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Biological aspects of the predatory mite, *Amblyseius fallacies* Garman (*Phytoseiidae*) feeding on thrips nymphs under laboratory condition.

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ABSTRACT

Predaceous mites play an important role in the biological control of phytophagous mites and insect pests such as thrips and whitefly. Biological parameters of *Amblyseius fallacies* Garman were tested under two degree of temperature 20 and 30°C and R.H.70±5% feeding on *Thrips tabaci* at Fac. Agric., Fayoum Univ., Egypt from March till June. The results indicated that the mean of immature periods at 20°C for eggs, larvae, protonymphs and deutonymphs, reached (2.64, 1.14, 1.86 and 2.79 days) and (2.46, 1.07, 1.93 and 3.21 days) for females and males, respectively. At 30°C the mean of these periods for female reached (2.64, 1.00, 1.64 and 3.21 days), while for males reached (2.50, 1.07, 1.29 and 3.43 days), respectively. The adult longevity period averaged at 20°C were 10.29 & 9.29 days, while at 30°C averaged were 8.14 & 6.86 days for female and males, respectively. Through the oviposition period which averaged between 6.43 and 4.71 days the mean of eggs deposited per female reached to 8.86 and 9.29 eggs at 20°C and 30°C, respectively. The total mean of food consumption for immature stages (protonymphs and deutonymphs) reached to 3.00 and 2.43 preys at 20°C, while reached to 3.43 and 2.71 preys at 30°C for females and males, respectively. The adult stage consumed from 19.89 to 9.14 preys at 20°C and 23.58 to 10.57 preys at 30°C for females and males, respectively.

Key words: Predaceous mites, *Amblyseius fallacies* and biological aspects.

INTRODUCTION

The *Phytoseiidae* are the most common plant inhabiting predatory mites. They have been considered to play an important role in the natural control of some phytophagous mites and insects. Several phytoseiid species have been commercially produced for the control of pest mites, thrips and whiteflies, Moraes and McMurtry (1981). Many species of *Phytoseiidae* are predators of mite pests; they are thus of huge interest in biological control programs. This family is widespread all over the world and includes three sub-families and more than 2,000 valid species Kostiainen & Hoy (1996) and McMurtry & Croft (1997). Variation in prey selection behavior, resulting in quantitative and / or qualitative differences in food intake, may results in differences in reproductive success. If this variation is genetically determined, natural selection is expected to favor thus genotypes that maximize their contribution to future generations. It is there fore expected that phytoseiid mites do not feed indiscriminately but prefer certain food types over others Van Lenteren (1986).

Biological control of thrips with predatory mite releasing began in European sweet pepper crops infested with the onion thrips, *Thrips tabaci.* Following several years of research, commercial use of *Amblyseius cucumeris* , *A. barkeri* (*mckenziei*) and *A. fallacies* Garman was begun in 1985 in Holland with releases on about 25% of the Dutch pepper acreage under glass (De Klerk and Ramakers 1986).Natural enemies, such as predaceous mites *Amblyseius fallacies* Garman (Phytoseiidae)

caused reduction of more pests (especially piercing and sucking pests). Predaceous mites play an important role in the biological control of phytophagous mites and some insect pests (Sengonca and Drescher, 2001). *A. fallacies* feeds on mites on berry and fruit crops, as well as a supplement to *P. persimilis* in greenhouse situations. *A. fallacies* can also survive on lower pest densities and feed on a variety of food sources such as two-spotted mites, European red mite and pollen. *A. fallacies* is pear-shaped and about the same size as it's prey and hairless. It is reddish in color when feeding on the European red mite, gold when feeding on the two-spotted spider mite in strawberries and blotchy green when feeding on the two-spotted spider mite in cane berries. Predator-prey interactions between phytoseiids and tetranychids in Japan revealed that the native predators *Amblyseius longispinosus* and *A. eharai* and the introduced predator *Phytoseiulus persimilis* were potential biological control agents of tetranychid mites reported by Mori *et al.,* (1990). *Thrips palmi* was an important pest of several crops, especially vegetables. The predatory mite *A. cucumeris* was successfully used in the control of various thrips species reported by, Cuellar *et al.,* (2002). The predatory mites *P. persimilis* and *A. cucumeris* in commercial greenhouses for augmentative biological control of thrips used by Opit *et al.,* (2005).

The present work aims to study some biological aspects of *A. fallacies* and investigate the effect of temperature and relative humidity under laboratory conditions.

