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Mites (Acari) associated with *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) in Malaysia, with a revised list of the mites found on this weevil

Masilamany Dilipkumar [a,*], Ali Ahadiyat [b], Peter Mašán [c], Tse Seng Chuah [d]

[a] Malaysian Agricultural Research and Development Institute, MARDI Seberang Perai, 13200 Kepala Batas, Pulau Pinang, Malaysia
[b] Department of Entomology, College of Agriculture and Natural Resources, Science and Research Branch, Islamic Azad University, Tehran, Iran
[c] Institute of Zoology, Slovak Academy of Sciences, Dúbravská cesta 9, 84506 Bratislava, Slovakia
[d] Department of Agro-technology, Faculty of Agro-technology and Food Science, University of Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

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ABSTRACT

There is a great deal of diversity among phoretic association particularly in mesostigmatic mites that exploited insect host to complete their dispersal strategy. Similarly, the red palm weevil, *Rhynchophorus ferrugineus*, also has been used as a carrier by the phoretic mites. In this study, we found *Centrouropoda almerodai* (Uropodidae), *Macrocheles mammifer*, *Macrocheles* cf. *oigru* (Macrochelidae), *Uroobovella assamomarginata* and *Uroobovella javae* (Dinychidae) as the phoretic mites associated with the Malaysian red palm weevils. Male weevils had significantly greater number of mites per host as compared to the female weevils. Present study revealed that the red palm weevils were infested with very large numbers of phoretic mites which occur mainly under the elytra. Our results combined with those in the literatures suggest the potential role of phoresy in the evolution of parasitism.

Introduction

The red palm weevil, *Rhynchophorus ferrugineus* Olivier, 1790 is an important pest of palm trees in Asia, which has been reported from 19 Asian countries (Murphy and Briscoe, 1999). In the recent years, this weevil has been assumed to be a serious pest in all major coconut growing tracks of Malaysia, as it is found throughout the year and causes great yield losses. Among the known palm pests, it is the most harmful because the infestations are often not detected until the fronds wilt and the crown collapses suddenly by which time the tree is beyond recovery (Sivapragasam et al., 2010). The late detection of red palm weevil infestations constitutes a serious problem in the fight against this lethal pest of coconut palms.

The biology of red palm weevil has been studied in many countries including India, Indonesia, Myanmar, Philippines, Iran and Spain (Avand-Faghih, 1996; Esteban-Duran et al., 1998; Murphy and Briscoe, 1999). Red palm weevil has been reported to be associated with numerous types of arthropods, including mites and parasitic insects and even microorganisms such as viruses, bacteria, fungi and nematodes (Murphy and Briscoe, 1999). The symbiotic relationship between some of these species could have positive, neutral or negative influences on the weevil, and the most least studied of which are the mites (Acari). Mites are known to be phoretic associated with red palm weevil and their relationships have been described by several authors (Al-Deeb et al., 2011; Hassan et al., 2011; Mazza et al., 2011). Phoresy is a phenomenon by which an organism (phoront) is actively carried on or in another organism (host) for a limited time period to complete their dispersal strategy to favourable habitats (OConnor, 1982; Kaliszewski et al., 1995).

To date, the identity and type of interaction of phoretic mites on the red palm weevil has not been studied in Malaysia. In fact, this is the second research on phoretic mites–insect interaction followed by the first study conducted by Ho (1990) on phoretic association between *Macrocheles muscaedomesticae* Scopoli, 1772 (Macrochelidae) and flies in Malaysia. This study was carried out to report the mite species associated with the red palm weevil and to determine the distribution patterns of mites on the weevil's body. Besides, the prospective consequences of phoretic mites on the red palm weevils have also been discussed in this paper.

Materials and methods

Sample collection

From November 2012 to March 2013, 150 live adults of the red palm weevil, *Rhynchophorus ferrugineus*, (sex ratio = 1:1) were collected by hand from infested coconut farms at Terengganu

* Corresponding author. Tel.: +60 4 5751632; fax: +60 4 5751725.
E-mail address: dilip@mardi.gov.my (M. Dilipkumar).

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(5° 33′ N, 103° 15′ E) and Kelantan (6° 13′ N, 102° 14′ E), Malaysia. Captured weevils were transported back to the laboratory and were stored in a freezer at −20 °C.

Mite identification and distribution pattern

Weevils were dissected individually under a stereomicroscope and the number of mite presence on the head, thorax, abdomen, elytra, membrane wings and legs were counted. Mites were separated from the weevils using a camel hair brush and preserved in 70% ethanol. These mites were then cleared and mounted in Hoyer's medium on permanent microscopic slides for identification under a microscope at 40–400× magnification. The mite species were identified with the help of the original descriptive papers (original descriptions and illustrations) in which these species were firstly described. Specimens of mite taxa identified in this study were deposited in the Entomology Laboratory of Station MARDI Bachok, Malaysia.

Statistical analysis

Statistical analysis was carried out using SPSS version 15.0. All data were found to be non-normally distributed and were therefore analysed via nonparametric methods. Host preference of phoretic mites either on male or female red palm weevils was compared using Mann–Whitney *U* test ($p \leq 0.05$). Kruskal–Wallis test was performed to analyse the distribution of mites on different body regions of the weevils ($p \leq 0.05$). The Student–Newman–Keuls method was further used for pairwise multiple comparisons ($p \leq 0.05$).

