



Occurrence of Papaya mealybug, *Paracoccus marginatus* as an emerging pest of *Hibiscus mutabilis* and its predator from Terai region of West Bengal

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ABSTRACT: The present study reports, the first record of papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink as a serious pest of *Hibiscus mutabilis* Linn. from the Terai region of West Bengal, India. Studies were conducted during the summer at Pundibari, Coochbehar and observed that about 80-90 per cent plants and 49.49 per cent leaves were infested by this sap sucker. Critical observation revealed that mealybugs as cotton-like masses were seen to accumulate on the above ground portion mainly on tender leaves, twigs and apical buds of plants. Both the nymphs and adults suck the sap and devitalize them. Infested plants also bear a significantly lower number of flowers as well as deformed flowers. The detailed studies on morphology, biology, host range etc. have been discussed in the paper. A lepidopteran predator, the apefly, *Spalgus epeus* westwood was also observed to be associated with the mealy bug colonies and were found to predate on it. The first, second, third and fourth instar predator larvae devoured 64.8±3.95, 176.2±12.2, 354±18.3 and 504.3±20.6 mealybug eggs/day, respectively, and could be a potential augmentative biocontrol agent of this polyphagous mealybug.

Keywords: Apefly, *Hibiscus mutabilis*, *Paracoccus marginatus*, Terai region, West Bengal

INTRODUCTION

Cotton rose or changing rose, *Hibiscus mutabilis* Linn. (family- Malvaceae), popularly known as *Sthalapadma* or *Sthalkamal*, is a common ornamental and medicinal plant in India. In the traditional system of medicines, its different plant parts viz., leaves, flowers, seeds, stems are used as emollient, in pectoral and pulmonary complaints, stimulant and leaves applied to swelling (Barve *et al.*, 2010). The plants are also reported to have antibacterial, antioxidant properties, hepato protective, filaricidal, anti-allergic and anti-diabetic activities (Chan *et al.*, 2016). Apart from these, this spectacular plant is also unique in the plant kingdom as flowers change its colour as white in the morning, pink in the afternoon, and red in the evening. This miraculous plant is often attacked by a number of insect pests throughout its growth period. Amongst them, leaf eating caterpillar, aphids, jassids etc. are important. Recently, serious incidences of a mealybug feeding on leaves, tender twigs, apical buds were observed in around the campus of Uttar Banga Krishi Viswavidyalaya, Pundibari (89°23'53" E, 26°19'86" N), Coochbehar, West Bengal, India during the summer season (April-June). The tender leaves, twigs and apical buds were initially observed to be heavily covered with whitish powdery masses of

mealybugs. Later, these were covered with black sooty mould which developed on the honey dew secreted by these insects. During the survey, several locals and horticulturists were also reported the same problem. This prompted to conduct a detailed study about this nefarious pest as practically no information is available about this pest from this region on *H. mutabilis*.

MATERIALS AND METHODS

The specimens of mealybugs collected were preserved in 80% alcohol, and sent to the Division of Crop Protection, ICAR-Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh, India and for detailed morphological and taxonomical studies. Morphometrics of *P. marginatus* feeding on *H. mutabilis* were studied under laboratory conditions. All stages of live *P. marginatus* (eggs, first, second and third instars of males and females, adult males and females) were separated and morphometric characters (length and width) were measured using stereo zoom microscope (Nikon SMZ-10A) with stage and ocular micrometer. Ten specimens of each of all above mentioned stages of male and female *P. marginatus* from *H. mutabilis* were taken and a total of 180 specimens were sampled.

Feeding potential of different stages of *S. epeus* larvae were evaluated under laboratory conditions using

eggs of *P. marginatus*. Egg sacs of different sizes were separated from gravid adult females, number of eggs within those sacs were counted under the stereo binocular microscope (Olympus SZ 61) and were offered to the larvae (starved for 6 h) for feeding. Both the larvae and mealybug eggs were released on a petri dish containing tender leaf of *H. mutabilis* and were kept in normal environmental condition with the prevailing temperature of 28-33°C and 70-80% relative humidity and observation was recorded at 24 h intervals. Ten larvae for each instar were maintained.

RESULTS AND DISCUSSION

The specimens were taxonomically identified as *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) by the following morpho-taxonomic characters as described by Tanwar *et al.*, (2010).

