

Biological Studies on the Phytoseiid Predator *Amblyseius cucumeris* (Oudemans) Reared on the Two Spotted Spider Mite *Tetranychus urticae* Koch

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ABSTRACT

This experiment was conducted to study the effect of different stages of the two spotted spider mite, *T. urticae* as prey on the biological aspects of the predaceous mite, *Amblyseius cucumeris* at the laboratory conditions, 20 and 30 °C and 75 % R.H. The incubation period of *A. cucumeris* averaged 3.2 and 3.3 days for the eggs of adult females fed on the adult and immature stages of *T. urticae*, at 20 °C, respectively. This period did not obviously changed with temperature increase, recorded 2.23 and 2.23 days, at 30 °C., respectively. The mean larval period of female and male of the predator recorded the longest period when the female individuals fed on immature stages of *T. urticae* at 20 °C. While the shortest period when the male individuals fed on the adult stages of *T. urticae* at 20 °C. The protonymphal period of the phytoseiid mite, durated the longest period 3.37 days when fed on *T. urticae* immature stages at 20 °C, and the shortest period 2.26 days when fed on the adult stage at 30 °C. The longest deutonymphal period lasted 2.82 for male individuals when fed on the adult stages at 20 °C, but the shortest deutonymphal period 1.4 days when fed on the same prey at 30 °C. Life cycle durated an average of 10.52 and 12.81 days when female individuals fed on *T. urticae* adult and immature stages at 20 °C, when reared at 20 °C, but lasted an average of 8.92 and 10.07 days at 30 °C, respectively. The longest period of the longevity was observed for the female when fed on the adult stage at 20 °C, but the shortest period when the male fed on immature stages at 30 °C. The highest deposited eggs recorded when the female fed on the immature stages at 30 °C, but the lowest number of deposited eggs when female fed on the adult stage of *T. urticae*.

INTRODUCTION

The cucumber, *Cucumis sativus* L., is a new greenhouse crop which can be grown successfully under protective structures year-round. The cucumber has high climatic demands especially humidity, air temperature and light intensity, and these main factors affect cucumber crop quality and quantity, therefore, their instability during the changing season should be considered. The two-spotted spider mite, *Tetranychus urticae* Koch is one of the most destructive pests. The divers host plant species may have been differentially affected by this pest. Cucurbit vegetable crops are commonly planted in numerous districts of Egypt affected by this pest. Cucurbit crops are preferable for this pest which decreases its yield. The rapid developmental rate and high reproductive potential of *T. urticae* allow it achieve damaging population levels very quickly under suitable conditions, resulting in an equal rapid decline of host plant quality. Because of its short life cycle and high reproductive rates, spider mite develops resistance faster than most insects (Guo *et al.*, 1998). Family Phytoseiidae contains a large number of species know to prey on spider and eriophyid mites, and there are numerous references indicating that certain species are important. Some phytoseiid seem to reproduce equally well on animal or non-animal foods (McMurry and Sciveen 1965a). Some others utilize such miscellaneous foods as fungi (Chant 1959), white flies (Teich 1966), moth eggs (Swirski *et al.*, 1967a, b), thrips (Bonde 1989) and nematodes (Muma 1967a). Watanabe *et al.*, (1994) tested technical viability using phytoseiid to control *T. urticae* in cucumber, only *Amblyseius* species was successfully established on cucumber, significantly reducing *T. urticae* population. So, the current study is conducted to study some of the biological aspects of the phytoseiid mite, *Amblyseius cucumeris* (Oudemans) at laboratory conditions.

MATERIALS AND METHODS

Amblyseius cucumeris newly deposited eggs were collected from cucumber plants in the experimental farm

belonging to faculty of griculture, Mansoura university and transferred to leaf cucumber discs, each disc one inch in diameter as rearing arenas in Peti-dishes on water saturated cotton and kept on 20 and 30 °C. Each newly hatched larvae (25 replicates) was supplied with sufficient known number of preys (*T. urticae* adults and immature stages). All larvae were reared individually under the tested temperatures. Before the final molt of female, or male a introduced to the replicate for mating and removed after one day, experiment was observed twice a da. The number of laid eggs as well as consumption rate were counted daily until female dies. Longevity and consumption of adult male were also counted. The different of different reared female's predator stages were recorded. Eggs of the reared females were collected daily from each female and determined. The statistical analysis (ANOVA) and regression) of the obtained results were performed using SAS program (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 biological aspects of the predaceous phytoseiid mite *Amblyseius cucumeris*.