Results

Five phoretic species from three different families of Mesostigmata are documented for the first time as associates of the red palm weevil in Malaysia, namely *Centrouropoda almerodai* Hiramatsu and Hirschman, 1992 (Uropodidae), *Macrocheles mammifer* Berlese, 1918, *Macrocheles* cf. *oigru* Walter and Krantz, 1986 (Macrochelidae), *Uroobovella assamomarginata* Hiramatsu and Hirschman, 1979 and *Uroobovella javae* Wiśniewski, 1981 (Dinychidae) (Fig. 1). The present study has shown that, mites were phoretically attached to all tested red palm weevils ($n = 150$). Phoretic load ranged from 11–838 and 42–1345 individuals per host on female and male red palm weevils, respectively (Fig. 2). Mean abundance of phoretic mites on male weevils was significantly higher than that on female weevils ($p = 0.004$). Kruskal–Wallis analysis showed that the mite loads were significantly different among the body regions of the weevil ($p \leq 0.001$) (Fig. 3). The mean distributions of phoretic mites on the inner elytral surface for both sexes were significantly greater than those observed in the other body regions ($p \leq 0.05$). The second highest phoretic load was observed in the membrane wing followed by the abdomen. However there is no significant difference between these two body regions. Meanwhile the lowest phoretic loads were observed in the head followed by the leg and thorax.

Discussion

Among the identified taxa of mites in Table 1, there are 25 species and 21 genera in 18 families and two superorders (Parasitiformes and Acariformes) reported in association with *R. ferrugineus*. The high

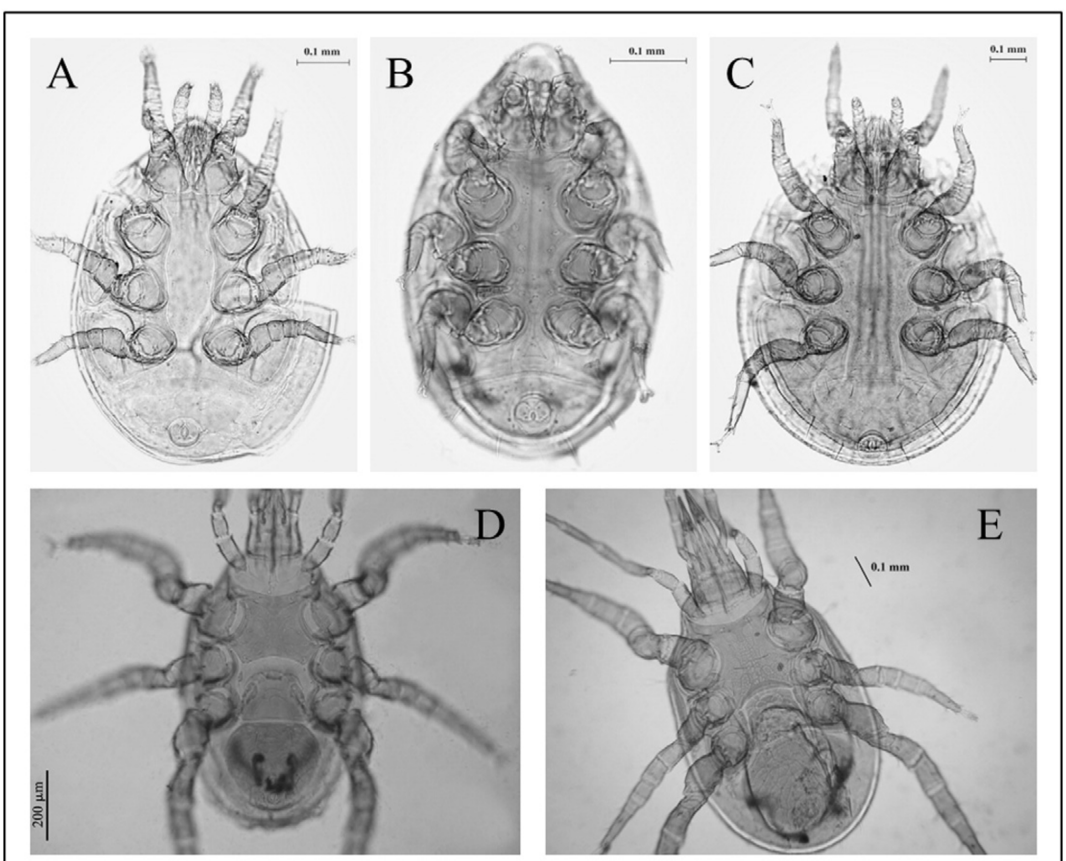

Fig. 1. Mesostigmatic mites found on *Rhynchophorus ferrugineus* in Malaysia: *Centrouropoda almerodai* (A), *Uroobovella javae* (B), *Uroobovella assamomarginata* (C), *Macrocheles* cf. *oigru* (D) and *Macrocheles mammifer* (E).