SUITABILITY OF THE CITRUS BROWN MITE, *EUTETRANYCHUS ORIENTALIS* AS PREY FOR NINE SPECIES OF PHYTOSEIID MITES (ACARI: TETRANYCHIDAE, PHYTOSEIIDAE)

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PREDATION
PHYTOSEIIDAE
EUTETRANYCHA ORIENTALIS
BIOLOGICAL PEST CONTROL

SUMMARY: Nine phytoseiid species were tested to evaluate their potential as predators of *Eutetranychus orientalis* (Klein). *Typhlodromus athiasae* Porath & Swirski, *Amblyseius barkeri* (Hughes) and *A. olivi* Nasr and Abou-Awad had a shorter developmental period than *T. transvaalensis* (Nesbitt). *T. athiasae* and *A. barkeri* showed the highest oviposition rates. *A. olivi* showed a low rate of oviposition although *T. transvaalensis* has not able to lay any eggs. Immatures survival of *T. talbii* Athias-Henriot, *T. balanites* El-Badry, *Amblyseius badryi* Yousef and El-Borolossy, *A. cabonus* (Schicha) and *A. lindquisti* Schuster and Pritchard were very low on *E. orientalis* and all failed to develop to adulthood.

PREDATION
PHYTOSEIIDAE
EUTETRANYCHA ORIENTALIS
CONTROLE BIOLOGIQUE

RÉSUMÉ : La prédation par espèces de Phytoseiidae sur *Eutetranychus orientalis* (Klein) est évaluée. *Typhlodromus athiasae* Porath & Swirski, *Amblyseius barkeri* (Hughes) et *A. olivi* Nasr & Abou-Awad ont un développement plus rapide que *T. transvaalensis* (Nesbitt). *T. athiasae* et *A. barkeri* montrent le meilleur taux de production d'œufs et *A. olivi* présente le plus bas, alors que *T. transvaalensis* ne produit aucun œuf. Le taux de survie des immatures de *T. talbii* Athias-Henriot, *T. balanites* El-Badry, *Amblyseius badryi* Yousef & El-Borolossy, *A. cabonus* (Schicha) et *A. lindquisti* Schuster & Pritchard est très bas sur *E. orientalis* et aucun n'atteint le stade adulte.

INTRODUCTION

Members of the genus *Eutetranychus* (Banks) feed primarily on trees and shrubs and some species are considered major economic pests. *E. orientalis* (Klein) is primarily a pest of citrus, other hosts include cotton, squash and grapevines. Predatory mites of the family Phytoseiidae are important biological control agents of tetranychid and eriophyid mites in a number of Egyptian cropping systems (EL-BANHAWY, 1974, ABOU-AWAD, 1983, ABOU-AWAD & EL-BANHAWY, 1986, ABOU-AWAD *et al.*, 1989 and MOMEN & EL-SAWAY, 1993). Some phytoseiids are generalized predators, i.e. they consume a wide range of food such as mites, scale crawlers (SWIRSKI *et al.*, 1967), pollen, honeydew and mildew (CHANT & FLESCHNER, 1960). A few of the phytoseiids are "specialized" predators feeding only on tetranychid mites (CHANT, 1961, FLAHERTY, 1967 and MORI & CHANT, 1966). CHESSON (1978) reviews the various attempts to quantify selective predation,

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which is defined as the situation in which relative frequencies of prey types in a predator's diet differ from the relative frequencies with which they are encountered in the environment. The present study was designed to determine the ability of some species of phytoseiid mites to develop and reproduce when offered *E. orientalis* as prey in the laboratory.

Materials and Methods

The suitability of the citrus brown mite, *E. orientalis*, as a food source was tested for 9 species of Phytoseiidae. *Amblyseius barkeri* (Hughes), the common phytoseiid found on cucumber, *Typhlodromus athiasae* Parath & Swirski, *T. talbii* Athias-Henriot and *T. transvaalensis* were collected from heavily infested mango leaves. *T. balanites* was obtained from the plant *Pluchea dioscoridis* (L.), *A. olivi* Nasr & Abou-Awad was found on leaves of olive trees; *A. badryi* and *A. lindquisti* Schuster & Pritchard were collected from debris under banana trees, while *A. cabonus* (Schicha) was found in soil associated with roots of *Pelargonium graveolens* Ait.

Adult females of *T. athiasae* and *A. barkeri* were taken from stock colonies maintained on larvae and nymphs of *Tetranychus urticae* Koch as prey in the laboratory of the N.R.C., Cairo. The laboratory colonies of *A. olivi*, *T. balanites*, *A. badryi*, *T. transvaalensis* and *A. lindquisti* were fed *Eriophyes dioscoridis* Soliman and Abou-Awad. Females of *T. talbii* and *A. cabonus* were fed on *Tydeus californicus* (Banks) in the laboratory.

