species	No. of individuals/156		Occurrence %	
			Pitfall traps	Water pan traps	Pitfall traps	Water pan traps
Hemiptera	Aphididae	<i>Aphis gossypii</i> Glover	530	461	42.78	40.72
	Cicadellidae	<i>Jacobiasca lybica</i> (Bergevin and Zanon)	140	210	11.30	18.55
		<i>Nephotettix</i> sp.	2	-	0.16	-
		<i>Orosius</i> sp.	2	8	0.16	0.71
	Delphacidae	<i>Sogatella</i> sp.	64	39	5.17	3.45
		<i>Sogatella furcifera</i> (Horváth)	-	7	-	0.62
	entatomidae	<i>Nezara viridula</i> (L)	24	6	1.94	0.53
		<i>Eysarcoris ventralis</i> (Westwood)	5	1	0.40	0.09
	Lygaeidae	<i>Remaudiereana annulipes</i> Baerensprung	3	4	0.24	0.35
		<i>Oxycarenus hyalinipennis</i> Costa	26	12	2.10	1.06
<i>Nysius cymoides</i> (Spinola)		3	4	0.24	0.35	
Pyrrhocoridae	<i>Scantius aegyptius</i> (Linnaeus)	-	5	-	0.44	
Tingidae	Unidentified	-	3	-	0.27	
Lepidoptera	Noctuidae	<i>Spodoptera littoralis</i> (Biosd.)	39	9	3.15	0.80
		(Semi lopper worms) Unidentified	6	5	0.48	0.44
	Agrotidae	<i>Earias insulana</i> Boisduval.	7	8	0.56	0.71
Coleoptera	Phalacridae	<i>Stilbus</i> sp. *	4	4	0.32	0.35
	Anthicidae	<i>Anthicus</i> sp. *	-	16	-	1.41
Orthoptera	Gryllotalpidae	<i>Gryllotalpa gryllotalpa</i> L.	5	8	0.40	0.71
		<i>Gryllus domesticus</i> L.	25	26	2.02	2.30
		<i>Liogryllus bimaculatus</i> De Geer	13	2	1.05	0.18
Collembola	Entomobryidae	<i>Lepidocyrtus incertus</i> (Hand.)	341	294	27.52	25.97
Total	-	-	123	1132	100	100
			9			

\* Visitor

The sucking insect pests (Hemiptera) is an important pest of okra plantation and it can cause economic damage to plants by feeding on the sap and some of them like aphids and whiteflies coating plant leaves with honeydew, which facilitates growth of sooty mold (Patel, *et al.*, 1997; Satar, *et al.*, 2005 and Leite, *et al.*, 2007).

The spiny bollworms, *Earias insulana* (Lepidoptera: Noctuidae) is a very serious and polyphagous pest attacking family Malvaceae. Cotton are economically the most important crops attacked by this pest and okra as a vegetable crop. *Earias insulana* is widely distributed in North Africa and other countries of the world (Abul-Nasr, *et al* 1973). The pest is active almost throughout the year on its different host plants under field conditions (Abul-Nasr, *et al* 1973 and Arif and Attique, 1990).

Predators collected from okra field by pitfall traps and water pan traps, in 2015 and 2016 (Table 3) show the occurrence of 21 species, 11 families and seven orders. *Solenopsis* sp. was the most dominant predator (50.04 and 50.39 % pitfall traps and water pan traps) respectively.

*A. gossypii* was observed attacking mainly the leaves of okra (Obeng-Ofori and Sackey, 2003). BenchaSri (2013) found that the most occurrence of *A. gossypii*, *A. biguttula* and *B. tabaci* from June to October on okra fields. Khan, *et al.* (2015) found that *B. tabaci*, *A. gossypii* and *Amrasca biguttula* (Ishida) were the major insect pests on okra.

Table 3: List and abundance of predators collected from okra fields by pitfall and water pan traps at El-Riad district, Kafr El-Sheikh Governorate, in 2015 and 2016 seasons.

Order	Family	Genus/species	No. of individuals/156		Occurrence %	
			Pitfall traps	Water pan traps	Pitfall traps	Water pan traps
Coleoptera	Coccinellidae	<i>Coccinella undecimpunctata</i> L.	9	17	0.68	2.20
		<i>Scymnus</i> spp.	5	8	0.38	1.04
		<i>Scymnus interruptus</i> (Goeze)	-	11	-	1.42
	Staphylinidae	<i>Paederus memnomius</i> Erichson	5	2	0.38	0.26
		<i>Philonthus</i> sp.	15	61	1.14	7.90
		Unidentified	6	-	0.45	-
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> Steph.	16	8	1.21	1.04
Hemiptera	Anthocoridae	<i>Orius</i> spp	9	12	0.68	1.55
	Reduviidae	<i>Reduvius</i> sp.	1	-	0.08	-
Diptera	Syrphidae	<i>Eupeodes corollae</i> (F)	-	5	-	0.65
		<i>Sphaerophoria</i> sp.	2	30	0.15	3.89
Hymenoptera	Formicidae	<i>Solenopsis</i> sp.	661	389	50.04	50.39
		Unidentified	170	115	12.87	14.90
	Sphecidae	Unidentified	17	29	1.29	3.76
		<i>Labidura minor</i> Boeseman	2	-	0.15	-
	Carbidae	<i>Bembidion</i> sp.	3	2	0.23	0.26
		<i>Pterostichus</i> spp.	4	-	0.30	-
		<i>Tachys</i> sp.	2	-	0.15	-
Odonata	Caenagrionidae	<i>Ischnura senegalensis</i> (Rambur)	2	2	0.15	0.26
Araneae	Araneae	Spiders	392	81	29.67	10.49
Total	-	-	1321	772	100	100

