Biology og *Euseius scutalis* (Acari: Phytoseiidae) on *Tetranychus urticae* and *Panonychus ulmi* (Acari: Tetranychidae) at Different Temperatures

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ABSTRACT

This study was conducted to determine the effect of different temperatures and prey type on the biology of *Euseius scutalis* Athias-Henriot (Acari: Phytoseiidae) fed on *Tetranychus urticae* Koch and *Panonychus ulmi* (Koch) (Acari: Tetranychidae) at 20, 25 and 30°C. The incubation period of *E. scutalis* was shortened with increasing temperature. The mean duration of immature stages was 10.3, 12.7; 7.0, 9.8 and 4.1, 5.7 days when the mite females fed on *T. urticae* and *P. ulmi* at 20, 25 and 30°C, respectively. The life cycle duration was 14.0, 15.5; 9.1, 12.4 and 5.6, 7.9 days when the females were fed on the aforementioned conditions, respectively. Average female longevity on T. urticae *and P. ulmi* was 27.7& 31.9 days at 20°C, followed by 22.4& 25.7 days at 25°C and 15.7& 20.4 days at 30°C, respectively. The maximum average fecundity (44.2 eggs/female) was observed at 25°C when females fed on T. urticae compared with 35.6 eggs/female on *P. ulmi*. Obtained relative values for males were generally less than those of females. Effect of temperature on obtained biological values expressed as rates (1/duration) between main aspects and tested temperatures was significant. Obtained R^2 values ranged between 0.90 and 0.655 with $P < 0.001$. It was concluded that *T. urticae* was preferred prey than *P. ulmi* and 30°C was the best for individual developmental rate while 25°C was the best for most fecundity regardless tested prey.

Key Words: Biology, *Euseius scutalis*, Phytoseiidae, Temperature, Tetranychidae.

INTRODUCTION

Members of the family Phytoseiidae have received considerably worldwide attention because of their potential as natural enemies of phytophagous mites. *Euseius* is a cosmopolitan genus which contains many species known to be facultative feeders on mite and insects with higher productivity on pollen (Mc Murty and Croft 1997).

Biology of some members of the genus *Euseius* was reported by authors on various prey types and different temperatures (Abou-Setta & Childers, 1987; Furtado & Moraes, 1998; Abd El-Halim *et al.*, 2000; Raza *et al.*, 2005; Kasap, 2008 and Al-Shammery 2010). The development and reproduction of the predatory mite *Euseius scutalis* Athias-Henriot (Acari: Phytoseiidae) when reared on pollen of *M. crocea* was reported (Bounfour and McMurty 1987).

The developmental time, survival and fecundity of *Euseius septicus* Chaudhari were determined at different temperatures (20, 25 and 30°C) and 60-70% R.H. fed on the two spotted spider mite (Raza *et al.*, 2005). Larval, nymphal, preoviposition and postoviposition period decreased as temperature increased.

The differences in biological aspects of *Euseius finlanandicus* when fed on *Tetranychus urticae* Koch (Acari: Tetranychidae) together with birch pollen at 16, 20, 25 and 30°C at 65 % R.H. and 16:8 photoperiod was reported (Kasap, 2008).

As a step towards evaluation of *E. scutalis* in bio-control, the effect of different temperatures on the biology of this species feding on the two spotted spider mite *T. urticae* and the European red mites, *Panonychus ulmi* (Koch) (Acari: Tetranychidae) under the laboratory conditions, was studied.

MATERIALS AND METHODS

The experiment was carried out under the laboratory conditions. *E. scutalis* culture was maintained using all the stages of *T. urticae* as prey. The effect of different temperatures on the biology of *E. scutalis* was determined by using water soaked cotton arena. This arena consisted of water soaked cotton ring of 1cm diameter that was placed over plastic sheet (7×7 cm) with a piece of blotting paper and fresh leaf placed in between the cotton ring and plastic sheet. Blotting paper and cotton ring kept moist through capillary action of water via piece of cotton that was dipped in water source. Cotton ring was used as a barrier to prevent the escape of mites from the arena. Moist blotting paper kept the leaf fresh for 4-5 days. The old leaf in arena was replaced with fresh leaf after 4-5 days.

The spider mites, *T. urticae and P. ulmi* were transferred from the laboratory cultures to the Petri dishes by using camel hair brush and then *E. scutalis* females were transferred to each petri-dish for egg laying and removed after completed oviposition. The Petri-dishes were kept separately in growth

chambers set at three temperatures (i.e. 20, 25 and 30°C). Each treatment consisted of five Petri dishes, containing 5 discs each. The characters observed included incubation period, duration of protonymph, deutonymph, preovipostion, oviposition and postoviposition periods and longevity at each temperature.

