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Relationships of broad mite (Acari: Tarsonemidae) density to damage of apical pepper leaves and phytochemical components.

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Abstract : The effect of the feeding of the broad mite *Polyphagotarsonesmus latus* (Banks) (Acari: Tarsonemidae) on the phytochemical components of apical sweet pepper leaves (*Capsicum annuum L.*) in nethouses was studied. The research was performed on traveta cultivar as a host plant. Nutrients were estimated in healthy (control) and lightly and highly infested apical leaves. A 3-fold increase in the population density of *P. latus* from 5.2 to 14.9 per leaf, are accompanied by decrease of 56.3% and 49.2% in the fresh and dry weight, respectively. In the heavily infested apical leaves, nitrogen, phosphorus and total proteins were the highest. The same thing was noticed to iron, zinc and manganese contents. A decrease in the potasium and copper contents were also detected. The broad mite *P. latus* had the strongest influence in increasing concentrations on the most phytochemical components of its host plants.
Keywords: damage; *Polyphagotarsonemus latus*; Tarsonemidae; Acari; *Capsicum annuum*; macro-and micronutrients; fertilizers; apical leaves; agricultural-acarology.

Introduction

The broad mite, *Polyphagotarsonemus latus* (Banks)(Acari: Tarsonemidae), was first noticed on pepper plants by Abou-Awad in Egypt; then it infested other vegetables in nethouses and in open field[1]. Broad mites feed on plant juice and possibly inject toxic compounds in plant tissues[2]. The general look of the infested plants is similar to those affected by hormone weedkiller[3]. Individuals are found on young leaves along the central vein damaging the primordia or corona before they form. During vegetative growth, the damage is mainly limited to the terminal shoots and young leaves. Several recent studies have reported that sucking phytophagous mites drain nutrients from their host plants and inject substances which can be toxic to plant tissues and can lead to changes in the mineral content of the plants or in the leaf phytochemical components[4-8].

Our Purpose in this study was performed to assess the effect of the feeding of tarsonemids on the mineral content of the apical sweet pepper leaves of traveta cultivar. These data are necessary to predict the severe damage of *P. latus* in nethouses environments.

Materials and methods

Leaves of traveta sweet pepper cultivar (*Capsicum annuum L*), with a history of broad mite infestations in nethouses at Tahrir province, El-Behera Governorate, were selected for the study. Two sets of traveta apical leaves were determined. Each set was replicated 10 times, with a replicate of twenty leaves, were cut from heavily and lightly infested plants, approximately the same leaf area. Leaves were picked at random from all directions of the plants and kept in polyethylene bags. Infested apical leaves were investigated under the stereoscopic microscope in the laboratory to estimate density of broad mite populations and weighted immediately from fresh weight and after been dried at 70˚C for 72h, for dry matter weight. Another sets of healthy (normal) traveta sweet pepper apical leaves were collected and taken to the Mineral Nutrition of Plants Laboratory for foliar analysis of Macro-and micronutrients contents and total proteins. The dried leaves were crushed by the aid of homogenizer to fine powder and started in glass bottles to determine total nitrogen and potassium contents according to the methods of[9]. The phosphorous content was determined according to the method described by[10]. F-test and correlation were used for comparison.

Results and discussion

Apical leaf areas of traveta sweet pepper plants in nethouses measure up to 19 cm^2, with an average of 5 individuals of the mite per leaf was considered a light infestation and those with an average of 15 individuals per leaf a heavy infestation. Density of mites, fresh weight and dried matter weight of lightly and heavily infested apical leaves are given in Table 1. A 3-fold increase in the population density of *P. latus* from an average of 5.2 to 14.9 per leaf, are accompanied by decrease of 56.3% and 49.2% in the fresh and dry weight, respectively, responsible for the deterioration aspect of the heavily infested apical leaves.

Chemical analysis proved that there were significantly changes occurred in macro-, micronutrients, and total protein contents of heavily mite infested which play an important role in the relation between the host plant and the tarsonemid feeding. Nutrients of healthy, lightly and highly mite infested of apical leaves are given in Table 2. In heavily infested apical leaves: nitrogen, phosphorus and total proteins increase were highest (9.85%, 161.54% and 9.85% respectively). Micronutrients increase was also noted in the iron (15.41%), zinc (5.59%) and manganese (18.31%) contents. A decrease in the potassium (-2.45%) and copper (-19.38%) contents were also detected. Healthy leaves contained less concentration of these aforementioned nutrients when compared with lightly and heavily infested apical leaves, except potassium and copper contents. The two latter elements provide a higher nutritive value of the food for *P. latus* mite. No significant differences were found in nitrogen, zinc and total protein between lightly infested and healthy apical leaves.