Morphometric study indicated variations existed with regard to sizes of all stages of male and female *P. marginatus* reared on *H. mutabilis* (Table 1). However, the variations were not significantly different. The eggs were translucent, oblong and greenish yellow in colour. The eggs were laid in groups, having 0.33±0.05 mm length and 0.14±0.05 mm width, in an ovisac, developed on the ventral side of the gravid female mealybug. Freshly emerged neonate nymphs, having a pair of six segmented antennae, were ellipsoidal in shape with 0.40±0.04 mm body length and 0.19±0.04 mm body width and whitish yellow in colour. Second instar nymphs were resembles with first instars except larger in size. They secreted white waxy powder on the dorsal side of the body after about 24 hours of first moult (Chellappan *et al.*, 2013). The sexes of individual mealybugs could be determined

during the latter part of the second instar as males changed their colour from yellow to pink (Amarasekare *et al.*, 2008). Body size of second instar female nymphs (0.71±0.02 mm length and 0.41±0.08 mm width) was slightly bigger than the second instar male (0.70±0.03 mm length and 0.40±0.06 mm width) and both the sexes had a pair of six-segmented antenna. Third instar nymphs of females were also oblong in shape with yellow in colour while the male counterpart was pink in colour with reduced body size (Table 1). Adult females had yellow coloured body, dusted with white mealy wax and eight segmented antennae (Chellappan *et al.*, 2013). Adult males were elongated and oval in shape, having highest width at the thorax. Although adult female were significantly bigger in size with 2.26±0.09 mm body length and 1.33±0.13 mm body width than the male (0.94±0.02 mm body length and 0.23±0.03 mm body width) but later had ten segmented, bristle shaped antennae which were much longer than that of female antennae.

Critical observation revealed that infestation of the *P. Marginatus* appeared as clusters of cotton-like masses on the above ground portion mainly young leaves, apical shoots of plants (Fig. 1). Both the nymphs and adults suck the sap of the plant and devitalize them, resulting the leaves become crinkled, yellowish and finally wither. Infested plants also bear a significantly lower number of flowers. They secret copious amount of honey dew deposited on leaves and twigs causing black sooty mould formation and thereby inhibit the normal photosynthetic activity of the affected plants. It was observed that nymphs and adults of *P. marginatus* were myrmecophily and often attended by a large number of black ants, *Camponotus compressus* (Hymenoptera: Formicidae) (Fig. 2). The infestation started during the onset of summer month (April) and continued till the end of June with highest infestation (49.5% infested leaves and 360.5 mealybugs per apical 10 cm of twigs) during 23rd standard meteorological weeks (second week of June) in the region. However, the population declined drastically during the rainy season as the region receives an average annual rainfall of 3000 mm. Infestation was more serious in its seedlings stage and in young plants. A brief biology of this polyphagous pest was also studied with tender *H. mutabilis* shoots as food under laboratory conditions. Gravid females lay up to 209±16.57 eggs during her lifetime. Freshly laid eggs were translucent white in colour. Incubation period ranged from 5.75 – 7.25 days (at 24-28°C temperature, 70±5% RH and 13:11 hour (L:D) photoperiod). Adult females attained

Table 1. Morphometrics of different life-stages on *P. marginatus* feeding on *H. mutabilis*

Life stages of <i>P. marginatus</i>	Morphometrics* (mm)	
	Length	Width
Egg	0.33±0.05	0.14±0.05
First instar nymph	0.40±0.04	0.19±0.04
Second instar nymph (Male)	0.71±0.02	0.41±0.08
Third instar nymph (Male)	1.13±0.12	0.56±0.08
Second instar nymph (Female)	0.70±0.03	0.40±0.06
Third instar nymph (Female)	0.93±0.04	0.41±0.03
Adult female	2.26±0.09	1.33±0.13
Adult male	0.94±0.02	0.23±0.03

*Mean of ten observations



Fig. 1. *P. marginatus* feeding on leaf of *H. mutabilis*



Fig 2. *P. marginatus* on stem of *H. mutabilis* attended by black ant, *Camponotus compressus*

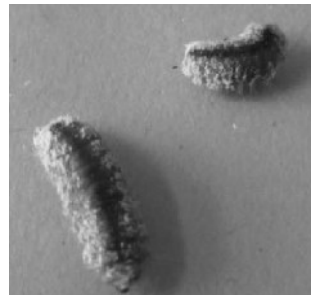


Fig. 3. Larvae of *Spalgiosepeus*



Fig. 4. Typical pupa of *S. epeus*

maturity through three nymphal instars. First, second and third nymphal periods ranged from 4 – 5.25, 3.75 – 5.0 and 4.75 – 6.75 days, respectively, with an average of 4.85, 4.55 and 5.55 days. Adult female and male longevity ranged from 22.50 – 30.75 and 2.25 – 3.25 days, respectively.