The statistical analysis (ANOVA and Regression) of the obtained results were performed using SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

The present experiment was conducted to determine the effect of different temperatures and prey type on the duration of various life stages, adult longevity and fecundity of *E. scutalis* fed on *T. urticae* and *P. ulmi*. Obtained results and their significances are presented in Tables (1and 2).

Incubation period:

Incubation period of *E. scutalis* averaged 3.7 & 2.8 days at 20°C; 2.1 & 2.6 days at 25°C; and 1.5 & 2.2 days at 30°C when reared on *T. urticae* and *P. ulmi*, respectively; this period decreased with temperature increase.

Larval stage:

At 20°C, *E. scutalis* females larval period was 2.3 and 2.9 days when fed on *T. urticae* and *P. ulmi*, respectively (Table 1). It was 1.9 and 2.3 days when males larval mite fed on these diets at 20°C, respectively. However, when the temperature increased to 25°C, the larval period was 1.5 and 2.5 days for females and 1.4 and 2.0 days for males, respectively. At 30, females larval period was 0.8 and 1.4 days, respectively.

Protonymphal stage:

The mean protonymphal period of *E. scutalis* female and male was 3.1 & 2.5 and 4.5 & 3.8 days when fed on *T. urticae* and *P. ulmi*, at 20°C, respectively. However, when the temperature increased to 25°C, the protonymphal stage period of this mite lasted 2.4 & 3.2 days for females and 2.1 & 2.9 days for males, respectively. On the other hand, at 30°C, the protonymph of *E. scutalis* lasted 1.1 & 2.1 for females and 0.7 & 1.7 days for males when fed on the same prey, respectively (Table 1).

Deutonymphal stage:

The mean deutonymphal period of *E. scutalis* was 4.9 and 5.3 days for female individuals when reared on *T. urticae* and *P. ulmi* at 20°C, respectively. This period was 3.8 & 4.5 days for males. This stage lasted 3.1 & 4.1; 2.9 & 3.4 days for females and males at 25°C, respectively. On the other hand, the deutonymphal period of *E. scutalis* as observed at 30°C lasted 2.2, 3.0; 1.5 and 2.6 days, respectively. (Table 1).

Life cycle:

The mean duration of life cycle for individuals was 14.0, 15.5 and 11.5, 13.4 days when the *E. scutalis* females and males fed on *T. urticae* and *P. ulmi* at 20°C, respectively. However, this period decreased at 30°C averaging 5.6, 7.9 and 4.1, 7.4 days, respectively. (Table 1).

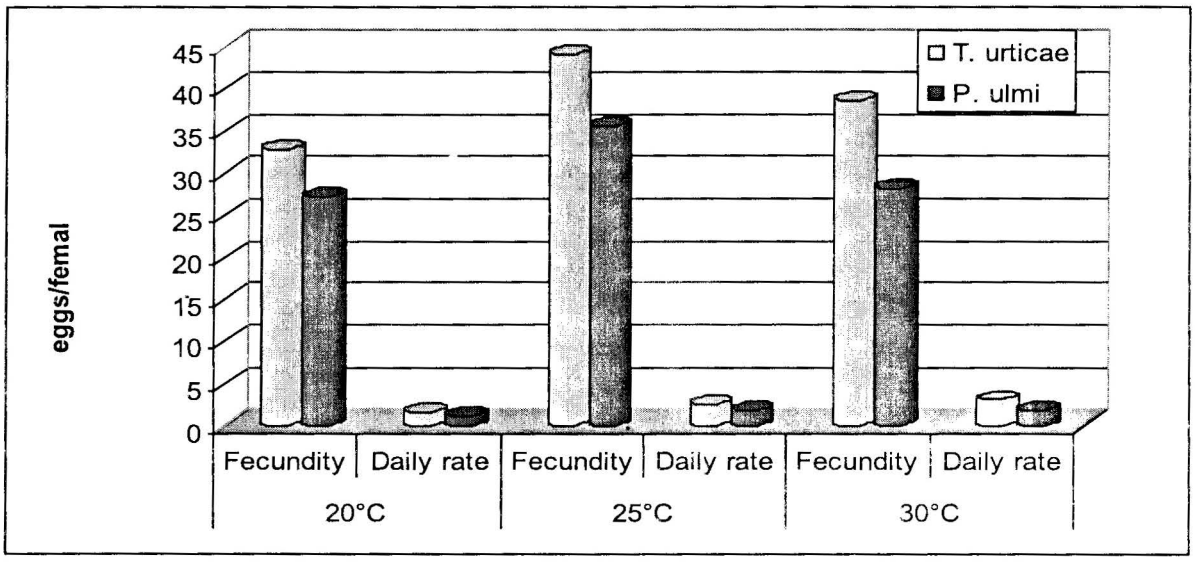

Fig. (1): Effect of prey type on *E. scutalis* female fecundity and daily rate when fed on *T. urticae* and *P. ulmi*.

