Predation of *Neozygites tanajoae*-infected cassava green mites by the predatory mite, *Typhlodromalus aripo* (Acari: Phytoseiidae)

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Summary

Typhlodromalus aripo is the most successful of the Neotropical predatory mites released for the classical biological control of the cassava green mite, *Mononychellus tanajoa,* in Africa. A few isolates of the entomopthoralean fungus, *Neozygites tanajoae*, which causes epizootics in *M. tanajoa* populations in Brazil, were imported to be released in Africa for the control of *M. tanajoa*. The present study evaluated the feeding preference of *T. aripo* for *M. tanajoa* infected by *N. tanajoae* in a preliminary attempt to determine the interaction between the two biological control agents. The feeding preferences of normal and starved, for 24 and 48 h, *T. aripo* for the healthy *M. tanajoa* and for those exposed to *N. tanajoe* were compared in choice and no choice tests. In general, *T. aripo* consumed significant quantities of infected *M. tanajoa* along with the healthy ones. Although, they appeared to have a slight preference for healthy *M. tanajoa*, significant difference ($P < 0.05$) was seen only in a no choice test when the predators that were starved for 24 h were used. The consumption of pathogen-infected pest mites by the predatory mites can reduce the effectiveness of the microbial control agent.

Key words

Mononychellus tanajoa, cassava, fungal pathogen, feeding preference

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Introduction

The cassava green mite, *Mononychellus tanajoa* (Bondar) (Acari: Tetranychidae) is an important arthropod pest of cassava, *Manihot esculenta* L. (Euphorbiaceae), in Africa (Nyiira 1976, Shukla 1976, Yaninek and Herren 1988). In a classical biological control effort, several species of Neotropical predatory mites were released in Africa between 1984 and 2000 (Yaninek et al. 1993, Yaninek and Hanna 2003). *Typhlodromalus aripo* DeLong (Acari: Phytoseiidae) is so far the most successful predatory mite spread across 20 African countries causing a significant reduction in *M. tanajoa* populations (Hanna and Toko 2001). In a parallel program to the classical biological control with predatory mites, a few isolates of the entomophthoralean fungus, *Neozygites tanajoae* Delalibera, Hajek & Humber (Zygomycetes: Entomophthorales), were imported from Brazil (Dara et al. 2001). *Neozygites tanajoae* is an important mortality factor in *M. tanajoa* populations in South America, causing frequent epizootics (Delalibera et al. 1992, Alvarez et al. 1993). Consumption of the infected mites by the predatory mites may limit the multiplication and spread of the pathogen in the host populations and thus its success as a biocontrol agent. Understanding of the interactions between the predator and the pathogen would be helpful for a better implementation of the *M. tanajoa* biological control program. This study was conducted to evaluate the feeding preference of *T. aripo* for *M. tanajoa* infected by *N. tanajoae*.

Materials and methods

This research was conducted at the International Institute of Tropical Agriculture, Republic of Benin. The feeding preference of unstarved adult *T. aripo* was compared with those starved for 24 and for 48 h when healthy and *N. tanajoe*-infected *M. tanajoa* were offered in choice and no choice tests. Field-collected *T. aripo* were maintained in the predatory mite rearing units. They were fed with the laboratory colonies of *M. tanajoa*. An indigenous isolate of *N. tanajoae*, which normally results in 60-85% of infection (Dara, unpublished), was used to infect the *M. tanajoa*. *Mononychellus tanajoa* killed by *N. tanajoae* were individually placed on a 2 cm dia cassava leaf disc and allowed to sporulate overnight at 23 °C in a plastic box (~15X20 cm) with moist cotton padding. To obtain infected mites for the assay, healthy *M. tanajoa* were placed around the sporulating mite cadavers to expose them to the fungal inoculum for 24 h.

Choice Test. Excised cassava leaves from greenhouse plants were thoroughly rinsed with distilled water and 10 mm dia discs were cut out. Three healthy and three infected *M. tanajoa* were placed on a leaf disc and were offered to one *T. aripo*. Healthy and infected *M. tanajoa* were distinguished by marking with green and red food coloring (Rayner's Food Coloring, Rayner & Co. Ltd., London, UK), respectively. Twenty-five such leaf discs were used within each category of starvation of *T. aripo* and placed in a plastic box with moist cotton padding. Predation was monitored for 28 h after treatment at hourly intervals during the first 8 h and at every 4 h thereafter, and the number of surviving and consumed prey was counted. This experiment was repeated three times.

No Choice Test. The procedure was similar as in the choice test except that five of each of the healthy and infected *M. tanajoa* were offered to *T. aripo* on separate cassava leaf discs. Within each category of starvation of *T. aripo*, 25 of such leaf discs were used for each type of *M. tanajoa*. This experiment was also repeated three times.

Statistical analysis. The data were analyzed by PROC GLM of SAS software (SAS Institute 1994) and mean percent of predation was obtained. Significant means were separated by least squares means procedure.

Results and discussion

In general, *T. aripo* appeared to prefer healthy *M. tanajoa* to the infected ones during most of the observation period, although the differences were not significant ($P \geq 0.05$) (Figure 1). Only in the no choice test, *T. aripo* starved for 24 h consumed significantly more ($P < 0.05$) healthy prey than infected ones from 16 to 28 h of predation (Figure 1E).

