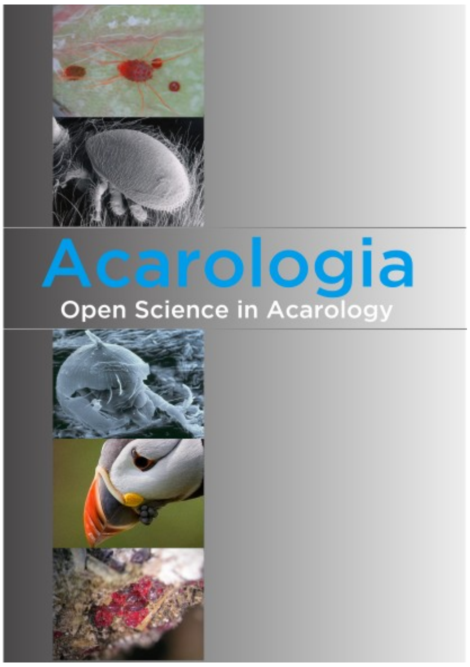

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New parasitism record of *Pyemotes tritici* (LaGreze-Fossat & Montagne, 1851) (Acari: Pyemotidae) on boll weevils inside cotton squares

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Short note

ABSTRACT

We report the occurrence of *Pyemotes tritici* (LaGreze-Fossat & Montagne) (Acari: Pyemotidae) parasitizing the boll weevil, *Anthonomus grandis* Boheman (Coleoptera: Curculionidae), in shed squares of cotton grown in a greenhouse. Parasitized larvae, pupae and adults of the cotton boll weevil had abdominal sternites and/or tergites covered by whitish spherical physogastric females of *P. tritici*. This is the first record of the cotton boll weevil parasitized by this mite species.

Keywords *Anthonomus grandis*; dust mite; parasitism; toxin

Introduction

Mites of the family Pyemotidae are reported as ectoparasites of a large number of arthropods He *et al.*, 2019; Sousa *et al.*, 2020; Chen *et al.* 2021), mainly insects of the orders Lepidoptera (Cunha *et al.*, 2006; Oliveira *et al.*, 2007; He *et al.* 2012, 2014; Liu *et al,* 2020; Tian *et al.* 2020), Hemiptera (Han, 2016; Li *et al.* 2019; Yu *et al.* 2019), and Coleoptera (Cunha *et al.* 2006; Guo *et al.* 2009; Oliveira *et al.*, 2010). *Pyemotes* spp., also known as “straw itch mites”, are of particular interest in applied acarology, both for their behavior as insect parasites and for their medical importance (Tomczyk-Socha *et al.* 2017; He *et al.*, 2019). Adult females of this mite attach themselves to the host to feed, undergoing physogastry, the expansion of the posterior portion of their body (opisthosoma) to facilitate offspring development (Cunha *et al.* 2006). According to Tomalski *et al.* (1988), approximately 200 to 350 sexually mature mites are produced per female. Males are the first to be born, as adults, immediately copulating with their adult sisters. The newborn females immediately seek new hosts, which once parasitized, become paralyzed by the release of toxins (Sousa *et al.*, 2020). Neurotoxins from a single female are sufficient to paralyze an insect host up to 150,000 times the size of the mite (Mullen and Oconnor, 2019). Studies on the potential of *Pyemotes zhonghuajia* as a biological control agent for eggs, larvae and pupae of the fall armyworm *Spodoptera frugiperda* (Smith) (Lepidoptera: Noctuidae) and the oriental armyworm *Mythimna separata* (Walker) (Lepidoptera: Noctuidae) demonstrated that a female is capable of killing more than 50% of first to third instar larvae of *S. frugiperda* and *M. separata* within 72 h under laboratory conditions (Liu *et al.*, 2020; Tian *et al.*, 2020).