Ladybird beetle as a natural enemy of aphids is one of the most important factors contributing to the aphid population reduction (Leite, *et al.*, 2007). The predators *Coccinella* spp., *Chrysoperla* sp., *Orius* sp., and spiders were found active feeding on mealybug population farms during both seasons (Sahito, *et al.*, 2011). Abdalla and Bilal (2012) detected coccinellids, chrysopids, syrphids, and spiders at variable levels, attacking mainly *B. tabaci* and *A. gossypii* besides other soft insects on okra in northern Sudan, and *C. carnea* was the most prevalent species in okra fields. Khan, *et al.* (2015) found that *C. septempunctata* (L.) and ant *Solenopsis invicta* (Buren) were the natural enemies recorded on okra.

#### Survey of species and spiders in okra plantations:

Spiders inhabiting okra plants were surveyed at the experimental fields at El-Riad, Kafr El-Sheikh Governorate for okra seasons; 2015 and 2016 (Table 4). The survey, achieved by pitfall traps, and hand catch revealed the occurrence of 12 families; Araneidae, Clubionidae, Dyctinidae, Dysderidae, Eutichuridae, Gnaphosidae, Linyphiidae, Lycosidae, Philodromidae, Salticidae, Tetragnathidae, and Theridiidae. The most abundant families was Lycosidae. The following ranks

were occupied by Araneidae (19.15%) and Philodromidae (16.80%). The remaining families were slightly represented; Dysderidae (0.16 %), Clubionidae (0.63%) and Eutichuridae (1.10%).

Table 4: Spiders collected on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2015 and 2016 seasons

Family	Taxon	Period of activity	No. of individuals	Occurrence%	
				Species	Family
Araneidae	<i>Araneus</i> sp.	Jul. Sept.	2	1.64	19.15
	<i>Argiope trifasciata</i> (Forskål)	Jul.	1	0.82	
	<i>Larinia</i> sp.	Jun. Jul. Aug. Sept. Nov.	8	6.56	
	<i>Metepeira</i> sp.	Jun. Jul. Aug. Sept.	50	40.98	
	<i>Singa</i> sp.	Jul.	14	11.48	
	Spiderlings	Jun. Sept. Oct.	47	38.52	
Clubionidae	<i>Clubiona</i> sp.	Jun. Jul. Aug.	4	100	0.63
Dictynidae	<i>Dictyna</i> sp.	Aug.	3	33.33	1.41
	<i>Lathys</i> sp.	Jul. Aug.	3	33.33	
	Spiderlings	Sept.	3	33.33	
Dysderidae	<i>Dysdera crocata</i> C. L. Koch	Jul.	1	100.0	0.16
Eutichuridae	<i>Cheiracanthium</i> sp.	Jul. Aug. Oct.	6	85.71	1.10
	Spiderlings	Jul.	1	14.29	
Gnaphosidae	<i>Pterotricha</i> sp.	Jul. Sept. Nov.	3	13.64	3.45
	<i>Zelotes</i> sp.	Jun. Jul. Oct. Nov.	5	22.73	
	Spiderlings	Jun. Jul. Aug. Sept. Oct. Nov.	14	63.64	
Linyphiidae	<i>Drapetisca</i> sp.	Jul. Aug. Sept.	8	36.36	3.45
	Spiderlings	Jun. Jul. Aug. Sept. Oct. Nov.	14	63.64	
Lycosidae	<i>Pardosa</i> spp.	Jun. Jul. Aug. Sept. Oct. Nov.	74	36.45	31.87
	<i>Hogna ferox</i> (Lucas)	Sept. Oct.	2	0.99	
	<i>Trochosa</i> sp.	Aug.	1	0.49	
	<i>Wadicosa fidelis</i> (O. P. Cambridge)	Jun. Jul. Sept. Oct. Nov.	46	22.66	
	Spiderlings	Jun. Jul. Aug. Sept. Oct. Nov.	80	39.41	
Philodromidae	<i>Thanatus albini</i> (Audouin)	Jun. Jul. Aug. Sept. Oct. Nov.	44	41.12	16.80
	<i>Thanatus</i> sp.	Jun. Jul. Aug. Sept. Oct. Nov.	62	57.94	
	<i>Philodromus</i> sp.	Jul.	1	0.93	
Salticidae	<i>Ballus</i> sp.	Jul. Aug. Oct. Nov.	8	13.79	9.11
	<i>Marpissa</i> sp.	Jul.	1	1.72	
	<i>Thyene imperialis</i> (Rossi)	Nov.	1	1.72	
	Spiderlings	Jun. Jul. Aug. Sept. Oct. Nov.	48	82.76	
Tetragnathidae	<i>Tetragnatha nitens</i> (Audouin)	Jun. Jul. Aug. Sept. Oct.	62	100	9.73
Theridiidae	<i>Steatoda</i> sp.	Jun. Jul. Aug. Sept. Oct.	15	75.0	3.14
	<i>Theridion</i> sp.	Oct.	1	5.0	
	Spiderlings	Aug. Sept.	4	20.0	
Total	-	-	637	-	100

