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Field Evaluation of Two Pesticides and A Predatory Mite Release in Controling Red Spider Mite Infesting Soybean and Cotton Plants

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ABSTRACT

This experiment was carried out during summer 2014 to evaluate the efficacy of the three pesticides Ortus super, Acramectin and Challenger super and release of the predatory mite, *Neoseiulus californicus* at three levels 1:5, 1:10 and 1:15 to control *Tetranychus urticae* Koch infesting soybean and cotton plants. Soybean experiment indicated that, the mean overall reduction percentages of the tetranychid mite were 51.2, 45.1, 39.8, 37.9 and 38.1 % for the three levels of predator release and Acramectin, and Challenger Super, respectively. These of cotton plants were 40.3, 32, 40.9, 44.3 and 46.3 %, respectively. The highest increase percentage in soybean seeds was recorded for the predator, *N. californicus* at the release level of (1:15) giving 55.8 % ; also it gave the highest increase percentage in cotton fibers recorded at the treatment of the predator, giving 45.3 % in comparison with control treatment. Thus, *N. californicus* successively reduced the population density of *T. urticae* on both soybean and cotton plants as compared with tested pesticides. Therefore, the release of *N. californicus* at 1:10 level represents a useful management strategy for *T. urticae*.

Key words: *Neoseiulus californicus*; *Tetranychus urticae*; Release; Cotton; Soybean.

INTRODUCTION

Soybean is attacked by several pests of which *Tetracnyhus urticae* Koch is the most serious. In order to control this mite, several pesticides were used which have bad side effects on the food storage inside seeds; furthermore it pollute the environment producing bad effects on human beings.

Studying the effect of different agricultural, chemical or/and biological treatments on the population density of *T. urticae* infesting cotton plants, gives clear idea about the suitable program of control which leads to reduce the harmful effect of the pest, as well as reducing the environmental pollution by using chemical compounds.

Therefore, the purpose of this study was to test innovative ideas in the control of the two spotted spider mite, *Tetranychus urticae* infesting soybean and cotton plants, focusing on biologically based management of mite using a multi-component approach.

MATERIALS AND METHODS

1- Experimental design and sampling procedure:

These experiments were carried out in Elgemiza Agricultural Research Station, Gharbia governorate during the period from June 2014 to August 2014. Plots of 168 m^2 for each treatment were divided into four sub plots as replicates, each sub plot was about 6 x 7 m. Cotton cultivar Giza 89 (*Gossypium barbadense* L.) seeds were planted in hills (2-3 cm deep) as a standard plant density. The spacing between rows was 70 cm (10 rows/7 m). One month later, leaf samples were taken weekly, 40 leaves/ treatment and carefully examined by dissecting stereomicroscope. Numbers of different stages of *Tetranychus* mites were recorded on both leaf upper and lower surfaces of leaves.

Other land area of 168 m^2 was prepared as previously mentioned and cultivated with soybean seeds *Glycine max* L .variety (Giza 111).

All treatments of both cotton and soybean experiments were arranged in a complete randomized block design.

2- Rearing of *T. urticae* and the predatory mite:

Rearing of *T. urticae* was carried out in the laboratory on potted beans *Phaseolus vulgaris* cultivated in an isolated compartment (1.5 x 2 m) in the experimental glasshouse. The used strain of *T. urticae* was originated from infested castor oil leaves. For the rearing of predatory mite, *Neoseiulus (Amblyseius) californicus*, large aluminum trays 30x20x7 cm were used; saturated cotton pads with water were put in the middle of each tray, leaving a space provided with water as a barrier to prevent predatory mites from escaping, in addition to a tangle foot ring around cotton pads. Leaves of citrus trees were established on cotton pads saturated with water. Infested bean leaves with *T. urticae* were provided every day as a source of food. Trays were kept in an incubator at 25 ± 2°C and 60±10% R.H.

3- Release of the predatory mite:

Predatory mite individuals prepared for release processes were left in a refrigerator at 10°C for 5 minutes to eliminate its activity in order to help in mites handling. Discs of mulberry leaves with predatory mite were put in Petri dishes, which were kept in ice boxes for transferring to the field; the release was carried out 1-2 hours before sunset and 3-

4 days after crop irrigation to warrant suitable air temperature and relative humidity. Distribution of leaf discs was ascertained to be closely tighten to *T. urticae* colonies, prey / predator rates were released when *T. urticae* was about 2 individuals/ leaf.

