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FIELD EVALUATION OF SOME SOYBEAN CULTIVARS FOR THEIR RELATIVE SUSCEPTIBILITY TO THE TWO-SPOTTED SPIDER MITE, *Tetranychus urticae* KOCH INFESTATION WITH RELATION OF SOME BIOTIC AND ABIOTIC FACTORS AT ASSIUT GOVERNORATE (Acari: Tetranychidae)

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ABSTRACT

Field experiments were carried out in Abnoub district, Assiut Governorate during two successive seasons 2010 and 2011 to study the population fluctuation of the two-spotted spider mite, *Tetranychus urticae* Koch and some associated common predators (*Scymnus* spp., *Orius* spp., *Geocoris pallidipennis* (Costa), *Charysoperla carnea* Stephens and true spiders) on seven soybean varieties. Also, the effect of different plant growth stages, common predators and some prevailing weather factors on the infestation of soybean varieties and the relative susceptibility of soybean varieties to infestation were studied. The obtained results indicated that Giza 111 variety attain the highest population of *T. urticae* while the lowest one was recorded with the two varieties Giza 22 and H 32. Moreover, coincidental appearance for both *T. urticae* and associated common predators. So, firstly appeared in low numbers during July then increased gradually to reach the peak during the end of August. Therefore, the population decreased sharply from September to the end of season, for all soybean varieties during the two seasons 2010 and 2011.

The effects of certain biotic and abiotic factors on the population density of *T. urticae* were investigated. The obtained data showed that the plant growth stages played the most important roles in regulating the population density of the two-spotted spider mite. Also, it could be substituted equations for predicting the infestation of *T. urticae* on soybean.

The soybean varieties differed in their relative susceptibility to the infestation with *T. urticae*. Whereas, Giza111, H30 and Clark were the highly susceptible varieties (HS). While, H117 and H127 varieties were exhibited relatively resistant (RR), but Giza22 and H32 varieties manifested a resistant degree (R).

INTRODUCTION

Soybean, *Glycine max* (L.) Merr., considered one of the relatively new crop into the Egyptian agricultural, which combines in one crop both the dominant supply of edible vegetable oil, and dominant supply of high-protein feed supplements for livestock. Other fractions and derivatives of the seed have substantial economic importance in a wide range of industrial, food, pharmaceutical, and agricultural products (Smith and Huyser, 1987). Yield and productivity of soybean can be significantly affected by some biotic factors such as insect and mite pests.

The two-spotted spider mite, *Tetranychus urticae* Koch, considered one of the main economic pests of soybean, which cause a great damage and sever losses (Taha *et al.* 1995; Shaalan *et al.* 2007 and El-Sanady *et al.* 2008). Many authors stated that the spider mites population reached its peak during the flowering and pod–formation period, which affected with different factors such as variety, sowing date and climatic factors (Zaher and Hanna 1980; Sawires *et al.* 1990 and Taha *et al.* 1995). The role of the predaceous

insects and mites in suppressing the population of the main soybean pests have been reported by several investigators (Wheatley and Boethel, 1992; El-Khouly *et al.* 1998; Gamieh and El-Basuony 2001 and Shaalan *et al.* 2007).

However, the population fluctuation of spider mites are affected by various biotic and abiotic factors, which play important roles in regulating their populations (Kogan and Herzog, 1980; Dent, 1991).

Soybean varieties differ as regard to their susceptibility to infestation with the spider mites, *Tetranychus* spp. (Sawires *et al.* (1990); Gamieh and El-Basuony (2001) and El-Sanady *et al.* (2008).

The objective of the present work is to study the density and population fluctuation of *T. urticae* in relation to plant growth stages, common associated predators and some prevailing climatic factors, during two successive growing seasons (2010 and 2011). Also, to obtain a better understanding of the classification of the susceptibility degrees of seven soybean varieties as host plants to spider mites, by considering general mean number of *T. urticae* / variety, as the standard of classification.

MATERIALS AND METHODS

The present investigation was conducted at Abnoub district located 25 km northeast of Assiut city, during two successive seasons, 2010 and 2011 to study the density and population fluctuation of *T. urticae* and some common predators (*Scymnus* spp., *Orius* spp., *G. pallidipennis*, *C. carnea* and true spiders) on some soybean varieties as well as the relative susceptibility of these varieties in relation to some biotic and abiotic factors. Seven soybean varieties (Hybrid 117, 127, 30 and 32; Giza 22 and 111 and Clark varieties) were sown during the first half of June for both seasons. An area of half feddan was chosen and divided into 28 plots. The seven soybean varieties were distributed in complete randomized blocks design with four replicates each. Normal agriculture practices were performed and no chemical pest control was done during the study periods. To determine the numbers of *T. urticae* and the common associated predators, successive weekly samples of ten leaves for each plot picked up at random were examined, starting from the first week of July until the end of season. Also, the period of each growth stage of soybean plant age was recorded, including (i.e. vegetative, flowering and fruiting stages).

