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# PHYSIOLOGICAL EFFECT OF THE HOST PLANT ON THE SUITABILITY OF *TETRANYCHUS URTICAE* AS PREY FOR *PHYTOSEIULUS PERSIMILIS* [*ACARI : TETRANYCHIDAE, PHYTOSEIIDAE*]

G. J. de MORAES[1] & J. A. McMURTRY

Division of Biological Control, Department of Entomology,
University of California, Riverside 92521, USA

Weight gain of adult females *Phytoseiulus persimilis* Athias-Henriot was determined after they were fed eggs or adult females of *Tetranychus urticae* Koch reared on either Lima bean (*Phaseolus vulgaris* L.) or nightshade (*Solanum douglasii* Dunal). No significant difference was found when the predator was fed eggs of *T. urticae* reared on either host. Predators were heavier when fed adult female *T. urticae* reared on bean. Apparently, a factor determining the prey's suitability is incorporated into its hemolymph or tissues and is not restricted to its gut content.

KEY-WORDS : *Tetranychus evansi, Tetranychus urticae, Phytoseiulus persimilis, Tetranychidae, Phytoseiidae.*

The effectiveness of natural enemies of arthropods can be directly influenced by morphological characteristics of the host plant or secondary plant compounds (**Vinson,** 1976). Plants may also affect natural enemies of arthropods through induced physiological modifications of the host or prey which render them either more or less suitable for parasitism or predation. **Gilmore** (1938) reported the unsuitability of *Protoparce sexta* (Johan.) (*Manduca sexta* L.) for *Apanteles congregatus* (Say) if the host had been reared on dark-fired tobacco. **Flanders** (1942) reported unsuccessful parasitism by the chalcidoids *Habrolepis rouxi* Compere and the Chinese strain of *Comperiella bifasciata* Howard when the prey, *Aonidiella aurantii* (Maskell), was on *Cycas revoluta* Thumb. Parasitization was successful when the same host was on citrus. He attributed the unsuccessful parasitism to the unsuitability of the host, which could not derive enough nutrition from *C. revoluta*. **Simmonds** (1944) reported 2 to 3 times more parasitism of *A. aurantii* by *C. bifasciata* when the host was reared on oranges than on lemons. **Hodek** (1973) reported several examples of the change in suitability of prey species to coccinellid predators, depending on the host plants on which the prey developed.

[1] Present address : CPATSA/EMBRAPA, 56300 - Petrolina, PE, Brazil.

The physiological unsuitability of the spider mite *Tetranychus evansi* Baker & Pritchard for the predaceous phytoseiid *Phytoseiulus persimilis* Athias-Henriot was reported by **Moraes & McMurtry** (1986). That unsuitability could conceivably be conferred to the prey by the host plant, *Solanum douglasii* Dunal (nightshade). The objective of this study was a preliminary evaluation of the indirect effect of that host on *P. persimilis* through the spider mite *Tetranychus urticae* Koch cultured on 2 host plants.

## METHODS AND MATERIALS

*P. persimilis* was obtained from a stock colony fed eggs and larvae of *Tetranychus pacificus* McGregor reared on Lima bean (*Phaseolus vulgaris* L.) plants. *T. urticae* was obtained from stock colonies maintained on Lima bean plants for ca. 1 year or on excised nightshade leaves for ca. 6 months. In some treatments, prey females were starved for 24 h before initiating the test. In others, prey females were changed from nightshade to bean and vice-versa where they remained for 24 h before starting the test.

The predators were fed either eggs or adults of *T. urticae*. To eliminate production of webbing and to permit using arenas of bean leaves for prey obtained from both plants, prey adults were immobilized by holding them at a temperature of − 15° C for 24 h before initiating the test. Gravid *P. persimilis* were starved for 24 h and then transferred in pairs to each of 5 bean leaf arenas (4 × 4 cm) per treatment, prepared as described by **Moares & McMurtry** (1985a). Each arena contained a 0.5 × 1.5 cm piece of black paper under which the predators could rest, and either 60 eggs or 30 adult female *T. urticae* scattered randomly. Those numbers represented ample supply of prey, as many of them were still available at the end of the test. The control treatment consisted of a group of 10 predators which remained unfed after the 24 h starvation period in a ca. 30 square cm bean leaf arena. The tests lasted 5 h, after which the predators were weighed in groups of 8 individuals in a Cahn electrobalance. If more than 8 individuals were still present in the arenas, they were weighed and the weight was then converted to micrograms per 8 individuals (which was the smallest number of predators remaining at the end of the test for any treatment). The tests were conducted in a laboratory at 25 ± 1° C and 40 + 10 % RH and repeated 5 times.

## RESULTS AND DISCUSSION

There was no significant difference in weight gain of predators fed eggs of *T. urticae* reared on bean or nightshade (table 1), but unfed predators were significantly lighter. Predators fed adult females of *T. urticae* reared on bean were significantly heavier than those fed *T. urticae* reared on nightshade. However, predators fed both kinds of prey were significantly heavier than the control (unfed), indicating that feeding by the predator on prey from nightshade was depressed but not deterred.

Being a non-feeding stage, the prey eggs do not contain raw material immediately acquired from the host plant, as opposed to the adult stage. Thus, the different effects of the host plants according to the prey stages suggested that a feeding depressant was restricted to the gut of the adult prey cultured on nightshade. To test this hypothesis, prey previously starved before initiating the test or changed from 1 host plant to another were offered to different groups of predators. When the adult female prey were starved for 24 h, there was no significant difference between weights of predators associated with *T. urticae* reared on nightshade and unfed predators. Changing the prey from bean to nightshade and vice-versa resulted in comparable weight gains of the predators on both hosts, both groups of predators being significantly heavier than the unfed predators. However, the weight gain of the 2 groups of predators was intermediate between predators that fed on prey reared on bean and those that fed on prey reared on nightshade without starvation.