Results in Table (5) show that spider population was the greatest by pitfall traps, and then, hand catch. The corresponding total spiders in the above-mentioned ways were 425 and 212 individuals. *Pardosa* spp. (17.41% ) were more abundant on okra plantations followed by *Thanatus* sp. (12.47 %) by pitfall traps, while hand catch, *T. nitens* (28.77 %) followed by *Metepeira* sp. (23.58 %).

Ghosh (2013) found that the important species of spider dominated in okra field are *Argiope luzona*, *Cryptophora cicatrosa*, *Hipassapa ntherina*, *Oxyopes javanes* and *Lycosa pseudoannulata*.

Table 5: Abundance of spiders collected from okra fields by pitfall traps and hand at El-Riad district, Kafr El-Sheikh Governorate in 2015 and 2016 seasons

Family	Taxon	Pitfall traps		Hand-catching	
		No. of species	Occurrence %	No. of species	Occurrence %
Araneidae	<i>Araneus</i> sp.	-	-	2	0.94
	<i>Argiope trifasciata</i> (Forskål)	-	-	1	0.47
	<i>Larinia</i> sp.	1	0.24	7	3.30
	<i>Metepeira</i> sp.	-	-	50	23.58
	<i>Singa</i> sp.	1	0.24	13	6.13
	Spiderlings	-	-	47	22.17
Clubionidae	<i>Clubiona</i> sp.	2	0.47	2	0.94
Dictynidae	<i>Dictyna</i> sp.	-	-	3	1.42
	<i>Lathys</i> sp.	-	-	3	1.42
	Spiderlings	-	-	3	1.42
Dysderidae	<i>Dysdera crocata</i> C. L. Koch	1	0.24	-	-
Eutichuridae	<i>Cheiracanthium</i> sp.	3	0.71	3	1.42
	Spiderlings	1	0.24	-	-
Gnaphosidae	<i>Pterotricha</i> sp.	3	0.71	-	-
	<i>Zelotes</i> sp.	5	1.18	-	-
	Spiderlings	14	3.29	-	-
Linyphiidae	<i>Drapetisca</i> sp.	5	1.18	3	1.42
	Spiderlings	14	3.29	-	-
Lycosidae	<i>Pardosa</i> spp.	74	17.41	-	-
	<i>Hogna ferox</i> (Lucas)	2	0.47	-	-
	<i>Trochosa</i> sp.	1	0.24	-	-
	<i>Wadicosa fidelis</i> (O. P. Cambridge)	46	10.82	-	-
	Spiderlings	80	18.82	-	-
Philodromidae	<i>Thanatus albini</i> (Audouin)	43	10.12	1	0.47
	<i>Thanatus</i> sp.	53	12.47	9	4.25
	<i>Philodromus</i> sp.	1	0.24	-	-
Salticidae	<i>Ballus</i> sp.	8	1.88	-	-
	<i>Marpissa</i> sp.	1	0.24	-	-
	<i>Thyene imperialis</i> (Rossi)	1	0.24	-	-
	Spiderlings	47	11.06	1	0.47
Tetragnathidae	<i>Tetragnatha nitens</i> (Audouin)	1	0.24	61	28.77
Theridiidae	<i>Steatoda</i> sp.	15	3.53	-	-
	<i>Theridion</i> sp.	1	0.24	-	-
	Spiderlings	1	0.24	3	1.42
<b>Total</b>	-	425	100	212	100

### Survey of parasitoids in okra plantations.

Results of parasitoids collected from okra field by pitfall traps and water pan traps in 2015 and 2016, are presented in Table (6). Twenty-seven species, belonging to 15 families, two orders were surveyed. The most common were *Trichopria* sp. (26.60 and 14.36%), *Telenomus* sp. (12.32 and 9.14 %) and *Aphenogomus* sp. (9.36 and 7.05%) by pitfall traps and water pan traps respectively. Also, Braconidae (*L. fabarum*) was aphid parasitoids, *Cotesia* sp. parasitized on Lepidoptera larvae, but *Opius* sp. and eulophids were parasitized on agromyzed leaf miners while Pteromalidae; *P. aphidis* was hyperparasitoid on aphid parasitoids. Bethelid (*Goniuzus* sp., *Parserola* sp.), Ichneumonidae and Tachinidae were parasitoids on

lepidopteran larvae, while Chalcidid; *Brachymeria* sp. parasitized on Lepidoptera pupae.