4- Field evaluation of three pesticides on *T. urticae* infesting soybean and cotton plants during 2014 season in comparison with three levels of *N. californicus*:

Three pesticides: Ortus super 5% EC (Fenpyroximate), Acramectin (Abamectin) mixture of 80% avermectin B1a and 20% avermectin B1 b and Challenger super 24% SC (Chlorfenapyr 36% SC) were evaluated in the control *T. urticae* infesting soybean and cotton plants.

Three plots of cotton plants were prepared; two were sprayed with Ortus super and Acramectin; while the third with water as control on 25th May 2014. Furthermore, three plots of soybean plants were prepared; two were sprayed with Challenger super and Acramectin; while the third plot was sprayed with water as control. Leaf samples of both soybean and cotton were collected before application then monthly after spray.

At the same time, four plots of soybean and cotton plants were prepared, where the predator *N. (Amblyseius) californicus* (McGorgr) were released. Each plot of each crop received one predator: prey ratio of 1:5, 1:10 and 1:15. Each plot consisted of three hills, each contained two plants. One plot of each crop was left without releasing as control.

Release was done when the plants had about 13-20 leaves.

The number of released predator was calculated as follow:

$$\text{Release No.\one hill} = \frac{\text{Total No. prey\leaf x leaf No.\plant x 2 plant}}{\text{Proposed prey : predator ratio}}$$

Rearing both prey and predatory mites; methods of release and statistical analysis were as mentioned in cotton experiments. Predator was released as follow:

$$\text{Release number} = \frac{\text{Total number of prey per replicate}}{\text{Proposed prey : predator ratio}}$$

Where the numerator was the multiple location produce from 3 elements: average density of cotton or soybean plants/replicate, average number of infested leaves/plant, and mean number of *T. urticae* moving stages/leaf.

All treatments of experiments were arranged in a complete randomized block design.

Statistical analysis:

The obtained data was statistically analyzed using analysis of variance (ANOVA) at 5 % probability. The measurements were separated using Duncan's Multiple Range Test (DMRT) through CoStat software program (Version 6.400). CoStat version 6.400 Copyright © 1998-2008 Cohort Software. 798 Lighthouse Ave. PMB 320, Monterey, CA, 93940, USA.

Corrected reduction percentages were calculated according to Henderson and Tilton (1955) formula as follow:

$$\text{Reduction \%} = 1 - \frac{\text{No. in Co}_{\text{before treatment}} \times \text{No. in T}_{\text{after treatment}}}{\text{No. in Co}_{\text{after treatment}} \times \text{No. in T}_{\text{before treatment}}} \times 100$$

RESULTS AND DISCUSSION

1- Field evaluation of two pesticides on *T. urticae* infesting soybean in comparison with three levels of *N. californicus*:

Table (1) showed the effect of the two chemical pesticides, Acramectin, Challenger super, in comparison with releasing three levels of *N. californicus* (1:5, 1:10, 1:15) in the control of *T. urticae* infesting soybean plants. Statistical analysis of the obtained results indicated that there were significant differences in the average numbers of *T. urticae* stages between control and all other treatments. Reduction percentages of *T. urticae* (Table 2) indicated that , the highest decrease in the numbers of the tetranychid mite , one month after application , was observed at the treatment of Challenger super giving 65.6 %, followed by the treatment of *N. californicus* release at the level of (1:5), recording 56 %; while the treatments of *N. californicus* release at the level of (1:5) and Acramectin resulted in 52.2 % decrease for both treatments and was 46.4% at *N. californicus* release of (1:10) level. Two months after application, reduction percentages sharply decreased specially at predator treatments. Furthermore, three months after application, predator treatments sharply increased resulting in reduction percentages of the tetranychid mite 81.8, 69.2 and 55.6 % , at the three levels of release, respectively; while it was only 19.2 and 11.2 % at Acramectin and Challenger super pesticides, respectively .

The mean overall reduction percentages of tetranychid mite were 51.2, 45.1, 39.8, 37.9 and 38.1% for the three levels of predator release and Acramectin, and Challenger Super, respectively.

2- Field evaluation of two pesticides on *T. urticae* infesting cotton in comparison with three levels of *N. californicus*:

Table (3) showed the effect of the two chemical pesticides, Acramectin, Ortus super, in comparison

Table 1: Average numbers of *T. urticae* moving stages per soybean leaf as influenced by releasing three levels of *N. californicus* and two pesticides during 2014 Summer season.

