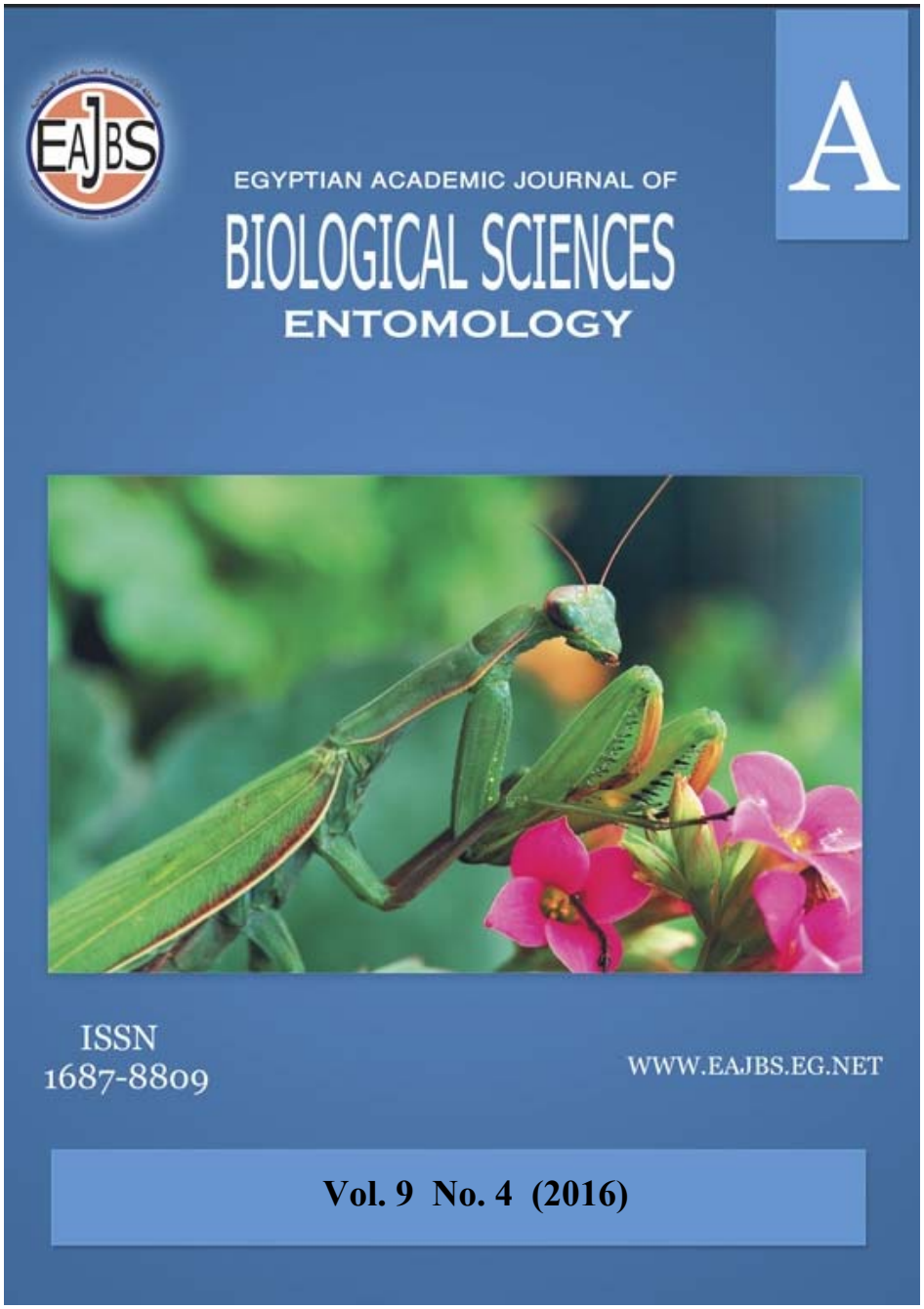

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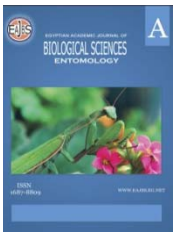

Predatory Spiders Associated with the Two Spotted Spider Mite *Tetranychus urticae* on Two Field Crops in Qalubyia Governorate, Egypt

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ABSTRACT

Five hundred and fifty eight spiders belonging to 11 families of order Araneae were associated with *T. urticae* and collected on clover and cotton crops at Qaha research station in Qalubyia governorate, Egypt during two successive years, 2013 and 2014. During the period of study, Salticidae was the most abundant of the collected spider followed by Theridiidae, Thomisidae, Philodromidae, Dictynidae, Eutichuridae (Miturgidae), Araneidae, Linyphiidae, Lycosidae, Agelenidae, and Gnaphosidae. The number of the collected spiders, families and percent occurrence of each family varied on the studied crops in different seasons. On clover, the collected families did not include Gnaphosidae in both years of study in addition to Araneidae in 2013 and Lycosidae, Philodromidae and Agelenidae in 2014. On cotton, Lycosidae and Agelenidae were not collected in both years in addition to Gnaphosidae in 2014.