MATERIALS AND METHODS

The biological aspects of predaceous phytoseiid mite *A. fallacies* were obtained during 2010 under laboratory conditions at 20 and 30°C and R.H.70±5% feeding on *Thrips tabaci* at Fac. Agric., Fayoum Univ., Egypt from March till June.

A. fallacies was found in Fayoum Governorate on several plants (Family: *Cucurbitaceae*), associated with phytophagous mites, mainly *Tetranychus urticae* and insect pests such as *Bemisia tabaci* and *Thrips tabaci*. *T. urticae* was offered daily to this predator as a main source of food on fresh bean leaves placed on wet cotton pad in plastic tray. Water was added daily to maintain suitable moisture. The stock culture was maintained at 25±2°C and R.H. 70±5%. The adult females of *A. fallacies* were collected from the field of vegetable crops (such as, Bean; Potato; Eggplant; Pepper and Cucumber) and transferred to the laboratory then supplied with prey larvae as food. Every newly predator egg was put singly on plastic rings 1cm in 5cm Petri dish with agar medium, kept under constant temperature degree (20 and 30°C). After hatching the predator was supplied with prey as food. Disks were checked daily during the entire developmental periods to determine the duration of developmental stages and number of consumed prey El-Laithy and Fouly (1992) and El-Laithy (1998).

Source of prey: Leaves infested by *T. tabaci* were collected with much enough number of prey from vegetable plants (Bean; Potato; Eggplant; Pepper and Cucumber) throughout the study period of predator. Nymphs were obtained from the culture and offered to the predator. The means of results were subject to statistical analysis using T-test of significances. The Duncan's procedures and the means were compared at 0.05% of probability by Duncan (1955).

RESULTS AND DISCUSSION

A- The development stages are presented in table (1) and show that:

1-Incubation period:

The incubation period of *A. fallacies* at 20°C ranged between 2-3.5 days with a mean of 2.64±0.26 for male and female and between 2-3 days with a mean of 2.5±0.15 at 30°C for male. Statistical analysis of the data revealed the presence of non-significant differences between the mean duration of egg stage for male and female at 20 and 30°C, respectively. These results are in general agreement with those obtained by Kain and Nyrop (1995), Riudavets 1995, and Sabelis and van Rijn (1997) who found that *A. fallacies* mite lays its eggs on the undersides of leaves near the top of the plant. The average is 2 eggs laid per female per day.

Table 1: Mean duration of *A. fallacies* immature stages at 20 & 30°C and 70% R.H.

Immature periods	20°C		30°C	
	Males	Female	Males	Female
Eggs	2-3.5 2.64^{a}±0.26	2-3.5 2.64^{a}±0.26	2-3 2.50 ^{a} ±0.15	2-3 2.64 ^{a} ±0.15
Larvae	0.5-1.5 1.07 ^{a} ±0.17	1-2 1.14^{b}±0.24	0.5-1.5 1.07a±0.17	0.5-1.5 1.00 ^{a} ±0.15
Protonymph	1.5-2.5 1.39b^{a}±0.17	1.5-2.5 1.86 ^{a} ±0.14	1-1.5 1.29b±0.10	1-2.5 1.64 ^{a} ±0.21
Deutonymph	2.5-4.5 3.07 ^{a} ±0.25	2.5-4.5 2.79 ^{b} ±0.20	2.5-4.5 3.43 ^{a} ±0.30	2.5-4.5 3.21^{b}±0.31

Duncan's Multiple Rang Test $P<0.05$

2-Larval stage:

The larval duration period of female was ranged between 1-2 days and 0.5-1.5 days with a mean of 1.14±0.24 and 1.00±0.15 days at 20 and 30°C, respectively. While, the larval duration period of male was ranged between 0.5-1.5 days and 0.5-1.5 days with a mean of 1.07±0.17 and 1.07±0.17 days, respectively**.** Statistical analysis of the data revealed the presence of significant differences between the mean duration of larval stage for male and female at 20 °C, respectively. While, at 30°C non-significant were observed.

3- Protonymphal stage:

In female, the protonympal period ranged between 1.5-2.5 days and 1-2.5 days at 20°C and 30°C, with a mean of 1.86±0.14 and 1.64±0.21, respectively. While those for male ranged between 1.5-2.5 days and 1-1.5 days with a mean of 1.39±0.17 and 1.29±0.10 days at 20°C and 30°C, respectively**.**

Statistical analysis of the data revealed the presence of non-significant differences between the mean duration of protonymphal stage for male and female at 20 and 30°C, respectively.

