

**DESCRIPTION OF THE ADULT FEMALE AND MALE OF PAPAYA
MEALYBUG, *PARACOCCUS MARGINATUS* WILLIAMS & GRANARA DE
WILLINK (HEMIPTERA : PSEUDOCOCCIDAE)**

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The detailed morphological study on adult male and female of the mealy bug, *Paracoccus marginatus* Williams & Granara de Willink has been carried out. The adult females possess 8 segmented antenna, multilocular pores, oral collar tubular ducts on venter and 10-11 pairs oral rim tubular ducts on margins of dorsum. The dipterous adult males are characterized by the presence of 10 segmented antenna, multilocular disc pores on the both surfaces and one pair of cluster of stellate or tail forming glandular pouch on each side of the dorsal abdominal segment IX.

Key words : Female, male, morphology, *Paracoccus marginatus*

INTRODUCTION

The papaya mealybug, *Paracoccus marginatus* is a hemipteran insect and belongs to family Pseudococcidae. It can be distinguished by its greenish yellow body (Miller *et al.*, 1999) colour with large amounts of white waxy secretion. It is polyphagous (Miller & Miller, 2002) in nature and sucks the sap of the plant and weakens that. The leaves become crinkled, yellowish and wither. The honey dew excreted by the bug and the associated black sooty mould formation impairs photosynthetic efficiency of the affected plants. In India it has caused havoc in agricultural and horticultural crops ever since its first report from Coimbatore in 2007. It has a wide host range of over 60 species of plants including economically important plants such as *Annona squamosa*, *Carica papaya*, *Hibiscus rosa-sinensis*, *Ipomoea* spp., *Manihot esculenta* and *Solanum melongena* (Meyerdirk & Kauffman, 2001). It assumed the status of a major pest 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). In the same year, standing mulberry crop over 1,500 hectares in Tirupur was destroyed by the pest leading to enormous financial losses to mulberry growers across the district. Other reasons for losses are due to their high resistance to pesticides as their body is covered by waxy layer.

Mealy bug identification has traditionally been based on the adult female since it causes the damage and is most readily collected. On the other hand male mealy bugs are minute and typically winged but are rarely observed. Williams & Granara de Willink (1992) published the taxonomic paper on *Paracoccus marginatus* and included the description and illustration of the adult female. They also provided description and key for the 21 species of *Paracoccus* occurring in Central and South Africa. Miller & Miller (2002) redescribed this with a comparison between *marginatus* and other species of *paracoccus* in Florida & Caribbean. The present work has been carried again to distinguish adult male and female of *P. marginatus* more vividly.

MATERIALS AND METHODS

The mealybug was collected from Mohanpur (Nadia), West Bengal from papaya plant and later reared on sprouted potato tubers in the laboratory at 25-34°C Temp. and 84-93% RH. The slides were prepared following the methods given by Williams and Watson (1988). The adult male and female mealy bug were collected from the culture and fixed in 70% alcohol. The specimens were placed in 10% KOH solution and heated in water bath for 2-5 minutes. Then the body content was gently pressed out, placing the specimen dorso-ventrally, following which KOH was removed by washing it in distilled water. After that, it was treated in 50% and 70% alcohol, for 8-10 min. each. If hard crystals were formed, then they were cleared by treatment with 95% alcohol for 5 minutes and then with carboxylene 10-15 minutes. The specimens were again washed in 95% alcohol to remove carboxylene (Xylene-3 parts, Carboic acid crystals-1 part). Then, all the cleared specimens were kept in acetoalcohol (Glacial acetic acid-20 parts, 50% alcohol 80 parts) for 15-20 minute. The specimens were then stained in acid fuschin (acid fuschin 0.5gm, 10% Hcl-25 ml and distilled water-300 ml) for 1 hour or more. Excess stain was removed by washing them in 95% alcohol for few minutes. Then they were dehydrated in absolute alcohol for 10 minutes and this process was repeated at least twice. Lastly the specimens were kept in clove oil for 20 minutes. Finally they were mounted on slides in DPX by placing them ventrally and covered with cover slips. These slides were dried on hot plate at 40°C for 15-20 days. Later measurements were taken and figures were drawn using a camera lucida.

RESULTS AND DISCUSSION

Adult female

The adult female is oval and about 2.29 (1.15-2.47) mm long and 1.43 (0.75-1.45) mm wide, dorsum with 18 pairs of cerarii (Fig. 1). Anal lobe cerarius with 1 auxiliary seta, 2 conical setae and 8-10 trilocular pores. Other cerarii having 2 conical setae and 2-3 trilocular pores.

