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SEASONAL ABUNDANCE OF THE TWO SPOTTED SPIDER MITE, *Tetranychus urticae* KOCH ON FOUR COTTON CULTIVARS AT DAKAHLIA GOVERNORATE, EGYPT

Rabie E.A. Esmaeel[1*], A.E. Basha[2], E.M. Mostafa[2] and A.E. Abd El Mageed[1]

1. Pl. Prot. Res. Inst., ARC, Egypt

2. Pl. Prot. Dept., Fac. Agric., Zagazig Univ., Egypt

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ABSTRACT: The two spotted spider mite (TSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is one of the major mite pests on agricultural crops worldwide. The present work aims to study abundance of TSM and the most common predatory phytoseiid species, *Typhlodromips capsicum* Mostafa (Acari: Phytoseiidae) on four cotton cultivars *viz*. Giza 45, Giza 86, Giza 87 and Giza 92 mostly cultivated in Egypt during two successive growing seasons 2016 and 2017 at Aga district, Dakahlia Governorate, Egypt in relation to prevailing atmospheric temperature and relative humidity. Also, the synchronization of TSM and *T. capsicum* under field conditions on the above-mentioned investigated cotton cultivars was investigated. Obtained results showed that TSM populations were significantly (P≤ 0.05) higher on the cotton cultivars Giza 45 and Giza 92 in comparison with the other investigated ones (Giza 86 and Giza 87) during the two investigated seasons 2016 and 2017. Populations of the phytoseiid species, *T. capsicum* did not significantly affected by the tested cotton cultivars. There were positive correlations between the changes of TSM and *T. capsicum* populations and temperature while the correlations with relative humidity were positively insignificant during the two investigated growing seasons. Good synchronization between TSM and *T. capsicum* populations on tested cotton cultivars was detected during the first and second seasons. These results showed that cotton cultivars, predatory mites and weather factors are of the most important factors affecting the populations of *T. urticae* on the investigated cotton cultivars.

Key words: Cotton, cultivars, spider mite, predatory mite, abundance, temperature, relative humidity.

INTRODUCTION

Cotton, *Gossypium hirsutum* L., is an important crop in producing natural fibers. It is a valuable domesticated plant cultivated in more than 75 countries and over 40 million hectares of lands (**Naseri, 1995**). According to **Helle and Sabelis (1985)**, approximately 33 species of spider mites were recorded on cotton plants around the world with different economic impacts. The two spotted spider mite (TSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is one of the major mite pest species on agricultural crops worldwide. It feeds by sucking the contents of plant cells and damage includes webbing, fine stippling, leaf yellowing, leaf drop, and even plant death (**Helle and Sabelis, 1985**). It has a definite role in crop losses due to global distribution, broad host range, high damage intensity, resilient reproduction and ability to inducing resistance against several insecticides (**Nicholls *et al*., 1998**). **Wilson *et al*. (1997), Steinkraus and Zawislak (2000) and Honarparvar (2010)** reported that TSM has been presumed as a damaging pest in cotton fields.

Host plants have developed a multitude of inducible defense mechanisms against aggressive biotic agents. This defense of plants induced *via* specific signal transduction which may negatively affect the herbivore's physiology (**Koiwa *et al*.,**

Corresponding author: Tel. : +201001860266
E-mail address: engrabie@yahoo.com

1997; Kahl *et al.*, 2000). In addition to such direct induced defenses, plants may also defend themselves against herbivores indirectly by emitting specific blends of volatiles that attract natural enemies of herbivores. For example, green leaf volatiles released from lima bean leaves infested by TSM may act as signal compounds in plant–plant or plant-natural enemies interactions (**Arimura *et al.*, 2001**).

Biological control by predatory insects and mites is increasingly being recommended. For TSM, biological control has centered on the use of predatory mites in the family Phytoseiidae (**Schausberger and Croft, 2000; Schausberger and Walzer, 2001**). Phytoseiid mite that is widely used and commercially available is *Phytoseiulus persimilis* Athias-Henriot. Releases of *P. persimilis* to suppress TSM populations have performed with varying degrees of success (**Berntein 1985; Bancroft and Margolies, 1999**). Biological control by release of phytoseiid mites for TSM control has been shown experimentally to reduce its density in cotton fields (**Osman and Zohdi, 1976; Tijerina-Chavez, 1991**). For any efficient pest management system, the study of pest population is of vital importance (**Tehri *et al.*, 2014**). Naturally occurring phytoseiid mite populations tend to be more abundant in perennial agricultural systems where conditions are considered to be more conducive for population persistence (**McMurtry, 1982**). There has been little information about the natural performance of *Typhlodromips. capsicum* against TSM in annual cropping systems such as cotton.

