J. Agric. Sci. Mansoura Univ., 32 (10): 8713 - 8721, 2007

LABORATORY TRIALS TO EVALUATE THE EFFECACY OF THE PREDATORY MITE SPECIES *Euseius metwallyi* AND *Typhlodromips capsicum* AS A BIOLOGICAL CONTROL AGENTS AGAINST THE TWO –SPOTTED SPIDER MITE, *Tetranychus urticae* (ACARI: PHYTOSEIIDAE: TETRANYCHIDAE)

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ABSTRACT

Some biological data of the phytoseiid mite species *Euseius metwallyi* Basha & Yousef and *Typhlodromips capsicum* Mostafa were investigated to evaluate their ability in controlling the two-spotted spider mite, *Tetranychus urticae* Koch under laboratory conditions of 29±3°C and 73±5 % R.H. Adult females of the two predatory mite species were provided daily during their adulthood with constant number of *T. urticae* adult females (5 preys/ predator female). It was noticed that, both phytoseiid species fed well and successfully reproduce on the introduced prey, with significant differences in their longevity, fecundity and prey consumption rates.

T. capsicum has significantly longer longevity compared to *E. metwallyi*. These values averaged 18.5 and 13.55 days for the former and later species, respectively. Adult females of *T. capsicum* showed higher fecundity, where they deposited a significantly greater number of eggs (17.67 eggs) during a significantly longer oviposition period (14.33 days) with a daily mean of 1.33 eggs. On the other hand, *E. metwallyi* adult females continued depositing eggs for a shorter oviposition period averaged 11.17 days, where they laid a total average of 12.33 eggs, with a daily men amount of 1.11 eggs.

Adult females of *T. capsicum* showed higher rate of predation during adulthood, where they attacked a significantly greater number of 63.00 preys as a total average with a significantly greater daily mean of 3.41 preys. For *E. metwallyi* adult females, these values were 41.5 and 2.71 preys, respectively. Average daily prey consumption and oviposition rates of both phytoseiid species during their longevity were discussed also. Generally, these results indicated that, both *E. metwallyi* and *T. capsicum* may be considered as biological control agents against the two-spotted spider mite *T. urticae* but the former species was more efficient predator against the investigated prey pest.

Keywords: Phytoseiidae, *Euseius metwallyi*, *Typhlodromips capsicum*, *Tetranychus urticae*, longevity, fecundity, prey consumption.

INTRODUCTION

Mites of the family Phytoseiidae are regarded to be of considerable economic importance, since they are predators on various agricultural pests. Several predacious phytoseiid mite species are important biological control agents of phytophagous mites, where they have been shown to supress the two-spotted spider mite populations on different crops (Helle & Sabelis, 1985;

Easterbrook *et al*., 2001; Pringle *et al*., 2001; Barber *et al*. , 2003; Fitzgerald *et al.,* 2003; Heikal & Fawzy, 2003 and Opit *et al*. 2004;).

In Egypt, the phytoseiid mite species *Euseius metwallyi* Basha & Yousef and *Typhlodromips capsicum* Mostafa proved to have a wide range of distribution at Sharkia Governorate in association with various agricultural pests. They preferentially attack the two-spotted spider mite *Tetranychus urticae* Koch, which is serious crop pests of the family Tetranychidae (Basha *et al.,* 2001 and Mostafa, 2004). Development, fecundity and feeding capacity of the two phytoseiid species when fed on immature stages of the two-spotted spider mite *T. urticae* were investigated by Basha (2001 and 2005). The present work aimed to obtain some biological data on longevity, prey consumption and fecundity of *E. metwallyi* and *T. capsicum* adult females when fed on *T. urticae* to evaluate their potential role as biological control agents against the investigated prey pest.

MATERIALS AND METHODS

Laboratory cultures of the phytoseiid species *E. metwallyi* and *T. capsicum* were separately initiated on grapevine, *Vitis vinifera* leaves, which were placed singly upside down on a wet cotton wool in opened Petri dishes. Cultures were kept at laboratory conditions and predators were fed on different stages of *T. urticae* three times per week (Pratt *et al*, 1999).

