

**Descriptions of all instars of the mealybug,  
*Planococcus lilacinus* (COCKERELL)  
(Hemiptera: Pseudococcidae) and its dermal secretion**

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**Abstract**

The sexually undifferentiated first instars nymphs and the three instars of the female of *Planococcus lilacinus* (COCKERELL, 1905) possess 18 pairs of cerarii while the second nymphal males have 13 pairs. The pair of cerarii with stout conical setae in these instars is 1, 3, 10, 18 and 2 respectively. The third and fourth nymphal males have a pair of wing buds and wing pads, respectively. The males have two clusters of stellate pores and 10-segmented antennae. The trilocular, quadrilocular, pentalocular and multilocular pores secrete waxy dusts and particles. Cluster of three or more trilocular pores with the help of cerarian setae secrete white waxy tassels in the margins. Oral collar tubular ducts, present in the adult females and last three nymphal instars of male, produce cottony fibres. A key to the identification of the various instars of this mealybug is given.

**Keywords:** Morphology, identification, pseudococcid, immature stages, sucking pest.

**Introduction**

The mealybug, *Planococcus lilacinus* (COCKERELL), commonly known as oriental mealybug is also synonymous to coffee (*Coffea arabica* L.) mealybug or cacao (*Theobroma cacao* L.) mealybug, or called Oriental cacao mealybug. The Coffee Board of India has identified the mealybug as one of the important pests of coffee in India (SEKHAR, 1964; REDDY *et al.*, 1999; ANONYMOUS, 2006). The insect also inflicts considerable loss to, custard apple (*Annona squamosa* L.), tamarind (*Tamarindus indica* L.), pomegranate (*Punica granatum* L.), and guava (*Psidium guajava* L.) in this country (SHUKLA & TANDON, 1984; MORTON, 1987; MANI & KRISHNAMOORTHY, 1990 and MANI, 1995). COCKERELL (1905) first described the mealybug but there were several

nomenclatural and misidentification problems regarding the correct identity of the mealybug, until the work of EZZAT & MCCONNELL (1956) which redescribed the species in detail and assigned it to the tribe Planococcini. Later COX (1989) dealt in detail with the genus. Descriptions of different instars of several species of mealybugs have been made by several authors (GHOSE, 1971; MILLER, 1975; GHOSH & GHOSE, 1989; NANDA & GHOSE, 1989; FARRELL, 1990; RAE, 1993) and keys to separate instars are available for a few genera or species complexes (GIMPEL & MILLER, 1996). In the recent time MILLER (1999) and MILLER & MILLER (2002) respectively have described immatures and males of *Maconellicoccus hirsutus* (GREEN) and *Paracoccus marginatus* WILLIAMS and GANARA DE WILLINK. But descriptions of the immature stages and adult male have not been published for *P. lilacinus*. Such information will help quarantine personnel by providing identification tools for the determination of mealybugs other than adult females intercepted during import-export of plant materials. The purpose of the paper is to provide descriptions, illustrations and a key to separate different instars of this mealybug.

### Materials and Methods

Populations of the mealybug were collected from guava and litchi plants and reared on sprouted potato tubers in the laboratory. Daily observations were made on the life cycle of the insect meticulously to collect the different instars, fixed in 70% ethyl alcohol. Permanent mounts of different instars of the mealybug were prepared following the techniques of Ghose (1971). The fixed specimens were taken into 90% alcohol and warmed on a boiling water-bath for a few minutes and then further boiled for a few minutes in 10% KOH to dissolve out the body contents. Then the remnants of the body content was gently pressed out, placing the specimen dorso-ventrally, following which KOH was removed by washing it in distilled water, twice. Then, it was treated in 50% and 70% alcohol, for 8-10 minutes each. The specimens were then kept in aceto-alcohol (glacial acetic acid - 20 parts, 50% alcohol - 80 parts) overnight. If hard crystals were formed, after washing of KOH in distilled water, the specimens were kept in 90% alcohol for 10 minutes and in carboxylene (xylene - 3 parts and carbolic acid crystals - 1 part) for 10-15 minutes to dissolve the crystals. The carboxylene was removed by treating the specimens in 90% alcohol. These specimens, thus prepared, were kept in aceto-alcohol overnight. The specimens were then stained in acid fuchsin for one to a few hours according to the degree of sclerotization and excess stain was removed by placing them in 95% alcohol for a few minutes and then dehydrated in absolute alcohol. For complete dehydration and cleaning, specimens were kept in clove oil for 20 minutes, mounted on slides in canada balsam and dried for 15-20 days on a hot plate at 40°C. Before mounting on slides, excess clove oil was absorbed by filter paper.

Measurements were taken based on ten specimens; figures were drawn using a Camera Lucida. A scale has been provided with each figure to indicate

the magnification of the specimens, measured with the help of a stage micrometer. The range of the measurements has been given along with the average within parentheses. For terminology of different morphological features mentioned in this paper, the author followed EZZAT & MCCONNELL (1956) and MCKENZIE (1967). The term, "clypeolabral shield" was used after WILLIAMS & WATSON (1988). In the diagrams, the left and right halves are the dorsal and ventral views respectively. The different types of micro ducts and pores have been represented with bigger dimensions than would be visible under the magnification.

### Description

#### Adult female (Fig. 1)

Body (mounted), 1.49-1.69 (1.59) mm long and 0.85-1.07 (0.95) mm wide, attaining much larger in size with age. Dorsum with 18 pairs of cerarii, all the cerarian areas are sclerotized, the degree of sclerotization being maximum in the abdominal segments IX and VIII, gradually decreasing anteriority. Each cerarius with 2 conical setae, 0-1 auxillary setae and 2-8 trilocular disc pores.

