Influence of some Sap Sucking Pests as Preys on the Biology and Capacity of Four Predatory Phytoseiid Mite Species

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ABSTRACT

The biology of the four Phytoesiid mites; *Phytoseiulus macropilis* (Banks), *Neoseiulus californicus* (McG.), *N. zaheri* (Yousef and El-Brollosy) and *N. cucumirs* (Oudemans) were differently affected by feeding on egg, immature and adult stages of *Tetranychus urticae* Koch and nymphs of *Thrips tabaci* Lind., *Aphis gossypii* Glover and first & second instars of *Bemisia tabaci* (Gennadius) in the laboratory at 30 ± 2°C ,70% ± 5 R.H. and 12/12 h. light/dark periods. The four phytoseiid species developed and reproduced on the spider mite *T. urticae* different stages . Concerning life cycle, *N. cucumeris* gave the shortest duration (4.4 days/♀) when fed on prey eggs, while *N. zaheri* gave the longest (6.8 days/♀). *P. macropilis* average female laid the highest number of eggs and daily rate (35.2 & 2.4 eggs) when fed on *T. urticae* eggs. From the phytoseiids tested, only *N. cucumeris* completed its development and reproduction on nymphal stages of *A. gossypii* and *T. tabaci* (life cycle duration 7.3 & 7.4 days; oviposition 16.3 & 16.0 eggs/♀ respectively).

Key Words: Sucking pests, Biology, Feeding Capacity, Phytoseiid mites

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is considered one of the important vegetable crops in Egypt. The cultivated area is estimated by 8894 feddan producing about 75276 Tons. The exported amount was 8.46 Tons in summer and (4610944m^2, 44771 Ton and 9.71 Kg/m^2) in winter according to Economic Sector report, Ministry of Agric. Egypt 2003. The national income from exporting cucumber in the coming years is expected to be increased and this requires to obtain healthy clean fruits without chemical pesticide treatment. The two spotted spider mite *Tetranychus urtica* Koch, is known to be one of the most important pests causing several damages to plants and fruits. This can be used as food for predators mass rearing to control some acarine and insect pests; the two-spotted spider mite, *T. urtica*, as well thrips *Thrips tabaci* L., aphids *Ahpis gossypii* Glov. and whitefly *Bemisia tabaci* Genn. Although in Egypt, growers still depend on chemical control of this noxious pests, yet in some other countries specially U.S.A. some phytoseiid mite predators are successfully used for its biocontrol; *Phytoseiulus persimilis* Athias-Henriot (Oatman & McMurtry 1966 and Decou, 1994); *Amblyseius californicus* (McG.); and *Metaseiulus occidentalis* (=*Typhlodromus occidentalis* Nesbitt). (Oatman *et al.* 1977).

Thus, the present work was conducted to determine the most favourate preys for each of the phytoseiid mites, *Phytoseiulus macropilis* (Banks), *Neosieulus califonicus* (McG.), *Neosieulus cucumeris* (Oudemans) and *Neosieulus zaheri* (Yousef and El-Brollosy).

MATERIALS AND METHODS

Effectiveness of the four phytoseiid species *P. macropilis, N. californicus, N. cucumeris* and *N. zaheri* as predators was tested in the laboratory at 30 ± 2°C, 70% ± 5% R.H. and 12/12 h light/dark periods, against eggs, immatures and adults of the two-spotted spider mite *T. urticae*, nymphs of the cotton thrips *T. tabaci*, the cotton aphids *A. gossypii* and the first and second instars of the whitefly *B. tabaci*.

For solitary rearing, newly deposited eggs were kept singly on a small *Acatypha margnata* W. Miller leaf approximately 3cm long with its edges lined with a cotton wool barrier. The leaf was put upside down on a wetted cotton wool pad in a glass Petri dish (10cm in diameter). Moisture was maintained by adding a few drops of water daily and the temperature was kept constant. Each newly hatched larva was supplied with a known number of prey and devoured individuals were replaced daily by new ones until the predator reached adulthood. Emerged females were inseminated and kept for oviposition. Each experiment was started with at least 25 newly hatched larvae and observations were made every 12h.

Food sources: An experiment was undertaken to rear the four species of phytoseiid mites at 30±2°C on eggs, immatures and adults of *T. urticae*, second nymphal instars of the whitefly *B. tabaci*, nymphs of cotton aphids *A. gossypii* and nymphs of cotton thrips *T. tabaci*. These pests are of economic importance in Egypt and were collected from the farm of the Faculty of Agriculture, Cairo University, Giza, *T. urticae* and *B. tabaci* from castor bean plants, aphid from cotton plants, whitefly from cucumber.