4- Deutonymphal stage:

The deutonympal time in female and males was ranged between 2.5-4.5 days with a mean of 2.79±0.20 days in females and 3.07±0.25 days in males at 20°C. While, at 30°C the deutonympal time in females and males, ranged between 2.5-4.5 days with a mean of 3.21±0.31days in females and 3.43±0.30 days in males. The period of total immature varied with sex and temperature. It ranged for females between 7-11 days and 6.5-11.5 days with a mean of 8.50±0.65 and 8.36±0.63 days at 20°Cand 30°C, respectively. While the period of immature for males, ranged between 6.5-11.5 and 6-10.5 days with a mean of 8.71±0.75 and 8.21±0.60 days, respectively. Statistical analysis of the data revealed the presence of non-significant differences between the mean duration of deutonymphal stage for male and female at 20 and 30°C, respectively.

These results are in general agreement with those obtained by Van Houten *et al,*. (1995) and Zhang Hui-yuan *et al.,(*2010) who stated that *A. fallacies* could complete its development period and lay eggs with one generation time of 9.54 d at (25±1) °C. Riudavets (1995) and Sabelis and van Rijn (1997) found that at (25°C), 6.2 days are required to complete the life cycle for *A. fallacies* ,also they found the *A. cucumeris* completes its life cycle in 11.1, 8.7, and 6.3 days at (20, 25 and 30°C). The lower threshold for larval development is (7.7°C).

B- The adult female longevity are presented in table (2) and show that:

1- Pre-oviposition period:

The preovipositin period ranged between 2-3 and 1-3 days with a mean of 2.43±0.20 and 1.86±0.34days at 20 and 30°C, respectively. Statistical analysis of the data revealed that significant effect on the pre-oviposition period for female at 20 and 30°C, respectively.

Table 2: Some biological aspects of *A. fallacies* feeding on *T. tabaci* nymphs at 20 & 30°C and 70%R.H.

Biological aspects	Period in days ± SD			
	20°C		30°C	
	Range	Average	Range	Average
Preovipostion	2-3	2.43 [a] ±0.20	1-3	1.86 [b] ±0.34
Oviposition	4-9	6.43 [a] ±0.65	3-6	4.71 [b] ±0.42
Postoviposition	1-3	1.71 [a] ±0.29	1-2	1.43[a]±0.20
Longevity	7-15	10.29 [a] ±1.02	5-11	8.14 [b] ±0.86
Life span	15-21	17.71 [a] ±0.75	13-17	14.57 [b] ±0.57
No. of eggs/female	5-13	8.86 [a] ±1.06	4-17	9.29 [a] ±1.74

Duncan's Multiple Rang Test P<0.05

1- Oviposition period:

The oviposition period ranged between 4-9 days and 3-6 days with a mean of 6.43±0.65 and 4.71±0.42 days at 20 and 30°C, respectively. Statistical analysis of the data revealed that significant effect on the duration of oviposition period for female at 20 and 30°C, respectively.

2- Post-oviposition period:

The post-oviposition period ranged between 1-3 days and 1-2 days with a mean of 1.71±0.29 and 1.43±0.20 days at 20 and 30°C, respectively. Statistical analysis of the data revealed that non-significant effect on the post-oviposition period for female at 20 and 30°C, respectively. In females, the adult longevity ranged between 7-15 days and 5-11 days with a mean of 10.29±1.02 and 8.14±0.86 days at 20 and 30°C, respectively. Statistical analysis of the data revealed that significant effect on the longevity period for female at 20 and 30°C, respectively. While, the adult male longevity ranged between 8-12 days and 5-9 days with a mean of 9.29±0.52 and 6.86±0.60 days at 20 and 30°C, respectively table (3).

Table 3: Longevity and life span of *A. fallacies* males (immature and adults) which feeding on *T. tabaci* nymphs at 20 & 30°C and 70%R.H.

Biological aspects		20°C		30°C	
		Range	Average	Range	Average
Period in days	Longevity	8-12	9.29 [a] ±0.52	5-9	6.86 [a] ±0.60
	Life span	13-18	15.14 [a] ±0.63	9-14	11.29[b]±0.17
No. of prey devoured	Longevity	6-13	9.14 [a] ±0.33	8-14	10.57 [a] ±0.18
	Life span	9-14	11.57[b]±0.25	11-16	13.29 [a] ±0.15

Duncan's Multiple Rang Test P<0.05

Statistical analysis of the data revealed that non-significant effect on the longevity period for male at 20 and 30°C, respectively.These results are in agreement with those obtained by Kain and Nyrop (1995), Helle and Sabelis (1985).