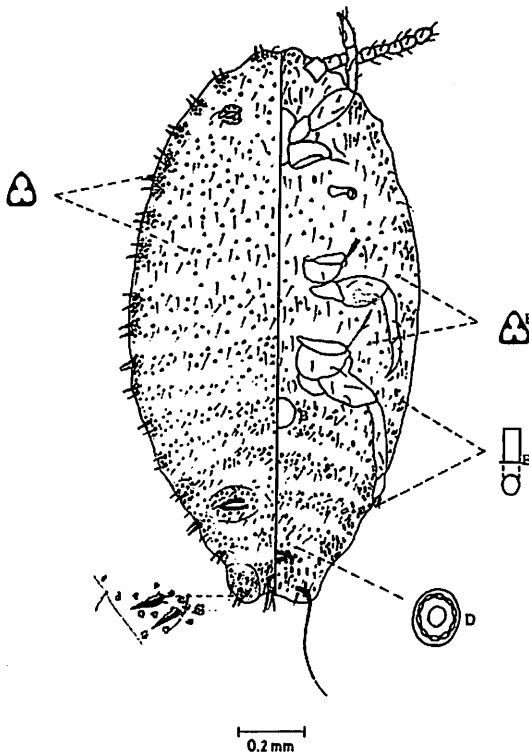


Fig. 1. Adult female of *Planococcus lilacinus*. A - vulva, B - circulus, C - apical seta, D - multi-locular disc pore, E - oral collar tubular duct, F - trilocular disc pore, G - expanded view of anal lobe cerarii.

The lips of the anterior and posterior pairs of ostioles are thickly sclerotized; the upper and lower lips of anterior ones with 7-14 triloculars, 2-4 setae; 6-15 triloculars, 2-5 setae respectively; the corresponding figures for the posterior ones being 11-17, 3-5; 7-11, 2-5 respectively. Anal ring 61-79 (71)  $\mu\text{m}$  in diameter, 6 anal ring setae, each 94-123 (110)  $\mu\text{m}$  long. Dorsum with trilocular disc pores and thin and long body setae, more numerous than on the venter, where setae being longer.

Circulus, broadly oval, 155-166 (161)  $\mu\text{m}$  long and 105-116 (109)  $\mu\text{m}$  wide. Multilocular disc pores and oral collar tubular ducts are present on the venter; being distributed across the abdominal segments IX-V; tubular ducts are also present at the ventral margins of all the segments of the body. Anal lobe bar distinct. The length of apical, cisanal, obanal and bar setae in  $\mu\text{m}$  are : 235-292 (260); 76-119 (100); 65-79 (71); and 76-90 (84). Antennae 8-segmented, 379-415 (388)  $\mu\text{m}$  long. Eyes 40-43 (41)  $\mu\text{m}$  in diameter at base and 18-25 (23)  $\mu\text{m}$  high. Clypeolabral shield 159-206 (181)  $\mu\text{m}$  long. Beak 148-199 (175)  $\mu\text{m}$  long and 90-116 (104)  $\mu\text{m}$  wide. Anterior spiracles 54-72 (61)  $\mu\text{m}$  long and 32-40 (35)  $\mu\text{m}$  wide at atrium; the posterior ones being 58-76 (68)  $\mu\text{m}$  and 43-51 (46)  $\mu\text{m}$ .

Measurement of hind leg in  $\mu\text{m}$  are as follows: coxa, 72-87 (77); trochanter, 79-101 (93); femur, 195-217 (201); tibia, 144-170 (152); tarsus, 90-97 (94); claw, 32-40 (36); tarsal digitules, 47-61 (51) and claw digitules, 25-32 (28).

### **Third instar female nymph (Fig. 2)**

Body (mounted), 0.95-1.35 (1.17) mm long and 0.57-0.87 (0.70) mm wide; ovoid in shape. Dorsum with 18 pairs of cerarii, cerarian area of the abdominal segments are sclerotized, the degree of sclerotization being maximum on the anal lobes, gradually decreasing anteriorly. The cerarii of abdominal segments, prothoracic segments III and the frontal one with 2 conical setae and 1-4 trilocular pores. Two thin spiny setae and 1-3 trilocular pores represent the remaining cerarii of head and thorax.

Lips of both the pairs of ostioles are sclerotized. The upper and lower lips of anterior and posterior pairs are with 3-6 triloculars, 1-2 setae; 3-5 triloculars, 0-1 seta; 4-5 triloculars, 0-2 setae; 3-5 triloculars and 0-2 setae respectively. Anal ring 43-58 (48)  $\mu\text{m}$  in diameter with 72-90 (79)  $\mu\text{m}$  long, 6 anal ring setae. Both dorsum and venter with trilocular disc pores and thin and long body setae, more abundant on the dorsum. Circulus oval, 69-90 (79) X 36-65 (48)  $\mu\text{m}$ . Anal lobe bar distinct. The length of apical, cisanal, obanal and bar setae in  $\mu\text{m}$  is 173-213 (193); 47-69 (55); 40-43 (41) and 47-58 (55). Antennae 7 segmented, 256-274 (269)  $\mu\text{m}$  long. Eyes 29-36 (30)  $\mu\text{m}$  in diameter at base and 14-18 (16)  $\mu\text{m}$  high. Clypeolabral shield 112-137 (123)  $\mu\text{m}$  long. Length and width of the beak are 105-123 (118)  $\mu\text{m}$  and 76-123 (95)  $\mu\text{m}$ . Length and width at atrium of anterior and posterior spiracles in  $\mu\text{m}$  are: 40-43 (42), 11-18 (17); 40-47 (44), 18-22 (20).

Measurement of hind leg in  $\mu\text{m}$  are: coxa, 47-51 (48); trochanter, 69-72 (70); femur, 112-137 (128); tibia, 87-94 (91); tarsus, 87-97 (92); claw, 29; tarsal digitules, 36-47(43) and claw digitules, 18-25 (21).

