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Thrips tabaci (LIND.) AS SUITABLE PREY FOR THREE PREDACIOUS MITES OF THE FAMILY PHYTOSEIIDAE (ACARI: PHYTOSEIIDAE)

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ABSTRACT

Laboratory experiments were conducted to investigate the influence of *Thrips tabaci* (lind.) nymphs on biological aspects of three phytoseiid species , *Amblyseius swirskii* A.-H., *Amblyseius deleoni* (Muma & Denmark) and *Amblyseius zaheri* Yousef & El-Borolossy in the laboratory at 27 ± 1 °C and 70 –80 % RH. The developmental was faster and reproduction was higher in case of *A. swirskii* compared with those of *A. deleoni* and *A. zaheri* . The total developmental period of immatures were 6.35, 6.76 and 7.06 days for *A. swirskii* , *A. deleoni* and *A. zaheri* , respectively. The predatory mite , *A. swirskii* showed the highest oviposition rate (40.18 eggs), while *A. zaheri* exhibited a lower fecundity (25.24 eggs) than that on *A. deleoni* (35.88 eggs) , respectively. The predatory females of *A. swirskii* , *A. deleoni* and *A. zaheri* consumed daily 4.75 , 4.12 and 3.47 individuals of *T. tabaci* nymphs, respectively. Life table parameters showed that the intrinsic rate of increase (rm) was 0.211, 0.201 and 0.179 per day for *A. swirskii, A. deleoni* and *A. zaheri*, respectively.

INTRODUCTION

Phytoseiid mites have been reported to play an important role in the biological control against several acarine pests in Egypt (El-Badry & El-Banhawy,1968; Abou-Awad *et al.*,1989; Momen & El-Saway, 1993; Aly, 1994; Abou-Elella, 1998; Rasmy *et al.*, 2000; El-Banhawy *et al.*, 2001 and Rasmy *et al.*, 2003).The phytoseiid mites *Amblyseius swirskii* A.-H., *Amblyseius deleoni* (Muma & Denmark) and *Amblyseius zaheri* Yousef & El-Borolossy, are well known predators, preying on several pests including red spider mites, eriophyid mites, nymphs of whiteflies and scale insects (Momen & El-Saway, 1993; Aly,1994 and Abou-Elella, 1998).

Thrips tabaci (Lind.) is a noxious pest infested many crops and vegtables, which causes a decreased in the yields. In vegtable crops *T. tabaci* has recently developed as serious pest duo to the amission of routine chemical treatments against the two spotted spider mite and the glasshouse whitefly (Bonde, 1989).

Several authors reported that other phytoseiid mites, i.e. *Amblyseius cucumeris* (Oudemans) and *Neoseiulus barkeri* (Hughes) were reported as a potential control agent for *T. tabaci* on cabbage, pepper and cucumber in greenhouses (Deklerk & Ramakers, 1986; Bonde,1989; Marisa & Sauro, 1991; Houten & Ammv, 1995 ; Wada,1999 and Abou-Eella & Abou-Elella, 2001). The present study was carried out to determine the ability of *A. swirskii*, *A. deleoni* and *A. zaheri* to develop and reproduce when offered nymphs of *T. tabaci* as prey in the laboratory.

MATERIAL AND METHODS

The suitability of the *T. tabaci* as a food source was tested for three species of phytoseiid mites. *A. swirskii* and *A. deleoni* were collected from heavily infested pear and mango leaves, while *A. zaheri* was found on cucumber.

The predatory mites, *A. swirskii, A. deleoni* and *A. zaheri* were obtained from laboratory cultures maintained on mulberry leaves, *Morus alba* L. infested with larvae and nymphs of *Tetranychus urticae* Koch as prey in the laboratory of the NRC, Cairo. The leaves were placed upsid-down on moist cotton pad in Petridishes.