Gravid female predators were taken at random from the colonies and transferred to rearing substrates. Females were left 24 hours and their oviposited eggs were used for different biological tests. Leaf discs of raspberry leaves, 3 cm in diameter, were used as rearing arenas. The discs were placed in Petri dishes, upper surface downwards, on water-saturated cotton. Eggs of each predator were transferred singly to the rearing discs, and the newly hatched larvae were supplied with sufficient known numbers of nymphs of *E. orientalis*, obtained from infested citrus leaves. Replacement of the prey was came out daily and records of development, food consumption and reproduction were recorded twice a day.

All the experiments reported herein were carried out under laboratory condition of 27 ± 2° C and 70–75% R.H.

Results and Discussion

Individuals of *A. barkeri*, *T. athiasae*, *A. olivi* and *T. transvaalensis* successfully developed from larva to adult when fed on the tetranychid mite *E. orientalis*. In contast, development was not completed in *A. badryi*, *A. cabonus*, *A. lindquisti*, *T. balanites* and *T. talbii* (Table 1). The total development period was longer in *T. transvaalensis* compared to *A. barkeri*, *T. athiasae* and *A. olivi* (significant at 1% level). *A. barkeri* and *T. athiasae* had the highest percentage of individuals reaching maturity on *E. orientalis* (Table 1).

Predator species	Egg	Larva	Protonymph	Deutonymph	Total	% reaching maturity
A. barkeri	2.0 ± 0.0	1.0 ± 0.0 a	1.85 ± 0.1 a	1.46 ± 0.14 a	6.31 ± 0.17 a	100
T. athiasae	2.00 ± 0.00	1.00 ± 0.00 a	1.79 ± 0.11 a	2.29 ± 0.13 b	7.07 ± 0.13 b	100
A. olivi	1.90 ± 0.14	1.0 ± 0.0 a	1.92 ± 0.14 a	2.08 ± 0.14 b	6.92 ± 0.29 ab	84
T. transvaalensis	2.0 ± 0.0	1.62 ± 0.0 b	3.08 ± 0.08 b	3.77 ± 0.17 c	10.46 ± 0.29 c	70
T. talbii	2.0 ± 0.0	1.0 ± 0.0 a				
T. balanites	2.0 ± 0.0	1.0 ± 0.0 a				
A. badryi	2.1 ± 0.0	1.0 ± 0.0 a				
A. cabonus	2.0 ± 0.0	1.0 ± 0.0 a				
A. lindquisti	2.0 ± 0.0	1.00 ± 0.0 a				

Table 1: Development of nine species of Phytoseiidae on *Eutetranychus orientalis* (nymph) as a food source at 27° C (N = 13 individuals). Mean developmental time in days ± S.E. Different letters in a vertical column denote significant difference (F-test P<0.01).

Predator species	Larva	Protonymph	Deutonymph	Adult females
A. barkeri	0.31 ± 0.13 a	8.31 ± 0.75 a	9.69 ± 1.24 a	8.62 ± 0.42 b
T. athiasae	0.57 ± 0.14 a	5.64 ± 0.49 b	9.14 ± 0.56 a	13.84 ± 1.80 a
A. olivi	2.15 ± 0.15 b	9.23 ± 0.46 a	10.54 ± 1.14 a	6.01 ± 0.27 b
T. transvaalensis	0.27 ± 0.12 a	6.53 ± 0.31 b	7.27 ± 0.48 a	7.34 ± 0.40 b

TABLE 2: Consumption rate per day of four species of Phytoseiidae on *E. orientalis* at 27° C (N = 13 individuals). Different letters in a vertical column denote significant difference (F-test: P<0.01).

Both *A. olivi* and *A. barkeri* have been reported to feed in the larval stage (ABOU-AWAD & EL-BANHAWY, 1986; MOMEN, 1995). The larvae of *T. athiasae* and *T. transvaalensis* were feeding instars, consuming an average of 0.57 and 0.27 tetranychid mite per day (Table 2). Individuals of *T. talbii*, *A. badryi*, *A. cabonus*, *T. balanites* and *A. lindquisti* moult to the protonymphal stage without feeding. Some individuals of certain phytoseiid mite species may moult to the protonymphal stage without feeding (BURNETT, 1971; AMANO & CHANT, 1977; SABELIS, 1981).

