

Paracoccus marginatus

INTRODUCTION

Paracoccus marginatus was first described by Williams & Granara de Willink in 1992 and is commonly called the papaya mealybug. Of the 79 species of *Paracoccus* so far described, four have been recorded from Caribbean countries, although their regions of original distribution were probably confined to Central and northern South America ((Watson and Chandler, 1999). *Paracoccus burnerae* (Brain) is considered to be a serious pest of citrus in South Africa while *Paracoccus marginatus* has become a polyphagous pest in Florida and the Caribbean.

The papaya mealybug secretes large amounts of white wax and has some host plants in common with the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green). Symptoms of plant damage are sometimes mistaken for those of *M. hirsutus* but *P. marginatus* can be distinguished by its greenish yellow body colour that is unlike the pink colour of *M. hirsutus*. The species epithet is derived from a latin word, meaning enclosed with a border and refers to the border of oral rim tubular ducts (Williams & Granara de Willink).

Identity

Authority : Williams & Granara de Willink, (1992)

Classification:

Kingdom : Animalia
Class : Insecta
Order : Homoptera
Family : Pseudococcidae
Genus : *Paracoccus*
Species : *marginatus*
Common name : Papaya mealybug
Role : Pest

Signs & Symptoms

Paracoccus marginatus attacks and damages various parts of the host plant including the leaves, stems, flowers and fruits. Visual symptoms of plant damage by *P. marginatus* are similar to those expressed on plants attacked by *M. hirsutus* particularly in cases of heavy infestation, or among older papaya mealybug colonies. The two pests share many common hosts. Some symptoms of plant damage are shown in (Fig.1).

The papaya mealybug favours many plants with heavy latex e.g. frangipani, *Euphorbia sp.* cassava, sweet potato, papaya and attack such plants at all stages of the plant life.. In some plants e.g. soursop the mealybug colonizes mainly the flowers and fruits. In others, various parts of the plant may be affected and a wide range of symptoms can be seen, although these may vary from plant to plant. Some plants are tolerant of the mealybug, attack and leaves and stems show no visual symptoms even in the presence of large mealybug colonies e.g. soursop, *Acalypha sp.*

Leaf damage – Curling, crinkling, rosetting, twisting and general leaf distortion; reduced in leaf size and surface area.

Stem and shoot damage - Shoots and young stems may be distorted and malformed; arrested growth at the shoot terminals lead to shortened internodes and rosetting at the shoot tip.

Flower damage - Flowers may be distorted and fail to open; where they open, petals may be twisted and/or malformed or show various types of blemishes. Premature flower drop and poor fruit set may occur.

Fruit damage - Fruit blemish and sooty mould may reduce the marketability and market value of fruits such as papaya, guava, soursop. Fruits may fail to develop normally and may be unusually small. Such fruits eventually shrivel and drop.



Crimpling and rosetting of leaves in *Frangipani*



Premature aging of leaves in papaya



Leaf drop in *Jathropa*



Shoot dieback in cassava



Mealybug colony on broad bean



Mealybug colony on egg plant



Mealybug colony and sooty mould on papaya fruit

Fig 3: Symptoms of the papaya mealybug *Paracoccus marginatus* on some of its host plants.

Morphology

Diagnostic features based on field characters

Most of the nymphs and adults female are greenish-yellow in colour with yellowish body fluid. Some of the nymphs have a reddish appearance. Females are also without dorsal stripes and dusted with mealy wax not thick enough to hide body colour on the dorsum and without discrete bare areas on the dorsum. Adult females are about 2-3 mm long i.e. about the size of the pink hibiscus mealybug. Ovisacs are most commonly produced beneath the body but sometimes behind the body of the female. The body is fringed with many short waxy filaments; the caudal filaments are about one fourth of the body length. Various stages of the papaya mealybug can be seen in a colony (Fig 2). Adult males are smaller, have a reddish body and white wings and two caudal (tail) filaments. Papaya mealybug secretes a sticky wax, which may partially cover or fully envelop the entire colony (Fig 3). The mealybug also produces sticky, sweet, straw-coloured honeydew that ants feed upon (Fig 3). The body of *Paracoccus* species often turns black in alcohol and goes dark-brown/black in potassium hydroxide (Watson and Chandler, 1999). The first signs of the presence of mealybugs may often be symptoms of plant damage – crinkling, curling and rosetting of leaves and the presence of sooty mould (Fig 1).

