BIOLOGICAL CONTROL

Predatory Activity of Phytoseiid Mites on the Developmental Stages of Coffee Ringspot Mite (Acari: Phytoseiidae: Tenuipalpidae)

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Atividade Predatória de Ácaros Fitoseídeos Sobre os Estádios de Desenvolvimento do Ácaro da Mancha-Anular do Cafeeiro (Acari: Phytoseiidae: Tenuipalpidae)

RESUMO - Através de bioensaios realizados em arenas com 3 cm de diâmetro, confeccionadas com folhas de cafeeiro flutuando em água, foram estudadas as fases do ácaro da mancha-anular do cafeeiro *Brevipalpus phoenicis* (Geijskes) quanto à preferência pelos diversos estádios do desenvolvimento dos ácaros predadores *Euseius alatus* DeLeon e *Iphiseiodes zuluagai* Denmark & Muma. Os experimentos foram conduzidos em laboratório a 25 ± 2ºC, 70 ± 10% de UR e 14 horas de fotofase. O estádio do ácaro vetor mais predado foi o de larva, seguido pelo de ninfa e ovo. A fase adulta teve muito pouca predação. De modo geral, a fase mais agressiva dos predadores foi a de fêmea adulta, seguida pela de ninfa. A fase de larva foi a menos eficiente na predação. As médias de predação de *E. alatus* e *I. zuluagai* para as diferentes fases do *B. phoenicis* foram respectivamente: larva (79% e 90%) > ovo (47% e 83%) > ninfa (40% e 77%) > adulto (1% e 18%), o que demonstra que *I. zuluagai* mostrou maior atividade predatória que *E. alatus*.

PALAVRAS-CHAVE: Rhabdovirus, controle biológico, ácaro-plano, *Brevipalpus phoenicis, Euseius alatus, Iphiseiodes zuluagai*.

ABSTRACT - By means of bioassays performed in arenas of 3 cm in diameter, manufactured with coffee leaves floating on water, the phases of the coffee ringspot mite *Brevipalpus phoenicis* (Geijskes) were studies on the preference by several developmental stages of the predaceous mites *Euseius alatus* DeLeon and *Iphiseiodes zuluagai* Denmark & Muma. The experiment was conducted in laboratory at 25 ± 2ºC, 70 ± 10% RH and 14 h photophase. The preferred stage of coffee ringspot vector virus was the larva followed by nymph and egg. Adults were least preyed on. In general, the most aggressive phase of the predators was the adult female followed by the nymph; the larval phase was the least aggressive. The average predation of *E. alatus* and *I. zuluagai* for the different phases of *B. phoenicis* were, respectively: larva (79% and 90%) > egg (47% and 83%) > nymph (40% and 77%) > adult (1% and 18%). This result indicated that *I. zuluagai* is more aggressive than *E. alatus* in relation to its predation upon *B. phoenicis*.

KEY WORDS: Rhabdovirus, biological control, flat-mite, *Brevipalpus phoenicis, Euseius alatus, Iphiseiodes zuluagai*.

The mite *Brevipalpus phoenicis* (Geijskes) has been reported on coffee trees in Brazil since 1951 (Anonymous 1951). More recently, it was related to coffee ringspot (Chagas 1973) caused by a virus of the Rhabdovirus group (Chagas 1988).

Coffee ringspot was not considered of any economic problem until 1988 (Chagas 1988). Since 1990, and specially in 1995, infestations by *B. phoenicis* and ringspot have been reported in the state of Minas Gerais causing intense leaf dropping on coffee trees, mainly in the region of Alto Paranaíba. The presence of the mite being also found in other coffee growing regions of Brazil, both in arabic (*Coffea arabica* L.) and canephora (*Coffea canephora* Pierre) coffee species.

