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Widespread infestation of *Pyemotes tritici* (Acari: Pyemotidae) in colonies of seven species of stored-product insects

Case Report

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ABSTRACT. Pyemotidae mites are ectoparasites of a large number of arthropods, and *Pyemotes tritici* (Acari: Pyemotidae) is often found parasitizing insects in various habitats, including in the laboratory. Here we report widespread infestation of *P. tritici* in laboratory colonies of various species of stored-products insects. *P. tritici* infestations were observed in laboratory colonies (MIPGrains/UFV) of *Sitophilus zeamais* (Coleoptera: Curculionidae), *Alphitobius diaperinus* (Coleoptera: Tenebrionidae), *Lasioderma serricorne* (Coleoptera: Anobiidae), *Acanthoscelides obtectus* (Coleoptera: Bruchidae), *Rhyzopertha dominica* (Coleoptera: Bostrichidae), *Ephestia* sp. (Lepidoptera: Pyralidae), and *Tribolium castaneum* (Coleoptera: Tenebrionidae). The widespread infestation of *P. tritici* in laboratory colonies of these species is a serious problem. This mite can substantially reduce insect populations or even kill them, making it impossible to rear the insects, as observed in this research. This ectoparasite is not recommended as a biological control agent in integrated pest management of stored-product pests because *P. tritici* can attack bees, mammals, and other animals and cause dermatitis in humans. In consideration of the above, the

widespread infestation of *P. tritici* in colonies of *S. zeamais*, *A. diaperinus*, *L. serricorne*, *A. obtectus*, *R. dominica*, *Ephestia* sp., and *T. castaneum* indicates that this mite should be monitored when raising stored-products insects to ensure the development of the insect populations and ensure that the laboratory environment is safe.

Key words: Straw itch mite; Natural enemy; Ecotoparasitism; Storage; Coleoptera

INTRODUCTION

The grain production chain requires suitable sanitary precautions owing to the occurrence of numerous pests that may cause economic damage, especially during the storage period, particularly in undeveloped countries such as Brazil (Lopes et al., 2018). Associated with this problem, several mites infest various materials, such as grains, dairy products, dried fruits, straw, and animal skin, that are produced and stored commercially; these are considered common contaminants in substrates where other arthropods also propagate (Hagstrum et al., 2013; Dhooria, 2016; Mullen and Oconnor, 2019).

Mites are reported ectoparasites of insects reared in laboratories, which are pests of stored grains (Bruce and Lecato, 1980; Tawfik et al., 1981; Hoschele and Tanigoshi, 1993; Cunha et al., 2006; Oliveira and Matos, 2006). Under favorable reproductive conditions of humidity and temperature, members of the Pyemotidae family are prominent (Bruce, 1984). *Pyemotes tritici* (Acari: Pyemotidae) are ectoparasites of a large number of arthropods, among which they are species of the insect class (Cunha et al., 2006). They have a short life cycle, rapid population growth, and various modes of dispersion; they adapt to different habitats, have diverse feeding habits, and ectoparasitize insects of the orders Coleoptera, Hymenoptera, Lepidoptera, Hemiptera, Strepsiptera, and Diptera (Oliveira et al., 2007; Menezes et al., 2009; Oliveira et al., 2010; Dhooria, 2016). An important characteristic of these mites is their ability to feed on several insect species at various stages of development, subsequently reproducing rapidly if the environmental conditions are suitable (Tawfik et al., 1981; Bruce, 1984; Cunha et., 2006).