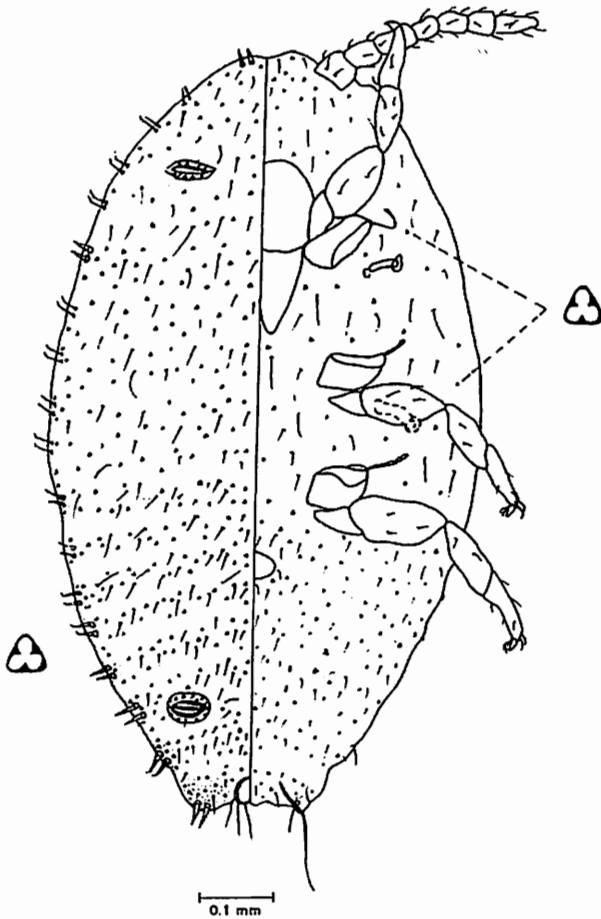


Fig. 2. Third instar female nymph.

### Second instar female nymph (Fig. 3)

Body (mounted), 0.63-0.88 (0.75) mm long and 0.38-0.52 (0.44) mm wide. Dorsum with 18 pairs of cerarii. Anal lobes sclerotized; each cerarius of IX and VIII segments with 2 conical setae and 1-2 trilocular pores; the frontal cerarii with 1 conical and 1 thin seta and 0-1 trilocular. The remaining cerarii are represented by 2 long and thin setae with 1-4 trilocular pores. The lips of the anterior and posterior pairs of ostioles are sclerotized. The upper and lower lips of both the pairs are with 0-2 triloculars, 0-1 seta; 1-2 triloculars, 0-2 setae; 0-2 triloculars, 0-1 seta, 1-2 triloculars, 0-1 seta respectively.

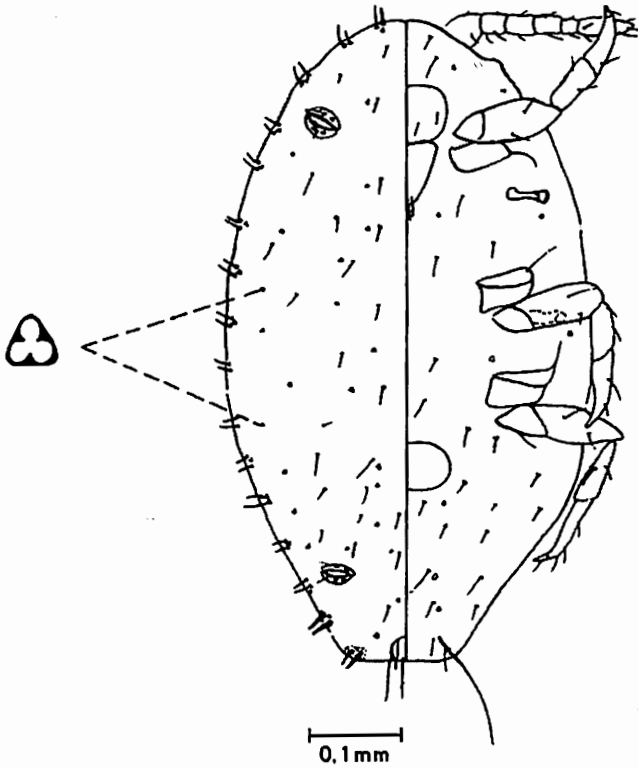


Fig. 3. Second instar female nymph.

Anal ring 25-29 (27)  $\mu\text{m}$  in diameter with 6 anal setae, each being 54-65 (59)  $\mu\text{m}$  long.

Trilocular pores and body setae present on both dorsum and venter, more abundant on dorsum.

Circulus oval, 51-69 (61)  $\mu\text{m}$  long and 54-65 (59)  $\mu\text{m}$  wide.

Anal lobe bar distinct. The length of apical, cisanal, obanal and bar setae in  $\mu\text{m}$  are: 119-148 (132); 32-36 (35); 22-36 (27); and 22-43 (32).

Antennae 6-segmented, 166-209 (187)  $\mu\text{m}$  long. Eyes 18  $\mu\text{m}$  in diameter at base and 7  $\mu\text{m}$  high. Clypeolabral shield 90-101 (95)  $\mu\text{m}$  long. Beak 83-109 (89)  $\mu\text{m}$  long and 47-79 (65) wide. Length and width at atrium of anterior and posterior spiracles are 29-32 (30)  $\mu\text{m}$ , 7-11 (9)  $\mu\text{m}$ ; 25-29 (26)  $\mu\text{m}$ , 7-11 (9)  $\mu\text{m}$ .

Measurement of hind leg in  $\mu\text{m}$  are as follows: coxa, 29-40 (34); trochanter, 36-58 (48); femur, 76-94 (89); tibia, 58-83 (74); tarsus, 68-76 (71); claw, 14-18 (17); tarsal digitules, 25-40 (33) and claw 11-18 (13).

**First instar nymph (Fig. 4)**

The sexes of this instar could not be differentiated. Body (mounted), 0.42-0.50 (0.47) mm long and 0.23-0.25 (0.24) mm wide. Dorsum with 18 pairs of cerarii, only the anal lobe cerarii have 2 stout conical setae and 1 trilobular pore. The other cerarian areas of the abdomen, thorax and head being represented by a pair of thin setae with 0-1 trilobular pore.

