

## Control Measures of *Tetranychus urticae* Koch on Two Cucumber Cultivars in Plastic Houses

M. F. Hassan<sup>1</sup>, Fatma S. Ali<sup>1</sup>, A. M. Hussein<sup>2</sup> and M. H. Mahgob<sup>2</sup>

<sup>1</sup> Zoology and Agric. Nematology Dept., Faculty of Agriculture, Cairo University, Egypt.

<sup>2</sup> Plant protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

### ABSTRACT

Biological control of *Tetranychus urticae* Koch different stages on two cucumber cultivars (Sahm & Heikal) grown in plastic houses in Nubaria District, Beheira Governorate, during 2004&2005 seasons was studied. Four predator phytoseiid mites; *Phytoseiulus macropilis* (Banks), *Neoseiulus californicus* (McG.), *N. cucumeris* (Oudemans), and *N. zaheri* (Yousef and El-Borolossy) were used against *T. urticae* different stages. *N. californicus* and *P. macropilis* gave the highest reduction percentages of *T. urticae* different stages (97.36 & 97.51 % adults; 98.49 & 98.45% immatures and 99.36& 98.59% eggs) in Sahm cultivar, while in Heikal cultivar the percentages were 87.14 & 92.50 %; 98.50 & 97.38 % and 97.87&97.85%, respectively during 2004. Similar results were obtained, during 2005. Chemical control by spraying the two compounds Vertemic & Ortus proved that Vertemic was the best in reducing *T. urticae* different stages by 89.55, 95.37 & 94.00% of the aforementioned successive prey stages. Integrated pest control, showed that releasing *N. californicus* and *P. macropilis* after spraying Vertemic gave in general the high reduction of *T. urticae* different stages but less than Vertemic alone. However using the two predators alone and not integrated with acaricides gave the highest reduction percentages.

**KEY WORDS:** Phytoseiidae, biological control, chemical control, integrated control.

### INTRODUCTION

Cucumber, *Cucumis sativus* L. (Family: Cucurbitaceae) is considered one of the important vegetable crops in Egypt. Its cultivated area during 2003 was about 13267 feddans, in plastic houses and about 11881 feddans in open field with total production about 44346 tons. This was according to Economic Sector report Ministry of Agriculture, Egypt 2003.

Cucumber is usually infested with several pests of which the two spotted spider mite, *Tetranychus urticae* Koch is considered one of the most important causing economic damage to plants and fruits. The recent approach is to use predatory mites as biological control agents instead of chemical control to avoid the undesirable effects of chemicals on the environment

Some phytoseiid species were known to predate successfully on mite pests and used as bio-control agents (El-Badry and Zaher, 1961; Zaher *et al.* 1969; Zaher and Shehata, 1971; Strong and Croft, 1995; McMurtry and Croft, 1997). Thus several studies were conducted to control the two spotted spider mite on certain plants by releasing the predatory mites *Phytoseiulus* Spp. (El laithy, 1992; Watanabe *et al.*, 1994, Ali, 1998; Heikal and Mowafi, 1998; Heikal *et al.*, 2000 and Heikal and Ibrahim, 2001). Thus, the present work was conducted to study the efficiency of release four predatory phytoseiid species; *Phytoseiulus macropilis* (Banks), *Neoseiulus californicus* (McG.), *N. cucumeris* (Oudemans) and *N. zaheri* (Yousef and El-Borolossy) and chemical control by using one

bio-pesticide (Vertemic) and a chemical (Ortus) and integration between chemical and biological control by predatory mites against *T. urticae* different stages infesting two cucumber cultivars in plastic houses.