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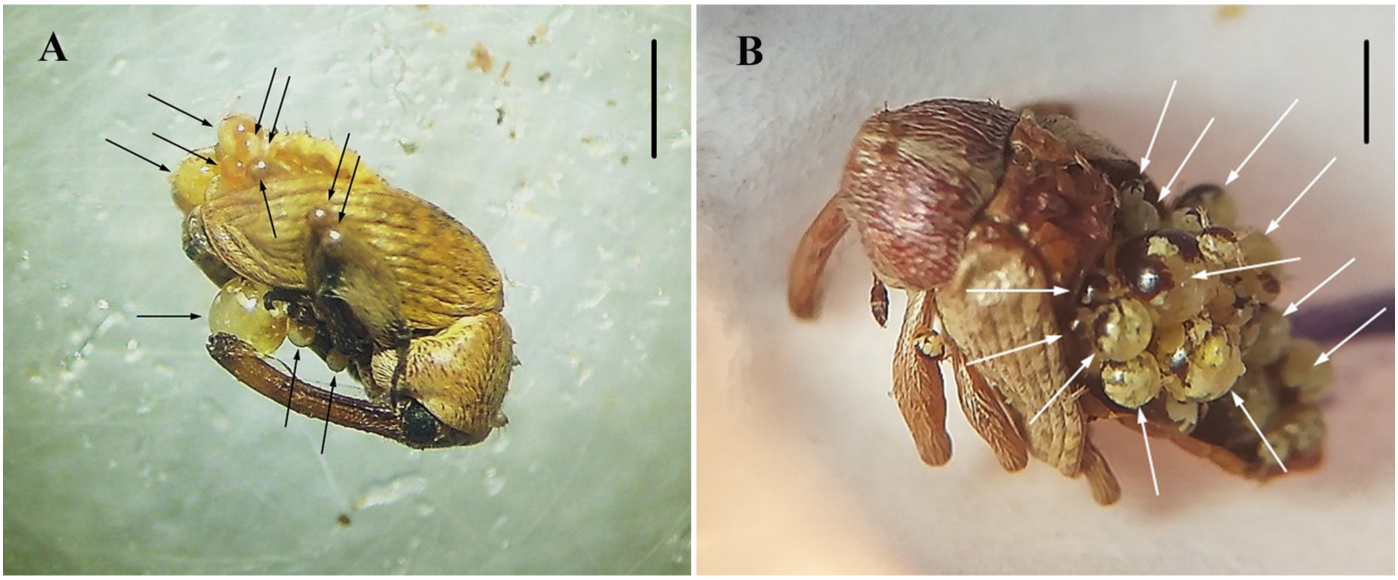

Figure 1 The cotton boll weevil, *Anthonomus grandis* Boheman (Coleoptera: Curculionidae) parasitized by *Pyemotes tritici* (LaGreze-Fossat & Montagne) (Acari: Pyemotidae). A: Pupae and B: adult (B). Scale bar = 1mm.

Here, we report a case of a pyemotid species parasitizing the cotton boll weevil, *Anthonomus grandis* Boheman (Coleoptera: Curculionidae) in Brazil.

Material and methods

The initial study was conducted to evaluate the resistance of cotton lines against the boll weevil, *A. grandis*, using transgenic and non-transgenic isolines (BRS 372) of cotton plants maintained in 15 L pots in a greenhouse at 29 ± 1°C, 60 ± 10% relative humidity and a 12 h photophase at Embrapa Algodão (7°13′50″S and 35°52′52″W). The pots were filled with 75% soil and 25% Plantmax™ commercial substrate (60% pine bark, 15% vermiculite and 25% humus). Forty-five days after germination, 481 cotton squares with oviposition punctures caused by cotton boll weevils were shed. These were collected and taken to the laboratory, where each was placed in a screened cage (23 × 35 × 31 cm) to await the emergence of adult weevils. Observations were made daily, until emergence ceased. Squares for which emergence did not occur were then dissected to assess whether the cause of mortality was due to the toxic *Bt* protein incorporated into the transgenic cotton plants. The dissection of cotton squares was performed according to Ramalho *et al.* (1993).

