J. Product. & Dev., 16(1):37 -50(2011)

BIOLOGICAL AND CHEMICAL CONTROL OF *TETRANYCHUS URTICAE* KOCH ON CUCUMBER, *CUCUMIS SATIVUS* L. IN GREENHOUSE

H. R. Gad [1]; EL-Naggar[2], M.E.; Tahany Roshdy, A.E.[1] and M. ELawa [2]

1. Faculty of Agriculture, Benha University, Banha, Egypt.

2. Plant protection Research Institute, Agriculture Research Center, Giza, Egypt.

ABSTRACT

The present work was carried out to evaluate the toxicity of four pesticides i.e. Abamactin, Bifenazte, Spinossad and Beauvaria bassiana against Tetranychus urticae Koch and predator mite comparing with release the predator mite, Phytoseiulus persimilis Athias-Henroit on Cucmber plant, Cucumis sativus that were assessed in greenhouse. Fabcomic, Acramite, Tracer and Biovar were much less toxic to adult females and immature of P. persimilis than to those of T. urticae. Chemical pesticides gave its maximum reduction after 3 days from treatment, 86.04, 72.61 and 76.52%, respectively for Fabcomic, Acramite and Tracer, while Biovar was the least. On the other hand releasing of P. persimilis at level 1:10 gave the best results of bio-control T. urticae infesting cucumber plant where it gave 26.09% reduction after 3 days from released and the reduction percentage increased gradually until reached its maximum values after 14 days with 88.41%. These results were nearly similar to those gave by other pesticides. P. Persimilis significantly affected by feeding on treated prey where longevity and fecundity decreased.

***Conclusively**, the predatory mite, P. persimilis introduced good results in controlling the two-spotted spider mite, T. urticae on cucumber plants in green houses. So, it can use as a biocontrol agent in controlling this dangerous mite pest on other plants, but it would be appear that conjoint use of the tested pesticides with P. persimilis in IBM have be sequence separated by time intervals that would be sufficient to minimize the toxicity effects on the predator.*

Key words: *Phytoseiulus persimilis, Tetranychus urticae, Pesticides, Biological control.*

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is considered one of the important vegetable crops in Egypt. Its cultivated area reached 30000 Feddans in summer and 10000 Feddans in winter (Ibrahim *et al.*, 2006). Cucumber cultivated in all Egypt Governorates for local market and exportation.

The two-spotted spider mite, *T. urticae* is one of important pest on cucumber it causes several damage to growth plant, resulting reduction in the quality and quantity of the production. The pest may be controlled with acaricides and biological control agents Chemical control should be kept to a minimum because of development of pesticides resistance and high level of chemical residues on fresh vegetables (Mostafa *et al.*, 1989 and Clarke *et al.*, 1994).

Phytoseiid predators are the most important biological control agents of phytophagous mites in integrated pest management programs of outdoor and greenhouse crops (McMurtry and Croft, 1997). *P. persimilis* was the most important predacious mites using for control the two-spotted spider mites; *T. urticae* under greenhouse (El-Laithy, 1992).

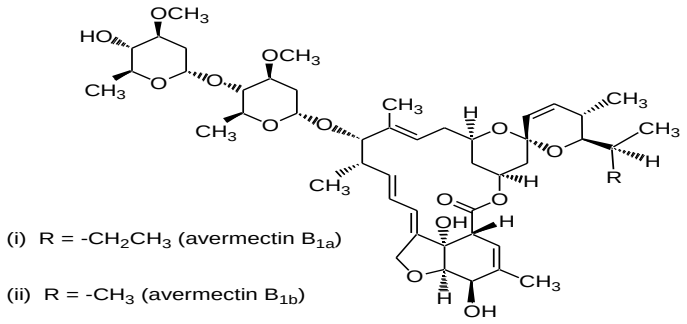
The present study aimed to throw more light on the importance of using selectivity pesticides for controlling Tetranychid mites; *T. urticae* and its side effect on predatory mite; *P. persimilis* when fed on treated prey with pesticides in addition to use *P. persimilis* only as bio-control agent against *T. urticae.*

