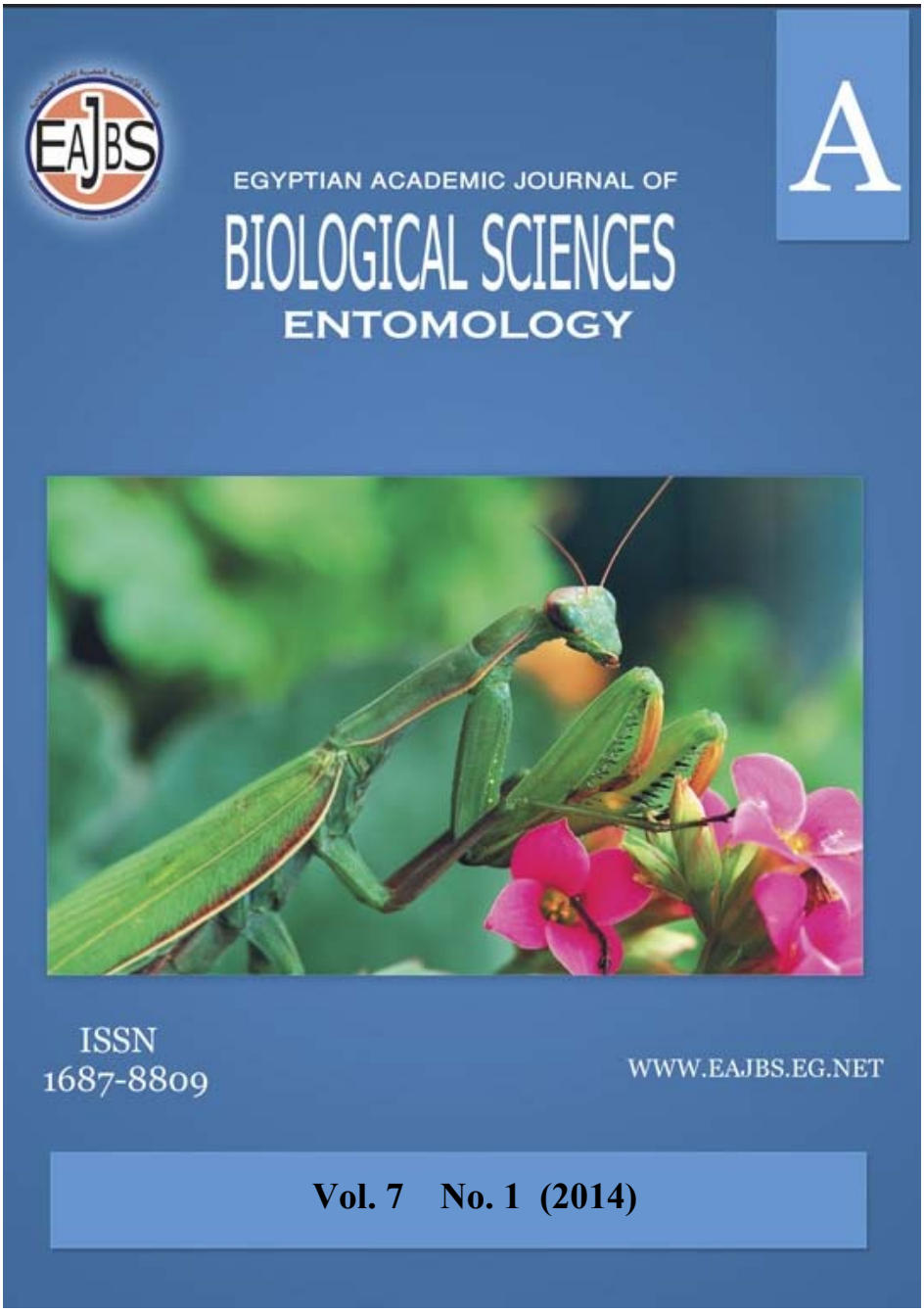

Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University .

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www.eajbs.eg.net

Received : 4/3/2014 Accepted :22/4/2014

Egypt. Acad. J. Biolog. Sci., 7(1): 165 – 171 (2014)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687-8809

www.eajbs.eg.net

Biological aspects of the predaceous mite, *agistemus vulgaris* soliman and gomaa and life table parameters on three host phytophagous mite species, (Acari: stigmaeidae)

Omar. M. O. Mohamed
Plant Protection Research Institute, Agricultural Research Center, Dokki, Cairo, Egypt.