The present work aims to study the seasonal abundance of TSM and its predatory phytoseiid mite, *T. capsicum* on four cotton cultivars *viz.* Giza 45, Giza 86, Giza 87 and Giza 92, in relation to temperature and relative humidity. Also, the synchronization between the two species was discussed.

MATERIALS AND METHODS

Experiments were conducted during 2016 and 2017 cotton growing seasons in Aga district, Dakahlia Governorate, Egypt. The cotton varieties Giza 45, Giza 86, Giza 87 and Giza 92 were selected for the present study. An area of 2000 m^2 was divided into sixteen plots (125 m^2/plot). The plots were isolated from each other by unplanted corridor (1 m in width). Every variety was replicated four times (each replicate in one plot) in a completely randomized block design. Sowing seeds was conducted on the second half of March 2016 and 2017.

Biweekly leaf samples (25 leaves each) were randomly taken from each of the investigated cotton cultivars from the lower, medium and upper leaves of plants after one month from sowing seeds till the end of the season. Leaves were put in paper bags and then transferred to the laboratory for examination by stereomicroscope. The numbers of TSM moving stages as well as phytoseiid species in each sample were recorded to obtain mean number per leaf.

To estimate the effect of mean temperature along with mean relative humidity on TSM and *T. capsicum* populations, daily records of temperature and relative humidity were obtained from the Agrometeorological Station at Dakahlia Governorate during 2016 and 2017. The daily records of each weather factor were grouped into biweekly means according to the sampling dates.

By using the computer program **CoHort Software (2004)**, the population of TSM and the most common phytoseiid species *T. capsicum* were correlated with the mean temperature and relative humidity. The correlation and simple regression were done between TSM and *T. capsicum* populations.

RESULTS

Seasonal Abundance of *T. urticae* on Four Cotton Cultivars

Results illustrated in Table 1 show that TSM population was significantly higher on cotton cultivars Giza 45 and Giza 92 in comparison with the other investigated cultivars Giza 86 and Giza 87 during the first season. Whereas, the general mean numbers of TSM moving stages per one leaf were 4.26, 4.14, 2.22 and 2.13 individuals for the cultivars Giza 45, Giza 92, Giza 86 and Giza 87, respectively. On the other hand, the highest numbers of TSM on Giza 45 and Giza 92 were recorded on 21st of June

Table 1. Seasonal abundance of *T. urticae* on four cotton cultivars during 2016 season

Sampling date	Cultivar				LDS (P≤0.05)	Temp. (°C)	RH (%)
	Giza 45	Giza 86	Giza 87	Giza 92			
22-4	1.28±0.23a	0.64±0.36bc	0.48±0.33c	1.00±0.40ab	0.45	20.6	69.6
7-5	3.60±1.04a	2.32±0.92ab	2.00±0.86b	3.00±1.36ab	1.42	22.8	65.1
22-5	4.20±1.17b	3.52±1.48b	3.00±0.98b	6.00±1.17a	1.63	21.6	72.0
21-6	6.64±1.18a	3.80±1.48b	3.96±1.34b	6.60±1.54a	1.87	24.6	65.5
7-6	8.28±1.22a	3.60±1.03b	2.80±1,28b	9.00±1.26a	1.61	23.9	72.4
6-7	7.80±1.50a	4.00±1.45b	4.20±1.33b	7.60±1.05a	1.80	25.6	70.0
21-7	8.20±1.36a	3.20±1.44b	3.80±1.67b	8.00±2.01a	2.20	25.7	78.6
5-8	7.20±1.27a	4.20±1.91b	3.60±1.31b	6.80±2.58a	2.48	27.6	75.9
20-8	4.88±1.20a	4.08±1.22a	4.40±1.27a	5.60±2.21a	2.06	27.8	78.5
4-9	4.16±0.98a	1.28±0.52b	1.00±0.37b	1.40±0.51b	0.86	26.9	76.9
19-9	2.12±0.91a	0.32±0.11b	0.40±0.28b	1.00±0.71b	0.80	26.6	75.2
4-10	1.00±0.32a	0.08±0.11b	0.12±0.11b	1.56±0.30a	0.31	25.5	70.8
19-10	0.32±0.18a	0.04±0.09b	0.04±0.09b	0.40±0.24a	0.22	24.7	75.4
3-11	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.04±0.09a	0.06	22.6	77.7
General mean	4.26±0.90A	2.22±0.87B	2.13±0.73B	4.14±1.10A	1.27	24.8	73.1

-Mean ± Standard error.