The consumption rate increased through the developmental stages respectively. Adult female of *T. athiasae* consumed higher number of nymphs of *E. orientalis* than did *A. barkeri*, *A. olivi* and *T. transvaalensis* (significant at 1% level) (Table 2). The relatively low consumption rates recorded in this study when *A. barkeri* and *A. olivi* were provided with *E. orientalis* as prey suggest that effectiveness at low prey densities may be the key to the apparent success of the two predators as a controlling agent of *E. orientalis*.

Predator species	Preoviposition	Oviposition	Adult	Lifespan
A. barkeri	1.85 ± 0.10 a	24.46 ± 0.70 a	38.08 ± 1.03 a	44.38 ± 1.03 a
T. athiasae	1.93 ± 0.16 a	18.43 ± 1.53 b	22.93 ± 1.58 b	30.00 ± 1.59 b
A. olivi	1.77 ± 0.12 a	16.23 ± 0.75 b	30.85 ± 0.89 c	37.62 ± 0.97 c
T. transvaalensis	0.0 b	0.0 c	42.69 ± 1.75 d	53.15 ± 1.84 d

TABLE 3: Average duration (in days) of various stages of the adult females of 4 species of Phytoseiidae at 27° C (N = 13 individuals). Different letters in a vertical column denote significant difference (F-test: P<0.01).

The preoviposition period was almost the same with the three phytoseiids (Table 3). Oviposition period likewise was shorter in *T. athiasae* and *A. olivi* than in *A. barkeri*. *T. transvaalensis* had a long adult period without reproductive activity and this implies that *T. transvaalensis* females may require nutrients other than *E. orientalis* to develop their eggs. *T. athiasae* had an adult longevity shorter than other phytoseiids (Table 3).

The highest rate of oviposition was recorded in *A. barkeri* and *T. athiasae* (Table 4). In the present study, *A. olivi* showed a low rate of oviposition suggesting that the host plant may have negatively affected the performance of the predator.

The total number of eggs laid per female by *A. barkeri* and *T. athiasae* seems to be in the high or medium range, respectively, when compared with those obtained for other phytoseiid species and *E. orientalis* as prey (SWIRSKI & DORZIA, 1968, 1969; METWALLY *et al.*, 1984; ABOU-AWAD *et al.*, 1989; EL-BAGOURY *et al.*, 1989; SHIH *et al.*, 1993).

Predator species	Total no. eggs oviposited	Average no. eggs oviposited/female/day during oviposition period
A. barkeri	58.0 ± 1.5	2.40 ± 0.11 a
T. athiasae	41.86 ± 2.82	2.48 ± 0.33 a
A. olivi	17.85 ± 0.9*1*	1.12 ± 0.07 b
T. transvaalensis	0.00 d	0.00 d

TABLE 4: Fecundity of four species of Phytoseiidae on *E. orientalis* as a food source at 27° C (N =13 individuals). Different letters in vertical column denote significant difference (F-test: P<0.01).

A high reproduction rate also was recorded with *E. orientalis* as prey for *A. largoensis* Muma, and *A. gossipi* El-Badry (KAMBUROV, 1971; YOUSEF & EL-HALAWANY, 1982). Only a few species considered in the highest fecundity range, such as *A. bibens* Blommers or the genus *Phyloseiulus* Evans, produce more than 50 eggs per female (MacMurtry *et al.*, 1970; Blommers, 1976).

In the present study, *E. orientalis* did not provide suitable food for development to be completed or for egg laying in *T. talbii*, *T. balanites*, *A. badri*, *A. cabonus* and *A. lindquisti*. El-Bagoury & Momen (1989) obtained an oviposition rate of 0.9 eggs/ female of *T. balanites* per day on the eriophyid mite, *E. dioscoridis*. *T. talbii* has been reported by Aly (1994) to develop and reproduce when fed on the tydeid mite *T. californicus* (Banks). Although detailed studies were not made, females of *A. badryi*, *A. lindquisti* and *A. cabonus* were also observed in the laboratory feeding on other animal prey such as the eriophyid mite, *E. olivi* Zaher & Abou-Awad, scale insect crawlers, and tydeid mites. The potential of these foods should be investigated further. The present study suggests that the predators *A. badryi*, *A. lindquisti*, *A. cabonus*, *T. balanites* and *T. talbii* are not closely associated with tetranychid mites. The reason for the unsuitability of *E. orientalis* for the phytoseiid predators tested is not known, but it might be attributed to the morpho-physiological characteristics (e.g. resistance of prey cuticle or ultrastructure) or it could be that *E. orientalis* is physiologically unsuitable as prey for the predators studied. Considerable work remains to be done to fully evaluate the effectiveness and control potential of the phytoseiid predators tested.

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