台灣農業研究 (J. Taiwan Agric. Res.) 60(1):72–76 (2011)

Preliminary Report on the Occurrence of Papaya Mealybug, *Paracoccus marginatus* Williams and Granara de Willink, in Taiwan [1]

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Abstract

Chen, S. P., J. Y. Wong, and W. J. Wu. 2011. Preliminary Report on the Occurrence of Papaya Mealybug, *Paracoccus marginatus* Williams and Granara de Willink, in Taiwan. J. Taiwan Agric. Res. 60:72–76.

The papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink, is a serious pest of many agricultural plants and ornamentals. It has spread throughout most countries of the Caribbean region, causing huge economic losses to papayas since 1994. This pest alert reports *P. marginatus* damaging papayas in Taiwan for the first time. Besides it also describes the fundamental biological data of *P. marginatus*, its existing host plants, and its distribution in Taiwan and around the world.

Key words: Papaya, Host plants, *Paracoccus marginatus*, New record.

Most of mealybugs (Hemiptera: Coccoidea: Pseudococcidae) are serious pests of agricultural plants and ornamentals. Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink was recently found on papaya (*Carica papaya* L.) in Taiwan. The papaya mealybug, is a polyphagous species native to Mexico and other Central American countries and became a pest when it invaded the Caribbean region. Since 1994 it has been recorded (Tanwar *et al*. 2010), it subsequently spread from the Central America and the Caribbean and now distributes over a wide range, including: Antigua and Barbuda (Antigua), Belize, British Virgin Islands, Costa Rica, Cuba, Dominican Republic, India (Coimbatore, Tirupur, Erode, Salem, Namakkal and Karur districts of Tamil Nadu), Indonesia (Java), Mexico (Baja, California Norte, Colima, Guerrero, Jalisco, Michoacan, Tabasco, Veracruz), Palau, Puerto Rico & Vieques Island (Puerto Rico), Reunion, Saint Kitts and Nevis Islands (Saint Kitts), Saint Martin & St. Barthelemy (Saint Barthelemy, Saint Martin), and USA (Florida, Guam, Hawaii, U.S. Virgin Islands) (Muniappan *et al*. 2008; Tanwar *et al*. 2010; Williams & Granara de Willink 1992).

This phytophagous pest induces leaf yellowing, defoliation, reduced plant growth, and destroys fruits on agricultural crops. The recorded host plants 27 families include Acanthaceae: *Fistulosa* sp. (Miller & Miller 2002), *Pachystachys lutea* Nees (Matile-Ferrero & Étienne 1998); Aizoaceae: *Trianthema portulacastrum* L.; Amaranthaceae: *Achyranthus aspera* L. (Tanwar *et al*. 2010); Annonaceae: *Annona muricata* L., *Annona squamosa* L.; Apocynaceae: *Plumeria* spp., *Plumeria alba* L., *Plumeria rubra* L.; Arecaceae: *Roystonea regia* (Kunth)

