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Effect of Different Temperatures on Some Biological Aspects of the Predaceous Mite, *Agistemus exsertus* Gonzalez

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ABSTRACT

Life cycle of *A. exsertus* female differed according to temperature degree; the shortest period was at 30 °C, 8.23 days, while the longest at 20 °C, 12.02 days. The developmental rate ranged from 68.14% at 20 °C to 73.04% at 30 °C for female. Survival female's immatures % was also affected with temperature being 73.45, 80.24 and 83.61% at 20, 25 and 30 °C, respectively. The total amount of consumed preys/predator different developmental stages and sex increased with increased temperature from 20 to 30 °C. The total average number of *T. urticae* fed by predator immatures was 17.23, 14.76 and 10.71 preys at 30, 25 and 20 °C. Also, female predator consumed greater number of prey individuals at high temperature, 78.34 preys at 30 °C, decreased to 65.25 preys at 25 °C but the rate of consumption was less at low temperature 50.00 preys at 20°C. The effect of temperature on life table parameters was determined. Net reproductive rate (R_o) differed according to temperature as this value increased with temperature increase. Thus, these values averaged 11.21, 15.04 and 21.57 times for 20, 25 and 30 °C. The intrinsic rate of increase (r_m) was 0.10, 0.13 and 0.15 individuals/female/day for the above same order. The mean generation time (T) decreased when the temperature increased.

Key words: *Agistemus exsertus*; Temperatures; Biological aspects.

INTRODUCTION

Family Stigmaeidae is one of the most important predators of phytophagous mites, especially *Agistemus exsertus* Gonzalez which well known as an efficient predator (Rai & Singh 1999 and Ahmed & Ibrahim 2001). Many authors recorded this stigmaeiid mite, as an aerial predator, occurring all over the year on several fruit trees, field crops, vegetables and ornamentals (Gupta *et al.*, 1971; Soliman 1987; El-Duweini *et al.*; 2003 and Azouz, 2005). Its population increases during spring, summer and autumn. It is usually found associated with colonies of tetranychid and tenuipalpid mites and scale insects.

A. exsertus was able to survive and reproduce on *Tetranychus urticae* eggs and immatures of which eggs were more favorable (Hanna *et al.*, 1984 and Shoeib, 1996). Abou-Awad and El-Sawi (1993) studied the effect of temperature on *A. exsertus*, reared on *T. urticae* eggs. The aim of the present study was to evaluate the effects of different temperatures on its biological aspects and life table parameters.

MATERIALS AND METHODS

Effect of temperature on predaceous mite:

Agistemus exsertus newly deposited eggs were transferred singly to leaf mulberry discs, each of one inch in diameter as rearing arenas in Petri-dishes on water saturated cotton and kept on 30, 25 and 20°C until hatching and incubation period was recorded. Each newly hatched larva (25 replicates) was supplied with sufficient known number of the prey (*T. urticae* immature). All larvae were reared individually under different temperatures, 30, 25 and 20 °C till reached adulthood. Before the final molt of the female, one adult male was introduced to the replicate for mating and removed after one day. Experiment was observed twice a day. The number of laid eggs was counted daily as well as consumption rate until female died. Longevity and consumption of adult male was also recorded. Three different temperatures (20, 25 and 30°C) were tested.

During developmental period, mortalities of different reared females' predator stages were recorded. Eggs of resultant females were collected daily from each female and sex ratio of the progeny was determined. Life table parameters were estimated using the life 48 computer program Abou-Setta *et al.* (1986).

Data were subjected to statistical analysis using one way analysis of variance, ANOVA Duncan (1955).

RESULTS AND DISCUSSION

Influence of temperature on developmental time:

The average duration of every stage of *A. exsertus* females and males at each temperature degree were presented in table (1). E incubation period decreased with temperature increase (20-30 °C), averaging 2.82, 3.23 and 3.90days at 20, 25 and 30 °C, respectively. Total immatures durated 8.12, 5.94 and 5.41 days at 30, 25 and 20°C, respectively. The male followed similar trend, but having shorter periods. These findings were previously mentioned by Ferla and Moreas (2003). In accordance with results obtained,

Table (1): *Agistemus exsertus*, life cycle and immatures survival at different temperatures