Table 6: List and abundance of parasitoids collected from okra fields by pitfall and water pan traps at El-Riad district, Kafr El-Sheikh Governorate

Order /Family	Genus/species	No. of individuals/ 150		Occurrence %	
		Pitfall traps	Water pan traps	Pitfall traps	Water pan traps
Hymenoptera	<i>Goniuzus</i> sp.	3	-	1.48	-
Bethyridae	<i>Parserola</i> sp.	3	-	1.48	-
	Unidentified	2	16	0.99	2.09
Braconidae	<i>Cotesia</i> sp.	-	3	-	0.39
	<i>Lysiphlebus fabarum</i> (Marshall)	2	3	0.99	0.39
	<i>Opius</i> sp.	12	9	5.91	1.17
Cerophronidae	<i>Aphenogomus</i> sp.	19	54	9.36	7.05
Chalcididae	<i>Brachymeria</i> sp.	-	4	-	0.52
Charapidae		2	5	0.99	0.65
Depriidae	<i>Trichopria</i> spp.	54	110	26.60	14.36
	Unidentified	13	4	6.40	0.52
Aphelinidae	<i>Encarsia</i> sp.	2	25	0.99	3.26
Encyrtidae	Unidentified	18	29	8.87	3.79
Eulophidae	Unidentified	4	69	1.97	9.01
Ichneumonidae	Unidentified	2	5	0.99	0.65
Platygastridae	<i>Baeus</i> sp.	4	11	1.97	1.44
	<i>Idris</i> sp.	2	2	0.99	0.26
	<i>Plotygaster</i> sp.	-	4	-	0.52
	<i>Telenomus</i> p.	25	70	12.32	9.14
	<i>Trissolcus</i> sp.	4	9	1.97	1.17
	Unidentified	6	24	2.96	3.13
Mymaridae	<i>Anagrus</i> spp.	-	46	-	6.01
Pteromalidae	<i>Pachyneuron aphidis</i> (Bouché)	2	8	0.99	1.04
	Unidentified	3	13	1.48	1.70
Trichogrammatidae	<i>Trichogramma evancens</i>	2	6	0.99	0.78
	<i>Oligosita</i> sp.	-	21	-	2.74
Diptera					
Tachinidae	Unidentified	19	216	9.36	28.20
Total	-	203	766	100	100

Mymarid; *Anagrus* sp. and trichogrammatid; *Oligosita* sp. were parasitized leafhopper eggs and *T. evancens* parasitized Lepidopteran eggs, platygastid, *Trissolcus* sp. parasitized on *N. viridula* eggs. cerophronid (*Aphenogomus* sp.) and depriid (*Trichopria* spp.) parasitized pupae of flies and *Encarsia* sp. parasitized whiteflies. The Platygastid, *Telenomus* spp. were parasitized Lepidoptera eggs and *Plotygaster* sp. parasitized flies, while *Baeus* sp. and *Idris* sp. were parasitized spider eggs. Barahoei *et al.* (2011) found that *L. fabarum* attacking five aphid species, among of them, *A. gossypii*. Khan, *et al.* (2015), Rakhshani, *et al.* (2015) and El-Fakharany (2016) also reported parasitisation of aphids by *L. fabarum* and its hyperparasitoid, *P. aphidis* under field conditions.

#### Population fluctuations of pests, insect predators and spiders in okra plantations: pests:

Population fluctuations of *J. lybica*, *B. tabaci* and *Tetranychus* sp. on okra plants at El-Riad, Kafr El-Sheikh, 2015 and 2016 seasons are shown in (Figs.1& 2). In 2015, on *J. lybica* the highest population densities were recorded on June 6& 20, July 4 &18, August 1 and September5, while those were recorded on June 20, July 4 &18, August 1, September 5 & 26 of whitefly. On spider mite were recorded on June

20, July 18, August 1, September 19 (Fig.1). In 2016, (Fig. 2) the highest peaks of *J. Lybica* were recorded on June 20, August 22 and October 10 also, June 20, July 4 &18, August 1 & 29, September 19 and October 10 of whitefly. The highest densities of sipder mite were recorded on June 20, August 8 & 29 and September 26. Krishnaiah (1980) reported about 40 to 56% losses in okra due to leafhopper. There is a reduction of 49.8 and 45.1% in height and number of leaves, respectively due to attack of leafhopper (Rawat and Sadu, 1973). Aphids and leafhoppers are important pests in the early stage of the crop which de-sap the plants, make them weak and reduce the yield. Failure to control them in the initial stages was reported to cause a yield loss to the tune of 54.04% (Chaudhary and Dadeech, 1989). The spider mite, *T. cinnabarinus* has assumed the status of major pest and caused 17.46% yield loss in okra (Sarkar, *et al.*, 1996).