Records of maximum and minimum temperature and average relative humidity (abiotic factors) were obtained from the meteorological station located at the Fac. Agric. Exp. Farm, Assiut University. The average numbers of the population density of *T. urticae* and both biotic and abiotic factors, within the inspected periods and through the examined seasons, was statistically analyzed using Multiple Regression Analysis (Fisher, 1950). These analyses were conducting using SAS statistical software (SAS Institute, 1988).

Classification of the susceptibility degrees of the tested soybean varieties to the two spotted spider mite, *T. urticae* infestation could depend on the mean number of *T. urticae* per variety as reported by Chiang and Talekar (1980), Nosser (1996) and Amro and Abdel-Galil (2008) with few modifications. General mean number (Mn) of *T. urticae* / variety was considered as the standard of classification. Range of change in susceptibility

(Rc) within a given soybean variety is equal: Maximum mean number – Minimum mean number. Unite change in soybean varieties (Uc) is the amount of change from one degree of susceptibility to the proceeding or the preceding degree whereas, Uc = Rc / 4. So, the tested soybean varieties could be classified into the following categories. The soybean varieties that had mean number of *T. urticae* more than (Mn+Uc) were considered highly susceptible (HS); ranging from (Mn) to (Mn+Uc), susceptible (S); less than Mn to (Mn – Uc), relatively resistant (RR); ranging from < (Mn – Uc) to (Mn – 2Uc), moderately resistant (MR) and less than (Mn – 2Uc) were considered resistant (R). Data obtained were statistically analyzed by using F-test. The mean were compared according to Duncan's multiple rang test (Snedecor and Cochran, 1971).

RESULTS AND DISCUSSION

1-Impact of soybean varieties on the population density of *T. urticae* infesting soybean plants:

Data in (Table 1) show the mean differential responses of seven soybean varieties cultivated during two successive growing seasons (2010 and 2011), to the infestation of *T. urticae* and the associated predators. It is evident from the obtained results that highly significant difference between the two seasons was observed for the mean of spider mite, *T. urticae* infestation (F=15.85; df=1; p=0.0001; LSD=6.934) of associated predators (F=22.72; df=1; p=0.0001; LSD= 0.887). The infestation of *T. urticae* and its associated predators during the second season (52.55 and 8.25 individuals/10 leaves) were higher than the first one (38.50 and 6.14/10 leaves). Also, soybean varieties indicated highly significant differences for the infestation of *T. urticae* (F=10.02; df=6; p=0.0001; LSD=12.972) and its associated predators (F=2.88; df=6; p=0.0108; LSD=1.64). The variety Giza 111 achieved the highest population of *T. urticae* and predators (970.49 and 8.28 individuals/10 leaves) with significant difference for *T. urticae* and insignificant difference for predators than the other varieties. While, the lowest infestation of *T. urticae* recorded with the two varieties Giza 22 and H 32 (28.87 and 29.53 individuals/10 leaves) with insignificant difference between them. However, the two varieties, Clark and H 117 harbored the lowest number of predators (5.32 and 6.51 individuals/10 leaves). These results are in harmony with finding of Sawires *et al*. (1990), Gamieh and El-Basuony (2001) and El-Doksh (2006) who found that soybean genotypes were different in susceptibility to spider mites, *Tetranychus* spp. infestation.

2-Population fluctuation of spider mite, *T. urticae* and its common predators occurring on soybean varieties:

The population fluctuations of the two spotted spider mite, *T. urticae* as well as the common predators (*Scymnus* spp., *Orius* spp., *G. pallidipennis*, *C. carnea* and true spiders) inhabiting seven soybean varieties (H117, H127, H30, H32, Giza22, Giza111 and Clark), during 2010 and 2011 seasons are illustrated in Figs. (1 and 2).

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F1-2

Results clearly revealed that the initial infestation of *T. urticae* took place in the first week of July, and then increased gradually during July and August to reach the peak during the fourth week of August. Thereafter, the number of individuals decreased sharply from the last week of August to the end of inspection, on the last week of September, for all soybean varieties during the two seasons. The obtained results agree with that finding by El-Doksh (2006) in Kafr El-Sheikh Governorate recorded many different peak times of *T. urticae* during July, August and September on different soybean varieties. Also, Takagi *et al.* (2008) indicated that *T. urticae* peaked during June, August, September, October and November throughout three seasons in Japan. However, these results disagree with that obtained by Louise *et al.* (2002) who mentioned that *T. urticae* reaching its peak in the end of July, when soybean planted in 20th May in El-Minia Governorate, while Shaalan *et al.* (2007) in Qalubiya Governorate showed that *T. urticae* reached its maximum during July.