-Means followed by the same lowercase letter (s) in columns or uppercase letter for general mean in row are not significantly different at P≤ 0.05 according to Duncan`s multiple range test.

when the mean temperature and relative humidity were 23.9°C and 72.4%, respectively. The highest numbers of TSM individuals on the cultivars Giza 86 and Giza 87 were recorded on 5th (27.6°C and 75.9% RH) and 20th of August (27.8°C and 78.5% RH). The lowest numbers of TSM on the four cotton cultivars were counted on 3rd of November when the mean temperature and relative humidity averaged 22.6°C and 77.7%, respectively.

With respect to the second season (Table 2), TSM exhibited its highest general mean of population density per leaf on the cotton cultivars Giza 45 (5.08) and Giza 92 (4.95) which were significantly higher than those on cultivars Giza 86 (2.66) and Giza 87 (2.59). The highest numbers of TSM on Giza 45 and Giza 92 were recorded on 15th of June where (mean temperature and relative humidity were 29.1°C and 46.4%, respectively; while, the highest numbers of TSM individuals on cultivars Giza 86 and Giza 87 were recorded on 30th of July (30.5°C and 56.6% RH) and 14th of August (31.0°C and 60.0% RH). The lowest numbers of TSM on the four cotton cultivars were recorded on 28th of October when the mean temperature and relative humidity were 24.1°C and 52.8%, respectively.

Statistically, there were positively insignificant correlations between the changes of TSM populations and air temperature during the first 2016 season; whereas, the correlation coefficient values between the two factors on cultivars Giza 45, Giza 86, Giza 87 and Giza 92 were 0.34^{NS}, 0.24^{NS}, 0.31^{NS} and 0.20^{NS}, respectively. During the second season (2017), the correlations were positively and highly significant (r = 0.72**), significant (r = 0.63*) and insignificant (r = 0.23^{NS} and 0.14^{NS}) on cultivars Giza 45, Giza 92, Giza 86 and Giza 87, respectively. With respect to relative humidity, all correlations with TSM populations were positively insignificant (Table 3).

Table 2. Seasonal abundance of *T. urticae* on four cotton cultivars during 2017 season

Sampling date	Cultivar				LDS (P≤0.05)	Temp. (°C)	RH (%)
	Giza 45	Giza 86	Giza 87	Giza 92			
16-4	1.08±0.39ab	1.00±0.32b	0.72±0.27b	1.64±0.65a	0.58	21.0	55.9
1-5	3.88±1.58a	2.64±0.91a	3.20±1.13a	3.48±1.14a	1.67	23.6	41.3
16-5	4.48±0.91b	4.00±1.44b	3.60±1.16b	6.56±2.03a	1.94	26.7	44.6
31-5	7.20±1.13a	4.40±0.95b	4.48±1.29b	7.04±1.96a	1.86	26.7	44.7
15-6	9.40±1.33a	4.28±1.08b	4.04±1.34b	9.32±2.43a	2.13	29.1	46.4
30-6	9.00±2.84a	4.20±0.68b	4.40±1.06b	8.40±1.99a	2.48	29.6	51.4
15-6	8.00±3.26a	3.72±0.18b	4.20±1.51b	9.08±3.00a	3.18	31.5	52.7
30-6	8.80±2.18a	4.72±0.84b	4.12±0.90b	8.28±2.40a	2.33	30.5	56.6
14-8	8.24±2.10a	4.60±1.82b	5.00±1.73b	9.12±1.98a	2.56	31.0	60.0
29-8	6.40±1.21a	2.80±1.28b	1.60±0.80b	2.16±1,28b	1.55	30.0	55.9
13-9	2.68±0.77a	0.52±0.33b	0.56±0.43b	2.00±1.20a	1.02	28.9	58.5
28-9	1.48±0.61a	0.32±0.30b	0.20±0.28b	1.56±0.38a	0.56	27.8	57.7
13-10	0.48±0.18a	0.04±0.09b	0.08±0.18b	0.64±0.22a	0.23	25.7	52.6
28-10	0.04±0.09a	0.00±0.00a	0.00±0.00a	0.04±0.09a	0.08	24.1	52.8
General mean	5.08±1.39A	2.66±0.73B	2.59±0.86B	4.95±1.48A	1.58	27.6	52.2

-Mean ± Standard error.
-Means followed by the same lowercase letter (s) in columns or uppercase letter for general mean in row are not significantly different at P≤ 0.05 according to Duncan`s multiple range test.