ABSTRACT

Mites of family Stigmaeidae are potential predators of various species of phytophagous mites through the world.The present study was conducted in Acarology Research Laboratory Plant Protection Research Institute, Dokki, Egypt. The aim of this work was to study the effect of different prey species on the biology of stigmaeid mite, *Agistemus vulgaris* Soliman and Gomaa. The results showed that *A.vulgaris* completed its life cycle in 12.56 days when fed on *Tetranychus urticae* Koch as compared to 12.09 and 10.75 days when fed on *Oligonychus sayedi* Zaher, Gomaa & El-Enany and *Aculops lycopersici* Massee, respectively. The maximum average fecundity (53.75 eggs/female) was recorded after feeding on *O. sayedi* where as after feeding on *T. urticae* and *A. lycopersici* , it was 28.43 and 21.93, respectively. Predatory mite has better life table parameters in comparison with the other prey mites. The biological aspects of the predator was as follow, Mean generation time (T) averaged 18.63, 19.18 and 15.34 days, respectively; Net reproductive rate (Ro) averaged 12.82, 24.38 and 9.81; intrinsic rate of natural increase (r_m) was 0.13, 0.16 and 0.14; finite rate of increase (λ) averaged 1.14, 1.18 and 1.16 when the mite fed on immature stages of *T. urticae*, *O. sayedi* and *A. lycopersici*, respectively. *A. vulgaris* is considered a promising biological control agent against phytophagous mites.

Keywords: Biology, Agistemus vulgaris, phytophagous mite, Tetranychus urticae, Oligonychus sayedi, Aculops lycopersici

INTRODUCTION

Members of Stigmaeidae are important natural enemies of several phytophagous mite pests on various crops (Gomaa, 1968; Santos,1976). *Agistemus* and *Zetzellia*, which are both common genera of the family Stigmaeidae, are polyphagous predators that have potential in the control of various tetranychid and eriophyid pests (El-Badry *et al*. 1969; Goldarazena *et al*. 2004and Khodayari *et al*. 2008).

In Egypt *Agistemus exsertus* Gonzalez**,** one of the most common stigmaeid mites, is known as an egg predator of various tetranychoid mites (El-Badry, *et al*., 1969; El-Bagoury *et al*., 1989). Research by Momen (2001); Romeih *et al*. (2004); El-Sawi and Momen (2006) and Momen and El-Sawi (2006) indicated that various insect eggs of the Pyralidae, Diaspididae, Noctuidae and Gelechiidae families were commensurate prey for the development and oviposition of *A. exsertus*.Due to their size, slow movement and, therefore,

Received : 4/3/2014 Accepted :22/4/2014

ease of capture, eriophyid mites provide a better source of food for the development of stigmaeid mites than do tetranychid mites (Thistlewood *et al*., 1996). *Agistemus exsertus* has been reported as an excellent predator of *Aculops lycopersici* (Massee), a serious pest throughout the Mediterranean region.

Two tetranychid mite species ,*Tetranychus urticae* Koch and *Oligonychus sayedi* Zaher, Gomaa & El-Enany are considered the most abundant tetranychid mites inhabiting leaves, buds, stems, shoots and fruits of different plant species (Al-Shammery, 2008 and Fouly and Al-Rehiayani, 2009).This work aims to study the different biological aspects and life table parameters of *Agistemus vulgaris* Soliman and Gomaa as a biological control agent when fed on three of phytophagous mites, *T. urticae*; *Oligonychus sayedi* (Tetranychidae) and *Aculops lycopersici* (Eriophyidae).

MATERIALS AND METHODS

Host and Stigmaeid Predatory Mite Culture:-

The predatory mite, *A. vulgaris* was collected from leaves of sponge gourd, *Luffa Cylindrica* M. Roem and reared on the leaves of mulberry, *Morus albe* L.infested with *T. urticae* as prey. The experiment was undertaken in laboratory condition of 28±2˚C and 70±5% R.H. was maintained in Acarology Laboratory of Plant Protection Research Institute, Sharkia, Egypt.

Food sources:-

The tetranychid mites, *T.urticae* and *Oligonychus sayedi* (Tetranychidae) were collected from leaves of maize, *Zea mays* L. but *Aculops lycopersici* (Eriophidae) was collected from leaves of tomato, *Lycopersicon esculentum* Mill. These species were reared on detached mulberry leaves and supplied to the predatory mite, *A.vulgaris*.

