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Effect of Temperature, Thermal Requirements and Prey Type on the Biology of *Typhlodrompis enab* El-Badry (Phytosiidae)

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ABSTRACT

This work was conducted to determine the effect of temperature and prey type on the biology of *Typhlodrompis enab* El-Badry (Acari: Phytosiidae). This phytoseiid was reared on three tetranychids, (i. e. *Eutetranychus orientalis* (Klein), *Tetranychus urticae* Koch and *Panonychus ulmi* (Koch)) at 20, 25, 30°C and 65±5% R.H. All life cycle parameters decreased as temperature increased. Obtained relative values for males were generally less than those of females. *E. orientalis* was the preferred one followed by *T.urticae* and the least was *P. ulmi.*

Key words: Biology, *Typhlodrompis enab*, Temperature, Tetranychidae.

INTRODUCTION

Plant inhabiting predacious mites play a considerable role in biological control of phytophagous mites. *Typhlodrompis enab* El-Badry is a common phytosiid mite on fruit trees in Egypt (El-Badry 1967, and Farid *et al.* 2011). Spider mites problem increased when natural enemies are destroyed by applications of broad spectrum insecticides, applied against other pests (Mainul Haque *et al.*, 2010). The phytoseiid mite of the genus *Typhlodrompis* has gained a great economic importance as a biocontrol agent and can successfully be used in the integrated pest management program (IPM) to control phytophagous mites. In a survey of the mites in apple and apricot orchards in Egypt in 1984-86, *Agistemus exsertus* and *Amblyseius enab* were recorded as the most important predators attacking the populations of *Tetranychus arabicus, Panonychus ulmi* and *Aculus schlechtendali* in apple orchards and *A. enab* was also very active attacking *Cenopalpus pulcher* in apricot orchards. The predatory mite *T. enab* was found on leaves of citrus, apple, grape orchard in Giza, Dakahlia, Qualubia and Fayoum Governorates, Egypt, (El-Halawany *et al.* 1990).

The current study was carried out to study biological aspects of this phytosiid by feeding on three phytophagous mites (i.e. the citrus brown mite, *Eutetranychus orientalis* (Klein); the two spotted spider mite, *Tetranychus urticae* Koch, and European red mite, *Panonychus ulmi* (Koch)) at 20, 25 and 30°C.

MATERIALS AND METHODS

Culture of *T. enab* was established at a laboratory in Plant Protection Research Institute. Stock culture of *T. enab* was maintained on *T. urticae* as prey on lima bean leaves in a controlled rearing room (25 ± 2°C and 65 ± 5% R.H). Twenty discs of fresh citrus, grape and apple leaves (3 cm. diameter) were placed on wet cotton in Petri dishes (10 cm. in diameter) for *E. orientalis*, *T. urticae* and *P. ulmi*, respectively. Every Petri dish contained four discs. Each disc was surrounded with wet cotton as barrier to prevent mite escape. Newly deposited eggs in the stock culture were transferred singly to these discs. Immature stages and adults of prey types were added later on as food source. The rearing discs were checked twice daily and the numbers of consumed prey were recorded and replaced by new ones all over the predator life span. The rearing experiment was carried out at 20, 25 and 30°C and 65 ± 5% R.H. Food source as immatures and adults of *E. orientalis*, *T. urticae* and *P. ulmi* were field collected from leaves of citrus, grape and apple located at Qualubia, Dakahlia and Giza Governorates, respectively. Statistical analysis of obtained data was conducted using Procs ANOVA and Reg in SAS (SAS Institute 1988).

RESULTS AND DISCUSSION

The present study was conducted to determine the effect of different temperatures and prey type on the duration of various life stages, of *T. enab*.

Developmental durations:

Obtained results are presented in Table (1). In general temperature increase decreased developmental duration regardless tested prey; while different prey types resulted in different preferences.