TABLE 1

*Average weight (µg) of groups of 8 adult females of* Phytoseiulus persimilis *when unfed or associated for 5 h with egg or adult stages of* Tetranychus urticae *reared on 2 hosts. Tests repeated 5 times. The predators were starved for 24 h before the test began*

| Prey stage | Unfed | Host plant | |
|---|---|---|---|
| | | Bean | Nightshade |
| Egg | 87 ± 9 a | 138 ± 10 b | 141 ± 11 b |
| Adult female | 82 ± 6 a | 144 ± 11 b | 103 ± 4 c |
| Adult female[A] | 82 ± 5 a | 128 ± 11 b | 81 ± 5 a |
| Adult female | 89 ± 2 a | 116 ± 13[B] b | 121 ± 8[C] b |

In a same row, averages followed by different letters are significantly different at 5 % level (t-Tests). (A) Prey starved for 24 h before the test started ; (B) Prey kept on bean leaves for 24 h. Previous feeding on nightshade ; (C) Prey kept on nightshade for 24 h. Previous feeding on bean.

The factors affecting the suitability to the predator is apparently incorporated into the hemolymph or tissues of the prey rather than being confined to the gut ; otherwise, the difference detected in weight gain when the prey reared on bean was starved for 24 h should not be as pronounced. Similarly, predators fed *T. urticae* kept on nightshade leaves for 24 h should also have gained less weight than those fed *T. urticae* kept on bean for 24 h. Specific storage sites of sequestered plant compounds are largely unknown in insects (**Blum,** 1981) and mites. **Nishio & Blum** (unpublished *in* **Blum,** 1981) provided the 1st detailed study on this aspect, determining the higher concentrations of sequestered cardenolide compounds in the hemolymph and wing scales of the monarch butterfly. Rapid incorporation and elimination of secondary plant compounds can occur. **Hikino** *et al.* (1975) showed that ecdysterone (exogenous phytoecdysone moulting hormone) was excreted by the silkworm, *Bombyx mori* L. faster than it was absorbed, but excretion and absorption were considerable within 15 mn.

Several possible reasons for the difference in suitability of the adult prey can be suggested : a) the acquisition or synthesis of compounds by *T. urticae* cultured on bean leaves that would act as feeding stimulants or attractants to *P. persimilis* ; b) the acquisition or synthesis of compounds by *T. urticae* cultured on nightshade leaves that would act as feeding depressants or repellants for *P. persimilis* ; c) the unsuitability of nightshade to the prey, rendering the prey less physiologically suitable for the predator. Based on a short test, it was suggested by **Moraes & McMurtry** (1985a) that nightshade is not as favorable for *T. urticae* as bean, because it had a much lower oviposition rate on nightshade.

It should be remembered that the predators used in this work were taken from a stock colony fed prey (*T. pacificus*) reared on bean plants. Had they been fed the same prey reared on nightshade, a different result could have been obtained.

The factors affecting the suitability is apparently not transmitted trans-ovarially, as predators feeding on eggs obtained on both host plants had the same weight gain. Some insects have been reported to have sequestered compounds in all developmental stages, including the eggs, whereas others are reported to have sequestered compounds only in developmental stages other than eggs (**Blum,** 1981). **Sabelis** (1981) studied the rate of successful attack of all stages of *T. urticae* by *P. persimilis* at different levels of food deprivation. The success ratio was higher on prey eggs than on adults, especially when the food content of the gut of

*P. persimilis* was between 50 and 80 % of the total capacity. Based on the results of the present study, this behavior should favor *P. persimilis* on nightshade plants, as the predator could escape the feeding depressant effect when consuming eggs. Under natural conditions, *P. persimilis* could apparently still oviposit and develop normally on *T. urticae* feeding on nightshade, when all stages of the prey occur on the plants. As shown by **Moraes & McMurtry** (in press 2), *P. persimilis* fed eggs, larvae and adult females of *T. urticae*, collected from bean and maintained on nightshade leaves for 3-4 days, showed an oviposition rate of 4.3 ± 0.9 eggs per female per day. That result is similar to the rate reported by **Ashihara** *et al.* (1978) for *P. persimilis* fed eggs of *T. urticae* reared on bean.


## RÉSUMÉ

Influence physiologique de la plante hôte sur la consommation de *Tetranychus urticae* par *Phytoseiulus persimilis* [Acariens : *Tetranychidae, Phytoseiidae*]

L'accroissement de poids des femelles adultes de *Phytoseiulus persimilis* Athias-Henriot a été déterminé après qu'elles aient été nourries avec des œufs ou avec des femelles adultes de *Tetranychus urticae* Koch élevé sur haricot de Lima (*Phaseolus vulgaris* L.) ou sur *Solanum douglasii* Dunal. Il n'y a pas de différence significative entre ces accroissements lorsque le prédateur est nourri avec des œufs de *T. urticae* déposés sur l'une ou l'autre des 2 espèces végétales. Le gain de poids du prédateur est plus élevé quand ce dernier est nourri avec des femelles de *T. urticae* élevées sur haricot de Lima. Apparemment, un facteur déterminant favorable se retrouve dans l'hémolymphe de la proie ou de ses tissus, et n'est pas seulement localisé dans le contenu de son tractus digestif.


MOTS CLEFS : *Tetranychus evansi, Tetranychus urticae, Phytoseiulus persimilis.*

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