Gravid female predators were taken at random from the colonies and transferred to rearing substrates. Females were left 24 hours and their deposited eggs were used for different biological aspects. Three groups,each consisting of thirty predators eggs were singly transferred individually to mulberry leaf discs, 2 cm in diameter. The newly hatched larvae were supplied daily with sufficient number of nymphs of *T. tabaci.* Nymphs of *T. tabaci* was collected from infested onion plant cultivated at NRC farm and transferred to the rearing substrate. Devoured prey were replaced daily with fresh ones. For mating emerged predatory females were coupled with fresh males and the number of deposited eggs per female was recorded. Offspring was kept for sex determination.

Observation on development, reproduction and consumption were recorded twice daily. Life table parameters were calculated according to a BASIC computer programme (Abou-Setta *et al.*, 1986).

All the experiments reported herein were carried out under laboratory condition of 27± 1 °C and 70- 80 % RH.

RESULTS AND DISCUSSION

Individuals of *A. swirskii* , *A. deleoni* and *A. zaheri* successfully developed from larva to adult when fed on the nymphs of *T. tabaci* Table (1).

Table 1: Developmental time in days of different stages of *Amblyseius swirskii, A. deleoni* and *A. zaheri* females fed on *Thrips tabaci* nymphs at 27 °C.

Developmental stages	*A. zaheri*	*A. deleoni*	*A. swirskii*
Egg	2.0 ± 0.0	2.0 ± 0.0	2.0 ± 0.0
Larva	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0
Protonymh	2.18 ± 0.10 a	1.52 ± 0.18 b	2.12 ± 0.13 a
Deutonymph	1.88 ± 0.12 b	2.24 ± 0.11 a	1.23 ±0.11 c
Total immatures	5.06 ± 0.16 a	4.76 ± 0.14 a	4.35 ± 0.12 b
Life cycle	7.06 ± 0.16 a	6.76 ± 0.14 a	6.35 ± 0.12 b
% Surviving	100	100	100
Adult longevity	23.59 ± 0.51 c	28.65 ± 0.79 b	39.05 ± 0.85 a
Life span	30.65 ± 0.63 c	35.41 ± 0.81 b	45.41 ± 0.82 a
N. obs.	20	20	22

Different letters in a horizontal column denote significant differences (F-test, $P \leq 0.05$).

The development of *A. swirskii* was significantly faster compared with *A. deleoni* or *A. zaheri* when fed on *T. tabaci* nymphs. *A. swirskii* had a high percentage (80-100 %) of juveniles reaching maturity when fed on young stages of *Bemisia tabaci* and *Retithrips syriacus*. In contrast, a low percentage (38.2 %) of juveniles reaching maturity when fed on the California red scale and some eggs having been produced after mating according to (Swirski *et al.*, 1967). Ragusa & Swirski (1977) found that crawlers of armoured scales and honeydew of the coccids and mealybugs serve only as survival food for *A. swirskii*. In most phytoseiids, mating is necesary to complete oviposition and multiple matings are required for maximum eggs output (Zaher *et al.*, 1969; Amano & Chant, 1978 ; Schulten *et al.*, 1978; Overmeer *et al.*, 1982; Momen, 1993; Aly, 1994; Momen, 1997; Abou-Elella,1998 and Rasmy *et al.*, 2003). In the present study , *A. swirskii*, *A. deleoni* and *A. zaheri*, several copulations were required for maximum egg production (El-Sawi & Abou-Awad, 1992; Momen & El-Saway, 1993; Abou-Elella, 1998 and Saber & Momen, 2000). Oviposition period was significantly longer when *A. swirskii* fed on *T. tabaci* nymphs compared to *A. deleoni* or *A. zaheri*. The total egg production of *A. swirskii* was significantly higher (40.18 eggs) than *A. deleoni* (35.88 eggs) and *A. zaheri* (25.24 eggs) Table (2). Similar results were reported by Bonde (1989) on *N. barkeri* (47.1 eggs) and Abou-Eella & Abou-Elella (2001) on *A. cucumeris* (50.56 eggs) when both species fed on *T. tabaci* nymphs. A comparison of our data with those published in the literature reveals some differences. Aly (1994) found that mated females of *A. swirskii* gave the longest oviposition period (26.2 days) and the highest reproduction (41.8 eggs) on *Eutetranychus orientalis* (Klein) at 28 °C, but the lowest reproduction (26.3 &27.8 eggs) and the decreased ovipostion (22.5 & 22.3 days) on *Tyrophagous putresentiae* (Schrank) and *T. urticae* , respectively at 27 °C (El-Laithy & Fouly , 1992 and El-Sherif *et al.*, 1999). It worth be mentioned that the food value of eggs of the moth *Prodenia litura* was very low in *A. swirskii* (Swirski *et al.*, 1967). A higher fecundity was reported on *A. deleoni* and *A. zaheri* when both species fed on *T. urticae* and pollen grains of *Phoenix dactylifera* L. (45.31 & 45.38 eggs) as well as the longest ovipostion period (24.46 & 15.62 days) at 27 °C , respectively (Abou-Elella , 1998 and Rasmy *et al.*, 2003). The sex ratio of the progeny in favoured of females in the three abovementioned predators.

