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EFFECT OF PREY TYPE AND PESTICIDES ON SOME BIOLOGICAL ASPECTS OF THE PREDATORY MITE *Agistemus exsertus* GONZ. (ACARI: STIGMAEIDAE)

El-Naggar, M.E.[1]; A. A. El-Fishawy[2]; M. A. Mahrous[2] and M. M. Elawa[1]

1- Plant Protection Research Institute, Dokki, Giza, Egypt

2- Plant Protection Dept. Faculty of Agric., Zagazig Univ., Zagazig, Egypt

ABSTRACT

The present study aimed to throw light on certain biological aspects of the predatory mite *Agistemus exsertus* Gonz. when fed on eggs, immatures and pesticide-treated nymphs of *Tetranychus urticae* Koch. Results indicated that, duration of immature stages of *A. exsertus* were insignificantly influenced by the stage of the introduced prey. The female and male life cycle durated an average of 10.89 and 10.48 days when fed on eggs of *T. urticae*, while the parallel values were 11.15 and 10.76 days when fed on immatures of the same prey. Female lived longer than male. Longevity of female and male were shorter on immature stages than on eggs of the prey. Feeding on *T. urticae* eggs resulted greater number of eggs (62.57 eggs) than fed on immature stages (57.22 eggs). Life span for the predator female and male lasted 29.48 and 27.31 days, respectively when mites fed on immatures of *T. urticae*. This periods were extended to 32.26 and 28.31 days for female and male respectively when reared on eggs of *T. urticae*. Food consumption of *A. exsertus* female and male stages was significantly affected by the stage of the prey. Means of total and daily devoured prey individuals were obviously increased with successive developmental stages. Female consumed greater number of eggs or immature stages of the prey than male. Longevity, fecundity and food consumption of *A. exsertus* female were significantly diminished when fed on nymphs of *T. urticae* treated with certain pesticide. Vertimec was the most deleterious one followed by Challenger and Ortus, while M-pede was the least one in this respect. Generally, conjoint usage of the tested pesticides and *A. exsertus* in IPM may require applying chemicals and biocontrol agent in sequence separated by time intervals that would be sufficient to minimize toxicity effects on the predator.

INTRODUCTION

The two spotted spider mite, *Tetranychus urticae* Koch is considered one of the most dangerous species of family Tetranychidae. It is difficult to control this pest by chemical compounds, since resistance can be developed within a few years (Geoghiou, 1990). Therefore, during the last decade there has been heightened interest to develop some other control tactics such the use of biological control agents. On the other hand, species belonging to prostigmatid mites of the family Stigmaeidae, especially *A. exsertus* are well known as efficient predators of mite and small insect pests (Yousef *et al.* 1982; Hafez *et al.* 1983; Zaher, 1986; Rai & Singh, 1999 and Ahmed & Ibrahim 2001). The study of the effect of prey type on the duration of developmental stages, feeding capacity and fecundity of *A. exsertus* is very essential for evaluating its role in reducing the population of plant pests associated with it in nature (Wafa *et al.* 1969).

Biological pest control tactics are used in conjunction with the traditional chemical control in integrated pest management systems (IPM). So, studying the effects on the predaceous mites preying on sprayed spider mite stages is very essential. Therefore, several investigators evaluated the effect of many pesticides on predaceous mite. They indicated that insecticides and acraicides used to control the phytophagous mites showed great toxicity to the predaceous mites (El-Banhawy & El-Bagoury, 1985 and Fouly, 1992). Moreover, the effect of feeding poisoned prey on the predaceous mites was studied also (El-Bagoury & El-Banhawy, 1987 and Kilany *et al.* 1997). Accordingly, the present work aimed to throw light on the effect of prey type on some biological aspects of *A. exsertus* when fed on eggs or immature stages of *T. urticae*. Moreover, effect of feeding *A. exsertus* females on treated *T. urticae* nymphs with four pesticides .