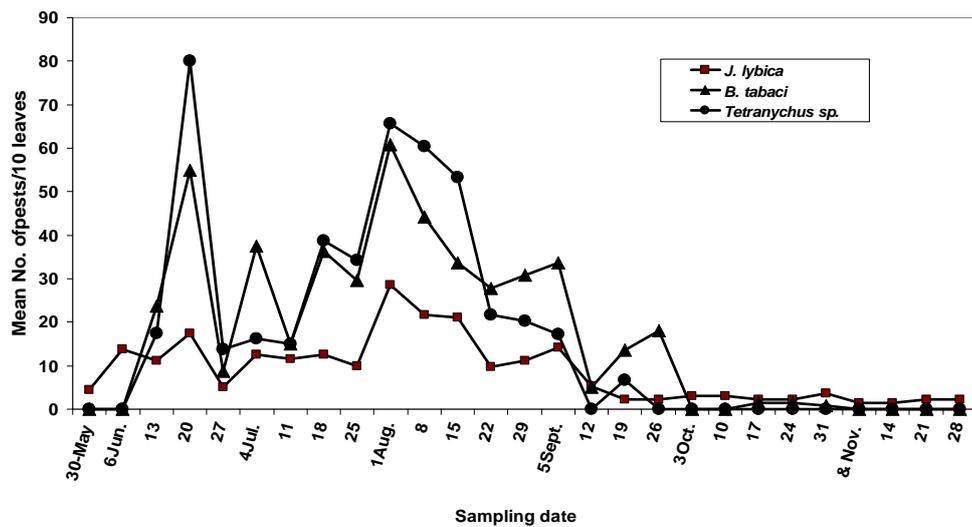


Fig. 1: Population fluctuations of pests on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2015 season.

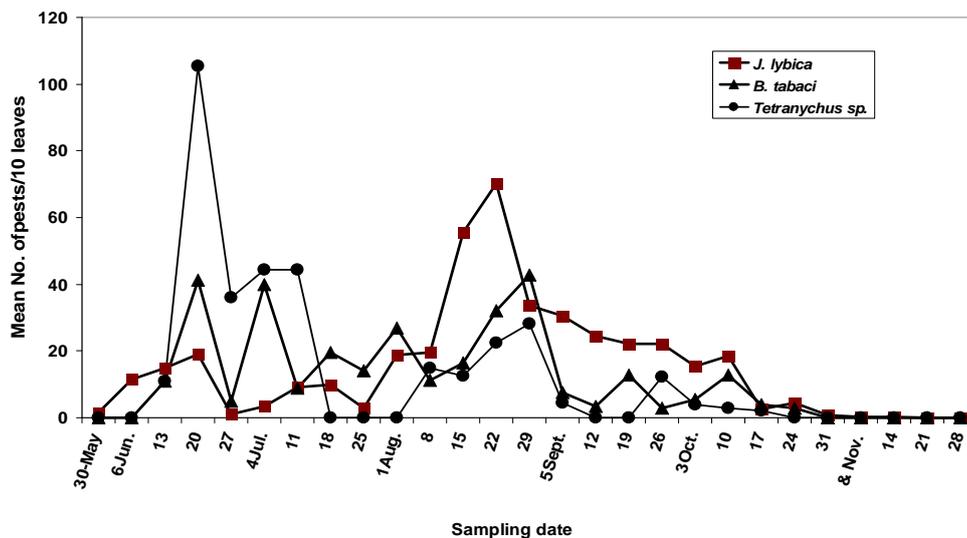


Fig. 2: Population fluctuations of pests on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2016 season.

In Fig. (3), *A. gossypii* exhibited five peaks in the two seasons. The peaks in 2015 were recorded on June 13&27, July 18, August 29 and October 17 while those in 2016 were detected on July 4, August 29, September 19 and October 10&24.

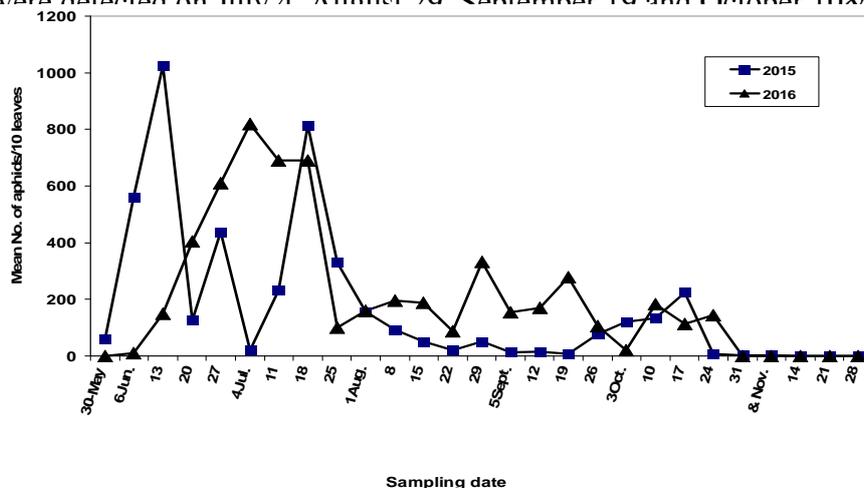


Fig. 3: Population fluctuations of *Aphis gossypii* on okra plants at El-Riad, Kafr El-Sheikh Governorate.