MATERIALS AND METHODS

3.1. Pesticides:

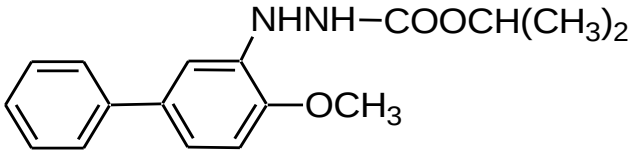
a. **Abamactin** (Fabcomic 1.8 % EC)

Chemical structure:



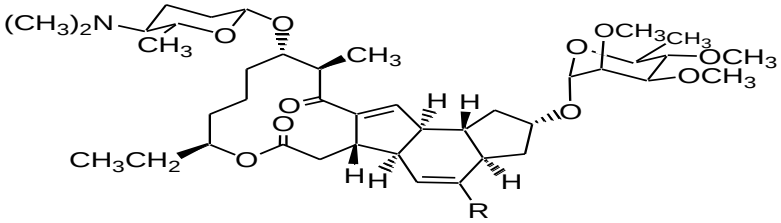
b. **bifenazte** (Acramite 23.5% SC)

Chemical structure:



c. **Spinosad** (Tracer 24% SC)

Chemical structure:



spinosyn A, R = H-

spinosyn D, R = CH_3-

d. Beauvaria bassiana (Biovar 23×10^6 spore/gm.)

3.2. Mite cultures from *T. urticae* **and** *P. persimilis*:

Field samples of egg plant leaves (*Solanum melongena*) infested by the two spotted spider mite individuals of *Tetranychus urticae*, were collected and placed in paper bags. Samples were transferred immediately to the laboratory. The mass culture was initiated by transferred groups of females and males using a camel's hair brush, placed in Petri-dishes 5cm diameter, which provided with untreated fresh discs of mulberry leaves (*Morus alba* **L.**) about 2.4 cm diameter. Each disc was placed on a pad of cotton wool which was fully saturated with water as a source of moisture and to prevent mite escaping.

Newly laid eggs were obtained by releasing the adult females on fresh and clean mulberry leaf discs overnight and removing all the adult females at the next day. After egg hatching, the newly larvae were placed on fresh leaf discs in prepared Petri-dishes as mentioned above. The old leaf discs were removed after one day and mites were fed on fresh leaf discs, wherever, it was necessary about 2-4 changes, to reached nymphs stages. All colonies were kept in an incubator at 28 ± 2ºC and 65 ± 5% R.H. The population density of mites in each colony was kept by providing of fresh host plants.

3.3. Mass rearing of the predatory mite; ***Phytoseiulus persimilis*****:**

A stock culture of the predatory mite; *P. persimilis* was collected from *Phaseolus vulgaris* **L.** at Ismailia Agriculture Research Station. Leaf discs of mulberry (*Mours alba* **L.**) were used as a substrate for rearing the predator. Leaf discs of 3 cm diameter were put in Petri-dishes on piece of cotton wool, each disc was lined with a wet cotton barrier. Drops of water were added daily to maintain suitable moisture for the predator. Whenever, leaf substrate began to deteriorate, it was changed by fresh one *T. urticae* different stages were offered as prey. The experiments were carried out under constant conditions 28±2ºC and 65 ± 5 % R.H.

3.4. Effect of feeding predatore mite; ***Phytoseiulus persimilis*** **females on treated** *T. urticae* **nymphs with some pesticides on certain biological aspects of the predator:**

LC_{50} values (2.70, 0.17, 118.7 and 10.09) of four pesticides i.e., Acramite, Fabcomic, Biovar and Tracer, respectively was evaluated on nymphs of *T. urticae***.** Nymphs of *T. urticae* placed on the mulberry leaf discs were dipped for ten seconds in each calculated LC_{50} concentration of the aforementioned pesticides. The survived treated nymphs were transferred to clean untreated mulberry leaf discs placed on moistened cotton wool in Petri-dishes. Twenty four hours later, the treated tetranychid nymphs were offered as food to the adult females of the predator; *Phytoseiulus persimilis.* Each female was supplied daily with enough treated. *T. urticae* nymphs. Study started with 20 from each predator mite females and conducted at a constant hygrothermal condition of 28 ± 2ºC and 65 ± 5% R.H. Percent mortality of predator females was calculated according to Abbott formula 1925. Longevity, fecundity and food consumption were calculated.