Incubation period:

Incubation period of *A. cucumeris* averaged 3.2 and 3.3 days for the eggs of adult female fed on the adult and immature stages of *T. urticae*, at 20 °C, respectively, Table (1), this period recorded 2.23 and 2.23 days, at 30 °C., respectively.

Larval stage:

The mean larval period of female and male *A. cucumeris* lasted the longest period when the female individuals fed on the immature stages of *T. urticae* and recorded 3.42 days, at 20 °C Table (1). However, the shortest period of *A. cucumeris* averaged 1.4 when the male individuals fed on the adult stages of *T. urticae* at 20 °C.

Protonymphal stage

As shown in Table (1). The protonymphal period of the phytoseiid mite, *A. cucumeris* durated an average of

2.56 and 3.37 days when the individuals fed on *T. urticae* adult and immature stages at 20 °C, respectively. While, lasted 2.26 and 2.34 days when the same individuals fed at 30 °C on the adult and immature stages, respectively.

Deutonymphal stage

Data arranged in Table (1) showed that the longest period of *A. cucumeris* was lasted 2.82 for male individuals when fed on the adult stages of *T. urticae* at 20 °C, but the shortest deutonymphal period was recorded 1.4 days at 30 °C.

Life cycle

The obtained data in Table (1) showed that the predatory mite, *A. cucumeris* duarated an average of 10.52 and 12.81 days when female individuals fed on *T. urticae* adult and immature stages at 20 °C, while lasted 8.92 and 10.07 days when reared at 30 °C, respectively. However, this period for the male predatory mites lasted 8.12, 9.47 days on 20 °C and 5.39, 9.17 days on 30 °C, respectively.

Longevity

The average duration of the adult stages male and female of the phytoseiid mite, *A. cucumeris* were presented in Table (1). The longest period of the longevity was observed for the female individuals of *A. cucumeris* when fed on the adult stage of *T. urticae* at 20 °C, but the shortest period was recorded when the male individuals of *A. cucumeris* fed on immature stages of *T. urticae* at 30 °C and recorded 16.64 days.

Preoviposition, oviposition and postoviposition periods of *A. cucumeris*

As shown in Table (1) the longest preoviposition period of *A. cucumeris* was determined for the female individuals fed on immature stages of *T. urticae* at 20 °C, but the shortest one was recorded when the female fed on

the adult stages of *T. urticae* at 30 °C. However, the female took the longest oviposition period when fed on *T. urticae* adult at 20 °C, but the shortest time was recorded at 30 °C when the individuals fed on the same prey and duarted 16.03 days.

Fecundity

The tabulated data in Table (1) showed that the highest deposited eggs for the predatory mite, *A. cucumeris* was noticed when the female fed on the immature stages of *T. urticae* at 30 C, as, it laid an average of 52.6 eggs, but the lowest number of deposited eggs was recorded for the female when fed on the adult stages of *T. urticae*, as it laid an average of 37.0 eggs.

Food consumption of *A. cucumeris* when fed on different stages of *T. urticae* at different temperatures

The feeding capacity of *A. cucumeris* on *T. urticae* was affected by temperatures and also with the type of used preys, Table (2). The total consumed prey/predator decreased as temperature increased from 20 to 30 °C for predator female individuals when fed on adult stages of the preyand devoured 146.6 and 142.3 adult preys, respectively, and 72.1 and 70.3 adult prey for the /predatory male, respectively. However, the number of devoured immature stages of *T. urticae* prey was high at 30 C than 20 °C for both female and male individuals of the predator, as, they consumed 148.5 and 34.6 immatures of the prey at 20 for female and males, respectively, and 151.3 and 68.7 immature stages of the prey, respectively at 30 °C.

A high consumption rate also was recorded on eriophyid prey for *Amblyseius gossipi* (Reda and EL-Bagoury 1986) and *Typhlodromus balanites* (EL-Bagoury and Momen 1989).