MATERIAL AND METHODS

A- Pure culture of the predatory mite and prey under study:

Samples of eggplant leaves (*Solanum melongena* L.) heavily infested with the phytophagous mite *T. urticae* Koch associated with its predator *A. exsertus* Gonz. were collected from Zahraa Village, Zagazig district, Sharkia Governorate. Leaves were collected and kept in paper bags and transferred immediately to the laboratory. Pure culture from each species was initiated by transferring males and females using a camel's hair brush to fresh discs of mulberry leaves (*Morus alba* L.) of one inch in diameter placed on cotton pad soaked with water in Petri-dishes of 10 cm in diameter.Whenever, leaf substrate began to deteriorate, it was changed by fresh one. Leaf discs of mulberry which was used as a substrate for culturing the predatory mite were supplied with *T. urticae* as needed. By repeating this technique enough individuals of both species were obtained for the next experiments. All Petri-dishes were placed in an incubator at 27±1°C and 65±5% R.H.

B. Rearing of *A. exsertus* on eggs or immature stages of *T. urticae*:

Gravid females of *A. exsertus* were transferred from the established culture to leaf mulberry discs to lay eggs. The newly deposited eggs were transferred singly to another leaf mulberry discs of one inch in diameter placed on moist cotton pad in Petri-dishes of 10 cm India meter. Each newly hatched larva was supplied with sufficient known number of the prey (eggs or immatures of *T. urticae*). All larvae were reared individually till reaching adulthood. Each rearing treatment started with 40 newly hatched larvae. Eggs of *T. urticae* were obtained by releasing adult females on fresh and clean mulberry leaf discs overnight and removing them at the next day. Immature stages of *T. urticae* were obtaind from the established pure culture. Petri-dishes were placed in an incubator at 27±1°C and 65±5% R.H. The consumed prey individuals were daily counted and replaced by another once. Duration of larval and nymphal stages, adult longevity, fecundity, and rate of consumption were calculated.

C- Effect treated nymph of *T. urticae* with some pesticides as preys on certain biological aspects of the predator:

Lc_{50} of four pesticides i.e. abamectin (Vertimec) 1.8 % EC, chlorfenapyr (Challenger) 36% EC, fenpyroximate (Ortus) 5% SC and fatty

acids (M-Pede) 49% SL were calculated on nymphs of *T. urticae* according to the method described by Dittrich (1962). 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 which was equal to 0.002, 0.044, 0.487 and 621.74 ppm., respectively. The survived treated nymphs were transferred to clean untreated mulberry leaf discs placed on moistened cotton pad in Petri-dishes. Twenty four hours later, the treated tetranychid nymphs were offered as food to adult females of the predator. Each female was supplied daily with enough treated *T. urticae* nymphs. Study was started with 40 predator mite females and conducted at a constant hygrothermal condition of 27±1°C and 65±5% R.H. Percent mortality of predator females, longevity, fecundity and food consumption were calculated.

RESULTS AND DISCUSSION

1- Duration of *A. exsertus* stages when fed on eggs and immature stages of *T. urticae*:

The developmental periods of female and male of *A. exsertus* fed on eggs and immature stages of *T. urticae* are shown in Table (1). Obtained data indicated that, the duration of immature stages of *A. exsertus* were insignificantly influenced by the stage of the introduced prey. These values were 7.18 & 6.82 and 7.38 & 7.10 days for female and male when the predator fed on eggs and immature stages of *T. urticae*, respectively. The female and male life cycle durated an average of 10.89 and 10.48 days when fed on eggs of *T. urticae*. These periods were slightly shorter than those fed on *T. urticae* immature stages (11.15 and 10.76 days) for female and male, respectively.

During adulthood, female lived longer than male and significantly affected by the stage of prey. Female and male longevity were shorter on immature stages (18.33 and 16.55 days) and extended to 21.37 and 17.83 days, for female and male, respectively, when reared on eggs of *T. urticae*. The total average of deposited eggs per predator female was also significantly affected by introduced stage of the investigated prey. Feeding on eggs of *T. urticae* resulted greater number of eggs (62.57 eggs) during oviposition period (15.19 days) than those fed on immature stages of *T. urticae* which laid 57.22 eggs during shorter oviposition period (12.41 days). Preovipositon and oviposition periods averaged 1.28 & 4.90 and 1.92 & 4.00 days when the predator female fed on eggs and immature stages of *T. urticae*, respectively.

Female generation period averaged 12.17 and 13.07 days at 27±1 °C and 65±5% R.H., when the predator fed on eggs and immature stages, respectively. Life span for the predator female and male lasted 29.48 and 27.31 days, respectively in the case of immature stages. These periods were extended to 32.26 and 28.31 days for female and male, respectively when reared on eggs of *T. urticae* prey.

