Typhlodromips swirskii (Athias- Henriot) as a biological control agent for *Panonychus citri* (McGregor) (Phytoseiidae, Tetranychidae)

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ABSTRACT

Typhlodromips swirskii was able to develop and reproduce when fed on *Panonychus citri*. Temperature negatively affected its biology. Generation period and adult female longevity decreased from (10.59±0.42) and (31.72±0.97) at 20 °C. to (7.81±0.40) and (21.72±0.41) days at 30 °C. respectively. Also female laid an average of (33.75±2.64) eggs at 20 °C., decreased to (24.19±1.72) days at 30 °C. However, r_m was 0.14 and 0.18 at both degrees respectively. *T. swirskii* proved to be effective predator for *P. citri*, as at high level of eight predators/ orange seedling, *Citrus aurantium* L., it gave the highest percent reduction from 27.27% after a five days to 88.89 % after a month from release.

Key Words: *Typhlodromips swirskii*, Biological control, *Panonychus citri*.

INTRODUCTION

Predaceous phytoseiid mites are important natural enemies of several phytophagous mites and other pests on various crops. *Typhlodromips swirskii* (Athias-Henriot) became commercially available in 2005 and is used in Europe as a control agent for whiteflies and thrips (Gerson and Weintraub, 2007). Compatibility of *Typhlodromips swirskii* and *Orius insidiosus* for biological control of *Frankliniella occidentalis* on roses has been reported by Chow *et al.*, (2010).

The citrus red mite, *Panonychus citri* (McGregor) has a worldwide distribution and is noted on over 80 species of host plants, including citrus (Bolland *et al.*, 1998 and Zhang, 2003). Serious infestation by *P. citri* can cause heavy defoliation and fruit drop (Jeppson *et al.*, 1975 and Emmanouel & Papadoulis, 1987). It has recently gained economic pest status on citrus in the East Mediterranean region and Turkey (Uygun *et al.*, 1992; Karaca, 1994; Kasap *et al.*, 1998 and Kasap, 2001). Most of the recent research on biological control of tetranychids, including *P. citri*, has been focused on the family Phytoseiidae, due to their contribution in maintaining prey populations at low densities (McMurtry and Croft, 1997).

Typhlodrompis swirskii (Athias-Henriot) and *Panonychus* sp. was recorded on citrus leaves in Egypt, Dakahleia governorate, subsequent biological studies revealed that the predator *T. swirskii* fed on immature stages of prey *Panonychus* sp. under favorable laboratory conditions (Elmoghazy, 2006).

Therefore, this work included biological studies of *T. swirskii* when fed on *P. citri* at 20 and 30 °C. as well as its influence when released at different levels, in suppressing population of *P. citri* infesting citrus seedlings, *Citrus aurantium* L.

MATERIALS AND METHODS

Mite cultures

T. swirskii stock culture was maintained on *P. citri*, as prey, on sour orange leaves in a controlled rearing room (25±2 °C, 65±5% R. H. and 16: 8 L: D). Both species were collected from sour orange trees, *Citrus aurantium* L.

Thirty discs of fresh citrus leaves (3 cm. diameter) were placed on wet cotton placed in foil-dishes (20 cm. in diameter and 2 cm. deep). Every foil-dish contained six discs of citrus leaves, each disc was surrounded with wet cotton as barrier to prevent mite escape. Newly deposited eggs were transferred singly from stock culture of predator mite to these discs and also immature stages of *P. citri* were transferred from stock culture as prey.

The rearing discs were checked twice daily and the numbers of consumed preys were recorded and replaced by new ones all over the predator life span. The rearing experiment was carried out at 20 and 30±2 °C. and 65±5% R.H. in laboratory, and observations were undertaken twice daily.

Release technique

Experiment took place from end of May till end of July. Pots planted with citrus seedlings, *Citrus aurantium* L., of 100 cm. height were put in 4 separate groups under field condition and each group was surrounded by a belt of 2 meters distance. Every seedling was infested with about 50 *P. citri* individuals and left till infestation averaged

2-3 mites individuals per leaf. Then, the predator was released in three densities by 4, 6, 8 females per seedling. To assess *P. citri* populations, 6 leaves from each level (top, middle and bottom) from 5 seedlings per group (treatment) were randomly chosen and examined on the seedlings every five days throughout a month.

Data analyses

The numerical data collected were computerized by using SPSS program (Statistical Package of Social Science) program, version 13, 2004 and Henderson & Teilton formula (1955).They were presented as mean value and standard deviation.

