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## Biology of scale insect, *Hemilecanium imbricans* (Green) (Coccidae: Homoptera)

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**Abstract**

Biology of the scale insect, *H. imbricans* was carried out in the Department of Agricultural Entomology, College of Agriculture Dharwad under laboratory conditions on pumpkin in November month during 2013-14 and 2014-15. The incubation period ranged from 30 to 36 days. The first instar nymphal period varied from 28 to 32 days. The second instar nymphal period varied from 36 to 42 days. The third instar nymphs were fully white, nymphal period varied from 38 to 45 days. The fourth nymphal period varied from 43 to 48 days. The prepupal period varied from 8 to 11 days. The pre-oviposition period ranged from 29 to 35 days. The oviposition period ranged from 25 to 34 days. The fecundity ranged from 878 to 1024 eggs per female in the encrusted cups. The total life cycle of *H. imbricans* on pumpkin ranged from 97 to 118 days. However, the total life cycle from egg to adult female ranged from 198-245 days.

**Keywords:** *Hemilecanium imbricans*, Fecundity, Prepuapa, instar etc.

**Introduction**

Scale insects infest a wide variety of host plants indeed. Perhaps no plant species is free from attack from one or the other of these scale insects. Approximately 630 species of coccids representing 10 per cent of the worlds known scale insect species have been recorded from India [1]. Scale insects vary dramatically in appearance and some of them are very small organisms (1–2 mm) that grow beneath wax covers, shiny pearl-like objects. Adult female scales are almost immobile and permanently attached to the plant they have infested. Adult males usually have wings (depending on their species) but never feed and die within a day or two. The hind wings of scale insects are reduced, commonly to the point that they generally are overlooked. The waxy covering of many species of scale insects protects them effectively from contact insecticides, which are only effective against crawlers. However, scale insects are oftenly controlled by use of horticultural oils, Fish oil rosin soap (FORS) that dissolves the wax coating and suffocate and kill them or by biological control agents such as parasitoid wasps, green lace wings, and predators like coccinellid beetles. In Thailand, *Hemilecanium mangiferae* was reported causing serious infestation during April, associated with sooty mold. On some trees, the surface of the twigs and branches was completely covered by the insects. Large amount of sooty mold was growing on the honey dew, blackening the ground just below the infested canopy, and also on the trunk, branches and twigs. Furthermore, the leaves of the infested trees showed a signs of yellowing [2].

**Materials and Methods****Area of Study**

The present study was conducted in Department of Agricultural Entomology, College of Agriculture Dharwad under laboratory conditions on pumpkin in November month during 2013-14 and 2014-15.

**Objective of study:** To know the biology of scale insect, *H. imbricans* under laboratory condition

**Collection of culture and observations of study**

The laboratory temperature ranged from 24 to 26°C and relative humidity varied from 60 to 70 per cent. Fully matured medium size red pumpkin fruits were obtained from local market. To facilitate easy handling pumpkin with ridges and grooves with small stalk was selected.

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The method standardized [3-4] was adopted for rearing of scale insects on pumpkins to obtain the culture throughout the period of research. Ripened pumpkins were selected and cleaned with water to get rid of dust and wiped with cloth. The pumpkin fruits were treated with 0.1 per cent bavistin 50 WP in order to prevent rotting and development of mould. For this purpose, the pumpkins were dipped in the fungicide suspension for 10 seconds, dried for 4 hours, again washed with water and dried in shade. Wounds, if any on the pumpkins were plugged with wax. The eggs of the scale insect obtained from infested mango twigs were placed over pumpkin and the crawlers were allowed to settle on pumpkin. The pumpkin infested with scales were kept in specially designed wooden cages (45 x 45 x 45 cm) having the door in the front, glass top and other sides covered with wire mesh. Thus the pure culture was maintained under laboratory condition to study the biology on pumpkin. Statistical analysis was done by SPSS. Results were expressed as range and Mean  $\pm$  SD.

## Results

### Egg

The matured female scale insect laid the eggs in groups loosely under surface of the encrusted cups. The freshly laid eggs were light pink in colour and oval shaped. One week before hatching, egg turned to dark pink, and developed a pair

of red spots at the anterior end representing compound eyes. The incubation period ranged from 30 to 36 days with a mean of  $30.75 \pm 1.55$  days (Table 1). The mean length and breadth of egg was  $0.511 \pm 0.02$  and  $0.22 \pm 0.008$  mm, respectively (Table 2).