Sampling dates	Average numbers of *T. urticae* stages / soybean leaf					
	T. urticae : *N. californicus*			Acramectin	Challenger Super	Control
	1:5	1:10	1:15			
Pre-treatment	14.6[a]	14.3[a]	14.1[a]	14.3[a]	14.3[a]	14.5[b]
June	4.7[b]	5.6[c]	6.3[b]	5.0[b]	3.6[b]	10.6[b]
July	7.4[b]	8.4[b]	10.4[a]	5.4[b]	4.2[b]	19.8[a]
August	1.3[c]	2.5[d]	4.5[b]	4.2[b]	4.1[b]	19.1[a]
$LSD_{5\%}$	2.9	2.6	2.35	2.65	1.36	4.15

$LSD_{5\%}$ among treatments = 2.6, Means in each column followed by the same letter(s) are not significantly different at $p<0.05$ according to Duncan's multiple-range test.

Table 2: Reduction percentages in moving stages of *T. urticae* infesting soybean plants as influenced by releasing three levels of *A. californicus* and two pesticides during 2014 Summer season

Sampling dates	Reduction % of *T. urticae* stages				
	T. urticae : *N. californicus*			Acramectin	Challenger Super
	1:5	1:10	1:15		
June	56	46.4	52.2	52.2	65.6
July	15.7	19.7	11.6	42.2	37.6
August	81.8	69.2	55.6	19.2	11.2
Overall mean	51.2	45.1	39.8	37.9	38.1

Table 3: Average numbers of *T. urticae* moving stages per cotton leaf as influenced by releasing three levels of *N. californicus* and two pesticides during 2014 Summer season

Sampling dates	Average numbers of *T. urticae* stages / cotton leaf					
	T. urticae : *N. californicus*			Acramectin	Ortus super	Control
	1:5	1:10	1:15			
Pre-treatment	13.1[a]	13.3[a]	13.4[a]	13.3[a]	13.2[a]	13.4[b]
June	3.9[b]	4.4[b]	5.2[b]	1.5[b]	2.1[b]	16.4[a]
July	5.5[b]	5.5[b]	8.1[b]	2.1[b]	3.2[b]	17.8[a]
August	5.1[b]	6.5[b]	7.9[b]	2.0[b]	3.1[b]	19.5[a]
$LSD_{5\%}$	2.4	2.7	2.9	1.3	1.3	3.2

LSD 5% among treatments = 2.0, Means in each column and last row followed by the same letter(s) are not significantly different at $p<0.05$ according to Duncan's multiple-range test.

Table 4: Reduction percentages *T. urticae* moving stages of infesting cotton plants as influenced by releasing three levels of *N. californicus* and two pesticides during 2014 Summer season

Sampling dates	Reduction of *T. urticae* stages %				
	T. urticae : *N. californicus*			Acramectin	Ortus super
	1:5	1:10	1:15		
June	75.7	73	68.3	90.8	87
July	29.9	15.2	43.5	29	40.4
August	15.4	7.9	11	13.1	11.6
Overall mean	40.3	32	40.9	44.3	46.3

Table 5: Average weights of soybean and cotton yields as influenced by releasing three levels of *N. californicus* and two pesticides during 2014Summer season to control *T. urticae* stages

Crop	Average numbers of crop yield (kg) / plot (42 m^2)						
	T. urticae : *N. californicus*			Acramectin	Challenger super	Ortus super	Control
	1:5	1:10	1:15				
Soybean	50[d]	60[b]	67[a]	56[c]	-	55[c]	43[e]
Increase %	16.3	39.5	55.8	30.2	-	27.9	-
Cotton	66[b]	70[ab]	77[a]	70[ab]	69[b]	-	53[c]
Increase %	24.5	32.1	45.3	32.1	30.2	-	-
$LSD_{5\%}$ for soybean treatments					3.7		
$LSD_{5\%}$ for cotton treatments					7.9		

Means in each row followed by the same letter(s) are not significantly different at $p<0.05$ according to Duncan's multiple - range test.

with releasing three levels of *N. californicus* (1:5, 1:10 and1:15) in the control of *T. urticae* infesting cotton plants. Statistical analysis of the obtained results indicated that there were significant differences in the average numbers of *T. urticae* stages between control and all other treatments. Reduction percentages of *T. urticae* (Table 4) indicated that, the highest decrease in the numbers of the tetranychid mite, one month after application, was observed at Acramectin treatment giving 90.8%, followed by that of Ortus super giving 87%; while it was 75.7% at *N. californicus* release at the level of (1:5), 73% at its (1:10) and 68.3% at (1:15). Two months after application, reduction percentages decreased to 29.9 , 15.2 and 43.5% at the three levels of release, respectively; while the reduction percentages of the tetranychid mite was 29 % at Acramectin and 40.4 at Ortus super treatments. Furthermore, three months after application, predator treatments sharply decreased resulting in reduction percentages of the tetranychid mite 15.4, 7.9 and 11%, at the three levels of release, respectively; while it was only 13.1and 11.6 % at Acramectin and Ortus super pesticides, respectively .