Table 2 : Oviposition period and fecundity of *Amblyseius swirskii* , *A. deleoni* and *A. zaheri* fed on *Thrips tabaci* nymphs at 27 °C.

Predators	Duration in days			No. of eggs / female	
	Preoviposition	Oviposition	Postoviposition	Total	Daily rate
A. zaheri	2.59 ± 0.12 a	17.53 ± 0.34 c	3.47 ± 0.40 b	25.24 ± 0.80 c	1.44 ± 0.02 b
A. deleoni	2.35 ± 0.12ab	22.12 ± 0.71 b	4.18 ±0.30 b	35.88 ±1.01 b	1.64 ± 0.03 a
A. swirskii	2.29 ±0.11 b	24.41 ±0.73 a	12.35 ± 0.58 a	40.18 ± 0.52 a	1.65 ± 0.05 a

Different letters in a vertical column denote significant differences (F- test, P ≤ 0.05).

Results in Table (3) showed that, larvae of *A. swirskii*, *A. deleoni* and *A. zaheri* developed without feeding. The consumption rate increased through

the development. The maximum rate was recorded during the ovipostion period as the female consumed a daily average of 4.75 ,4.12 and 3.47 of *T. tabaci* nymphs for *A. swirskii* , *A. deleoni* and *A. zaheri* , respectively. This results agree with those of Bonde (1989) who stated that the adult female of *N. barkeri* consumed 4.32 nymphs of *T. tabaci* per day during a period of 10 days.

Table 3 : Consumption rate per day of *Amblyseius swirskii* , *A. deleoni* and *A. zaheri* fed on *T. tabaci* nymphs at 27 °C.

Stage of predator	A. *zaheri*	A. *deleoni*	A. *swirskii*
Larva	-	-	-
Protonymph	1.59 ± 0.12 b	2.0 ± 0.0 a	2.24 ± 0.11 a
Deutonymph	2.18 ± 0.10	2.59 ± 0.12	2.65 ± 0.13
Total immatures	3.76 ± 0.17 b	4.59 ± 0.13 a	4.89 ± 0.19 a
Adult female	3.47 ± 0.12 c	4.12 ± 0.21 b	4.75 ± 0.23 a

Different letters in a horizontal column denote significant differences (F-test P ≤ 0.05).