To study prey consumption and ovipostion rates of *E. metwallyi* and *T. capsicum*, these predators were reared singly on grapevine leaf discs of about 3 cm in diameter as rearing arenas as the method described by Yousef and El-Halawany (1982). Leaf discs were placed singly, upside down on cotton wool pads soked with water in opened Petri dishes. Each leaf disc was surrounded by a wet strip of cotton wool to prevent mite individuals from escaping and to supply them with water (Castagnoli and Simoni, 1999). Enough moisture in the cotton layer was maintained by adding few drops of water daily. A total of 30 quiescent female deutonymphs of each phytoseiid species obtained from stock culture were transferred individually and placed singly on 30 replicated leaf discs for each phytoseiid species. Adult male of each phytoseiid species was introduced to each rearing arena of the emergence . After mating was completed the male was removed and predator adult females were fed singly during their longevity on constant number of *T. urticae* adult females (5 prey individuals/predator female/ day) as prey.

All of experimental dishes were placed in a transparent plastic containers and kept at laboratory conditions. Rearing female individuals were observed twice a day until the start of oviposition, thereafter observations were obtained daily to determine the duration of preoviposition, oviposition and postoviposition periods. The consumed prey individuals by each predator female were counted and replaced with another alive ones. The number of eggs laid per predator female were recorded. Daily observations were continued until all individuals died. Experiments were carried out under

laboratory conditions of 29± 3°C and 73 ± 5% R.H.. Data were subjected to statistical analysis using F-test according to Snedecor (1966).

RESULTS AND DISCUSSION

I. Adult females longevity:

The average durations of preoviposition, oviposition, postoviposition periods as well as longevity and fecundity of *E. metwallyi* and *T. capsicum* when fed on 5 *T. urticae* adult females per day are shown in Table (1). It was noticed that during adulthood, adult female of *T. capsicum* took an average of 1.33 and 2.83 days in the pre-oviposition and post-oviposition periods, respectively, with insignificant differences in these values for *E. metwallyi* (1.82 and 2.33 days, respectively). Significant differences between the two phytoseiid species were found in the duration of oviposition period, longevity and the total number of deposited eggs laid by predator female of both species. *T. capsicum* females continued depositing eggs for a significantly longer oviposition period averaging 14.33 days, where they laid a significantly greater total average of 17.67 eggs, with daily mean amount of 1.23 eggs. On the other hand, *E. metwallyi* adult females continued ovipositing eggs for short period averaging 11.17 days, where they deposited fewer number of 12.33 eggs as a total average with nearly sequel daily mean of 1.11 eggs (Table, 1).

Table (1): Longevity and fecundity of *Euseius metwallyi* and *Typhlodromips capsicum* when fed on *T. urticae* females at 29 ± 3ºC and 73±5% % R.H.

Predators	Pre-oviposition period	Oviposition period	Post-oviposition period	Longevity	Number of deposited eggs	
					Ta	Dm
E. metwallyi	1.82± 0.31	11.17± 0.17	2.33± 0.21	15.33± 0.21	12.33± 0.49	1.11± 0.05
T. capsicum	1.33± 0.21	14.33± 0.21	2.83± 0.17	18.50± 0.22	17.67± 0.76	1.23± 0.05
L.S.D $_{0.05}$	ns	0.598**	ns	0.684**	2.020**	ns

Ta: Total average Dm: Daily mean ± Standard error

Statistical analysis indicated that, the longevity of the two predator females was significantly differed, where *T. capsicum* female showed longer longevity compared with *E. metwallyi* female. These periods averaged 18.50 and 15.33 days for the former and later species, respectively. In general, during adulthood, the adult female of *T. capsicum* showed significant longer oviposition period, higher fecundity and longer longevity when compared to other phytoseiid *Euseius metwallyi*. These results nearly agree with those obtained by El-Laithy and Fouly (1992). They reported that *Amblyseius scutalis* female laid a total average of 13.5 eggs during oviposition period of 12.86 days when fed on *T. urticae* nymphs. Galazzi and Nicoli (1996) reported that, no significant difference was recorded in the duration of the preoviposition period of 3 strains of *Phytoseiulus persimilis* when fed on *T. urticae* in the laboratory. Similarly, Abou-Setta *et al*. (1997) found that the main daily ovipositional rate of *Proprioseiopsis rotundus* was one egg per day (max. 2) when fed on *T. urticae*. Furthermore, the duration of preoviposition,