Changes of population densities of the monthly collected spiders and their prey, *T. urticae*, ran nearly in parallel during the whole seasons of cotton with peak in September and up till the prey peak on clover in March. Although the population of *T. urticae* decreased in the next months following the peak on clover, the spiders continued increasing to reach their peak in May 2013 and 2014. The total number of collected spider's movable stages was higher in 2013 than 2014 on each crop and on cotton than clover in each year of study. On the other hand, the total number of *T. urticae* collected was higher in 2014 than 2013 on each crop and on clover than cotton in each year of study.

Laboratory studies on life stage duration, food consumption and predation rate of early immatures and adult female of *Thanatus albini, Steatoda triangulosa* and *Thomisus spinifer* (family Philodromidae, Theridiidae, Thomisidae, respectively), showed the efficacy of the three selected spider species as predators on adult *Tetranychus urticae*. Immatures and adult females of the studied spiders consumed more and lived longer when fed on females than males of *T. urticae.* In immature spiders, the number of consumed prey/spider, the daily predation rate and mostly the stage duration (except *S. triangulosa*) gradually increased by increasing age from the first to third spiderling. In female adult spiders, the 3 parameters, except predation rates of *Thomisus spinifer*, were the highest in female *T. albini*, followed by *T. spinifer* then *S. triangulosa.* The significance of the obtained result was discussed.

INTRODUCTION

Spiders are considered to be one of the most important predators which can be used as biological control agents regulating populations of mites, insects and other important agricultural pests by feeding on all life stages of the prey (Nyffler *et al*., 1994; El-Naggar *et al*.,1999; El-Erksousy *et al*., 2002; Ibrahim *et al*. 2012). In Egypt, biological, ecological and taxonomical studies concerning spiders as predators of the spider mites have not yet been adequate to determine which species can be used as a biological control agent of the two spotted spider mite, *Tetranychus urticae* (Hussein

et al., 1998; El-Naggar *et al*., 1999; El-Erksousy, 2000).

The present study determines percent occurrence of spider families associated with the two spotted spider mite, *T. urticae* and their abundance on clover and cotton crops at Qaha research station in Qalubyia governorate during two successive years, 2013 and 2014. Also, laboratory studies investigate the life duration, food consumption and predation rate of immature stages and adult females of three spider species (representing 3 of the most abundant spider families) when fed on adults of *T. urticae*. The present study offers basic knowledge of some ecological and biological aspects which are required for further understanding and in the assessment of the mite–predator relationships between *T. urticae* and naturally associated spiders.

MATERIALS AND METHODS

Ecological studies:

Different life stages of *Tetranychus urticae* and associated spiders on cotton and clover crops at Qaha research station in Qalubyia governorate, Egypt were collected from 10-20 plants bi-weekly during two successive years, 2013 and 2014 as described by Ibraheem (2016). Spiders were mostly identified to their families (Katson, 1978; El-Hennawy, 2002). Monthly temperature and relative humidity were obtained from the meteorological station in the form of maximum, minimum and average monthly temperature and relative humidity.

Biological studies:

Spider laboratory colony:

Laboratory colonies of 3 species of the most abundant predatory spider families associated with the collected mite *T. urticae* were established. Adults of 20 males and 20 females of each of the selected species, *Thanathus albini*, *Steatoda triangulosa* and *Thomisus spinifer* were placed in pairs into glass tubes and supplied with newly hatched preys of the first larvae of *Spodoptera littoralis and* adult *T. urticae,* then each tube was thoroughly covered by a muslin cloth. The tubes were kept in an incubator at 27± 2˚ C and 60 - 70 % RH and feeding was continued till the spiders laid the egg sacs. The newly hatched spiderlings were transferred to separate tubes and supplied with preys to complete their life cycle till adult stage.

Predation of spiders on *Tetranychus urticae*:

Egg-sacs of the selected spiders were kept in the laboratory at 27 ± 2˚C & 60 – 70% RH till hatching of spiderlings. The progeny of 20 newly hatched spiderlings were separated individually in glass tubes of 7 cm long and 3 cm diameter then covered by a muslin cloth fixed by a rubber band. The first spiderlings were provided daily with 5 preys of adult females or males *Tetranychus urticae*. The number of preys was increased to 10 at the second spiderling and to 15 at the third spiderling daily till the end of the experiment.

Ten adult females were placed individually in glass tubes of 7 cm long and 3 cm diameter then covered by a muslin cloth and kept at 27 ± 2˚C & 60 – 70% RH. Each female was provided daily with 25 to 30 adult males or females *T. urticae* till the end of the experiment. The number of consumed prey, daily predation rate and duration of each life stage was calculated.

Statistical analysis:

The obtained results from seasonal abundance of *T. urticae* and spiders movable life stages on the clover and cotton crop were analyzed by statistical package of Social Science (SPSS), version 20 for windows. In the experiments of spider stages duration, food consumption and predation rate, data were subjected to

analysis of variance (ANOVA) and the means were compared by L.S.D. test mostly at 0.05 level, using SAS program.