Newly mated female of predatory mite; *P. persimilis* were transferred to leaf discs of mulberry. Leaf discs were examining daily and number of consumed and longevity were recorded. All the killed preys were removed and replaced with another a live one. This experiment was carried out less than 28 ± 2º C and 65 ± 5% R.H.

3.5. Acaricidal activity of certain pesticides against *T. urticae* **and** *P. persimilis* **on cucumber (***Cusumis sativus* **L.) under greenhouse.**

This investigation carried out to study the toxicity effect of the tested pesticides, Acramite, Fabcomic, Biovar and Tracer. Against the two spotted spider mite, *Tetranychus urticae* and *P. persimilis*. The experimental area at Sharkia governorate was divided into 15 plots each plot considered as treatment that divided into 12 rows which divided into 4 replicates

surrounded by non cultivated belt. Spraying was carried out by using a knapsack motor sprayer. One concentration, 50, 5, 200 and 50 ppm was used from each pesticide, Fabcomic , Acramite, Biovar and Tracer which considered treatment. Representative samples of 20 leaves were collected after 3, 7, 10 and 14 days of application at randomly from each plot. The leaves were examined using binocular microscope and the number of moving stages per leaf was recorded. Samples from untreated plants were taken as control samples (check). Reduction percentages due to the treatments were calculated according to Henderson and Telton Equation (1955).

Reduction%= **1-**Treatment after × Control before/Treatment before× Control after x100

6. Releasing of the predatory mites; *Phytoseiulus persimilis* **in greenhouse:**

The two spotted spider mite, *Tetranychus urticae* was reared on kidney bean plants, *Phaseolus vulgaris* **L.** planted in greenhouse at Sharkia Governorate. The plants were infested with *T. urticae* taken from egg plants at 20 days and then individuals of the *T. urticae* mite moved off the infested leaves to the new foliage.

The phytoseiid predators, *P. persimilis* was reared on large metal box 35×25×5 cm, cotton pad were used, cotton pad were put in the middle of each box on 2cm thick piece of sponge, leaving a space provided with water as a barrier to prevent predatory mite from escaping. The predators were provided with pieces of bean leaves cutting infested by *T. urticae* as a food source. The plastic boxes were kept in an incubator at 28 ± 2ºC and 65 ± 5% R.H. water was added daily to maintain suitable moisture for the predators rearing.

Cucumber seedlings were transplanted in 10^{th}, October in greenhouse and the predators were transferred in 30^{th}, October. Cucumber plants were included with predator and prey at ratio 1:10 in three replicates, each 3×3 $m^{2.}$ A plastic sheet was fixed between each replicate to avoid the predatory mite escaping to the other one. The required population numbers of predatory mite individuals were calculated according to the following formula (El-Nagger *et al*., 2008):

$$\text{Released number} = \frac{\text{Total no. of } T.\textit{urticae} \text{ in treatment} \times \text{predator ratio}}{\text{prey ratio}}$$

The infestation bean leaves with the predatory mite were transferred in an ice-box to the green house and then distributed on infested cucumber plants except the treatment which kept free from any controlling agents.

After one week of releasing 20 cucumber leaves were picked up and transferred to the laboratory in paper bags, the movable stages of *T. urticae* and all stages of the predatory mites were counted after3, 7, 10 and14 subsequent days.

7. Statistical Analysis:

The data obtained were subject to statistical analysis. Duncan`s New Multiple Range Test (Duncan, 1955) was used to determine the significant of difference between mean values of the treatments. Deterrent index calculated according to Lundgren (1975).

Deterrent index = B – A / A + B x100

Where, B: number of eggs in control, A: number of eggs in treatment

Mortality percentages for the different tested stages were counted and calculated by using Abbott's formula (1925).