The highest population densities of *P. solenopsis* (Fig. 4) were recorded on June 20, July 25, August 8, September 5&19 in the two seasons, in addition on July 4 in 2016 and on October 17 in 2015.

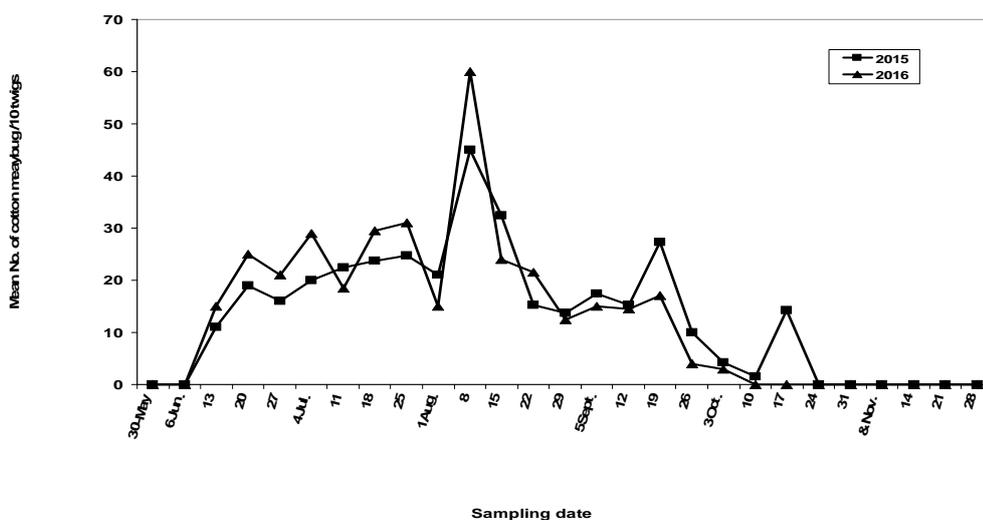


Fig. 4: Population fluctuations of *Phenacoccus solenopsis* on okra plants at El-Riad, Kafr El-Sheikh Governorate.

Khan, *et al.* (2015) found that the highest density of *B. tabaci* on 30<sup>th</sup> June, 3.56 *A. gossypii* on 23<sup>rd</sup> June, *A. biguttula biguttula* on 7<sup>th</sup> July, *C. trifurcate* on 14<sup>th</sup> July and *D. koenigii* on 21<sup>st</sup> July. Rehman *et al.* (2015) observed maximum population *A. biguttula biguttula* recorded in the first week of July. Nahiyoona, *et al.* (2016) found that the mealy bug population in the first season on okra was observed in January, then population was gradually increased and recorded one peak population in May, and decreased in June in the second season due to okra last stage and maturity. Ali, *et al.* (2017) revealed that the peak population of jassid 3.31 insect/leaf was recorded on July 2, while minimum population was recorded on August 6, with 1.57 insect/leaf on okra.

**Predators**

In 2015 and 2016 seasons (Figs. 5, 6), seven peaks of *C. undecimpunctata* were recorded and four peaks of *S. gilvifrons* on okra. However those peaks of *Scymnus* sp. were six in 2015 and five in 2016.

