FIRST RECORD FOR *CATHARTUS QUADRICOLLIS* AND *CALLOSOBRUCHUS MACULATUS* CULTURES ATTACKED BY THE MITE *PYEMOTES TRITICI*

PRIMER REGISTRO DE COLONIAS DE *CATHARTUS* *QUADRICOLLIS* Y *CALLOSOBRUCHUS MACULATUS* ATACADAS POR *PYEMOTES TRITICI*

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ABSTRACT

It is recorded the occurrence of *Pyemotes tritici* (Lagrèze-Fossat & Montagné) on *Cathartus quadricollis* (Guérin-Ménéville) and *Callosobruchus maculatus* (Fabricius), reducing insect's populations in laboratory conditions. This mite was observed feeding on larvae and pupae of *C. quadricollis*, and adults of *C. maculatus*. The mite toxin quickly paralyzed larvae and adults attacked. The mite *P. tritici* is a lethal problem for mass rearing of insects and its effective eradication ultimately depends on the periodic monitoring of the insect colonies. As result, the mite *P. tritici* can be a new alternative for the biological control of *C. quadricollis* and *C. maculatus* in stored products. However, this possibility must be better understood before it could be recommended, because *Pyemotes* sp. could also cause dermatitis in the humans.

Key words: Acari, parasitism, biological control, Coleoptera, stored grains.

RESUMEN

Se registra la ocurrencia de *Pyemotes tritici* (Lagrèze-Fossat & Montagné) sobre *Cathartus quadricollis* (Guérin-Ménéville) y *Callosobruchus maculatus* (Fabricius), reduciendo las poblaciones de estos insectos bajo condiciones de laboratorio. Este ácaro fue observado alimentándose sobre larvas y ninfas de *C. quadricollis* y de adultos de *C. maculatus*. La toxina del ácaro paraliza totalmente las larvas y los adultos atacados. El ácaro *P. tritici* es un problema letal para producción masal de insectos, y su erradicación efectiva depende de una supervisión periódica de las colonias de insectos. De acuerdo con los resultados, el ácaro *P. tritici* puede ser una nueva alternativa para el control biológico de *C. quadricollis* y de *C. maculatus* en productos almacenados. Sin embargo, esta posibilidad necesita de estudios adicionales para posterior recomendación, visto que varias especies de *Pyemotes* también pueden causar dermatitis en seres humanos.

Palabras clave: Acari, parasitismo, control biológico, Coleoptera, granos almacenados.

The species of *Pyemotes* are leading a parasitoid mode of life, particularly favoring the various developmental stages of mostly insects. Owing to their parasitoid mode of life and aggressive attack on their host they might be considered as potential tools in biological control programs. The mite *Pyemotes tritici* (Lagrèze-Fossat & Montagné)

has been studied as a potential biological control agent because of its high reproductive potential, short life cycle and wide host range (Moser *et al.*, 1971; Bruce & Lecato, 1979; Bruce, 1983; Bruce & Wrensch, 1990).

The mite *P. tritici* is associated with virtually every insect order. More than 100 insect species

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are known hosts of *P. tritici* among Coleoptera, Hymenoptera, Lepidoptera, Homoptera, Strepsiptera and Diptera, but it is primarily associated with Coleoptera and Lepidoptera (Cross *et al.*, 1975; Bruce & Lecato, 1980; Bruce & Wrensch, 1990). In most cases, it was found on rearing mass in laboratories and stored products, attacking larval stages of *Plodia interpunctella* (Hübner), *Ephesia cautella* (Walker), *Oryzaephilus mercator* (Fauvel), *Lasioderma serricornis* (Fabricius), *Anagasta kuehniella* (Zeller) and *Sitophilus zeamais* Motschulsky, and adults of *Tribolium castaneum* (Herbst), *Sitotroga cerealella* (Oliver) and *Acanthoscelides obtectus* (Say) (Bruce & Lecato, 1979; Bruce & Lecato, 1980; Tawfik *et al.*, 1981; Hoschele & Tanigoshi, 1993; Oliveira & Matos, 2006; Cunha *et al.*, 2006; Oliveira *et al.*, 2007).

The biology of this mite species was studied by many researches (Moser, 1975; Bruce & Lecato, 1980; Bruce, 1983; Bruce & Wrensch, 1990). Due to its short life cycle period and a high reproductive potential, *P. tritici* population can easily increase. Females of this mite species produced up to 355 offspring. Males emerged faster than females (Tomalski *et al.*, 1988; Bruce & Wrensch, 1990; Hoschele & Tanigoshi, 1993). *P. tritici* is well characterized by two aspects: its physogastric process and suppression of immature stages. Physogastry is the extensive enlargement of a female's body during feeding period. During this phase, development of offspring begins. Development takes place inside the enlarged opisthosomal sac of these now gravid females with eggs proceeding directly to adults. The second contributes to the shortening of its life cycle, because this mite does not pass through the nymphal stages (Bruce, 1984; Gerson & Smiley, 1990; Evans, 1992).