The effect of food type on life table parameters is show in Table (4). Population of the predacious mites *A. swirskii* , *A. deleoni* and *A. zaheri* could multiply 27.11, 23.52 , 15.21 (Ro) in generation time of 15.64 , 15.47 , 15.17 days (T) when the predators fed on nymphs of *T. tabaci.* In addition to, the intrinsic rate of increase (rm) was 0.211, 0.201and 0.179 individuals/ female/day; while the finite rate of increase (e^{rm}) was 1.234, 1.222 and 1.196 female daughters / female / day for the predatory mites *A. swirskii, A. deleoni* and *A. zaheri*, respectively.The results were similar to those of Abou-Setta (1988) on *Euseius mesembrinus* (Dean); Dinh *et al.*, (1988) on *Amblyseius idaeus* (Denmark & Muma) and *A. anonymus* Chant & Baker; El-Laithy & Fouly (1992) on *A. scutalis* & *A. swirskii* ; Abou-Awad *et al.*, (1998) on *Amblyseius olivi* Nasr & Abou-Awad ; Abou-Elella (1998) on *A. deleoni* & *A. zaheri*; El-Sherif *et al.*, (1999) on *A. swirskii* and Rasmy *et al.*, (2003) on *A. zaheri.*

Table 4 : Effect of *T. tabaci* nymphs on the life table parameters of *Amblyseius swirskii* , *A. deleoni* and *A. zaheri* at 27 °C.

Parameters	*A. zaheri*	*A. deleoni*	*A. swirskii*
Net reproductive rate (Ro)	15.21	23.52	27.11
Mean generation time (T) days	15.17	15.47	15.64
Intrinsic rate of increase (r m)	0.179	0.201	0.211
Finite rate of increase (e^{rm})	1.196	1.222	1.234
Sex ratio (females / total)	0.67	0.69	0.70

Generally, the evaluation of these predators as a biological control agent obviously depends on its reproductive rate which postively correlated with prey consumption during oviposition period. Sabelis (1981) reported that the total eggs deposited during oviposition period represented about 70 % from total protein of preys.

Therefore, it could be concluded that *T. tabaci* provided commensurate nutritional effects on the survivorships and reproduction of *A. swirskii* , *A. deleoni* and *A. zaheri*. Results indicated that the abovementioned phytoseiids can played an important role as a biological agent on *T. tabaci*. Much more information is needed on the influence of different predators in suppressing the population of *T. tabaci* on greenhouses.

REFERENCES

Abou-Awad, B. A.; A. A. El-Sherif; M. F. Hassan and M. M. Abou-Elella (1998). Studies on development, longevity, fecundity and predation of *Amblyseius olivi* Nasr & Abou-Awad (Acari : Phytoseiidae)on various kinds of prey and diets. J. Plant Diseases and Plant Prot., 105 (5): 538-544.

Abou-Awad, B. A.; A. K. Nasr; E.A. Gomaa and M. M. Abou-Elella (1989). Life history of the predatory mite, Cydnodromella negevi and the effect of nutrition on its biology (Acari:Phytoseiidae). Insect Sci. Appl., 10 (5): 617- 623.

Abou-Eella, M. M. and G.M. Abou-Elella (2001). Laboratory studies on development and oviposition of *Neoseiuls cucumeris* (Oudemans) (Acari : Phytoseiidae). Egyption J. Biol. Pest Contr., 11 (2): 115- 118.

Abou-Elella, G. M. (1998). Studies of certain aspects of some predacious phytoseiid mites. Ph. D. Thesis, Cairo Univ., 182 pp.

Abou-Setta, M. M. (1988). Biology of *Euseius mesembrinus* (Acari : Phytoseiidae) including programme for life table calculation and a long probit model for development time and finite rate of increase. Ph. D. Thesis, Univ. Florida.

Abou-Setta, M. M. ; R. W. Sorrell and C. C. Childers (1986). Life-48 : a BASIC computer programme to calculate life table parameters for an insect or mite species. Fla. Entomol., 69 (4) : 690- 697.

Aly, Fatma, S. (1994). Biological and ecological studies on some predacious mesostigmatic mites with special reference to the family Phytoseiidae. Ph. D. Thesis, Fac. of Agric., Cairo Univ., 258 pp.