Table (1): Average numbers of *T. urticae* and the associated common predators inhabiting some soybean varieties during 2010 and 2011 seasons, Assiut Governorate.

S. V.		Mites	Predators
Years	2010	38.50 b	6.14 b
	2011	52.55 a	8.25 a
F value		15.85	22.72
P		0.0001	0.0001
LSD		6.934	0.877
Varieties	H 117	39.47 cd	6.51 bc
	H 127	44.04 bc	7.33 ab
	H 30	53.18 b	7.49 ab
	H 32	29.53 d	7.42 ab
	Giza 22	28.87 d	8.00 ab
	Giza 111	70.49 a	8.28 a
	Clark	53.06 b	5.32 c
F value		10.02	2.88
P		0.0001	0.0108
LSD		12.972	1.64

Means followed by the same small letter(s) in the same column do not significantly different at 0.05 level of probability.

The predators showed coincidental appearance with *T. urticae*, which firstly appeared in low numbers during July throughout the two seasons (2010 and 2011) on the seven soybean varieties. Then, increased to record the highest numbers during the last and first week of August and September, respectively. Therefore, the population of predators fluctuated in few numbers until the end of the two seasons. El-Khouly *et al.* (1998) showed that the population of common predators; *Paederus alfrii* (Koch), *Coccinella undecimpunctata* (L.), *Charysoperla carnea* Stephens and *Scyminus* spp. in soybean fields were peaked twice, the first peak in late July and the second

one in late season during August and September in Kafr El-Sheikh Governorate. Shaalan *et al.* (2007) found that *Orius albidipennis* (Rossi) reached the maximum average on June 28th and July 17th during 2005 and 2006 seasons. These contradictory results may be due to differences of the locations, environmental conditions, soybean varieties and sowing dates.

1. Simultaneous effects of certain abiotic and biotic factors on the population density of *T. urticae* on some soybean varieties:

Data presented in (Table 2) show the multi-regression between the mean population density of *T. urticae* and some biotic factors [(plant age including three stages; vegetative stage (X_1), flowering stage (X_2) and fruiting stage (X_3); predators (X_4)], as well as some weather factors [max. Temp. (X_5); min. Temp. (X_6); relative humidity (X_7)] during the two studied seasons (2010 and 2011) on the seven soybean varieties.

Table (2): Multi-regression analysis between the mean numbers of *T. urticae* infesting soybean and each of plant age, predators and certain weather factors during 2010 and 2011 seasons, Assiut Governorate.

Removed variable		r	R	$R^2 \times 100$	Decrease in $R^2 \times 100$	E. V. %
Non		-	0.984	96.8	-	-
Plant age	Vegetative stage (X_1)	0.582 *	0.582	33.9	62.9	33.9
	Flowering stage (X_2)	0.406	0.908	82.4	14.4	48.5
	Fruiting stage (X_3)	0.263	0.946	89.4	7.4	7.0
Predators (X_4)		0.692 **	0.948	89.8	7.0	0.4
Max. Temp. (X_5)		0.150	0.958	91.8	5.0	2.0
Min. Temp. (X_6)		-0.272	0.965	93.2	3.6	1.4
Relative humidity (X_7)		0.197	0.984	96.8	0.0	3.6

r = Correlation coefficient. **R = Multiple regression coefficient.** **R^2=Coefficient of determination.**

E. V. % = Explained variance percentage. **** Significant at 1 % level of probability.** *** Significant at 5 % level of probability.**

The simple correlation analysis revealed that all studied variables had positive effect with *T. urticae*, except of insignificant negative effect for the minimum temperature. However, the coefficient of determination was (R^2 = 0.968) indicating that the seven mentioned variables were responsible for (96.8%) of the population changes for *T. urticae* on the seven soybean varieties during the studied period. Shaalan *et al.* (2007) indicated that the simple correlation coefficients of the relative humidity and predators were positive with *T. urticae*. El-Doksh (2006) revealed negative correlations of *T. urticae* with maximum and minimum as well as relative humidity on Giza21, Giza22 and Giza35 varieties, while positive correlation for Giza111 variety. Younes *et al.* (2001) reported that moving stages of *T. urticae* had positive correlated with temperature while it was negatively correlated with the relative humidity.