### MATERIALS AND METHODS

#### Mass rearing of four predatory phytoseiid species and *T. urticae* as prey:

Four predatory phytoseiid species, of which two exotic species *P. macropilis* and *N. californicus* were obtained from cultures at Plant Protection, Department National Research Center, Giza. The other two species are endogenous, of which *N. cucumeris* collected from weeds in El-Kannater, Qalubya Governorate and *N. zaheri* from weeds in Dakahlia Governorate. The aforementioned predatory species were then mass-reared in the laboratory by using aluminium pans, 30 x 20 x 7 cm. with wet cotton pads at the bottom. Tangle foot surrounding the edge of the pan was applied. Groups of females and males of each of the four predatory species were transferred to leaves of ficus, *Ficus discora* L. put on the cotton pads in the aluminum pans and kept in an incubator at 30 ± 2°C and 70 ± 5% R.H. *T. urticae* different stages were offered as prey. Groups of females and males from each predator species were transferred to potted bean plants, *Phaseolus vulgaris* L infested with *T. urticae* as prey and kept in musline cages.

#### Release of predatory mites:

Acarine predator release started on 8<sup>th</sup> February during the two seasons of 2004 and 2005, when

cucumber plants were about 60-100cm long, and population of *T. urticae* on cucumber averaged 25 individuals/leaf. (Leaf area about 50-60 cm<sup>2</sup> for Sahm and Heikal cultivars, respectively) The ratio between predator and prey adopted was 1:10. (Heikal and Fawzy 2003).

Bean leaves with each of the predatory mite species were put in plastic bags tightly closed with rubber bands, and kept in ice box at 8°C until reaching the plastic house. The release was carried out 1-2 hours before sunset. The leaves with known number of predatory mites were hung between cucumber leaves. After releasing, samples were taken weekly and *T. urticae* was assessed as well as the four predatory mite species.

#### Chemical control experiments:

A pilot experiment was conducted using Vertemic 1.8% EC as biocide, 40cm/100 litter water and Ortus 5% SC as a chemical insecticide 50cm/100 litter water, against *T. urticae*. The previous compounds were tested on the two cucumber cultivars (Sahm and Heikal) grown in plastic houses, in Nubaria District, Beheira Governorate, during 2004 and 2005 seasons.

Application of pesticides started when population of *T. urticae* averaged 25 individuals per leaf in the plastic house. Spray occurred by using a compressor sprayer (20 liters capacity). Samples of 20 leaves per treatment were taken randomly, before spraying then weekly afterwards, carefully examined and numbers of alive *T. urticae* different stages were recorded. Reduction percentages of *T. urticae* different stages were determined according to Henderson and Tilton (1955) and Fliming & Retmakaram (1985).

Reduction% =

$$\left(1 - \frac{\text{Treatment after} \times \text{Control before}}{\text{Treatment before} \times \text{Control after}}\right) \times 100$$

#### Integrated control experiments:

Results of biological control revealed that the release of the two predators *P. macropilis* and *N. californicus* as well as the biocide Vertemic gave the best control. Therefore, three treatments were sprayed by Vertemic on 8<sup>th</sup> February 2005, while the fourth was left as control. After four weeks of Vertemic spray the two predators *P. macropilis* and *N. californicus* were released on 7<sup>th</sup> March, while the third treatment was sprayed again with Vertemic. These results were compared with those of releasing the two predators without integration with Vertemic.

Samples of 20 leaves per treatment were taken one day before treatment then weekly afterwards for 11 weeks.

## RESULTS AND DISCUSSION

#### Biological control:

To avoid the extensive use of chemicals, four predatory mite species, two exotic species *P. macropilis* and *N. californicus*, and two indigenous species *N. cucumeris* and *N. zaheri* were used to estimate the most effective predators against *T. urticae* infesting two cucumber cultivars (Sahm and Heikal) during the two successive seasons 2004 and 2005. The release was conducted on cucumber Sahm and Heikal cultivars on the 8<sup>th</sup> February after two weeks planting seedlings and when full grown plant reached 60-100cm long and average number of *T. urticae* adults/leaf was 24.2 & 25.6; immatures 24.0 & 25.4; and eggs 48.1 & 49.4 for Sahm cultivar during 2004 and 2005 seasons. For Heikal cultivar, these averages were 20.5 & 20.5 adults; 33.4 & 38.7 immatures and 59.2 & 56.2 eggs/leaf during 2004 and 2005 seasons.