RESULTS AND DISCUSSION

The four phytoseiid mites pass through five developmental stages; egg, larva, 2 nymphs and adult. Female phytoseiid mites did not start oviposition without mating. The larvae appeared to be non-feeding as reported for other phytoseiid mites (Doss 1958; Laing, 1968; Amano and Chant, 1977 and El-Borolossy, 1979). In this investigation the predators immature stages, developed to the adult stage then reproduced when fed on *T. urticae* eggs, immatures and adults, but deutonymphs of the three predators; *P. macropilis, N. californicus* and *N. zaheri* failed to develop to adulthood on *T. tabaci* and *A. gossypii* while those of *N. cucumeris* developed

Table (1): Duration of developmental stages of four phytoseiid predatory species when fed on *Tetranychus urticae* different stages at 30°C.

Predator Developmental Stages	Sex	Duration in days											
		P. macropilis			*N. californicus*			*N. cucumeris*			*N.zaheri*		
		Eggs	Immatures	Adults	Eggs	Immatures	Adults	Eggs	Immatures	Adults	Eggs	Immatures	Adults
Egg	♂	0.8 ±0.00	0.9 ±0.00	0.8 ±0.00	1.2 ±0.00	1.2 ±0.00	1.2 ±0.00	1.1 ±0.00	0.9 ±0.00	1.1 ±0.00	1.3 ±0.00	1.3 ±0.00	1.3 ±0.00
	♀	0.8 ±0.00	0.9 ±0.00	0.8 ±0.00	1.2 ±0.00	1.2 ±0.00	1.2 ±0.00	1.1 ±0.00	0.9 ±0.00	1.1 ±0.00	1.3 ±0.00	1.3 ±0.00	1.3 ±0.00
Total immatures	♂	4.1 ±0.00	3.0 ±0.30	3.5 ±0.18	3.6 ±0.02	3.5 ±0.45	3.5 ±0.03	3.0 ±0.02	5.6 ±0.05	5.8 ±0.30	4.9 ±0.06	3.8 ±0.06	3.9 ±0.16
	♀	4.3 ±0.03	3.8 ±0.46	4.0 ±0.03	3.8 ±0.90	3.6 ±0.60	4.5 ±0.11	3.3 ±0.03	5.7 ±0.03	5.2 ±0.10	5.5 ±0.03	4.6 ±0.17	5.0 ±0.25
Life cycle	♂	4.9 ±0.02	3.9 ±0.98	4.3 ±0.21	4.8 ±0.04	4.7 ±0.05	4.7 ±0.27	4.1 ±0.03	6.5 ±0.05	6.9 ±0.34	6.2 ±0.08	5.1 ±0.08	5.2 ±0.16
	♀	5.1 ±0.09	4.7 ±0.05	4.8 ±0.30	5.0 ±0.07	4.8 ±0.05	5.7 ±0.17	4.4 ±0.01	6.6 ±0.05	6.3 ±0.32	6.8 ±0.25	5.9 ±0.25	6.3 ±0.25
Oviposition		22.6 ±1.56	17.3 ±0.10	14.4 ±0.80	20.1 ±1.44	16.7 ±1.70	23.7 ±0.90	14.2 ±1.07	22.6 ±0.49	25.5 ±2.01	10.5 ±1.02	12.4 ±1.20	16.2 ±1.16
Longevity	♂	17.3 ±1.73	13.1 ±0.59	13.6 ±1.90	14.3 ±1.93	13.2 ±1.20	19.8 ±1.40	9.6 ±0.66	15.1 ±0.70	14.8 ±4.66	8.7 ±0.78	12.3 ±1.00	14.8 ±1.92
	♀	30.4 ±2.49	24.0 ±0.40	22.3 ±1.40	27.8 ±1.72	21.2 ±1.90	28.9 ±1.14	18.7 ±0.45	32.1 ±1.44	36.4 ±1.80	17.4 ±1.35	18.1 ±1.13	24.3 ±0.78
Life span	♂	22.2 ±1.73	17.0 ±0.87	17.9 ±1.95	19.1 ±2.92	17.9 ±1.41	24.5 ±1.14	13.7 ±0.66	21.6 ±0.72	21.7 ±2.77	14.9 ±0.78	17.4 ±1.08	19.5 ±1.94
	♀	35.5 ±2.46	28.7 ±0.06	27.1 ±1.88	32.8 ±1.73	26.0 ±1.82	34.6 ±1.40	23.1 ±0.45	38.7 ±1.48	42.7 ±1.98	24.2 ±1.34	24.0 ±1.07	30.6 ±0.78
No. of eggs/♀		11.1 ±0.70	22.9 ±0.25	35.2 ±1.88	14.1 ±1.04	23.6 ±1.35	25.7 ±2.90	17.6 ±1.11	12.2 ±1.6	10.1 ±1.14	11.6 ±0.66	17.0 ±1.61	15.2 ±2.22
Daily rate		0.5 ±0.10	1.3 ±0.09	2.4 ±0.11	0.7 ±0.05	1.4 ±0.35	1.1 ±0.21	1.2 ±0.12	0.5 ±0.80	0.4 ±0.05	1.1 ±0.12	1.4 ±0.19	0.9 ±0.15