Table 3. Correlation coefficient values (r) between *T. urticae* populations on four cotton cultivars in relation to temperature and relative humidity during 2016 and 2017 seasons

Season	Factor	Cultivar			
		Giza 45	Giza 86	Giza 87	Giza 92
2016	**Temp. (°C)**	0.34^{NS}	0.24^{NS}	0.31^{NS}	0.20^{NS}
	RH (%)	0.05^{NS}	0.11^{NS}	0.07^{NS}	0.09^{NS}
2017	**Temp. (°C)**	0.72**	0.23^{NS}	0.14^{NS}	0.63*
	RH (%)	0.13^{NS}	0.30^{NS}	0.31^{NS}	0.19^{NS}

* = Significant at 0.05 level of probability. **= Highly significant at 0.01 level of probability. NS= Not significant.

Seasonal Abundance of the Phytoseiid Species *T. capsicum* on four Cotton Cultivars

The general mean ± Standard error for number of *T. capsicum* per leaf did not significantly ($P \leq 0.05$) differed from one cotton cultivar to another during the first season of 2016. However, it reached 0.92, 0.80, 0.68 and 0.60 individuals on cultivars Giza 45, Giza 92, Giza 87 and Giza 86, respectively. On the other hand, the highest numbers of this predator were recorded on 21st of July on cotton cultivars Giza 45 and Giza 92 when the mean temperature and relative humidity were 25.7°C and 78.6% While, the highest numbers of this predator on cultivars Giza 86 and Giza 87 were recorded on 20th of August when the mean temperature and relative humidity were 27.8°C and 78.5%. The lowest numbers of *T. capsicum* on the four cotton cultivars were recorded on 3rd of November when the mean temperature and relative humidity were 22.6°C and 77.7%, respectively (Table 4).

The general mean number of *T. capsicum* per leaf were not significantly different on the tested four cotton cultivars during 2017 season; however, it reached 0.56, 0.72, 0.68 and 0.62 individuals on cultivars Giza 87, 45, 92 and 86, respectively (Table 5). The highest numbers of *T. capsicum* on Giza 86, Giza 87 and Giza 92 were recorded on 30th of July when the mean temperature and relative humidity were 30.5°C and 56.6%. While, the highest number of *T. capsicum* was recorded on cultivar Giza 45 on 14th of August at mean temperature 31.0°C and relative humidity 60.0%. The lowest numbers of *T. capsicum* on the four cotton cultivars were recorded on 28th of October when the mean temperature and relative humidity were 24.1°C and 52.8%, respectively.

Statistical analysis indicated that *T. capsicum* population exhibited positive response to the increase of temperature during both seasons. The calculated r-values between changes of *T. capsicum* population and temperature on cotton cultivars Giza 45, Giza 86, Giza 87 and Giza 92 were 0.58^{*}, 0.44^{NS}, 0.50^{NS} and 0.47^{NS}, respectively during the first season. These values were 0.59^{*}, 0.60^{*} and 0.72^{**}, respectively, during the second season. Population of *T. capsicum* exhibited insignificant positive responses to the increase of relative humidity during the first and second seasons (Table 6).

Synchronization Between TSM and *T. capsicum* Populations

Results illustrated in Fig. 1 show that there was a good synchronization between TSM and *T. capsicum* populations on all tested cotton cultivars during both seasons. This synchronization is explained statistically by correlation coefficient values (r) between the two species; which were positively high significantly correlated.

The highest response of *T. capsicum* population to the increase of TSM population during the first season was recorded on cultivar Giza 87; where, increase of TSM population by one individual increased *T. capsicum* population by 0.24 individual. While, the highest response of *T. capsicum* population to the increase of TSM population during the second season was recorded on cultivar Giza 86; where, each increase of TSM population by one individual increased *T. capsicum* population by 0.20 individual (Fig. 1). The lowest response of *T. capsicum* population to the increase of TSM population was recorded on cotton cultivar Giza 92 during first and second seasons (b-values were 0.11 and 0.10), respectively.

