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Passionvine Mealybug, *Planococcus minor* (Maskell) (Hemiptera: Pseudococcidae)[1]

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Introduction

The passionvine mealybug, *Planococcus minor* (Maskell), was discovered in the continental U.S. for the first time in southern Florida during December, 2010 (Stocks and Roda 2011). The passionvine mealybug was one of several species predicted to have a high likelihood of being introduced to the United States for some time (Miller et al. 2002) and was listed by USDA, APHIS as a high priority threat. The only other U.S. report for the mealybug is from Hawaii (Stocks and Roda 2011). Also known as the Pacific mealybug, the pest is of Asian origin, but it is widely distributed in many tropical and subtropical areas including the Neotropics (Cox 1989). Given its polyphagous nature (Venette and Davis 2004), this pest should be given careful attention in a new area such as Florida, which has an important agricultural sector and amenable climate.

Distribution in the Neotropics

The passionvine mealybug has been reported from at least 21 countries/territories in the Neotropics, which encompasses Bermuda, several Caribbean islands, Mexico, Central and South America (Williams and Granara de Willink 1992). A list of these countries/territories include: Argentina, Barbados, Bermuda, Brazil, Colombia, Costa Rica, Cuba, Dominica, Galapagos Islands, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, St. Lucia, Surinam, Trinidad, and the U.S. Virgin Islands.

Taxonomy and Identification

Passionvine mealybug and the citrus mealybug, *Planococcus citri* (Risso) are morphologically similar and are frequently misidentified due to similarities in appearance, host range, and distribution (Williams and Granara de Willink 1992). A morphological scoring matrix based on six diagnostic characters is still used to distinguish these cryptic species, relying on a point scoring system to identify adult females (Cox 1983). Specimens having a total score of 35 or less are determined to be passionvine mealybug, while those having a total score of greater than 35 are determined to be citrus mealybug. Molecular diagnostics has proven to be a fast and more reliable method of distinguishing between the two mealybugs (Rung et al. 2008) and was used recently to positively confirm that south Florida populations were indeed *P. minor* (Stocks and Roda 2011).

Description

The eggs of passionvine mealybug are yellow, minute and are protected in an ovisac that is partially exposed underneath the posterior end of the adult female (Figure 1). Both sexes have a pinkish appearance during the first two instars and are indistinguishable. The wingless female is the larger gender and has five growth stages: egg, three nymphal instars, and adult. Adult females (Figure 2) are oval-shaped, wingless, distinctly segmented with a dorsomedial bare area in older stages, possessing three pairs of legs and a pair of 8-segmented antennae. They are pale yellow when newly

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molted (Figure 3), but later turn brownish-orange, and their skin is gradually covered in a white, powdery, waxy secretion. Adult females can measure up to 4 mm in length, and the body margins produce 18 pairs of short lateral filaments with the two hindmost filaments being longer than the others. Males have six growth stages: egg, two nymphal instars, prepupal and pupal stages that develop inside a waxy cocoon, and adult. Adult males are pink in color, approximately 1 mm long with three distinct body divisions, with three pairs of legs, one pair of wings and two caudal filaments (Figure 4). Adult males are delicate, ephemeral and easily overlooked in the field.

Figure 1. Freshly laid eggs of the passionvine mealybug, *Planococcus minor* (Maskell) are yellow.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

Biology and Life Cycle

The optimal temperature range for the development of passionvine mealybug appears to fall between 20 and 29°C. Female mealybugs developed in as little as 27 days at 29°C, while males took slightly longer (Francis et al. in press). Females made up 60 to 73% of populations and there is no evidence of parthenogenetic reproduction in the species (Francis et al. in press). Adult females produced 206 to 270 eggs between 20 and 29°C (Francis et al. in press). Available host plant type appears to influence mealybug fecundity (Maity et al. 1998). In warm climates, the mealybug can stay active and reproduce throughout the year. Ants are often associated with passionvine mealybug as honeydew consumers, and their presence or absence can affect mealybug relative abundance (Bigger 1981).