oviposition and post-oviposition periods of the phytoseiid mite *Typhlodromalus tenuiscutus* were 1.8, 16.4 and 4.6 days, respectively when reared on cassava mite, *Mononychellus caribbeanae* as prey (Rios *et al*., 1999). Ragusa *et al.* (2000) cleared that, the phytoseiid mite *Cydnodromus picanus* female laid less than 2 egg/female/ day when fed on *T. urticae* females.

II. Daily prey consumption and oviposition rates:

Data in Table (2) show daily prey consumption and oviposition rates of the phytoseiid mites *E. metwallyi* and *T. capsicum* during their longevity when fed on constant number of *T. urticae* adult female as prey (5 preys/ predator female/day). Both phytoseiid species showed tendency to feed and reproduce on the above mentioned prey. Adult females of *T. capsicum* consumed greater number of preys daily during their longevity. This value averaged 3.17 preys, one day after mating and increased gradually to maximum average of 4.33 preys, eight days after mating and then decline. The lowest daily rate of prey consumption (0.83 prey) was recorded one day before prodator female death. Similarly Blommers and Etten (1975) showed that the adult female of *Amblyseius bibens* consumed 2 - 4 preys of *T. urticae* adult females daily with prey density of eight preys per arena. Zhang *et al*., (1996) reported that adult females of *Phytoseiulus persimilis* consumed 4 - 5 females of *Tetranychus kanzawai* per day. The daily number of *T. urticae* adults consumed by *Typhlodromus pyri* was 2 - 5 preys (Khan and Fent, 2005).

Table (2): Daily prey consumption and oviposition rates of *Euseius metwallyi* and *Typhlodromips capsicum* when fed on females of *T. urticae* at 29±3 ºC and73 ±5 % R.H.

Days after mating	Average number of prey consumed per female per day		Average number of eggs laid by female per day	
	E.metwallyi	***T. capsicum***	***E. metwallyi***	***T. capsicum***
1	2.00±0.00	3.17±0.17	0.00±0.00	0.00±0.00
2	2.33±0.21	3.67±0.21	0.33±0.21	0.67±0.21
3	3.00±0.00	3.83±0.17	0.83±0.17	1.00±0.00
4	3.00±0.00	3.83±0.17	1.00±0.00	1.17±0.17
5	3.17±0.17	4.00±0.00	1.17±0.17	1.50±0.22
6	3.67±0.33	4.17±0.31	1.50±0.22	1.67±0.21
7	3.67±0.21	4.17±0.17	1.50±0.22	1.67±0.21
8	3.67±0.21	4.33±0.21	1.33±0.21	1.67±0.21
9	3.17±0.17	4.17±0.17	1.00±0.00	1.50±0.22
10	3.17±0.17	3.83±0.17	1.00±0.00	1.17±0.17
11	3.00±0.00	3.83±0.17	1.00±0.00	1.00±0.00
12	2.17±0.17	3.50±0.22	0.83±0.17	1.00±0.00
13	1.83±0.17	3.50±0.22	0.50±0.22	1.00±0.00
14	1.67±0.21	3.17±0.17	0.33±0.21	1.00±0.00
15	1.50±0.22	3.00±0.00	0.00±0.00	1.00±0.00
16	0.50±0.34	2.17±0.40	0.00±0.00	0.50±0.22
17	0.00±0.00	2.17±0.40	0.00±0.00	0.17±0.17
18	0.00±0.00	1.67±0.33	0.00±0.00	0.00±0.00
19	0.00±0.00	0.83±0.40	0.00±0.00	0.00±0.00
20	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

± : Standard error

On the other hand, during adulthood, female of *E. metwallyi* attacked fewer number of preys. The daily consumption rate averaged 2 preys , one day after mating, then increased gradually and reached its highest value of 3.67 preys 6, 7 and 8 days after mating. Thereafter, it decreased to a minimum average of 0.50 prey one day before death.

