

## THE ROLE OF BIOLOGICAL AGENTS IN THE CONTROL OF SPIDER MITES INFESTING TOMATO PLANTS

M. H. Mahagoub

Dept. of Vegetable and Ornamental Pests, Plant Prot. Res. Institute, A.R.C. Dokki, Giza

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**ABSTRACT:** A semi-field experiment was carried out at Plant Protection Research Institute, Dokki, Giza under green house conditions, to evaluate the effect of the predatory mite, *Phytoseuilus persimilis* as a predaceous mite and the crude extract of *Lantana camara* (2 g / liter water) in addition to the acaricide, Ortus 5 % EC at the rate of 2 ml /liter water against the two spotted spider mite, *Tetranychus urticae* infesting tomato plants. Results indicated that the reduction percentages of the adult stages of the spider mites were 89.7, 50.2 and 76.7 % in 2014 season for *Phytoseuilus persimilis* , the extract of *Lantana camara* and Ortus 5 % EC , respectively , while the reduction percentages were 94.6,74.1, and 81.7 % for spider mite eggs , respectively. Meanwhile , results indicated that the reduction percentages of the adult stages of the spider mites were 91.7, 48.6 and 76.3 % in 2015 season for *Phytoseuilus persimilis* , the extract of *Lantana camara* and Ortus 5 % EC ,respectively , while the reduction percentages were 93.7,72.5, and 82.0 % for spider mite eggs , respectively.

**Key words:** *Lantana camara*, *Phytoseuilus persimilis*, *Tetranychus urticae*, Vegetables

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### INTRODUCTION

Tomato, *Solanum lycopersicum* (Fam.: Solanaceae) is one of the most important vegetable crops in Egypt. It is cultivated in large tracts and it represents one third of the total vegetable area in Egypt. To protect tomato plants from cooler air and exposure to frost during winter, plants are grown under plastic tunnels. Spider mites are widespread pests attacking a wide variety of agricultural crops causing damage either directly by sucking plant sap or indirectly by transmitting plant diseases.

The integrated pest management means the use of different methods of potential agents to suppress population densities of pests. From this point of view, the present study is an attempt to evaluate the efficacy of three different control methods in suppressing spider mites attacking tomato plants under greenhouse conditions.

Many authors have studied the effect of predaceous mites on the changes in the populations of *T. urticae* such as El-Badry and Zaher, 1961; Zaher and Shehata, 1971; Port and Scopes, 1981; El-Laithy, 1992; Watanabe *et al.*, 1994; Strong and Croft,

1995; McMurtry and Croft, 1997; Ali, 1998; Heikal and Moawfi, 1998; Heikal *et al.*, 2000; Heikal and Ibrahim, 2001; Heikal and Fawzy, 2003; Ali *et al.*, 2005; Hassan *et al.*, 2007; Khalequzzman *et al.*, 2007 and Fiedler, 2012.

Many products of botanical origin proved to have ovicidal, repellent, antifeedant and toxic activity against insects and spider mites. Many researchers have experienced these results (Muzemu *et al.*, 2011; Abdel-Moniem *et al.*, 2012; Antonious *et al.*, 2014; Geng *et al.*, 2014 and Rajashekar *et al.*, 2014).

On the other hand, the chemical control of spider mites have been used widely all over the world. Chemical have been used either to protects seeds before emergence above the ground or to protect newly emerged seedlings and later the growing plants (Price, 1993; Hossain *et al.*, 2006; Hassan *et al.*, 2008; Pozzebon *et al.*, 2011 and Shah and Shukla, 2014).

The present study was conducted to evaluate the effect of different potential agents to control red spider mite infestation under greenhouse conditions.

