

Notas Científicas

Parasitism of the mite *Acarophenax lacunatus* on *Tribolium castaneum*

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Abstract – The objective of this work was to assess the parasitism potential of *Acarophenax lacunatus* (Cross & Krantz) on *Tribolium castaneum* (Herbst). The experimental units encompassed Petri dishes containing 25 g of wheat infested with 20 adults of this beetle species. After seven days of infestation, different mite densities (0, 2, 4, 6, 8 and 10 females) were inoculated into the Petri dishes. The increase in mite density led to a linear increase in parasitism, and a consequent reduction in populations of this insect. It is possible to use this mite species in the biological control of *T. castaneum*.

Index terms: Acarophenacidae, Tenebrionidae, biological control, stored wheat.

Parasitismo do ácaro *Acarophenax lacunatus* sobre *Tribolium castaneum*

Resumo – O objetivo deste trabalho foi avaliar o potencial de parasitismo do ácaro *Acarophenax lacunatus* (Cross & Krantz) sobre *Tribolium castaneum* (Herbst). As unidades experimentais consistiram de placas de Petri contendo 25 g de grãos de trigo infestados com 20 adultos desse coleóptero. Depois de sete dias da infestação, os ácaros foram introduzidos em diferentes densidades (0, 2, 4, 6, 8 e 10 fêmeas) nas placas de Petri. O aumento da densidade do ácaro acarretou aumento linear do parasitismo, com conseqüente redução das populações desse inseto. É possível utilizar esse ácaro no controle biológico de *T. castaneum*.

Termos para indexação: Acarophenacidae, Tenebrionidae, controle biológico, trigo armazenado.

Conventional chemical control is the most frequently technique used to protect stored grains against insect attacks (White & Leesch, 1996). Although efficient, chemical control is responsible for the increase in the development of resistance among several pest species as well as for food contamination by chemical residues. Consequently there is a search for alternatives that minimize such negative effects (Brower et al., 1996). Several researchers consider biological control an important tool to solve problems caused by chemical control.

Tribolium castaneum (Herbst) can be found all over the world, mainly because of the international trade of agricultural products (Sokoloff, 1974). The insect is highly tolerant to climatic changes, and is one of the most harmful pests occurring in processed grain (wheat flour, ration, bran and corn flour), particularly when in bulk (Rees, 1996).

Acarophenax lacunatus (Cross & Krantz) was first reported in colonies of the rusty grain beetle, *Cryptolestes ferrugineus* (Stephens), by Cross & Krantz (1964). This mite species show physogastry reproduction, a phenomenon characterized by the progeny development into the female body emerging as sexual mature adults. The efficiency of the mite in controlling other pest coleoptera is already known and was described in previous works (Faroni et al., 2000; Oliveira et al., 2002, 2003), in which harmful parasite of beetles pests of Bostrichidae family were reported. In addition, the mite was tolerant to the most frequent insecticides used to control stored products pests (Gonçalves et al., 2004) and, for this reason, it may be used as a natural enemy in integrated pest management programs in storage facilities, particularly in tropical regions.

Due to problems related to this beetle's insecticide resistance (Zettler & Cuperus, 1990), the objective of this work was to evaluate the potential of using the mite *A. lacunatus* as parasite of *T. castaneum*.

Populations of *A. lacunatus* were obtained from laboratory colonies of *T. castaneum* infested by the mite species and maintained in jars with 1.7 L capacity, on broken wheat grain with 13% moisture content. Physogastric females of *A. lacunatus* were obtained following Faroni et al. (2000).

The experiments were conducted in a bioclimatic chamber at a $30\pm 2^\circ\text{C}$ temperature, $65\pm 5\%$ relative humidity and 24 hours scotophase. Experimental units consisted of Petri dishes (14 cm diameter) containing 25 g of broken wheat (13% moisture content) and infested with 20 *T. castaneum* adults aged between three to seven days. Seven days after infestation with *T. castaneum*, time required to beetles oviposition, Petri dishes were infested with different densities of the mite (0, 2, 4, 6, 8, and 10 *A. lacunatus* females per Petri dish), in eight replicates. Petri dishes were covered with a PVC film to prevent insect and mite escapes, as well as contamination, and were maintained under controlled conditions for 30 days.

After 30 days of storage, the content of each Petri dish was sieved through meshes with different sizes of open spaces, separating the broken grains and insects from the residual dust, which contained mites (Faroni et al., 2000), and *T. castaneum* eggs and larvae. Residue was analyzed with a stereoscopic microscope. The instantaneous growth rate of *A. lacunatus* (r_i) was determined by the equation: $r_i = \ln(N_f/N_0)/\Delta_t$; in which N_f is the final number of mites; N_0 is the initial number of mites; and Δ_t is the variation in time (number of days the experiment was conducted) (Walthall & Stark, 1997). Data were submitted to regression analyses.