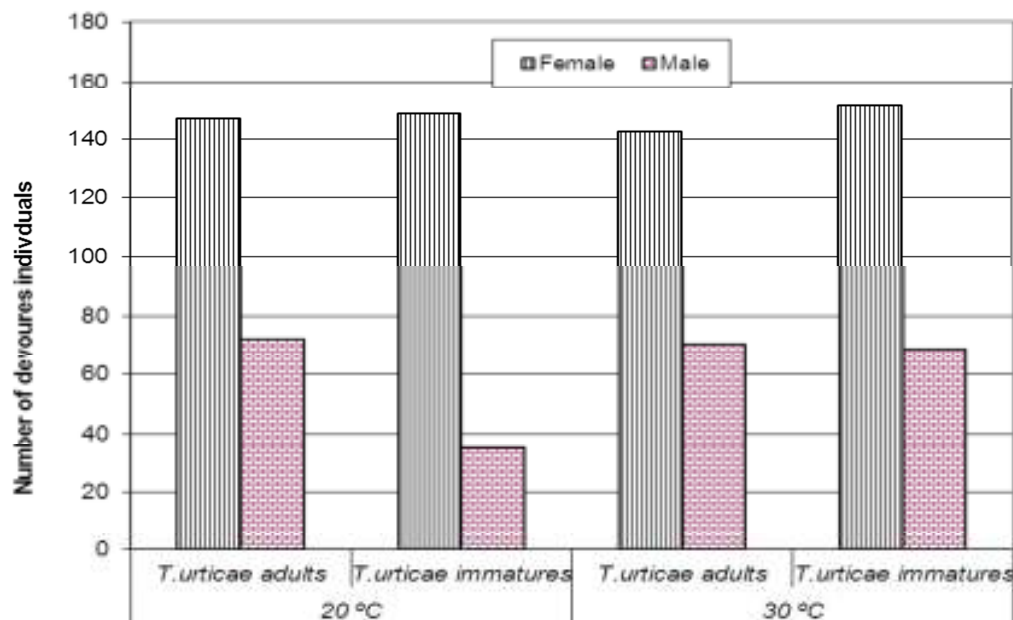


Fig.1. Food consumption of the predaceous mite, *A. cucumeris* when fed on different stages of *T. urticae* as preys.

Table 1. Duration (mean±SD) of different stages and fecundity of *A. cucumeris* when fed on *T. urticae* adult and immature sages

Predator stages	Sex	20 °C		30 °C	
		<i>T. urticae</i> adult stage	<i>T. urticae</i> immature stage	<i>T. urticae</i> adult stage	<i>T. urticae</i> immature stage
Egg	♀	3.2±0.32	3.3±0.26	2.23±0.15	2.23±0.16
		1.53±0.13	2.58±0.08	1.35±0.16	2.34±0.06
Larva	♀	2.29±0.14	3.42±0.21	2.23±0.16	2.48±0.09
		1.4±0.08	2.49±0.04	1.37±0.17	2.31±0.18
Protonymph	♀	2.56±0.17	3.37±0.26	2.26±0.26	2.34±0.10
		2.3±0.18	2.22±0.29	1.28±0.17	2.25±0.16
Deutonymph	♀	2.5±0.06	2.66±0.07	2.21±0.18	2.47±0.09
		2.82±0.13	2.12±0.05	1.4±0.07	2.32±0.17
Total immature	♀	7.35±0.45	9.45±0.64	6.7±0.36	7.29±0.51
		6.52±0.51	6.83±0.57	4.05±0.23	6.88±0.49
Life cycle	♀	10.52±0.39	12.81±0.29	8.92±0.34	10.07±0.30
		8.12±0.29	9.47±0.16	5.39±0.36	9.17±0.44
Longevity	♀	24.16±0.86	24.15±0.56	19.52±0.74	24.13±0.63
		18.24±0.57	17.98±0.52	16.75±0.51	16.64±0.35
Life span	♀	34.67±0.96	37.01±0.53	28.45±0.97	34.2±0.58
		26.15±0.81	27.24±0.84	22.73±1.65	25.81±0.54
Preoviposition	♀	2.22±0.04	2.65±0.23	1.22±0.20	2.27±0.73
Oviposition	♀	19.47±0.82	19.04±0.67	16.03±0.63	18.7±0.50
Postoviposition	♀	2.41±0.17	2.56±0.11	2.36±0.28	2.9±0.35
Fecundity	♀	37.0±0.156	51.2±2.44	41.6±1.71	52.6±1.65