On the other hand, the highest effect of *T. capsicum* on TSM population during the first season was recorded on cultivar Giza 86 (R^2 = 0.836). While, during the second season, the highest effect of *T. capsicum* population on TSM population was recorded on Giza 45 (R^2= 0.918) (Fig. 1).

DISCUSSION

The present results indicated that the highest populations of TSM infesting the tested cotton cultivars were recorded during June, July and August. These results are nearly in agreement with those of **Sunita (1996)**, **Putatunda and Tagore (2003)** and **Gulati (2004)**; they reported that the peak population of TSM was found

Table 4. Seasonal abundance of *T. capsicum* on four cotton cultivars during 2016 season

Sampling date	Cultivar				LDS (P≤0.05)	Temp. (°C)	RH (%)
	Giza 45	Giza 86	Giza 87	Giza 92			
22-4	0.32±0.18a	0.24±0.09a	0.20±0.14a	0.40±0.28a	0.25	20.6	69.6
7-5	0.60±0.24a	0.52±0.30a	0.56±0.38a	0.56±0.26a	0.41	22.8	65.1
22-5	0.72±0.33a	0.88±0.27a	0.80±0.32a	0.68±0.30a	0.41	21.6	72.0
21-6	1.24±0.36a	0.72±0.30b	0.72±0.23b	1.32±0.30a	0.40	24.6	65.5
7-6	1.00±0.28a	0.67±0.22a	0.68±0.23a	0.88±0.33a	0.36	23.9	72.4
6-7	1.32±0.36a	0.84±0.38b	0.96±0.26ab	0.96±0.26ab	0.43	25.6	70.0
21-7	1.92±0.23a	0.88±0.39c	1.24±0.43bc	1.68±0.41ab	0.50	25.7	78.6
5-8	1.40±0.37a	1.12±0.30ab	0.84±0.38b	1.24±0.36ab	0.45	27.6	75.9
20-8	1.88±0.29a	1.28±0.46b	1.92±0.18a	1.04±0.43b	0.47	27.8	78.5
4-9	1.60±0.58a	0.72±0.30b	0.72±0.23b	1.64±0.57a	0.33	26.9	76.9
19-9	0.40±0.20a	0.20±0.20a	0.36±0.26a	0.32±0.30a	0.33	26.6	75.2
4-10	0.28±0.23a	0.16±0.17a	0.24±0.26a	0.24±0.22a	0.30	25.5	70.8
19-10	0.12±0.18a	0.08±0.11a	0.16±0.22a	0.20±0.20a	0.24	24.7	75.4
3-11	0.08±0.18a	0.08±0.18a	0.12±0.18a	0.04±0.09a	0.22	22.6	77.7
General mean	0.92±0.26A	0.60±0.27A	0.68±0.26A	0.80±0.31A	0.36	24.8	73.1

-Mean ± Standard error.
-Means followed by the same lowercase letter (s) in columns or uppercase letter for general mean in row are not significantly different at P≤ 0.05 according to Duncan`s multiple range test.

Table 5. Seasonal abundance of *T. capsicum* on four cotton cultivars during 2017 season

Sampling date	Cultivar				LDS (P≤0.05)	Temp. (°C)	RH (%)
	Giza 45	Giza 86	Giza 87	Giza 92			
16-4	0.36±0.27a	0.28±0.27a	0.24±0.22a	0.36±0.26a	0.36	21.0	55.9
1-5	0.48±0.27a	0.48±0.27a	0.48±0.39a	0.48±0.23a	0.37	23.6	41.3
16-5	0.64±0.22a	0.76±0.09a	0.64±0.26a	0.60±0.24a	0.30	26.7	44.6
31-5	0.76±0.26a	0.64±0.22a	0.60±0.20a	0.80±0.20a	0.29	26.7	44.7
15-6	1.16±0.22a	0.68±0.29b	0.68±0.29b	0.76±0.26b	0.31	29.1	46.4
30-6	1.24±1.77a	0.68±0.33b	0.96±0.26ab	1.04±0.09a	0.31	29.6	51.4
15-6	0.96±0.30ab	0.84±0.17ab	0.72±0.22b	1.16±0.30a	0.34	31.5	52.7
30-6	1.20±0.24ab	1.84±0.33a	1.04±0.33b	1.40±0.75ab	0.61	30.5	56.6
14-8	1.42±0.30a	1.12±0.36a	1.04±0.30a	1.32±0.27a	0.42	31.0	60.0
29-8	0.88±0.48a	0.64±0.22a	0.60±0.20a	0.60±0.20a	0.40	30.0	55.9
13-9	0.36±0.33a	0.24±0.26a	0.32±0.18a	0.48±0.29a	2.67	28.9	58.5
28-9	0.32±0.27a	0.20±0.24a	0.24±0.17a	0.24±0.26a	0.32	27.8	57.7
13-10	0.12±0.18a	0.16±0.17a	0.16±0.17a	0.24±0.33a	0.30	25.7	52.6
28-10	0.12±0.18a	0.16±0.22a	0.12±0.27a	0.04±0.09a	0.27	24.1	52.8
General mean	0.72±0.38A	0.62±0.25A	0.56±0.25A	0.68±0.27A	0.52	27.6	52.2