RESULTS

Spider families associated with *Tetranychus urticae* on clover and cotton crops:

Five hundred and fifty eight spiders belonging to 11 families of order Araneae were associated with *T. urticae* and collected on clover and cotton crops at Qaha research station in Qalubyia governorate, Egypt during two successive years, 2013 and 2014. Of the collected 11 families on the two crops Salticidae was the most abundant during the period of study constituting 25.27% of the total collected spiders (558) followed by Theridiidae (24.19%), Thomisidae (21.68%), Philodromidae (16.13%), Dictynidae (3.05%), Eutichuridae (Miturgidae) (2.87%), Araneidae (2.69%), Linyphiidae (1.97%), Lycosidae (1.08%), Agelenidae (0.54%), and Gnaphosidae (0.54%). The number of the collected spiders, families and percent occurrence of each family varied in the seasons of each crop during 2013 and 2104.

Two hundred and nine spiders associated with *T. urticae* were collected on clover crop during 2013 and 2014 seasons. The collected families (nine and seven, respectively) included the aforementioned 11 families except Gnaphosidae in both years in addition to Araneidae in 2013 and Lycosidae, Philodromidae and Agelenidae in 2104. Theridiidae was the most abundant family on clover crop during the period of study constituting 29.67% of the total collected spiders followed by Salticidae (28.23%), Thomisidae (15.79%), philodromidae (11.48%), Dictynidae (3.83%), Linyphiidae (3.83%), Lycosidae (2.87%), Eutichuridae (Miturgidae) (1.91%), Agelenidae (1.44%), and Araneidae (0.96%).

In 2013, Salticidae had the highest incidence of occurrence constituting 35.43% of the season total collected spiders on clover (127), followed by Philodromidae (18.89%), Thomisidae (18.11%), Theridiidae (12.59%), Lycosidae (4.72%), Linyphiidae (3.15%), Dictynidae (2.36), Eutichuridae (Miturgidae) (2.36), and Agelenidae (2.36%). In 2014, Theridiidae had the highest percent of occurrence constituting 56.09% of the season total collected spiders (82), followed by Salticidae (17.07%), Thomisidae (12.19%), Dictynidae (6.09%), Linyphiidae (4.88%), Araneidae (2.44%), and Eutichuridae (Miturgidae) (1.22%).

Most of the families started appearance with small numbers on clover in early winter in January (Dictynidae, Saltcidae, Lycosidae, Philodromidae, Thomisidae, Therdiidae, Linyphiidae, and Araneidae) in one or both years of study. Others appeared late in March (e.g Eutichuridae (Miturgidae) and Agelenidae). The monthly collected total number of spiders gradually increased to reach peaks of 58 and 23 spiders in May constituting 45.67% and 28.05% of the season total collected spiders (127 & 82) on clover in 2013 and 2014 , respectively.

Three hundred and fourty nine spiders associated with *T. urticae* were collected on cotton crop at Qaha research station during 2013 and 2014 seasons. The collected families (nine and eight, respectively) included the aforementioned 11 families except Lycosidae and Agelenidae in both years in addition to Gnaphosidae in 2014. Thomisidae was the most abundant family on cotton during the period of study constituting 25.21% of the total spiders collected (349) followed by Salticidae (23.50%), Theridiidae (20.92%), Philodromidae (18.91%), Araneidae (3.72%), Eutichuridae (Miturgidae) (3.44%), Dictynidae (2.58%), Linyphiidae (0.86%), and Gnaphosidae (0.86%).

In 2013 Salticidae was the most abundant family constituted 30.15% of the season total collected spiders on cotton (199), followed by Thomisidae (27.14%), Philodromidae (18.59%), Theridiidae (11.05%), Araneidae (5.03%), Eutichuridae (Miturgidae) (4.02%), Dictynidae (1.51%), Gnaphosidae (1.51%), and Linyphiidae (1.01%). In 2014, Theridiidae was the most abundant family constituting 34% of the season total collected spiders on cotton (150) followed by Thomisidae (22.6%), Phiodromidae (19.33%), Salticidae (14.67%), Dictynidae (4%), Eutichuridae (Miturgidae) (2.67%), Araneidae (2%), and Linyphiidae (0.67%).

Most of the families started appearance with small numbers on cotton in late spring in May (Salticidae, Eutichuridae (Miturgidae), Thomisidae, Philodromidae, Theridiidae) and others appeared in summer in June (Dictynidae and Gnaphosidae), July (Araneidae), and August (Linyphiidae) in one or two seasons. The total monthly collected spiders gradually increased to reach peaks of 62 & 52 spiders on cotton in September constituting 31.16% and 34.67% of the season total collected spiders on cotton (199 & 150) in 2013 and 2014, respectively, then decreased in October at the end of the cotton season.