**Table 1:** Biological parameters of *Hemilecanium imbricans* on pumpkin

| Stage                            | Mean $\pm$ SD      | Range (n=10) |
|----------------------------------|--------------------|--------------|
| Egg (Incubation Period) (Days) * | $30.75 \pm 1.55$   | 30-36        |
| Nymphal duration (Days) *        |                    |              |
| I instar                         | $27.50 \pm 1.55$   | 28-32        |
| II instar                        | $39.40 \pm 1.22$   | 36-42        |
| III instar                       | $42.24 \pm 0.89$   | 38-45        |
| IV instar                        | $43.38 \pm 0.84$   | 43-48        |
| Total Nymphal period (days) *    | $152.61 \pm 5.12$  | 152-164      |
| Prepupal period (Days) *         | $10.50 \pm 1.38$   | 8-11         |
| Pre oviposition period (Days) *  | $32.40 \pm 1.59$   | 29-35        |
| Oviposition period (Days) *      | $30.12 \pm 1.98$   | 25-34        |
| Fecundity (Number of eggs) *     | $899.00 \pm 15.68$ | 878-1024     |
| Adult longevity (Days)           |                    |              |
| Male*                            | $7.50 \pm 0.87$    | 6-9          |
| Female*                          | $52.50 \pm 3.55$   | 50-55        |
| Total life cycle (Days)          |                    |              |
| Male*                            | $111.79 \pm 4.97$  | 97-118       |
| Female*                          | $237.01 \pm 12.33$ | 198-245      |

\*Average of ten samples

**Table 2:** Morphometry of different stages of *Hemilecanium imbricans*

| Stage                 | Length (mm) *    |           | Breadth (mm) *   |           |
|-----------------------|------------------|-----------|------------------|-----------|
|                       | Mean $\pm$ SD    | Range     | Mean $\pm$ SD    | Range     |
| Egg                   | $0.511 \pm 0.02$ | 0.45-0.55 | $0.22 \pm 0.008$ | 0.23-0.24 |
| <b>Nymphal stages</b> |                  |           |                  |           |
| I instar              | $2.23 \pm 0.11$  | 2.11-2.31 | $1.29 \pm 0.07$  | 1.21-1.37 |
| II instar             | $2.91 \pm 0.19$  | 2.44-3.33 | $2.25 \pm 0.14$  | 2.05-2.50 |
| III instar            | $3.81 \pm 0.05$  | 3.69-3.89 | $2.88 \pm 0.14$  | 2.67-2.91 |
| IV instar             | $4.12 \pm 0.07$  | 3.89-4.25 | $3.41 \pm 0.18$  | 2.91-3.44 |
| Pre pupa              | $1.49 \pm 0.04$  | 1.39-1.61 | $0.41 \pm 0.05$  | 0.37-0.59 |
| <b>Adult</b>          |                  |           |                  |           |
| Male                  | $1.81 \pm 0.12$  | 1.61-1.89 | $0.49 \pm 0.18$  | 0.41-0.94 |
| Female                | $4.18 \pm 0.12$  | 4.03-4.49 | $3.21 \pm 0.13$  | 2.94-3.45 |

\*Average of five samples

### Nymphs

The scale insect had four nymphal instars. After hatching, nymphs of different instars fed on tender juice by inserting their stylet into pumpkin. First instar nymphs (Crawlers) were reddish pink in colour and freely crawled all over the tender parts of pumpkin. The details of each nymphal stage are presented here under Table 1 and 2.

The freshly emerged first instar nymphs (crawlers) were transparent, pinkish in color. The first instar nymphal period varied from 28 to 32 days with a mean of  $27.50 \pm 1.55$  days. The average length and breadth of first instar was  $2.23 \pm 0.11$  and  $1.29 \pm 0.07$  mm, with a range of 2.11 – 2.31 mm and 1.21– 1.37 mm, respectively.

After first moulting, the second instar nymph turned to white with lot of whitey mealy secretion all over its body. The second instar had four well developed wax glands which can be easily identified through four white spots appearing over the body of the insect. Marginal setae have also observed at the peripheral region of the insect body. The second instar nymphs completely inserted its stylet into pumpkin and continuously fed on the sap of the pumpkin. The second instar nymphal period varied from 36 to 42 days with a mean of  $39.40 \pm 1.22$  days. The average length and breadth of second

instar was  $2.91 \pm 0.19$  and  $2.25 \pm 0.14$  mm with a range of 2.44 -3.33 mm and 2.05 - 2.50 mm, respectively.

The third instar nymphs were fully white, round in shape completely covered with white mealy powdery all over the body and bigger than the second instar. The coiled hairs/setae were more prominent on its body and completely covered marginal setae with lot of pearl like honey dew excretion all over the body. The nymphal period varied from 38 to 45 days with a mean of  $42.24 \pm 0.89$  days. The average length and breadth of third instar was  $3.81 \pm 0.05$  and  $2.88 \pm 0.14$  mm with a range of 3.69 -3.89 mm and 2.67 -2.91, respectively.