Amano, H. and D.A. Chant (1978). Some factors affecting reproduction and sex ratio in two species of predacious mites , *Phytoseiulus persimilis* Athias-Henriot and *Amblyseius andersoni* (Chant) (Acari : Phytoseiidae). Can. J. Zool., 56 (7) : 1593- 1607.

Bonde, J. (1989). Biological studies including population growth parameters of the predatory mite *Amblyseius barkeri* (Acarina : Phytoseiidae) at 25 °C in the laboratory. Entomophaga, 34 (2) : 275- 287.

Deklerk, M. L. and P.M.I. Ramakers (1986). Monitoring population densities of the Phytoseiid predator *Amblyseius cucumeris* and its prey after large scale introductions to control *Thrips tabaci* on sweet pepper. Med. Fac. Landbouww. Dijksuniv. Gent., 15 (3a) : 1045-1048.

Dinh, N. V.; A. Janssen and M.W. Sabelis (1988). Reproductive success of *Amblyseius idaeus* and *A. anonymus* on a diet of two-spotted spider mites. Exp. Appl. Acarol., 4 : 41- 51.

El-Badry, E. A. and E. M. El-Banhawy (1968). Studies on the mating behaviour of the predacious mite *Amblyseius gossipi* (Acarina: Phytoseiidae). Entomophaga, 13 : 159- 162.

El-Banhawy, E. M.; S. M. Hafez and S. A. Saber (2001). Response of *Amblyseius cydnodactylon* (Phytoseiidae) to increasing prey density of *Tetranychus urticae* (Tetranychidae) in absence or presence of nymphs of *Bemisia tabaci* (Homoptera) in Egypt. Internat. J. Acarol., 27 (3) : 241-244.

El-Laithy, A. Y. and A.H. Fouly (1992). Life table parameters of the two phytoseiid predators *Amblyseius scutalis* (Athias-Henriot) and *Amblyseius swirskii* A.- H. (Acari : Phytoseiidae) in Egypt. J. Appl. Entomol., 113 (1) : 8- 12.

El-Sawi, S. A. and B.A. Abou-Awad (1992). Starvation and fertilization affecting reproduction in *Amblyseius gossipi* El-Badry (Acari: Phytoseiidae). J. Appl. Entomol., 113 (3) : 239- 243.

El-Sherif, A. A. ; A. K. Nasr and M. M. Abou-Elela (1999). Laboratory studies on developmental and oviposition rates of *Amblyseius swirskii* A.- H. (Acari : Phytoseiidae) fed on *Tyrophagous putrescentiae* (Acari : Acaridae). Arab J. Biotech.., 2 (2) : 121- 126.

Houten, Y. M. V. and L. Ammv (1995). Influence of temperature and humidity on the survival of eggs of the thrips predator *Amblyseius cucumeris.* Med. Fac. Landbouww. Dijksuniv. Gent., 60 (3a) : 879- 884.

Marisa, C. and S. Sauro (1991). Biological observation and life table parameters of *Amblyseius cucumeris* (Oud.) (Acarina : Phytoseiidae) reared on different diets. Redia , 73 (2) : 569-583.

Momen, F. M. (1993). Effect of single and multiple copulation on fecundity, longevity and sex ratio of the predacious mite, *Amblyseius barkeri* (Hugh.) (Acari : Phytoseiidae) (in German). Anz. Sch. Pfl. Umw., 66 (8): 148- 150.

Momen, F. M. (1997). Copulation, egg production and sex ratio in *Cydnodromella negevi* and *Typhlodromus athiasae* (Acari: Phytoseiidae). Anz. Sch. Pfl. Umw., 70 (2) : 34- 36.

Momen, F. M. and El-Saway, S. A. (1993). Biology and feeding behaviour of the predatory mite, *Amblyseius swirskii* (Acari : Phytoseiidae). Acarologia , 34 (3) : 199- 204.