Incubation period: Incubation period of *T. enab* female averaged 3.7, 3.7 and 3.9 days at 20 °C; 2.3, 2.3 and 2.5 days at 25 °C; 1.9, 2.0 and 2.1 days at 30 °C when reared on *E. orientalis, T. urticae* and *P. ulmi*, respectively. On the other hand for male it durtated 3.4, 3.4 and 3.6 days at 20 °C; 2.1, 2.1 and

Table (1): Mean developmental times (days) of *T. enab* different stages when fed on tetranychids at constant temperatures

Prey	Temp.	Sex	Egg	Larva	Protonymph	Deutonymph	Life cycle	Longevity	Generation	Life span
E. orientalis	20	♀	3.7	2.6	3.6	3.8	13.7	29.5	16.5	43.2
		♂	3.4	2.4	3.4	3.6	12.7	19.9	-	32.6
	25	♀	2.3	2.1	2.8	2.9	10.1	21.3	11.6	31.4
		♂	2.1	1.7	2.4	3.0	9.1	14.7	-	28.8
	30	♀	1.9	1.6	2.1	2.5	8.3	16.8	9.4	25.1
		♂	1.8	1.4	2.1	2.3	7.6	12.2	-	19.9
T. urticae	20	♀	3.7	3.1	3.6	3.9	13.7	27.4	16.6	41.3
		♂	3.4	3.1	3.3	3.6	13.4	21.6	-	35.0
	25	♀	2.3	2.3	2.6	3.1	10.3	21.9	12.0	32.2
		♂	2.1	2.0	2.5	2.9	9.5	15.8	-	25.3
	30	♀	2.0	1.8	2.3	2.8	8.9	20.1	10.5	28.9
		♂	2.0	1.4	2.2	2.7	8.3	14.8	-	23.1
P. ulmi	20	♀	3.9	3.2	3.5	4.3	14.6	27.6	17.0	42.1
		♂	3.6	3.3	3.6	3.7	14.0	25.7	-	39.7
	25	♀	2.5	2.7	3.0	3.4	11.1	27.1	14.2	38.6
		♂	2.5	2.6	2.8	3.3	27.1	22.0	-	33.1
	30	♀	2.1	2.2	2.5	3.2	10.1	25.4	11.9	35.2
		♂	2.2	2.3	2.5	3.1	25.4	19.7	-	29.7

Table (2) Effect of prey type on the female different durations and aspects regardless tested temperature

Prey type	Life cycle	Generation	Ovi position	Longevity	Life span	Daily rate
T. urticae	10.83 b	12.84 b	18.65 b	22.91 b	33.77 b	0.85 b
E. orientalis	10.33 c	12.04 c	17.46 c	21.68 c	32.04 c	1.05 a
P. ulmi	12.01 a	14.37 a	22.02 a	26.66 a	38.65 a	0.69 c
Lsd	0.38	0.46	1.03	1.16	1.24	0.06

Means in the same column followed by the same letter are not significantly different (P<0.05).

Table (3): Liner regression analysis values for the effect of temperature on *T. enab* developmental rate

Stage	Prey type	a	b	to	K	R^2
Larva	*E. orientalis*	-0.074	0.022	3.36	45.45	0.946
	T. urticae	-0.139	0.023	6.06	43.67	0.991
	P. ulmi	0.092	0.014	6.57	71.42	0.985
Protonymph	*E. orientalis*	-0.117	0.019	6.03	51.54	0.981
	T. urticae	-0.061	0.017	3.59	58.82	0.999
	P. ulmi	0.074	0.010	7.40	100.00	0.998
Deutonymph	*E. orientalis*	-0.069	0.013	5.30	76.92	0.998
	T. urticae	-0.035	0.011	3.16	90.09	0.983
	P. ulmi	0.078	0.008	9.67	123.45	0.922
Generation	*E. orientalis*	-0.029	0.004	7.25	250.00	0.997
	T. urticae	0.010	0.004	2.91	285.70	0.983
	P. ulmi	0.008	0.003	3.20	400.00	0.998

a = Intercept b= Slope of temperature To(°C) = (-a/b) K (DDUS) = 1/b

2.5 days at 25 °C; 1.8, 2.0 and 2.2 days at 30 °C when fed on these diets, respectively. These periods decreased as temperature increased.