Life table parameters

Developmental period of different stages and sex ratio of *T. swirskii* progeny were determined and oviposition was recorded daily for each female. Life table parameters were estimated using the life 48, BASIC computer program (Abu-Setta *et al.*, 1986).

RESULTS AND DISCUSSION

Temperature negatively affected the developmental duration of *T. swirskii* different stages as it decreased when temperature increased from 20°C. to 30±2°C. when fed on *P. citri.*

Table (1) showed that at 20 and 30°C. the duration of male total immature stages of *T. swirskii* averaged (6.25±0.42) and (4.58±0.20) days, while averaged (6.63±0.43) and (4.72±0.26) days for female respectively. The male life cycle lasted (8.50±0.45) and (6.67±0.26) days, and that of female lasted (9.01±0.48) and (6.91±0.33) days. Generation period averaged (10.59±0.42) and (7.81±0.40) days at both temperature degrees respectively. Female longevity lasted (31.72±0.97) and (21.72 ± 0.41) days respectively.

Table (1): Developmental duration of predatory mite *Typhlodromips swirskii* fed on *Panonychus citri* at 20 and 30±2 °C. and 65±5% R.H.

Stage	Sex	Duration (days)	
		20 °C	30 °C
Total immatures	♂	6.25 ± 0.42	4.58 ± 0.20
	♀	6.63 ± 0.43	4.72 ± 0.26
Life cycle	♂	8.50 ± 0.45	6.67 ± 0.26
	♀	9.01 ± 0.48	6.91 ± 0.33
Generation period	♀	10.59 ± 0.42	7.81 ± 0.40
Longevity	♂	26.33 ± 0.82	16.50 ± 0.55
	♀	31.72 ± 0.97	21.72 ± 0.41
Life span	♂	34.67 ± 0.98	23.17 ± 0.41
	♀	40.72 ± 0.93	28.63 ± 0.97

Statistical analysis of the obtained results revealed the occurrence of significant differences between male and female developmental duration periods.

Data presented in table (2) showed that the number of eggs and the daily rate produced by adult female were affected by temperature.

Table (2): Adult female longevity and fecundity of *Typhlodromips swirskii* fed on *Panonychus citri* at 20, 30 ± 2 °C. and 65 ± 5 % R. H.

Parameters		20 °C.	30 °C.
Average periods (days)	Pre-oviposition	1.59±0.42	1.03 ± 0.22
	Oviposition	27.63±0.96	19.19±0.98
	Post-oviposition	2.50±0.52	1.44±0.44
	Longevity	31.72±0.97	21.72±0.41
No. of eggs / female	Total average	33.75±2.64	24.19±1.72
	Daily rate	1.22±0.09	1.26±0.04

The present results coincided with those obtained by (Zhang, 2003) who recorded a shorter developmental time at high temperature. Kasap and Lu (2004) found that In general, the development duration, preoviposition and postoviposition periods of *Euseius scutalis* (A. H.) fed on *P. citri* were shortened as temperature increased.

Data presented in table (3) and Figs. (1, 2) clearly showed that sex ratio was not affected by increasing temperature. Therefore, according to life table parameters, the temperature obviously affected the intrinsic rate of increase (r_m) of *T. swirskii* as it was 0.14 at 20°C and increased to 0.18 individual/female/day at 30°C. These values were subsequently used to calculate the specific rate of fecundity (Mx) and survival rate curves (Lx) of *T. swirskii*.

Table (3): Effect of temperature on life table parameters of *Typhlodromips swirskii* when feed on *Panonychus citri*.

Parameters	20 °C.	30 °C.
Net reproductive rate (R_o)	17.73	12.74
Generation time (T)	19.33	14.13
Intrinsic rate of increase (r_m)	0.14	0.18
Finite rate of increase ($\exp{r_m}$)	1.16	1.19
Sex ratio (female/total)	0.72	0.72