## **MATERIALS AND METHODS**

This experiment was conducted at a greenhouse of the Agricultural Experimental Station belonging to the Plant Protection Research Institute at Dokki, Giza Governorate for two successive seasons (2014 and 2015). The effect of the predatory mite (*Phytoseiulus persimilis* Athias-Henriot), botanical extract (*Lantana camara* L.) and the chemical acaricide (Ortus) against the spider mite, *Tetranychus urticae* Koch infesting tomato plants (Alex 61 cultivar) was evaluated. Tomato seedlings (30 days old) were transplanted in small plastic pots (16 cm in diameter) filled with clay: peat moss (1:1), one seedling per each pot in 15 April, 2014 and 2015. Pots were inoculated with 20 *T. urticae* stages, maintained under greenhouse conditions of about 30°C. Pots were divided into four groups where four applications were conducted, the first group were used to evaluate the predatory mite, *P. persimilis*, the second group to evaluate *Lantana camara* extract, the third group to evaluate the acaricide, Ortus, and the last one served as a control.

### **a) The biological control agent:**

Individuals of the predatory mite, *P. persimilis* were obtained from its mass rearing on the spider mite *T. urticae* on bean plants in the laboratory (Mahgoub, 2006). Releasing of the predatory mite was applied at a level ranged between 1:7 – 1:10 of *P. persimilis* : *T. urticae* on tomato plants. Bean leaves with the predatory mite were transferred in an ice box to the pots cultivated with tomato in the greenhouse. After releasing, samples were taken weekly and the active stages of both the predatory mite and the spider mite were counted. The reduction percentages in spider mite stages were determined using the formula of Henderson and Tilton (1955).

### **b) The botanical extract:**

#### **Preparation of the plant extract of *Lantana camara*:**

Healthy leaves of *Lantana camara* were

washed to get rid of any pests or dust, dried in shady place at room temperature. After dryness, leaves were crushed and 400 g of the plant powder were put in a glass beaker, soaked in one liter of distilled water and left for 72 hrs., then filtered and the filtrate was left to dry. The acute dry matter was put in a sealed bottle and saved in the refrigerator until use. The extracted matter was used with the concentration of 2 g/liter water (Jepson *et al.*, 1975 and Kennedy, 1986).

Sampling procedure was carried out from May 3<sup>rd</sup> up to July 8<sup>th</sup> during both seasons. Pre-spray counts were made to determine the initial population density of *T. urticae*. The reduction percentage in spider mite individuals was determined using the formula of Henderson and Tilton (1955).

### **c) The chemical control agent:**

**Trade name:** ORTUS ® 5% SC Suspension Concentration.

**Active ingredient :** Fenpyroximate 5% w/w.

**Description:** ORTUS® 5% SC is a oxime compound used as a acaricide. It inhibits the cell respiration of pest.

The acaricide, Ortus 5% SC was used at a rate of 2 ml /liter water. The acaricide was applied as the population density of spider mites reached average of 5.7 individuals/tomato leaf. Weekly samples of tomato leaves were randomly taken before and after spraying. The reduction percentage in eggs and motile stages of *T. urticae* was determined using the formula of Henderson and Tilton (1955).

Survey was done on May 10<sup>th</sup> on one plant/pot for the above mentioned treatments. Samples of 12 leaves per treatment were taken randomly making a sum of 48 leaves for all treatments before spraying (pre-count) then weekly counts were done after application. Collected samples were transferred to the laboratory for examination and counting the eggs and active stages of *T. urticae* (adults and immature).

## **RESULTS AND DISCUSSION**

The results of testing the effect of three potential control agents viz.: a biological control agent, *Phytoseiulus persimilis*; a plant extract of *Lantana camara* and a chemical acaricide, Ortus 5% EC against *Tetranychus urticae* on tomato plants (Alex 61) during two successive seasons are shown in Tables (1 & 3). The reduction percentages in the population of *T. urticae* due to the use of these three agents are shown in Tables (2 & 4).

### **Abundance of *T. urticae* population during 2014 season:**

Data presented in Table (1) show that the treatments applied twice; on the day of pre-count of *T. urticae* population May 3<sup>rd</sup> and on June 2<sup>nd</sup> during 2014 season had a pronounced effect on the target pest. Counting of adults, immature and egg stages began three weeks after transplanting of tomato seedlings on 12 leaves per treatment and numbers are presented as averages of these counts/leaf. The population density of *T. urticae* in the untreated pots reached 8.3, 23.5 and 14.1 for adults, immature and egg stages, respectively.