Overmeer, W. P. ; M. Doodeman and A. Q. van Zon (1982). Copulation and egg production in *Amblyseius potentillae* and *Typhlodromus pyri* (Acari : Phytoseiidae). Z. Angew. Entomol., 93 (1) : 1- 11.

Ragusa, S. and E. Swirski (1977). Feeding habits , post embryonic and adult survival, mating, virility and fecundity of predacious mite *Amblyseius swirskii* (Acari: Phytoseiidae) on some coccids and mealybugs. Entomophaga , 22 (4) : 383-392.

Rasmy , A. H. ; F. M. Momen; M. A. Zaher and G. M. Abou-Elella (2003). Influence of diet on life history and predatory capacity of *Amblyseius zaheri* Yousef & El-Borolossy (Acari : Phytoseiidae). Insect Sci. Appl., 23 (1) : 31- 34.

Rasmy, A.H.; M. A. Zaher; F. M. Momen; M. S. Nawar and G. M. Abou- Elella (2000). The effect of prey species on biology and predatory efficiency of phytoseiid mites : 1-*Amblyseius deleoni* (Muma & Denmark). Egyption J. Biol. Pest. Contr., 10 : 117-121.

Sabelis, M. W. (1981). Biological control of the two-spotted spider mite using phytoseiid predators Part 1 : Modelling the predator-prey interaction at the individual level. Agric. Res. Rep., 910, Puda Wageningen, 242 pp.

Saber, S. A. and F. M. Momen (2000). Effect of mating factors on reproduction and sex ratio of the predacious mite, *Amblyseius zaheri* Yousef and El-Borolossy (Acari : Phytoseiidae). J. Pest. Sci., 73 : 113-115.

Schulten, G. G. M. ; R. C. M. van Arendonk; V. M. Russell and F. A. Roorda, (1978). Copulation , egg production and sex ratio in *Phytoseiulus persimilis* and *Amblyseius bibens* (Acari : Phytoseiidae). Entomol. Exp. Appl., 24 (2) : 145- 153.

Swirski, E.; S. Amitai and N. Dorzia (1967). Laboratory studies on the feeding, development and reproduction of the predacious mites *Amblyseius rubini* Swirski and Amitai and *Amblyseius swirskii* Athias-Henriot (Acarina : Phytoseiidae) on various kinds of food substances. Israel J. Agric. Res., 17 :101- 119.

Wada, T. (1999). Development of cucumeris R and its future prospect. Agrochemical ,
73 : 17 – 19.

Zaher, M. A.; A. K. Wafa and K. K. Shehata (1969). Life history of the predatory mite *Phytoseius plumifer* and the effect of nutrition on its biology (Acarina : Phytoseiidae). Entomol. Exp. Appl., 12 (4) : 383-388.

حشرة التربس كغذاء مفضل لثلاث من المفترسات الاكاروسية والتابعة لعائلة فايتوسيدى

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تم دراسة تأثير تغذية حوريات حشرة التربس على الخصائص البيولوجية لثلاث من المفترسات الاكاروسية والتابعة لعائلة فايتوسيدى على درجة حرارة ٢٧ °م ودرجة رطوبة ٨٠% وقد أوضحت نتائج الدراسة ما يلى :

- لوحظ أن التغذية على حوريات حشرة التربس كانت ملائمة للنمو والتطور والتكاثر بالنسبة لهذه المفترسات الثلاثة وهى: *Amblyseius swirskii* , *A. deleoni* , *A. zaheri*
- معدل التطور كان سريعا وكذلك زاد معدل وضع البيض بالنسبة لإناث المفترس *Amblyseius swirskii* بينما كان التطور بطيء وكذلك قل معدل وضع البيض بالنسبة لإناث المفترسان *A. deleoni* , *A. zaheri*
- لوحظ أيضا زيادة معدل استهلاك الغذاء للأطوار الغير كاملة وكذلك الإناث للمفترس *Amblyseius swirskii* , بالمقارنة بالمفترس *A. deleoni* ؛ المفترس *A. zaheri* .