Experimental Procedure:-

Experimental arenas were prepared as follows:

Twenty four gravid females of *A. vulgaris* were taken randomly and transferred to rearing substrates. Females were left 24 h. and their oviposited eggs were used to start biological aspects. Leaf discs of mulberry leaves (4 cm in diameter) were used as rearing arenas. The discs were placed on cotton wool soaked with water in Petri-dishes. Newly laid eggs of the predator, *A. vulgaris* were transferred singly to the rearing discs. Hatched individuals were fed during their life span on one of the aforementioned preys moving stages. Observations were recorded twice daily. In all cases, data was statistically analyzed by ANOVA-test to compare means (L.S.D-test, where P>0.05). Life-table, parameters of *A. vulgaris* were followed the formula of Andrewwartha and Birch (1954), Laing (1968) and Basic computer program of Abou Setta *et al*., (1986) where

The life table parameters were calculated as follows:

L=No. of female alive

X=Actual female age (in days)

(**Lx**)=The age rate of survival at day x (the fraction of females surviving from (0) until at least age (x)

(**mx**) = The age specific fecundity rate (Mean number of daughters born in an interval to amother of age (x) = born female/ female

(**Ro**) =The net reproductive value = Σ (Lx mx) the total females born in two successive generations or the rate of multiplication in one generation.

($\mathbf{r_m}$)= The intrinsic rate of increase (r_m) which is calculated by iteratively solving the Euler equation, Σ (e - rm x Lx mx) = 1(females/female/day)

- The mean generation time (**T**) = Σ (Lx mx)

- The finite rate of increase (**λ**) = erm (number of times the population multiplies in a unite of time)
- The doubling time (**Dt**) = *rmh*2
-Gross reproductive rate (GRR) Σ mx

RESULTS AND DISCUSSION

Effect of diets on biological aspects:-

The predatory mite, *Agistemus vulgaris* Soliman and Gomaa successfully developed and reproduced on the phytophagous species, *Tetranychus urticae*, *Oligonychus sayedi* (Tetranychidae) and *Aculops lycopersici* (Eriophyidae). The mean developmental period from egg to emergence adult (life cycle) was significantly affected on the two mite species. As shown in Table (1), the incubation period of *A. vulgaris* ranged from 1.93 to 2.90 days. Concerning duration time, larval stage lasted 3.46; 2.90 and 2.71 days when provided with immature of *T. urticae, O. sayedi* and *A. lycopersici*, respectively. The same trend was observed for predator protonymph, where it lasted an average of 3.17, 2.77and 2.43 days, while the deutonymph lasted 3.27; 2.99 and 2.65 days, respectively. The data have been reported to the same trend by (Hafez *et al*., 1983; El-Bagoury *et al*., 1989 and Momen, 2011). Therefore, the earlier results showed that the developmental time of *A. vulgaris* was significantly affected by food source and lasted 9.93 ,8.75 and 8.31 days when predator immature stages were subjected to immature of *T. urticae* ,*O. sayedi* and *A. lycopersici*, respectively.

Table1: Developmental time of immature stages, adult longevity of *Agistemus vulgaris* fed on different peys at 28 ± 2 ˚C and 70 ±5 % R.H.

Prey mite species	*Tetranychus urticae*	*Oligonychus sayedi*	*Aculops lycopersici*
Egg	2.75±0.19	1.93±0.15	2.90±0.15
Larva	3.46±0.16	2.90±0.28	2.71±0.19
Protonymph	3.17±0.24	2.77±0.22	2.43±0.22
Deutonymph	3.27±0.26	2.99±0.22	2.65±0.21
Total immature	9.93±0.32	8.75±0.36	8.31±0.17
Life cycle	12.56±0.44	12.09±0.31	10.75±0.30
Longevity	18.84±1.06	23.06±0.57	13.15±0.60
Life span	29.5±1.29	33.78±0.58	25.78±0.71