Correlation coefficient (r) values were estimated to demonstrate the relationship between the densities of *P. latus* movable stages and the previous components. The obtained data presented in Table 3 showed that non-significantly positive correlation in case of nitrogen, phosphorus, total proteins, iron, zinc and manganese (r = 0.07, 0.77, 0.41, 0.20, 0.42 and 0.26, respectively), and negative in case of potassium (-0.11) and copper (-0.61). However [1] reported that the population density of *P. latus* immatures and adult stages on cucumber plants in plastic houses and under open field conditions increased by increasing true protein in the leaves, and its population decreased by increasing phosphorus and potassium elements. The majority of the data collected are in mostly agreed with those obtained from *Acristus cauliflorus* Schott. (Solanaceae) and *Bougainvillea spectabilis* Willd. (Nyctaginaceae) leaves infested by the two eriophyid mites *Aceria acnisti* Keifer and *Phyllocoptes bouganvilleae* Keifer, respectively [11] and in contrast with those obtained from peanut (*Arachis hypogae* L.) leaves infested by the leaf hopper, *Empoasca kraemeri* Ross and Moore, by [12] where a significant reduction in N, P, K, Ca, Mg and Mn leaf contents was observed.

Some results are also partially agreed with that obtained by many researchers. [13] recorded a significant positive correlation between *Tetranychus neocaledonicus* population and the nitrogen content on the leaves. [4] reported that there was no significant difference in N, P and K contents of healthy and infested leaves of the tossa jute cultivars and also in their interaction between cultivar and infestation by *P. latus*. On cucumber, [6] found that the relationship between *T. urticae* and nitrogen was positive, while it was negative with potassium and phosphorus. However, it is suggested that clear understanding of some nutrients removed from the sweet pepper apical leaves in nethouses by the broad mite, *P. latus* might enable some deficiencies caused by its feeding to be made up by special program application of specific fertilizers.

Table 1. Average weight of *Capsicum annuum* for twenty of both lightly and heavily infested apical leaves of traveta cultivar by *Polyphagotarsonemus latus*.

Traveta cultivar					
Lightly infested			**Heavily infested**		
No. mites	**Fresh weight (g)**	**Dry matter (g)**	**No. mites**	**Fresh weight (g)**	**Dry matter (g)**
4.0	2.4	0.45	13.2	1.2	0.2
5.8	2.2	0.40	19.8	0.6	0.2
5.2	2.5	0.52	14.0	1.2	0.2
4.2	2.7	0.52	11.0	1.3	0.3
8.8	1.7	0.33	5.6	1.3	0.3
5.2	2.4	0.36	17.4	1.0	0.2
5.0	2.4	0.44	16.0	1.1	0.2
3.8	2.9	0.55	8.0	1.1	0.25
7.0	1.7	0.30	32.4	0.6	0.2
3.0	2.9	0.56	11.6	1.0	0.2
S 52	23.8	4.43	149	10.4	2.25
X 5.2	2.38	0.443	14.9	1.04	0.225

Table 2. Average macronutrient % and micronutrient ppm in healthy and both lightly and heavily infested *Capsicum annuum* apical leaves by *Polyphagotarsonemus latus* of traveta cultivar.

Traveta cultivar					
Nutrients	**Healthy apical leaves**	**Lightly infested apical leaves**	**Heavily infested apical leaves**	**% increase/decrease attributed to mite infestation**	
				Heavily/Lightly	**Heavily/Healthy**
Macro-nutrients					
N	2.64±0.12 a	2.82±0.23a	2.9±0.38a	2.84	9.85
P	0.26±0.096a	0.38±0.22b	0.68±0.16c	78.95	161.54
K	1.142±0.057a	1.122±0.035b	1.114±0.065b	-0.71	-2.45
Total proteins	16.5±0.75a	17.625±1.44a	18.125±2.4a	2.84	9.85
Micro-nutrients					
Fe	281.6±8.61a	300.4±7.28b	325±7.07c	8.19	15.41
Zn	64.4±2.4a	66.8±1.72a	68±1.67ab	1.80	5.59
Mn	42.6±1.02a	50.2±1.72b	50.4±1.62b	0.40	18.31
Cu	32±1.41a	26.2±0.74b	25.8±1.166b	-1.53	-19.38

Different letters in a horizontal columns denote significant difference (F-test, $p<0.5$, $p<0.1$)

Table 3. Correlation coefficient between macro- and micronutrients and *Polyphagotarsonemus latus* populations on lightly and heavily infested apical leaves of traveta sweet pepper cultivar during 2009/2010 season.

Correlation coefficient values		
Nutrients	**Lightly infested apical leaves**	**Heavily infested apical leaves**
Macro-nutrients		
N	0.213	0.068
P	0.442	0.773
K	-0.024	-0.114
Total proteins	0.123	0.406
Micro-nutrients		
Fe	0.131	0.201
Zn	0.958	0.421
Mn	0.281	0.259
Cu	-0.433	-0.611

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