Larval stage: At, 20 °C, *T. enab* females larval period was 2.6; 3.1 and 3.2 days when fed on *E. orientalis, T. urticae* and *P. ulmi,* respectively. It was 2.4, 3.1 and 3.3 days when males larva were fed on these diets at 20 °C, respectively. However, when the temperature increased to 25 °C, the larval period was 2.1, 2.3 and 2.7 days for females and 1.7, 2.0 and 2.6 days for males, respectively. At 30 °C female and male larval periods were 1.6, 1.4; 1.8, 1.4 and 2.2, 2.3 days, respectively.

Protonymphal stage: The mean protonymphal period of *T. enab* female and male was 3.6, 3.4, 3.6, 3.3 and 3.5, 3.6 days when fed on *E. orientalis, T. urticae* and *P. ulmi* at 20 °C, respectively. At 25 °C this stage period lasted 2.8, 2.6 and 3.0 days for female and 2.4, 2.5 and 2.8 days for males, respectively. At 30 °C this stage lasted 2.1, 2.2 and

Table (4): Food consumption of *Typhlodrompis enab* El-Badry different stages during life span feeding on tetranychids

Prey	Temp.	Sex	Total immatures	Oviposition	Longevity	Life span
E. orientalis	20	♀	8.10±0.9	42.70±5.1	45.00±5.3	50.10±5.7
		♂	5.80±0.5	-	18.20±1.9	22.00±2.2
	25	♀	7.30±1.3	58.20±8.2	60.80±7.8	68.10±8.3
		♂	6.00±0.9	-	33.83±3.5	39.83±3.4
	30	♀	6.60±1.3	51.90±6.7	54.30±6.7	60.90±7.0
		♂	4.80±0.8	-	23.40±3.9	28.20±4.5
T. urticae	20	♀	5.40±0.8	23.10±3.9	25.60±3.8	31.10±3.5
		♂	4.16±0.4	-	10.83±2.1	15.00±2.5
	25	♀	7.70±1.4	49.20±5.5	52.40±5.2	60.10±5.3
		♂	6.60±0.6	-	26.80±1.9	33.40±1.5
	30	♀	7.10±1.0	37.10±5.0	40.80±4.8	48.00±5.1
		♂	5.20±1.0	-	17.70±2.2	22.80±2.3
P. ulmi	20	♀	4.30±0.7	8.10±1.7	10.8±1.7	15.10±1.5
		♂	3.60±0.6	-	5.8±0.9	9.40±1.1
	25	♀	7.90±1.2	19.40±3.3	22.8±3.5	30.75±3.7
		♂	5.33±0.8	-	17.00±2.0	22.33±2.3
	30	♀	7.70±1.4	26.00±4.7	29±4.6	36.70±5.0
		♂	5.20±0.8	-	13.6±2.1	18.8±2.2

2.5 days for females and 2.1, 2.2 and 2.5 days for males when fed on the same prey, respectively.

Deutonymphal Stage: The mean deutonymphal period of *T. enab* was 3.8, 3.9 and 4.3 days for female when reared on *E. orientalis, T. urticae* and *P. ulmi* at 20 °C, respectively. This period was 3.6, 3.6 and 3.7 days for males. This stage lasted 2.9, 3.0, 3.1; 2.9, and 3.4, 3.3 days for females and males at 25 °C respectively. On the other hand, the deutonymphal period of *T. enab* was observed at 30 °C lasted 2.5, 2.8 and 3.2 days, respectively, Table (1).

Life Cycle: The mean life cycle duration differed according to the type of tested prey and temperature, being 13.7, 12.7; 13.7, 13.4 and 14.6, 14.0 days when the *T. enab* females and males fed on *E. orientalis, T. urticae* and *P. ulmi* at 20 °C, respectively. However these periods decreased at 30 °C averaging 8.3, 7.6; 8.9, 8.3 and 9.9, 10.1 days, respectively.

Adult longevity: Mean female longevity was 29.5, 27.4 and 27.6 days at 20 °C; 21.3, 21.9 and 27.1days at 25 and 16.8, 20.1 and 25.4 days at 30 °C when fed on *E. orientalis*, *T. urticae* and *P. ulmi*, respectively.