An apefly predator, *Spalgus epeus* Westwood (Lepidoptera: Lycaenidae) was also found to be associated with the mealybugs. Larvae were stout, brownish black in colour found to feed on the mealybugs voraciously. Early instar larvae, resembling closely to the mealybug adults, are difficult to identify within the mealybug colonies as their body remains covered with powdery mealy masses just like adult mealy bugs. Later instar larvae mostly rested in the junction of the leaf petiole and main branch, whereas the early instars were seen on the under surface of the leaflet near the basal region. They were seen on the under surface of the leaflet near the basal region, whereas the late instar larvae were found to rest in the junction of the leaf petiole and main branch. Early instar larvae (*i.e.*, first and second instars) were found to feed on egg masses as well as ready to hatch or just hatched nymphs that but yet to come out from the egg sac. The predator larvae devoured the entire egg sac along with its sticky covering silken threads. This

could be the reason behind the fact that white waxy coatings of the egg sac get adhered to the body hairs of larvae. Unlike other predator, larvae of *S. epeus* were mostly sluggish in habit and sedentary in nature. They used to avoid crawlers as the latter was fast moving. Later instar larvae *viz.*, third onwards predate upon egg sac as well as nymphs which are immobile, plump and fleshy. A significant difference was observed between in their daily average consumption. First instar larvae consumed an average of 64.8 ± 3.95 eggs/day whereas the feeding rate of second and third instar larvae were 176.2 ± 12.2 and 354 ± 18.3 eggs/day (Fig. 5), respectively. Fourth instar larvae were voracious feeder and devoured 504.3 ± 20.6 eggs/day. Last *i.e.*, fifth instar larvae were pre-pupal stage and therefore, did not feed. Pupa of *S. epeus* were light brown in colour with typical monkey or phantom faced (Fig. 4). Adult males were medium sized moth with mottled brown in colour. Forewing with a white quadrate spot from the end of the discoidal cell. Adult females had both light brown wings with forewing with a broader white discal space.

P. marginatus is a native of Mexico and/or Central America (Miller *et al.*, 1999) was first reported from Caribbean islands in 1995 and since then has spread to 13 countries in the Caribbean, Florida in the USA, and

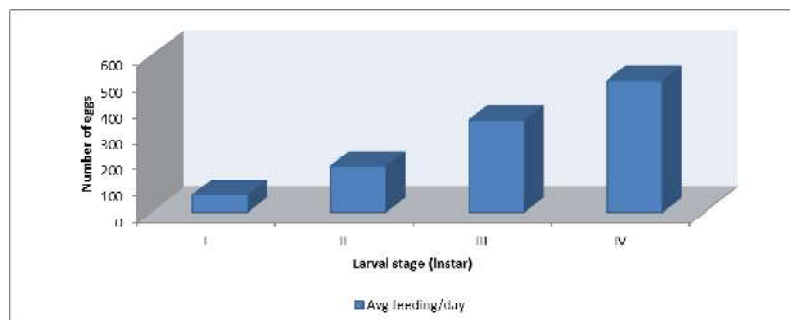


Fig. 5. Feeding potential of different larval stages of *S. epeus* on eggs of *P. marginatus*