The population of the pest was 8.3, 23.6 and 14.6, respectively in the pots of *P. persimilis*; while the different stages were 8.6, 23.2 and 14.3 individuals, respectively in the pots treated with *L. camara* leaf extract, while these numbers were 8.3, 23.5 and 14.3 individuals in the treated pots with Ortus.

After one week of the first application, the population density of *T. urticae* decreased to reach 4.2 adults, 9.3 immature stages and 6.1 eggs in the *P. persimilis* treatment. In the pots treated with the plant extract, average numbers reached 4.9, 9.1 and 7.2 individuals; while it reached 1.9, 2.1 and 3.2 individuals in the chemical pesticide treatment. On the other hand, average numbers of *T. urticae* different stages were increased in the control treatment being 12.7

adults, 48.4 immatures and 23.1 eggs/tomato leaf. The decrease in the average population density continued for two weeks more in the treatments of the plant extract and Ortus after which the population density of *T. urticae* increased again. The populations of different stages in the *P. persimilis* application area were continued to decrease due to the activity of the bio-agent.

After the second application (on June 2<sup>nd</sup>), the efficiency of *P. persimilis* was increased considerably and the populations of immature stages and adults of *T. urticae* were disappeared from tomato leaves till the end of the experiment on July 8<sup>th</sup>. The population density of different stages were decreased in the pots treated with *L. camara* plant extract reaching 5.2, 10.1 and 7.8 for adults, immatures and eggs, respectively. These averages were 1.9, 2.1 and 4.1 individuals in the pots treated with Ortus. By the end of the season, the populations of *T. urticae* different stages were all increased in the different treatments – except the release of *P. persimilis* – and untreated pots. Average numbers reached 40.2, 49.2 and 42.1 for adults, immatures and eggs, respectively in the plant extract treatment. These averages were 23.1, 38.0 and 32.2, respectively in the Ortus treatment; while it were highly increased in untreated plots being, 60.2, 107.1 and 87.1 individuals, respectively.

### **The reduction percentages in *T. urticae* population due to different treatments:**

Data presented in Table (2) show the percentages in *T. urticae* due to different treatments. It is easy to notice that there is a significant difference between the effect of using *P. persimilis* as a natural enemy for *T. urticae* than the other two control measures. The highest percentages in population reduction were in the pots treated with chemical acaricide (Ortus) being 85.0% in adult population, 96.0% in immature

population and 86.5% in egg population; while the lowest percentages of reduction

were in the pots treated with the *L. camara* plant extract.

**Table (1): Average numbers of *Tetranychus urticae* stages per tomato leaf as affected by *P. persimilis* release and *L. camara* extract compared to Ortus during 2014 season**

Date	Control			<i>P. persimilis</i>			Lantana extract			Ortus 5% EC		
	A	I	E	A	I	E	A	I	E	A	I	E
3/5/2014	8.3	23.5	14.1	8.3	23.6	14.6	8.6	23.2	14.3	8.3	23.5	14.3
10/5	12.7	48.4	23.1	4.2	9.3	6.1	4.9	9.1	7.2	1.9	2.1	3.2
17/5	15.7	59.2	45.2	5.1	8.2	4.2	11.4	14.6	11.3	4.4	6.3	8.1
24/5	22.9	63.4	56.2	2.4	4.2	3.2	19.2	26.1	16.3	7.2	18.3	13.5
2/6*	34.2	70.5	61.2	1.1	2.1	1.3	28.3	38.2	22.2	15.2	27.1	17.3
9/6	41.2	75.6	69.2	0.9	1.5	0.7	5.2	10.1	7.8	1.9	2.1	4.1
16/6	45.8	83.2	72.1	0.0	0.0	0.0	12.3	26.2	12.6	5.0	10.2	10.2
23/6	52.2	92.5	79.2	0.0	0.0	0.0	20.2	24.2	20.2	10.3	18.1	16.5
30/6	58.3	98.2	84.1	0.0	0.0	0.0	34.2	38.2	28.4	18.6	29.2	20.1
8/7	60.2	107.1	87.1	0.0	0.0	0.0	40.2	49.2	42.1	23.1	38.0	32.2
<b>Average</b>	59.2	72.2	35.1	3.0	4.9	2.2	18.2	25.9	18.5	13.9	17.5	9.6

