PREDATORY CAPACITY OF *Chrysoperla externa* (Hagen, 1861) (Neuroptera: Chrysopidae) on *Brevipalpus phoenicis* (Geijskes, 1939) (Acari: Tenuipalpidae)

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ABSTRACT: *Chrysoperla externa* (Hagen, 1861) (Neuroptera: Chrysopidae) is present naturally in many plants, as a natural enemy with a high predatory potential. The mite *Brevipalpus phoenicis* (Geijskes, 1939) (Acari: Tenuipalpidae) is a polyphagous pest and is the vector of the coffee ring spot virus in coffee plants. This work was made to evaluate the predatory capacity of *C. externa* larvae on *B. phoenicis* through bioassays. The experiments were done under laboratory conditions, using 3-cm diameter arenas made up of 'Catuai' coffee leaves (*Coffea arabica* L.). Fifty mites were placed in each arena for each development phase and green lacewing larva (1st 2nd and 3rd instar), with 16 replicates. The evaluation period was of 4 hours. First instar larvae showed better predatory capacity when compared to those of second and third instars regardless the mite developmental stage. Preference of first instar larvae of *C. externa* was for eggs, followed by larvae, nymphs and finally by adults of *B. phoenicis*. Therefore, results indicate that larvae of *C. externa* can act as an auxiliary organism in regulating *B. phoenicis* populations in coffee trees agroecosystems.

Key words: *Coffea arabica*, coffee ring spot mite, green lacewing, biological control.

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RESUMO: *Chrysoperla externa (Hagen, 1861) (Neuroptera: Chrysopidae) ocorre naturalmente em diversas plantas hospedeiras, apresentando-se como um inimigo natural com grande potencial de predação. O ácaro Brevipalpus phoenicis (Geijskes, 1939) (Acari: Tenuipalpidae) é polífago e no cafeeiro é vetor do vírus da mancha-anular. Objetivou-se com este trabalho avaliar a capacidade predatória de larvas de C. externa sobre B. phoenicis, mediante bioensaios. Os experimentos foram realizados em laboratório, empregando-se arenas com 3 cm de diâmetro, confeccionadas com folhas de cafeeiro 'Catuaí' (Coffea arabica L.). Em cada arena foram colocados 50 ácaros, em cada fase do desenvolvimento, e uma larva do crisopídeo (1º; 2º e 3º instar), com 16 repetições. O período de avaliação foi de quatro horas. As larvas de primeiro ínstar apresentaram capacidade predatória superior em relação àquelas de segundo e terceiro ínstares. Houve preferência das larvas de primeiro ínstar pela predação de ovos, seguida das larvas, ninfas e, por último, de adultos de B. phoenicis. Os resultados obtidos permitem inferir que larvas de C. externa podem estar atuando como organismo auxiliar na regulação da densidade populacional do ácaro B. phoenicis em agroecossistemas cafeeiros.*

Palavras-chave: Coffea arabica, ácaro da mancha-anular do cafeeiro, crisopídeo, controle biológico.

1 INTRODUCTION

Many factors, biotic and abiotic, restrict coffee plants yield and among the biotic ones insects, mites and diseases are directly responsible for expressive damages in that culture (GRAVENA, 1992).

The mite *Brevipalpus phoenicis* (Geijskes, 1939) (Acari: Tenuipalpidae) is a polyphagous arthropod-pest, found in many hosts plants. In Brazil is known to be present on coffee plants (*Coffea* spp.) since 1950 (Amaral, 1951), associated to the coffee ringspot in this Rubiacea which is caused by a virus belonging to the *Rhabdovirus* group Chagas (1973, 1988). This mite is particularly spread in many different regions being found in citrus (REIS, 1978; CHIAVEGATO, 1991). They move slowly and are found hidden in branche fissures, fruits and in the most internal leaves of the plants (REIS et al., 2000b).

In the 1990's and specially in 1995, the *B. phoenicis* infestation and the coffee ring spot symptoms were described as very strong, causing falling of leaves in coffee plants in crops located in the Alto Paranaíba region, MG-Brazil (FIGUEIRA et al., 1996). In the South of Minas Gerais State, Brazil, this species occurrence is very commom all over the year. However, it is in the driest period of the year from February/March to October/November and low temperatures that the highest populations are found (REIS et al 2000a.; REIS, 2002).

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The biggest damage is due to the virus, characterized by leaves with chlorous spots which fall very early. On the other hand, earlier fall of the fruits is caused by fungus, mainly *Fusarium* and *Colletotrichum*. In coffee berries, round shape and depressed lesions facilitate fungus penetration which causes rottening of the berries, and tasteless, resulting in reduction of beverage quality (REIS & CHAGAS, 2001).