The four phytoseiid predatory mites, *N. californicus*, *P. macropilis*, *N. cucumeris* and *N. zaheri* greatly reduced the number of *T. urticae*, while it increased on plants free of predators after 11 weeks of release (Table 1). Throughout 11 weeks after release the aforementioned predators, the total number of *T. urticae* on Sahm cultivar in 2004 and 2005 seasons averaged 2.65, 2.80, 12.24 & 7.54; and 2.80, 3.93, 12.58 & 7.80 adults/leaf; 2.36, 2.39, 19.60 & 7.97 and 2.57, 2.69, 18.70 & 8.79 immatures/leaf; and 4.29, 4.65, 33.71, 10.62 and 4.52, 4.76, 20.97 and 11.45 eggs/leaf, respectively.

On the other hand, the total number of *T. urticae* in the control averaged 24.40 adults, 56.66 immatures and 53.60 eggs, in 2004 season, while it averaged 25.29, 57.64 and 54.62 in 2005 season.

Similar results were obtained for Heikal cultivar during 2004 & 2005 seasons (Table 1). Reduction percentages as a result of releasing the four predatory mites, proved that *N. californicus* gave the highest reduction percentage of *T. urticae* different stages of These percentages of adults, immatures and eggs for Sahm cultivar were 97.36, 98.45 & 99.36% and 95.07, 97.74 & 98.97% in 2004 & 2005 seasons, respectively.

*P. macropilis* rated the second as it gave reduction percentages of 97.51, 98.45 & 98.59% and 94.50, 97.50 & 98.31% of adults, immatures and eggs during 2004 & 2005 seasons, respectively. The lowest reduction percentages of prey different stages were recorded when *N. cucumeris* was released as it recorded 45.85, 68.47 & 65.28 % and 51.85, 71.51 & 66.68% during the two years respectively. *N. zaheri* gave moderate reduction percentages of 70.14, 84.62 & 85.00 and 69.30, 85.60 & 86.95% for adults, immatures and eggs during 2004 & 2005

seasons for Sahn cultivar, respectively. Similar results were obtained for Heikal cultivar. Investigating the effect of releasing three predatory mites *P. persimilis*, *T. swirskii* and *A. barkeri* against *T. urticae* on three soybean varieties, El-Saiedy (1999) elicited *P. persimilis* to give the most efficient results followed by *T. swirskii*, while *A. barkeri* was less effective. Heikal and Fawzy (2003) released *P. macropilis* against *T. urticae* in a greenhouse and recorded reduction percentages to be 90.1% after 24h. The maximum reduction was 85% in open field after 4 weeks of predator release.

It is of interest to note that, while the two predators *N. californicus* and *P. macropilis* decreased *T. urticae* different stages with nearly equal high percentages (more than 95%), the other two predators *N. cucumeris* and *N. zaheri* preferred feeding on prey immatures and eggs than on adults. Percentage reduction of these two stages increased by 15-20% than those of adult and *N. zaheri* showed better efficiency than *N. cucumeris* on both cultivars in the two seasons 2004 & 2005.

#### Chemical control:

Spraying Vertemic and Ortus on Sahn cultivar during 2004 & 2005 seasons against *T. urticae* occurred when average number of *T. urticae* per leaf was 23.9 & 42.9 adults 24.5 & 25.1 immatures; 48.9 & 49.2 eggs (leaf about 2cm). Both compounds reduced *T. urticae* different stages, but Vertemic sharply reduced the different stages to zero after the 1<sup>st</sup> and 2<sup>nd</sup> week of spraying. The total averages at the end of experiment (after 11 weeks) were 4.06, 5.26 & 7.09 and 5.80, 5.36 & 7.19 adults, immatures & eggs/leaf for Vertemic while for Ortus were 8.34, 10.66 & 14.27 and 10.20, 12.12 & 15.87 for the aforementioned stages in Sahn cultivar during 2004 & 2005, respectively (Table 2).

