

IDENTIFICATION OF *RASTROCOCCUS RUBELLUS* WILLIAMS (HEMIPTERA: PSEUDOCOCCIDAE) ON MANGO: A NEW RECORD TO SRI LANKA

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ABSTRACT

An island-wide survey of mealybugs (Hemiptera: Pseudococcidae) conducted in 2008/09 helped identify two species of *Rastrococcus* from Sri Lanka. *R. invadens* Williams was identified from samples collected on *Plumeria* sp. and *Ficus arnottiana*, while *R. rubellus* Williams was found on *Plumeria* sp. Although *R. invadens* has been recorded in Sri Lanka before, this is the first record of the oriental mealybug, *R. rubellus*, from the country. *R. rubellus* was found in mixed colonies with *R. invadens*; so far, the infestations have not been associated with any severe crop losses. The survey revealed that *R. rubellus* is confined to a limited area in Colombo District. This restricted distribution suggested that it may be a new introduction to the country. Diagnostic characters to aid recognition of *R. rubellus*, and details of its distribution and host range within Sri Lanka are given.

Key words: Mealybugs, *Rastrococcus rubellus*, *Rastrococcus invadens*, Sri Lanka

INTRODUCTION

An epidemic of mealybugs (Hemiptera: Pseudococcidae) occurred in Sri Lanka in early 2008, infesting a number of plant species and causing severe damage. A survey conducted in 2008/09 found that five species were responsible for the epidemic: Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink on papaw and *Plumeria* spp. (Galanihe *et al.* 2010); Gray pineapple mealybug (*Dysmicoccus neobrevipes* Beardsley) on banana (*Musa* spp.) (Anon 2009); Cotton mealybug (*Phenacoccus solenopsis* Tinsley) on a wide range of crops and weeds (Prishanthini and Vinobaba 2009); *Rastrococcus invadens* Williams, on *ficus* & *Plumeria* (Williams 2004); and *R. rubellus* Williams, on plumeria a new record for Sri Lanka. The two *Rastrococcus* species were found mostly feeding on mango trees (*Mangifera indica*) but were also found on *Artocarpus integrifolius*, *Alocasia* sp., *Costus speciosus*; and on *Plumeria* spp. This paper provides diagnostic characters to aid recognition of *R. rubellus*, and details of its distribution and host range within Sri Lanka as recorded in 2008/09.

MATERIALS AND METHODS

An island-wide mealybug survey was conducted from August 2008 to July 2009 to determine the pest mealybug species, their distribu-

tions and host plant ranges. Representative samples collected from *Plumeria* spp. and *Ficus arnottiana* were preserved for authoritative identification by placing small infested pieces of plant in 70% ethanol. Each sealed, labeled vial was immersed in freshly boiled water for 20 minutes to denature enzymes and ensure optimal preservation. The samples were then shipped to the Plant Pest Diagnostic Center, California Department of Food and Agriculture, Sacramento, California, USA (CDFA-PPDC) for authoritative identification.

At CDFa-PPDC, the mealybugs were prepared as archival-quality slide mounts by maceration of the body contents in 10% KOH, staining of the cuticle with acid Fuchsin and then slide-mounting them in Canada balsam, using the method given by Watson & Chandler (2000). They were then examined using a Zeiss compound microscope with phase contrast illumination at magnifications of x25-x800. Specimens were identified using the keys in Williams (2004) and Williams and Granara de Willink (1992), and with reference to specimens in the California State Collection of Arthropods (CSCA) at CDFa-PPDC. One or more permanent slide mounts of each species were deposited in the insect museum of the Department of Agriculture, Sri Lanka, and some additional slides were deposited in CSCA.

One of the diagnostic characters noted in the field was colour of the body contents, but this

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was often obscured by the white coating of mealy wax on the insect's cuticle. The body content colour was most easily seen when a live mealybug was crushed and smeared on white paper.