1. Contribution No. 2481 from Taiwan Agricultural Research Institute (TARI), Council of Agriculture. Accepted: March 25, 2011.
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(Martínez *et al*. 2005); Compositae: *Ambrosia cumanensis* Kunth, *Parthenium hysterophorus* L. (Ben-Dov 1994), *Tridax procumbens* L.; Capridaceae: *Cleome viscosa* L. (Tanwar *et al*. 2010); Caricaceae: *Carica papaya* L. (Ben-Dov 1994); Commelinaceae: *Commelina benghalensis* L.; Convolvulacea: *Convolvulus arvensis* L. (Tanwar *et al*. 2010), *Ipomoea carnea* Jacq. (Miller & Miller 2002); Euphorbiaceae: *Acalypha* spp. (Williams & Granara de Willink 1992), *Acalypha wilkesiana* Muell. (Miller & Miller 2002), *Euphorbia hirta* L., *Jatropha curcus* L. (Tanwar *et al*. 2010), *Jatropha integerrima* Jacq. (Matile-Ferrero & Étienne 1998), *Manihot chlorostica* Standl. & Goldman, *Manihot esculenta* Crantz (Williams & Granara de Willink 1992), *Phyllanthus niruri* L. (Tanwar *et al*. 2010), *Ricinus communis* L. (Martínez *et al*. 2005); Fabaceae: *Acacia* sp., *Bauhinia* sp. (Miller & Miller 2002), *Cajanus cajan* (L.) (Matile-Ferrero & Étienne 1998), *Erythrina abyssinica* Lam., *Gliricidia sepium* (Jacq.) (Martínez *et al*. 2005), *Mimosa pigra* L. (Williams & Granara de Willink 1992), *Tetramnus labialis* (L.) (Matile-Ferrero & Étienne 1998); Lamiaceae: *Leucas aspera* (Willd), *Ocimum sanctum* L. (Tanwar *et al*. 2010); Lauraceae: *Persea americana* Mill. (Miller & Miller 2002); Malpighiaceae: *Malpighia glabra* L. (Matile-Ferrero & Étienne 1998); Malvaceae: *Abutilon indicum* L., *Ceiba pentandra* (L.), *Gossypium hirsutum* L. (Tanwar *et al*. 2010), *Hibiscus* sp. (Williams & Granara de Willink 1992), *Hibiscus rosa-sinensis* L., *Malvasicus arboreus* (Torr. & Gray) (Matile-Ferrero & Étienne 1998), *Sida* sp. (Williams & Granara de Willink 1992); Moraceae: *Morus alba* L.; Myrtaceae: *Psidium guajava* L. (Tanwar *et al*. 2010); Poaceae: *Uniola paniculata* L., *Zea mays* L.; Polygonaceae: *Coccoloba* sp.; Rosaceae: *Raphiolepis umbellata* Thunb. (Miller & Miller 2002), *Rosa* sp. (Matile-Ferrero & Étienne 1998); Rubiaceae: *Canthium inerme* (L.) (Tanwar *et al*. 2010), *Hamelia* sp. (Miller & Miller 2002), *Mussaenda* sp. (Matile *et al*. 2000); Rutaceae: *Citrus paradisi* Macfad. (Miller & Miller 2002); Solanaceae: *Cestrum nocturnum* L. (Matile-Ferrero & Étienne 1998), *Lycopersicon esculentum* Mill. (Tanwar *et al*. 2010), *Solanum melongena* L. (Miller & Miller 2002), *Solanaum torvum* Sw. (Tanwar *et al*. 2010); Sterculiaceae: *Guazuma* sp. (Miller & Miller 2002), *Guazuma tomentosa* Kunth. (Martínez *et al*. 2005)); Verbenaceae: *Clerodendrum paniculatum* L., *Tectona grandis* L. (Miller & Miller 2002).

Detailed morphological characters for all stages of this species were described and illustrated by Miller & Miller (2002). Adult females (Fig. 1 right) are 2.0–2.4 mm long and 1.4–1.5 mm wide, yellowish and covered with a white waxy coating. Diagnostic characters of slide-mounted adult females (Fig. 2) for distinguishing this species from all other New World *Paracoccus* species are: (1) oral-rim tubular ducts present only on the margin (unique with *P. marginatus*) and (2) no pores present on the hind tibiae (only *P. townsendi* and *P. villanuevai* also lack pores on the hind tibiae) (Miller & Miller 2002). Males appear yellowish in first and second instar and turn to pink during the pre-pupal and pupal stages. Adult males (Fig. 1 left) are approximately 1.0 mm long, 0.3 mm wide (widest at the thorax). Eggs laid in ovisac covered with wax are greenish yellow. They are oviposited on the shoots, midribs of young leaves and fruits, and develop under the adult females. It was reported that approximately 80–90% of the eggs survived between 20 and 30°C, and the highest fecundity was at 25°C with each female producing an average of 300 eggs (Amarasekare *et al*. 2008). After egg hatch, the nymphs move and develop rapidly with four instars for female and five instars for male. The papaya mealybug serious infestations are observed as clusters of cotton-like masses on the above-ground portion of plants (Fig. 3). Adult males and females required 303.0 and 294.1 degree-days (DD), respectively, to complete their development between 18 and 30°C (Amarasekare *et al*. 2008). This suggests that it is capable of producing overlapping generations in areas of Taiwan within this temperature range.

Since August 2010, the papaya mealybug has been found in Taichung City, Nantou County, Changhua County, Yunling County and Kaohsiung City, and to date 12 host species have been found infested, i.e., *Plumeria acutifolia* L. (new record), *Bidens pilosa* L. (new record), *C. papaya* L., *M. esculenta* Crantz, *M. glabra* L., *H. rosa-sinensis* L., *H. syriacus* L. (new record), *M. alba* L., *P. guajava* L., *Torenia fournieri* Lind. (new record), *P. hysterophorus* L. and *S. melongena* L..