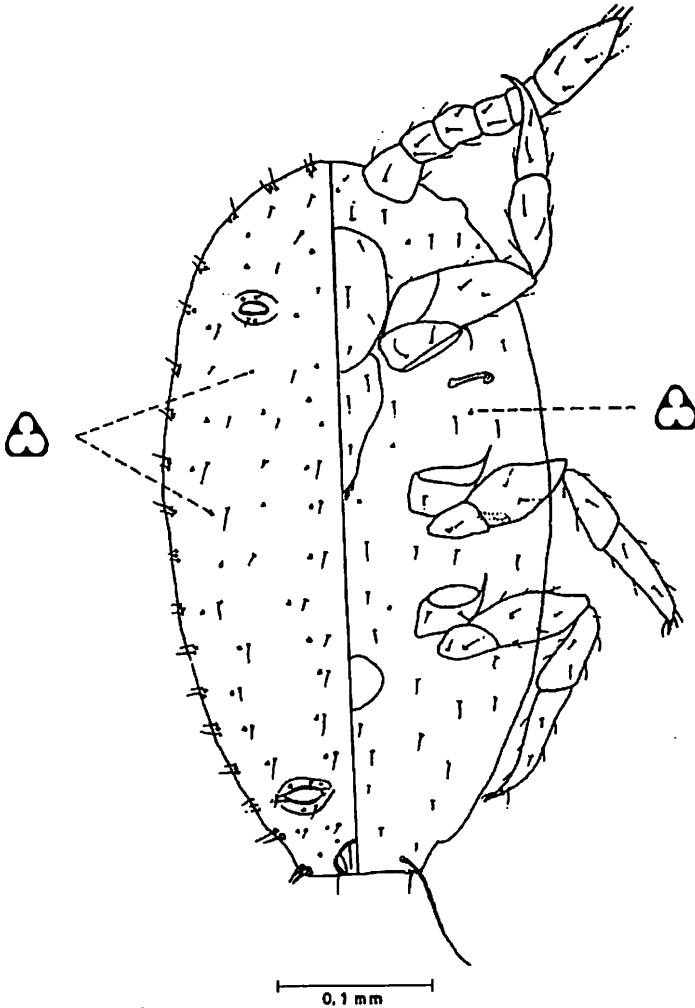


Fig. 4. First instar nymph.

The lips of both the pairs of ostioles near opening are sclerotized; the upper and lower lips of anterior ones with 1-2 trilobulars, 0-2 setae; 1 trilobular, 0-1 seta; the corresponding figures for the posterior ones being 1, 1-2; 0-1, 0-1. Anal ring 25-32 (28)  $\mu$ m in diameter; 6 anal ring setae, each 47-61 (53)  $\mu$ m

long. Dorsum with trilocular disc pores and body setae, more numerous than on venter.

Curculus, oval, 32-47 (41) X 29-43 (33)  $\mu\text{m}$ . Anal lobe bar distinct. The length of apical, cisanal, obanal and bar setae in  $\mu\text{m}$  are as follows: 101-122 (114); 22-29 (25); 18-25 (19); and 22-25 (24). Antennae, 6-segmented, 162-176 (171)  $\mu\text{m}$  long. Eyes, 14-18 (17)  $\mu\text{m}$  in diameter at base and 7  $\mu\text{m}$  high. Clypeolabral shield, 79-90 (86)  $\mu\text{m}$  long. Beak, 68-83 (75)  $\mu\text{m}$  long and 50-58 (53)  $\mu\text{m}$  wide. Anterior spiracles, 22-29 (24)  $\mu\text{m}$  long and 7  $\mu\text{m}$  wide at atrium; the figures for posterior ones being 18-25 (23)  $\mu\text{m}$  and 7  $\mu\text{m}$ .

Measurement of the hind leg in  $\mu\text{m}$  are: coxa, 22-29 (25); trochanter, 32-36 (35); femur, 58-68 (63); tibia, 43-65 (55); tarsus, 54-61 (58); claw, 18-25 (20); tarsal digitules, 32-36 (34) and claw digitules, 14-22 (18).

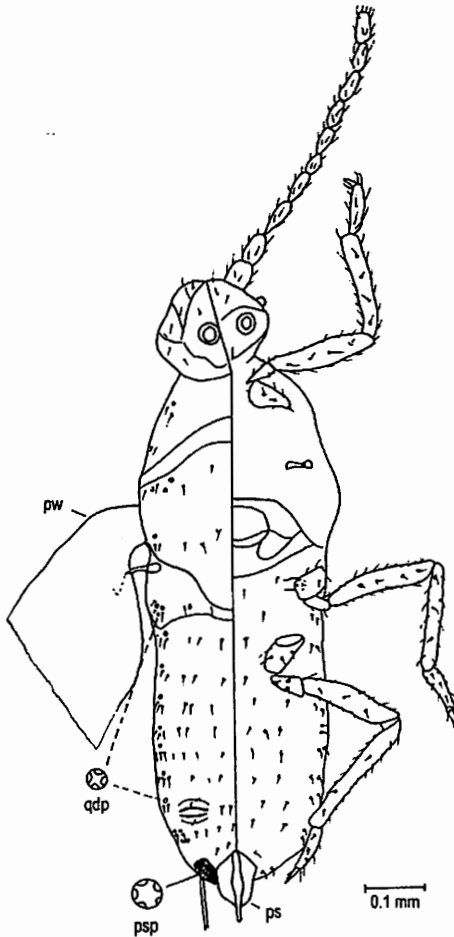


Fig. 5. Adult Male. pw – part of wing, qdp – quadriocular disc pore, psp – pentalocular stellate pores, ps – penial sheath.