Mortality percentage% =No. of dead individual/ No. of total individual x 100

RESULTS AND DISCUSSION

1. *Side Effect of feeding predatory mites;* *P. persimilis* *females on treated* *T. urticae* *nymphs with four pesticides* LC_{50} *on certain biological aspects of the predator:*

Data in Table (3) and Figure (2) showed that, female longevity, fecundity and consumption of *P. persimilis* were significantly affected when fed on *T. urticae* nymphs treated with LC_{50} of four pesticides *i.e.*, Acramite, Fabcomic, Biovar and Tracer which obtained from Tables (1 & 2) and Figure 1. The effect of the pesticides on female longevity can be arranged descending according to the pesticide efficiency recording 21.06, 22.73, 22.88 and 25.19 days for fabcomic,

Acramite, Tracer and Biovar, respectively, comparing with the control treatment that elapsed 27.45 days. The same trend was noticed on the fecundity which recorded 32.41, 43.06, 46.52 and 50.45 eggs, while in untreated females it was 59.70 eggs. The adult female of *P. persimilis* consumed higher number of untreated prey followed by those treated with tracer, Biovar, Acramit and Fabcomic. Fabcomic was more potent pesticides compared with other pesticides because it reduced total deposited eggs (Deterrent index) 29.62 % followed by 16.19, 12.40 and 8.39% for Acramite, Tracer and Biovar, respectively.

Table 1. Mortality percentage of *Tetranychus urticae* nymphs treated with different concentrations of some pesticides after 24 h.

Pesticides	Conc. ppm	Total number	No. of dead	Mortality %
Fabcomic	1	80	74	92.5
	0.5	80	55	68.75
	0.1	80	30	37.5
	0.05	80	16	20
Acramite	10	80	71	88.75
	5	80	59	73.75
	2.5	80	35	43.75
	1	80	15	18.75
Tracer	20	80	73	91.25
	15	80	52	65
	10	80	37	46.25
	5	80	14	17.5
Biovar	200	80	56	70
	100	80	33	41.25
	50	80	17	21.25
	25	80	7	8.75

Table 2. Toxicity of some pesticides against nymphs of *Tetranychus urticae*

Pesticides	Lc_{50} ppm	Toxicity index	Slope	Confidence limits of Lc_{50}	
		Lc_{50} ppm		Upper	Lower
Fabcomic	0.17	100	1.54	0.21	0.14
Acramite	2.70	6.46	2.15	3.13	2.31
Tracer	10.09	1.73	3.42	11.91	8.31
Biovar	118.71	0.14	2.08	143.59	101.43

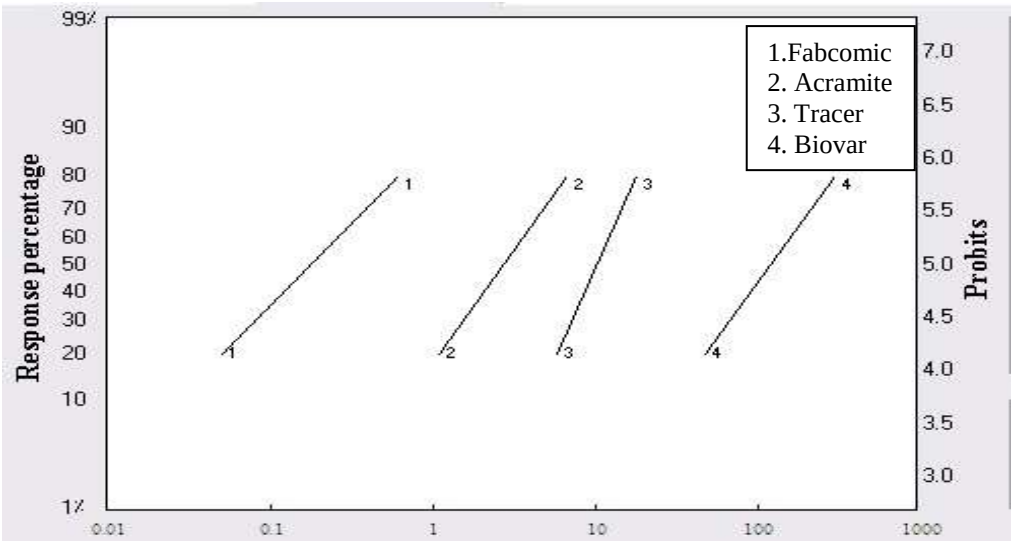


Figure 1. LC-P lines of four pesticides against nymphal stage of *Tetranychus urticae*

