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POPULATION DYNAMICS OF THE TWO SPOTTED SPIDER MITE, *Tetranychus urticae* KOCH IN RELATION TO SOME SPECIFIC CHEMICAL CONSTITUENTS OF FOUR PEPPER VARIETIES LEAVES

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ABSTRACT: *An experiment was conducted in a greenhouse at Qalubiea Governorate to estimate the population dynamics of the two spotted spider mite, Tetranychus urticae Koch on four pepper varieties; two with yellow-coloured fruits (Llobii and Cobly) and two with red-coloured fruits (Lorekii and Depika) during a single growing season. Also, it was carried out for the analysis of some specific chemical constituents of all varieties leaves and clarifies the resistance of the mite infestation.*

The results showed that the two pepper varieties with red colour fruits were more susceptible cultivars as their harbored significantly higher number of spider mite stages (20.11 adults, 74.81 immature and 71.88 eggs / leaflet for Lorekii and 16.03 adults, 70.53 immature and 70.12 eggs / leaflet for Depika), than those with yellow colour fruits (5.76 adults, 16.98 immature and 18.51 eggs / leaflet for Llobii and 5.88 adults, 15.31 immature and 16.40 eggs / leaflet for Cobly; LSD; $P < 0.05$), which are iea susceptible ones to T. urticae.

The obtained data indicated that there was correlation between the phytochemical contents and the rate of mite infestation. Analysis of chemical constituents of pepper leaves showed that red coloured-fruits varieties had significantly higher number of phytophagous mite (LSD; $P < 0.05$) which was associated with higher levels of sugar content (23.75% for Lorekii and 24.92% for Depika) and this indicates a positive significant relationship with the population densities and sugar content. While the reverse was true with total phenol (0.26 for Lorekii and 0.25 % for Depika), which indicates a negative significant relationship. On the other hand, the yellow-coloured fruit varieties exhibited lower infestation number of phytophagous mite (LSD; $P < 0.05$) and this was associated with lower levels of sugar content (19.44 % for Llobii and 19.32 % for Cobly), contrary to total phenol (0.29 % for Llobii and 0.30 % for Cobly), which indicates a negative significant relationship with the population densities.

Key words: *population dynamics Two-spotted spider mite, Tetranychus urticae, yellow-coloured pepper fruits (Llobii and Cobly), red-coloured pepper fruits (Lorekii and Depika), chemical constituents.*

INTRODUCTION

Pepper, *Capsicum annum* L. (Family Solanaceae) is considered one of the important solanaceous plants cultivated in Egypt in both open fields and under greenhouses for local consumption and for exportation to the foreign markets. Pepper plants, are liable to infestation with the two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) especially under greenhouse conditions and it considered one of the most important pest (Abdallah, 2002), it feds on the plant sap causing serious damage varying according to the degree of infestation. The infestation of mites reduce the quantity and quality of harvestable fruits (Trumble and Nakakihara, 1984; Mckinlay and Thomson, 1987 and Kunimoto, 2000).

During the last years, several pepper varieties with different coloured fruits was appeared in the local markets. There was a need to estimate their liability to infestation with two spotted spider mite especially under the greenhouses in order to select the most resistant one to avoid use of any chemicals to control this pest. Dahms (1972) identified 16 possible criteria to evaluate pest resistance in plants among which the number of pest motile stages attracted to cultivars when given a free choice. Painter (1951) defined tolerance as a resistance in which the plant shows an ability to grow and reproduce or to require pest injury to a marked degree in spite of supporting as insect population early equal to that damaging in susceptible host. The susceptibility of different vegetable crops to mite infestation was studied by several authors among them; Farrag *et al.* (1980), Sharaf (1986), and Doss *et al.* (1995) on beans, Helaly *et al.* (1982) , East and Edelson (1990) on watermelon, Megali *et al.* (1992) and Darwish *et al.* (1996) on pea. While few studies available about the susceptibility of different pepper varieties to mite infestations, Megali and Faris (1997), and Iskandar *et al.* (2002) on pepper, Abou-Zaid (2007) on five different cucumber cultivars.

The present study was undertaken in a greenhouse to estimate the population fluctuation of the two spotted spider mite, *T. urticae* on four pepper varieties; two with yellow-coloured fruits (Llobii and Cobly) and two with red-coloured fruits (Lorekii and Depika). Also, analysis of some specific chemical constituents includes total sugar, total phenols, total free amino acids and total carbohydrate of all pepper varieties leaflets was carried out.