The mite *B. phoenicis* is often found associated with the predaceous mites *Iphiseiodes zuluagai* Denmark & Muma and *Euseius alatus* DeLeon (Acari: Phytoseiidae), among others. Phytoseiids have been widely studied and considered the most effective predatory mites (McMurtry *et al.* 1970, Moraes 1991). Pallini Filho *et al.* (1992) reported a number of species of predator mites on coffee trees, among them, *I. zuluagai* and *E. alatus*, which were the object of this study. The consumption of prey by phytoseiid mites has been investigated chiefly for mites of the family Tetranychidae. Smith & Newsom (1970) showed that adult females of the phytoseiid *Neoseiulus fallacis* (Garmam) are the most efficient phase in relation to predation on *Tetranychus urticae* Koch (Acari: Tetranychidae), while other stages of the predator still contributed to the control of the pest. Using eggs of *T. urticae* as prey, Ma & Laing (1973) found that larvae of *Neoseiulus chilenensis* (Dosse) did not feed, and that the females were more efficient in predation than males, mainly during the oviposition period. Gravena *et al.* (1994) estimated the predatory activity of the phytoseiid *Euseius citrifolius* Denmark & Muma upon citrus leprosis mite, *B. phoenicis*, and found that larvae, nymphs and adult females were similar and or superior in the predatory activity than adult males.

Because the predatory mites *I. zuluagai* and *E. alatus* are found on coffee (Pallini Filho *et al.*1992) and citrus trees (Reis *et al.* 2000), on which *B. phoenicis* is also an important pest, this study was conducted to investigate the predatory activity of those predaceous mites on each developmental stage of *B. phoenicis*.

Material and Methods

The predation potential of the predaceous mites was studied through bioassays using arenas of 3 cm in diameter, made of healthy and unsprayed coffee leaves (*C. arabica*) floating in water. The study was conducted at the acarology laboratory of the Centro Regional de Pesquisa do Sul de Minas, of Empresa de Pesquisa Agropecuária de Minas Gerais - EPAMIG, in Lavras (MG), at 25 ± 2ºC, 70 ± 10% RH and photophase of 14 h (daylight lamp).

Five arenas were placed to float on water in open dishes petri 15 cm in diameter by 2 cm in depth. Each arena contained a central hole to fit the passage of a pin. The pins were fixed by the head to the bottom of the dish with silicone glue before adding the water, in such a way as to prevent touching each other or the walls of the dish. Water was added daily to prevent the arenas from touching the bottom, serving as a permanent barrier to prevent the mites from escaping (Reis *et al.* 1998).

Bioassays were performed using every possible combinations between each developmental phase of *I. zuluagai* and *E. alatus* (larva, nymph, male and female) and the prey *B. phoenicis* (egg, larva, nymph and adult female). A control was included, consisting of each prey phase without predator. Each combination and respective control had ten replications. Each arena received a predator and 20 prey at the desirable phases. After 24 hours of the introduction of the mites into the arena, the numbers of completely preyed, partially preyed, naturally dead, dead in water and living mites were counted. The mites, both predators and *B. phoenicis*, were obtained from

Table 1. Number (mean ± SE) of individuals of *B. phoenicis* (n = 20) at different developmental stages preyed upon by different stages of the predaceous mites *E. alatus* (*E.a.*) and *I. zuluagai* (*I.z.*) within a period of 24 h.

Predator stages	Stages of *B. phoenicis* /predator species							
	Egg		Larva		Nymph		Adult	
	E. a.	*I. z.*	*E. a.*	*I. z*	*E. a.*	*I. z.*	*E. a.*	*I. z.*
Check	0.0 ± 0.00 c	0.0 ± 0.00 c	0.0 ± 0.00 c	0.0 ± 0.00 c	0.0 ± 0.00 c	0.0 ± 0.00 d	0.0 ± 0.00 b	0.0 ± 0.00 c
Larva	2.7 ± 0.44 b	1.9 ± 0.38 c	14.8 ± 0.59ab	5.7 ± 0.75 b	7.2 ± 0.67a	2.1 ± 0.41 c	0.0 ± 0.00 b	0.1 ± 0.18 c
Nymph	4.2 ± 0.61 b	18.4 ± 0.56a	16.0 ± 0.54ab	18.1 ± 0.75a	9.6 ± 0.44a	15.1 ± 0.67ab	0.2 ± 0.21ab	2.4 ± 0.48ab
Adult (male)	5.5 ± 0.70 b	11.7 ± 0.82 b	13.4 ± 0.69 b	16.2 ± 0.79a	3.8 ± 0.46 b	11.0 ± 0.70 b	0.1 ± 0.18ab	1.4 ± 0.56 bc
Adult (female)	18.2 ± 0.49a	19.8 ± 0.25a	17.7 ± 0.49a	19.7 ± 0.26a	10.3 ± 0.50a	19.8 ± 0.26a	0.5 ± 0.2 a	7.0 ± 0.70a
CV (%)	32.3	21.3	11.6	24.5	21.6	10.0	23.9	50.9