C- Fecundity:

Laboratory observations reported that, the adult female of *A. fallacies* deposited eggs ranged between 5-13 days and 4-17 eggs per female with an average of 8.86±1.06 and 9.29±1.74 eggs at 20 and 30°C, respectively table (2). Statistical analysis of the data revealed that non-significant effect on the fecundity for female at 20 and 30°C, respectively.

Different results were obtained by Zhang Hui-yuan *et al.,* (2010) who stated that the average amount of eggs laid by female *A.cucumeris* was 36.70. El-Laithy (1998) found that *Agistemus exsertus* had the highest fecundity rate of 66.6 eggs/ female, followed by *Amblyseius swirskii* 44.4 and *P. finitimus* 23.5 eggs / female.

D- Life span:

In females, this duration of life span ranged between 15-21 days and 13-17 days with an average 17.71±0.75 and 14.57±0.57 days at 20 and 30°C, respectively table (2). Statistical analysis of the data revealed that significant effect on the life span for female at 20 and 30°C, respectively.

While, the corresponding value for males lasted from 13-18 days and 9-14 days with a mean of 15.14±0.63 and 11.29±0.17 days table (3). Statistical analysis of the data revealed that significant effect on the life span for male at 20 and 30°C, respectively. These results are in agreement with those obtained by Kain and Nyrop (1995), Helle and Sabelis (1985). El-Laithy (1998) found that the predatory mites successfully fed on *Eriophyes olivi* . The developmental time of the predaceous mites averaged 10.5, 5.7 and 7.9 days, for Agistemus *exsertus* , *Amblyseius swirskii* and *P. finitimus*, respectively. Different results were obtained by Zhang Hui-yuan *et al., (*2010) who stated that life span was (38.52 d) of female. Reis *et al.*(2007) studied the life history of predatory mite *A. hericolus* using *Brevipalpus phoenicis* as prey .The adult female had a longevity of 38 days. The intrinsic rate of population increase was 0.15 and the mean generation time was 25.3 days.

E- Predation potential:

1- Larvae:

2- The observations reported that, the larval stage of both predator sexes could not feed on thrips nymphs table (4).

Table 4: Mean consumption of immature stages of *A. fallacies* upon feeding on *T. tabaci* nymphs at 20 &30°C and 70%R.H.

Biological aspects	20°C		30°C	
Immature stage	Male	Female	Males	Female
Larvae	-	-	-	
Protonymph	1-2 1.29 [a]	1-2 1.29 [a]	1-2 1.43 [a]	1-2 1.57 [a]
Deutonymph	1-3 1.86[b]	1-4 2.29 [a]	1-3 2.00 [b]	1-4 2.57 [a]
Total	2-3 2.43[b]	2-4 3.00 [a]	2-4 2.71[b]	3-5 3.43 [a]

Duncan's Multiple Rang Test P<0.05

1- Protonymphs:

In female, the protonymph consumed 1-2 and 1-2 prey with a mean of 1.29 and 1.57 prey at 20°C and 30°C, respectively. While the protonymph of male

consumed 1-2 and 1-2 prey with a mean of 1.29 and 1.43 prey table (4). Statistical analysis of the data revealed that non-significant differences between the means of protonymphs for male and female at 20 and 30°C, respectively.

2- Deutonymphs:

The number of *T. tabaci* nymphs consumed by female was 1-4 and 1- 4 prey with a mean of 2.29 and 2.57 prey at 20°C and 30°C, respectively. But, the number of *T. tabaci* nymphs consumed by male was 1-3 and 1-3 prey with a mean of 1.86 and 2.00 prey, respectively. The total consumption of female immature ranged 2-4 and 3-5 prey with average 3.00 and 3.43 prey. While for immature male consumed 2-3 and 2-4 prey with average 2.43 and 2.71 prey at 20 and 30°C, respectively table (4). Statistical analysis of the data revealed the presence of significant differences between the means of deutonymphs for male and female at 20 and 30°C, respectively. These results are in agreement with those obtained by Reis *et al.*(2007) who found that predation and ovipostion of *A. herbicolus* increased with increasing prey density.

3- Adult:

As shown in table (5) the Pre-oviposition , Oviposition and Post-oviposition periods of female the predator consumed at 20°C (2-7), (6-15) and (2-5) prey with average 4.43, 12.23 and 3.23 prey, respectively. While at 30°C these periods ranged (2-9), (8-19) and (3-6) prey with average 5.86, 13.43 and 4.29 prey, respectively table (5). These results are in agreement with those obtained by Kain and Nyrop (1995), Helle and Sabelis (1985). Riudavets (1995) and Sabelis & van Rijn (1997) found that, a pair of mites *Amblyseius cucumeris* eat five 1st larvae of WFT each day on average, but older life stages are immune to attack because of their larger size and more effective defensive behaviors.