**Adult male (Fig. 5)**

Macropterous; body (mounted), 0.93-1.02 (0.97) mm long including the projected penial sheath and 0.31-0.38 (0.34) mm wide. Only posterior pair of ostioles present. Penial sheath including the projected tip 86-97 (93)  $\mu\text{m}$  long and 72-97 (81)  $\mu\text{m}$  wide at base, the tip being 7-11 (9)  $\mu\text{m}$  wide. Dorsum with quadrilocular disc pores. One cluster of stellate or tail forming pentalocular disc pores, 35-40, present on each side of dorsal abdominal segment IX. In the centre of each cluster there are 2 setae, 259-292 (275)  $\mu\text{m}$  long.

One pair of membranous wings, 0.64-0.74 (0.70) mm long and 0.19-0.27 (0.22) mm wide. Hamulohalterae 54-65 (60)  $\mu\text{m}$  long and 14-22 (17)  $\mu\text{m}$  wide with a hooked spine, 47-65 (52)  $\mu\text{m}$  long. Antennae 10-segmented, the total length being 498-553 (515)  $\mu\text{m}$ , three pairs of eyes, dorsal, ventral and lateral. Diameter of former two pairs are 29-36 (32)  $\mu\text{m}$  and 25-36 (32)  $\mu\text{m}$ ; lateral one 32-36 (35)  $\mu\text{m}$  in diameter at base and 14-25 (21)  $\mu\text{m}$  high. Mouthparts are absent.

**Fourth instar male nymph (Fig. 6)**

Body (mounted), 0.97-1.06 (1.03) mm long and 0.33-0.36 (0.34) mm wide. Only one pair of ostioles, each lip with one seta. Anal tube present in between dorsal abdominal segments X-IX, apparently without any opening, 25-29 (26)  $\mu\text{m}$  long and 25-36 (31)  $\mu\text{m}$  wide. Dorsum and venter with multilocular disc pores and oral collar tubular ducts. Disc pores are mainly distributed in the submarginal to submedian regions except in dorsal prothorax and metathorax where those are only present in the median zones. Those pores are not found in the head region and the abdominal segments X-VIII of both the dorsum and venter. Oral collar tubular ducts are distributed all over the body, restricted to the margin and submarginal regions. Both multilocular disc pores and oral collar tubular ducts are numerous on dorsum than on the venter.

A pair of wing pads, 292-371 (341)  $\mu\text{m}$  long and 111-126 (119)  $\mu\text{m}$  broad, obliquely attached to the mesothorax.

Antennae 10-segmented, 356-387 (370)  $\mu\text{m}$  long. Eyes and mouthparts absent. Anterior spiracles, 32-36 (35)  $\mu\text{m}$  long and 14-18 (16)  $\mu\text{m}$  wide at atrium; figures for the posterior ones being 32-36 (34)  $\mu\text{m}$  and 11-18 (14)  $\mu\text{m}$ .

Measurement of the different parts of hind leg in  $\mu\text{m}$  are as follows: coxa, 40-47 (42); trochanter, 54-58 (56); femur, 104-126 (117); tibia, 90-130 (108); tarsus, 72-112 (89), claw, 25-32 (29). Tarsal and claw digitules are absent.

**Third instar male nymph (Fig. 7)**

Body (mounted), 0.88-0.96 (0.94) mm long and 0.41-0.49 (0.45) mm wide. The upper lips of both anterior and posterior pairs of ostioles are with 1 seta and 0-2 setae. Anal ring absent. An anal tube, apparently without any external opening, 25  $\mu\text{m}$  long and 22-25 (23)  $\mu\text{m}$  wide at the end, is present at the junction of abdominal segments X and IX in dorsum. One pair dorsal setae, 79-97 (89)  $\mu\text{m}$  long are present on the abdominal segment IX. Both dorsum and venter with multilocular disc pores, oral collar tubular ducts and body setae, distributed almost all over the body. Number and size of the disc pores

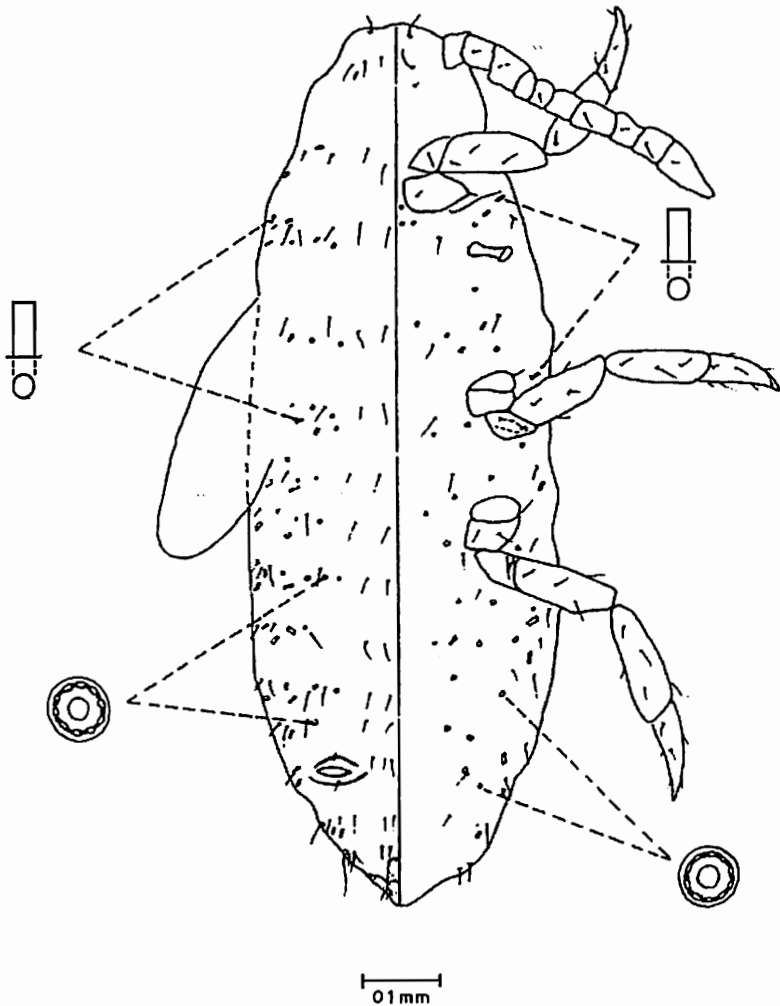


Fig. 6. Fourth instar male nymph.

on both the derms are same, collar ducts being more numerous in the dorsum.