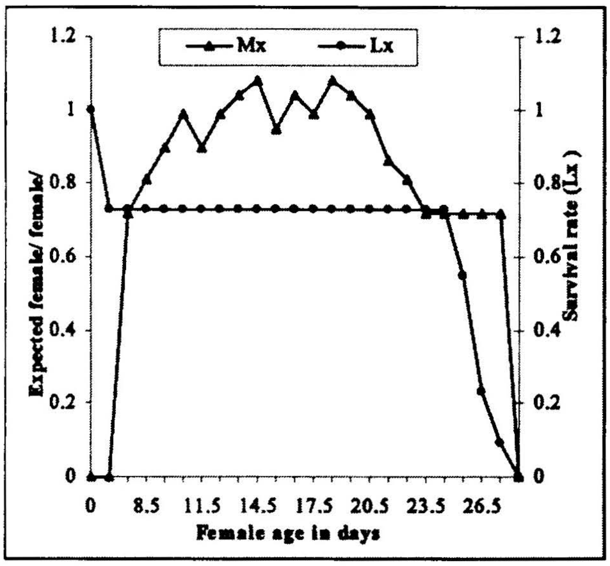

Fig. (1): Natality and survivorship of *Typhlodromips swirskii* individaually fed on *Panonychus citri* at 20 ± 2 °C. and 65 ± 5 % R.h.

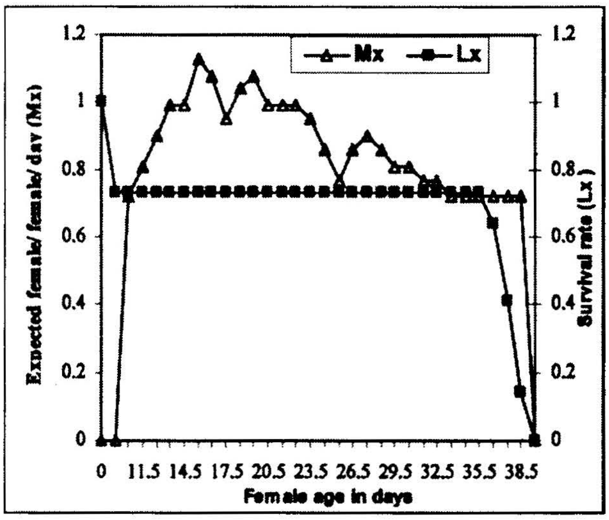

Fig. (2): Natality and survivorship of *Typhlodromips swirskii* individaually fed on *Panonychus citri* at 30 ± 2 °C. and 65 ± 5 % R.h.

Nomikou *et al.*, (2001, 2002) reported that r_m of *E. scutalis* fed on *P. citri* averaged 0.23-0.29 according to the temperature. Kasap and Lu (2004) found that r_m value of *E. scutalis* fed on *P. citri* was lower than the previous one where it averaged between 0.16 and increased to 0.29 (female/female/day) by increasing temperature.

The influence of *T. swirskii* released at three levels on *P. citri* infesting citrus seedling, *Citrus aurantium* L. under field conditions

Data presented in Table (4) revealed that *T. swirskii* provided effective control of *P. citri* as the average number of its survival moving stages reached its lowest values in treatment (C= 8 predators/plant at release) which contained the highest number of predators.

Table (4): Average number of moving stages of *Panonychus citri* survived after *Typhlodromips swirskii* release.

Days after release	Moving stages of *Panonychus citri*			
	A	B	C	Control
5	60.4±2.23	53.8±2.29	48.2±2.12	66.0±2.12
10	72.2±1.89	66.2±2.13	54.0±1.41	83.8± 2.29
15	90.2±1.67	84.0±2.28	59.8±2.29	108.2±3.54
20	83.8±1.18	72.2±2.03	42.2±2.01	138.0± 4.30
25	78.2±2.21	60.0±2.50	29.8±2.01	149.8±4.62
30	71.8±1.40	41.8±1.77	18.2±1.43	162.0±4.05

A= 4, B= 6 and C= 8 female predators/plant
control = without predator/plant

Consequently, data presented in table (5) showed that the highest level of (8 predators/plant) enhanced the highest total reduction percentages from 27.27 % after five days to 88.89 % after a month.

Table (5): Reduction Percentage (%) of *Panonychus citri* population infesting citrus plants after releasing different levels of *Typhlodromips swirskii.*

Predatory levels	Time after release(days)					
	5	10	15	20	25	30
A	9.1	14.28	16.67	39.13	48.0	55.56
B	18.18	21.43	22.22	47.82	60.01	74.07
C	27.27	35.71	44.44	69.56	80.01	88.89

A= 4, B= 6 and C= 8 female predators/plant

T. swirskii has been studied for many years as predator of spider mites and citrus pests in Egypt where it naturally occurs (El-Ltaithy and foully 1992).

Thus, it can be concluded that *T. swirskii* is expected to play a considerable role in the biological control of *P. citri* in citrus orchards.

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