Table (1): Duration (in days) of different stages of *A. exsertus* Gonz. when fed on eggs and immature stages of *T. urticae* Koch at 27± 1°C and 65 ± 5 % R.H .

Predator stage	Duration (in days)			
	Female		Male	
	Eggs	Immatures	Eggs	Immatures
Egg	3.71	3.77	3.66	3.66
Larva	2.23[a] ± 0.48	2.47[a] ± 0.47	2.25[a] ± 0.65	2.33[a] ± 0.77
L.S.D. 5%	0.26		0.40	
Protonymph	2.24[a] ± 0.49	2.29[a] ± 0.44	2.16[a] ± 0.62	2.22[a] ± 0.74
L.S.D. 5%	0.24		0.35	
Deutonymph	2.61[a] ± 0.56	2.62[a] ± 0.50	2.41[a] ± 0.69	2.55[a] ± 0.85
L.S.D. 5%	0.27		0.44	
Total immatures	7.18 ± 1.56	7.38 ± 1.42	6.82 ± 1.97	7.1 ± 2.36
Life cycle	10.89 ± 2.37	11.15 ± 2.14	10.48 ± 2.28	10.76 ± 2.07
Preoviposition	1.28 ± 0.27	1.92 ± 0.36	-	-
Generation	12.17± 2.65	13.07 ± 2.51	-	-
Oviposition	15.19± 3.31	12.41 ± 2.38	-	-
Postoviposition	4.9 ± 1.06	4.00 ± 0.76	-	-
Longevity	21.37[a]±4.66	18.33[b] ± 3.52	17.83[a]±5.15	16.55[b] ± 5.51
L.S.D. 5%	0.79		0.78	
Life span	32.26 ± 7.04	29.48 ± 5.67	28.31±6.18	27.31 ± 5.25
Average number of deposited eggs/ female	62.57[a]±13.66	57.22[b]±11.01		
L.S.D. 5%	2.00			

± S.E.= Standard error

Means in column followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test (Duncan, 1955).

2. Food consumption of *A. exsertus* stages when fed on eggs and immature stages of *T. urticae*:

Data in Table (2) showed that food consumption of *A. exsertus* female and male stages was significantly affected by the stage of the prey i.e. eggs or immature stages of *T. urticae*. Means of total and daily devoured prey individuals were obviously increased with successive developmental stages. Larval, protonymphal and deutonymphal stages for female and male of the predator devoured a total average of 6.14 & 6.11, 6.88 & 6.88 and 11.18 & 9.77 prey individuals of *T. urticae* immature stages. These values averaged 7.47 & 6.50, 9.76 & 9.08 and 16.57 & 13.25 eggs, when the predator fed on egg stage of the same prey. Immature stages of predator female consumed higher number of *T. urticae* eggs (33.80 eggs) showing a daily mean of 14.03 eggs than that when fed immature stage of the same prey 24.20 individuals with a daily mean of 9.74 prey individuals. During adulthood, female consumed greater number of eggs and immature stages of prey species than male. These averages values were 157.28& 122 and 92&69.66 prey for female and male when the predator fed on eggs and immature stages of *T. urticae*, respectively.

Generally, the obtained results cleared that the eggs of *T. urticae* were more favorable as prey than immature stages. In this concem, these

results are in harmony with those reported by Abou-Awad and Elsawi (1993). They mentioned that eggs of *T. urticae* were the best food for *A. exsertus*, resulting quicker development, longer longevity and higher rate of reproductive. Moreover, Shoeib (1996) reared the predator mite *A. exsertus* on eight animal foods of which *T. urticae* (eggs and immature stages) and showed that eggs of *T. urticae* came the first as it shortened the duration of life cycle (11.25 days) and immatures of *T. urticae* (12.54 days). Adult female longevity was 18 days when fed on eggs of *T. urticae* and 21.13 days when fed on immature stage of *T. urticae*. In addition, Ahmed and Ibrahim (2001), reared *A. exsertus* on eggs and immature stages of *T. urticae*. *T. urticae* eggs were the most favorable diet for the predator *A. exsertus*.