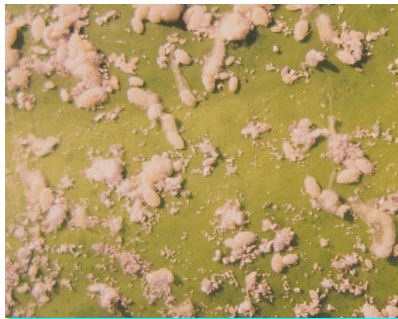


Fig 2: Papaya mealybug colony showing various stages of the mealybug

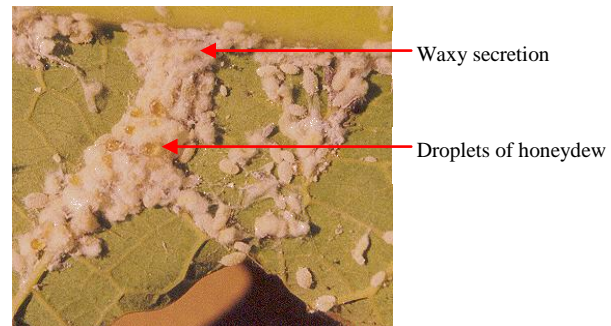


Fig 3: Colony of papaya mealybug with waxy secretion and honeydew

Adult male

Slide-mounted characters – the adult male of papaya mealybug differs from the other instars by having a distinct aedeagus with ventral lobes that are broad and cylindrical in dorsal-ventral view, lateral pore clusters, a heavily sclerotized thorax and head, and well-developed wings. Antennae are 10-segmented with bristle shaped and fleshy setae. Eighth abdominal tergite usually without setae.

Second-instar female

Field features – body colour yellow

Slide-mounted characters - the second-instar female of papaya mealybug differs from other mealybugs by lacking oral-collar tubular ducts and multilocular pores, and by having 5 setae on the third antennal segment.

Third-instar female

Slide-mounted characters – The third instar females can be distinguished from all other instars by having 6 or 7 segmented antennae. When 6-segmented with hind tibia divided by hind tarsus the length is usually 1.2 μm , and about 9 setae on the hind tibia. Multilocular pores absent, without vulva.

Adult female

Field features – body greenish-yellow, dusted with mealy wax not thick enough to hide body colour, without discrete bare areas on dorsum, with many short waxy filaments around the body margin. Ovisacs developed beneath and behind adult female.

Slide-mounted characters – adult females can be distinguished from all other instars by having multilocular pores, translucent pores on the hind coxa and a vulva.

Biology & Ecology

The life cycle of the papaya mealybug is not well known. There are at least three female instars and four male instars. Eggs are pale yellowish-green in colour and are laid in ovisacs that are situated either at the tip of or beneath the abdomen.

Dispersal/vectors

Infested plants, fruits transported by man to non-infested areas.

Management

Mealybugs are difficult to control because they inhabit protected areas such as cracks, crevices and under the bark of their host plants, where they are difficult to reach. They live in clusters and are covered with a waxy secretion that protects them. Eggs are laid in a protective waxy ovisac. Some mealybugs may develop resistance to certain insecticides.

An integrated pest management (IPM) approach can be applied to management of the papaya mealybug. This approach combines the use of cultural practices, chemical and biological control.

Cultural Control

- Localized quarantine should be employed to avoid moving infested plants or plant material from place to place and outside of the infested area.
- Wash plants with mild soapy water.
- Dislodge mealybugs physically by hosing down plants frequently.
- Use high pressure hose to wash produce clean of mealybugs.
- Spray with insecticidal soap.
- Control ants, which feed on the honeydew produced by the mealybugs. Ants also protect mealybugs from natural enemies and transport them from place to place.
- Prune and burn infested shoots and branches. Use pruning shears or secateurs for softer stems. A sharp machete/cutlass or hand saw should be used to make a clean cut of branches
- Remove and burn dry crinkled, older leaves with attached mealybug colonies. Do not use infested plant material as mulch this should be removed from the field and burned

Cultural control may be difficult when the mealybug attacks several host plants at the same time

Chemical Control

Chemicals give good short-term control but chemical control is difficult and requires repeated application of the insecticide. Long-term chemical treatment is therefore not advised.

- Spray or drench the roots when necessary with imidacloprid (Attack[®], Admire[®]) every 5-6 weeks. This insecticide when used as a root drench is compatible with natural enemies.
- Spray more frequently (only when absolutely necessary) with other insecticides such as Perfekthion (cygon), Neemex, Carbaryl(sevin), white (mineral) oils.
- A sticker should always be used with the insecticide when spraying for mealybugs

Apply chemical control judiciously to avoid killing natural enemies i.e. parasites and predators

Biological Control

Biological control involves the use of natural enemies i.e. parasites and predators for pest management. Most control programmes for mealybugs stress the use of classical biological control because:

- It is sustainable.
- It is environment friendly.
- Insects do not build up resistance.
- Parasitoids are often highly effective and are also often host-specific.

