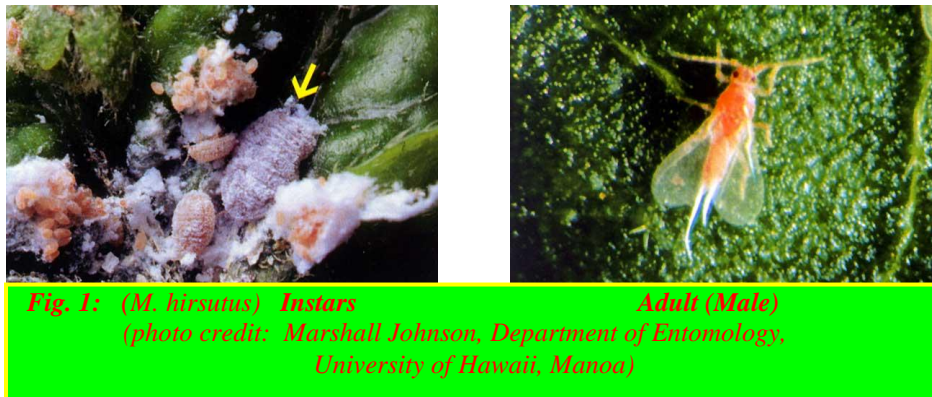


Maconellicoccus hirsutus

Introduction

The hibiscus or pink mealybug, *Maconellicoccus hirsutus* (Green), is a serious pest of many plant species. It has a wide range of hundreds of unrelated plant hosts; the list is growing as the pest spreads into new geographical areas. So far, the pest has been found on 215 genera of plants. However, its primary host list is much smaller. Its wide host range favours rapid spread and complicates effective control.

In spite of its wide distribution, the hibiscus mealybug (HMB) was a major pest only in India and Egypt prior to its discovery in the Caribbean.



Identity

Y.M. Ezzat (1958)

Authority	: Green
Classification	
Kingdom	: Animalia
Phylum	: Arthropoda
Class	: Insecta
Order	: Homoptera
Family	: Pseudococcidae
Genus	: <i>Maconellicoccus</i>
Species	: <i>hirsutus</i>
Synonyms	: <i>Phenacoccus hirsutus</i> (Green), <i>Pseudococcus hibisci</i> , <i>Phenacoccus giomeratus</i> (Green), <i>Phenacoccus quaternus</i> (Green), <i>Spilococcus perforatus</i> (De Lotto).
Common names	: Egyptian hibiscus mealybug, hibiscus mealybug, pink mealybug, Hibiscus Schmieriaus, grape mealybug, grapevine mealybug and mulberry mealybug
Role	: Pest

Signs & Symptoms

D. J. Williams (1988)

The hibiscus mealybug injects toxic saliva into the plant as it feeds. This results in malformed leaf and shoot growth, stunting, and occasional death. Leaves show a characteristic curling, while heavily infested plants have shortened internodes leading to rosetting or a "bunchy top" appearance. A heavy, black, sooty mould may develop on infested leaves and stems as a result of heavy honeydew secretions of the mealybug. Infested fruits may be entirely covered with the white waxy coating of the mealybug. Fruits become shrivelled and dry and fruit drop may result. If flower blossoms are attacked, the fruit sets poorly. In plants such as peanuts, potatoes, and some grasses, the pest has been reported to attack the root systems.

Morphology

USDA (1996)

Eggs

Eggs are initially orange in colour but turn pink on maturity. Eggs are minute, varying from 0.3 to 0.4 mm in length and contained in an eggsack of white wax.

Nymphs

Newly hatched nymphs are called "crawlers". The nymphal stage is wingless and appears much like the female in form. The female nymphs have three instars, while male nymphs have four instars. The last instar of the male is an inactive stage with wing buds within a cocoon of mealy wax. The nymphal stages may last as long as 30 days.

Adult

Both female and male adult hibiscus mealybugs are about one eighth inch (3 mm) long. Female bodies are pink in colour with a white waxy covering. They are wingless and appear as ovoid shapes covered by a mass of white mealy wax. Males have a pair of wings and two long waxy tails and are capable of flight. (Fig 1)

Biology & Ecology

S.K. Ghose (1972)

The pest forms colonies on the host plant, and if left undisturbed, the colonies will grow into large masses of white waxy coverings on branches, fruiting structures, leaves, and even whole plants, including large trees. Ants normally attend the pest.

The pest can occur seasonally in colder regions from infestations spread by wind currents. In cool climates, the pest overwinters in the soil or on the host plant, either in the egg stage or as an adult.

Life cycle

Reproduction may occur by means of parthenogenesis in the absence of the male.

The mature female lays eggs in an ovisac of white wax, usually in clusters on the twigs, branches, and bark of the host plant and also on the leaves and terminal ends. Eggs number as many as 654 eggs per ovisac and hatch into nymphs or crawlers after a period of 3 - 9 days.

Female nymphs have three instars, while male nymphs have four instars. The last instar of the male is an inactive stage. The nymphal stages may last as long as 30 days when they develop into female and male adults.

