Striped Mealybug *Ferrisia virgata* Cockerell (Insecta: Hemiptera: Pseudococcidae)[1]

Ariane McCorquodale and Amanda Hodges[2]

Introduction

The striped mealybug, *Ferrisia virgata* Cockerell, is a small insect that is a pest of a broad range of plants. It has been unintentionally introduced across the globe through international trade. Mealybugs are sap-feeding insects that tap into the phloem via a piercing, straw-like mouthpart known as a stylet. Severe infestations of mealybugs can be fatal to a plant. Large populations of mealybugs appear as accumulations of white, cottony-looking wax on the plant. This wax is produced by special glands and gives the insects the "mealy" appearance from which the name "mealybug" is derived.

Synonymy

Dactylopius virgatus

Pseudococcus marchali

Pseudococcus bicaudatus

Ferrisia virgata

Ferrisiana virgata

Ferrisia neovirgata

Distribution

Ferrisia is a New World genus native to the Americas (Williams and Watson 1988). The striped mealybug is one of two *Ferrisia* species to spread to the Old World, and it can now be found in tropical and temperate climates across the globe (Kosztarab 1996, Williams 2004, Williams and Granara de Willink 1992, Williams and Watson 1988). The striped mealybug has also achieved economic significance as a pest of several agricultural crops, including cocoa and cotton (Ameyaw et al. 2014, Kosztarab 1996, Oliveira et al. 2014).

Description

In 2012, Kaydan and Gullan published a taxonomic review of the genus *Ferrisia*, and described several new species from specimens that were formerly classified as *Ferrisia virgata*. The authors proposed that *Ferrisia virgata* is a species complex consisting of several morphologically similar but genetically distinct species. For the purposes of this publication, the striped mealybug common name refers to members of the *Ferrisia virgata* complex.

The striped mealybug is named for the two dark, dorsal stripes that run longitudinally down its body. These stripes are visible on the mealybug cuticle through bare patches in the waxy covering (Figure 1). Length of the adult female body is approximately 2.0–4.5 mm (Kaydan and Gullan

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2. Ariane McCorquodale; and Amanda Hodges, associate Extension scientist; Department of Entomology and Nematology, UF/IFAS Extension, Gainesville, FL 32611.

2012). Additional identifying features of the striped mealybug are the two posterior waxy tails or tassels with a length half that of the mealybug body, the presence of crystalline, hair-like rods extending laterally from the body, and the absence of an ovisac (egg sac) (Ferris 1950).

Figure 1. Adult and immature female *Ferrisia virgata* Cockerell on croton.
Credits: Ariane McCorquodale, UF/IFAS

First and second instar nymphs are light yellow with six antennal segments (Highland 1956). Third instar nymphs have seven antennal segments. Males begin to differentiate from females in the third instar when the body color turns dark and the body shape begins to resemble the adult form. Wing buds are present in third instar males. Faint dorsal stripes and small caudal tassels gradually become apparent in females with each molt. Adult males are heavily sclerotized, dark gray in color, winged, and have ten antennal segments (Figure 2). Adult females are greenish-yellow in color with two dorsal, dark gray stripes, and antennae with eight segments (Ferris 1950, Highland 1956, Kaydan and Gullan 2012).

Figure 2. Adult male and immature female *Ferrisia virgata* Cockerell on croton.
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Ferrisia gilli Gullan, or Gill's mealybug (Figure 3), is a native species that is indistinguishable from the striped mealybug in the field and is not a member of the *Ferrisia virgata* complex (Gullan et al. 2003). *Ferrisia gilli* is a pest in pistachio and almond orchards in California, where it is believed to have been introduced (Kaydan and Gullan 2012).

Figure 3. A female Gill's mealybug, *Ferrisia gilli* Gullan, on the underside of a magnolia leaf.
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Biology

The striped mealybug has three nymphal instars. At the end of the third instar the female molts into the sexually mature adult form. Males begin constructing a cocoon at the onset of the second instar and continue feeding and maturing while inside (Highland 1956). The third instar in males is a prepupa stage after which a puparia is formed. The male reaches sexual maturity upon the molt from puparia to the winged adult stage. Reproduction of the striped mealybug occurs sexually. Though the striped mealybug is not parthenogenic (a form of asexual reproduction), a closely related species, *Ferrisia malvastra*, is (Kaydan and Gullan 2012). Females do not produce ovisacs but construct "pads" made of waxy filaments (Figure 4). Eggs are deposited on the pad and the first instar nymphs hatch within a few hours (Awadallah et al. 1979b). There are three to five generations per year (Ammar et al. 1979, Awadallah et al. 1979b, Highland 1956).