Parasitoids

Several mealybug biological control successes throughout the world have been attributed to the impact of parasitoids on mealybug pests (Myerdirk, 2000). Several primary parasitoids have been identified as natural enemies of *P. marginatus*. These included: *Anagyrus loecki* Noyes and Menezes, *Apoanagyrus californicus*, *Acerophagus* sp. and *Pseudophycus* sp.. *Acerophagus* emerged as the dominant parasitoid species in Puerto

Rico and the Dominican Republic (Kauffman *et al.*, 2001). Other secondary parasitoids or hyperparasitoids associated with the papaya mealybug include *Aprostocetus* which is sometimes a primary parasitoid but more usually a secondary parasitoid of Homoptera and related insects, and *Cheiloneurus inimicus* another hyperparasitoid (McComie, 2000). Parasitism may be as high as 58.3% (Kauffman *et al.*, 2001). Another potential candidate for which there is information is the parasitoid *Pseudleptomastix* (Arnold, 2001). Parasitoids from Mexico and the Caribbean are listed in Schauff (2000), described and illustrated several parasitoids of *P. marginatus*.

Natural enemies of the papaya mealybug

Predators

A number of predators attack *Paracoccus marginatus*. Among them are the larvae and adults of the introduced Australian ladybird beetle *Cryptolaemus montrouzieri* (Fig. 4), indigenous *Scymnus* spp., the Cecidomyiidae *Diadiplosis coccidarum* (Cockerel), chrysopid (lace wing) larvae and adults and Syrphid (hover fly) larvae. Predators such as ladybird beetles and lace wing flies are effective in rapidly reducing high populations of mealybugs.

HOST NOTES

This polyphagous species has been reported on at least 16 plant families and over 40 species that include economically important crops such as papaya, cassava, citrus, *Annona* spp., yam, sweet potato, peas and beans, ochro, eggplant and guava and ornamentals such as hibiscus, *Jathropha*, *Allamanda*, *Acalypha*, *Hamelia*, *Frangipani* and leander; and weeds such as sida (Miller and Miller, 1999; McComie, 2000; Meyerdirk *et al.*, 2000).

DISTRIBUTION

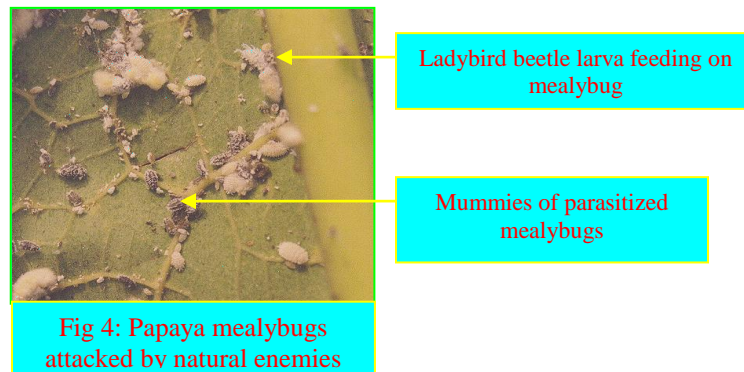
P. marginatus was originally reported from the Neotropical region including Mexico, Belize, Costa Rica, Guatemala (Williams & Granara de Willink, 1992) and subsequently from the Caribbean region and Florida. By 2000, distribution records showed that the pest was present in Antigua, British Virgin Islands, Montserrat, St Kitts and Nevis, United States Virgin Islands (Watson and Chandler, 1999) and also in Cuba, Dominican Republic, Haiti, Puerto Rico, St Marten, Guadeloupe, St Barthelemy and Florida (Miller and Miller, 1999). In 2001 *P. marginatus* was reported in Barbados and St. Lucia.

PEST SIGNIFICANCE

Paracoccus marginatus attacks over 50 species of plants including field crops, fruit trees ornamentals, weed and scrub vegetation. The pest is of major quarantine significance in the Caribbean region. The potential economic loss due to this pest has not been quantified. It is a serious risk when infested plant material is transferred from place to place. The waxy secretions with mealybugs may become attached to animals or birds or human clothing and may be transported from place to place in this way. "Crawlers" may also become wind-borne and be transported from place to place.

Inspection Procedures

Live plants, cuttings, fruits and vegetables can carry eggs and nymphs that may go undetected. Potential host plants particularly those from an infested country should be carefully examined for the presence of white waxy secretions and mealybugs. A magnifying hand lens (x10) should be used during examination. In addition to general examination, special attention should be focused on areas where mealybugs are likely to hide, such as shoot tips, leaf bases and crevices on the plant material. Commodities for export should preferably be grown in a pest-free area. Pre-entry quarantine inspection and treatment should be prerequisites for export. A valid original phytosanitary certificate declaring the produce to be pest-free, should accompany shipment of fresh produce. Any shipments of fresh produce from an infected country should be carefully inspected and treated appropriately before permitting entry to a country that is free from the papaya mealybug.



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