Table (2): Durations of developmental stages of *Neosieulus cucumeris* when fed on *Tetranychus. urticae* immatures, *Aphis gossypii* and *Thrips tabaci* at 30°C.

Predator Stage	Sex	Duration in days when fed immatures of		
		Tetranychus urticae	*Aphis gossypii*	*Thrips tabaci*
Egg	♂	0.9 ± 0.00	1.1 ± 0.00	1.1 ± 0.03
	♀	0.9 ± 0.00	1.1 ± 0.10	1.1 ± 0.00
Total immatures	♂	5.6 ± 0.06	5.4 ± 0.02	6.1 ± 0.01
	♀	5.7 ± 0.03	6.2 ± 0.03	6.3 ± 0.03
Life cycle	♂	6.5 ± 0.05	6.5 ± 0.02	7.2 ± 0.01
	♀	6.6 ± 0.05	7.3 ± 0.02	7.4 ± 0.03
Oviposition		22.6 ± 0.49	7.8 ± 0.40	12.8 ± 0.40
Longevity	♂	15.1 ± 0.70	7.2 ± 0.40	11.3 ± 0.45
	♀	32.1 ± 1.44	13.4 ± 0.80	19.0 ± 0.02
Life span	♂	21.6 ± 0.72	13.7 ± 0.46	18.5 ± 0.45
	♀	38.7 ± 1.48	20.7 ± 0.79	26.4 ± 0.03
No. of eggs/♀		12.2 ± 1.60	16.3 ± 1.10	16.0 ± 1.78
Daily rate		0.5 ± 0.80	2.1 ± 0.14	1.3 ± 0.14

to adult. *N. zaheri* was reared by Rasmy *et. al.* (2003) on whitefly nymphs. As shown in Table (1), *T. urticae* eggs appeared to be the most profitable food source of *N. cucumeris* as it resulted in highest female fecundity and the shortest developmental period, (17.6 eggs per female and 4.4 days). Table (1) shows that when the four predators were fed on immatures of *T. urticae* the durations of their developmental stages (egg-adult) averaged 4.7, 4.8, 5.9 and 6.6 days for *P. macrpilis*, *N. californicus*, *N. zaheri* and *N. cucumeris*, respectively. *T. urticae* adults proved to be the most profitable food of *P. macropilis* as it accelerated developmental time (4.8 days) and resulted in high female fecundity (35.2 eggs/♀ and daily rate 2.4 eggs). Generally, immature stages of *T. urticae* were considered the most suitable food for *N. californicus* and *N. zaheri* while eggs of *T. urticae* were the best prey for *N. cucumeris*.

Data presented in Table (3) show that feeding capacity of the four predatory mites were affected by prey stages. The number of devoured prey eggs increased in *N. californicus*, the total number of *T. urticae* eggs consumed and the daily consumption rate ranged from 598.0 and 21.5 eggs per day to 151.4 eggs and 8.7 eggs per day for adult females of *N. californicus* and *N. zaheri*, respectively. Similar results, when predators were fed on *T. urticae* immatures and adults. The number of immatures consumed per adult female *N. californicus* and daily rate decreased from 420.9 and 19.9 individuals per day to 213.6 and 11.9 individuals for *N. zaheri* adult female. Consumption averaged 243.1& 91.0 and 8.4 & 3.7 adults per day for *N. californicus* and *N. zaheri* adult female, respectively. Generally, *N. californicus* may be considered a promising candidate for the biological control of *T. urticae* based on its high consumption, rapid development and high fecundity.

Data in Tables (2) and (4) show that when *N. cucumeris* predator was fed on *A. gossypii* and *T. tabaci* nymphs ,the duration of the predator developmental time averaged 7.3 and 7.4 days while female fecundity was nearly similar (16.3 and 16.0 eggs/♀with 2.1 and 1.3 daily rate), respectively . The total and daily rate numbers on *T. tabaci* nymphs were greater than those on *A. gossypii* averaging 132.3, 7.0 and 59.7, 4.5 individuals, respectively.