Means followed by same letter in the columns do not differ among them by Tukey's test ($P \leq 0.05$).

maintenance rearing (Reis & Alves 1997b) which enabled the utilization of mites of uniform age.

Results and Discussion

Results obtained are shown on Table 1. Throughout the observation time, neither natural death nor death in water of the mite *B. phoenicis* was observed in the check treatment. Thus, no correction for predation was performed.

The phases of *B. phoenicis* consumed, in order of preference, by the larvae of the predator *E. alatus* were: larva (75%) > nymph (39%) > egg (14%) > adult (0%). By the nymphs were: larva (80%) > nymph (48%) > egg (21%) > adult (1%). By the females were: egg (91%) > larva (89%) > nymph (52%) > adult (2.5%). By the males of the predator were: larva (67%) > egg (28%) > nymph (19%) > adult (1%) (Fig. 1).

The phases of *B. phoenicis* consumed, in order of preference, by the larvae of *I. zuluagai* were: larva (29%) > nymph (11%) > egg (10%) > adult (1%). By the nymphs were: egg (92%) > larva (91 %) > nymph (76%) > adult (13%); by the females were: egg (99%) > nymph (99%) > larva (98.5%) > adult (35%). By the males of the predator were: larva (81%) > egg (59%) > nymph (55%) > adult (7%) (Fig. 2).

The average predation of nymphs, males and females of *E. alatus* and *I. zuluagai* for the different phases of *B. phoenicis* were, respectively: larva (79% and 90%) > egg (47% and 83%) > nymph (40% and 77%) > adult (1% and 18%), which showed greater predatory activity by *I. zuluagai* than *E. alatus*. For both predators, adult female was the most efficient phase in relation to consumption of all the developmental phases of *B. phoenicis*, mainly that of *E. alatus*. Similar results were obtained by Gravena *et al.* (1994) for *E. citrifolius* feeding on *B. phoenicis*. Smith & Newsom (1970) and Ma & Laing (1973) also

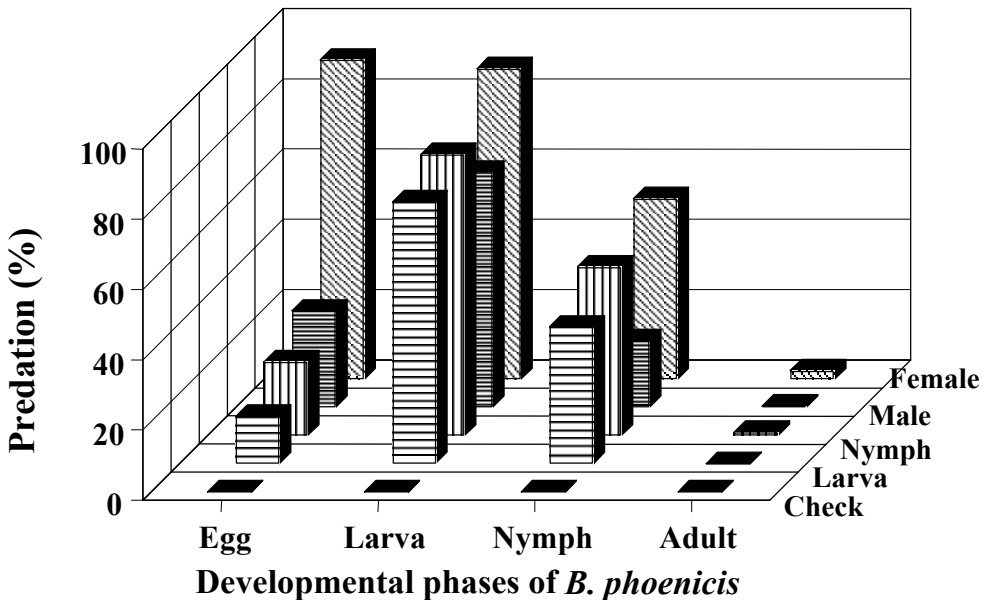

Figure 1. Percentage of predation of *B. phoenicis* at different developmental stages by larva, nymph and adult (male and female) of *E. alatus.*