Head : Antenna 8-segmented measuring about 383.21 (299.36-587.72) μ m long and the measurements of the segments in micron are : I, 50.51 (40.1-66.72) \times 34.74 (30.88-38.6); II, 44.33 (38.6-50.18) \times 33.97 (27.02-34.74); III, 46.27 (42.89-47.23) \times 21.62 (19.3-27.02); IV, 27.92 (26.15-30.32) \times 22.39 (19.3-23.16); V, 37.18 (29.42-45.14) \times 20.84; VI, 22.14 (19.83-23.96) \times 19.3; VII, 31.68 \times 18.52 (19.3-15.44); VIII, 88.15 (79.50-98.35) \times 25.48 (19.3-34.74). Eyes about 31.05 (29.21-34.96) μ m wide and about 19.23 (17.03-21.02) μ m high. Labium about 103.49 (98.17-134.26) μ m long and 59.03 (49.26-75.97) μ m wide, Clypeolabral shield is about 122.86 (119.89-124.06) μ m long and 114.68 (113.10-116.15) μ m wide.

Thorax : Average measurement of hind legs in μ m are as follows: 94.16 (77.49-107.99) \times 94.83 (77.2-135.8); trochanter, 81.06 (77.2-100.36) \times 39.24 (34.74-57.9); femur, 166.62 (135.1-212.3) \times 59.83 (46.32-57.9); tibia 173.7 (154.4-231.6) \times 30.88 (17.02-38.6); tarsus, 72.05 (46.32-115.8) \times 25.73 (23.16-34.74); Length of trochanter + femur, 249.94 (212.66-239.32); tibia + tarsus, 270.2 (239.32-347.4); ratio of the length of trochanter + femur to tibia + tarsus, 1:1.09; claw, 24.44 (23.16-30.88) with small denticle. Tarsal digitule about 23.80 (15.44-27.02) μ m long and claw digitule about 28.95 (23.16-27.02) μ m long.

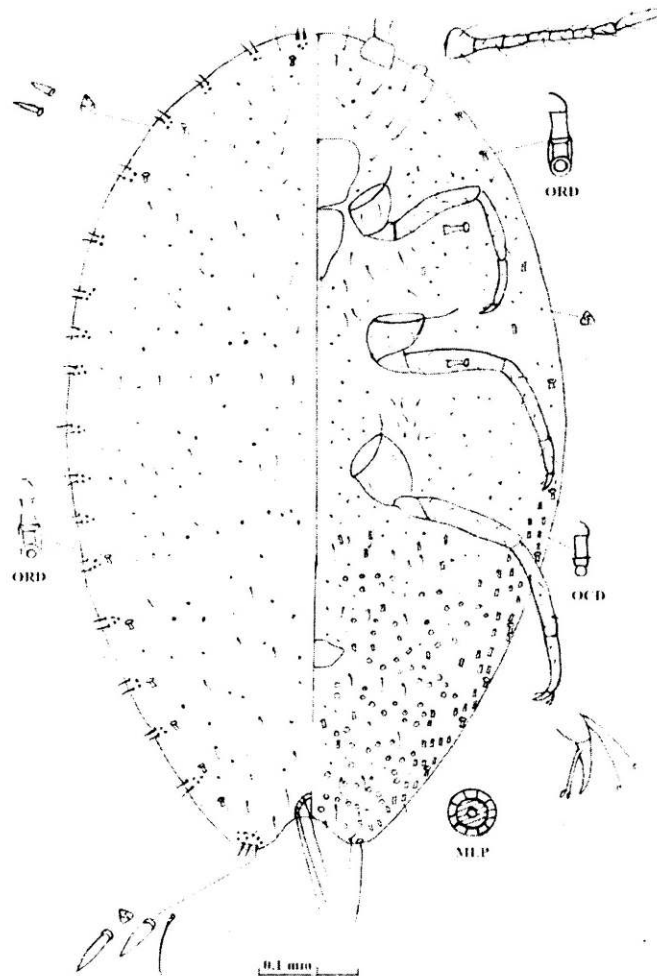


Fig. 1: Adult female of *P. marginatus* Williams and Granara de Willink.
(MLP = Multilocular pore, OCD = Oral collar duct, ORD = Oral rim duct)

Anterior spiracle, about 40.53 (38.6-50.18) μm long and 30.26 (27.02-38.6) wide at the atrium. The corresponding figures for posterior spiracles are 50.18 (38.6-108.08) μm and 31.52 (27.02-42.46) μm , respectively.

Abdomen : Anal ring, about 80.21 (76.86-87.45) μm in diameter with 6 anal ring setae, each about 113.29 (84.32-129.98) μm long. The length of apical seta 184.22 (128.43-205.67) μm . Anal lobe bar present. Circulus about 74.18 (70.08-77.48) μm in diameter.