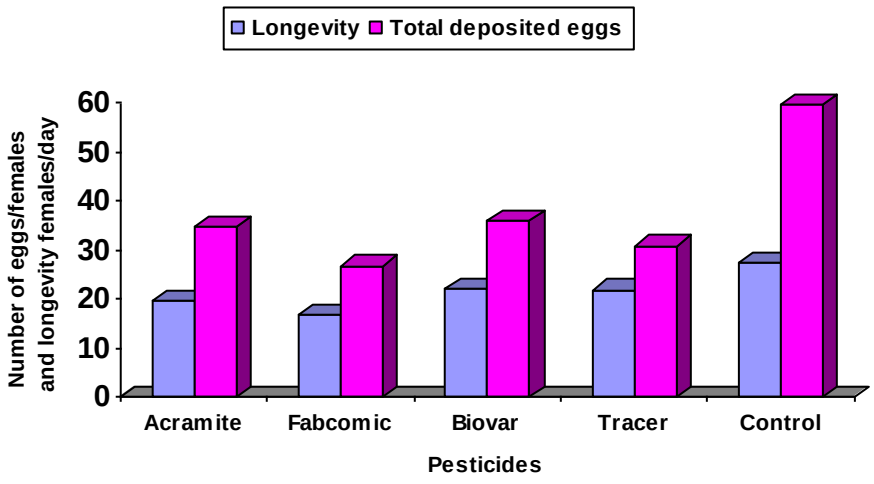


Figure 2. Effect of feeding *P. persimilis* females on treated *T. urticae* nymphs with LC_{50} of tested pesticides.

2. Reduction percentages of phytophagous mite, *T. urticae* **and predacious mite,** *P. persimilis* **on cucumber (***Cucumis sativus* **L.) under greenhouse:**

Data in Table (4) summarized the efficacy of some pesticides at different concentration against *T. urticae* and *P. persimilis*. Reduction percentages of mite population measured till 14 days post treatment. This data indicates that significant and high infestation reduction was recorded after 3 days of treatment against *T. urticae* adults, with chemical tested materials under field conditions and after 7 days with bio-pesticide, Biovar. Although, the rate of efficiency (i.e. infestation reduction percent) of the tested materials was increased by increasing the rate used, but the rate increase in efficacy was not proportional with the increase in the rate of concentration applied for all the investigated periods after treatments. Also, the rate of infestation reduction was significantly reduced with the lapse of time. Fabcomic at 5ppm conc. was the most toxic compounds as they caused 86.04% and 51.79% reduction in *T. urticae and P. persimilis* population after 3 days, respectively with mean redaction after 14 days 69.52% and 43.75 %, followed by Acramite at 50 ppm conc. as they caused at 72.61% and 46.13% and mean reduction 61.54% and 46.09%, Tracer at the same concentration which gave 67.52% and 17.89% reduction and mean reduction 56.10% and 14.85% and Biovar at 500 ppm conc. as they caused 38.27% and 14.13% reduction with mean reduction 47.40% and 14.05% in *T. urticae* and *P. persimilis* population, respectively. Tested pesticides were much less toxic to the predator; *P. persimilis* than its prey; *T. urticae*. Reduction percentage reduced after 7 – 14 days in chemical pesticides but with fungicides (Biovar) reduction percentage increased gradually after treatment. These results were nearly similar to Zhi-Qiang and Sanderson (1990).

3. Release of predacious mites for control of *Tetranychus urticae* **in greenhouse:**

Data arranged in Table (4) indicated that, the examine cucumber leaves collected just before releasing *P. persimilis*. Infestations with the two-spotted spider mite, *T. urticae* was generally high as its populations at the pre-count 14.60 and 1.50 individual / leaf for prey and Predatory, respectively at ratio between predator and prey 1: 10 while rached 17.20 and 3.15 for control, respectively. Three days after release, the percent reduction results reductions in number of the target pest, *T. urticae* movable stages 26.09% reduction in treatment. While rached 39.97% after 7 days .The reduction percentage in mite count after 10 and 14 days from release was 61.26 and 88.41%, respectively. Statistically analysis in Table (4) reveled

that there are no significantly differences between treated with pesticides and releasing *P. persimilis* at 1:10. So these data proved that releasing of *P. persimilis* at level 1: 10 gave the best results of bio-control of *T. urticae* infesting cucumber plants in greenhouse. These results are in agreement with (El-Naggar *et al.*, 2008) reported that, the reduction percentage after release the predatory mites *P. persimilis* for the three levels of treatment 1: 5, 1: 10 and 1: 15 were 71.83, 82.84 and 76.51%, respectively under green house and (Heikal and Fawzy, 2003) released the predatory mite *Phytoseiulus macropilis* for controlling the two spotted spider mite, *T. urticae* in a net greenhouse. The reduction percentage reached about 90%.