Finally, from the previous results, it could be concluded that the predatory mite *A. exsertus* may be useful as biological control agent against the two-spotted spider mite, *T. urticae* .

3. Duration, fecundity and food consumption of *A. exsertus* females when fed on *T. urticae* nymphs treated with certain pesticides:

Data in Table (3) showed that, the female longevity, fecundity and consumption of *A. exsertus* were significantly affected when fed on *T. urticae* nymphs treated with LC_{50} of four pesticides i.e. Vertimec, Challenger, Ortus and M-Pede. The effect of the pesticides on female longevity can be arranged descendingly according to the pesticide efficiency recording 9.24, 12.07, 13.45 and 17.76 days for Vertimec, Challenger, Ortus and M-Pede, respectively, comparing with the control treatment that elapsed 18.33 days. The same trend was noticed for the fecundity which recorded 28.64, 40.31, 47.3 and 55.2 eggs, while in untreated females it was 57.22 eggs. The adult female of *A. exsertus* consumed higher number of untreated prey followed by those treated with M-Pede, Vertimec, Challenger and Ortus. Mortality percentages were estimated for *A. exsertus* female when fed on treated *T. urticae* nymphs. These values were observed in the oviposition period. These percentage were 26.47, 20.58, 31.37 and 14.22 % for Finally it could be concluded that feeding the predator on a prey treated with M-Pede has less effect on its longevity and fecundity than other pesticides. These results coincide with those reported by Kilany *et al.* (1997) who studied the toxicity of three acaricides, Comite, Peropal and Tedion against the predaceous mite , *A. exsertus*, when fed on nymphs of *T. urticae* that had been treated with these compounds. The acaricides affected development, longevity, consumption of prey and fecundity of females.

Generally, it would be appear that conjoint usage of the tested pesticides with *A. exsertus* in IPM may require applying chemicals and biological control agent in sequence separated by time intervals that would be sufficient to minimize the toxicity effects on the predator.

Table (2): Food consumption of different stages of *A. exsertus* Gonz. preying on eggs and immature stages of *urticae* Koch at 27± 1° C and 65 ± 5 % R.H.

Predator stages	*Female*				*Male*			
	Total consumption		Daily consumption		Total consumption		Daily consumption	
	Eggs	Immatures	Eggs	Immatures	Eggs	Immatures	Eggs	Immatures
Larva	7.47 [a] ± 1.63	6.14 [b] ± 1.18	3.34 ± 0.07	2.48 ± 0.47	6.50 [a] ± 1.87	6.11 [a] ± 2.03	2.88 ± 0.83	2.62 ± 0.87
L.S.D. 5 %	0.84				0.54			
Protonymph	9.76 [a] ± 2.13	6.88 [b] ± 1.32	4.35 ± 0.94	3.01 ± 0.57	9.08 [a] ± 2.62	6.88 [b] ± 2.29	4.20 ± 1.21	3.09 ± 1.03
L.S.D. 5 %	0.87				1.01			
Deutonymph	16.57 [a] ± 3.61	11.18 [b] ± 2.15	6.34 ± 1.38	4.26 ± 0.81	13.25 [a] ± 3.82	9.77 [b] ± 3.25	5.49 ± 1.58	3.83 ± 1.27
L.S.D. 5 %	1.35				2.18			
Total immatures	33.80 ± 7.37	24.20 ± 4.65	14.03 ± 3.06	9.74 ± 1.87	28.83 ± 8.33	22.76 ± 7.58	12.57 ± 3.63	9.54 ± 3.18
Adult	157.28 [a] ± 34.34	92 [b] ± 17.70	7.35 ± 1.60	5.01 ± 0.96	122 [a] ± 35.26	69.66 [b] ± 23.22	6.84 ± 1.97	4.20 ± 1.40
L.S.D. 5 %	6.62				4.02			

Means in column followed by the same letter are not significantly different at the 5% level according to Duncan s multiple range test (Duncan, 1955)

Table (3): Biological effects of feeding *A. exsertus* females on treated *T. urticae* nymphs with LC_{50} of tested pesticides.