A pair of small wing buds 90-126 (109)  $\mu\text{m}$  long and 94-108 (104)  $\mu\text{m}$  wide, more or less at right angles to the lateral margins of the mesothorax.

Antennae apparently 8-segmented, 227-241 (235)  $\mu\text{m}$  long. Eyes and mouthparts absent. The length and width at atrium of the anterior and posterior pairs of spiracles are 36-40 (37)  $\mu\text{m}$  and 11-14 (13)  $\mu\text{m}$ .

Measurement of the hind leg in  $\mu\text{m}$  are as follows: coxa, 32-36 (33); trochanter, 47-58 (52); femur, 83-97 (92); tibia + tarsus + claw, 140-158 (150); both tarsal and claw digitules absent.

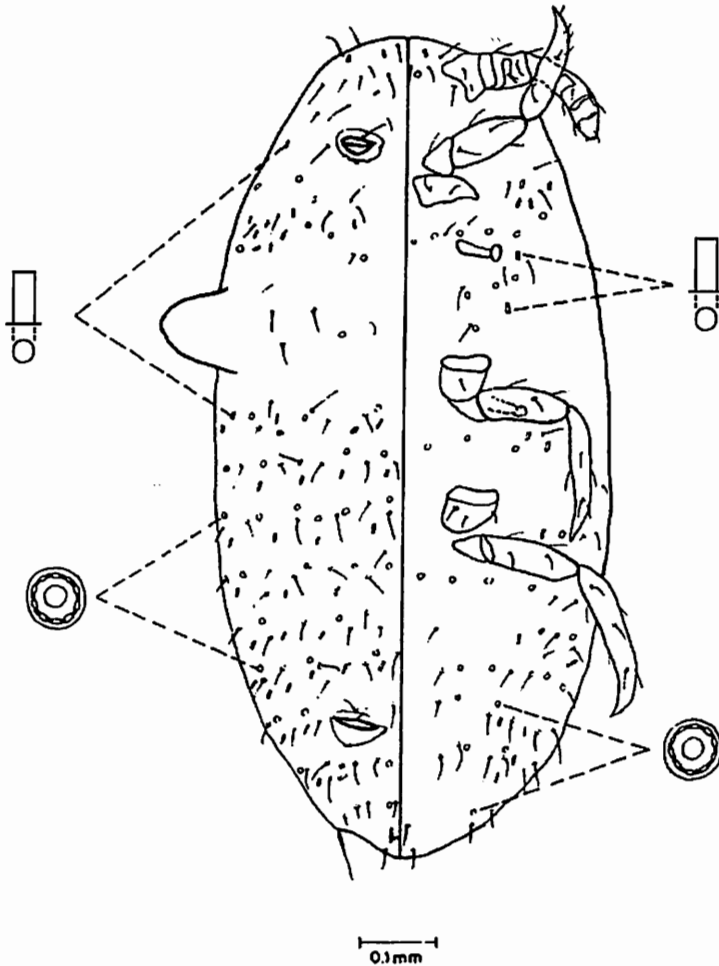


Fig. 7. Third instar male nymph.

**Second instar male nymph (Fig. 8)**

Body (mounted), 0.79-0.97 (0.88) mm long and 0.42-0.47 (0.37) mm wide. Dorsum with 13 pairs of cerarii, cerarii of abdominal segments IX and VIII with 2 conical setae and 1-3 trilocular pores. The other cerarian zones of the abdominal segments VII-II, metathoracic II and I, mesothoracic II and I and prothoracic I, each being represented by 2 thin setae and 1-2 trilocular pores. The lips of the anterior and posterior ostioles near opening are sclerotized. The upper and lower lips of the anterior pair with 1-2 triloculars, 0-1 seta; 1-2 triloculars, 0-1 seta; the figures for the posterior ones being 1-3, 0-1; 1-2, 0-1 respectively.

Anal ring, 22-36 (30)  $\mu$ m in diameter with 58-65 (60)  $\mu$ m long 6 ring setae.

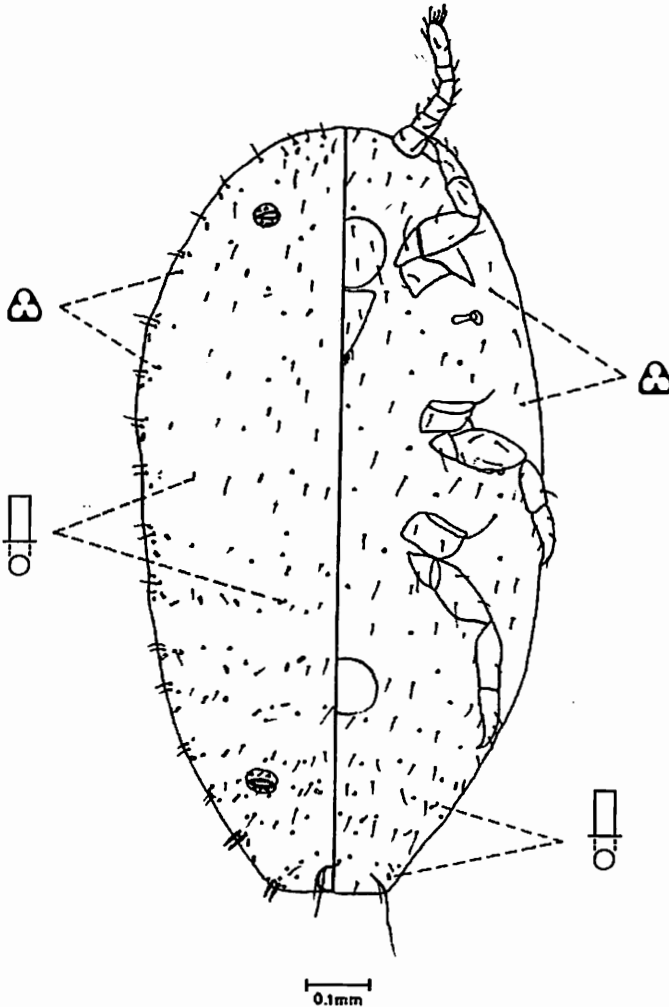


Fig. 8. Second instar male nymph.

