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Phoretic mites associated with ambrosia beetles in Florida avocados*

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Ambrosia beetles spend most of their life inside galleries built on host trees. They use the xylem as a substrate for farming symbiotic fungi, carried in specialized sac-like structures called mycangia. Most of their symbionts offer no threat to plants. However, some of these symbionts are phytopathogens that infect avocado (*Persea americana*) and other plants in the family Lauraceae. *Raffaelea lauricola* is a fungal pathogen vectored by several species of ambrosia beetles in the United States. It is the causal agent of laurel wilt, a deadly disease affecting avocado and forest ecosystems in Florida. The cryptic living habits of the ambrosia beetles make their management challenging. Conventional insecticide and fungicide applications have not been successful so far. This system requires novel IPM strategies.

A few other organisms inhabit ambrosia beetle galleries, such as nematodes and phoretic mites. Little is known about the ecology of phoretic mites and their potential application in IPM. As a first step to understand the association between ambrosia beetles and phoretic mites, a survey was conducted in eight avocado orchards and swampbay (*Persea palustris*) stands in Florida. Ambrosia beetles were captured in flight using modified Lindgren traps, as they emerged from infested logs placed in emergence chambers, and were also physically excavated from infested logs. Nine mite species in five families were collected from nine beetle hosts, including *Asca* sp. (Ascidae), *Proctolaelaps bickleyi* and *Proctolaelaps* sp. (Melicharidae), *Acarothorectes curculionium*, *Elattoma* sp., *Brasilopsis floridensis*, and *Pediculaster* sp. (Pygmephoridae), *Tarsonemus* sp. (Tarsonemidae), and *Histiogaster arborsignis* (Acaridae). The mite family Pygmephoridae was the most abundant group. *Acarothorectes curculionium* and *Elattoma* sp. were the most common phoretic mite species, and *B. floridensis* is a new mite species found in this study (named and described in Khaustov *et al.* 2022). The phoretic associations were not specific to a particular ambrosia beetle species. *Histiogaster arborsignis* is a cosmopolitan phoretic mite commonly associated with wood-boring insects. This fungivorous mite can be easily mass-reared and could potentially transport fungal spores into the beetle galleries. The fungal feeding plasticity of *H. arborsignis* was assessed through no-choice assays offering *R. lauricola*, *Fusarium* sp., six non-pathogenic ambrosia beetle fungal symbionts, and two commercially available beneficial fungi. The ability of *H. arborsignis* to carry and inoculate *Beauveria bassiana* and *Trichoderma harzianum* into ambrosia beetle colonies was also assessed. *H. arborsignis* developed and reproduced for two generations on all beetle symbionts, particularly more on *Graphium* sp. No reproduction *on T. harzianum* or *B. bassiana* was observed. The mites transferred beneficial fungi to *X. bispinatus* galleries in avocado sawdust rearing media, affecting the beetles' survivability and reproduction. *Histiogaster arborsignis* has consistently shown a close association with the beetle fungal symbionts and the potential to be incorporated into innovative IPM practices for managing wood boring pests.

This research is the first step towards understanding complex symbiotic associations between phoretic mites, ambrosia beetles and ambrosia fungi. Future studies will evaluate the potential of phoretic mites to be incorporated into innovative IPM practices for managing ambrosia beetles and other wood-boring pests.

Keywords: ambrosia beetles, laurel wilt, phoretic mites, entomovectoring, fungi, *Histiogaster*, wood-boring pests, biological control

Reference

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