Typhlodromalus aripo consumed significant quantities of both healthy and infected *M. tanajoa* in all tests. Feeding of *T. aripo* on infected *M. tanajoa* will have a negative impact on the control of the latter with the fungus as it would reduce amount of inoculum available for spreading the infection. Pell et al. (1996) found that when pea aphid, *Acyrthosiphon pisum* Harris (Homoptera: Aphididae), infected with the entomophthoralean fungus, *Erynia neoaphidis* Remaudière & Hennebert was offered to starved *Coccinella septumpunctata* L. (Coleoptera: Coccinellidae), it preyed on both live infected and fungus-killed aphids. In contrast, unstarved predatory mites consumed significant quantities of live infected *M. tanajoa* in our study. However, when fungus-killed *M. tanajoa* were offered in a preliminary study, *T. aripo* examined and left the prey without attempting to feed on the cadaver (data not presented). Once it realized that the prey was not consumable, it avoided reexamining the fungus-killed *M. tanajoa* in successive encounters as it foraged for the prey.

Although *T. aripo* consumed considerable quantities of fungus-infected *M. tanajoa*, it appeared to show a slight preference for healthy prey. Since the level of infection from the isolate used in the test is normally 60-85% (Dara, unpublished), certain proportion of the prey consumed in the infected category might, in fact, have been

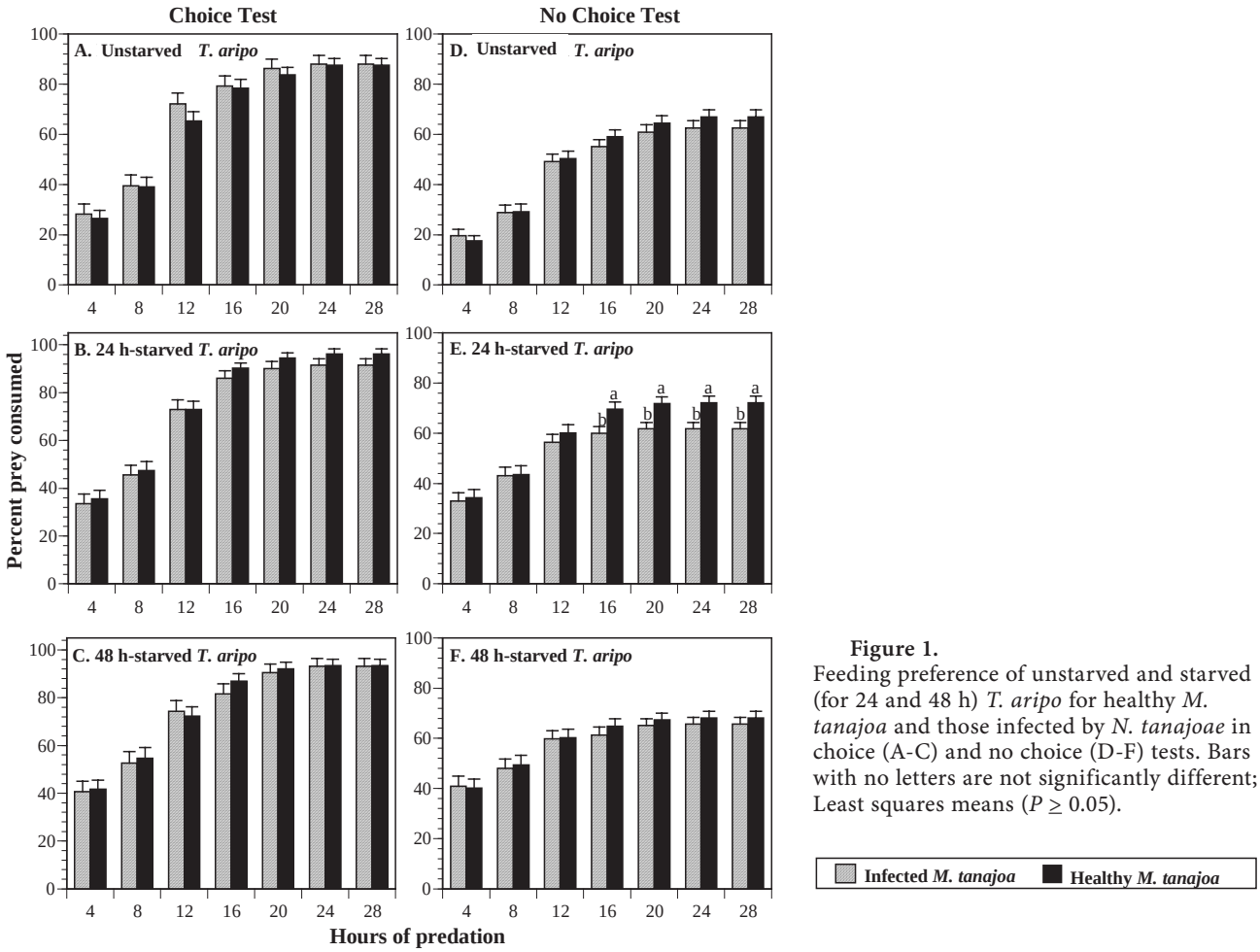

Figure 1.
Feeding preference of unstarved and starved (for 24 and 48 h) *T. aripo* for healthy *M. tanajoa* and those infected by *N. tanajoae* in choice (A-C) and no choice (D-F) tests. Bars with no letters are not significantly different; Least squares means ($P \geq 0.05$).

healthy. Removing that proportion of healthy prey might have showed a significant preference of *T. aripo* for healthy prey. However, unlike in the case of some other arthropods, it is not possible to visually distinguish live infected individuals from healthy *M. tanajoa*. This study warrants a thorough look at the interaction between the predatory mites and the fungal pathogen before a large-scale release of the pathogen is attempted for the biological control of *M. tanajoa* in Africa.

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