In comparison with clover, the total numbers of spiders collected in the two years of study and in each of 2013 and 2014 were higher on cotton (349, 199 & 150, respectively) than on clover (209, 127 & 82, respectively) and in 2013 than 2014 on each of clover and cotton.

Population density of spiders and their prey of *Tetranychus urticae* on clover and cotton:

Figs. (1a, 1b) show that the monthly population density of the predatory spiders (movable stages) collected on clover in 2013 and 2014 gradually increased with the increasing number of monthly population of the prey *T. urticae* nearly up till the prey peak in March. This was followed by a decrease of the prey population in next months (April & May) at the end of the clover season. However, the monthly collected predatory spiders continued increasing to reach a maximum of 58 and 23 spiders in May 2013 and 2014, respectively, while the climate mean temperature was increased.

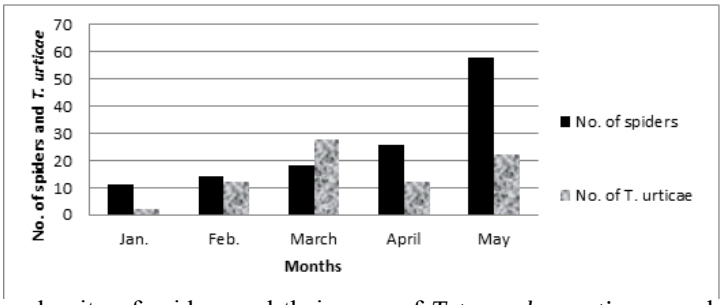

Fig. 1a: Population density of spiders and their prey of *Tetranychus urticae* on clover crop at Qaha station, Qalubyia governorate during 2013 season.

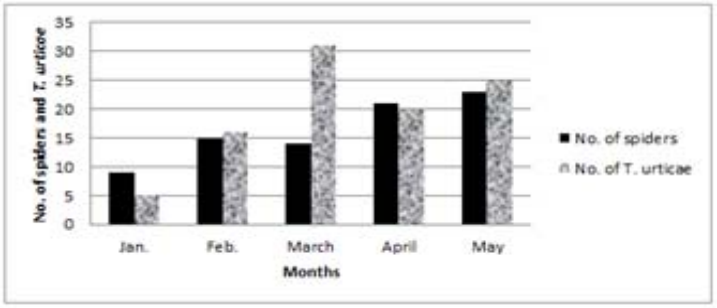

Fig. 1b: Population density of predatory spiders and their prey *Tetranychus urticae* on clover crop at Qaha station Qalubyia governorate during 2014 season.

On cotton, the pattern of changes of the population density of the monthly collected predatory spiders ran nearly in parallel to that of the prey population throughout each season (Figs. 2a, 2b). Both the prey and predator increased to reach their population peaks of 28 mites & 62 spiders and 34 mites & 52 spiders in September 2013 and 2014, respectively followed by a decrease in October. During the cotton season the climate mean temperature gradually increased from May to August followed by a slight gradual decrease in September and October in each of 2013 and 2014.

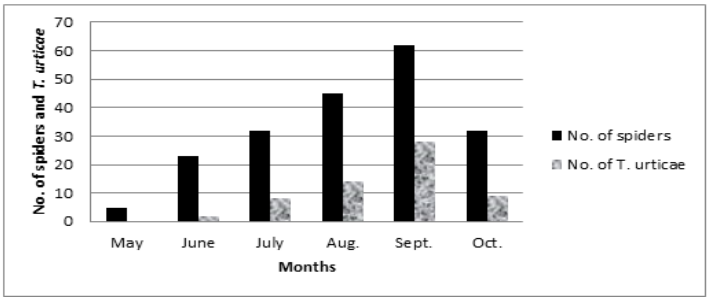

Fig. 2a: Population density of spiders and their prey *Tetranychus urticae* on cotton crop at Qaha station, Qalubyia governorate during 2013 season.

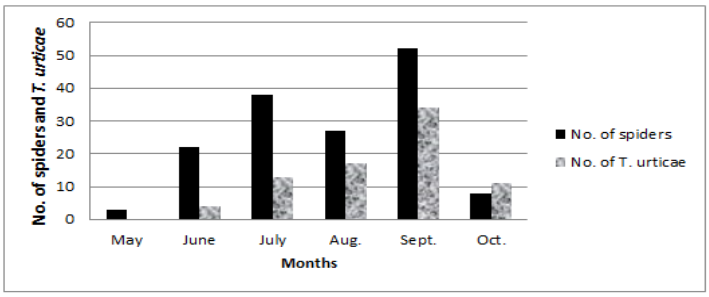

Fig. 2b: Population density of spiders and their prey *Tetranychus urticae* on cotton crop at Qaha station, Qalubyia governorate during 2014 season.

Life stage duration, food consumption and predation rate of immatures and adult females of spiders fed on *Tetranychus urticae:*

Thanatus albini, *Steatoda triangulosa*, *Thomisus spinifer* were selected as representative species of three of the most common families (Philodromidae, Theridiidae, Thomisidae, respectively) of predatory spiders collected in the present work. Life stage duration, food consumption and predation rates of early immatures and adult females of the selected three spiders species fed on adult male and female *T. urticae* are shown in Tables (1-4).