Reduction percentages of *T. urticae* after 11 weeks were 89.55%, 95.33 & 94.0% and 89.92, 94.32 & 93.95% adults, immatures & eggs for Vertemic during 2004 & 2005 seasons; and 66.83, 79.65 & 77.58% and 65.08, 77.60 & 74.08% for Ortus during the two seasons in Sahn cultivar, respectively.

Table (1): Average number and reduction percentage of *T. urticae* stages/leaf on two cucumber cultivars affected by release four predacious mite species during two seasons, 2004 & 2005.

Cultivars	Average number and reduction percentage of <i>T. urticae</i> stages/leaf																
	Adult					Immatures					Egg						
	<i>N. calif.</i>	<i>P. macr.</i>	<i>N. cucu.</i>	<i>N. zaheri</i>	Control	<i>N. calif.</i>	<i>P. macr.</i>	<i>N. cucu.</i>	<i>N. zaheri</i>	Control	<i>N. calif.</i>	<i>P. macr.</i>	<i>N. cucu.</i>	<i>N. zaheri</i>	Control		
Sahn	2004	N	2.65d	2.80d	12.24b	7.54c	24.40a	2.36c	2.39c	19.60b	7.97c	56.66a	4.29d	4.65d	33.71b	10.62c	53.60a
		%	97.36	97.51	45.85	70.19	--	98.45	98.45	68.47	84.62	--	99.36	98.59	65.23	85.00	--
	2005	N	2.80d	3.93d	12.58b	7.80c	25.29a	2.57d	2.69d	18.70b	8.79c	57.64a	4.52d	4.76d	20.97b	11.45c	54.62a
		%	95.07	94.50	51.85	69.30	--	97.74	97.50	71.51	85.60	--	98.97	98.31	66.68	86.95	--
Heikal	2004	N	3.02c	2.98c	4.98b	4.99b	40.52a	3.67b	3.24b	6.48b	5.25b	87.39a	6.71b	6.67b	9.13c	7.90b	97.34a
		%	87.14	92.50	88.06	88.22	--	98.50	97.38	93.31	95.45	--	97.87	97.85	94.75	95.40	--
	2005	N	3.48b	3.91b	6.16b	6.68b	43.61a	4.82b	5.88b	8.11b	9.01b	89.42a	9.01b	7.89v	10.72b	10.02b	98.17a
		%	93.27	92.71	84.33	83.40	--	97.90	96.58	91.86	91.33	--	97.72	96.37	92.18	92.63	--

N= average number during 11 weeks

%= average reduction percentage

Table (2): Effect of the two pesticides, Vertemic and Ortus on *T. urticae* different stages and reduction percentage/leaf of two cucumber cultivars during two seasons, 2004 & 2005.

Cultivars	Average number and reduction percentage of <i>T. urticae</i> stages/leaf during 11 weeks from spray										
	Adult			Immature			Egg				
	Vertemic	Ortus	Control	Vertemic	Ortus	Control	Vertemic	Ortus	Control		
Sahn	2004	N	4.06 c	8.34 b	24.40a	5.26 b	10.66b	56.66 a	7.09 c	14.27 b	53.60 a
		%	89.55	66.83	--	95.33	79.65	--	94.00	71.58	--
	2005	N	5.80 c	10.20b	24.53 a	5.36 b	12.12 b	57.64 a	7.19 c	15.87 b	54.62 a
		%	89.92	65.08	--	94.32	77.60	--	93.65	74.08	--
Heikal	2004	N	9.96 b	12.71 b	40.52 a	19.95 b	27.84 b	87.39 a	24.56 c	38.31 b	84.02 a
		%	86.17	81.52	--	92.17	89.79	--	87.49	78.80	--
	2005	N	5.13 b	7.95 b	43.61 a	9.00 b	17.75 b	89.43	12.88 b	20.77 b	98.17 a
		%	94.90	90.47	--	95.90	89.58	--	97.97	94.44	--

Table (3): Average number and reduction percentage of *T. urticae* stages/leaf on two cucumber cultivars affected by release two predacious mite species after spraying Vertemic during 2005 season.