Conclusively, The predatory mite, *P. persimilis* introduced good results in controlling the two-spotted spider mite, *T. urticae* on cucumber plants in green houses. So, it can use as a biocontrol agent in controlling this dangerous mite pest on other plants, but it would be appear that conjoint use of the tested pesticides with *P. persimilis* in IBM have be sequence separated by time intervals that would be sufficient to minimize the toxicity effects on the predator.

REFERENCES

Abbott, W. S. (1925): A method of computing the effectiveness of an insecticide. *J. Econ. Entomol*., **18** (2): 265- 267.

Clark, N. D.; J. L. Shipp; W.R. Jarvis; A. P. Padopoutos and T. J. Jewett (1994): Integrated management of greenhouse crops a conceptual and potentially practical model. *Hortic. Sci*., **29:**846-849.

Duncan, D. B. (1955): Multiple Range and multiple F. test. *Biometrics*, **11**:1-42.

El-Laithy, A. Y. M. (1992): Some aspects on the use the predatory mite *Phytoseiulus persimilis* **Athias-Henriot** for biological control of the two spoted spider mite, *Teteranychus urticae* **Koch** in greenhouses in Egypt. *J. Plant. Dis. Prot*., **99** (1):93-100.

El-Naggar, M. E.; A. M. Metwally; Zakia, E. A. Darwish and Azzia, M. M. Abou-Zaid (2008): Biological control of *Tetranychus urticae* Koch on cucumber plants by using of two predaceous mites, *Phytoseiulus persimilis* and *Neoseiulus californicus* under greenhouse condition. *Egypt. J. Agric. Res.*, **86** (1): 269- 279.

Heikal, I. H. and M. M. Fawzy (2003). Apreliminary study of biological control of *Tetranychus urticae* Koch on cucumber (Acari: Tetranychidae). *Egypt. J. Agric. Res*., **81** (1): 93 – 100.

Hinderson, C. F. and Tilton, E. W. (1955): Test with acaricides against the brown white mite. *J. Eco. Ento.*, **48:** 157- 161.

Ibrahim, G. A.; N. M. Abd El- Wahed and A. M. Halawa (2006): Biological control of the two spotted spider mite, *Tetranychus urticae* Koch using the

phytoseiid mite, *Neoseiulus cucummeris* on cucumber (Acari: Tetranychidae:Phytoseidae), *Egypt. J. Agric. Res.*, **84**(40: 1033-1037.

Lundgren, L. (1975). Natural plant chemical acting as oviposition deterrents on cabbage butterflies *Pieris brassicae* (**L.**), *P. rapae* (**L.**) and *P. napi* (**L.**). *Zool. Scr.*, **4**:253-258.

McMurtry, J. A. and B. A. Croft (1997): Life-styles of phytoseiid mite and their roles in biological control. *Annu. Rev. Entomol.*, **42**:291-321.

Mostafa, A. M. A; Y. M. Ahmed; A. Shoukry and A. M. El-Adawy (1989): Development of resistance to profenofos in the adult female mite, *Tetranychus urticae* Koch. *Egypt 3rd Nat. Conf. of Pest & Dis. of Veg & Fruits in Egypt and Arab Count.*, 422-433.

ZHi-Qiang, Z. and P. Sanderson (1990). Relative toxicity of Abamectin to the predatory mite *Phytoseiulus persimilis* (Acari: Phytoseiidae) and two spotted spider mite (Acari: Tetranychidae). *Ento. Soc. Of America*. **83** (5): 1783 – 1790.

إستخدام المكافحة الحيوية وبعض المبيدات لحلم العنكبوت الأحمر ذو البقعتين *Tetranychus urticae* والمفترس الأكاروسى *Phytoseiulus persimilis* لإظهار مدى نجاحه فى المكافحة تحت الصوب

جاد حماده حسن راضى[١] ، محمود السيد النجار[٢] ، تهانى رشدى عبد الظاهر[١] ، محمد عليوه محمد[٢]

١. قسم وقاية النبات - كليه الزراعه – جامعه بنها – بنها – مصر

٢. معهد بحوث وقايه النبات – مركز البحوث الزراعية – جيزة- مصر.