Life stage duration, food consumption and predation rate of early immatures of *Thanatus albini, Steatoda triangulosa* and *Thomisus spinifer* fed on adult *T. urticae:*

The duration of the first, second and third spiderlings of the 3 tested spider species varied and was the shortest ($p<0.05$) in the first spiderling of *T. albini and T. spinifer* and the third spiderling of *S. triangulosa* in comparison to the other two spiderlings. Also, the spiderling duration of each stage was slightly longer ($p<0.05$) when fed on female *T. urticae* than male with the longest total duration in *T. spinifer* followed by *S. triangulosa* and *T. albini*, respectively.

Results in Tables (1-3), showed that the 3 early immature stages of the 3 tested spider species consumed different numbers of adult female and male *T. urticae* during the life period of the spiderlings. The number of consumed adults of *T. urticae*

per spider was the least in the first spiderling and gradually increased in the second and third spiderlings ($p<0.001$) with more consumption of adult females than males *T. urticae* ($p<0.05$). The highest total consumption of the adult mites was in *T. spinifer* followed by *T. albini* and *S. triangulosa,*respectively.

Table 1: Stage duration, food consumption and predation rate of the 3 early immature stages of *Thanatus albini* (F. Philodromidae) fed on adult male and female *Tetranychus urticae* at 27± 2˚C and RH 60-70%.

Spider stage	Stage duration in days (fed on *T. urticae*)		Food consumption (no. of preys consumed/ spider)		Predation rate (no of preys consumed/day)	
	Female *T. urticae*	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***
1st spiderling	8.4 ± 0.26	6.4 ± 0.26	30.2 ± 1.44	21 ± 0.45	3.62 ± 0.07	3.4 ± 0.07
	(8-9)	(6-7)	(27-35)	(20-22)	(3 -3.9)	(2.8 -3.7)
2nd spiderling	10.8 ± 0.45	9.2 ± 0.26	65.4 ± 2.07	57.8 ± 1.18	6.08 ± 0.41	6.3± 0.25
	(10- 12)	(8- 10)	(60- 70)	(55- 60)	(5.2- 7)	(5.5 - 7.5)
3rd spiderling	11.2 ± 0.45	8.6 ± 0.26	129.4 ± 1.8	105.8 ± 3.6	11.6 ± 0.67	12.3 ± 0.67
	(10 -12)	(8 -9)	(125 - 135)	(100 - 115)	(10.4 -13.5)	(11.1 - 14.1)

Table 2: Stage duration, food consumption and predation rate of the 3 early immature stages of *Steatoda triangulosa* (F. Theridiidae) fed on adult male and female *Tetranychus urticae* at 27± 2˚C and RH 60-70 %.

Spider stage	Stage duration in days (fed on *T. urticae*)		Food consumption (no. of preys consumed/spider)		Predation rate (no. of preys consumed / day)	
	Female *T. urticae*	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***
1st spiderling	13.8± 0.45	10.6 ± 0.68	34± 2.24	28.4 ± 0.77	2.48 ± 0.25	2.7 ± 0.24
	(13- 15)	(9- 12)	(30 - 40)	(25- 30)	(2- 3.1)	(2.1- 3.3)
2nd spiderling	13.4 ± 0.26	11.2 ± 0.45	46.4 ± 1.18	40.8 ± 0.45	3.4 ± 0.09	3.6 ± 0.19
	(13 - 14)	(10 - 12)	(42 - 50)	(40 - 42)	(3.2 - 3.8)	(3.4 - 4.2)
3rd spiderling	11.6 ± 0.26	9.8 ± 0.45	61.8 ± 1.37	60.6 ± 1.44	5.3 ± 0.05	6 ± 0.31
	(11 - 12)	(9 - 11)	(60 - 65)	(55 - 60)	(5 - 5.6)	(5.3 - 6.7)

Table 3: Stage duration, food consumption and predation rate of the 3 early immature stages of *Thomisus spinifer* (F. Thomisidae) fed on adult male and female *Tetranychus urticae* at 27± 2˚C and RH 60-70%.