The coffee agroecosystem has favorable conditions for implementation of integrated control programs given the crop perennial nature which favours the populational rate increase of the predators and parasitoids that can reach levels capable of helping the insects and mite-pest populational rate control (ALTIERI, 1994; HILL, 1997).

In the Neotropical Region chrysopids, specially *Chrysoperla externa* (Hagen, 1861) (Acari: Tenuipalpidae), are found naturally in many agroecosystems as on coffee crops, and is a predator which aids in population control of phytophagous organisms (ALBUQUERQUE et al., 1994; CARVALHO & CIOCIOLA, 1996).

D'Antonio et al. (1981) observed that two *Chrysopa* (= *Chrysoperla*) larvae consumed 11 eggs of the red coffee spider mite *Oligonychus ilicis* (McGregor, 1917) (Acari: Tetranychidae) in coffee plant in just a single day. They also observed that when two larvae of this green lacewing were placed on each leave of the coffee plant containing 14 adult mites, all specimens were predated in less than 24 hours. However, very little is known about their activities and predatory capacity, particularly in the which *B. phoenicis* stage, this predator is more effective.

The objective of this study was to evaluate the predatory capacity of *C. externa* larvae in all larval instars to control *B. phoenicis* in the egg, larva, nymph and adult phases.

2 MATERIAL AND METHODS

Adults of *C. externa* were collected in coffee plants (*Coffea arabica*) at the "Universidade Federal de Lavras" (UFLA) *campus* and kept at room temperature of 25 ± 2 °C, 70 ± 10% RH and photophase of 12 hours. Rearing was done following Ribeiro et al. (1991) methodology, placing 10 couples of the lacewing in cages made of 20-cm long and 15-cm diameter PVC tubes placed vertically on 25-cm diameter plastic trays, coated internally with filter paper and closed with a PVC lid. The insects were fed with brewers'yeast and honey (1:1 v/v). Third generation eggs, aproximatelly 12 hours old, were taken from the tube and placed individually in 2.5-cm diameter and 8.5-cm long glass tubes which were used to obtain the larvae for the study.

Twelve hours after larvae emergence, 64 1st instar larvae not fed yet.were used for the study. Additional 128 larvae were fed *ad libitum* with eggs of *Anagasta kuehniella* (Zeller, 1879) (Lepidoptera: Pyralidae), until molting to 2nd instar, when 64 of them were used for the experiments. The remaining 64 larvae were fed on the same type of prey until they reached the 3rd instar, and 12 hours after the ecdise and on fasting, they were used in this final stage.

Stock rearing of *B. phoenicis* in the laboratory was performed after collecting them on 'Catuai' coffee plants at farm in Ijacy County, State of Minas Gerais, Brazil.Rearing was done according to Chiavegato's (1986) methodology, on citrus fruits collected at UFLA's orchard. The oranges were coated with paraffin in the laboratory in order to enhance its protection, leaving a 3-cm diameter area clear on its top, known as 'crown region', in order to rear the mite. The area was cleaned with a brush to remove other mites and/or eventual insects that could be present which could interfere with the rearing of the *B. phoenicis*. A barrier of BioStick^R was made to isolate the arena where the mites were reared and to prevent them from escaping.

The bioassays were conducted in the Acarology Laboratory of the "Empresa de Pesquisa Agropecuária de Minas Gerais – EPAMIG-CTSM/ EcoCentro", at room temperature of 25 ± 2 °C, 70 ± 10% RH and photophase of 14 hours, using 3-cm diameter leaf discs of 'Catuai' coffee plants. The leaf discs (8) were then placed to float in water in 15-cm diameter and 2-cm high Petri dishes (Figure 1) without lid, using Reis et al. (2000c) methodology, when the predatory activities of phytoseiid mites were evaluated in the development stages of *B. phoenicis*.

The statistical experimental design in factorial arrangement was used with combinations among the three instars of *C. externa* and the stages of egg, larva, nymph and adult of *B. phoenicis* totalizing 12 treatments and 16 replicates. Each leaf disc received one larva of the green lacewing and 50 preys in each

Figure 1 – Arenas used to study predation of *Brevipalpus phoenicis* formed by 3-cm diameter leaf discs of Catuai' coffee plants, floating on water in Petri dish.

development stage for consumption evaluations for each predator instar .

A preliminary test took place, before performing this experiment in which 16 first-instar larvae of *C. externa* were fed *ad libitum* with the mite *B. phoenicis* in all developmental stages. As a result of this test, a 4-hour period was established to evaluate the predatory capacity of larvae of *C. externa* on *B. phoenicis* since in a longer period than 4 hours many larvae specially those in second and third instars, showed high trend to disperse, leaving the arenas in search for new preys just after praying upon the various mite stages.

