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COMPARISON OF *TETRANYCHUS EVANSI* AND *T. URTICAE* [*ACARI : TETRANYCHIDAE*] AS PREY FOR EIGHT SPECIES OF PHYTOSEIID MITES

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Eight phytoseiid species were tested to evaluate and compare their potential as predators of *Tetranychus evansi* Baker & Pritchard and *T. urticae* (Koch). The study was conducted using arenas of excised nightshade (*Solanum douglasii* Dunal) and Lima bean (*Phaseolus vulgaris* L.) leaves infested with either *Tetranychus* species. When the prey was *T. evansi*, the predators *Amblyseius californicus* (McGregor) and *Phytoseiulus persimilis* Athias-Henriot from Ventura, California, showed the highest oviposition rates. However, those rates were 4 to 6 times lower than rates for the same predators feeding on *T. urticae*. Only *A. californicus* and the strain of *P. persimilis* from Beni-Mellal, Morocco, had survivorship higher than 50 % 8 days after the beginning of the experiment. The results indicated that *T. evansi* is an unfavorable prey for all the phytoseiids tested.

KEY WORDS : Phytoseiidae, Tetranychidae, *Amblyseius*, *Phytoseiulus*, *Phytoseius*, *Tetranychus*, *Typhlodromus*.

The spider mite *Tetranychus evansi* Baker & Pritchard causes considerable damage to tomato in northeastern Brazil (**Ramalho & Flechtmann,** 1979), to tobacco in Zimbabwe (**Blair,** pers. comm.) and to domestic plantings of eggplant in southern California, USA. This species also occurs in Florida (**Denmark,** 1973) and Texas, USA (**Qureshi** *et al.*, 1969), Puerto Rico (**Medina Gaud & Garcia Tuduri,** 1977), and several islands in the Indian Ocean (**Gutierrez,** 1974 and pers. commun.).

Only a few species of natural enemies have been reported associated with *T. evansi*. Among these are the phytoseiids : *Amblyseius caudatus* Berlese in Mauritius Island (**Moutia,** 1958), and several species in Brazil, including *Amblyseius idaeus* (Denmark & Muma), *Euseius citrifolius* Denmark & Muma, *Euseius sibelius* (DeLeon), *Phytoseius quianensis* DeLeon and *Phytoseius pernambucanus* Moraes & McMurtry (**Moraes & McMurtry,** 1983). The effect of these phytoseiids on populations of *T. evansi* is unknown.

The objective of this study was to evaluate and compare the oviposition rates and survivorship of 8 species of phytoseiid mites when offered *T. evansi* and the 2-spotted spider mite, *T. urticae* (Koch) as prey. The latter species is a suitable prey for some of the predators tested (**Ashihara** *et al.*, 1978 ; **McMurtry** *et al.*, 1970 ; **Sabelis,** 1981).

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METHODS AND MATERIALS

The experiment was conducted in a laboratory at 25 ± 1° C, 40 ± 10 % RH and 12/12-h light/dark periods.

Except for 1 population of *Typhlodromus occidentalis* Nesbitt, the predators were taken from stock colonies maintained on eggs and larvae of *Tetranychus pacificus* McGregor as prey in the insectary of the University of California, Riverside (UCR). The laboratory colony of *T. occidentalis* was also fed pollen of iceplant (*Maleophora crocea* (Jacquin) Schwantes). One population of *T. occidentalis* recently collected from nightshade plants (*Solanum douglasii* Dunal) on the UCR campus was also used in this study. The prey species *T. evansi* was also collected from nightshade on the same campus ; whereas *T. urticae* was obtained from a stock colony maintained on Lima bean (*Phaseolus vulgaris* L.) plants in the laboratory of UCR.

Gravid female predators were taken at random from the colonies and isolated in arenas kept on foam mats in stainless steel pans with water. Each arena consisted of a 10 to 20 square cm nightshade leaf whose borders were covered by a 1 cm-wide strip of Cellucotton to avoid leaf dehydration and to prevent the mites from escaping. Three days before introducing the predators, the arenas were infested with 20 adult females of either *T. evansi* or *T. urticae*. Consequently, when the predators were added, eggs, larvae and adult females of the tetranychids were immediately available as food. Every 3-4 days, the predators were transferred to new arenas.

The numbers of eggs laid and live predators were counted daily for 11 days. The eggs of the predators were removed daily from the arenas. The egg count of the 1st day was not considered in calculating the oviposition rate because of the effect of previous feeding on oviposition.

