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Biology and Thermal Requirements of *Euseius scutalis* (Athias-Henriot) Fed on Three Pest Prey Types and Pollen

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ABSTRACT

Biological aspects and thermal requirements of *Euseius scutalis* (Athias-Henriot) fed on *Tetranychus urticae* Koch, *Eutetranychus orientalis* (Klein), *Bemisia tabaci* (Genn.) and date palm pollen were studied under laboratory conditions. The female life span duration was (35.3, 29.95, 22.6), (40.1, 29.9, 21), (38.7, 30.9, 22.8) and (41.9, 29.9 20.6) days when fed on *T. urticae, E. orientalis B. tabaci* and pollen at 20, 25 and 30ºC, respectively. Corresponding developmental rates were 0.028, 0.033and 0.44 on *T. urticae,* 0.025, 0.033 and 0.048 on *E. orientalis,* 0.026, 0.032 and 0.044 on *B. tabaci* and 0.024, 0.033 and 0.049 on pollens per day at same temperatures. These rates were fitted to linear equation with R^2 of 0.958, 0.98, 0.975, and 0.984. Male developmental times, rates and thermal requirement for development were very similar. Fecundity per female was 32.8, 38.5, 44.2; 27.2, 35.6, 28.2; 31.4, 24.6, 17 and 31.8, 33.8, 44.4 eggs/female over tested temperatures and diets, respectively. Pollen recorded lowest thermal requirements for *E. scutalis* different stages with highest daily ovipostion; while *T. urticae* recorded the highest (especially for females) with similar total fecundity with pollen. Obtained results suggest that the best food source for the *E. scutalis* was pollen followed by *T. urticae* then *E. orientalis* and finally *B. tabaci*. The best tested temperature was 30°C. The wide range of food sources and temperature range may explain the wide spread of this phytoseiid predator in the Egyptian agricultural environment where it is found on most plants. Enhancement of occurrence of this mite over different plants may reduce to some extend the need of applying pesticides.

Key words: *Euseius scutalis; Bemisia tabaci*; *Tetranychus urticae*; *Eutetranychus orientalis*; Temperature, Thermal requirements, Development.

INTRODUCTION

Many studies on predacious mites of the family Phytoseiidae are worldwide and important natural enemies of different phytophagous pests on a variety of plants. They are important part of mites' natural control and can be used in applied bio-control of mites and some insects (Gerson *et al*., 2003; Fouly *et al*., 2011and Mostafa, 2012). Phytoseiid mites were classified according to their life-style into four categories and sub ones. *Euseius scutalis* (Athias-Henriot) fits the fourth category as pollen feeding generalist predators. Consideration is given to the relative importance of each of these types in biological control and pest management programs (McMurtry and Croft, 1997; Luh and Croft, 2001and McMurtry *et al*., 2013). The role of particularistic and generalist possible predators in the control of phytophagous arthropod populations has been reviewed extensively (Schausberger and Walzer, 2001).

Persistence of generalist predatory mites on vegetation with a scarcity or absence of prey is a requirement for successful biocontrol tricks of herbivore mites. These mites feeds to not only on herb feeding mites but have also the ability to feed on some other sources of food and reproduce more rapidly on a variety of plant pollens (Abou-Setta and Childers, 1987; Gnanvossou *et al*., 2005; Emmert *et al*., 2008 and Fouly *et al*., 2011). Certain herb pollens have been easily used for mass-rearing phytoseiids in the laboratory for experimental purposes or field release.

Genus *Euseius* is optional predators, which are not only mite potential predators but also, have the ability to feed on other source of food such as white take flight, small arthropods and pollens (Fouly and Hassan, 1991and Abou-Awad *et al*., 1992).

The major impact of generalists, such as *Euseius* species, is at low population densities of spider mites, where they may prevent the widespread colonization and increase of the infestation species (McMurtry, 1992). Also, field statement evidently showed that *E. scutalis* is generally found in association with tetranychid mite species, scale insects, ovum and various immature levels of other insects as well as plant pollen (Yousef and El-Halawany, 1982; McMurtry *et al*., 1992; Al-Shammery, 2010, 2011).