MATERIALS AND METHODS

An experiment was conducted during the period from October, 2006 to May, 2007 in a glasshouse at Qalubia governorate. Nursery of four pepper varieties, *i.e.* two with yellow-coloured fruits (Llobii and Cobly) and two with red-coloured fruits (Lorekii and Depika) were transplanted. Two rows of each four varieties was cultivated alternatively and replicated four times for each variety. After three weeks from transplanting, weekly samples of ten leaves of each variety were picked and placed separately into plastic bag and transported to the laboratory. All mite stages (egg, immature and adult) were

counted using stereomicroscope and the average number of mite stages per 10 leaves were tabulated.

One-way analysis of variance (ANOVA) and mean comparison using Fisher's least significant difference (LSD) were conducted for the number of phytophagous mite, using the Super ANOVA program (Gagnon *et al.*, 1989). Significance level was $P \leq 0.05$.

Chemical analysis of pepper leaves: Three weeks after transplanting,

Samples of Pepper leaves of the four pepper varieties were collected and transferred to laboratory for analysis. Leaves were cut to small pieces. Five grams of these pieces for each variety were kept in small glasses which contain 50 ml ethyl alcohol 80 % at 10°C in the refrigerator. Samples were taken out of the refrigerator for homogenizing using a mixer. The homogenized samples were filtered through G-3 silica filter paper. Ethyl alcohol was added to the filterate up to 100 ml volume. Chemical analysis of some specific chemical constituents for the filterate was done according to the following procedures:

1- Total phenols determined by the colorimetric method of Floin-Denis as described by Swain and Hillis (1959).
2- Total amino acids were estimated as total of free amino acids according to Rosen (1965).
3- Total carbohydrates were estimated as total soluble sugars and total non-soluble sugar. They were determined according to Smith *et al.* (1965).

RESULTS AND DISCUSSION

Population dynamics of the two-spotted spider mite on pepper varieties:

The mite population dynamic is recorded over the whole season as weekly samples and graphically illustrated in (Figure 1) during 2006/2007 growing season on four pepper varieties. As for red coloured fruit varieties (Lorekii and Depika) the infestations by two spotted spider mite, *T. urticae* were early started and their population remained very lower 2.35 individuals for Lorekii and 6.90 individuals / leaves for Depika, to mid November; next the population started to increase rapidly to a peak in the mid of January and then the population decreased rapidly for both varieties. After that, they started to increase again towards the second peak and their maximum in the mid of April 342 individuals for Lorekii and 325.84 individuals / leaves for Depika after that the population decreased gradually till the end of the pepper growing season (Figure 1).