Treatments	Duration (in days)				Fecundity	Consumption		Mortality %
	Preoviposition	Oviposition	Postoviposition	Longevity		Total	Daily	
Vertimec 1.8 % EC	2.16±0.43	6.24±1.24	0.84±0.16	9.24 [c] ±1.84	28.64 [d] ±5.72	33.68 [c] ± 6.73	3.64 ±0.72	26.47 [b]
Challenger 36 % SC	2.40±0.51	8.31±1.77	1.36±0.28	12.07 [b] ±2.57	40.31 [c] ±8.59	26.09 [c] ±5.56	2.16 ±0.46	20.58 [c]
Ortus 5 % SC	2.15±0.48	9.05±2.02	2.25±0.5	13.45 [b] ±3.00	47.3 [b] ±10.58	21.55 [c] ±4.82	1.60 ±0.35	31.37 [a]
M-Pede 49% SL	2.08±7.08	12.12±2.42	3.56±0.71	17.76 [a] ±3.55	55.20 [a] ± 11.04	56.12 [b] ±11.22	3.15 ±0.63	14.22 [d]
Control	1.92±0.36	12.41±2.38	4±0.76	18.33 [a] ±3.52	57.22 [a] ± 11.02	92 [a] ±17.70	5.01 ±0.96	2.85 [e]
L.S.D. 5 %				1.67	6.07	11.84		1.81

Means in column followed by the same letter are not significantly different at the 5% level according to Duncan s multiple range test (Duncan, 1955).

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تأثير نوع الغذاء والمبيدات على المظاهر الحيوية للمفترس *Agistemus exsertus*.

محمود السيد النجار[١]، عادل عبد الحميد الفيشاوي[٢]، مصطفى النبوي محروس[٢] و محمد عليوه محمد[١]

١- معهد بحوث وقاية النباتات – الدقي – جيزة

٢- قسم وقاية النبات – كلية الزراعة – جامعة الزقازيق

يهدف هذا البحث إلى إلقاء الضوء على بعض الظواهر الحيوية للمفترس *A. exsertus* عند تغذيته على البيض أو الأطوار الناقصة أو الحوريات المعاملة بالمبيدات لحلم العنكبوت الأحمر ذو البقعتين *T. urticae* و بمكن توضيح النتائج المتحصل عليها فيما يلي:

١- كان لطور الفريسة (بيض أو أطوار ناقصة) من حلم العنكبوت الأحمر تأثير غير معنوي على فترة حياة الأطوار الغير كاملة للمفترس في حين كان هذا التأثير معنوي علي مدة حياة الأطوار الكاملة حيث بلغت دورة حياة كل من أنثي وذكر المفترس ١٠,٨٩ و ١٠,٤٨ يوما علي التوالي وذلك عند التغذية علي الأطوار الناقصة لنفس الفريسة كما عاشت الأنثى مدة أطول من الذكر و نقصت فترة حياة كل من الذكر والأنثى عند التغذية علي الأطوار الناقصة بالمقارنة بتغذيتهم علي البيض وأتضح أن الإناث التي تغذت علي البيض وضعت عدد أكبر من البيض ٦٢,٥ بيضة مقارنة بالتغذية علي الأطوار الناقصة ٥٧,٢٢ بيضة وبلغت فترة الحياة الكلية life span لكل من أنثي وذكر المفترس ٢٩,٤٨ و ٢٧,٣١ يوما علي التوالي وذلك عند التغذية علي الأطوار الناقصة بينما بلغت ٣٢,٢٦ و ٢٨,٣١ يوما علي التوالي عند التغذية علي البيض.

٢ – كان لطور الفريسة تأثير معنوي علي الاستهلاك الغذائي لكل من أنثي وذكر المفترس كما زاد معدل الاستهلاك مع تطور المفترس و كان معدل استهلاك الأنثى أكبر من معل استهلاك الذكر.

٣- عند تغذية إناث المفترس علي حوريات معاملة بالتركيز الذي يقتل ٥٠ % من المبيدات الفيرتيمك و الشالنجر و الأورتس و إم بيد. كان الفيرتيمك أشد هذه المبيدات فاعلية يليه الشالنجر ثم الأورتس بينما يأتي إم بيد في المؤخرة. وبصفة عامة عند استخدام المبيدات و المفترس في برامج المكافحة المتكاملة نوصي بوجود فترة زمنية بين المعاملة بالمبيدات و استخدام أو إطلاق المفترس وذلك لتقليل التأثير السام لهذه المبيدات علي المفترس.