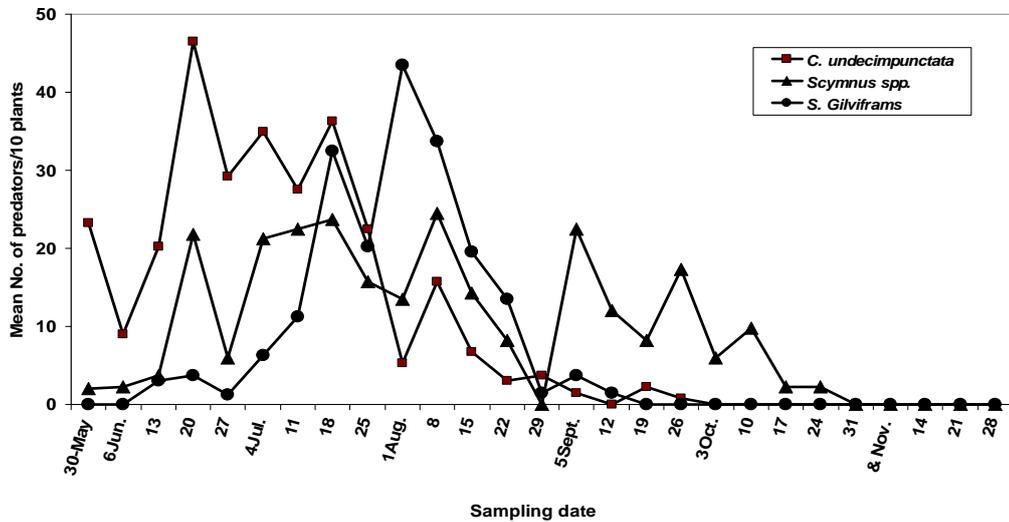


Fig. 5: Population fluctuations of predators coccinellid on okra plants at El-Riad, Kafr El- heikh Governorate in 2015 season.

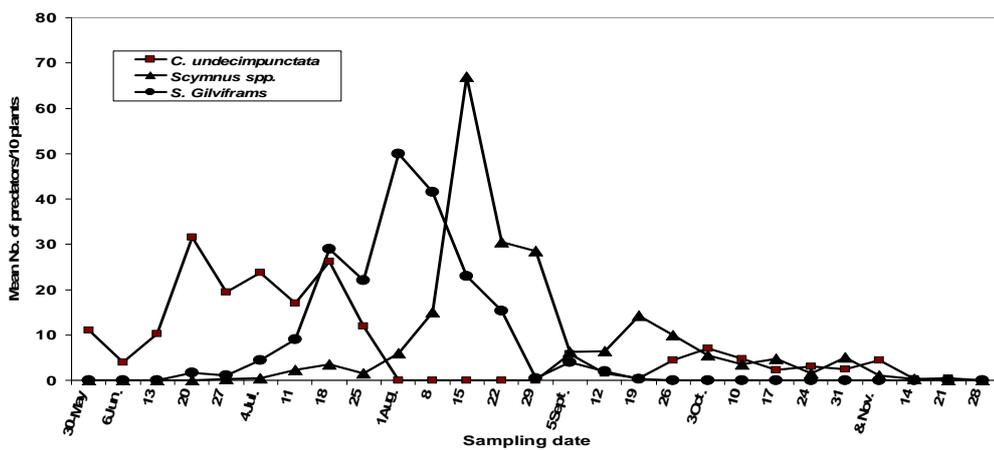


Fig. 6: Population fluctuations of predators coccinellid on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2016 season.

Population fluctuations of *E. corollae*, *C. carnea* and *A. aphidimyza* on okra plants at El-Riad, Kafr El-Sheikh, 2015 and 2016 seasons are shown in (Figs.7 and 8) *E. corollae* exhibited four peaks in 2015 and five in 2016, while *C. carnea* were recorded six peaks in 2015 and three in 2016 and three peaks of *A. aphidimyza* in the two seasons.

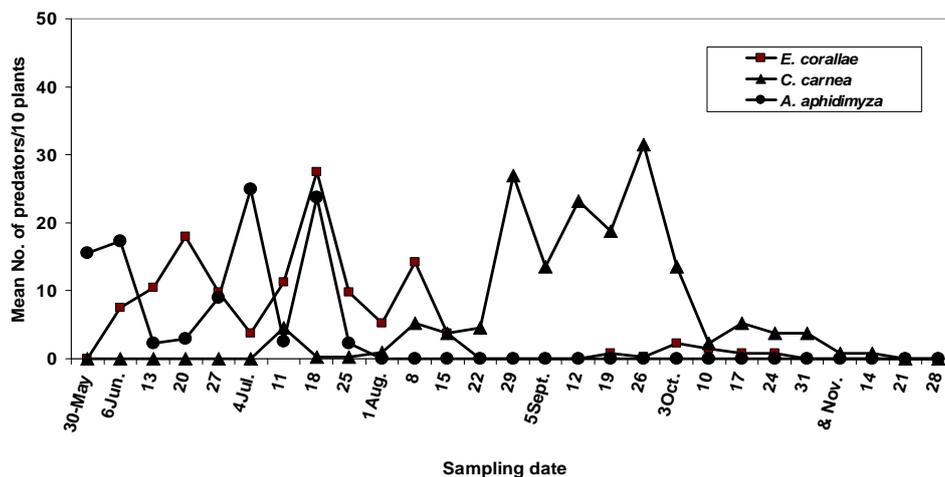


Fig. 7: Population fluctuations of predators on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2015 season