Trilocular pores and body setae present on both the derms. Oral collar tubular ducts present on both the surfaces of the body, more numerous on dorsum, distributed almost all over dorsum and only on the ventral abdominal segments, IX-VI. Circulus, oval, 79-90 (83)  $\mu\text{m}$  long 61-76 (68)  $\mu\text{m}$  wide. Anal lobe bar distinct. The length of apical, cisanal, obanal and bar setae in  $\mu\text{m}$  are: 133-162 (152); 29-36 (32); 22-29 (24) and 32-54 (43).

Antennae, 6-segmented, 180-210 (202)  $\mu\text{m}$  long. Eyes, 25-32 (27)  $\mu\text{m}$  in diameter at base and 7-11 (8)  $\mu\text{m}$  high. Clypeolabral shield 108-126 (113)  $\mu\text{m}$  long. Length and width of beak being 83-104 (94)  $\mu\text{m}$  and 58-72 (63)  $\mu\text{m}$ . Anterior spiracles, 29-32 (31)  $\mu\text{m}$  long and 7-11 (10)  $\mu\text{m}$  wide at atrium; corresponding figures of the posterior ones being 25-32 (31)  $\mu\text{m}$  and 7-11 (9)  $\mu\text{m}$ .

Measurement of coxa, trochanter, femur, tibia, tarsus, tarsal claw, tarsal and claw digitules of hind leg in  $\mu\text{m}$  are: 32-43 (38); 47-54 (51); 101-108 (104); 68-86 (76); 61-79 (70); 14-22 (17); 29-40 (34) and 14-22 (17).

**Key to the identification of various instars of *P. lilacinus* (COCKERELL)**

- 1. 6-segmented antennae ..... 2
- More than 6-segmented antennae ..... 4
- Antennal segmentation obscure ..... Third instar male nymph
- 2. Oral collar tubular ducts present ..... Second instar male nymph
- Tubular ducts absent ..... 3
- 3. One pair of cerarii in the abdominal segment IX ..... First instar nymph
- Two pairs of cerarii in the abdominal segments VIII & IX ..... Second instar female nymph
- 4. 7-segmented antennae, 18 pairs of cerarii of which abdominal, prothoracic III and the frontal ones with 2 stout conical setae ..... Third instar female nymph
- 8-segmented antennae, 18 pairs of cerarii, each with 2 stout conical setae ..... Adult female
- 10 segmented antennae ..... 5
- 5. One pair of wing pads ..... Fourth instar male nymph
- One pair of wings, 2 clusters of stellate pores in abdominal segment IX ..... Adult male

**Discussion**

The studies on morphology of different instars of the mealybug, *Planococcus lilacinus* (COCKERELL) have resulted in some important observations and helped to prepare a key to the identification of all the instars of the mealybug and to reveal the functions of various dermal glands.

In course of the present investigation, it has been observed that the first instar nymphs, the sexes of which cannot be differentiated, and three instars of females possess 18 pairs of cerarii whereas those in the second nymphal males are 13. The pair of cerarii with stout conical setae in these instars are 1, 3, 10, 18 and 2 respectively. The second nymphal male and female have 6-segmented antennae but the former is readily recognised by the presence of oral collar ducts. The last two instars of female possess 7 and 8 segmented antennae. The third and fourth instar male nymphs possess a pair of small wing buds and long obliquely attached wing pads; the adult males have a pair of fully developed membranous wings and two clusters of stellate or tail forming pores (BEARDSLEY, 1960).

Now an attempt is made to elaborate the functions of dermal glands. The first instar nymphs which possess only trilocular pores are observed to have waxy dusts on their bodies. The trilocular pores, present also on both surfaces of the body of all instars of female and second instar male, are the sources of this waxy secretion (GHOSE, 1971).

The waxy marginal tassels, observed in external appearance of different female instars and second instar male nymphs in life are also produced by these trilocular disc pores with the help of cerarian setae (GHOSH & GHOSE, 1988).

The multilocular disc pores, present on the venter of the adult female and both surfaces of the third and fourth instar male nymphs, secrete globular waxy particles. The waxy particles, observed on the dorsum of the adult males are due to the quadrilocular pores. The wax secreted through the pentalocular disc pores, with the support of two long and thick dorsal setae produces a pair of long white waxy caudal processes in the dorsal abdominal segment IX.

The role of all these mentioned disc pores as observed by GHOSH & GHOSE (1987) in *Novonilacoccus oryzae* GHOSH & GHOSE, GHOSH & GHOSE (1988) in *Planococcoides bengalensis* GHOSH & GHOSE, GHOSH & GHOSE (1988) in *Coccidohystrix insolita* (GREEN), GHOSH & GHOSE (1989) in *Nipaecoccus viridis* (NEWSTEAD) and PAUL & GHOSE (1989) in *Ferrisia virgata* (COCKERELL), is also in conformity with the present investigation.

They also stated that the oral collar tubular ducts present on the venter of the adult females and on both the derms of the second, third and fourth instar of male nymphs produce cotton-like waxy threads to form ovisac in oviparous species, a thin layer of waxy threads in ovoviviparous species and secrete cottony puparia in male nymphs.