Data obtained were submitted to the analysis of variance and means compared using Scott and Knott's test ($P<0.05$) (SCOTT & KNOTT, 1974).

3 RESULTS AND DISCUSSION

The habits of the green lacewing larvae to suck the contents of eggs, nymphs and adults of the mites leaving behind only the egg corion and the remaining of larvae, nymphs and adults facilitated the observation of the number individual mites predated during the experimental period, regardless the developmental stage (Figure 2).

Predation by first instar larvae of *C. externa* (3.2 mm in length) was higher than those of second and third instars for all development mite stages (Table 1). Lower predation by larvae of second (6.2 mm in length) and third (10.8 mm in length) instars (SOUZA,1999), may be due to the small mite size, with eggs measuring 0.1 mm and adults 0.3 mm approximately.

Figure 2 – First instar larva of *Chrysoperla externa* predating eggs of *Brevipalpus phoenicis* on foliar discs of 'Catuai' coffe plants (40x).

This hypothesis is based on Sandness & MacMurtry (1970) results which points out the relation between the predator size and its prey as an important factor in the predatory process efficiency. Similar results were observed by Hydorn & Whitcomb (1979) when larvae of second instar of *Chrysoperla rufilabris* (BUMEISTER, 1839) (Neuroptera: Chrysopidae) died before reaching the third instar while consuming the mite *Tetranychus gloveri* Banks, 1900 (Acari: Tetranychidae).

The alternative food supplied to larvae from second and third instar lacewings (eggs of *A. kuehniella*) before the mite predatory process experiment beginning, could have also influenced the predatory process due to the "learning process" in relation to the prey, despite the fact that no food was supplied for 12 hours before the experiment.

The highest predation level reached by first instar larvae of *C. externa* was on eggs followed by larvae and nymphs and finally by adults of *B. phoenicis* (Table 1 and Figure 3) which probably happened due to the higher adult mobility level when compared to nymphs and larvae of the mite. These results are similar to those found by Reis et al. (2000c) when phytoseiide mites, *Euseius alatus* DeLeon, 1966 and *Iphiseiodes zuluagai* Denmark & Muma, 1972

Table 1 – Mean (±SE) number of *Brevipalpus phoenicis* destroyed by larvae of first, second and third instars of *Chrysoperla externa* in a 4-hour period (n=50). Lavras, MG, Brazil, 2003.

Mite Developmental Stages	Mean number of mites predated/instar of *C. externa*		
	First [1]	Second [1]	Third [1]
Egg	38,1±2,76aA	7,2±0,52bA	4,5±0,32bA
Larva	35,3±2,56aB	5,9±0,43bA	4,3±0,31bA
Nymph	33,6±2,44aB	5,6±0,40bA	4,2±0,30bA
Adult	24,1±1,75aC	5,3±0,38bA	4,1±0,30bA
VC - 29,02%			

[1]Means followed by the same low case letter in the row and capital letter in the column are not statistically different by the Scott and Knott test (P<0.05).

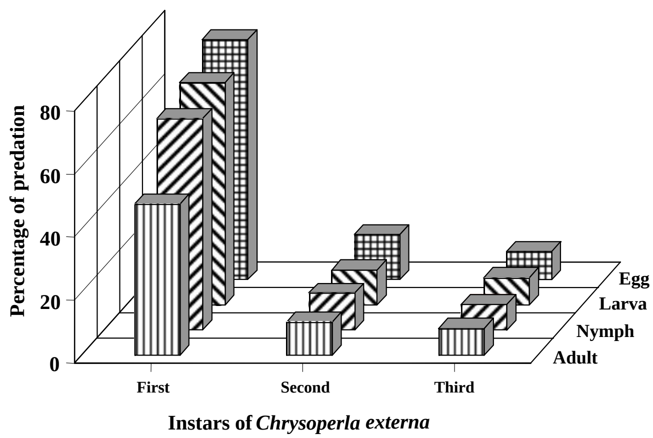

Figure 3 – Percentage of predation of *Brevipalpus phoenicis* in the phases of egg, larva, nymph and adult by larvae of *Chrysoperla externa* in each instar at 25±2^{o}C, 70±10% RH and photophase of 14 hours. Lavras, MG, Brazil, 2003.

(Acari: Phytoseiidae) was bigger predatory activity for the larvae followed by eggs and nymphs and finally adults of *B. phoenicis.*

Predatory capacity *C. externa* at second and third instars was significantly lower, without differences in the number of preys consumed according to the development stages of *B. phoenicis* (Table 1 and Figure 3).

4 CONCLUSIONS

First instar *C. externa* larvae are efficient in predatory process in all stages of *B. phoenicis* development.

C. externa as general predator is helping in the population regulation in coffee agroecosystems.

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