A = Adults                      I = Immature stages                      E = Eggs  
 \* = The date of the second application of different treatments

**Table (2): Reduction percentages in *Tetranychus urticae* stages on tomato leaves after 10 weeks of application with *Phytoseiulus persimilis* and *L. camara* extract and Ortus 5%**

Date	<i>P. persimilis</i>			Lantana extract			Ortus 5% EC		
	A	I	E	A	I	E	A	I	E
10/5/2014	66.4	81.0	74.3	62.8	80.9	69.1	85.0	95.7	86.5
17/5	67.1	86.2	91.0	30.6	75.1	75.4	72.6	89.4	82.3
24/5	89.7	93.4	94.6	19.5	58.3	71.4	68.2	71.3	76.3
2/6*	96.8	97.0	98.0	20.5	45.2	64.2	55.2	61.6	72.1
9/6	97.9	98.0	99.0	87.9	89.5	88.8	95.4	97.3	94.1
16/6	100.0	100.0	100.0	74.1	68.1	82.7	89.0	87.7	86.1
23/6	100.0	100.0	100.0	62.8	62.6	74.8	80.2	80.5	79.4
30/6	100.0	100.0	100.0	43.6	60.6	66.6	68.0	70.3	76.5
<b>Average</b>	89.7	94.5	94.6	50.2	67.5	74.1	76.7	81.7	81.7

A = Adults                      I = Immature stages                      E = Eggs  
 \* = The date of the second application of different treatments

## **The role of biological agents in the control of spider mites infesting .....**

The relevant percentages of reduction were 62.8% in adults, 80.9% in immatures and 69.1% in eggs. The release of *P. persimilis* to control the population of *T. urticae* led to reduction percentages reached 66.4% in adults, 81.0% in immatures and 74.3% in eggs. After three more weeks, the release of *P. persimilis* proved to be the most effective method in controlling *T. urticae* population than other treatments. Reduction percentages were 96.8, 97.0 and 98.0% in adult, immature and egg populations, respectively. On the other hand, the lowest reduction percentages were in plant extract treatment being 20.5, 45.2 and 64.2% in adult, immature and egg populations, respectively.

The reduction percentages in population of the spider mite were much higher than those obtained by the plant extract, the reduction percentages were 55.2% in adults, 61.6% in immature and 72.1% in eggs.

### **Abundance of *T. urticae* population during 2015 season:**

Data presented in Table (3) show that the applied treatments also had a great effect on the population of different stages of *T. urticae*. While the different stages had increased in the untreated treatment, these stages were drastically decreased in all treatments after one week of treatment (i.e. on May 10th). Average numbers reached 4.4 adults, 10.7 immatures and 7.4 eggs, respectively in the bio-agent (*P. persimilis*) application. The same trend was observed for the other two treatments (L. camara extract and the acaricide, Ortus). After this decrease, the population began to increase steadily till the second spraying was applied especially in the plant extract and acaricide treatment. Again, three weeks after of the application of the second spray, the population of *T. urticae* different stages reached none at the pots where *P. persimilis* was released. The average numbers reached 22.4, 35.2 and 21.3 for adults, immatures and egg stages, respectively.

These averages were much lower 9.4, 19.0 and 14.6 individuals, respectively while a huge increase occurred in untreated pots till the end of the experiment.

### **The reduction percentages in *T. urticae* population due to different treatments:**

Data presented in Table (4) show the percentages in *T. urticae* due to different treatments during 2015 season. Again, it is easy to notice the significant differences between the effect of the chemical acaricide (Ortus) and either the plant extract or the bio-agent *P. persimilis* one week after the first spray. The reduction percentages reached 88.2, 93.8 and 82.3% in adults, immatures and egg populations, respectively. By the time of the second spray (June 2<sup>nd</sup>), the reduction percentages due to the release of *P. persimilis* were much higher than those of the plant extract or Ortus. The averages reached 97.2% for adults, 96.2% for immatures and 97.5% for eggs. These percentages were 28.5, 47.7 and 62.2% for the stages, respectively in the case of the plant extract. The high reduction percentages in *T. urticae* population were increased till the end in pots where *P. persimilis* was released. These percentages were much lower in the other treatments especially where the plant extract was used. From the previously obtained, it is well-noticed that the use *P. persimilis* was very effective in reducing *T. urticae* populations on tomato plants.