Dermal structure

The setae on dorsum and venter 15.06 (6.97-20.79) μm and 38.31 (26.96-51.97) μm , respectively. Trilocular pores are fairly evenly distributed on both the body surfaces, dorsum and venter. Their approximate numbers are; dorsum, abdominal segments, IX,

79-90; VIII, 80-83; VII, 81-87; VI, 80-85; V, 81-89; IV, 82-90; III, 84-87; II, 90-91; metathorax, 78-86; mesothorax, 92-93; prothorax, 90-92; head, 90-97. On venter abdominal segments, IX, 50-54; VIII, 50-60; VII, 54-56; VI, 50-60; V, 45-50; IV, 50-62; III, 55-67; II, 51-54; metathorax, 52-57; mesothorax, 65-70; prothorax, 55-62 and head 52-57.

Multilocular disk pores are restricted to abdominal segments of venter only. Their approximate numbers are, abdominal segment IX, 10-12; VII, 18-22; VI, 10-12, VI, 6-10; V, 6-11; III, 5-8; II, 3-5.

Oral collar duct is absent on dorsum but present on the venter. Their approximate numbers are, abdominal segment IX, 15-16; VIII, 13-15; VII, 15-16; VI, 20-21; V, 6-8; IV, 8-10; III, 9-11; II, 10-11; metathorax, 14-16; mesothorax, 16-17; prothorax, 9-11; head, 5-7.

Oral rim tubular ducts usually present on the margin of the dorsal side and their approximate numbers are abdominal segment IX, 1; VIII, 2; VII, 2; VI, 1; V, 2; IV, 1; III, 1; II, 1; metathorax, 2; mesothorax, 2; prothorax, 2; head, 0.

Adult male

Body of adult male is deep red in color with transparent wing (Fig. 2). Body measures about 3.21 (0.78-0.83) mm in length and 1.22 (0.3-0.4) mm in breadth including the projected penial sheath and 94.2 (77.2-96.2) μm in length and 70.1 (62.2-74.0) μm in width. Cerarii absent.

Head : Antenna 10-segmented measuring about 461.27 (428.46-490.22) μm long and the measurements of the segments in micron are : I, 48.25 (46.32-50.18) \times 38.6; II, 57.8 (46.32-61.76) \times 24.13 (23.16-27.02); III, 41.46 (38.6-42.46) \times 21.23 (19.3-23.06); IV, 46.42 (42.46-50.18) \times 21.23 (19.3-23.16); V, 53.06 (50.18-54.04) \times 21.23 (19.3-23.16); VI, 47.29 (46.32-50.18) \times 21.23 (19.3-23.16); VII, 41.46 (38.6-42.46) \times 19.3; VIII, 39.57 (38.6-42.46) \times 19.3; IX, 41.46 (38.6-42.46) \times 33.48 (27.02-38.6); X, 39.57 (38.6-42.46) \times 19.3 and XI, 54.04 \times 19.3, with setae all over the antenna.

Dorsal eye about 34.1 (30.2-42.43) μm in diameter and lateral eye 17.32 (12.24-20.13) μm in diameter. Mouthparts are absent.

Thorax : One pair of wing, about 656.2 (463.2-694.8) μm long and 183.35 (154.4-212.3) μm wide. Hamulaltri about 69.48 (65.62-73.34) μm long and 19.3 (19.3-23.16) μm wide with apically hooked seta about 59.83 (57.9-61.76) μm long.

Average measurement of hind legs in μm are as follows : coxa, 66.59 (57.9-77.2) \times 38.6; trochanter, 38.6 \times 21.23 (19.3-23.16); femur, 160.19 (154.40-162.12) \times 30.88 (23.16-38.6); tibia, 193.0 \times 22.20 (19.3-27.02); tarsus, 77.20 \times 19.3 (15.44-23.16); length of trochanter + femur, 198.79; tibia + tarsus, 273.095; ratio of the length of trochanter + femur to tibia + tarsus, 1:1.37; claw, 17.05 (14.7-17.64) without denticle. Tarsal digitule about 7.93 (7.35-8.82) μm and claw digitule 6.45 (5.88-7.35) μm long respectively.

Anterior spiracle, about 23.15 (18.33-24.26) μm long and 17.32 (14.21-20.58) μm wide at the atrium. The corresponding figures for posterior spiracles are 21.17 (17.24-23.73) μm and 18.68 (14.37-24.11) μm respectively.