In Brazil, the first account of the presence of mites belonging to the family Pyemotidae referred to the species *Pyemotes ventricosus* ectoparasitizing the pink bollworm *Pectinophora gossypiella* (Lepidoptera: Gelechiidae) of the cotton plant (Costa Lima, 1917). Pyemotid mites were also reported in a study on the diversity of mite fauna in beans, maize, and feed grains in supermarkets and free fairs in the city of Recife, PE, Brazil (Sousa et al., 2005). These mites do not feed on grains but are ectoparasitoids of insects infesting the grains sampled in the study. *P. tritici* infestation in adults of *Acanthoscelides obtectus* (Coleoptera: Bruchidae) in the laboratory has been reported to reduce the host population (Oliveira and Matos, 2006). Moreover, infestations of *Pyemotes* sp. were observed in colonies of *Anagasta kuehniella* (Lepidoptera: Pyralidae), *Sitophilus zeamais* (Coleoptera: Curculionidae) (Cunha et al., 2006), *Tuta absolute* (Lepidoptera: Gelechiidae) (Cunha et al., 2006; Oliveira et al., 2007), *Cathartus quadricollis* (Coleoptera: Silvanidae) and *Callosobruchus maculatus* (Coleoptera: Chrysomelidae) (Oliveira et al., 2010).

Knowledge on the range of species of stored-products insects and hosts of *P. tritici* is of great relevance for good laboratory practice because in addition to *P. tritici* reducing

the populations of the colonies (Dhooria, 2016), *P. tritici* causes dermatitis in humans (Rosen et al., 2002). Therefore, we report the occurrence of *P. tritici* in colonies of seven species of stored-product insects in the Laboratory of Integrated Pest Management of Stored-Product Pests (MIPGrains), Federal University of Viçosa, Viçosa, MG, Brazil.

In the MIPGrains Laboratory, a considerable number of sphere-shaped mites were observed corresponding to greatly expanded gravid or physogastric females of *P. tritici* in nymphs of *S. zeamais* (Figure 1A), and larvae of *Alphitobius diaperinus* (Coleoptera: Tenebrionidae) (Figure 1B), *Lasioderma serricorne* (Coleoptera: Anobiidae) (Figure 1C), *A. obtectus* (Figure 1D), *Rhyzopertha dominica* (Coleoptera: Bostrichidae) (Figure 1E), *Ephestia* sp. (Lepidoptera: Pyralidae) (Figure 1F) and *Tribolium castaneum* (Coleoptera: Tenebrionidae) (Figure 1G). The other small mites observed in Figure 1 are non-physogastric females or males. Mite specimens were collected and identified as *P. tritici* according to a dichotomous key (Cross al., 1981). Notably, all insect colonies infested with *P. tritici* presented high mortality rates and the insects were lethargic; therefore, they were being discarded.

Because the *P. tritici* female is physogastric, her opisthosoma becomes enormously distended with embryos beginning development several hours after attachment, and this distention may continue until the sac is several times the length of the mite body (Bruce and Lecato, 1980). This contributes to the shortening of the life cycle of the mite because new adults emerge from the female body, thereby bypassing the nymph stages (Oliveira et al., 2007). Previous studies have demonstrated the high reproductive potential of *P. tritici*, in which females produced up to 355 offspring, with a mean progeny of 254 offspring (Bruce and Wrensch, 1990), which explains the high incidence of *P. tritici* in the insect populations reported in this study. The females seek their hosts after fertilization, holding the host tightly with their chelicera and paralyzing them with the release of toxins. Neurotoxins from a single female are sufficient to paralyze an insect host up to 150,000 times its size (Mullen and Oconnor, 2019). The coloring of physogastric females appears to be a subsequent effect of the injection of toxins in the hosts. It is observed that the coloring of the mites is closely related to the coloring of their hosts, assuming a light or dark color (Figure 1), corroborating the findings of other studies (Menezes et al., 2009; Oliveira et al., 2010).

Despite the widespread infestation of *P. tritici* on several species of stored-products insects reported in this study, the use of this ectoparasite involving its release into the environment is not recommended because *P. tritici* causes dermatitis in mammals (Rosen et al., 2002; Cunha et al., 2006; Mullen and Oconnor, 2019). Although there is no recommendation of acaricide to control *P. tritici* infestation in insect colonies, Hanks et al. (1992) reported that sulfur by contact application (0.5 g) was effective in reducing *P. tritici* parasitism in *Phoracantha semipunctata* (Coleoptera: Cerambycidae). However, the use of this product when raising stored-products pests requires great caution because sulfur can also affect the reproduction of the same insects, as reported for *R. dominica* (Gonçalves et al., 2007). Effective eradication of *P. tritici* requires periodic monitoring of the insect colonies and disposal of infested materials. Furthermore, unused or large colonies should be avoided in the laboratory. Maintaining only the minimum number of insects is ideal, as well as avoiding grains with moistened molds. Finally, better knowledge of the range of hosts of *P. tritici* broadens the basis for more appropriate laboratory techniques aiming to ascertain the most optimal conditions to rear the insects and guarantee well-being and safety in the workplace.