Cultivars	Average number and reduction percentage of <i>T. urticae</i> stages/leaf during 11 weeks																	
	Adult						Immatures						Egg					
	<i>N. calif.</i> **	<i>P. macr.</i> **	Vertemic	<i>N. calif.</i> ***	<i>P. macr.</i> ***	Control	<i>N. calif.</i> **	<i>P. macr.</i> **	Vertemic	<i>N. calif.</i> ***	<i>P. macr.</i> ***	Control	<i>N. calif.</i> **	<i>P. macr.</i> **	Vertemic	<i>N. calif.</i> ***	<i>P. macr.</i> ***	Control
Sahm	N 2.72b	2.83b	3.26b	2.80d	3.93d	24.65d	4.32b	7.47b	4.55b	2.57d	2.69d	90.96a	6.55b	6.57b	7.43b	4.52d	4.76d	54.43a
	% 83.92	91.64	86.39	95.07	94.50	--	88.91	87.37	90.75	97.74	97.50	--	90.55	89.82	80.22	98.97	98.31	--
Heikal	N 3.91b	3.69b	3.48b	3.48b	3.91b	35.74a	8.47b	8.49b	6.87b	4.82b	5.88b	88.16a	7.91b	8.25b	8.70b	9.01b	7.89c	88.52a
	% 81.55	84.68	90.36	93.27	92.71	--	84.23	83.96	91.42	97.90	96.58	--	87.17	86.67	90.01	97.72	96.37	--

\*\* Release of predatory mites after 4 weeks from spraying Vertemic

\*\*\* Release of predatory mites without spraying

On Heikal cultivar similar results were obtained as Vertemic gave better control of *T. urticae* (Table 2). Waheeb (1998) studied the initial and residual effect of Vertemic, Milbeknock and Sumite on *T. urticae* in soybean field.

#### Integrated control:

Effect of the two effective predatory mites *P. macropilis*, *N. californicus* and the effective biopesticide Vertemic on *T. urticae* different stages during 2005 season was studied.

Table (3) recorded the effect of releasing the two predatory mites *N. californicus* and *P. macropilis* after four weeks of spraying Vertemic against *T. urticae* different *T. urticae* stages on Sahm and Heikal cucumber cultivars during 2005 season. The total averages/leaf after 7 weeks of releasing *N. californicus* and *P. macropilis* 4 weeks of spraying Vertemic (11 weeks from the beginning of experiment) were 2.72, 2.83, 3.26 & 24.65 adults; 4.32, 4.47, 4.55 & 90.96 immatures; and 6.55, 6.57, 7.43 & 54.43 eggs when using *N. californicus*, *P. macropilis*, Vertemic alone & the control on Sahm cultivar, respectively. The reduction percentages of *T. urticae* on Sahm cultivar were 83.92, 91.64 & 86.39% adults; 88.91, 87.37 & 90.75% immatures, 90.55, 89.82 & 80.22% eggs when integrating Vertemic with predatory mites and Vertemic alone, respectively in Sahm cultivar. Here again Heikal cultivar gave similar results (Table3).

Using only predators against *T. urticae* gave better reduction than that when spraying bio or chemical pesticide before releasing predatory phytoseiid mites or using chemical alone; moreover it saves money and effort and not causing pollution of the environment (Table3).

Finally, it could be concluded that, biological control by release four predatory phytoseiid mites on cucumber Sahm and Heikal cultivars showed that *N. californicus* and *P. macropilis* gave the highest

reduction percentages of *T. urticae* different stages, while *N. zaheri* and *N. cucumeris* gave less reduction.