Temperature is a major abiotic factor affecting the dynamics of arthropod pests and their natural enemies (Huffaker *et al*., 1999). The understanding of insect and mite different types to climatic conditions performs an essential role in pest management to forecast the timing of development, reproduction and dormancy or migration (Gorji *et al*., 2008).

Previous studies in Egypt, indicated that *E. scutalis* definitely is the most considerable and vastly disseminate phytoseiid mite (El-Laithy and Fouly, 1992; Abou-Awad *et al*., 1998 and Fouly *et al*., 2013). *E. scutalis* was observed feeding on spider mites, eggs and small insect species that live in the same habitat. As a result, *E. scutalis* is recognized as one of the generalist that can feed on a variety of food source.

The aim of this study was to increases our knowledge about *E. scutalis* biology when reared under laboratory conditions on three pest mites and pollen under different temperatures.

MATERIALS AND METHODS

Collection of mites:

E. scutalis and the spider mite *Tetranychus urticae* Koch were collected from leaves of blackberry, *Rubus ursinus* Cham & Schldl infested plants at the farm of the Faculty of Agriculture, Al-Azhar University, in Cairo.

Culture of *E. scutalis*:

The predatory mite was reared on a freshly mulberry leaves, *Morus alba* placed upside down on cotton pads in plastic trays. Water was added when needed to maintain suitable moisture. An abundance of *T. urticae* stages was offered daily to the predator as a main source of food. Trays were maintained at 25±2°C and 70 ± 5% R.H. Newly deposited eggs of the predator were transferred solitary to experimental units each consisted of mulberry leaf disc 2.5 cm diameter placed lower side up on water soaked cotton bed (10 cm diameter and 1 cm thick) in a Petri dish (12 cm diameter). The borders of the leaves were surrounded by barrier (a mixture of Canada balsam, castor and citronella oils). The number of eggs laid was counted daily. The observations continued allover predator life span at 20, 25 and 30±2°C. A total of 25 replicates per temperature or diet were prepared.

Experimental procedures:

T. urticae and Eutetranychus orientalis (Klein) motil stages, the white fly, *Bemisia tabaci* nymphs (which was collected from cabbage *Brassica oleracea* var. capitata L.) and date palm pollens were considered as food sources. All groups were incubated at 20, 25 and 30±1°C and 75±3 %R. H.

Thermal requirements for different developmental stages of *E. scutalis,* were calculated using Microsoft Excel application. Developmental rates were estimated as 1/developmental times. Using linear regression (Y = a + bX) for obtained developmental rates over tested temperatures (X) developmental threshold (t_o °C) and thermal degree days (K value) (Physiological time) was calculated.

RESULTS AND DISCUSSION

Thermal effect and requirements for development:

Obtained results for developmental durations, rates and thermal requirements are presented in Tables (1-3) for female and male, respectively.

Developmental times over tested temperatures revealed negative relation with temperature increase; while developmental rates were positive. Female life span developmental time was, 35.3, 29.95 and 22.6 when fed on *T. urticae*; 40.1, 29.9 and 21 days when fed on *E. orientalis*; 38.7, 30.9 and 22.8 on *B. tabaci* and 41.9, 29.9 and 20.6 on data palm pollen at 20, 25 and 30ºC, respectively. Corresponding rates were 0.028, 0.033and 0.44 on *T. urticae*, ٠.025, 0.033 and 0.048 on *E. orientalis*; 0.026, 0.032 and 0.044 on *B. tabaci* and 0.024, 0.033 and 0.049 on pollens per day. These rates were fitted to linear equation with R^2 of 0.958, 0.98, 0.975, and 0.984. Total developmental thermal requirement was 628.173, 440.89, 554.943 and 405.23 degree days over thermal threshold of 2.812, 9.422, 6.12 and 10.7ºC. Male developmental times, rates and thermal requirement for total development were very similar. Total female life cycle was 9.9, 5.8, 7.85; 11.5, 8.8, 5.7; 10.9, 8.3, 5.8 and 9.9, 6.8, 4.6 days for females at tested (20, 25 and 30ºC). Corresponding values for male were; 8.9, 6.5, 4.4; 10.4, 7.5, 5.3; 8.9, 7.5, 5.5 and 9.1, 5.7, 4.5 days, respectively (Table 3).