The hibiscus mealybug can complete its entire cycle in 23 - 30 days (Curlett, 1996). Under optimum laboratory conditions, there can be as many as 15 generations a year.

Dispersal/vectors

EPPO (1996)

In its egg stage, the hibiscus mealybug disperses most easily by wind. The wax, which sticks to each egg, also facilitates passive transport by animals or man. Newly hatched nymphs or “crawlers” are very mobile and may disperse over the host especially toward tender growing parts or be carried away by wind, man or animals. Wingless crawlers, nymphs, and females have also been known to travel short distances over the ground to get to other host plants in adjoining fields. Agricultural commerce is mainly responsible for the spread of the pest.

Management

B. R. Barlett (1978)

Biological Control

Cryptolaemus montrouzieri, a native of Australia has been used successfully to reduce large populations of *M. hirsutus* in Egypt and the Caribbean. In Egypt, however, it was unable to survive the cold of winter in sufficient numbers to be effective and the main biological control agents were the parasitoids *Anagyrus kamali* and *Achrysopophagus sp.* (Bartlett, 1978).

In Egypt, almost total control of the mealybug is maintained using the parasitoid *Anagyrus kamali* (Williams, 1996). This parasitoid has also been widely introduced to the Caribbean region to control *M. hirsutus* with very good success (Pollard, 1995; Garland, 1998; Kairo *et al.*, 2000). Additional introductions of predators such as *Cryptolaemus montrouzieri* have been used on some Caribbean islands to reduce mealybug populations further (Gautam *et al.*, 1996). In general, a biological control programme utilising *C. montrouzieri* together with parasitoid releases of *A. kamali* and *Gyranusoidea indica* has proven to be extremely effective in the Caribbean region (Kairo *et al.*, 2000).

Cryptolaemus is generally more effective at high pest populations, while *A. kamali* is more so at low pest populations. Use of pesticides reduce natural enemy populations and allow a resurgence of the mealybug. For biological control purposes, *M. hirsutus* can be reared in the laboratory on pumpkins (Mani, 1990; Meyerdirk 1997).

In India, where grapes are grown in areas that may have severe wintry spells, the control agents used are the parasitoid *Anagyrus dactylopii* and the coccinellid predators *Scymnus coccivora*, *S. conformis* and *S. gratusus* (Mani, 1989).

Colonies of *M. hirsutus* hidden in crevices amongst cabbage-like growths can be difficult or impossible for natural enemies to attack especially for the larger coccinellid predators. This may limit the success of biological control agents in regulating pest populations because they cannot reach the mealybugs to attack them.

Host-Plant Resistance

In Egypt, the grape varieties *Romi* and *Banati* were found to be susceptible to attack by *M. hirsutus*, with the variety *Moscato* being the most tolerant and least affected (Amin and Emam, 1996).

Chemical Control

Mani (1989) mentions that sticky banding such as 'tanglefoot' has been used in India to protect grape bunches from infestation by *M. hirsutus*. Pesticide sprays tend to be of limited effectiveness against *M. hirsutus* because of its habit of hiding in crevices, and the waxy covering of its body (Williams, 1996); systemic insecticides are more likely to be effective. Mani (1989) states that most granular insecticides are ineffective against *M. hirsutus*. Any pesticide used against *M. hirsutus* should be carefully selected to avoid injury to its natural enemies, since they are likely to be important in helping to keep populations at low levels in the long term.

In India, there is some evidence of pesticide resistance developing against Aldicarb (Mani, 1989), hence pesticides are only used to control heavy infestations of the mealybug and populations are subsequently maintained at low levels by biological control.

IPM Programmes

In India, the main biological control agents used to regulate *M. hirsutus* on grapes are the parasitoid *Anagyrus dactylopii* and the predators *Scymnus coccivora* and *S. gratusus*. These are used as a part of an integrated pest management regime involving pesticide use if the mealybug populations reach a high level (Mani, 1989).

In India, integrated pest management using both coccinellid beetle predators and pesticides (Dichlorvos and Chlorpyrifos) has been achieved on grapes. Dichlorvos was also found to be non-toxic to the key hymenopteran parasitoid, *Anagyrus dactylopii* (Mani, 1989).

An Integrated Management approach to hibiscus mealybug control using insecticides, cultural practices and biological control has been widely adopted. However, pesticides cannot easily penetrate the heavy wax layers on the pest's body. So they are an ineffective control technique against this mealybug species. Cutting and burning host material, which was tried on the islands of Grenada and Trinidad and Tobago, also had little impact on their spread.

Biological control is therefore the best long-term solution.

Natural enemies

At present, 21 parasites and 41 predators are known to attack the hibiscus mealybug worldwide. Mani (1989) lists a wide range of natural enemies of *M. hirsutus* recorded in the literature for India, including parasitic Hymenoptera, predatory Heteroptera (Coreidae), Neuroptera, Lepidoptera (Noctuidae), Diptera (Cecidomyiidae) and Coleoptera (Coccinellidae).