Table (1): Duration (mean+SD) of different stages of *E. scutalis* when fed on *T. urticae* and *P. ulmi*.

Predator stage	Sex	20°C		25°C		30°C	
		T. urtica	*P. ulmi*	*T. urticae*	*P. ulmi*	*T. urticae*	*P. ulmi*
Egg	♀	3.7±0.54	2.8±0.54	2.1±0.54	2.6±0.54	1.5±0.41	2.2±0.41
	♂	3.3±0.74	2.8±0.74	1.9±0.50	2.3±0.50	1.3±0.44	1.9±0.45
Larva	♀	2.3±0.57	2.9 ±0.27	1.5±0.22	2.5±0.41	0.8±0.27	1.4±0.27
	♂	1.9±0.41	2.3 ±0.41	1.4±0.27	2.0±0.27	0.6±0.22	1.2±0.27
Protonymph	♀	3.1±0.41	4.5±0.42	2.4±0.27	3.2±0.50	1.1±0.44	2.1±0.27
	♂	2.5±0.41	3.8±1.11	2.1±0.22	2.9±0.44	0.7±0.22	1.7±0.35
Deutonymph	♀	4.9±0.22	5.3 ±0.27	3.1±0.27	4.1±0.75	2.2±0.54	3.0±0.50
	♂	3.8±0.41	4.5±0.65	2.9±0.27	3.4±0.41	1.5±0.41	2.6±0.44
Total immatures	♀	10.3±1.03	12.7±0.41	7.0±0.22	9.8±0.67	4.1±0.83	5.7±0.96
	♂	8.2±0.75	10.6±1.64	5.5±0.44	8.3±0.83	2.8±0.65	5.5±0.86
Life cycle	♀	14.0±1.29	15.5 ±0.70	9.1±0.57	12.4±1.03	5.6±1.15	7.9±1.35
	♂	11.5±1.39	13.4±1.98	7.4 ±0.93	10.4±1.25	4.1±0.65	7.4±1.30
Longevity	♀	27.7±1.47	31.9±1.18	22.4±2.10	25.7±1.67	15.7±2.59	20.4±3.71
	♂	24.0±1.14	27.4±1.87	19.2±1.30	22.0±1.67	12.8±1.94	16.0±0.89
Life span	♀	41.7±1.64	47.4±0.62	31.5±1.39	38.1±1.67	21.3±1.72	28.3±1.34
	♂	35.5±1.07	40.8±1.91	26.5±1.10	30.3±1.71	18.9±1.98	22.9±2.07
Pre-oviposition	♀	3.1±0.75	3.2±0.35	2.0±0.44	2.60±0.22	1.3±0.44	2.18±1.25
Oviposition	♀	20.4±1.67	23.4±2.58	17.6±1.92	19.30±0.30	12.6±2.40	15.6±3.11
Post-oviposition	♀	4.20±1.30	5.30±0.89	2.8±0.83	3.80±0.89	1.8±0.83	2.7±0.97

Table (2): Significance of different duration means for the different stages of *E. scutalis* when fed on *T. urticae* and *P. ulmi*.

Stage	Prey type	Mean		F value	P
Egg	*T. urticae*	2.3	a	0.26	0.612
	P. ulmi	2.4	a		
Larva	*T. urticae*	1.4	a	10.45	0.0021
	P. ulmi	2.0	b		
Protonymph	*T. urticae*	1.9	a	23.07	0.0001
	P. ulmi	3.0	b		
Deutonymph	*T. urticae*	3.1	a	10.46	0.0021
	P. ulmi	3.8	b		
Total immatures	*T. urticae*	6.3	a	37.45	0.0001
	P. ulmi	8.7	b		
Pre-oviposition	*T. urticae*	2.1	a	1.97	0.1726
	P. ulmi	2.7	a		
Oviposition	*T. urticae*	16.9	a	6.36	0.0181
	P. ulmi	19.4	b		
Post-oviposition	*T. urtica*	2.9	a	7.22	0.0032
	P. ulmi	3.9	b		
Total egg	*T. urtica*	38.5	b	14.39	0.0008
	P. ulmi	30.3	a		
Longevity	*T. urtica*	20.3	a	27.58	0.0001
	P. ulmi	23.9	b		
Life span	*T. urtica*	29.3	a	29.34	0.0001
	P. ulmi	34.6	b		