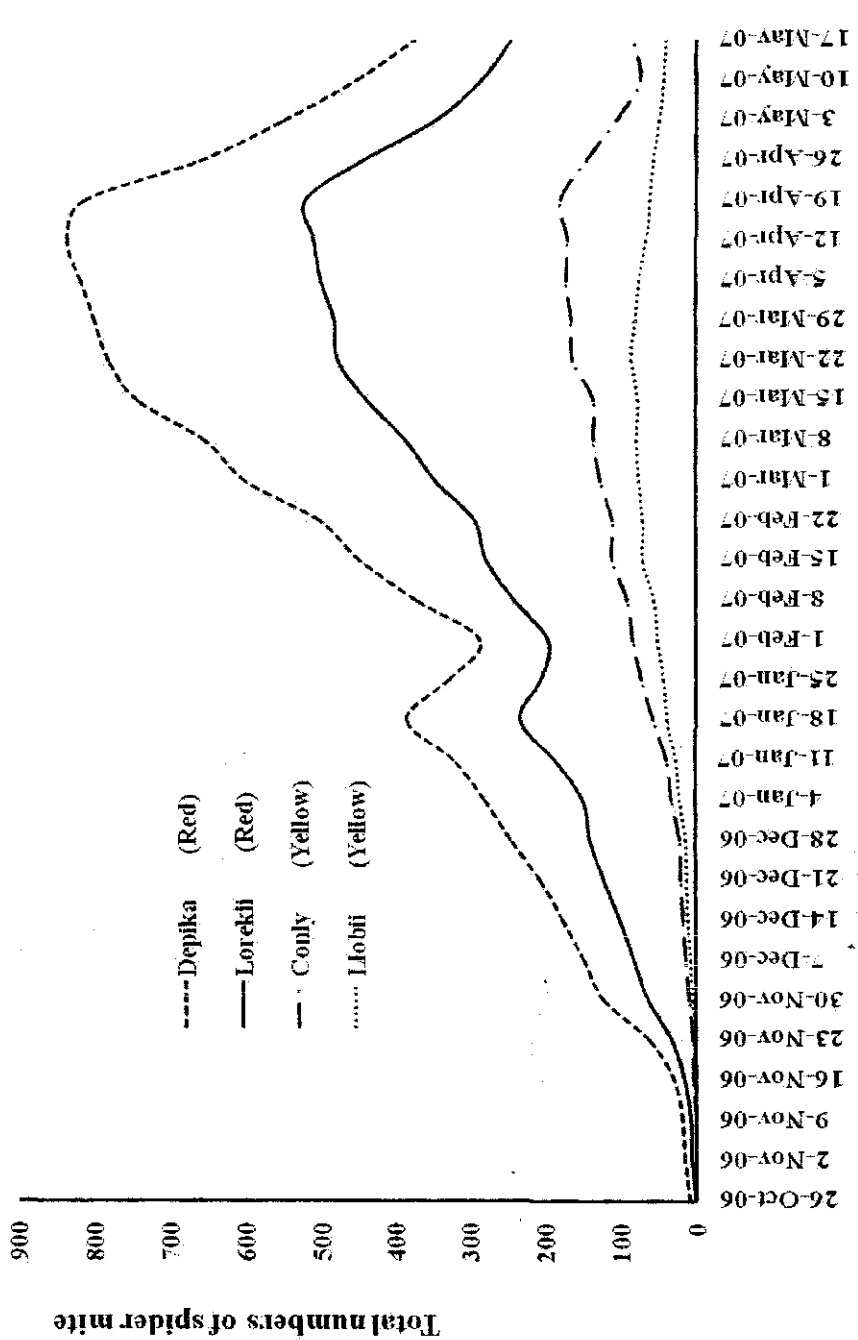

Figure 1: The population dynamic of *T. urticae* mobile individuals infested leaves of four pepper varieties.

The infestations by *T. urticae* on yellow colcur fruits and (Llobii and Cobhly) were zero at the three primary inspections (26 October to 9 November; Figure 1). The spider mite populations appeared with few numbers 2.61 for Llobii and 2.81 individuals for Cobly on 16 November and gradually increased to reach its maximum on 22 of March 86.12 individuals / leaves for Llobii. While for Cobly the population gradually increased to reach its maximum on 19 April 119.03 individuals / leaves; then the population decreased till the end of the growing season.

The overall mean numbers of spider mite eggs were significantly different among the pepper verities, being higher for pepper varieties with red colour fruits (Lorekii 71.88 eggs and Depika 70.12 eggs / leaves) than those with yellow colour fruits (Llobii 18.51 eggs and Cobly16.40 eggs / leaves; $F_{3,116}$ = 23.15; $p< 0.05$; Table 1). Also, there was a significant difference in average number of immature stages among the leaflets of pepper verities ($F_{3,116}$ = 25.46; $p< 0.05$). Likewise, over all mean numbers of adult stage were significant difference among the pepper verities, being higher on pepper varieties with red colour fruits (Lorekii 20.11 and Depika 16.03 individuals/ leaves) than those with yellow colour fruits (Llobii 5.76 and Cobly 5.88 individuals/ leaves; $F_{3,116}$ = 17.91; $p< 0.05$)

The results showed that the two pepper varieties with red colour fruits were more susceptible cultivars as their leaves had significantly higher total over all mean number of spider mite stages (166.80 for Lorekii and 156.68 individuals /leaf for Depika; Table 1), than those with yellow colour fruits (41.24 for Llobii and 37.58 individuals /leaflet for Cobly; LSD; $P < 0.05$) which are more resistant ones to *T. urtica* infestation..