This paper will cover only the observations made on *Rastrococcus* spp. The host ranges of *R. invadens* and *R. rubellus* were determined based on field observations. However, some of the host species recorded may not have been capable of sustaining a long-term infestation over multiple generations.

RESULTS

Pest species responsible for the mealybug epidemic

The main pest species was papaya mealybug, *Paracoccus marginatus*, which caused heavy damage, mainly to papaw and *Plumeria* spp. but more than 40 host species were recorded. It was observed to have spread all over the country (Galanihe *et al.* 2010). Of the four other pest species found, the gray pineapple mealybug (*Dysmicoccus neobrevipes* Beardsley), a polyphagous species (Ben-Dov 2012b), mainly damaged banana (*Musa* spp.) (Anon 2009). The cotton mealybug, *Phenacoccus solenopsis* Tinsley, infested a wide range of crops and weeds (Prishanthini and Vinobaba 2009; Ben-Dov 2012c). *R. invadens*, which was collected from Sri Lanka for the first time by E.E. Green in 1900 (Williams 1986), and *R. rubellus*, a new record for Sri Lanka, were found together in mixed populations in which *R. invadens* was the dominant species. The number of *R. rubellus* specimens found was relatively low.

Authoritative identification *Rastrococcus* species

The two species of *Rastrococcus* in the mixed populations were identified by Gillian Watson as *Rastrococcus invadens*, the mango mealybug; and *R. rubellus*, a new country record from Sri Lanka.

Diagnostic characters

In the field, most *Rastrococcus* species differed from many other mealybugs because they did not form tight colonies and their ovisac wax was not sticky (Plate 1). The body of the adult female was oval, pale, flat, and completely covered with white powdery wax. A series of



Plate 1



Plate 2

Plate 1 & 2: Colours of *Rastrococcus rubellus* on mango leaves & fruits

conspicuously long, white wax filaments was present around the body margin, giving the insect a star-like appearance. The marginal filaments were relatively short at the anterior end and become progressively longer towards the rear (Plate 2). The adult male had a translucent, pale yellow, elongated body, long many-segmented antennae and one pair of wings.

Rastrococcus invadens and *R. rubellus* are very similar to each other. In the field, adult females of *R. rubellus* were usually slightly larger than those of *R. invadens*. The colour of the body contents also differed, being pale green in *R. invadens* but pink in *R. rubellus*. In microscope slide mounts, the frontal cerarii of *R. rubellus* were almost always linked by sclerotized cuticle, whereas in *R. invadens* they were usually separated by a strip of membranous cuticle; this difference was illustrated by Williams (1989 and 2004).

Host ranges

In Sri Lanka, *Rastrococcus* spp. mainly infested mango, *Mangifera indica* L., but were also found on *Artocarpus integrifolius* L. f., *Plumeria* spp., *Alocasia* sp., *Ficus* sp. and *Costus speciosus* (J. König) Sm. *R. invadens* Williams was identified from samples collected on *Plumeria* sp. and *Ficus arnottiana*, and *R. rubellus* Williams was identified from *Plumeria* sp.

In West Africa, introduced *R. invadens* mainly infested mango and *Citrus* spp. (Williams

1986). Mango, citrus, breadfruit, banana, *Plumeria alba* and *Ficus* spp. were reported by Agouké *et al.* (1988) as the most-attacked plants by *R. invadens* in West Africa; however, the species has a much wider host range that includes 65 plant species in 28 families (Ben-Dov 2012d).

Information on *R. rubellus* in the literature is scarce. Its hosts have been recorded as *M. indica*, *Plumeria rubra*, *Mallotus paniculatus*, *Ficus* sp., *Citrus aurantium*, *C. grandis* and *C. microcarpa* (Ben-Dov 2012e; Agouké *et al.* 1988).