RESULTS

The oviposition rates of the phytoseiids tested are presented in table 1. The rates were always much lower when the prey was *T. evansi*. On this prey, *Amblyseius californicus* (McGregor) and *Phytoseiulus persimilis* Athias-Henriot collected from strawberry plants in Ventura, California, USA (originally obtained from a Chilean stock cultured in West Germany) laid the most eggs. However, those rates were 4 to 6 times lower than rates for the same predators on *T. urticae*. *Phytoseiulus longipes* Evans, *P. macropilis* (Banks) and populations of *P. persimilis* collected in Agadir and Beni-Mellal, Morocco, had lower rates of oviposition on *T. evansi* than either *A. californicus* or the Ventura strain of *P. persimilis*. The predators *Phytoseius hawaiiensis* Prasad, *Typhlodromus annectens* (DeLeon), *T. occidentalis* Nesbitt and *T. porresi* McMurtry laid few eggs during the 11-day tests when fed *T. evansi*.

Both *T. annectens*, *T. porresi* and, surprisingly, *T. occidentalis* showed a low rate of oviposition when fed *T. urticae*. The low rate of *T. occidentalis* on a prey species known to be favorable suggested that the host plant negatively affected the performance of the predator. Therefore, a feeding test was conducted with *T. occidentalis* and *P. macropilis*, using bean instead of nightshade leaves. The results (table 1) indicated that this change in host plant did not result in high oviposition rates, although the rate of *T. occidentalis* was more than doubled. Because of the highly variable oviposition rates of *T. occidentalis*, no conclusion could be made regarding the effect of the host plant. However, a brief test conducted in arenas of nightshade leaves infested with the tomato russet mite, *Aculops lycopersici* (Massee), resulted in an oviposition rate of 1.5 ± 1.5 eggs per female per day (28 replicates). These results did not support the hypothesis of a negative effect of the host plant on the predator, although different prey species may differently utilize secondary plant compounds for their own protection.

TABLE 1

Oviposition rates and survivorship of different phytoseiid predators fed eggs, larvae and adult females of T. evansi *and* T. urticae. *Unless otherwise indicated, the host plant was nightshade*

Predator	Oviposition[a] (eggs/ ♀ /day) ± S.D.				Survivorship (%)					
	N[b]	*T. evansi*	N	*T. urticae*	*T. evansi*			*T. urticae*		
					4[e]	8	11	4	8	11
A. californicus	12	0.5 ± 0.5i	11	2.0 ± 0.7j	91.7	66.7	50.0	100.0	90.9	90.9
P. longipes	12	0.1 ± 0.1i	10	2.7 ± 0.9j	91.7	41.7	8.3	100.0	90.0	90.0
P. macropilis	15	0.1 ± 0.1i	17	2.7 ± 1.6j	66.7	26.7	13.3	82.4	70.6	70.6
P. macropilis[d]	–	–	10	2.8 – 1.2	–	–	–	100.0	80.0	80.0
P. persimilis[e]	22	0.4 ± 0.5i	10	2.6 ± 0.7j	72.7	31.8	13.6	100.0	100.0	90.0
P. persimilis[f]	15	0.3 ± 0.2i	15	1.8 ± 0.7j	80.0	53.3	26.7	86.7	80.0	66.7
P. persimilis[g]	52	0.7 ± 0.9i	10	4.3 ± 0.9j	61.5	32.7	25.0	100.0	100.0	100.0
P. hawaiiensis	14	0.01 ± 0.04	–	–	64.3	0.0	0.0	–	–	–
T. annectens	13	0.02 ± 0.04i	14	0.5 ± 0.3j	53.8	0.0	0.0	78.6	71.4	71.4
T. occidentalis	14	0.04 ± 0.1i	39	0.3 ± 0.3j	92.9	0.0	0.0	92.3	43.6	7.7
T. occidentalis[d]	–	–	30	0.7 ± 0.7	–	–	–	66.7	46.7	43.0
T. occidentalis[h]	16	0.00 ± 0.02	–	–	12.5	0.0	0.0	–	–	–
T. porresi	27	0.01 ± 0.04i	13	0.1 ± 0.3j	74.1	0.0	0.0	92.3	7.7	0.0

[a] Oviposition rates followed horizontally by the same letters are not significantly different at 5 % level-t Test ; [b] number of replicates ; [c] days after beginning of the test ; [d] prey feeding on bean leaves ; [e] strain from Agadir, Morocco ; [f] strain from Beni-Mellal, Morocco ; [g] strain from Ventura, California ; [h] predators recently collected from the field.