Parasitoids - *Anagyrus dactylopii*, attacks adult mealybugs, in the Far East, Indonesia, Philippines, Thailand, India, Iran, Iraq, and Oman. *A. dactylopii* was introduced to Barbados, Peru, Hawaii and Fiji. *Anagyrus kamali*, attacks adults in China, Indonesia (Java), India, Sri Lanka, Pakistan. *A. kamali* was introduced into Jordan, Hawaii, Egypt, Trinidad, Grenada, Guyana, St. Kitts and St. Lucia.

Predators - *Cryptolaemus montrouzieri*, attacks adults, eggs, larvae, nymphs and pupae in Australia. *C. montrouzieri* was introduced into New Zealand, Hawaii, Brazil, Costa Rica, Puerto Rico, USA, California, Texas, Florida; Bermuda, Italy, Israel, Indonesia, Hong Kong, China, Egypt, Trinidad, Grenada, Guyana, St. Kitts and St. Lucia.

Scymnus coccivora, attacks adults, eggs, nymphs and in the Indian subcontinent, Sri Lanka and SE Asia including Malaysia and Thailand.

Pest Significance and Phytosanitary Risk

When first introduced into the Caribbean, HMB posed a serious pest risk and, in fact, caused significant losses several plant species including crop, ornamental and forest species. Hosts of economic importance included (*Annona* spp.), *Spondias* spp., okra (*Abelmoschus esculentus*), mango, sorrel (*Hibiscus sabdariffa*), *Albizia saman* and other ornamentals important to the tourist industry, forest trees such as blue mahoe (*Hibiscus elatus*) and teak (*Tectona grandis*) (Pollard, 1995). At the height of the infestation in the region, HMB also disrupted Caribbean agricultural trade and commerce. Quarantine measures ranged from some countries totally prohibiting entry of agricultural produce from infested countries to others imposing strict conditions for the importation of fresh produce. Exports from pest - free areas were also accommodated, for example, after initially having a total ban on imports from several countries (e.g. Guyana, Trinidad and Saint Lucia), Barbados developed bilateral protocols with these countries which allowed the entry of produce based on the recognition of pest free areas in the exporting countries. Other hosts include ornamental *Hibiscus* in Papua New Guinea (Williams and Watson, 1988); and cocoa in the Solomon Islands (Williams and Watson, 1988) and Grenada (Pollard, 1995).

Plant material imported from areas infested with *M. hirsutus* presents the greatest risk to non-infested countries between 7° and 30° latitude.

Phytosanitary Measures

Inspection Methods

Examine plant material, especially growing tips, for distorted, stunted, bunchy growths containing white woolly wax, tiny salmon-pink eggs, and sooty mould or sticky honeydew. The honeydew produced may attract attendant ants. The entire mealybug colony tends to become covered by white, sticky, elastic, woolly, waxy ovisac material. When the sticky ovisac wax is parted with a needle, clusters of pink eggs and pink to grey females become visible. In heavier infestations, white masses of wax concealing mealybugs may occur in axils and on twigs and stems. Good light conditions are essential for examination; in poor light, a powerful flashlight is helpful. One of the commonest, favoured hosts of *M. hirsutus* is *Hibiscus rosa-sinensis*. This is a good host to monitor for early detection of the arrival of the pest.

Garland (1998) recommends a fumigant for use against *M. hirsutus*, on plants in greenhouses in Canada. Since its appearance in the Caribbean region in 1994/1995, *M. hirsutus* is regarded to be of high quarantine importance by the CPPC. If regulation is required, planting material of host-plant species of *M. hirsutus* should be inspected in the growing season previous to shipment and be found free of infestation. A phytosanitary certificate should guarantee absence of the pest from consignments of either planting material or produce. Any shipments of fresh plant material from an infested country to one that is not yet infested, should be examined thoroughly to detect the incidence of *M. hirsutus*.

Host Notes

Y. Ben-Dov (1994)

HMB attacks hibiscus, citrus, coffee, sugar cane, annonas, plums, guava, mango, okra, sorrel, teak, mora, pigeon pea, peanut, grapevine, maize, asparagus, chrysanthemum, beans, cotton, soybean, cocoa, and many other plants.

Notes

Y. Ben-Dov (1994)

HMB is polyphagous on many plants. The main hosts are plants in the family Malvaceae, notably *Hibiscus* and *Gossypium* species.

Distribution

Y. Ben-Dov (1994)

This pest occurs in most tropical areas of the world, including Asia, the Middle East, Africa, Australia, and Oceania. The hibiscus mealybug arrived in Egypt from India in 1912 and in Hawaii in 1984. After being identified in Grenada in 1995, it subsequently spread throughout the Caribbean, into South America, Central America and North America.

Known distribution is as follows:

Caribbean: Anguilla, Antigua and Barbuda, Aruba, The Bahamas, British Virgin Islands, Barbados, Curacao, Dominica, Dominican Republic, Grenada and Carriacou, Guadeloupe, Haiti, St Marten, Saint Lucia, St. Eustatius, St. Kitts and Nevis, St. Vincent and the Grenadines, Guyana, Martinique, Montserrat, Puerto Rico, United States Virgin Islands (St. Croix, St John, St. Thomas), T&T.

Central America: Belize.

North America: United States of America (south Florida, southern California).

South America: Guyana, French Guyana, Suriname, Venezuela.

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