يهدف هذا البحث الى دراسة التاثير الغير المباشر لبعض المبيدات على الحلم الأكاروسى المفترس (*Phytoseiulus persimilis*) التابع لعائلة فيتوسيدى بالأضافة الى المقارنة بين استخدام هذة المبيدات واطلاق هذا المفترس فى مكافحة حلم العنكبوت الأحمر ذو البقعتين وذلك تحت ظروف الصوب وهذا للأستفادة من دور هذا المفترس وأخذه فى الأعتبار ضمن برامج المكافحة المتكاملة وقد أوضحت النتائج التى اجريت على الأتى :

١. تأثرت الخصوبة ومدة الحياة وكذلك معدل الأستهلاك لأناث المفترس تأثيرا معنوبا عند تغذيتها على حوربات معامله بالتركيز الذى يقتل ٥٠% من المبيدات

الفابكوميك والأكراميت والتريسر والبيوفار حيث عاشت الأناث المعاملة لمدة ٢١.٠٦ و ٢٢.٧٣ و ٢٢.٨٨ يوما وأخيرا ٢٥.١٩ يوم لهذة المبيدات على التوالى بالمقارنة بالاناث التى غذيت على حوربات غير معاملة و عاشت ٢٧.٤٥ يوما

كما كان لهذة المبيدات تأثير واضح على الخصوبة لدى الأناث حيث بلغ متوسط عدد البيض الكلى لكل انثى ٣٢.٤١ و ٤٣.٠٦ و ٤٦.٥٢ و ٥٠.٤٠ بيضة / الأنثى على نفس الترتيب السابق بينما وضعت الأناث الغبر معامله ٥٩.٧٠ بيضة/ الأنثى.

أستهلكت الاناث غير المعاملة عدد أكبر من الفرائس متبوعا بالتى عوملت بالمبيدات التريسر و البيوفار والأكراميت ثم الفابكوميك على التوالى وبصفة عامه عند استخدام المبيدات والمفترس فى برامج المكافحة المتكاملة يجب الحرص على وجود فترة زمنية بين المعاملة بالمبيدات واطلاق المفترس وذلك لتقلبل التأثير السام على المفترس.

٢. درست فاعلية المركبات السابقة على الحلم العنكبوتى الاحمر ذو البقعتين وذلك على نباتات الخيار المنزرعة فى الصوبة وذلك بتركيزات ٥ و٥٠ و٥٠ و٥٠٠ جزء فى المليون لكل من الفابكوميك والاكراميت والتريسر والبيوفار لمدة ١٤ يوم من المعاملة حيث سجلت اعلى نسية خفض للمبيدات السابقة بعد ثلاثة ايام من المعاملة ماعدا المبيد الحيوى وصل اعلى نسية خفض يعد اليوم السايع من المعاملة وعند دراسة كفاءة اطلاق المفترس الاكاروسى (*Phytoseiulus persimilis*) بمعدل ١ :١٠ مفترس/ فريسة وصلت نسية الخفض اقصاها بعد ١٤ يوم من الاطلاق حيث بلغت حوالى ٨٨.٤١% نسبة خفض وعند دراسة متوسط نسب الخفض بعد المعاملة بالمبيدات واطلاق المفترس وجد انة لايوجد فروق معنوية تذكر مما يؤكد مدى اهميته ونجاح المفترس الاكاروسى (*Phytoseiulus persimilis*) فى المكافحة الحيوية للاكاروس النباتى.

التوصية: أعطي المفترس الأكاروسي *P. persimsilis* نتائج جيدة في مكافحة الحلم العنكبوتي ذو البقعتين علي نباتات الخيار تحت ظروف الصوب مع إمكانية إستحدام كعوامل بيولوجية فعالة في مكافحة هذة الآفة الخطيرة علي النباتات و لكن عن إستحدام هذة المفترس مع المبيدات في برامج المكافحة المتكاملة يجب ترك وقت مناسب بين إستخدام المبيدات و إطلاق المفترس حتي يمكن تقليل التأثير السام علي المفترس.