#### REFERENCES

- Ali, Fatma, S., 1998. Life tables of *Phytoseiulus macropilis* (Banks) (Gamasida: Phytoseiidae) at different temperatures. Exp. Appl. Acarology, 22: 335-342.
- El-Badry, L. A. and M. A. Zaher, 1961. Life-history of the predator mite *Typhlodromus (Amblyseius) cucumeris* Oudemans. Bull. Soc. Ent. Egypt, 45: 427-434.
- El-Laithy, A. Y. M., 1992. Some aspects on the use the predatory mite *Phyto-seiulus persimilis* Athias-Henriot for biological control of the two spotted spider mite *Tetranychus urticae* Koch in greenhouses in Egypt. J. Plant Dis. Prot. 99 (1): 93-100.
- El-Saiedy, E. M. A., 1999. Integrated control studies on *Tetranychus urticae* Koch on Soya bean pant. M. Sc. Thesis, Fac. Of Agric. Minufiya Univ., 144 pp.
- Flaming, R. and Retnakaran, A. 1985. Evaluating single treatment date using Abbotts formula with reference to insecticides. J. Econ. Ent. 78: 1179-1181.
- Heikal, I. H. and Fawzy, M. M., 2003. A preliminary study of biological control of *Tetranychus urticae* Koch on cucumber (Acari: Tetranychidae). Egypt. J. Agric. Res., 81 (1): 93-100.
- Heikal, I. H. and Ibrahim, G. A., 2001. Release of *Phytoseiulus macropilis* (Banks) to control *Tetranychus urticae* Koch on strawberry in Ismailia Governorate, Egypt (Acari: Phytoseiidae, Tetranychidae). Egypt. J. Agric. Res., 79 (3): 893-906.
- Heikal, I. H. and Mowafi, M. H., 1998. Biological control of *Tetranychus urticae* on bean plants by

- two introduced predators. Al-Azhar J. Agric. Res., 27: 185-196.
- Heikal, I. H.; Fawzy, M. H., Ibrahim, H. M. and Ibrahim G. A., 2000. Preliminary studies on the release of the predatory mite *Phytoseiulus macropilis* (Banks) on strawberry plant to control *Tetranychus urticae* Koch (Acari: Tetranychidae, Phytoseiidae). Egypt. J. Agric. Res., 78 (4): 1517-1523.
- Mc Murtry, J. A. and Croft, B. A., 1997. Life cycles of phytoseiid mites and their role in biological control. Ann. Rev. Entomol., 42: 291-321
- Strong, W. B. and Croft, B. A., 1995. Inoculative release of phytoseiid mites (Acarina: Phytoseiidae) into the rapidly expanding canopy of hops for control of *Tetranychus urticae* (Acarina: Tetranychidae) Environ. Entomol., 24 (2): 446-453.
- Waheeb, M. I. A., 1998. Ecological and control studies on *Tetranychus urticae* Koch infecting some field crops in Gharbia Governorate, M. Sc. Thesis. Fac. Of Agric., Minufiua, Univ., 114pp.
- Watanabe, M. A.; De-Morales, G. J.; Gastaldo, I. J. R. and Nicolella, G., 1994. Biological control of two-spotted mite with predatory Phytoseiids (Acari: Tetranychidae, Phytoseiidae) on cucumber and strawberry. Scientia, Agricola, 51 (1): 75-81.
- Zaher, M. A. and Shehata, K. K., 1971. Biological studies on the predatory mite *Typhlodromus pyri* Scheuten with the effect of prey and non-prey substances (Acarina: Phytoseiidae). Z. ang. Ent., 67: 389-394.
- Zaher, M. A.; Wafa, A. K. and Shehata, K. K., 1969. Life history of the predatory mite *Phytoseius plumifer* (C. & F.) and effect of nutrition on its biology. (Acarina: Phytoseiidae). Ent. Exp. Appl., 12: 383-388.