The mean overall reduction percentages of tetranychid mite were 40.3, 32, 40.9, 44.3 and 46.3% for the three levels of predator release and Acramectin, and Ortus super, respectively.

3- Effect of different control treatments of *T. urticae* on soybean and cotton yields:

Statistical analysis of the average weights of soybean and cotton yields Table (5) as influenced by releasing three levels of *N. californicus* and two pesticides during 2014 Summer season to control *T. urticae* stages, indicated significant differences in the soybean seed yields and cotton fibers between control and all other treatments.

The highest increase percentage in soybean seeds was recorded at the treatment of the predator, *N. californicus* at the release level of (1:15) giving 55.8% in comparison with control treatment, followed by that of (1:10) resulted in 39.5 %; while *N. californicus* at (1: 5) gave only 16.3% increase. Furthermore, Acramectin and Ortus super treatments gave 30.2% and 27.9% increase in soybean seeds, respectively.

Regarding to cotton treatments, the highest increase percentage in cotton fibers was recorded at the treatment of the predator, *N. californicus* at the release level of (1:15) giving 45.3% in comparison with control treatment, followed by that at the release level of (1:10) and Acramectin treatments resulted in 32.1%; while *N. californicus* at the release level of (1:5) gave the lowest increase 24.5 %. Furthermore Challenger super treatment gave 30.2 % increase in cotton fibers.

It could be concluded that *N. californicus* successively reduced the population density of *T. urticae* on both soybean and cotton plants as compared with tested pesticides. Therefore, the release of *N. californicus* at 1:10 level represents a useful management strategy for *T. urticae*.

The obtained results are in harmony with those obtained by El Kady *et al.* (2007) who tested two potential bio-insecticides (Spinetoram 12% and Vertimec 1.8%) against lab. strain of the moveable stages of *T. urticae* after 24, 48 and 72 h of treatment. Significant correlation between insecticides concentrations and mortality over 3 day's period (P # 0.05). Moreover, field bioassays were conducted to evaluate the efficacy of spinetoram and vertimec on eggplant till 19 days of sprays against different stages of *T. urticae* and found that all doses of spinetoram caused reduction of infestations. In addition Keratum *et al.*,(2010) evaluated the toxic effect of six compounds of different mode of actions, three wereknown as acaricides (Abamectin, Ethion and Chlorfenapyr), one pyrethroid (Cyhalothrin), one mineral oil and one plant extract (*Allium sativum*) against the eggs and adult females of the two spotted spider mite, *T. urticae* and adult females of their predators *Amblyseius gossipi*, *Phytoseiulus macropilis* and *Stethorus gilvifrons* using leaf- disc dip technique. They found that Abamectin had a special position in mite chemical control or in integrated mite management because of its high toxic effect and it's high toxicity index among different mite control agents. Also, Elmoghazy *et al.* (2012) evaluated the efficacy of two predatory mites *Neoseiulus californicus* (McGregor) and *Typhlodromips swirskii* (Athias-Henriot),with Vertimec® 18EC and Challenger 36% Sc biocides as control agents for *Tetranychus urticae* Koch on two cultivars of the faba bean *Vicia faba* (L.) in open field, and found the reduction percentage of different stages of *T. urticae* was achieved after releasing *N. californicus* and *T. swirskii* at prey-predator ratio of 7:1. After releasing the two predatory mites and spraying biocide, *N. californicus* gave the highest reduction percentage of *T. urticae* on the faba bean, followed by *T. swirskii*, Vertimec® 18 EC and Challenger 36% Sc. On the other hand, *N. californicus* gave the highest reduction percentage of *T. urticae* on the faba bean, followed by Vertimec® 18 EC, *T. swirskii* and Challenger 36% SC. Recently Abdel-Wali *et al.*, (2012) conducted laboratory studies to evaluate the duration of residual toxicity of the acaricides; Abamectin, Milbemectin and

Chlorfenapyr to six populations of the two spotted spider mite (*Tetranychus urticae*) collected from cucumber grown under plastic houses in the six main cultivated areas in Jordan , compared to a Syrian susceptible strain. Results indicated that the loss of susceptibility in the six populations to the closely related acaricides Abamectin and Milbemectin were clearly indicated even after one day of application, where the mortality did not exceed 24 and 33%, compared with 96 and 97% for Syrian susceptible strain for the two acaricides, respectively. Finally our results indicated the possibility of large scale producing and releasing the predatory mite, *P. macropilis* to control spider mites on sweet pepper plants under screen houses in commercial plantations.

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