Figure 2. Adult female passionvine mealybug, *Planococcus minor* (Maskell) on potato sprout.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

Figure 3. Newly molted female passionvine mealybug, *Planococcus minor* (Maskell) (bottom left).
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Host Plants

Worldwide, the reported host range of passionvine mealybug includes more than 250 wild and cultivated host plants in nearly 80 families, some of which include important

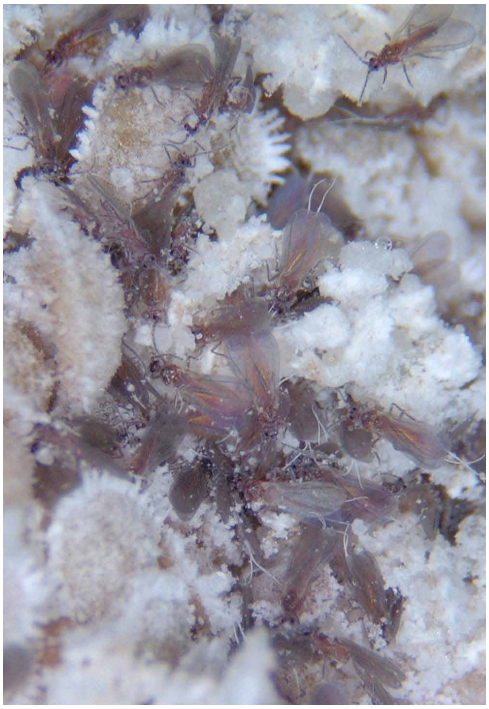

Figure 4. Adult male passionvine mealybug, *Planococcus minor* (Maskell) congregating over females.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

agricultural crops such as banana, citrus, cocoa, coffee, corn, grape, mango, potato and soybean (Venette and Davis 2004). With such a wide host range, there is a possibility that the mealybug might find and utilize additional new hosts as it spreads into new areas (USDA, APHIS 2002). However, although some *Planococcus* spp. have a wide host range, a few such as passionvine mealybug appear to exhibit distinct preferences, commonly occurring on cocoa (*Theobroma cacao* L.; Sterculiaceae) (Figure 5) wherever the crop is grown (Cox 1989). It is therefore very likely that published host plant lists include many secondary hosts that may not be preferred by the mealybug.

Damage

Similar to other pseudococcids, feeding activity of passionvine mealybug causes reduced yield, lower plant or fruit quality, stunted growth, discoloration and leaf loss (Venette and Davis 2004). Plant death may also be caused by viral diseases vectored by passionvine mealybug (Cox 1989). In such cases, passionvine mealybug may be an economic pest even at low densities (Franco et al. 2009). The mealybug also excretes copious amounts of honeydew onto the plant. Sooty mold grows on the honeydew and builds up on the leaves, fruits and other plant parts. The mold can cover so much area that it interferes with the plant's normal photosynthetic activity (Williams and Granara de Willink 1992). Honeydew and sooty mold also cause cosmetic defects

Figure 5. Passionvine mealybug, *Planococcus minor* (Maskell) and attendant ants on cocoa pod in Trinidad.
Credits: Amy Roda, USDA APHIS CPHST.

to plants and fruits, directly affecting the sale of such produce (Zada et al. 2004). Interestingly, the passionvine mealybug has not been reported to cause serious damage in the Caribbean, or Central and South America, which is likely due to the presence of natural enemies such as those documented in Trinidad (see below).

Biological Control

With the introduction of passionvine mealybug into Florida, biological control should be part of the overall control strategy against this pest if it becomes a major economic and/or ecological threat. As with other mealybugs, the passionvine mealybug is highly amenable to biological control. Recent studies in Trinidad discovered the existence of a thriving natural enemy complex which seemed to keep populations of the pest under effective control. This complex included both predators and parasitoids.