three countries each in Central and South America by 2000 (Miller *et al.*, 1999, Kauffman *et al.*, 2001). In 2002, it was reported in the Pacific Islands (Meyerdirk *et al.*, 2004, Muniappan *et al.*, 2006) and in 2008 in Indonesia, India, and Sri Lanka (Muniappan *et al.*, 2008). In 2009, it was reported from Bangladesh and Maldives and in 2010 in Cambodia, Philippines and Thailand (Muniappan, 2011). In India, it was first reported from Coimbatore, Tamil Nadu during 2007. It assumed the status of a major pest in India in 2009 when it caused severe damage to economically important crops and huge losses to farmers in Coimbatore, Erode, Tirupur and Salem districts of Tamil Nadu (Tanwar *et al.*, 2010). Being polyphagous, it has a wide host range of over 60 species of plants, including economically important plants such as *Annona squamosa* Linn., *Carica papaya* Linn., *Hibiscus rosa-sinensis* Linn., *Ipomoea* spp., *Manihot esculenta* Crantz and *Solanum melongena* Linn. (Meyerdirk and Kauffman, 2001); *Lycopersicon esculentum* Mill., *Jatropha curcus* Linn. (Tanwar *et al.*, 2010). Recently, Seni and Chongtham, 2013 reported incidence of *P. marginatus* on *H. mutabilis* from Kalyani, West Bengal. To the best of our knowledge, there has been no report of this pest as a serious sap sucker on *H. mutabilis* from Terai region of West Bengal. The present study reported here is the first report of *P. marginatus* as an emerging pest of *H. mutabilis* and its lepidopteran predator from the region. We aim to conduct detailed studies on the bio-ecology and integrated management practices for this pest with special emphasis on their biological control.

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REFERENCES

- Amarasekare, K. G., Mannion C. M., Osborne L. S. and Epsky, N. D. 2008. Life history of *Paracoccus marginatus* (Hemiptera: Pseudococcidae) on four host plant species under laboratory conditions. *Environmental Entomology*, 37: 630-635.
- Barve, V. H., Hiremath, S. N., Pattan, S. R. and Pal, S. C. 2010. Phytochemical and pharmacological evaluation of *Hibiscus mutabilis* leaves. *Journal of Chemical and Pharmaceutical Research*, 2(1): 300-309.
- Chan, E. W. C., Wong, S. K., Chan, H. T. 2016. A Review on the Phytochemistry and pharmacology of two *Hibiscus* Species with Spectacular Flower Colour Change: *H. tiliaceus* and *H. mutabilis*. *International Journal of Pharmacognosy and Phytochemical Research*, 8(7); 1200-1208.
- Chellappan, M., Lawrence, L. and Ranjith, M. T. 2013. Biology and morphometry of *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae). *Entomon*, 38(2):97-110.
- Kauffman, W. C., Meyerdirk, D. E., Warkentin, R., Alvarez, P. and Abud, A. 2001. Biological control of papaya mealybug in the Caribbean safeguarding the US Poster Presentation. International Organization for Biological Control, August 2-5, 2001, Bozeman, Montana.
- Meyerdirk, A., D. E., Muniappan, R., Warkentin, R., Bamba, J. and Reddy, G.V.P. 2004. Biological control of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) in Guam. *Plant Protection Quarterly*, 19(3): 110-114.
- Meyerdirk, D. E. and Kauffman, W. C. 2001. Status on the development of a biological control program for *Paracoccus marginatus* Williams, papaya mealybug. Internal USDA, APHIS, PPQ Report.
- Miller, D. R., Williams, D. J. and Hamon, A. B. 1999. Notes on a new mealybug (Hemiptera: Coccoidea: Pseudococcidae) pest in Florida and the Caribbean: The papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink. *Insecta Mundi*, 13:179-181.
- Muniappan, R. 2011. Recent invasive hemipterans and their biological control in Asia. www.icac.org/tis/regional.
- Muniappan, R., Meyerdirk, D.E., Sengebau, F. M., Berringer, D. D. and Reddy, G. V. P. 2006. Classical biological control of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) in the Republic of Palau. *Florida Entomologist*, 89: 212-217.
- Muniappan, R., Shepard, B. M., Watson, G. W., Carner, G. R., Sartiami, D., Rauf, A. and Hammig, M. D. 2008. First report of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae), in Indonesia and India. *Journal of Agriculture and Urban Entomology*, 25: 37-40.
- Seni, A. and Chongtham, S. 2013. Papaya mealybug *Paracoccus marginatus* Williams & Granara De Willink (Hemiptera: Pseudococcidae), A current threat to agriculture - a review. *Agri. Reviews*, 34(3): 216-222.
- Tanwar, R. K., Jeyakumar, P. and Vennila, S. 2010. Papaya mealybug and its management strategies Technical Bulletin 22. National Centre for Integrated Pest Management, New Delhi, pp. 6-7.

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