The total consumption of adult female the mite consumed 10-27 and 13-34 prey with average 19.89 and 23.58 prey, and during life span consumption ranged between 14-28 and 18-33 preys with average 21.43 and 26.86 preys at 20 and 30°C, respectively table (5). While adult male consumed from 6-13 to 8-14 preys with average 9.14 and 10.57 preys, and life span consumption ranged between 9-14 and 11-16 preys with average 11.57 and 13.29 preys at 20 and 30°C, respectively table (3). Similar results were obtained by Kain and Nyrop (1995) Helle and Sabelis (1985). Riudavets (1995) and Sabelis and van Rijn 1997) observed and recorded that female mites (*Amblyseius barkeri*) live 30 days and over this time consume about 89 first instar thrips larvae. This predator aggregates on high density patches of WFT larvae, where it feeds on young larvae and lays its eggs. Statistical analysis of the data revealed the presence of significant differences between the means of Pre-oviposiotion, Oviposition, Post-oviposition, longevity and life span for female at 20 and 30°C.

Table 5: Food consumption of *A. fallacies* females (immature and adults) upon feeding on *T. tabaci* nymphs at 20 & 30°C and 70%R.H.

Biological aspects	No. of prey devoured			
	20°C		30°C	
	Range	Average	Range	Average
Preovipostion	2-7	4.43 [b]	2-9	5.86[a]
Oviposition	6-15	12.23 [b]	8-19	13.43 [a]
Postoviposition	2-5	3.23 [b]	3-6	4.29 [a]
Longevity	10-27	19.89 [b]	13-34	23.58 [a]
Life span	14-28	21.43 [b]	18-33	26.86 [a]

Duncan's Multiple Rang Test $P<0.05$

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ARABIC SUMMARY

المظاهر البيولوجية للأكاروس المفترس ***Amblyseius fallacies*** **Garman**
المنتمي لعائلة ***Phytoseiidae*** عند التغذية علي حوريات التربس تحت ظروف المعمل

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تمت تربية الأكاروس المفترس *Amblyseius fallacies* تحت درجتي حرارة 20 و 30 ±2°م ورطوبة 70±5% بالمعمل وذالك عند التغذية علي حوريات التربس عند درجة حرارة 20°م حيث بلغ متوسط فترة نمو الأطوار غير الكاملة لكل من البيض ،اليرقة، الحورية الأولي، والحورية الثانية (2.64، 1.14، 1.86 و 2.79 يوم) و (2.64، 1.07، 1.93و 3.21 يوم) بمتوسط كلي لهذه الفترات (8.50 يوم) و (8.71 يوم) لكل من الإناث والذكور علي الترتيب . بينما عند درجة حرارة 30°م بلغ متوسط هذه الفترات علي الترتيب (2.50، 1.00، 1.64 و 3.07 يوم) للأناث بمتوسط كلي لهذه الفترات (8.36 يوم) بينما للذكور بلغ متوسط هذه الفترات علي الترتيب (2.50، 1.07، 1.29و 3.43 يوم) بمتوسط كلي لهذه الفترات (8.21 يوم) . بلغ متوسط حياة الطور الكامل عند درجة حرارة 20°م (10.29 و 9.29 يوم) واستغرقت عند درجة حرارة 30°م (8.14 و 6.86 يوم) للإناث والذكور علي الترتيب. ولوحظ خلال فترة وضع البيض التي بلغت في المتوسط (6.43 و 4.71 يوم) أن الأنثى وضعت في المتوسط (8.86 و 9.29 بيضة) عند درجة حرارة 20 و 30°م علي الترتيب. بلغ متوسط استهلاك الغذاء الكلي للأطوار غير الكاملة للأكاروس المفترس عند درجة حرارة 20°م (3.00 و 2.43 فريسة) من حوريات التربس، وعند درجة حرارة 30°م بلغ (3.43 و 2.71 فريسة) للإناث والذكور علي الترتيب. وأثبتت الدراسة أن الطور الكامل أستهلك في المتوسط (19.89و 9.14 فريسة) عند درجة حرارة 20°م و (23.58و 10.57 فريسة) عند درجة حرارة 30°م للإناث والذكور علي الترتيب.