The daily oviposition rate of *T. capsicum* was 0.67 egg, in the beginning of the oviposition period, increased gradually to the maximum average of 1.67 eggs at six, seven and eight days after mating. The lowest daily oviposition rate (0.17 egg) was recorded seventeen days after mating (end of the oviposition period). For *E. metwallyi*, the daily oviposition rate was 0.33 egg at the first day of eggs deposition, rose slowly to the highest maximum average of 1.50 eggs five and six days after mating and then decline to the lowest value of 0.33 egg at the end of the oviposition period. Similar results were obtained by Amano and Chant (1979). Since they reported that the oviposition rate of *Phytoseiulus persimilis* and *Amblyseius andersoni* reached its highest maximum values one and two weeks after mating and then decline, respectively. Fouly and El-Laithy (1992) also showed that the females of the phytoseiid species *Amblyseius barkeri* laid their greatest number of eggs during the first week of oviposition period when fed on *T. urticae* nymphs.

III. Adult females efficiency:

Data presented in Table (3) indicated that, adult females of both phytoseiid species adult showed markedly differences in their ability to consume adult females of the two-spotted spider mite *T. urticae*. During pre-ovipostion period, there were no significant differences in the total average of preys consumed by predator females, but differences were found in the daily mean of prey consumption during the same period. Adult females of *T. capsicum* fed on a total average of 4.33 preys, with a more significant daily mean of 3.25 preys. For *E. metwallyi*, these values were 3.83 and 2.06 preys, respectively (Table 3).

Table (3): Prey consumption of *Euseius metwallyi* and *Typhlodromips capsicum* during their longevity when fed on *T. urticae* females at 29 ±3ºC and73 ±5% R.H.

Predators	Pre-oviposition period		Oviposition period		Post-oviposition period		Longevity	
	Ta	Dm	Ta	Dm	Ta	Dm	Ta	Dm
E. metwallyi	3.83± 0.75	2.06± 0.05	34.17± 0.95	3.06± 0.09	3.50± 0.34	1.56± 0.20	41.50± 0.85	2.71± 0.07
T. capsicum	4.33± 0.71	3.25± 0.17	53.83± 0.98	3.76± 0.05	4.83± 0.65	1.75± 0.26	63.00± 1.48	3.41± 0.06
L.S.D $_{0.05}$	ns	0.399**	3.035**	0.227**	ns	ns	3.805**	0.198**

Ta = Total average Dm= Daily mean ± Standard error

Adult females of both phytoseiid species seemed to be more voracious during their oviposition period and showed significant differences between the two species in the total average and daily mean of prey consumption during this period.

Adult female of *T. capsicum* attacked significantly greater number of preys than *E. metwallyi* adult female, where it devoured a total average of 53.83 preys, with a daily mean of 3.76 preys. This number represented 85.44 % of the total preys consumed during adult female longevity. On the other hand *E. metwallyi* adult female killed fewer number of preys during its oviposition period, where it consumed 34.17 preys as a total average and daily mean of 2.06 preys. This number represented 82.43 % of the total preys consumed during adult female longevity. The newly emerged female of the phytoseiid mite *Amblyseius cydnodactylon* seemed to be more efficient than old ones. (Yousef *et al*., 1984).El-Laithy and El-Sawi (1998) reported that the highest rate of prey consumption for *Neoseiulus californicus* was observed during the oviposition period regardless of diet source.

No significant differences were recorded in the total average and daily mean of preys consumed by the two phytoseiid species adult females during postoviposition period. *E. metwallyi* adult female attacked a total average and daily mean of 3.50 and 1.56 preys, respectively during post-oviposition period. For *T. capsicum* these values were 4.83 and 1.75 prey individuals, respectively (Table 3). These results nearly agree with those of Abdallah *et al*. (2001). They reported that, the number of prey protonymphs of *T. urticae* consumed by the phytoseiid mite *Euseius finlandicus* was highest in the oviposition period, lower in the pre-oviposition period and lowest in the post-oviposition period.