E. scutalis female longevity was 27.12 days when reared on *T. urtic*ae at 25ºC (El-Laithy and Fouly, 1992). Female longevity and life span of *E. scutalis* reared on nymphs of *T. urticae* were 30.68 and 27.25 days, at 25 and 30ºC, respectively (Osman *et al*., 2013), while same parameters were reported as 29.57, 22.79 and 18.54 days, at 25, 20 and 30ºC, respectively when reared on pollens by Saleh *et al*. (2015). Differences in findings regarding total developmental duration may be due to differences in prey and the experimented temperature degrees.

Data in (Table 4) indicated that, mean number of eggs deposited per *E. scutalis* female was 32.8, 38.5, 44.2; 27.2, 35.6, 28.2; 31.4, 24.6, 17 and 31.8, 33.8, 44.4 eggs over tested when fed on *T. urticae*, *E. orientalis*, *B. tabaci* and pollens at 20, 25 and 30ºC temperatures, respectively. Similar results were obtained by Allawi (1991) who found that *E. scutalis* fed on castor bean, corn and pollen collected by honey bees laid a total number of 52.20, 33.50 and 40.53 eggs per female with a daily rate of 2.10, 1.43 and 1.98 eggs, respectively. Moreover, El-Laithy and Fouly, 1992 found that *E. scutalis* and *A. swirskii* fed on *T. urticae* laid 13.5 and 27.8 eggs per female, Table (1): Mean duration in days of *E. scutalis* immature stages fed on *T. urticae*, *E. orientalis*, *B. tabaci* and date palm pollen at different temperatures

Variable	Temp. (°C)	Total immature				Life cycle			
		T. urticae	*E. orientalis*	*B. tabaci*	Pollens	*T. urticae*	*E. orientalis*	*B. tabaci*	Pollens
Duration	20	4.8	6.4	8.4	7.3	9.9	11.5	10.9	9.9
	25	4.2	4.7	6.5	5.3	7.85	8.8	8.3	6.8
	30	3.2	3.1	4.4	3.3	5.8	5.7	5.8	4.6
Rate	20	0.208	0.156	0.119	0.137	0.101	0.087	0.092	0.101
	25	0.238	0.213	0.154	0.189	0.127	0.114	0.12	0.147
	30	0.313	0.323	0.227	0.303	0.172	0.175	0.172	0.217
Regression values	Intercept	-0.007	-0.185	-0.104	-0.206	-0.045	-0.096	-0.073	-0.136
	Slope	0.01	0.017	0.011	0.017	0.007	0.009	0.008	0.012
	t_0 (°C)	0.714	11.14	9.595	12.379	6.289	10.834	9.107	11.669
	K (Degree days)	96	60.121	92.4	60.225	140.049	113.017	123.961	85.925
	R^2	0.942	0.967	0.959	0.955	0.978	0.95	0.973	0.986

Table (2): Mean duration in days of adult female longevity and life span of *E. scutalis* fed on *T. urticae*, *E. orientalis*, *B. tabaci* and date palm pollen at different temperatures.

Variable	Temp (°C)	Total immatures				Life cycle			
		T. urticae	*E. orientalis*	*B. tabaci*	Pollen	*T. urticae*	*E. orientalis*	*B. tabaci*	Pollens
Duration	20	4.8	6.4	8.4	7.3	9.9	11.5	10.9	9.9
	25	4.2	4.7	6.5	5.3	7.85	8.8	8.3	6.8
	30	3.2	3.1	4.4	3.3	5.8	5.7	5.8	4.6
Rate	20	0.208	0.156	0.119	0.137	0.101	0.087	0.092	0.101
	25	0.238	0.213	0.154	0.189	0.127	0.114	0.12	0.147
	30	0.313	0.323	0.227	0.303	0.172	0.175	0.172	0.217
Regression values	Intercept	-0.007	-0.185	-0.104	-0.206	-0.045	-0.096	-0.073	-0.136
	Slope	0.01	0.017	0.011	0.017	0.007	0.009	0.008	0.012
	t_0 (°C)	0.714	11.14	9.595	12.379	6.289	10.834	9.107	11.669
	K (Degree days)	96	60.121	92.4	60.225	140.049	113.017	123.961	85.925
	R^2	0.942	0.967	0.959	0.955	0.978	0.95	0.973	0.986