These results are in agreement with those obtained by Ali *et al.* (2005) who found that *P. macropilis* is had a short life cycle when fed on *T. urticae*. Hassan *et al.* (2007) reported that using *P. macropilis* and spraying Ortus against *T. urticae* gave good results of control at plastic houses in Nubaria. El-Laithy *et al.* (2008) found that the reduction percentages of different stages of *T. urticae* was achieved after releasing *P. persimilis* at prey-predator ratio 1:10 and 1:7 ranged between 50-80% in Behera

Governorate. Mahgoub *et al.* (2011) reported that releasing *P. persimilis* and *Neoseiulus californicus* on pepper cultivars to control *T. urticae* population gave very high reduction percentages in all stages. Similar results were also obtained by Watanabe *et al.*, 1994; Strong and Croft, 1995; McMurtry and Croft, 1997; Ali, 1998; Heikal and Moawfi, 1998; Heikal *et al.*, 2000; Heikal and Ibrahim, 2001; Heikal and Fawzy, 2003; Ali *et al.*, 2005; Hossain *et al.*, 2006; Hassan *et al.*, 2007; Khalequzzman *et al.*,

2007; Pozzebon *et al.*, 2011; Fiedler, 2012; Abdel-Moniem *et al.*, 2012; Antonious *et al.*, 2014; Geng *et al.*, 2014 and Shah and Shukla, 2014.

It could be concluded that, it is not recommended to use either or plant extract as well as the chemical acaricide alone to control *T. urticae* in tomato fields, it is suggested that an IPM strategy based on chemical and biological agents should be applied.

**Table (3): Average numbers of *T. urticae* stages / tomato leaf as affected by the release of *P. persimilis* and treatment with *L. camara* extract and Ortus during 2015 season**

Date	Control			<i>P. persimilis</i>			Lantana extract			Ortus 5% EC		
	A	I	E	A	I	E	A	I	E	A	I	E
3/5/2015	10.4	25.2	19.1	10.4	28.2	18.6	9.9	27.6	19.0	10.2	27.0	19.2
10/5	13.5	46.5	25.3	4.4	10.7	7.4	4.5	9.5	8.9	1.6	3.1	4.5
17/5	21.6	60.2	50.2	3.3	7.4	5.2	9.3	15.4	13.5	4.5	7.6	9.1
24/5	24.7	66.4	58.2	2.7	4.6	3.1	18.2	27.5	18.6	9.5	20.1	15.4
2/6*	35.9	72.2	67.2	1.0	3.1	1.6	24.4	40.5	25.2	18.4	25.4	19.6
9/6	40.6	78.9	73.3	0.9	2.1	1.1	13.2	9.2	8.2	2.1	3.1	3.2
16/6	48.2	85.2	78.2	0.1	1.1	0.2	19.4	24.9	13.6	5.2	10.5	7.3
23/6	53.1	93.1	84.3	0.0	0.8	0.0	22.4	35.2	21.3	9.4	19.0	14.6
30/6	61.1	98.7	90.2	0.0	0.0	0.0	31.5	39.7	30.1	15.2	31.1	20.1
8/7	68.2	100.3	98.2	0.0	0.0	0.0	39.2	50.2	45.1	21.7	49.6	25.6
<b>Average</b>	64.4	72.7	38.1	3.7	5.8	2.3	20.4	28.0	19.2	13.9	19.7	9.8

A = Adults I = Immature stages E = Eggs  
 \* = The date of the second application of different treatments

**Table (4): Reduction percentages in *T. urticae* stages on tomato leaves after 10 weeks of application with *Phytoseiulus persimilis* and *L. camara* extract and Ortus 5%**