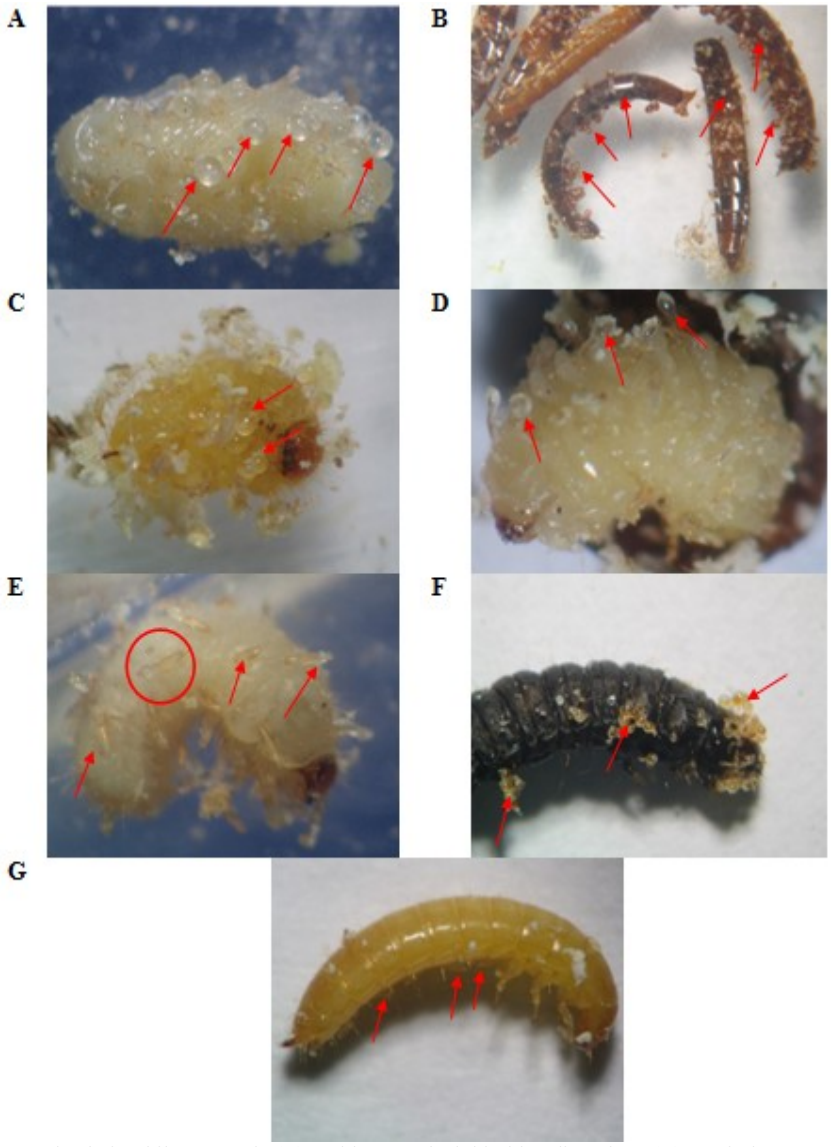

Figure 1. Nymph of Sitophilus zeamais (A) and larvae of Alphitobius diaperinus (B), Lasioderma serricorne (C), Acanthoscelides obtectus (D), Rhyzopertha dominica (E), Ephestia sp. (F), and Tribolium castaneum (G) ectoparasitized by Pyemotes tritici

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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