-Mean ± Standard error.
-Means followed by the same lowercase letter (s) in columns or uppercase letter for general mean in row are not significantly different at P≤ 0.05 according to Duncan`s multiple range test.

Table 6. Correlation coefficient values (r) between *T. capsicum* populations on four cotton cultivars in relation to temperature and relative humidity during 2016 and 2017 seasons

Season	Factor	Cultivar			
		Giza 45	Giza 86	Giza 87	Giza 92
2016	Temp. (°C)	0.58*	0.44^{NS}	0.50^{NS}	0.47^{NS}
	RH (%)	0.27^{NS}	0.15^{NS}	0.28^{NS}	0.15^{NS}
2017	Temp. (°C)	0.59*	0.59*	0.60*	0.72**
	RH (%)	0.19^{NS}	0.08^{NS}	0.04^{NS}	0.18^{NS}

* = Significant at 0.05 level of probability. **= Highly significant at 0.01 level of probability. NS= Not significant.

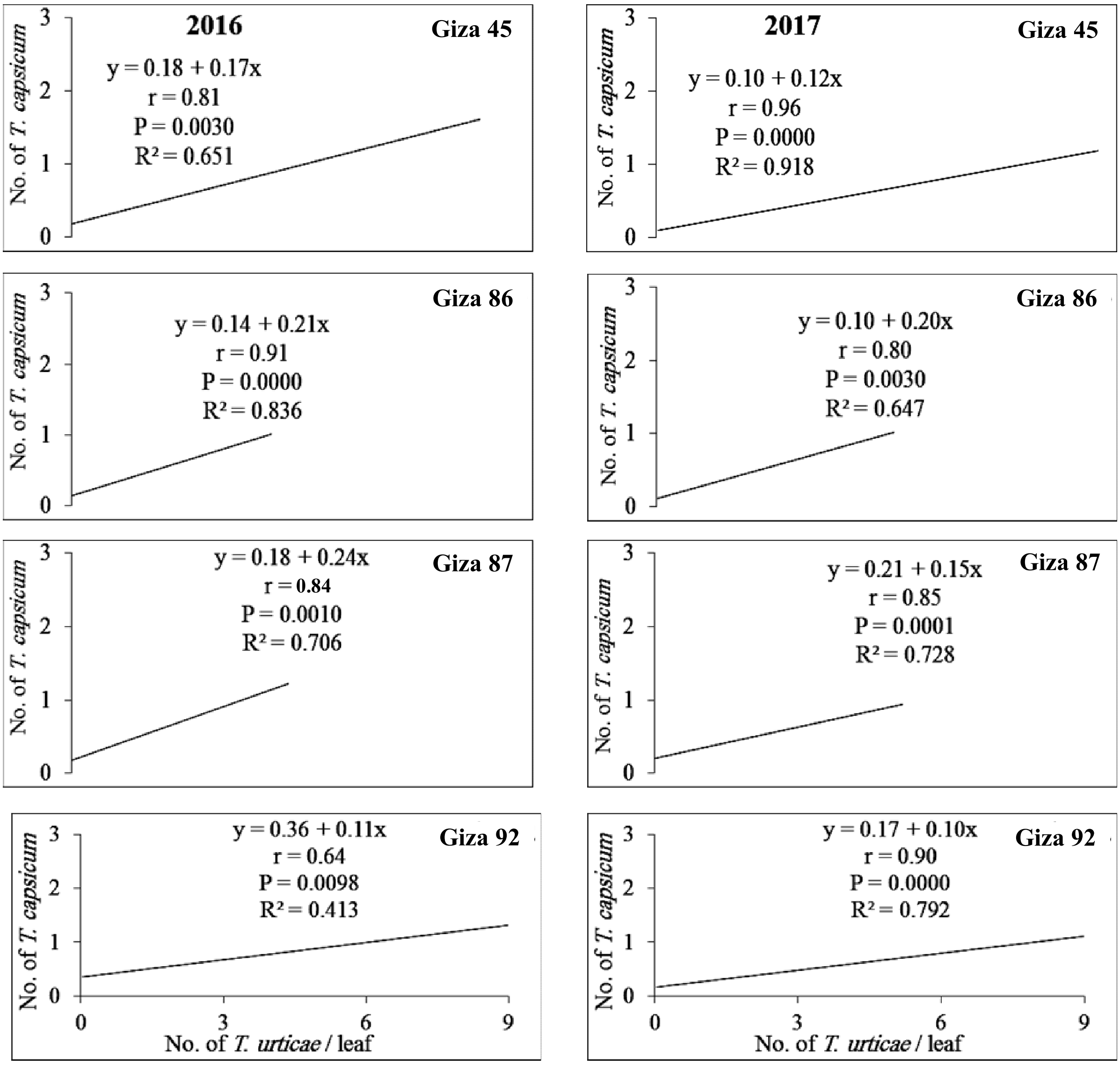

Fig. 1. Relationship between populations of *T. urticae* and the predatory mite, *T. capsicum* on four cotton cultivars during 2016 and 2017 seasons

during June, July and August on eggplants and okra plants. Also, on okra plants TSM peak of activity was recorded on April (**Natarajan, 1989**), January to April (**Lal, 1982**), May-June (**Sharma and Pande, 1981; Singh and Singh, 1993**). With respect to **Dhooria (2003)**, the peak population of TSM was appeared on tomato from September to November and on eggplants, cucurbits, cowpea from May to June. According to **Gupta *et al.* (1971)**, TSM attacked plants during hot and dry period *i.e.* April to June, resulting in significant yield loss. The variations between the present results and others may be attributed to host plant species and/or the variation of ecological factors.

The obtained results showed that TSM population was significantly higher on cotton cultivars Giza 45 and Giza 92 in comparison with cultivars Giza 86 and Giza 87 during the first and second growing seasons. These results corroborate previous studies that demonstrated differences in spider mites performance on different host plants (**Gould, 1978; Rovenska *et al.