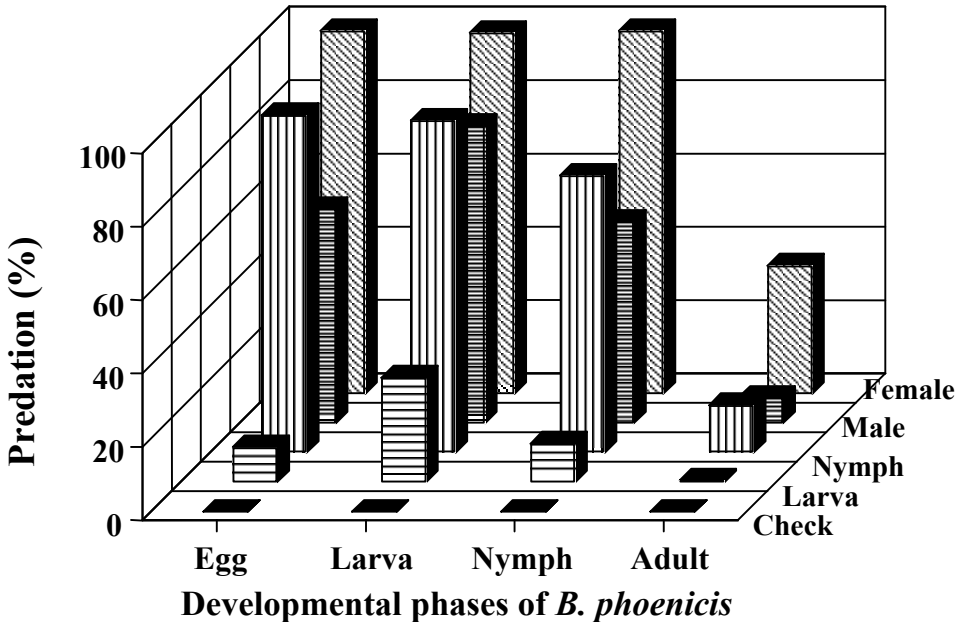

Figure 2. Percentage of predation of *B. phoenicis* at different developmental stages by larva, nymph and adult (male and female) of *I. zuluagai*.

found the greatest efficiency of females of phytoseiids as predators, in relation to the other developmental phases, with tetranychid mites as a prey.

The larval phase of the predators was the least efficient, perhaps because of their reduced size and the short duration of that stage (Reis & Alves 1997a, Reis *et al*. 1998). Several authors reported non-feeding larval stage for different phytoseiid species (Chant 1959, Putman 1962, McMurtry & Scriven 1964, Ma & Laing (1973), Moraes &, McMurtry 1981). This was not the case for the species used in the present study as well as in the study conducted by Gravena *et al.* (1994). However larvae of *I. zuluagai* and *E. alatus* were not seen feeding when they were given only castor bean pollen (*Ricinus communis* L.) as food (Reis & Alves 1997a, Reis *et al*. 1998).

Nymphs of the predators showed a performance similar to that of females, except for *E. alatus* when the prey was in the egg stage. Such nymphs showed a considerably lower prey in capacity than females. Male predators were more effective in preying on larvae.

The larval phase of the ringspot mite was the most consumed by predators, followed by the egg phase. The adult of *B. phoenicis* was less preferred for predation (Table 1). Similar results were obtained by Gravena *et al.* (1994) for *E. citrifolius* preying on *B. phoenicis* on citrus leaves.

The results showed how important is the preservation of the predatory mites *I. zuluagai* and *E. alatus* in the coffee crop, because of their high potential for preying on *B. phoenicis*.

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