Temp. (°C)	Sex	Development duration in days (mean ±S.E)					Life cycle	Survival %	Development %
		Egg	Larva	Proto-nymph	Deuto-nymph	Total immature			
30	♀	2.82±0.04	1.43±0.30	1.51±0.62	2.47±1.23	5.41±0.04	8.23±0.02	83.61±2.56	73.04±2.02
	♂	2.79±0.02	1.44±0.26	1.30±0.73	2.21±1.62	4.95±0.07	7.74±0.05	79.26±2.41	72.00±1.97
25	♀	3.23±0.11	1.63±0.41	1.70±0.56	2.61±1.59	5.94±0.02	9.17±0.03	80.24±2.72	75.25±1.86
	♂	2.90±0.13	1.50±0.60	1.65±0.38	2.57±1.21	5.72±0.11	8.62±0.01	76.00±1.98	73.48±1.59
20	♀	3.90±0.07	2.32±0.82	2.81±0.94	2.99±1.57	8.12±0.15	12.02±0.07	73.45±1.64	68.14±1.47
	♂	3.70±0.05	2.31±0.93	2.45±0.87	2.65±1.43	7.41±0.16	11.11±0.04	67.58±1.59	62.53±1.32

± Standard Error

Table (2): Food consumption of *Agistemus exsertus* fed on *T. urticae* at different temperatures

Temp. (°C)	Sex	Total immatures	Oviposition period	Adult longevity	Life span
30	♀	17.23±0.09	52.12±1.14[a]	78.34±1.76[a]	95.57±2.01
	♂	15.51±0.04	-	59.07±1.34	74.58±1.68
25	♀	14.76±0.11	44.41±1.18[b]	65.25±1.85[b]	80.01±1.32
	♂	13.83±0.16	-	52.67±1.13	66.50±1.43
20	♀	10.71±0.13	29.47±0.96[c]	50.00±1.20[c]	60.71±1.17
	♂	7.00±0.02	-	38.24±1.07	45.24±1.05

Means in columns followed by the same letter are not significantly different at p≤5% ± standard error

Table (3): Life table parameters of *Agistemus exsertus* at different temperatures

Temp. (°C)	Sex	Longevity (days)	Fecundity	Sex ratio♀%	R_o	T	r_m	λ
30	♀	12.13±0.04[c]	43.78±1.82[a]	70.25±1.87[a]	21.57	10.61	0.15	1.21
	♂	11.56±0.02	-	-	-	-	-	-
25	♀	17.02±0.10[b]	40.50±1.41[a]	69.08±1.43[a]	15.04	11.83	0.13	1.00
	♂	12.98±0.24	-	-	-	-	-	-
20	♀	20.34±0.28[a]	28.47±0.09[b]	67.46±1.15[a]	11.21	14.05	0.10	0.77
	♂	17.68±0.22	-	-	-	-	-	-

Means in columns followed by the same letter are not significantly different at p≤5% ± standard error.

egg incubation total immatures and life cycle of *A. exsertus* differed according to temperature degree. The shortest period was at 30 °C (8.23 days); while the longest was at 20 °C (12.02 days). The developmental rate ranged from 68.14% at 20 °C and 73.04% at 30°C for female. For female survival immature% affected with different temperature these values were 73.45, 80.24 and 83.61% at 20, 25 and 30 °C, respectively. These results are agreement with Abo-Taka *et al.* (2009) who studied the effect of the four temperature degrees 15, 20, 25 and 30 °C on different stages of the predaceous mite, *A. exsertus*. Life cycle was very low at 30 °C; while it increased at 15 °C.

Feeding capacity:

Feeding capacity of *A. exsertus* on *T. urticae* was affected by temperature (Table 2) with significant differences at three different temperatures.

The total amount of consumed prey/predator different developmental stages and sex increased as temperature increased from 20 to 30 °C. The total average number of *T. urticae* fed by predator immatures was 17.23, 14.76 and 10.71 preys at 30, 25 and 20°C.Female predator consumed greater number of preys at high temperature (78.34 preys at 30 °C and 65.25 preys at 25 °C). Male followed similar trend as that of female, but in smaller numbers. Also, Yue and Childers (1994) who reared *A. exsertus* on citrus spider mite *P. citri* in Florida at 15, 20, 25, 30 and 35 °C obtained best results with regard prey consumption and egg production at 25°C. Also, Inoue and Tanaka (1983) showed that *Agistemus terminalis* female preyed on 1, 2.4 and 3.4 *Panonychus citri* / day when kept at 20, 25 and 30°C, respectively.

Adult female longevity, fecundity and life table parameters:

Temperature negatively affected the duration of *A. exsertus* adult, Table (3). Adult female longevity decreased with increasing temperature from 20 to 30 °C.

Average female lived for 20.34, 17.02 and 12.13 days at 20, 25 and 30 °C, respectively. Concerning female fecundity, temperature had a significant effect on egg total egg production; the greatest number of eggs (43.78 eggs) was deposited by female at 30 °C.