It is also evident from (Table 2) that by dropping each variable, step by step from the input analysis data, to explain the gradual representing efficiency

of each variable on the population changes of the mite pest (Explained Variance, E.V. %), the plant age representing in the three growth stages (flowering. Vegetative and fruiting stages) were ranked as the first three important factors (48.5, 33.9 and 7%, respectively) followed by the relative humidity, maximum temperature and minimum temperature (3.6, 2.0 and 1.4, respectively). While, the predators recorded the lowest effect (0.4%).

Because of plant age realized the main effect on population density of *T. urticae*, regression analysis was performed using the plant age per weeks (X) and the corresponding log mean number of *T. urticae* (Y). regression equation was presented in (Figure 3).

$Y = 0.4482 + 0.1731 X + 0.1102 X^2 + 0.0088 X^3$

f

It seems that the cubic regression model provided the best fit of the data by indicating the high value of determination coefficient ($R^2 = 0.894$) and showing highly significant difference among the plant ages for the number of *T. urticae* (F=25.38; df=3,9 ; p=0.0001). Based on this model the population density of *T. urticae* on soybean can be predicted by looking for plant age. In general, when the soybean plants were in the flowering stage during the second half of August, at this time *T. urticae* recorded the highest population density.

In concurrence with these results, El-Doksh (2006) and Salem *et al.* (2012) mentioned that the population of *T. urticae* attained its peak during the last week of August.

2. Relative susceptibility of soybean varieties to spider mite, *T. urticae*:

Data represented in table (3) summarized the relative susceptibility degree of the seven soybean varieties to spider mite, *T. urticae*. The relative susceptibility level were calculated during each season separately and for two seasons together for achieving more accurate data about this phenomenon under study. Statistical analysis of the data revealed highly significant differences (P< 0.01) between the tested soybean varieties as well as between the two seasons.

Table (3): Average numbers [(a)] and susceptibility degrees of certain soybean cultivars to *T. urticae*, during 2010 and 2011 seasons, Assiut Governorate.

Soybean cultivar	2010		2011		MEAN	
	Mean ± SD	Susceptibility degree	Mean ± SD	Susceptibility degree	Mean ± SD	Susceptibility degree
H117	31.87±6.77bcd	RR	47.08±8.43bcd	RR	39.47±10.78 cd	RR
H127	40.08±9.04abc	S	48.00±2.81bcd	RR	44.04±7.40 bc	RR
H30	42.64±3.37 ab	S	63.72±4.99 b	S	53.18±12.16 b	HS
H32	22.03±4.06 d	R	37.03±14.19cd	MR	29.53±12.44 d	R
Giza 22	29.84±11.79cd	MR	27.90±15.02 d	MR	28.87±12.12 d	R
Giza 111	52.20±12.89 a	HS	88.77±20.47 a	HS	70.49±25.20 a	HS
Clark	50.79±1.38 a	HS	55.33±10.83bc	S	53.06±7.34 b	HS
Mean	38.49±12.59**B**		52.55±21.41**A**		45.52±18.75	
F-value	8.69 **		6.93 **		10.02 **	

(a) Based on 10 soybean leaves / plot.

F value: ** = Highly significant at 0.01 level probability.

Means followed by the same letter(s), in each column, are not significantly different at 0.05 level probability, by Duncan's multiple range test.

Means followed by the same bold capital letter, in each row, are not significantly different at 0.05 level probability, by Duncan's multiple range test.

S= Susceptible HS= Highly Susceptible RR= Relatively Resistant

MR= Moderately Resistant R= Resistant

The used statistical method enabled to classify the tested soybean varieties into various relative resistance categories. During the first season, data (Table 3) showed that, Giza111 and Clark exhibited highly susceptible degree (HS), which harbored the highest average numbers of *T. urticae*, followed by H30 and H127 were susceptible varieties (S). While, H117 variety showed some sort of resistance and appeared as relatively resistant (RR). On the other hand, Giza22 variety was moderately resistant (MR). The lowest number of spider mite, *T. urticae* was recorded on H32 variety. Therefore, it could be considered as a resistant variety (R).

On the other hand, data (Table 3) indicated similar response of the varieties H117, H30, Giza22 and Giza111 with the first season. However, the three varieties H127, H32 and Clark showed differential response than the first season. The soybean variety H127 had relatively resistant (RR) and H32

variety had moderately resistant (MR), while Clark variety had susceptible degree (S) for the infestation by *T. urticae*.