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#### References

- ANONYMOUS, 2006. - Pests and Diseases. In: *Handbook for planters*. Coffee Board, India. Available from <http://indiacoffee.org/planter/agronomic.htm>
- BEARDSLEY J.W., 1960. - A preliminary study of the males of some Hawaiian mealybugs (Homoptera: Pseudococcidae). *Proceedings of the Hawaii Entomological Society*, 17 (2): 199-243.
- COCKERELL T.D.A., 1905. - Some Coccidae from the Philippine Islands. *Proceedings of the Davenport Academy of Sciences*, 10: 127-136.
- COX J.M., 1989. - The mealybug genus *Planococcus* (Homoptera: Pseudococcidae). *Bulletin British Museum (Natural History). Entomology*, 58 (1): 1-78.
- EZZAT Y.M. & MCCONNELL H.S., 1956. - A classification of the mealybug tribe Planococcini (Pseudococcidae: Homoptera). *Bulletin, University of Maryland Agricultural Experiment Station*, A-84: 1-108.
- FARRELL G.S., 1990. - Description of the immature stages and the adult male of an Australian mealybug, *Melanococcus albizziae* (MASKELL) (Coccoidea: Pseudococcidae). *Memoirs of the Museum of Victoria*, 51: 49-64.
- FERRIS G.F., 1950. - Atlas of the scale insects of North America. Series V. *The Pseudococcidae (Part I)*. pp. 1-278. California, Stanford University Press.
- GHOSE S.K., 1971. - Morphology of various instars of both sexes of the mealybug, *Maconellicoccus hirsutus* (GREEN), (Pseudococcidae : Hemiptera). *Indian Journal Agricultural Sciences*, 41 (7): 602-611.
- GHOSH A.B. & GHOSE S.K., 1987. - *Novonilacoccus*, a new genus (Pseudococcidae:

- Hemiptera) and a new species, *Novonilacoccus oryzae* GHOSH and GHOSE with the description of all the instars. *Proceedings of the Zoological Society, Calcutta*, 36: 37-51.
- GHOSH A.B. & GHOSE S.K., 1988. - Description of all the female and male instars of the mealybug, *Coccidohystrix insolita* (GREEN) (Homoptera: Pseudococcidae). *Environment and Ecology*, 6 (4): 817-824.
- GHOSH A.B. & GHOSE S.K., 1989. - Descriptions of all instars of the mealybug, *Nipaeococcus viridis* (NEWSTEAD) (Homoptera: Pseudococcidae). *Environment and Ecology*, 7 (3): 564-570.
- GHOSH L.C. & GHOSE S.K., 1988. - A new species of the genus *Planococcoides* (Homoptera; Pseudococcidae) with descriptions of all the instars of female and male. *Environment and Ecology*, 6 (3): 604-610.
- GIMPEL JR W.F. & MILLER D.R., 1996. - Systematic analysis of the mealybugs in the *Pseudococcus maritimus* complex (Homoptera: Pseudococcidae). *Contributions on Entomology, International*, 2: 1-163.
- MANI M., 1995. - Studies on the natural enemies of oriental mealybug, *Planococcus lilacinus* (Ckll.) (Homoptera: Pseudococcidae) in India. *Journal of Entomological Research*, 19 (1): 61-70.
- MANI M. & KRISHNAMOORTHY A., 1990. - Outbreak of mealybugs and record of their natural enemies on pomegranate. *Journal of Biological Control*, 4: 61-62.
- MILLER D.R., 1975. - A revision of the genus *Heterococcus* FERRIS with a diagnosis of *Brevienia* GOUX (Homoptera: Coccoidea: Pseudococcidae). *United States Department of Agriculture Technical Bulletin*, 1497: 1-61.
- MILLER D.R., 1999. - Identification of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Hemiptera; Sternorrhyncha; Pseudococcidae). *Insecta Mundi*, 13: 189-203.
- MILLER D.R. & MILLER G.L., 2002. - Redescription of *Paracoccus marginatus* WILLIAMS and GANARA DE WILLINK (Hemiptera: Coccoidea: Pseudococcidae) including descriptions of the immature stages and adult male. *Proceedings of the Entomological Society, Washington*, 104: 1-23.
- MCKENZIE H.L., 1967. - *Mealybugs of California with taxonomy, biology and control of North American species* (Homoptera: Coccoidea: Pseudococcidae). pp. 524. California, University of California Press.
- MORTON J., 1987. - Taramind. In: *Fruits of worm climates* (Ed. MORTON J.F.). pp. 115-121 Florida, USA.
- NANDA P.K. & GHOSE S.K., 1989. - Descriptions of all instars of the mealybug *Rastrococcus iceryoides* (GREEN) (Homoptera: Pseudococcidae). *Environment and Ecology*, 7: 329-336.
- PAUL P.K. & GHOSE S.K., 1989. - Descriptions of various instars of *Ferrisia virgata* (COCKERELL) (Pseudococcidae, Homoptera). *Environment and Ecology*, 7 (4): 838-845.
- RAE D.J., 1993. - A method for discrimination between instars of *Saccharicoccus sacchari* (COCKERELL) (Hemiptera: Pseudococcidae). *Journal of the Australian Entomological Society*, 32: 249-252.
- REDDY K.B., BHAT P.K. & NAIDU, R. 1999. - Suppression of mealybugs and green scale infesting coffee with natural enemies in Karnataka. *Pest Management and Economic Zoology*, 5 (2): 119-121.
- SEKHAR P.S. 1964. - Pests of coffee. In: *Entomology in India* (Ed., N.C. Pant) ["A special number of the Indian Journal of Entomology"]. pp. 9-109. New Delhi, The Entomological Society of India.
- SHUKLA R.P. & TANDON P.L., 1984 - Insect pests on custard apple. *FAO Plant Protection Bulletin*, 32 (1): 31-32.
- WILLIAMS D.J. & WATSON G.W., 1988. - *The scale insects of the tropical South Pacific region. Part 2. Mealybugs (Pseudococcidae)*. pp. 260. Wallingford, U.K., CAB International Institute of Entomology.