Table (3): Mean duration in days of adult male longevity and life span of *E. scutalis* fed on *T.urticae*, *E. orientalis*, *B. tabaci* and date palm pollen at different temperatures.

Variable	Temp. (°C)	Total immatures				Life cycle			
		T. urticae	*E. orientalis*	*B. tabaci*	Pollen	*T. urticae*	*E. orientalis*	*B. tabaci*	Pollens
Duration	20	19.6	24	25.8	29.2	28.5	34.4	34.7	38.3
	25	16.8	19.4	19.4	19.4	24.125	25.4	25.4	25.1
	30	10.6	13.6	16	13.6	16.2	19.3	22.7	17.8
Rate	20	0.051	0.042	0.039	0.034	0.035	0.029	0.029	0.026
	25	0.06	0.052	0.052	0.052	0.041	0.039	0.039	0.04
	30	0.094	0.074	0.063	0.074	0.062	0.052	0.044	0.056
Regression values	Intercept	-0.04	-0.024	-0.008	-0.045	-0.021	-0.017	-0.001	-0.034
	Slope	0.004	0.003	0.002	0.004	0.003	0.002	0.002	0.003
	t_0 (°C)	9.235	7.556	3.545	11.481	7.7	7.376	0.441	11.462
	K (Degree days)	230.84	313.84	421.22	254.56	375.36	439.68	656.4	332.55
	R^2	0.89	0.954	0.998	0.995	0.917	0.997	0.953	0.997

Table (4): Fecundity of *E. scutalis* on three tested temperatures.

Variable	Temp. (ºC)	*T. urticae*	*E. orientalis*	*B. tabaci*	pollens
Mean number of eggs/female	20	32.8	27.2	31.4	31.8
	25	38.5	35.6	24.6	33.8
	30	44.2	28.2	17	44.4
Eggs/female/day	20	1.7	1.2	1.7	1.8
	25	2.4	2.4	1.4	2.7
	30	3.1	2.8	1.2	5.3

respectively. Feeding on *B. tabaci* only, *E. scutalis* female laid an average of 1.0 egg per day (Fouly and Hassan, 1991). Osman *et al.* (2013) found that *E. scutalis* number of eggs deposited per female was 31.93, 28.63 and 24.3, when fed on palm pollens, *T. urticae* and *B. tabaci*. Feeding on *B. tabaci* only, female mite of *E. scutalis* laid an average of 28.0, 22.93 and 19.0 eggs per day at 20, 25 and 30^{0}C, respectively (Saleh *et al*., 1991).

Thermal Requirements:

Thermal requirements for *E. scutalis* total immature development was lowest at *E. orientalis* and pollen and maximum on *T. urticae*. Similarly, during adult female longevity lowest value was on pollen and maximum was on *T. urticae*. For female life span lowest value was on pollen and maximum was on *B. abaci*. In the mean time Total fecundity was highest at *T. urticae* and pollen, while lowest was on *B. abaci*. Mean daily oviposition was highest on pollen fowled by *E. orientalis* and *B. abaci*, respectively (Tables 1 to 4).

Obtained results suggest that the best food source for the *E. scutalis* was pollens followed by *T. urticae* then *E. orientalis* and finally *B. tabaci*. The best tested temperature was 30°C. The wide range of food sources and temperature range may explain the wide spread of this phytoseiid predator in the Egyptian agricultural environment where it is found on most plants. Enhancement of occurrence of this mite over different plants may reduce to some extend the need of applying pesticides.

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