The average combined data of the two seasons, irrespective of growing seasons (Table 3), manifested a resistant degree (R) in two soybean varieties Giza22 and H32 to *T. urticae* infestation; whereas varieties of H117 and H127 appeared as relatively resistant varieties (RR), while varieties of Giza111, H30 and Clark seemed to be highly susceptible varieties (HS). In conformity with these results, Salman *et al.* (2002) realized that Giza21 and Crawford were susceptible, while Giza111, Giza35, Giza82 and Clark were low resistant for *T. urticae* infestation during the two successive seasons, 1999 and 2000 in Sohag Governorate. El-Doksh (2006) observed that Giza111 and Giza35 varieties were the most susceptible ones to infestation with moving stages of *T. urticae*, while Giza21 had the lowest susceptibility of infestation. Also, these results are in harmony with those of El-Sanady *et al.* (2008) who stated that Giza22 was intermediate but Giza111 was highly susceptible to *T. urticae* infestation.

From the aforementioned results, soybean varieties of Giza22 and H32 followed by H117 and H127 can be recommended as varieties for their resistant or relatively resistant to *T. urticae* infestation. Finally, Van Edmen (1987) reported that, the variations in the susceptibility degrees among the tested soybean varieties towards the infestation by *T. urticae*, may be due to the presence of antixenosis (non preference) and /or antibiosis phenomena.

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تقييم حقلي لبعض أصناف فول الصويا للإصابة بآكاروس العنكبوت ذو البقعتين *Tetranychus urticae* Koch وعلاقتها ببعض العوامل الحيوية والغير حيوية في محافظة أسيوط (Acari: Tetranychidae)

ماجد زاهي إمبارك

معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الجيزة- جمهورية مصر العربية

أجريت تجارب حقلية على سبع أصناف فول صويا في مركز أبنوب ، بمحافظة أسيوط خلال موسمي ٢٠١٠ و ٢٠١١ لدراسة تعداد آكاروس العنكبوت الأحمر ذو البقعتين وبعض المفترسات المصاحبة (الاسكمنس ، الاوريس ، الجيوكوريس ، أسد المن ، العناكب حقيقية). وكذلك دراسة تأثير بعض العوامل الجوية والمفترسات على إصابة فول الصويا بآكاروس العنكبوت ذو البقعتين ، ومدى قابليتها للإصابة بالعنكبوت الأحمر.

أوضحت النتائج أن أعلى تعداد لآكاروس العنكبوت ذو البقعتين قد سجل على صنف Giza 111 بينما اقل تعداد سجل على Giza 22 ، H 32. أيضا هناك تزامن بين ظهور كل من آكاروس العنكبوت ذو البقعتين والمفترسات المصاحبة. حيث ظهر كل من آكاروس العنكبوت والمفترسات خلال شهر يوليو ثم زاد التعداد تدريجيا ليصل إلى القمة خلال الأسبوع الرابع من أغسطس ثم أخذت الأعداد تتناقص بشدة بداية من شهر سبتمبر حتى نهاية الموسم وذلك خلال موسمي الدراسة (٢٠١٠ ، ٢٠١١ م).

عند دراسة تأثير بعض العوامل الحيوية والغير حيوية على الكثافة العددية لآكاروس العنكبوت ذو البقعتين. أوضحت النتائج أن عمر النبات يلعب دورا هاما في تنظيم تعداد هذه الآفة حيث وجد أن مرحلة التزهير تؤثر في تعداد الآكاروس بنسبة (٤٨.٥ %) يليها مرحلة النمو الخضري (٣٣.٩ %) ثم مرحلة النمو الثمري (٧ %) ، يليهم من حيث الأهمية في التأثير كل من الرطوبة النسبية ، الحرارة العظمي ، الحرارة الصغرى ، المفترسات بنسب (٣.٦ ، ٢.٠ ، ١.٤ ، ٠.٤ %). أيضا أمكن استنتاج معادلة من الدرجة الثالثة للتنبوء بالإصابة بآكاروس العنكبوت ذو البقعتين على فول الصويا ، أوضحت أن أعلى تعداد للآكاروس خلال مرحلة التزهير في شهر أغسطس في اتفاق مع تعداد الآكاروس الموجود فعلا على النبات .

من ناحية أخرى ، اختلفت أصناف فول الصويا في درجة قابليتها للإصابة بآكاروس العنكبوت ذو البقعتين. فقد أوضحت النتائج أن الأصناف Giza 111 ، H 30 ، Clark كانت شديدة القابلية للإصابة. في حين أن الأصناف H 117 ، H 127 أظهرت مقاومة نسبية للإصابة ، بينما أوضحت الأصناف Giza 22 ، H 32 درجة مقاومة للإصابة بآكاروس العنكبوت ذو البقعتين.