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Table (3): Food consumption of four phytoseiid predatory species on different stages of *Tetranychus urticae* during its life span at 30°C.

Predator Stage	Sex	No. of devoured prey individuals											
		P. macropilis			*N. californicus*			*N. cucumeris*			*N. zaheri*		
		Eggs	Immatures	Adults	Eggs	Immatures	Adults	Eggs	Immatures	Adults	Eggs	Immatures	Adults
Protonymph	♂	9.1 ± 0.70	8.0 ±1.61	5.6 ±1.10	4.7 ±0.45	8.3 ±2.53	3.8 ±0.60	4.9±0.30	3.5 ±0.92	1.0 ±0.00	8.7±0.64	7.2±1.50	2.5±0.50
	♀	10.5 ± 0.50	8.9 ±1.51	7.2 ±1.50	8.2 ±0.87	14.4 ±2.70	9.0 ±0.90	7.2 ±0.40	5.1±0.9	1.7±0.50	10.8±0.97	11.5±1.14	4.0±0.60
Deutonymph	♂	12.1 ± 0.83	7.8 ±1.20	6.3 ±1.50	7.2 ±0.87	11.9 ±2.21	5.0 ±0.60	5.7 ±0.45	10.5±1.43	2.0±0.60	8.5±0.50	10.5±1.14	2.6±0.70
	♀	21.0 ± 0.89	8.2 ±1.80	8.4 ±1.10	7.5±0.50	12.4±2.10	7.8 ±1.00	8.3 ±0.45	14.4±1.56	2.4±0.50	15.8±1.16	12.6±1.02	3.9±0.90
Total immatures	♂	21.2 ±1.17	15.8 ±2.09	11.9 ±1.40	11.9 ±0.94	20.2 ±2.52	8.8 ±0.10	10.6±1.13	14.0±1.73	3.0±0.60	17.2±0.97	17.9±1.18	5.0±1.00
	♀	31.5 ±2.90	17.1 ±1.20	15.6 ±1.90	15.7±1.10	27.3±3.49	16.8±1.50	15.5±0.50	19.6±1.96	4.1±0.50	26.6±0.91	24.0±4.21	7.9±0.90
Oviposition		474.4±34.03	240.8±36.21	108.7 ±7.60	455.7±41.36	337.1±8.59	210.4±2.20	294.5±5.60	231.0±12.72	126.7±1.30	99.9±10.21	162.3±11.6	65.7±9.94
Longevity	♂	167.6±13.51	74.8 ±15.8	45.4 ±2.72	154.1±3.09	103.5±15.55	86.6±5.00	96.4 ±5.97	22.6 ±2.78	25.4 ±2.70	33.8 ±1.15	81.1±8.81	26.7±3.60
	♀	578.9±46.12	285.4±37.44	144.6±10.50	598.0±4.45	420.9±60.98	243.1±20.1	364.1±4.88	295.9±13.37	166.7±2.90	151.4±9.16	213.6±15.37	91.0±14.80
Life span	♂	188.8±13.12	90.6±16.19	57.3 ±0.80	166.0±3.11	123.7±16.79	95.4 ±1.50	107.0±9.94	36.6 ±3.27	28.6 ±2.7	51.0 ±1.81	90.0 ±8.58	31.7 ±3.5
	♀	610.4±47.40	302.5±38.93	160.2±10.80	613.7±3.85	448.2±62.1	259.9±20.4	379.6±4.92	315.5±12.96	170.8±2.9	178.0±2.25	242.6±16.36	98.9 ±15.3

Table (4): Food consumption of *Neoseiulus cucumeris* on *Tetranychus urticae* immatures, *Aphis gossypii* and *Thrips tabaci* during its life span at 30 °C.

Predator Stage	Sex	No. of devoured prey individuals		
		Tetranychus urticae	*Aphis gossypii*	*Thrips tabaci*
Protonymph	♂	3.5 ± 0.92	1.2 ± 0.40	3.8 ± 0.40
	♀	5.1 ± 0.90	10.0 ± 0.63	8.2 ± 0.40
Deutonymph	♂	10.5 ± 1.43	1.8 ± 0.40	4.2 ± 0.40
	♀	14.4 ± 1.56	6.0 ± 0.63	8.3 ± 0.45
Total immatures	♂	14.0 ± 1.73	3.0 ± 0.63	8.0 ± 0.63
	♀	19.6 ± 1.96	12.0 ± 0.44	16.5 ± 0.67
Oviposition		231.0 ± 12.72	38.5 ± 2.15	97.4 ± 2.76
Longevity	♂	22.6 ± 2.78	17.3 ± 1.45	42.6 ± 2.30