In all cases, it was noticed that immature stages of *A. lycopersici* accelerated the development more than *O. sayedi*, and *T. urticae*. From the earlier results, it can be noticed that *O. sayedi* prolonged the longevity of predator (23.06days) followed by *T. urticae* (18.84 days) and *A. lycopersici* (13.15days). These results are similar to the findings of (Hafez *et al*., 1983; Abou-Awad & El-Sawy, 1993) when studied the effect of two tetranychid mite species on the life stage of stigmaeid mite, *Agistemus exsertus* founding that feeding on *T. urticae* favoured faster development as compared to feeding on *T. cucurbitacearum*. Osman and Zaki (1986) reared *Agistemus exsertus* in the laboratory on the eriophyid *Aculops lycopersici*, a pest of tomato in Egypt and its development, fecundity and efficiency as a predator were studied at 30˚C and 75% R.H, the egg stages 2.1 days, the oviposition period 4.89 days and the life span of the adult female 7.2 days. The daily prey consumption by an adult female of *Agistemus exsertus* averaged 60.3 eggs or 45.3 immature and mature mobile mite stages. Thus, *A. exsertus* appears promising as a biological control agent against *Aculops lycopersici on* tomato. During oviposition period female mite lived on *O. sayedi* for 19.28 days and laid

an average of 53.75 eggs with a daily rate of 2.84 eggs, while it lived for 19.75and 11.12 days and laid 28.43 and 21.93 eggs with an average of 1.43 and 2.03 egg day when female predator preyed on immature stages of *T. urticae* and *A. lycopersici*, respectively Table (2).

Table 2: Effect of different prey mite species on the duration of oviposition period, total and daily rate of egg production of *Agistemus vulgaris*

Prey mite species	Duration of oviposition period	Average no. of deposited eggs	
		Total eggs	Egg/day
Tetranychus urticae	19.75±1.05	28.43±2.12	1.43±0.19
Oligonychus sayedi	19.28±0.58	53.75±1.66	2.84±0.15
Aculops lycopersici	11.12±0.61	21.93±1.08	2.03±0.12

Therefore, feeding on *O. sayedi* significantly prolonged predator longevity and caused a higher rate of fecundity (egg producting).The consumption rate of the tested preys increased through the developmental stages of the predator, respectively. During the adult longevity the predater consumed higher number of *Aculops lycopersici* (19 leaf discs 0.50 cm in diameter) than other prey species, while consumed the lowest number of *O. sayedi* (82.5 individuals/female), Table (3)

Table 3: Consumption rate of *Agistemus vulgaris* fed on three phytophagous species at 28 ± 2 ˚C and 70 ±5 % R.H.

Prey mite species	Larva	Protonymph	Deutonymph	Adult female
Tetranychus urticae	1.56± 0.20	3.21± 0.39	4.68 ± 0.41	124.43 ± 11.35
Oligonychus sayedi	0.87± 0.17	1.93± 0.19	3.25± 0.29	82.5 ± 0.88
Aculops lycopersici	Leaf disc (0.50 cm in diameter)	Leaf disc (0.50 cm in diameter)	2 Leaf disc (0.50 cm in diameter)	19 Leaf disc (0.50 cm in diameter)
Significant	**	**	**	**

(Leaf disc (0.50 cm in diameter) equivalence 50 (Egg,immature and Adult) *A. lycopersici*)

The predator larvae consumed an average of 1 leaf disc (0.50 cm in diameter), 1.56 and 0.87 individuals/female/day, of *A. lycopersici*, *T. urticae* and *O. sayedi*, respectively. The results are in agreement with those obtained by (Nawar, 1992) who studied the oviposition and prey consumption rates of *A. exsertus* in laboratory, where the number of eggs laid by females and the consumption of *T. urticae* as a prey increased with increasing prey density to maximum averages of 1.43 deposited eggs and 5.8 devoured larvae per day at a prey density of 7 larvae per predator.Greater prey density dcreased predator oviposition and feeding capacity.

Effect of preys on reproduction, fecundity and Life table parameters of *Agistemus vulgaris*:-

The calculated life Table parameters were constructed using the survival data of a specific age class and (LX) and the female offispring produced per female in each age class (mx).The net reproductive rate (Ro),the mean generation time (T), the intrinsic rate of increase (r_m),and the finite rate of increase (λ) and Gross reproduction rate (GRR)**,** Table (4).