Date	<i>P. persimilis</i>			Lantana extract			Ortus 5% EC		
	A	I	E	A	I	E	A	I	E
10/5/2015	67.7	79.5	70.1	65.2	81.3	64.6	88.2	93.8	82.3
17/5	81.4	89.0	89.3	44.5	76.6	73.0	73.8	88.2	82.0
24/5	89.2	93.8	94.4	22.6	62.1	67.9	60.6	71.7	73.6
2/6*	97.2	96.2	97.5	28.5	48.7	62.2	47.5	67.2	71.0
9/6	98.0	97.7	98.5	68.8	89.3	88.7	95.1	96.3	95.6
16/6	99.9	98.8	99.8	57.8	73.3	82.5	88.9	88.5	90.7
23/6	100.0	99.2	100.0	55.7	65.5	74.6	81.6	81.0	82.8
30/6	100.0	100.0	100.0	45.9	63.2	66.4	74.5	70.6	77.8
<b>Average</b>	91.7	94.3	93.7	48.6	70.0	72.5	76.3	82.2	82.0

A = Adults I = Immature stages E = Eggs  
 \* = The date of the second application of different treatments

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**Table (5): Mean numbers of the predatory mite, *Phytoseiulus persimilis* / leaf after releasing on tomato plants during 2014 and 2015 seasons.**

Date of examination	Mean numbers of the predatory mite, <i>P. persimilis</i> / leaf	
	2014	2015
10 May	3.7	4.6
17	5.1	5.8
24	6.4	7.1
2 June	6.9	7.7
9	7.1	6.4
16	4.3	3.2
23	0.5	1.1
30	0.0	0.3
7 July	0.0	0.0
Overall mean	3.4	3.6

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## دور المواد الحيوية فى مكافحة أكاروس العنكبوت الاحمر المتطفل على نباتات الطماطم

محمد حمادة أحمد محجوب

معهد بحوث وقاية النباتات - مركز البحوث الزراعية

### الملخص العربى

أجريت تجربة عملية بإحدى الصوب الزراعية البحثية بمعهد بحوث وقاية النباتات بالدقى للمقارنة بين تأثير إطلاق المفترس الاكاروسى *Phytoseiulus persimilis* والرش بمستخلص نبات ال *Lantana camara* والرش بالمبيد الاكاروسى ( أورتس 5% ) فى تقليل اعداد العنكبوت الاحمر *Tetranychus urticae* على نبات الطماطم صنف Alex 61 خلال الموسمين الزراعيين 2014 ، 2015 . وتم عملية اطلاق المفترس الاكاروسى عند نسبة تتراوح بين 1-7 / 1-10 ( مفترس لكل فريسة) كما تم رش المستخلص النباتى بمعدل 2 مجم / لتر ماده فعالة والمقارنة مع نتائج المبيد الموصى به ( اورتس) 5% . وتم فحص عينات ورقية اسبوعيا بعد المعاملة وتم عد أطوار أكاروس العنكبوت الاحمر المختلفة ، وتم حساب نسب موت اطوار اكاروس العنكبوت الاحمر. واطهرت النتائج ان نسبة الموت من الافراد الكاملة خلال الموسم 2014 كانت 89.7 ، 50.2 ، 76.7% لكل من المفترس الاكاروسى ومستخلص اللانتانا ومبيد الاورتس على التوالى ، بينما كانت 94.6 ، 74.1 ، 81.7% على بيض العنكبوت الاحمر على التوالى . واطهرت النتائج ان نسبة الموت من الافراد الكاملة خلال الموسم 2015 كانت 91.7 ، 48.6 ، 76.3% لكل من المفترس الاكاروسى ومستخلص اللانتانا ومبيد الاورتس على التوالى ، بينما كانت 93.7 ، 72.5 ، 82.0% على بيض العنكبوت الاحمر على التوالى. يوصى البحث بضرورة وضع برنامج مكافحة متكامل يضم كل من المفترسات والمستخلصات النباتية والمبيد فى وقت الضرورة للحد من اعداد العنكبوت الاحمر.