Adult male followed similar trend as that of female longevity but having shorter periods. The effect of temperature on life table parameters was determined. Net reproductive rate (R_o) differed according to temperature as this values increased with temperature increase. Thus, these values averaged 11.21, 15.04 and 21.57 times for 20, 25 and 30 ºC. The intrinsic rate of increase (r_m) was 0.10, 0.13 and 0.15 individual/female/day for the above same order. The mean generation time (T) decreased when the temperature increased. Similar results were also obtained by Yue and Childers (1994) who investigated the effects of temperature on development and reproduction of *Agistemus exsertus*. The mite was provided with eggs of *Panonychus ulmi* as a food source. At 15, 20, 25, 30 and 35ºC, the mean length of a generation was 35.9, 18.1, 14.5, 11.4 and 12.6 days, respectively. A female produced an average 66.0, 69.0, 46.5, 25.5 and 18.8 eggs, respectively. The attack rate of females on eggs was less at 20 and 30ºC than at 10 or 40ºC. Also, Abou-Awad and Elsawi (1993) found that at 27ºC, r_m value of *A. exsertus* fed on *T. urticae* was 0.15. El- Laithy (1998) found that expected rate of increase (λ) of *A. exsertus* was 1.24 when kept at 27ºC.

REFERENCES

Abou-Awad, B. A. and El-Sawi, S. A. 1993. Biology and life table of the predacious mite, *Agistemus exsertus* Gonz. (Acari: stigmaeidae). Anz. Schadling. Pflanzenschutz. Umwelt., 66(5): 101–103.

Abou-Setta, M. A.; Sorrell, R. W. and Childers, C. C. 1986. Life 48: A basic computer program to calculate life table parameters for an insect or mite species. Fla. Entomol., 69: 690-697.

Abo-Taka, S. M.; Sweelam, M. E.; Hussain, A. M. and Wallash, E. M. 2009. Effect of different temperature on some biological characters of predator, *Agistemus exsertus*. Nile Dalta Conf. on Export Crops, Fac. of Agric., Minufiya Univ.

Amira, A. A. M. Shoeib.1996. Biological and ecological studies on some predaceous mites. Ph. D. Thesis, Fac. Agric., Cairo, Univ., 224pp.

Azouz, H. A. A. 2005. Ecological and biological studies on some mites associated with cotton and some field crops in Beni Suef governorate, Ph. D. Thesis, Fac. Agric. Al-Azhar Univ., 185pp.

Duncan, D. B. 1955.Multiple range and multiple F. tests.Biometrics.11:1- 41

El-Duweini. F. K.; Gerges, M. F.; Sourial, L. S. and Henien. S. M. 2003. Survey of insects and mites associated with soybean and maize in various intercropping systems. J. Agric. Sci. Mansoura, Univ.. 28(2): 1439-1446.

El-Laithy, A. Y. M. 1998. Laboratory studies on growth parameters of three predatory mites associated with eriophyid mites in olive nurseries. Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz, 105(1):78-83.

Ferla, N. J. and Moraes, G. J. de. 2003. Biology of *Agistemus floridanus* Gonzalez (Acari: Stigmaeidae). Revista Brasileira de Zoologia, 20 (2): 261-264.

Gupta, S. K.; Dhooria, M. S. and Sidhu, A. S. 1971.A note on predators of citrus mites in Punjab. Science and Culture, 37: 484pp.

Hanna, M. A.; Shereef, G. M. and Megali, M. K. 1984. Effect of food type on longevity and fecundity of the predatory mite, *Agistemus exsertus* Gonzalez (Acari: Prostigmata) with first description of its prelarva. Bull. Soc. Ent. Egypte, 63: 57-62.

Inoue, K. and Tanaka, M. 1983. Biological characteristics of *Agistemus terminalis* (Quayle) (Acarina:Stigmaeidae) as a predator of citrus red mite, *Panonychus citri* (McGregor). Japanese J. Appli.Entomol. Zool., 27: 280-288.

Rai, S. N. and Singh, J. 1999. Biology of *Agistemus industani* (Acari: Stigmaeidae) an efficient predator of *Tetranychus ludni* on mulberry. All India coordinated research project on agricultural acarology, department of entomology. Instit. Agricul. Sci. Banaras Hindu Univ. Varanasi, 221-500.

Soliman, S. M. 1987. Morphological and biological studies on some predaceous mites of suborder: Actinedida. M. Sc. Thesis, Fac. Agric. Al-Azhar Univ., 75 pp.

Wafaa, O. G. Ahmed and Ibrahim, A. M. A. 2001. Feeding capacity, reproduction and competition between the two predators, *Agistemus exsertus* Gonzalez (Prostigmata: Stigmaeidae) and *Orius laevigataus* (Fieber) (Hemiptera: Anthocoridae) associating with the spider mite, *Tetranychus urticae* Koch. J. Agric. Sci., Mansoura Univ., 26(9): 5783-5790.

Yue, B. and Childers, C. C. 1994. Effects of temperature on life table parameters of *Agistemus exsertus* Gonzalez (Acari: Stigmaeidae) and its attack rate on *Panonychus citri* eggs. Inter. J. Acarol., 20(2): 109-113.