Immediately upon emergency, females of *P. tritici* are mated and thus almost always disperse as fertilized adults. They can tightly attach to the host body and paralyze it by injecting its venom (toxins). The attachment is explained by their capability for easily piercing the cuticle with their chelicerae in order to suck the host (Tawfik *et al.*, 1981). In addition, the venom of a single female is enough to paralyze an insect host (Tomalski *et al.*, 1988), even if it is not proper for reproduction (Bruce & Wrensch, 1990). As result, this generalist behavior and efficient killing are strong points that must be considered for a promising biological control strategy.

We used one strain of the "square-necked grain beetle" *Cathartus quadricollis* (Guérin-Méneville) originally collected from maize on farm wood store in Aguanil, Minas Gerais, Brazil. The strain of the "cowpea weevil" *Callosobruchus maculatus* (Fabricius) was collected on laboratory cultures in Campos dos Goytacazes, Rio de Janeiro, Brazil. These populations were reared in glass bottles (1.5 L) in the laboratory (28 ± 2 °C, $70 \pm 5\%$ r.h.). Broken corn grains were used as food (13% m.c.) for *C. quadricollis* and whole beans for *C. maculatus* (13% m.c.). Grains were previously disinfected and kept at -18 °C to avoid reinfestation.

Cultures of the *C. quadricollis* and of the *C. maculatus*, stored in the Laboratório de Grãos Armazenados (Departamento de Engenharia Agrícola-Universidade Federal de Viçosa, Brasil) were heavily parasitized by the mite *P. tritici*. Subsequent examination of hosts showed that all were parasitized. We observed high mortality levels of *C. quadricollis* and *C. maculatus*. After carefully analysis, we concluded it was due to the high increased population and parasitism of *P. tritici* over these insects. *C. quadricollis* is cosmopolitan in distribution and has been found in wheat, rolled barley, rice, cacao and tobacco, and *C. maculatus* occurs throughout the tropical and subtropical regions of the world. It is a primary insect pest of stored legumes (Arbogast, 1991).

The health problems caused by *P. tritici* arise when they bite humans or other mammals. These bites cause painful itching skin lesions that have earned the name "hay-itch mite" for the more common species. This mite is also known as "straw-itch mite" and its venom can also injure humans, causing dermatitis (Moser, 1975). The attack actually involves the mite piercing the skin with its sharp stylet-like mouthparts, and injecting venom that would normally be used to paralyze or kill its insect host. A patient often has hundreds of these bites, which can be very painful. Examples of such cases are in a worker handling straw in Australia (Southcott, 1976), and people handling hay, straw and grain in Israel (Yeruham *et al.*, 1997), USA (Kinkle and Greiner, 1982; Walter and Landis, 1994) and Germany (Grob *et al.*, 1998).

The mite *P. tritici* was observed feeding on larvae and pupae of *C. quadricollis* (Figure 1), and adults of *C. maculatus* (Figure 2), with one or more mites per host (Figures 1 and 2). Soon after the parasitic attachment, toxins paralyzed larvae and adults these

Figure 1. *Cathartus quadricollis* larvae (A) and pupae (B) attacked by physogastric females of *Pyemotes tritici*.

Figure 2. *Callosobruchus maculatus* adult attacked by physogastric females of *Pyemotes tritici*.

species. Under the effect of parasitism by *P. tritici*, the hosts undergo marked color and shape changes. At this point, mites became yellowish, turning then brownish during feeding. *P. tritici* opisthosoma also changed and the female body enlarged, becoming spherical and milky (physogastric process).

P. tritici is a lethal problem for rearing mass of insects, since it can kill the whole population (Trivelli & Velásquez, 1985), as observed in this present study. However, *P. tritici* can also be considered a strong biological control agent for *C. quadricollis* and *C. maculatus*, pursuing fast reproduction ability and efficient parasitism performance over these insects. In agreement with Hoschele & Tanigoshi (1993), if *P. tritici* is used as a biological control agent, proper management will be needed because of this ability to administer painful bites. Thus, good control of the environment in which the mite is to be released is essential. A positive characteristic of *P. tritici* is that the mites are small enough not to have any adverse impact in the appearance of the product they are to protect. Once the pest has been eradicated, this mite species will die out as well. The commodity can be handled again after a sufficient safety period has elapsed. Therefore, the usefulness of *P. tritici* as a biological control agent seems promising and deserves additional investigation.

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