Statistical analysis indicated that significant differences were detected between the two phytoseiid species adult females in the total average and daily mean of prey individuals devoured during their longevity. *T. capsicum* adult female fed on a significantly more total average and daily mean of 63.00 and 3.41 preys, respectively. A lower total average (41.50) and daily mean (2.71) of prey consumption were recorded with *E*. *metwallyi* adult female (Table 3).

From the previous results it can be concluded that, both phytoseiid species *E. metwallyi* and *T. capsicum* may be sonsidered as potential biological control agents against the two-spotted spider mite *T. urticae*,. *T. capsicum* appeared more efficient than *E. metwallyi*, because of its higher fecundity, longer ovipositional period, and longevity as well as higher rates of prey consumption.

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دراسات معملية على نوعى الحلم المفترس *Euseius metwallyi* و *Typhlodromips capsicum* كأحد عوامل المكافحة البيولوجية للحلم العنكبوتى ذو البقعتين *Tetranychus urticae* (أكارى : فيتوسيدى : تترانيكيدى)

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استهدفت هذه الدراسة إجراء مقارنة بين نوعى الحلم المفترس *Euseius metwallyi* , *Typhlodromips capsicum* من فصيلة Phytoseiidae لإيضاح كفاءة كل منهما كأحد عوامل المكافحة البيولوجية للحلم العنكبوتى ذو البقعتين *Tetranychus urticae* . حيث تم تغذية إناث كل من نوعى الحلم المفترس خلال الطور الكامل على مستوى ثابت من إناث الحلم العنكبوتى ذو البقعتين يوميا (٥ فرائس/أنثى المفترس) تحت ظروف المعمل على درجة حرارة ٢٩ ± ٣°م ورطوبة نسبية ٧٣ ± ٥ %.

وأوضحت النتائج أن إناث كل من نوعى الحلم المفترس تتغذى وتتكاثر بصورة جيدة على الفريسة سالفة الذكر مع وجود اختلافات معنوية بينهما فى فترة طول العمر longevity ، والخصوبة fecundity ومعدل استهلاك الفرائس prey consumption rate.

وكانت فترة طول العمر لإناث النوع *T. capsicum* أطول وبدرجة معنوية مقارنة بالنوع *E. metwallyi* حيث بلغت ١٨,٥، ١٣,٥٥ يوماً لكل من النوع الأول والثانى على الترتيب، كما سجلت زيادة معنوية فى خصوبة النوع *T. capsicum* حيث استمرت الإناث فى وضع البيض لفترة أطول بلغت حوالي ١٤,٣٣ يوماً وضعت خلالها عددا اكبر من البيض (١٧,٦٧ بيضة) وبمعدل يومي لوضع البيض بلغت قيمته ١,٣٣ بيضة، بينما أظهرت إناث النوع *E. metwallyi* معدل خصوبة اقل حيث وضعت الانثى عددا اقل من البيض (١٢,٣٣ بيضة) فى فترة وضع بيض اقصر (١١,١٧ يوماً) وبمعدل يومى ١,١١ بيضة.

كما تميزت إناث النوع *T. capsicum* بكفاءتها الافتراسية العالية خلال فترة طول العمر وحيث بلغ مجموع ما تلتهمه الانثى الواحدة ٦٣ فرداً من إناث الحلم العنكبوتى ذو البقعتين وبمعدل أستهلاك يومى ٣,٤١ فرداً من الفريسة المذكورة، فى حين كانت إناث النوع *E. metwallyi* ذات كفاءة افتراسية أقل حيث بلغ مجموع ما تلتهمه الأنثى الواحدة ٤١,٥ فريسة بمعدل افتراس يومى ٢,٧١ فريسة. كما أحتوت الدراسة على مناقشة تفصيلية لمعدل وضع البيض اليومي وكذلك معدل الاستهلاك اليومى من الفرائس لإناث كل من نوعى الحلم المفترس خلال فترة طول العمر الخاصة بكل منهما.

وعموماُ وفى ضوء النتائج المتحصل عليها يمكن أعتبار نوعى الحلم الفيتوسيدى محل الدراسة من أهم عوامل المكافحة الحيوية للحلم العنكبوتى ذو البقعتين كما تميز النوع *T. capsicum* بكفاءته الافتراسية العالية مقارنة بالنوع *E. metwallyi* .