Distributions

Of the five pest mealybug species found in the 2008 epidemic, *Paracoccus marginatus* was the dominant species, being highly invasive. It probably originated from Mexico and/or Central America and has been spreading westwards around the globe. In Sri Lanka it quickly spread to numerous plant species all over the country (Galanihe *et al.* 2010). *Dysmicoccus neobrevipes* was found mainly in the Western province (Anon, 2009). *Phenacoccus solenopsis* was reported mainly from the Eastern province (Vinobaba and Prishanthini, 2009). *R. invadens* is native to Southern Asia, and is quite widespread in mainland southern Asia (Williams 2004). *R. rubellus* was described from Malaysia (Williams 1986) and has been reported also from Hong Kong, Indonesia and Laos (Ben-Dov *et al.* 2012e).

DISCUSSION

All 30 of the described species of *Rastrococcus* are native to the Oriental and Australasian

regions, occurring in Australasia and southern Asia (Williams 1989). They feed on a range of fruit trees; none are host-specific, so they are all of potential economic importance wherever they may be accidentally introduced outside their native ranges. *R. invadens* caused major damage to mango, citrus and other fruits when accidentally introduced to Ghana and Togo, West Africa in 1981 (Williams 1989), with up to 80% loss of mango yield in Ghana (Willink and Moore 1988). It spread very rapidly throughout West Africa (Williams 1986). Infestation of mango fruits by *R. invadens* was found to affect their nutritional status (Tobih *et al.* 2002).

Five species of *Rastrococcus* have been recorded from Sri Lanka in the literature: *R. iceryoides* (Green), *R. invadens*, *R. mangiferae* (Green), *R. spinosus* (Robinson) and *R. taprobanicus* Williams. Green (1922) recorded *R. spinosus* from Sri Lanka; however, Williams (2004) studied Green's slide material and found that Green had misidentified a mixture of *R. invadens* and *R. taprobanicus* as *R. spinosus*. So there is no evidence that *R. spinosus* has ever been established in Sri Lanka, and only four *Rastrococcus* species have been recorded from Sri Lanka before.

The new record of *R. rubellus* brings the total number of *Rastrococcus* species present in Sri Lanka to five (Table 1). To date, *R. rubellus* has not been observed causing any significant economic damage to mango or other fruit trees on the island.

In view of E.E. Green's collection of *R. invadens* from Sri Lanka in 1900 (Williams

Table 1: *Rastrococcus* species recorded in Sri Lanka

<i>Rastrococcus</i> species	Location	Host-plant(s)	Year collected	Reference
<i>R. iceryoides</i>	Not specified	<i>Tephrosia candida</i> ; <i>Odina woodier</i> ; <i>Callicarpa lanata</i> ; <i>Wendlandia notoniana</i>	pre-1923	Green (1922)
<i>R. invadens</i>	Peradeniya; Kandy; Murunkan	Malvaceae; <i>Honckenya ficifolia</i> ; <i>Lannea wodier</i> ; <i>Murrayakoenigii</i> ; <i>Capparis</i> sp.	1909 1912	Williams (1989)
	Peradeniya	<i>Ficus</i> sp.	1900	Williams (1989)
	Colombo	<i>Ficus arnottiana</i>	11.vi.2009	Current paper
<i>R. mangiferae</i>	Moratuwa	<i>Plumeria</i> sp.	9	
	Punduloya	<i>Mangifera indica</i>	pre-1897	Green (1896)
	Maskelia	<i>Mangifera indica</i>	1922	Williams (1989)
<i>R. taprobanicus</i>	Bandarawella			
	Trincomalee	undet. host	No date; identified by Green	Williams (1989)
<i>R. rubellus</i>	Ibbagamuwa	undet. hosts	1964 1979	Williams (2004)
	Colombo			
	Moratuwa	<i>Plumeria</i> sp.	11.vi.2009	Current paper

1986), this species might be native to the island, or it may have been introduced a long time ago; if the latter, it might have died out in Sri Lanka but then have been reintroduced recently. *R. invadens* and *R. rubellus* were collected only in a limited area in Sri Lanka, in the Colombo District of the Western province of Sri Lanka, suggesting that one or both species may have been introduced recently from mainland Asia.

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