The previous results are generally in agreement with results conducted before to evaluate the susceptibility of different vegetables varieties to the red spider mite infestation. Helaly *et al.* (1982) reported that Azmerly variety proved more favourable than Fetriat for *T. urticae* infestation on cowpea. Megali *et al.* (1992) stated that among the 16 pea cultivars; Danue, Norvist and Helka were the most tolerant cultivars to mite infestation. Doss *et al.* (1995) studied the comparative tolerance of three bean cultivars (Helda, Cerbo and Novax) to infestation with the spider mite, *T. arabicus*, and reported that the highly infested cultivars by the spider mite was Helda, while Cerbo was moderately invested and Novax had the lowest infestation. Also, Megali and Faris (1997) reported that among 42 bean cultivars tested to infestation by two-spotted spider mites, the cultivars HAB450, Kentucky-Blue and Flex were tolerant to mites infestation compared to the cultivars BARC-RR3, Tavera RS and Flexo. Iskandar *et al.* (2002) tested 13 pepper varieties against spider mites infestation, and found that both sweet and hot pepper groups were liable to mite infestation, but sweet pepper group was more susceptible to mite infestation than hot one; they found that Gedeon F1 and Pant F1 was the most resistant sweet pepper varieties also, Elpaso and Kayeen Lang Slim was the most resistant hot pepper varieties.

Table (1): Over all mean numbers of spider mite stages on leaves of the four pepper varieties

Red						Yellow					
Depika			Lorekii			Conly			Llobli		
Egg stage											
Mean ± SD	Max.	Min.	Mean ± SD	Max.	Min.	Mean ± SD	Max.	Min.	Mean ± SD	Max.	Min.
70.12 ± 47.52 $_a$	150.0	4.1	71.88 ± 47.81 $_a$	146.0	0.9	16.40 ± 15.71 $_b$	52.8	0.0	18.51± 13.04 $_b$	37.1	0.0
Immature stages											
70.53 ± 47.44 $_a$	143.7	1.2	74.81 ± 49.23 $_a$	154.0	0.6	15.31 ± 14.18 $_b$	47.2	0.0	16.98 ± 12.70 $_b$	35.1	0.0
Adult stage											
16.03 ± 10.50 $_a$	35.1	1.5	20.11 ± 13.83 $_a$	45.0	0.8	5.88 ± 5.42 $_b$	19.0	0.0	5.76 ± 4.79 $_b$	14.5	0.0
Total populations											
156.68 ± 104.14 $_a$	325.8	6.9	166.80 ± 109.77 $_a$	342.0	2.3	37.58 ± 35.15 $_b$	119.0	0.0	41.24 ± 29.97 $_b$	86.1	0.0

Observed (means) followed by different subscript letters within rows are significantly different from each other ($P < 0.05$) LSD test

Chemical analysis of pepper leaves:

Several workers have noted that different vegetable varieties present different effects of the potentials for phytophagous mites. The difference in suitability may be related to the chemical constitution of the host plant, to the leaf structure or to physical surface. Analysis of some chemical constituents of leaflets of the four pepper varieties showed that red coloured-fruits pepper varieties higher amount of total sugar (23.75% for Lorekii and 24.92 % for Depika; Table 2) and total carbohydrate (23.87 % and 24.93 % for the same varieties respectively), compared to the yellow-coloured fruit varieties which had les amount of total sugar (19.44 % for Llobii and 19.32 % for Cobly) and total carbohydrate (19.75 and 18.92 % respectively). While the reverse was true with total phenols where the yellow-coloured fruit varieties had the higher amount (0.29 % for Llobii and 0.30 % for Cobly) and total free amino acids (0.075 and 0.081 %, respectively), compared to the red-coloured fruit varieties which had amount of total phenols (0.26 for Lorekii and 0.25 % for Depika) and total free amino acids (0.052 and 0.053 % respectively).

Table (2): Chemical constituents of pepper leaves of four varieties

Varieties	Chemical			
	Total Sugar (%)	Total Phenols (%)	Total free Amino acids g/100 g (%)	Total Carbohydrates (%)
Yellow-coulured fruits varietie				
Llobii	19.44	0.29	0.075	19.75
Cobly	19.32	0.30	0.081	18.92
Red-coulured fruits varietie				
Lorekii	23.75	0.26	0.052	23.87
Depika	24.92	0.25	0.053	24.93

There are many reports about chemical constituents of resistant and susceptible plants to mite infestation. Differentiations in their total phenols, total amino acids and total carbohydrates are affected by mite infestation. Analysis of chemical constituents of leaflets of pepper varieties showed that red coloured-fruits varieties had significantly higher number of phytophagous mite species (LSD; $P < 0.05$) which was associated with higher levels of sugar content (23.75% for Lorekii and 24.92 % for Depika; Table 2) and these indicate a positive significant relationship with the population densities and sugar content. While the reverse was true with total phenol (0.26 for Lorekii and 0.25 % for Depika) and total free amino acids (0.052 and 0.053 % respectively), which indicate negative significant relationships with the population densities. On the contrary, the yellow-coloured fruit varieties exhibited lower infestation number of phytophagous mite (LSD; $P < 0.05$) and this was associated with lower levels of sugar content (19.44 % for Llobii and 19.32 % for Cobly), while the reverse was true with total phenol (0.29 % for

Llobii and 0.30 % for Cobly) and total free amino acids (0.075 and 0.081 % respectively), which indicated negatively significant relationships with the population densities as the results throughout the growing season.