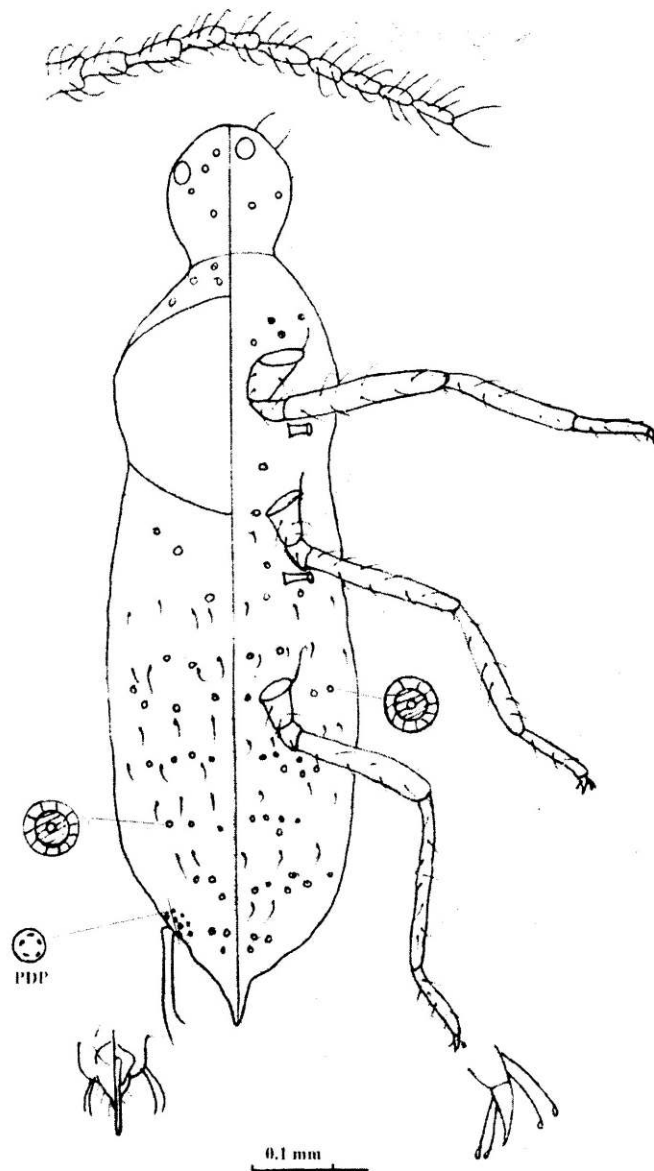


Fig. 2 : Adult male of *P. marginatus* Williams and Granara de Willink.
(PDP = Pentalocular disc pore)

Abdomen : Penial sheath, resting on IXth abdominal segments, is about 95.2 (86.2-106.4) μm long and 70.8(62.5-74.08) μm wide at base, with 68.5 (54.04-79.8) μm long aedeagus.

Anterior spiracle, about 23.15 (18.33-24.26) μm long and 17.32(14.21-20.58) μm wide at the atrium. The corresponding figures for posterior spiracles are 21.17 (17.24-23.73) μm and 18.68 (14.37-24.11) μm , respectively.

Dermal structure

Ostioles not discernible. The setae on dorsum and venter are 26.13 (15.44-27.02) μm and 15.44 (11.76-17.64) μm , respectively. Trilocular pores absent.

Multilocular disc pores present on both dorsum and venter surfaces of the body. Their approximate numbers are : on dorsum, abdominal segments, IX, 9-11; VIII, 7-9; VII, 3-6; VI, 2-5; V, 2-5; IV, 2-4; III, 3-4; II, 6-10; metathorax, 3-4; mesothorax, 9-11; prothorax, 2-3 and head, 2-3; on venter abdominal segment, IX, 2-4, VIII, 2-4; VII, 2-4; VI, 2-3; V, 2-5; IV, 2-5; III, 2-4; II, 2-5; metathorax, 3-4; mesothorax, 2-4; prothorax, 2-3; and head 0.

One cluster of stellate or tail forming glandular pouches is present on each side of the dorsal abdominal segment IX. In each cluster there are 45-50 pentalocular disc pores. In the center of this cluster there are two setae of about 208.74 (205.8-225.32) μm long and one small setae of about 94.86 (94.08-102.9) μm long.

The dipterous adult males are characterized by the presence of 10-segmented antenna, pentalocular disc pores on both of the body surfaces, penial sheath and a pair of clusters of stellate or tail forming glands on the dorsum of abdominal segment IX. Miller & Miller (2002) used the term multilocular pore but not pentalocular which have 5 loculi, as observed by the present author. It is revealed from the above that in the present study the number of cerarii in adult females was not at par with that of Miller & Miller (2002) but it was more (18 pairs) than the range (16-17 pairs). However, the validation characters of *P. marginatus* as mentioned in scale net by Anonymus (2010) include 18 pairs of cerarii. Cox (1987) redefined the genus with 18 pairs of cerarii since the preocular pairs are sometimes not discernible. Williams & Willink (1992) in the key to species of *Paracoccus* considered 8 pairs of abdominal cerarii as one of the key characters of *P. marginatus*. The present author supports the views of Williams & Willink (1992) and considers the presence of 8 pairs of abdominal cerarii as one of the validation character not 18 pairs of cerarii in dorsum as mentioned in scale net.

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