*, 2005**). Also, ovipositional rate was used to differentiate host suitability of the tested plants (**Dabrowski and Bielak, 1978**). The variation in host preference of TSM may be attributed to chemical plant compounds and plant trichomes, since **Rasmy (1985)** and **Maluf *et al.* (2001)** reported that trichomes vary in both size and intensity in tomato, cherry tomato and eggplant leaves with varying effects on spider mites. The host plant range of TSM may also be determined by the selection pressure imposed by the low host plant suitability on potential hosts (**Yano *et al.*, 1998**).

Plant species show variations in their direct defense mechanisms against herbivorous pest, such as the composition of toxic secondary metabolites, proteinase inhibitors, spines and glandular hairs (**Rhoades and Cates, 1976; Rhoades, 1985 ; Rosenthal and Berenbaum, 1991**). Besides direct defense, plants can also defend themselves indirectly by promoting the effectiveness of natural enemies of the herbivores, for example by offering alternative food or shelter (**Price *et al.*, 1980**; **Price, 1981; Dicke, 1999; Sabelis *et al.*, 1999**). Another way of indirect defense is to attract predators by the release of herbivore induced volatiles, which differ from the volatiles of mechanically damaged leaves in a qualitative and/or quantitative way (**Dicke and Sabelis, 1988a; Dicke, 1999**). The volatile chemicals induced in plants by herbivores that play a role in the attraction of the predators are called synomones (**Dicke and Sabelis, 1988b**). So, plants infested with TSM may indirectly defend themselves by releasing volatiles that attract the predatory mite, *Phytoseiulus persimilis* (**Van den Boom *et al.*, 2002**). These findings may explain the high synchronization between TSM and *T. capsicum* populations on cotton cultivars in the present study. Also, **Bruin *et al.* (1992)**, **Takabayashi *et al.* (1994)** and **Krips *et al.* (1996)** reported that the predatory mite *P. persimilis* is attracted to TSM-induced plant volatiles has been presented for many host plants. Moreover, the attraction of *T. capsicum* to TSM-infested plants cannot be explained by herbivore-derived volatiles but is caused by plant-derived volatiles (**Van den Boom *et al.*, 2002**).