The results confined that the increasing of total sugar content lead to an increase in the population of *Tetranychus uticae* on the tested varitites, while a negative relationship was detected with total phenol and free amino acids. Current findings agreed with previous studies, the high infestation of the mite may be related to the high sugar content exhibited (Nel, 1989 and El-Saiedy, 2003). Kielkiewiez *et al.* (1983); El-Saiedy (2003) and Mahgoub (2004) stated that the phenol content distribution in the infested tissues of the resistance leaves is considered as an important factor in the defense reactions of plants against mite attacks. It was evident from the above results that the red coloured-fruits varieties (Lorekii and Depika) were more suitable hosts for *T. urticae*. Contrary, the yellow-coloured fruit varieties (Llobii and Cobly) poor hosts for *T. urticae*, we recommend growing the yellow-coloured fruit varieties which previously classified as higher resistance ones.

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ديناميكية تعداد الأكاروس العنكبوتى ذو البقعتين الـ Tetranychus urticae وعلاقته بالتركيب الكميائى لاوراق الفلفل

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الملخص العربي

في القليوبية أجريت تجربة بالصوبة لتقدير الاصابة بالأكاروس العنكبوتى ذو البقعتين وتذبذب تعداده على اربع اصناف من الفلفل، صنفان أصفر اللون (Llobii and Cobly) والآخران أحمر اللون (Lorekii and Depika). و اجراء بعض التحاليل لمحتوى الاوراق وربطها بتعداد الآفه.

اوضحت الدراسة ان اصناف الفلفل ذوات اللون الأحمر أكثر حساسية لأن اوراقها تصاب باعداد كثيرة من الأكاروس (اطوار مختلفة) (فوجد بالنسبة للصنف الـ Lorekii ٢١,١١ فرد بالغ و ٧٤,٨١ اطوارغير بالغة و ٧١,٨٨ بيضة لكل ورقه و للصنف الـ Depika ١٦,٠٣ فرد بالغ و ٧٠,٥٣ اطوارغير بالغة و ٧٠,١٢ بيضة لكل ورقة) اكثر من الاصناف ذوات اللون الأصفر (فبالنسبة للصنف الـ Llobii ٥,٧٦ فرد بالغ و ١٦,٩٨ اطوارغير بالغة و ١٨,٥١ بيضة لكل وريقة و للصنف الـ Cobly ٥,٨٨ فرد بالغ و ١٥,٣١ اطوارغير بالغة و ١٦,٤٠ بيضة لكل ورقة).

وقد وجد ارتباط بين المحتوى الكيماوى للوريقه ومعدل اصابتها بالأكاروس. واظهر التحليل الكميائى لاوراق الفلفل بان اصناف الفلفل ذوات اللون الأحمر تصاب باعداد كثيرة من الأكاروسات والتى ترتبط بزيادة نسبة السكر فى الورقة (حيث وجد بنسبة ٢٣,٧٥ % للصنف الـ Lorekli و ٢٤,٩٢ % للصنف الـ Depika)، ويظهرهذا علاقة موجبة بين معدل الكثافة

العددية ومحتوى السكر.

بينما العكس كان صحيحاً مع نسبة الفينول (الصنف الـ Lorekii ٠,٢٦% وللصنف الـDepika ٠,٢٥ %) حيث كان هناك علاقة سالبة. وعلى الجانب الآخر، اظهرت اصناف الفلفل ذوات اللون الأصفر قلة الاصابة بالأكاروسات حيث ارتبط قلة تعدادها بقلة نسبة السكر فى الوريقات (حيث وجد بنسبة ١٩,٤٤% للصنف الـ Llobii و ١٩,٣٢ % للصنف الـ Cobly) و العكس صحيح مع نسبة الفينول (حيث وجد بنسبة ٠,٢٩% للصنف الـ Llobii و٠,٣٠ % للصنف الـ Cobly) واظهر هذا علاقة سالبة بالكثافة العددية للأكاروسات.