Spider stage	Stage duration in days (fed on *T. urticae*)		Food consumption (no. of preys consumed/spider)		Predation rate (no. of preys consumed/ day)	
	Female *T. urticae*	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***	**Female *T. urticae***	**Male *T. urticae***
1st spiderling	19.2 ± 0.26	14 ± 0.26	70.6 ± 0.52	61.4 ± 0.52	3.66 ± 0.03	4.42 ± 0.09
	(18- 20)	(12- 15)	(69- 72)	(60- 65)	(3.6- 3.8)	(4- 5.4)
2nd spiderling	22.8 ± 0.93	19.6 ±0.26	117.4±1.61	101 ± 2.24	5.18 ± 0.30	5.14 ± 0.18
	(20 - 24)	(19 - 20)	(110 - 122)	(95 - 105)	(4.8 -6.1)	(4.7 - 5.5)
3rd spiderling	22.6 ± 0.68	21 ± 0.45	217.8±1.29	185.2±1.29	9.52 ± 0.29	8.84 ± 0.25
	(21 - 24)	(20 - 22)	(215 - 220)	(180 - 190)	(8.3 - 10.5)	(8.2 - 9.5)

The predation rate (no. of preys consumed/ spider/ day) of the early immatures of the tested spider species was the lowest ($p<0.05$) in the first spiderling and gradually increased in the second and third spiderlings of each species but mostly with no significant difference ($p>0.05$) between predation rates of the corresponding spiderling stages which were fed on *T. urticae* females and males in each species. The highest predation rates occurred in the 3rd & 2nd spidrlings ($p<0.05$) of *T. albini* followed by *T. spinifer* and *S. triangulosa*, respectively.

Life stage duration, food consumption and predation rate of adult female spiders fed on adult *Tetranychus urticae*:

Results represented in table (4) showed that adult females of the three selected spider species, *T. albini* (F. Philodromidae), *S. triangulosa* (F. Theridiidae), and *T. spinifer* (F. Thomisidae) were able to survive for relatively short periods 2.9-8 days when fed solely on adult *T. urticae*. The duration of survival periods was the longest in female *T. albini* followed by *T. spinifer* then *S. triangulosa* ($p<0.05$), respectively, when they were fed on adult females or males of *T. urticae.*

Table 4: Stage duration, food consumption and predation rate of female adult spiders fed on adult male and female *Tetranychus urticae* at 27± 2˚C and RH 60- 70 %.

Spider family	Female spider	Spider duration in days (fed on *T. urticae*)		Food consumption (no. of preys consumed/spider)		Predation rate (no. of preys consumed/ day)	
		Female *T. urticae*	Male *T. urticae*	Female *T. urticae*	Male *T. urticae*	Female *T. urticae*	Male *T. urticae*
Philodromidae	*T. albini*	8± 0.45 (7-9)	6.4±0.26 (6-7)	212.8±1.7 (150-189)	157.5± 1.3 (144 – 182)	26.6± 0.56 (24-29)	24.6±0.34 (22-28)
Theridiidae	*S. triangulosa*	3.2±0.30 (3-4)	2.9±0.26 (2- 4)	76.12±0.39 (66-70)	67±0.54 (62-68)	23.79±0.65 (22-25)	23.1±0.26 (22-24)
Thomisidae	*T. spinifer*	4.5±0.26 (4-5)	3.7±0.24 (3-4)	126.45±1.23 (100- 118)	100.8±1.65 (98- 112)	28.1±0.69 (27-29)	27.2± 0.34 (26-29)

During the relatively short survival period, female *T. albini* consumed the largest numbers of female and male *T. urticae* followed by *T. spinifer* then *S. triangulosa* with more consumption of females than males *T. urticae* ($p<0.001$) in the three species.

The predation rates of the 3 tested female adult spiders ($p<0.05$) was the highest in *T. spinifer* when fed on female and male *T. urticae* followed by *T. albini* and *S. triangulosa* with slightly higher predation rates on females than males *T. urticae* except in case of *S. triangulosa* where no significant difference ($p>0.05$) was observed.

DISCUSSION

Spider families associated with *Tetranychus urticae* on clover and cotton crops

Ecological and biological studies have been carried out on spiders in Egypt (e.g. El-Heneidy et al., 1996; Metwally et al., 2002; Abo- zaed, 2008; Ibrahim et al., 2012). However, studies on spiders associated with *T. urticae* or other acarine pests are scarce (El- Erksousy, 2000). In the present study, 558 spiders belonging to 11 families of order Araneae associated with *T. urticae* were collected on clover and cotton at Qaha research station in Qalubyia governorate, Egypt during two successive years, 2013 and 2014. Salticidae was the most abundant of the total collected spiders on the two crops, followed by Theridiidae, Thomisidae, Philodromidae, Dictynidae, Eutichuridae (Miturgidae), Araneidae, Linyphiidae, Lycosidae, Agelenidae, and Gnaphosidae. Many of these families were recorded in different governorates, localities and crops in Egypt (Gabboiur et al., 1996; Hussein et al., 1998; El-Erksousy, 2000; Metwally et al., 2002, Abo-zaed, 2008). The numbers of the collected spiders, percent occurrence and hence abundance of each family varied on each of the two studied crops in 2013 and 2014.

On clover, nine and seven of the aforementioned 11 spider families were collected in 2013 and 2014, respectively. The collected families did not include

Gnaphosidae in both years in addition to Araneidae in 2013 and Lycosidae, Philodromidae, and Agelenidae in 2014. However, during the period of study, Theridiidae was the most abundant family on clover followed by Salticidae, Thomisidae, Philodromidae, Dictynidae, Linyphiidae, Lycosidae, Eutichuridae (Miturgidae), Agelenidae, and Araneidae. In accordance with the present study, Negm et al. (1976) found that Salticidae, Thomisidae, and Tetragnathidae were the best represented families of Araneae in clover fields in Assiut, Egypt.