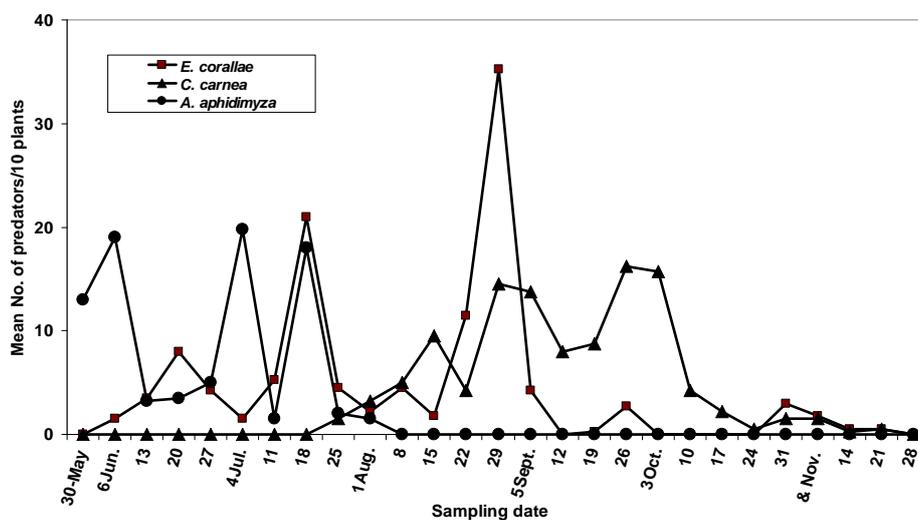


Fig. 8: Population fluctuations of predators on okra plants at El-Riad, Kafr El-Sheikh Governorate in 2016 season

Population densities of the spiders are presented in Fig. (9). In 2015, the population of spiders peaked on June 20, July 18, August 22 and September 5 & 26. Correspondent peaks in 2016 were on June 20, July 18, August 1 & 22, and October 3 & 24.

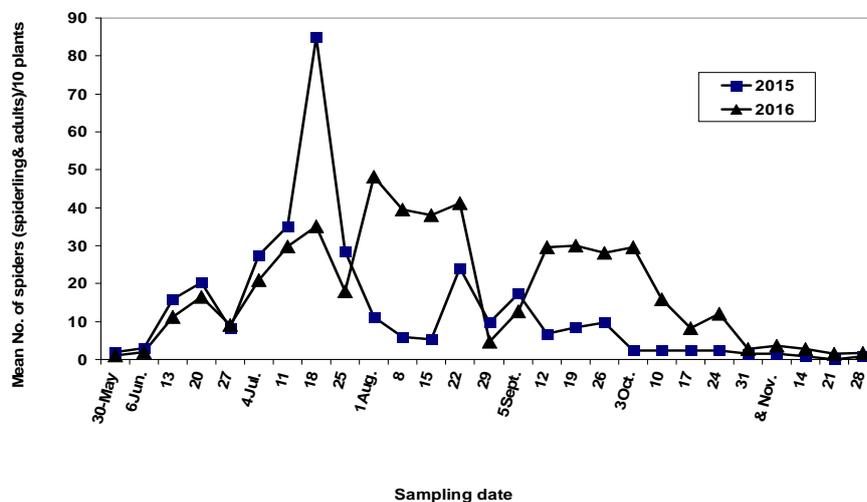


Fig. 9: Population fluctuations of spiders on okra plants at El-Riad, Kafr El-Sheikh Governorate.

Abdalla and Bilal (2012) found that spiders were the dominant predators in autumn and summer seasons, in okra fields. Ghosh (2013) reported that spider population was very high during April-May and August-September on okra. Khan, *et al.* (2015) found that highest density of *C. septempunctata* and spider, *Dictyna* sp. were on 21<sup>st</sup> July and *Solenopsis invicta* (Buren) on 16<sup>th</sup> June.

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#### ARABIC SUMMARY

حصر و تقلبات تعداد الآفات مفصلية الأرجل و أعدائها الطبيعية في زراعات الباميا بمحافظة كفر الشيخ - مصر

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تم حصر الآفات مفصلية الأرجل و أعدائها الطبيعية في حقول الباميا خلال موسمي ٢٠١٥، ٢٠١٦ بمركز الرياض - محافظة كفر الشيخ. أوضحت الدراسة وجود ٢٣ نوعا تنتمي إلى ١٧ عائلة و ثمانى رتب. كانت العناكب هي أكثر المقترسات شيوعا، خصوصا في خلال الفترة من يونيو و حتى أكتوبر. أمكن حصر ١٢ عائلة من العناكب (باستخدام مصائد الحفرة و الاصطياد المباشر) هي: Araneidae, Clubionidae, Dyctinidae, Dysderidae, Eutichuridae, Gnaphosidae, Linyphiidae, Lycosidae, الأكثر شيوعا، تلاها العناكب من عائلة Theridiidae و Philodromidae, Salticidae, Tetragnathidae, كانت عائلة Lycosidae هي الأكثر شيوعا، تلاها العناكب من عائلة Araneidae, Philodromidae. وكانت باقي العائلات Dysderidae, Clubionidae, Eutichuridae ممثلة بأعداد قليلة. كما تم حصر ١٥ نوعا من الطفيليات تنتمي إلى ١٣ عائلة، وكان أكثر الطفيليات شيوعا هو النوع *Trichopria* spp.