Table 2 . Effect of different factors on the different biological aspects of the predacious mite *A. cucumeris* at 20 and 30 °C

Variable	Factor	F.	P.	L.S.D. at 0.05 level
Incubation period	Temp.	29.17	0.000***	0.0783
	Diet	568.17	0.000***	
	Sex.	300.5	0.000***	
Larva	Temp.	98.704	0.000***	0.065
	Diet	647.648	0.000***	
	Sex.	450.729	0.000***	
Protonymph	Temp.	198.38	0.000***	0.082
	Diet	117.245	0.000***	
	Sex.	227.082	0.000***	
Deutonymph	Temp.	638.722	0.000***	0.054
	Diet	8.046	0.0059**	
	Sex.	383.425	0.000***	
Life cycle	Temp.	618.28	0.000***	0.147
	Diet	834.54	0.000***	
	Sex.	11.82.8	0.000***	
Longevity	Temp.	188.58	0.000***	0.272
	Diet	60.46	0.000***	
	Sex.	624.85	0.000***	
Life span	Temp.	279.9	0.000***	0.413
	Diet	218.59	0.000***	
	Sex.	1524.37	0.000***	

A carefully examination of the data arranged in Table (2) indicated that temperature and diets factors expressed as highly significant positive on the different biological aspects of the predacious mite, *A. cucumeris* adult stages males and females. L.S. D. at 0.05 level = 0.783, 0.147 and 0.272 for incubation period, life cycle and longevity for both sexes (male and female), respectively. Also, from the statistical point of view, the simple correlation value, Table (3) was positive relationship with the female predacious mites fed on the adult stages of *T.*

urticae for effect of both temperature degrees (20 and 30 °C), but it was negative when fed on the immature stages of the introduced prey. On the other hand, the relation between temperature and the male individuals of the predacious mite was negative at 20 °C when the mites fed on the adult stages of *T. urticae* and positive at 30 °C. However, the effect of 30 °C on the biological aspects of *A. cucumeris* male was positive when fed on prey adult stages and negative when the immature stages of *T. urticae* were introduced for the male predator as food source, Table (3)

Table 3. The correlation between the different factors affecting on the predacious mite *A. cucumeris*

Sex	Prey stages	Temp.	Corr.	Slope	Y int (a)
♀	Adult stage of <i>T. urticae</i>	20 °C	0.049	0.023	2.244
		30 °C	0.606	0.656	0.76
	Immature stages of <i>T. urticae</i>	20 °C	-0.563	1.0461	4.94
		30 °C	-0.0649	-0.080	2.703
♂	Adult stage of <i>T. urticae</i>	20 °C	-0.0988	0.0600	1.565
		30 °C	0.3361	0.3469	0.9016
	Immature stages of <i>T. urticae</i>	20 °C	0.1784	0.1028	2.2250
		30 °C	-0.382	-1.144	4.984

Similar results were conducted by Zhang *et al.*, (2000) who evaluated the potential of predatory mite *Amblyseius cucumeris* (Oudemans) in the laboratory to as a biocontrol agent against the spider mite *Schizotetranychus nanjingensis* Ma & Yuan, a pest of the moso bamboo in Fujian, China. When fed *S. nanjingensis* females and eggs, the life cycle of *A. cucumeris* (developmental time from egg to egg 7.7 days for the first generation and 7.8 days for the second generation) was as long as its life cycle on its normal diet in the laboratory, *Tyrophagus putrescentiae* (Schrank) (7.8 days) at 27-28 °C. Adult females of *A. cucumeris* started to lay eggs at the age of 3 days with a daily rate of 1-4 eggs (average of 2.2) over a period of 7-18 days and a total fecundity of 35.8 (14-47) eggs. The number of prey consumed by predators increased with prey density and the number of eggs produced was directly correlated with the number of prey consumed. Female predators consumed twice as many female spider mites as did male and deutonymph predators (6 versus 3 per day at 9 prey per leaf). The predatory mite *Amblyseius cucumeris* (Oudemans), sometimes cited in literature as *Neoseiulus cucumeris*, is such a predator.