This pest can spread rapidly and can cause serious injury to the host plants, resulting in economic damage. An integrated pest management (IPM) including cultural practices, chemical and biological control can be applied to manage papaya mealybug. The parasitoid natural enemies of the papaya mealybug include *Acerophagus papayae* (Noyes and Schauff), *Anagyrus loecki* (Noyes and Menezes), *Anagyrus californicus* Compere, *Pseudaphycus* sp. and *Pseudleptomastix mexicana* (Noyes & Schauff 2003). All above parasitoids have been observed attacking on 2nd-3rd instar nymphs, but not capable of reducing high population of this pest in a short period. *Spalgius epius* (Westwood) (Lepidoptera: Lycaenidae), being the dominant predator, feeds efficiently on the ovisacs, nymphs and adults of the papaya mealybug (Tanwar *et al*. 2010). The predatory larvae could devour about 42 to 53 (48.15 ± 4.08) ovisacs and 196 to 222 (210.99 ± 10. 77) nymphs and adults of *P. marginatus* (Thangamalar *et al*. 2010) during the whole larval period.

Fig. 1. Male adult of *Paracoccus marginatus* (left), and the female adult (right).

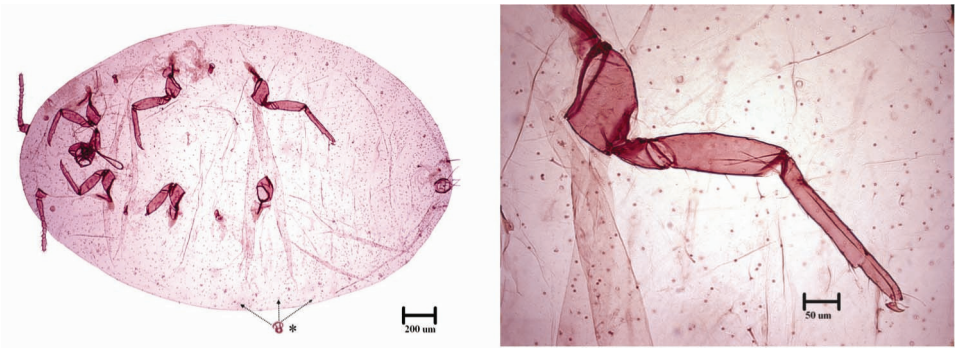

Fig. 2. Slide-mounted female adult of *Paracoccus marginatus* (left, oral-rim tubular ducts:*), and the detailed characters of hind tibia of *Paracoccus marginatus* (right).

Fig. 3. The clusters of cotton-like masses on fruits (left) and stems (right) of papaya tree after serious papaya mealybug infestation.

Botanical insecticides such as neem oil (1 to 2%), NSKE (5%), or Fish Oil Rosin Soap (25 g/L) and chemical insecticides such as profenophos 50 EC (2 mL/L), chlorpyriphos 20 EC (2 mL/L), buprofezin 25 EC (2 mL/L), dimethoate 30 EC (2 mL/L), thiamethoxam 25 WG (0.6 g/L), imidacloprid 17.8 SL (0.6 mL/L) were suggested to control this pest (Thangamalar *et al*. 2010).

However, papaya mealybug is difficult to control because it inhabits protected areas such as cracks and under the bark of their host plants, where cultural practices and chemical control treatments are difficult to reach. Integrating monitoring and pest control measures is necessary for crop production.

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台灣新發現的木瓜秀粉介殼蟲 (半翅目：粉介殼蟲科) 為害初報[1]

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摘 要

陳淑佩、翁振宇、吳文哲。2011。台灣新發現的木瓜秀粉介殼蟲 (半翅目：粉介殼蟲科) 為害初報。台灣農業研究 60:72–76。

木瓜秀粉介殼蟲 (*Paracoccus marginatus* Williams and Granara de Willink) 是農作物及觀賞作物的重要害蟲。自 1994 年以來，此害蟲在加勒比海區附近國家成為重要入侵害蟲，迄今造成許多國家木瓜及其他農作物的重大經濟損失。本文首次報導木瓜秀粉介殼蟲在台灣危害木瓜之情形及整理此害蟲之分佈、寄主植物及其基本生物學等相關資料。

關鍵詞：木瓜、寄主植物、木瓜秀粉介殼蟲、新記錄。

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1. 行政院農業委員會農業試驗所研究報告第 2481 號。接受日期：100 年 3 月 25 日。
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