On cotton, nine and eight of the aforementioned 11 spider families were collected in 2013 and 2014, respectively. The collected families did not include Lycosidae and Agelenidae in both years in addition to Gnaphosidae in 2014. In contrast to the present findings Lycosidae was represented in Menofyia as the most dominant family on cotton and other plants in summer season (Gabboiur et al., 1996). The present study showed that Thomisidae was the most abundant family on cotton during the period of study followed by Salticidae, Theridiidae, Philodromidae, Araneidae, Eutichuridae (Miturgidae), Dictynidae, Linyphiidae, and Gnaphosidae. In Egypt, occurrence of spiders on cotton has been recorded in many governorates and localities (El-Heneidy et al., 1996; El-Erksousy, 2000; Abo-zaed, 2008; Ibrahim et al., 2012). Furthermore, many of the spider families on cotton in the present work were collected from other plants such as vegetables (Gabboiur et al., 1996; Soliman, 2003) fruits (Metwally et al., 2002) and field crops (Ibrahim et al., 2012).

Most of the spider families started appearance with low numbers on clover and cotton in winter (January) and late spring (May), respectively in both years of study. The monthly collected number of spiders gradually increased to reach maximum on clover and cotton at the relatively high temperature in May and September 2013 and 2014, respectively. Li Diaqin & Jackson (1996) found that spiders live in warmer climates and their rate of growth, development and life history traits were affected by change in temperature.

In comparison with clover, the total numbers of spiders collected in both years of study and in each of 2013 and 2014, respectively, were higher on cotton than clover and in 2013 than 2014 on each crop. Qu et al. (1986) reported that spiders of order Araneae are closely correlated with the crop, occurrence of insect pests, farming practice, chemical application and climatic factors. In the present study, the relatively higher temperatures during cotton season (24.2- 30.6˚C) than clover (11.9-25.5˚C) and preying of spiders on cotton pests might have contributed to the higher population densities of the spiders collected on cotton. The spiders feed well on the major cotton pests of noctuid larvae, the pink bollworm, *Pectinophora gossypiella* (El- Erksousy & Amer, 2007) and the cotton leaf worm *Spodoptera littoralis* (El-Erksousy, 2000; Abo-zaed, 2014) and other cotton pests as the aphid, *Aphis gossypii* and the leaf hopper, *Empoasca* sp. (Hendawy & EL-Mezzayen, 2003). Larvae of both noctuids are used for laboratory rearing of the spiders in Egypt (El- Erksousy, 2000).

Interrelationships of spiders and their prey *Tetranycus urticae* on clover and cotton:

Appearance of spiders and their prey of *T. urticae* started on clover in winter (January) and on cotton in late spring and summer (May & June), respectively in both 2013 and 2014. In each season, the numbers of the collected spiders and prey were the lowest at the start and gradually increased in next months. The increased monthly population density of the spiders continued together with that of *T. urticae* nearly in parallel during the whole cotton seasons with maximum in September (then decreased in October) and up till the prey peak in March in each clover season. However, although the population density of *T. urticae* on clover was decreased in

next months following the peak (April & May), the monthly collected numbers of predatory spiders continued increasing to reach maxima at the higher mean temperatures in May (24.2 & 25.5˚C) than in March (19 & 21.58˚C). The continued increased density of the predator after the decrease of the prey density suggested a relative independence of the predatory spiders from *T. urticae* as a prey and pointed to another factor (s) or reason (s) of the observed increase. Climatic conditions especially temperature and relative humidity have been found to be the main factors affecting changes of population densities of the spiders (Costa, 1995; Abo-zaed, 2008) and *T. urticae* (Cai, 1987). In the present study, the low temperature in winter (January & February) might be the main reason of the low densities of *T. urticae* and spiders on clover and the increasing temperatures in spring contributed to the increased densities of *T. urticae* and spiders to peaks in March and May, respectively.

In comparison of the associated predatory spiders with *T. urticae*, the higher total numbers of the spiders movable stages on each of the clover and cotton in 2013 than in 2014 and on cotton than on clover in each year of study might have contributed to the lower number of *T. urticae* collected on clover and cotton in 2013 than 2014 and to the lower number *T. urticae* on cotton than clover in each year (Ibraheem, 2016).

Life stage duration, food consumption and predation rate of immatures and adult females of spiders fed on adult *Tetranychus urticae*:

Life stage duration, food consumption and predation rates of the 3 early immature stages and adult females of *Thanatus albini, Steatoda triangulosa and Thomisus spinifer* were determined by feeding the spiders on adult females and males of *T. urticae*. Generally the 3 parameters increased gradually by increasing age of the spiderlings from the first to the third stage (except duration in *S. triangulosa*). These results conform to most studies on other spider species fed on *T. urticae* (El-Erksousy, 2000) or other preys such as *Pectinophora gossypiella* (El-Erksousy & Amer, 2007) and *Spodoptera littoralis* (Abo-zaed, 2014). In the present study, food consumption and to less extent duration of spiderlings and adult females were higher when the spiders were fed on female than male adult *T. urticae*, but mostly no significant difference in the predation rates were observed on consuming male and female *T. urticae*.