It is abiocontrol agent widely used for the control of various species of thrips on cucumber and pepper in greenhouses through preventive, mass releases (Gillespie 1989; Bennison and Jacobson 1991 and Wada 1999).

One reported evaluation of it against the eriophyid mite *Aculops lycopersici* (Masse) showed that it failed to reproduce on this mite (Brodeur *et al.* 1997). *A. cucumeris* was effective against the broad mite *Polyphagotarsonemus latus* (Banks) on reenhouse plants in China (L.R. Liang, personal communication).

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دراسات بيولوجية على المفترس *Amblyseius cucumeris* عند تربيته على العنكبوت الاحمر ذو البقعتين *Tetranychus urticae* KOCH

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أجريت هذه التجربة لدراسة تأثير الأطوار المختلفة للعنكبوت الاحمر ذو البقعتين *T. urticae* كفرانس على الجوانب البيولوجية للمفترس الأكاروسي *Amblyseius cucumeris* تحت الظروف المعملية (٢٠ و ٣٠ درجة مئوية ورطوبة نسبية ٧٥%). حيث كانت فترات حضالة البيض للمفترس *A. cucumeris* بمتوسط ٣.٢ و ٣.٣ يوم لبيض الاناث عند تغذيتها على الطور الكامل والأطوار الغير كاملة للعنكبوت الاحمر ذو البقعتين على درجة حرارة ٢٠ درجة مئوية. على التوالي، كما ان هذه الفترة لم تتغير بشكل معنوي مع زيادة درجات الحرارة حيث سجلت ٢.٢٣ و ٢.٢٣ يوما عند درجة حرارة ٣٠ درجة مئوية. على التوالي. كما سجلت مدة العمر البرقي لكلا من اناث وذكر المفترس الأكاروسي فكانت أطول فترة استغرقتها الحياة ١٠.٥٢ - ١٢.٨١ يوم عند تغذية الاناث على الأطوار الغير الكاملة من العنكبوت الاحمر عند درجة حرارة ٢٠ درجة مئوية. في المقابل كانت اقصر فترات العمر البرقي عند تغذية ذكور المفترس على الحشرات الكاملة للعنكبوت الاحمر عند نفس درجة الحرارة. كما وجد ان الفترة اللازمة لاتمام طور ما قبل الحورية هي ٣.٣٧ يوم وتعتبر أطول الفترات عند التغذية على الأطوار الغير كاملة للعنكبوت الاحمر عند ٢٠ درجة مئوية. في حين كانت اقصر الفترات عند التغذية على الحشرات الكاملة للعنكبوت الاحمر وبلغت ٢.٢٦ يوم عند درجة حرارة ٣٠ درجة مئوية. من ناحية اخرى بلغت الفترة اللازمة لطور ما بعد الحورية لذكور المفترس اقصاها (٢.٨٢ يوم) عند تغذية على الطور الكامل عند درجة حرارة ٢٠ درجة مئوية. بالمقابل بلغت هذه الفترة ادناها (١.٤ يوم) عند التغذية على نفس الطور عند اختلاف درجة الحرارة (٣٠ درجة مئوية). في حين كان متوسط الفترة اللازمة لاتمام دورة الحياة ١٠.٥٢ - ١٢.٨١ يوم عند تغذية الاناث على كلا الأطوار الكاملة وغير الكاملة للعنكبوت الاحمر عند درجة حرارة ٢٠ درجة مئوية. في المقابل قلت هذه الفترة الى ٨.٩٢ - ١٠.٠٧ عند درجة حرارة ٣٠ درجة مئوية. على الجانب الاخر، لوحظ ان أطول فترة لعمر الاناث كانت عند تغذيتها على الطور الكامل عند درجة حرارة ٢٠ درجة مئوية. في حين كانت اقصر فترة لعمر الذكور عند تغذيتها على الأطوار الغير الكاملة عند درجة حرارة ٣٠ درجة مئوية. كما كانت اعلى نسبة وضع للبيض عند تغذية الاناث على الأطوار الغير الكاملة عند درجة حرارة ٣٠ درجة مئوية واقل نسبة لوضع البيض عند التغذية على الطور الكامل للعنكبوت الاحمر ذو البقعتين.