The mean generation time (T) of *A. vulgaris* was significantly affected by the type of used food. The longest time needed for one generation (19.18 days) was recorded when the mite fed on immature of *O. sayedi* immature, whereas, the shortest period was (15.34 days) on immature of *A. lycopersici*. The population of *A. vulgaris* had the capacity to double (DT) every (5.06, 4.16 and 4.65 times) within a single generation when fed on three mentioned preys, respectively.Net reproductive rate (R_o) was (12.82, 24.38 and 9.82) per generation,

respectively. The immature of *O. sayedi* proved to be the optimium food compared with those tested as it had the highest values of (r_m)=0.17. On the other hand, when the values of (r_m) was converted to the finite rate of increase (e^{rm}) or (λ), it was clear that population of predator had capacity to multiply about (1.14, 1.18 and 1.16) times/female/day when it fed on five mentioned foods, respectively.

Table 4: Life table parameters of *Agistemus vulgaris* fed on *T. urticae*, *O. sayedi* and *A. lycopersici* at 28 ± 2˚C and 70 ±5 % R.H.

Parameters / prey species	*Tetranychus urticae*	*Oligonychus sayedi*	*Aculops lycopersici*
Mean generation time (T_c) [a]	18.633	19.18	15.341
Doubling time (DT) [a]	5.062	4.1613	4.656
Net reproductive rate (R_o) [b]	12.825	24.384	9.816
Intrinsic rate of increase (r_m) [c]	0.1363	0.1666	0.1489
Finite rate of increase (λ)	1.141	1.181	1.161
Gross reproduction rate (GRR)	18.58	28.5	12.15

[a] Days [b] per generation [c] Individuals/female/ day

Gross reproductive rate (GRR) was (18.58, 28.5 and 12.15) times/female/day when the predator mite reared on the same three mentioned foods, respectively. It could be generally concluded that immature of *O. sayedi* was the most suitable food for the development and reproduction of predator stigmaeid mite *A. vulgaris*. These results are in line with the findings of (Yousef *et.al* 1982; Saber, 2012 and Aly & Saber, 2012) who studied the effect of prey species on biology and fecundity of two stigmaeid mites, *Agistemus gossipi* and *A. exsertu*s and showed that fecundity was higher when mites were fed on *Tetranychus urticae* as compared to *T. granati,* El-Badry *et al*., 1969, Momen, 2001and Al-Shammery,2011,they studied the life table of *A. exsertus*.

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ARABIC SUMMARY

الظواهر البيولوجية للمفترس الأكاروسى أجيستيمس فولجارس المتغذى على ثلاث أنواع من الحلم النباتى التغذية ودراسة جداول الحياة

عمر محمد عمر محمد
معهد بحوث وقاية النباتات -مركز البحوث الزراعية –الدقى –مصر

درست كفاءة المفترس الاكاروسى *Agistemus vulgaris* على ثلاث فرائس من الأكاروسات نباتية التغذية نوعين من عائلة الحلم العنكبوتى الأحمر *Tetranychus urticae*, *Oligonychus sayedi* ونوع من عائلة الحلم الدودى *Aculops lycopersici*

و أوضحت النتائج النقاط التالية:-

1- نجح المفترس فى التشكل والنمو من طور اليرقة الى الطور البالغ عند التغذية على الثلاث فرائس.

2- فترة التشكل والنمو الكلية طالت عند تغذية المفترس على *O.sayedi* بالمقارنة بالفريستين الأخرتين.

3- المفترس أستهلك أعلى معدل من الفرائس عند التغذية على *A.lycopersici* وأستهلك أقل معدل عند التغذية على *O.sayedi* بالمقارنة بالنوع *A.lycopersici*.

4- كانت أطول فترة لطول العمر وكذلك دورة الحياة بالنسبة للمفترس الأكاروسى عند التغذية على *O.sayedi* بالمقارنة بباقى الفرائس .

5- أعلى معدل لوضع البيض سجلة المفترس الأكاروسى عند التغذية على النوع *O.sayedi* وأقل معدل لوضع البيض بالنسبة للمفترس عند التغذية على النوع *A. lycopersici*

6- أوضحت نتائج التحليل الاحصائي لجداول الحياة ان متوسط مدة الجيل (T) كانت (15.34,19.18,18.63). الوقت اللازم لتضاعف الجيل (DT) كانت (4.65، 4.16، 5.06)- معدل الزيادة الذاتي وكذلك معدل الزيادة بالنسبة للوقت (λ,r_m) كانت (0.13 ، 0.16 ، 0.14) و (1.14 ، 1.18 ، 1.16) للمفترس عند التغذية علي *T. urticae* و *O. sayedi* و *A. lycopersici* علي التوالي – معدل مدة الجيل (R_o) كانت (12.82 ، 24.38 ، 9.81).