Table (3): Regression values for relation between selected biological aspects rate and temperature using different types of prey

Prey type	Stage	Sex	a	b	P	R^2
T. urticae	Total immature	♀	-0.6096	0.0068	0.0001	0.8841
		♂	-0.0990	0.0090	0.0003	0.6550
	Life cycle	♀	-0.0256	0.0044	0.0001	0.8616
		♂	-0.0050	0.0063	0.0001	0.7500
	Longevity	♀	-0.0440	0.0100	0.0001	0.9026
		♂	-0.0190	0.0027	0.0001	0.7790
	Life span	♀	-0.0090	0.0014	0.0001	0.7620
		♂	-0.0168	0.0020	0.0001	0.7559
P. ulmi	Total immature	♀	-0.1927	0.0144	0.0001	0.7117
		♂	-0.3810	0.0240	0.0001	0.7087
	Life cycle	♀	-0.1150	0.0097	0.0001	0.6980
		♂	-0.2479	0.0160	0.0001	0.7840
	Longevity	♀	-0.0200	0.0027	0.0001	0.7750
		♂	-0.0350	0.0037	0.0001	0.7548
	Life span	♀	-0.0197	0.0021	0.0001	0.8230
		♂	-0.0296	0.0028	0.0001	0.7051

Adult longevity:

Mean female longevity was 27.7 & 31.9 days at 20°C; 22.4 & 25.7 days at 25°C and 15.7 & 20.4 days at 30°C, when fed on *T. urticae*, and *P. ulmi*, respectively. The differences were significant ($P < 0.05$). On the other hand the male longevity was 24.0 & 27.4 at 20°C, 19.2 & 22.0 days at 20°C, but at 30°C, it was 12.8 and 16.0 days, respectively. (Table 1).

Immature stages were affected significantly by both studied factors (i.e. prey type and temperature). The general trend was that obtained durations were significantly longer on *P. ulmi* than *T. urticae*. This applied to both females and males. There results indicated that *T. urticae* was the preferred prey compared with *P. ulmi*. Obtained relative values for males were generally less than females.

Female specific results:

Pre-ovipostion, oviposition and post-oviposition periods were longer on *P. ulmi* than *T. urticae* regardless tested temperature. Total fecundity and daily rate were significantly higher on *T. urticae* than *P. ulmi* (Table 2). Fecundity and daily oviposition rates are illustrated (Fig1). The mean of deposited eggs and daily rate were 32.8, 1.59 and 27.2, 1.16 eggs/female at 20°C on *T. urticae* and *P. ulmi*, respectively. These values were 44.2, 2.54 and 35.6, 1.84 eggs/female at 25°C and 38.6, 3.1 and 28.2, 1.8 eggs/female at 30°C, respectively.

Effect of temperature:

This relation was expressed between main aspects durations as rate (1/duration) and tested temperatures. The main aspects considered were total immatures, life cycle, and life span. Results revealed strong significant regression relations. R^2 values ranged between 0.6550 and 0.9026 with $P < 0.001$ (Table 3).

These results conformed the relation between main aspects durations and temperature. Generally it could be concluded that 30°C was the best for individual developmental rate, while 25°C was the best for population increase where most fecundity occurred.

The present study clearly indicated the effect of different temperatures and prey type on the developmental time of different stages of *E. scutalis*. The results can be compared with Kasap and Sekeroglu (2004) who reported that total developmental times of *E. scutalis* were 6.7, 4.9 and 4.2 days at 20, 25 and 30°C, respectively using a diet of all stages of citrus red mite, *Panonychus citri* (McGregor). In general, pre-oviposition and post-oviposition periods of *E. scutalis* were shortened as temperature increased, but the oviposition period was longer at 25°C than at 20 and 30°C. The shortest female survival time of *E. scutalis* was at 30°C as 10.1, followed by 23.7 days and 28.6 days at 20 and 25°C, respectively. Raze *et al.* (2005) revealed that temperature had significant influence on the biology of *Euseius septicus* Chaudhari. They concluded that the most favorable temperature for the continuity of the developmental processes of the predatory mite *E. septicus* fed on *T. urticae* was 25°C.

Yue *et al.* (1994), noticed that *Euseius mesembrinus* (Dean) developed in 8-5-12.5 days after feeding on different kinds of pollen grains. The present results agree with those of El-Laithy and

Fouly (1992), who noticed that male and female life cycle of *E. scutalis* averaged 6.8 and 7.8 days, respectively at 25°C. Immature stages of *T. urticae* generally accelerated the development of the predator more than those of *Eutetranychus orientalis* (Klein), while immature stages of *Oligonychus afrasiaticus* (McGregor) were less preferred prey type.

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