The key predators were: *Cryptognatha nodiceps* Marshall, *Diomus* sp.,*Tenuisvalvae bisquinquepustulata* (Fabricius) (Coleoptera: Coccinellidae); *Calliodis* sp. (Hemiptera: Anthocoridae); *Ocyptamus stenogaster* species group (Dipteran: Syrphidae), and *Diadiplosis coccidarum* Cockerell (Diptera: Cecidomyiidae). Larvae of *D. coccidarum* appeared to be major predators of the mealybug and were observed feeding voraciously on infested potatoes deployed in the field. Two solitary endoparasitoids were also found attacking the mealybug: *Leptomastix dactylopii* Howard, and *Coccidoxenoides perminutus* Girault (Hymenoptera: Encyrtidae) (Francis et al. in press). Studies with *L. dactylopii* (Figure 6) demonstrated that the parasitoid successfully oviposited into 3rd instar immatures as well as adult female

mealybugs, while *C. perminutus* (Figure 7) successfully oviposited into the first three immature instars, suggesting some degree of complementarity (A. Francis, unpublished data).*Leptomastix dactylopii*is an arrhenotokous species, while *C. perminutus* populations consist entirely of females. The key distinction between the mummified mealybugs parasitized by the two species is that those with *L. dactylopii*are brown in color (Figure 8), and those with*C. perminutus*are smaller and have a greenish color (Figure 9). Both parasitoids, in particular, were consistently recovered during surveys in Trinidad together with the various predators using sentinel traps containing passionvine mealybug infested potatoes (Figure 10). This method of recovering natural enemies proved to be very effective and has potential for additional field applications.

Figure 7. *Coccidoxenoides perminutus* Girault (adult female), a solitary endoparasitoid of *Planococcus* spp.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

Several of the natural enemies from Trinidad are also present in the U.S. and are likely to play a key role in the management of this pest. For instance, *D. coccidarum*eradicated a population of passionvine mealybug within two weeks in south Florida (A. Roda, unpublished data). Both *L. dactylopii* and *C. perminutus* are commercially available in the U.S. for control of the citrus mealybug and would be readily available for field release, if necessary. It has been some time now since the passionvine mealybug was discovered in Florida,and there have been no reports of damaging populations. It seems reasonable to hypothesize that some of the natural enemies mentioned above, particularly *L. dactylopii, C. perminutus*, and *D. coccidarum*, are keeping populations of the pest in check. It is also recommended

Figure 8. Mummified mealybugs parasitized by *Leptomastix dactylopii* Howard are brown in color.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

Figure 9. Mummified mealybugs parasitized by *Coccidoxenoides perminutus* Girault are green in color.
Credits: Antonio Francis, Center for Biological Control, Florida A&M University.

that these natural enemies be released in the first instance if damaging populations are discovered.

Monitoring/Surveillance

Recently, the sex pheromone of the passionvine mealybug was isolated, identified, and synthesized (Ho et al. 2007, Millar 2008). It was suggested that pheromone-baited traps would provide a highly sensitive and effective method of detecting even small populations of the pest (Millar 2008). The baited traps have been used recently to detect and monitor field populations of the passionvine mealybug in Trinidad and south Florida (A. Roda, unpublished data). The traps should therefore have an immediate impact as a detection tool in threatened or high-risk areas for introduction of the mealybug such as areas in south Florida.

Figure 10. Sentinel trap containing potato infested with passionvine mealybug, *Planococcus minor* (Maskell) used to recover natural enemies in Trinidad.
Credits: Amy Roda, USDA APHIS CPHST.

Chemical Control

Despite its frequent use, chemical control is often ineffective (Krishnamoorthy and Mani 1989) because mealybugs are located primarily in protected sites on plants such as cracks, crevices and under bark where insecticide penetration is difficult (Geiger and Daane 2001). However, systemic insecticides that reach all parts of the plant are the most effective to use against this and similar pests (Daane et al. 2004). Some examples include neonicotinoids such as acetamiprid, clothianidin, dinotefuran, imidacloprid, and thiamethoxam (Buss and Turner 2006). Despite the high costs, environmental and health concerns associated with chemical control, it is still one of several tactics employed to control mealybugs in greenhouses and nurseries where zero tolerance standards exist for these types of pests.

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