Figure 4. Adult female *Ferrisia virgata* Cockerell with filamentous pad on hibiscus.
Credits: Lyle J. Buss, UF/IFAS

Host Plants

As a polyphagous species, the striped mealybug can be found on numerous hosts. Common hosts in Florida are copperleaf (*Acalypha* spp.), croton (*Codiaeum variegatum*), hibiscus (*Hibiscus rosa-sinensis*), seagrape (*Coccoloba* spp.) and citrus as well as popular home garden vegetables such as tomato, eggplant, and pepper (García et al. 2015, FDACS DPI database, personal communication). In addition to the hosts described previously, the striped mealybug is a pest of amaranth, cassava, ficus, magnolia, plumeria, silk tree (*Albizia* spp.), and sugar-apple (*Annona* spp.), as well as cocoa and cotton, upon which the striped mealybug has had economic significance (Ameyaw et al. 2014, Oliveira et al. 2014). For extensive host lists for *Ferrisia* spp. please visit http://scalenet.info/ (Ben-Dov 1994).

Damage

Mealybugs affect nutrient levels in plants through sap-feeding, thereby reducing growth (Dreistadt 2001, Franco et al. 2009). Mealybugs often produce a substance that is sticky and high in carbohydrates known as honeydew. Honeydew is an excellent medium for the growth of sooty mold, a fungus that forms a dark film on the leaf surface and impairs photosynthesis. Large aggregations of mealybugs on plants appear as unsightly white, sticky masses of wax and individuals, which can render plants unmarketable (Figure 5). Leaf discoloration and leaf and fruit drop are also symptoms of mealybug infestations; however, symptoms will vary depending on plant species and plant health status.

Figure 5. *Ferrisia virgata* Cockerell infestation on hibiscus flower bud. Credits: Lyle J. Buss, UF/IFAS

The striped mealybug is known to vector plant pathogens, a trait uncommon in mealybugs. It has been reported to transmit *Cocoa swollen shoot virus, Citrus tristeza virus*, and *Piper yellow mottle virus* (Ameyaw et al. 2014, Bhat et al. 2003, Thorold 1975).

Management

Cultural Control

Early detection provides the best chance at managing mealybugs due to the vulnerability of the immature stages (Dreistadt 2001, Franco et al. 2009). Carefully inspect purchased plants to avoid spreading mealybugs. Scout susceptible plants for mealybugs or masses of cottony wax. Mealybugs can be difficult to see with the naked eye, and they often reside in cryptic or hidden locations such as the crooks of branches and undersides of leaves, which may appear distorted. If mealybugs are not apparent but an infestation is suspected, sooty mold and ant activity may also be clues to a mealybug or other honeydew-producing insect problem. Infested plants should be isolated or removed and disposed of immediately to prevent spread. In many commercial greenhouses, highly infested plants are destroyed because such infestations are very difficult to control.

Biological Control

For greenhouses, commercially available insects such as the mealybug destroyer (*Cryptolaemus montrouzieri*), green lacewings, and brown lacewings can be purchased to prevent mealybug outbreaks (Dreistadt 2001, Franco et al. 2009). Outdoors, these and other naturally present mealybug enemies can be conserved through avoidance of foliarly applied, broad-spectrum insecticides. Another consideration when using biological control agents for mealybug management is the presence of ants. Honeydew is very attractive to ants as a source of food. Some species of ants will defend mealybugs from predation and parasitism to protect their access to the honeydew. If it is suspected that ants are contributing to a mealybug infestation it is recommended to use insecticide baits, traps, or granules combined with barriers like sticky tape to prevent ants from hindering predation or other mealybug control efforts (Dreistadt 2001).

Chemical Control

Due to their waxy hydrophobic covering, managing mealybugs with pesticide sprays can be difficult (Dreistadt 2001, Franco et al. 2009). Contact insecticides are most effective when the younger stages are targeted. This is because first and second instar mealybugs are not protected by the dense waxy covering that develops in the later instars. Insect growth regulators (IGRs), insecticidal soaps, and horticultural oils are suggested for treating early instar mealybugs and can be applied directly to the plant and mealybugs. Systemic insecticides, which are applied to the soil and taken up into the plant by the roots, have also been

shown to be effective. However, because mealybugs have overlapping generations, repeated, frequent applications are often necessary and this may hasten the development of insecticide resistance. Frequent pesticide use can also negatively impact beneficial insects.

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