Statistical analysis showed that TSM and *T. capsicum* populations were positively correlated with the increase of air temperature during the first and second seasons of the present study. On the other hand, relative humidity, populations of TSM and *T. capsicum* were insignificantly positive correlated with the changes of it. These results are confirmed by **Putatunda and Tagore (2003)**, **Gulati (2004)** and **Haque *et al.* (2011)**. They reported that temperature had direct positively impact on TSM populations on various host plants. **Chhillar *et al.* (2007)** stated that most of the phytophagous mites remain at low level during winter season. According to **Jeppson *et al.* (1975)**, warm and dry weather is favourable for the multiplication and spread of TSM. **Khalequzzaman *et al.* (2007)** reported that temperature and humidity are of the factors affected the activity of *T. capsicum*. On the other hand, the present study comes in the same line of **Putatunda and Tagore (2003)** who found no relation between TSM population and relative humidity.

Results of this study indicate that the tested cotton cultivars were found to be favorable hosts for the tetranychid mite, *T. urticae* and may be considered as a serious pest for these cultivars. The most predaceous mites recoded on these cultivars, the phytoseiid species *T. capsicum* that showed an important role as a potential biological control agent against *T. urticae* on cotton plants in Egypt.

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الوفــرة المـوســـمية لحُلُــم العكنبــوت الأحمـــر ذو البقعتيـــن علــــى أربعـــة أصناف من القطن في محافظة الدقهلية - مصر

ربيع السيد عبده إسماعيل[١]ــ عبدالعزيز النشرتي باشة[٢]ــ السيد محمود مصطفى[٢] ــ أحمد السيد عبد المجيد[١]

١- معهد بحوث وقاية النباتات - مركز البحوث الزراعية - مصر

٢- قسم وقاية النبات - كلية الزراعة - جامعة الزقازيق - مصر

يُعتبر حُلُم العنكبوت الأحمر ذو البقعتين *Tetranychus urticae* Koch من آفات الحُلُم الرئيسية على المحاصيل الزراعية وعالمية الانتشار، وتهدف الدراسة الحالية إلى دراسة تعداد حُلُم العنكبوت الأحمر ذو البقعتين وأيضا الحلم الفيتوسيدى المفترس *Typhlodromips capsicum* Mostafa الأكثر انتشاراً على أربعة أصناف من القطن هي جيزة ٤٥ و جيزة ٨٦ وجيزة ٨٧ وجيزة ٩٢ والأكثر زراعةً في مصر خلال موسمي الزراعة ٢٠١٦ و ٢٠١٧ بمنطقة أجا في محافظة الدقهلية بمصر وعلاقة ذلك بدرجة الحرارة والرطوبة النسبية الجوية السائدة، وأيضاً دراسة علاقة الارتباط بين تعدادات حُلُم العنكبوت الأحمر ذو البقعتين والحُلُم المفترس تحت ظروف الحقل على أربعة أصناف من القطن سالفة الذكر، أظهرت النتائج المتحصل عليها أن أعداد حُلُم العكنبوت الأحمر كانت عالية بدرجة معنوية علي صنفي جيزة ٤٥ وجيزة ٩٢ بالمقارنة مع صنفي جيزة ٨٦ وجيزة ٨٧ خلال موسمي ٢٠١٦ و٢٠١٧، لم تتأثر أعداد الحُلُم المفترس بأصناف القطن المختلفة، وإحصائياً وجدت علاقة ارتباط موجبة بين التغير في أعداد حُلُم العنكبوت الأحمر ذو البقعتين والحُلُم المفترس ودرجة الحرارة، كما وجدت علاقة ارتباط موجبة غير معنوية للرطوبة النسبية خلال موسمي الزراعة، بينما وجدت علاقة تزامن جيدة بين أعداد حُلُم العنكبوت الأحمر والحُلُم المفترس على جميع أصناف القطن المختبرة أثناء الموسمين الأول والثاني، وعموماً توضح هذه النتائج أن أصناف القطن والحُلُم المفترس والظروف الجوية من العوامل التي تؤثر في أعداد حُلُم العنكبوت الأحمر ذو البقعتين على أصناف القطن المُختبرة.

المحكمـــون:

١- أ.د. نبيل عبدالله أحمد إبراهيم أستاذ الحيوان الزراعي – كلية التكنولوجيا والتنمية – جامعة الزقازيق.

٢- أ.د. مصطفى النبوي محروس أستاذ الحيوان الزراعي المتفرغ – كلية الزراعة – جامعة الزقازيق.