Results and discussion

Emergence was not recorded from 154 (32%) cotton squares. In 42 of these (27%), the weevil was found to be parasitized by the mite *Pyemotes tritici* (LaGreze-Fossat & Montagne) (Acari: Pyemotidae); identification based on Cross *et al.* (1981). No differences were observed in the parasitism rates of boll weevils between transgenic and non-transgenic cotton plants. Among the parasitized insects, five (12%), 18 (43%) and 19 (45%) were in the larval, pupal (Figure 1A) and adult (Figure 1B) phases, respectively. The mites were found on the abdominal sternites and/or tergites of the host, visible as whitish spherical physogastric females (Figure 1 A, B).

In Brazil, *P. ventricosus* mites have been recorded on the pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) (Costa Lima, 1917). Pyemotid mites were also reported on the tomato leafminer *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) (Cunha *et al.*, 2006; Oliveira *et al.*, 2007), the flour moth *Anagasta kuehniella* (Zeller) (Lepidoptera: Pyralidae), the corn weevil *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae) (Cunha *et al.* 2006), as well as on *Cathartus quadricollis* (Guérin-Méneville) (Coleoptera: Silvanidae) and *Callosobruchus maculatus* (Fabricius) (Coleoptera: Curculionidae) (Oliveira *et al.*, 2010). The first report of *Pyemotes* group *ventricosus* mites parasitizing cotton boll weevils was made by Herrera in northern Mexico (Cross and Chesnut, 1971), but the species was not identified. Therefore, this is the first report of the cotton boll weevil being parasitized by *P. tritici*. Because this mite species is free-living, being commonly found in dried, insect-infested plant products such as hay, straw, and grains (Sousa *et al.*, 2020); we believe that they were introduced into the greenhouse through the substrate incorporated into the soil used for cotton cultivation. In Brazil, infestations by *P. tritici* of nests of stingless bees, *Melipona subnitida*, *M. asilvae*, *Tetragonisca angustula* and *Frieseomelitta varia* (Hymenoptera: Meliponina) and of laboratory reared *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) was previously reported (Kerr *et al.* 1996; Nogueira-Neto, 1997; Menezes *et al.* 2009; Sousa *et al.* 2020). *P. tritici* females have high reproductive potential, producing approximately 254 offspring per female (Bruce and Wrensch, 1990), potentially explaining their high incidence in populations of cotton boll weevils in the greenhouse.

Although *P. tritici* has characteristics relevant to biological control, such as a short life cycle, wide host range and rapid population growth (He *et al.*, 2019), the direct use of mites of this group as a biological control agent for cotton boll weevils through their release into the environment is not recommended. Past attempts at field releases of *P. ventricosus* in cotton crops in Texas, USA were apparently disappointing (Pierce *et al.*, 1912; Cross and Chesnut, 1971). In addition, and more importantly, this mite can have undesirable effects on humans, causing dermatitis (Cunha *et al.*, 2006; Tomczyk-Socha *et al.*, 2017). Due to these practical problems, past research turned toward the potential use of toxins synthesized by certain mite species of this genus. The TxP1 toxin, for example, produced by *P. tritici*, has been purified and characterized by Tomalski *et al.* (1988). The incorporation of this toxin improved success in the use of nuclear polyhedrosis virus against *Helicoverpa zea* (Boddie) (Lepidoptera: Noctuidae) and of *Baculovirus* species against *Trichoplusia ni* (Hübner) (Lepidoptera: Noctuidae) (Popham *et al.*, 1997; Burden *et al.*, 2000; Kroemer *et al.*, 2015). Therefore, we believe that the best way to take advantage of the *P. tritici* mite in biological control programs for cotton boll weevils is through the incorporation of its toxins into bioinsecticides. Furthermore, these bioinsecticides have the potential to improve the effectiveness of current pest control programs and, in some cases, may exhibit synergism with existing integrated pest management (IPM) techniques (Wratten, 2009), without causing undesirable effects in humans. These *P. tritici* mite toxins can also be incorporated into the genome of entomopathogens and cultivated plants (Windley *et al.*, 2012).

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