The phytoseiids also showed lower survivorship when fed *T. evansi* than *T. urticae* (table 1). On the former prey species, only *A. californicus* and the Beni-Mellal strain of *P. persimilis* had survivorship higher than 50 % 8 days after the experiment began. During that same period, all individuals of *Phytoseius* and *Typhlodromus* died. With *T. urticae* as prey, more than 70 % of the predators were alive at the end of the experiment, except for *T. occidentalis* and *porresi*. The former predator had a survivorship of only ca. 8 % when *T. urticae* was on nightshade, and 43 % when it was on bean. Only 1 of 13 individuals of *T. porresi* was alive 8 days after the experiment began, and it died before the 11th day. In the test of *A. lycopersici* as prey, 68 % of *T. occidentalis* were alive at the end of the experiment.

On both prey species, most dead female predators were found in the arenas. However, many dead *P. persimilis* were in the water barrier.

DISCUSSION

The oviposition rates obtained using *T. urticae* as prey were similar to those previously reported for *A. californicus* (**Friese & Gilstrap,** 1982 ; **McMurtry,** 1977) and *P. longipes* (**Badii & McMurtry,** 1984). The Ventura population of *P. persimilis* showed an oviposition rate similar to rates reported by **Ashihara** *et al.* (1978), **Friese & Gilstrap** (1982) and **Sabelis** (1981). The rates of the Agadir and Beni-Mellal populations of *P. persimilis* were much lower than that of the Ventura population, but similar to the rates reported by **Amano & Chant** (1977) and **Badii & McMurtry** (1984). These results suggested either that the Morocco populations are less adapted to feeding on *T. urticae* or that they really have a lower reproductive capacity.

Sanderson & McMurtry (1984) studied the oviposition rates of *P. hawaiiensis* on several prey species. They obtained a rate of 0.68 eggs per female per day on all combined stages of *T. pacificus*, but significantly lower rates on eggs or eggs plus larvae of the same prey.

The species *T. annectens* and *T. porresi* laid considerably fewer eggs per day than reported by **McMurtry** *et al.* (1984). The rate of oviposition of *T. occidentalis* on *T. urticae* was lower than the rates reported in the literature (**Badii & McMurtry,** 1984 ; **Chant,** 1961 ; **Laing,** 1969 ; **Sabelis,** 1981 ; **Friese & Gilstrap,** 1982 ; **McMurtry** *et al.*, 1984). The different results obtained by those authors are probably due to the different species of *Tetranychus* or prey stages offered to the predator.

The higher rate of oviposition and survivorship of *T. occidentalis* on *A. lycopersici* than on both tetranychid prey agree with the results of **Burrell & McCormick** (1964). Those authors obtained oviposition rates of 1.3 and 0.7 eggs per female *T. occidentalis* per day on the eriophyid *Aculus schlechtendali* (Nalepa) and on unspecified tetranychids, respectively. The survivorship of immatures of *T. occidentalis* was also much higher on *A. schlechtendali* than on species of tetranychids.

The low rates of oviposition and survivorship of all 8 phytoseiids fed *T. evansi* indicated that this spider mite is an unfavorable prey. Species such as *P. persimilis* and *T. occidentalis* are commonly associated with spider mites that web profusely (**McMurtry** *et al.*, 1970), and thus were expected to be favored by *T. evansi*, which also produces abundant webbing. **Moraes & McMurtry** (unpublished) reported that *P. persimilis* aggregated on filter paper discs treated with extracts of *T. evansi* webbing plus excreta. The results of the present study indicate that the webbing *per se* does not determine the acceptance of a spider mite as prey for a phytoseiid. However, webbing may be an important factor influencing the initial steps of the chain of events in the food selection process.

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RÉSUMÉ

Comparaison de *Tetranychus evansi* et *Tetranychus urticae* [*Acari. : Tetranychidae*] en tant que proies pour huit espèces d'acariens phytoseiids

Huit espèces d'Acariens phytoseiides étaient testées en vue de comparer leurs potentialités prédatrices vis-à-vis de *Tetranychus evansi* Baker & Pritchard et de *Tetranychus urticae* (Koch). L'étude était réalisée sur des feuilles détachées de *Solanum douglasii* Dunal et de *Phaseolus vulgaris* L. Les feuilles avaient été infestées avec l'une ou l'autre des espèces de *Tetranychus*. *Amblyseius californicus* (McGregor) et *Phytoseiulus persimilis* Athias-Henriot, de Ventura, ont donné les taux d'oviposition les plus élevés avec *T. evansi*, mais ces taux étaient 4 à 6 fois inférieurs à ceux obtenus lorsque la proie était *T. urticae*. Seuls *A. californicus* et la souche de *P. persimilis* de Beni-Mellal avaient une survie supérieure à 50 %, 8 jours après le début du test. Les résultats indiquent que *T. evansi* n'est pas une proie favorable pour toutes les espèces testées.

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