In the present study, *T. urticae* as the only consumed food could not maintain the life of the female adult spider except for few days (2.9-8 days) or enable the early 3 spiderlings to complete the life cycle to adult stage which is similar to findings of Ibrahim et al. (2012). On the other hand El-Erksousy (2000) succeeded to complete the life cycle of the spiderlings of the Theridiid *Crustulina conspicua* (5-6 spiderlings) by feeding the predator on huge numbers of adult *T. urticae* (about 1822 & 2453 mites for male & female spiderlings).

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ARABIC SUMMERY

العناكب المفترسة المصاحبة لأكاروس العنكبوت ذو البقعتين تترانكس أورتيكا على محصولين حقليين بمحافظة القليوبية فى مصر

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تم جمع خمسمائة وثمانية وخمسين عنكبوت ينتمون إلى إحدى عشر فصيلة من رتبة أراني مصاحبين للتترانيكس أورتيكا على محصولي البرسيم والقطن معا فى محطة بحوث قها بمحافظة القليوبيه فى مصر على مدار سنتين متتاليتين 2013 و 2014. وكانت فصيلة السالتيسيدي هى السائده ويتبعها عائلة الثريديدي و التوميسيدي و الفيلودروميدي و الديكتينيدي و الميتورجيدي و الأرانيدي و اللينيفيدي و الليكوسيدي و الأجلينيدي و الجنافوسيدي. وقد تغيرت أعداد العناكب والفصائل التى تم جمعها ونسبة تواجد كل فصيلة على المحاصيل التى تم دراستها فى المواسم المختلفة. وفى موسم البرسيم لم تشتمل الفصائل التى تم جمعها على عائلة جنافوسيدي فى عامي الدراسة بالإضافه إلى أرانيدي فى 2013 و الليكوسيدي و الفيلودرميدي والأجلينيدي فى 2014. وفى موسم القطن لم تشتمل الفصائل التى تم جمعها على عائلة ليكوسيدي و أجلينيدي فى عامي الدراسة بالإضافه إلى جنافوسيدي فى 2014. وبدأت العناكب والتترانكس أورتيكا فى الظهور بأعداد قليله فى أول كل موسم فى كلا المحصولين وزادت تدريجيا لتصل ذروتها فى سبتمبر ثم تنقص فى باقي موسم القطن بنمط متوازي وفى موسم البرسيم وصلت الزيادة فى أعداد التترانكس إلى الذروة فى شهر مارس ونقصت فى الشهور التالية أما العناكب فاستمرت فى الزيادة لتصل ذروتها على البرسيم فى شهر مايو. وزاد العدد الكلى للعناكب التى تم جمعها على كل من محصول البرسيم والقطن فى سنة 2013 عنه فى 2014 وعلى القطن عنه على البرسيم فى كل من العامين. وعلى الجانب الآخر زاد العدد الكلى للتترانكس أورتيكا الذى تم جمعه على كل من المحصولين سنة 2014 عنه فى سنة 2013 وعلى البرسيم عنه فى القطن فى كل من العامين.

تمت الدراسة المعملية على مدة الحياة و الاستهلاك الغذائي و معدل الإفتراس اليومي للأطوار الثلاثة الأولى و الأنثى البالغه لكل من العناكب من نوع ذاناتس ألبيني و ستاتودا ترينجيولوزا و توميسس سبينيفر التي تم إختيارها لتمثل ثلاث من الفصائل السائدة (فيلودروميدي و ثريديدي و توميسيدي على التوالى) للعناكب التى تم جمعها أثناء فترة الدراسة. وأظهرت النتائج فاعلية أنواع العناكب الثلاث كمفترسات على الطور البالغ للتترانيكس أورتيكا. وأن الأطوارغير البالغة و الأنثى البالغة التي تم دراستها تستهلك عدد أكثر من الفرائس وتعيش مده أطول عندما تتغذى على إناث التترانيكس أورتيكا عنها فى الذكور. وأن العدد الذي يتم إستهلاكه من الفرائس لكل عنكبوت و معدل الإفتراس اليومي وغالبا مدة حياة الأطوار تزيد تدريجيا بزيادة العمر من الطور الاول إلى الطور الثالث فى الأطوار غير البالغة للعنكبوت. وفى الأنثى البالغه كانت الثلاث معاملات (ما عدا معدل الإفتراس اليومي في توميسس سبينيفر) الأعلى في أنثى ذاناتس ألبيني و يتبعها توميسس سبينيفر ثم ستاتودا ترينجيولوزا. وقد تمت مناقشة النتائج المتحصل عليها فى هذا البحث ودلالاتها.