The increase in *A. lacunatus* female density led to a linear increase in *T. castaneum* egg parasitism (Figure 1) and to a reduction in the insect's adult (Figure 2) populations. Faroni et al. (2000) observed a similar trend for *Rhyzopertha dominica* (Fabricius), which showed a decrease of approximately 40 to 94% in population growth, 45 days after inoculation of various densities of *A. lacunatus* physogastric females. Oliveira et al. (2002, 2003) studied *A. lacunatus* parasitism on different hosts, and found that the mite also reduces the number of larvae and adults among the beetles *Dinoderus minutus*

(Fabricius) and *C. ferrugineus*. Reduction was a linear measure of egg parasitism.

A special feature of *A. lacunatus* and other Acarophenacidae is physogastry, the process of enlargement of the female body while feeding on the host. The process allows simultaneous accommodation of several embryos and the development of sexually mature, emerging progeny (Evans, 1992). The progeny is, therefore, capable of parasitising host eggs immediately after birth and of interrupting the development of *T. castaneum* eggs. This process was also observed among *Acarophenax mahunkai* (Steinkraus & Cross), whose parasitism necessarily destroys the eggs of the beetle *Alphitobius diaperinus* (Panzer) (Steinkraus & Cross, 1993).

An increase in mite density reduced *A. lacunatus* growth instantaneous rate ($F = 6.24$; $p < 0.001$), indicating a possible competition for food (*T. castaneum* eggs) when the population of natural enemies was higher. There were no significant differences in grain weight loss due to insect attack ($F = 3.53$; $p > 0.05$) or in number of dead insects ($F = 0.13$; $p > 0.05$) among treatments. These data show that *A. lacunatus* does not affect adult insects. However, egg parasitism can reduce the potential for pest reinfestations.

Faroni et al. (2001) showed that the high biotic potential of *A. lacunatus* allows the mite to control the environment. *A. lacunatus* can produce up to 12 generations per month, as opposed to the 35 days

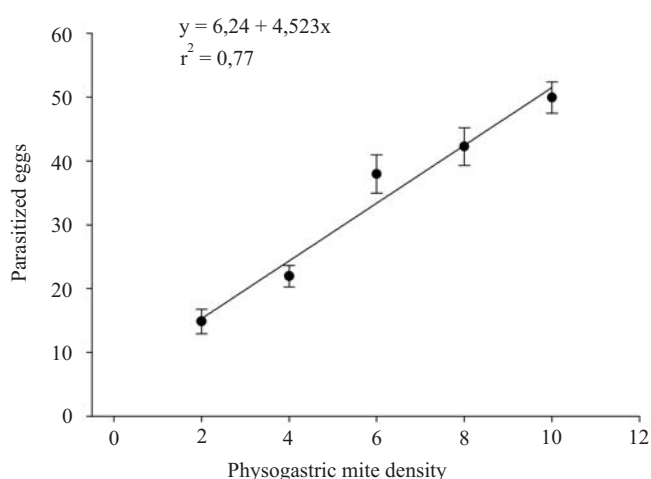


Figure 1. Number of parasitized eggs of *Tribolium castaneum*, 30 days after inoculation of physogastric females of *Acarophenax lacunatus* ($F = 129.32$; $p < 0.0001$; $df_{\text{error}} = 38$).

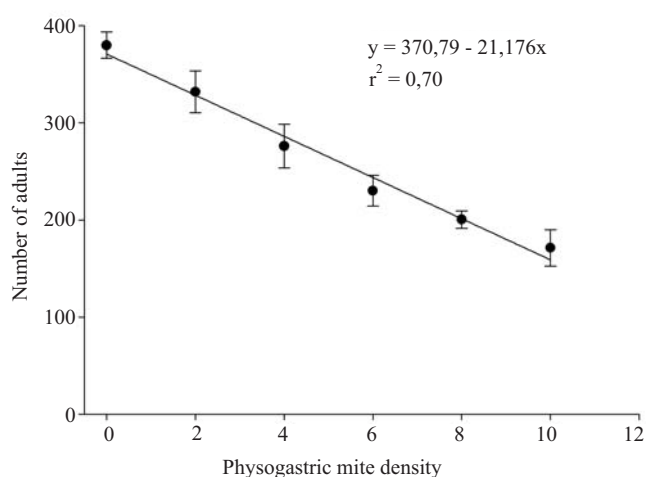


Figure 2. Number of *Tribolium castaneum* adults, 30 days after inoculation of physogastric females of *Acarophenax lacunatus* ($F = 108.38$; $p < 0.0001$; $df_{\text{error}} = 46$).

R. dominica takes to produce one generation. Oliveira et al. (2002, 2003) found similar results and showed that *A. lacunatus* can, in a short period, develop faster than the coleoptera-hosts *D. minutus* and *C. ferrugineus*.

Parasitism of the mite *A. lacunatus* led to a reduction in the number of *T. castaneum* larvae and adults, showing that the mite can affect populations of the beetle. *T. castaneum* adults can survive for several months, or even years, and, under optimal conditions (30 to 35°C and 75% relative humidity), their population might increase significantly (Rees, 1996). Therefore, it is important that biological control agents have higher population increase rates than their hosts, as in the case of *A. lacunatus*. This ability to reduce the population of *T. castaneum* suggests that this mite species may be an important biological control agent of *T. castaneum* in the tropics.

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