These results are in agreement with Isik 2007 and Abou-Awad *et al.* 2009. The present study clearly indicated that biological aspects of *T. enab* at different temperatures and prey types on the developmental time of different stages of *T. enab*. Preoviposition and postoviposition period of *T. enab* were shortened as temperature increased. The oviposition period was longer at 20 than at 25 and 30 °C. Total fecundity was significantty higher on *E. orientalis* than *T. urticae* and *P. ulmi*. Generation of *T. enab* when fed on *E. orientalis* was the shortest. Male predator life span followed similar trend except having shorter period.

Studied biology of the predatory mite *Typhlodromips enab* EI-Badry (Acari: Phytoseiidae) were studied at different temperatures under laboratory conditions. Predatory mite females completed their total immature development times in 8.68, 6.15 and 4.73 days at 20, 25 and 30 °C, respectively (70±10% R.H. and 14L: 10D photo period). Mated females laid an average 0.88, 0.57 and 0.64 eggs per female per day and 4.40, 4.63 and 6.40, eggs over their the entire lives in the above given temperatures, respectively. Total average life span of *T. enab* was 21.80, 16.49 and 15.20 days at 20, 25 and 30 °C. Cemal *et al.* (2007). These results are agree with El-Lathy and Fouly (1992), Ali and Zaher (2007), Al-Shammery (2010), El-Moghazy (2010), Foully *et al.*(2011) and Abbassy *et al.*(2012).

Effect of prey on the female different durations and aspects regardless tested temperature is presented in Table (2) .There was a highly significant difference between them. *E. orientalis* was the preferred one followed by *T.urticae* and the least was *P. ulmi.*

Thermal requirements: Results of applying the linear model to the relation between temperature and rate of development is presented in Table (3). Obtained R^2 values of *E. orientalis T. urticae* and *P. ulmi* renged between 0.922 and 0.999 for larva, protonymph , deutonymph and generation, respectively. Using the equation resulted in determination of lower thresholds (t_o) as 3.36, 6.06,

6.57; 6.03, 3.59, 7.40; 5.30, 3.16, 9.67 and 7.25, 2.91, 3.20 °C .The thermal constant (K) was estimated as 45.45, 43.67, 71.42; 51.54, 58.82, 100.00; 76.92, 90.09, 123.45 and 250.00, 285.70, 400.00 DDs on three phytophagous mites.

Feeding consumption of *T. enab* on tetranychaids different stages:

Average daily consumption of *T. enab* different stages when fed on *E. orientalis, T. urticae* and *P. ulmi* is presented in Table (4). The relevant values at 20 °C were 8.10, 5.80; 5.40, 4.16 and 4.30, 4.60 individuals for *T. enab* immatures, females and males, respectively. At 25 °C the relevant values were 7.30, 6.00; 7.70, 6.60 and 7.90, 5.33 individuals when the female and male fed on these prey types, respectively. At 30 °C, the immature stages of *T. enab* consumed 6.60, 4.80, 7.10, 5.20 and 7.70, 5.20 individuals, respectively. The average number of consumption of movable stages of these diets increased with the development of the predator stages. During oviposition period, the predator attacked 42.7, 31.1 and individuals at 20° C, while these results were 58.2, 49.2 and 19.2 individuals at 25 °C. At 30 °C, the average number of consumed prey was 51.9, 37.1 and 26.4 individuals when *T. enab* females fed on these prey types. The average number of consumed prey by adult females during oviposition was more than pre and postoviposition. The predatory mite could consume 45.00 ,25.60 and 10.80 individual for female longevity at 20 °C, 60.80, 52.40 and 22.40 individuals, at 25°C, 54.30, 40.80 and 29.00 individual, at 30 °C on these prey type, respectively. Tested the citrus brown mite *E. orientalis* was more favorable as prey than tested *T. urticae,* and *P. ulmi.* Thus the present results revealed that, *E. orientalis* was the preferable food and 25 °C were the most suitable, for mass rearing *T. enab.*

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