The fourth instar nymphs were brown in colour and provided with hard rigid brownish to black cup like encrustation on its body. The fully developed fourth instars looked like black pebbles on the pumpkin. During this stage all marginal setae and coiled hairs were detached from the body. The nymphal period varied from 43 to 48 days with a mean of  $43.38 \pm 0.84$  days. The average length and breadth of fourth instar was  $4.12 \pm 0.07$  and  $3.41 \pm 0.18$  mm with a range of 3.89 - 4.25 mm and 2.91-3.44 mm, respectively.

The nymphs completed their entire period by sucking the sap from pumpkin. Moulting occurred on pumpkin by shedding exuviae which adhered to scale insect itself at different

instars. The exuvia can be separated from scale insect easily with the help of needle. The total nymphal period ranged from 152 to 164 days with an average of  $152.6 \pm 5.12$  days. Female adults were dark brown in colour with well developed hard rigid cup like encrustation which cannot be separated from its body. The newly formed adults were small in size creamy white with a pair of wings. The wings were creamy with pinkish coastal margin. The abdominal tip of the male insect is having a sharp needle like structure called stylet. Male adult scale insects never fed on the pumpkin. 6 to 7 days after eclosion the males died. The adults measured  $1.81 \pm 0.12$  mm and  $0.49 \pm 0.18$  mm with a range of 1.61–1.89 mm and 0.41–0.94 mm, in length and breadth respectively.

### Prepupa

In case of male insect an extra life stage was noticed as prepupal stage before emergence of adult male insect. The prepupal stage can be easily identified by presence of well-developed wing pads. The prepupal period varied from 8-11 days with a mean of  $10.50 \pm 1.38$  days. The average length and breadth of prepupa was  $1.49 \pm 0.04$  and  $0.41 \pm 0.05$  mm with a range of 1.39 – 1.61 mm and 0.37-0.59 mm, respectively.

Female on an average measured  $4.18 \pm 0.12$  mm and  $3.21 \pm 0.13$  mm with a range of 4.03- 4.49 mm and 2.94 –3.45 mm, in length and breadth, respectively. The pre-oviposition period ranged from 29 to 35 days with an average of  $32.40 \pm 1.59$  days. The oviposition period ranged from 25 to 34 days with a mean of  $30.12 \pm 1.98$  days.

The adult female laid eggs loosely under surface of the encrusted cups. However, majority of the eggs were below the encrusted cups. Eggs were clearly visible on pumpkin when the encrusted cup was separated from the surface of pumpkin. The fecundity per female ranged from 878 to 1024 eggs per female in the encrusted cups with an average of  $899 \pm 15.68$  eggs per female.

### Total life cycle

The total life cycle of *H. imbricans* on pumpkin from egg to male adult ranged from 97 to 118 days with a mean of  $111.79 \pm 4.97$ . While, total life cycle from egg to adult female ranged from 198-245 days under laboratory condition with a mean of  $237.01 \pm 12.33$  days. Biological studies carried out during 2014-15 indicated very little variation with respect to various biological parameters and Morphometry.

### Discussion

The incubation period ranged from 30 to 36 days. The mean length and breadth of egg was  $0.511 \pm 0.02$  and  $0.22 \pm 0.08$  mm, respectively. The first instar nymphal period varied from 28 to 32 days. The second instar nymphal period varied from 36 to 42 days. The third instar nymphal period varied from 38 to 45 days. The fourth nymphal period varied from 43 to 48 days. The prepupal period varied from 8-11 days. The pre-oviposition period ranged from 29 to 35 days. The oviposition period ranged from 25 to 34 days. The fecundity per female ranged from 878 to 1024 eggs per female. The longevity of males ranged from 6 to 9 days. The longevity of females ranged from 50 to 55 days. The total life cycle of *H. imbricans* on pumpkin from egg to male adult ranged from 97 to 118 days. However, total life cycle from egg to adult female ranged from 198-245 days. These present findings are in close agreement with report<sup>[5]</sup> who has tentatively placed *Hemilecanium coriaceum* in the genus *Hemilecanium*, even though it lacked the four cribriform plates that are typical of

the genus. He indicated similarities of *H. coriaceum* with *H. imbricans*, such as marginal setae forming a fringe around the body margin, the presence of ten setae on the anal ring and the presence of scattered glandular pores on the dorsal derm as being reported in the present finding.

Further, scale, *Parasaissetia* sp. was found to have three life stages with an incubation period of 4 days. The insect was found to spend immature life for 41 days in three nymphal instars lasting for 16, 13 and 12 days, respectively. The pre-oviposition period was 37 days with the prolonged oviposition period of 70 days<sup>[6]</sup>. However, in the present study the incubation period of *H. imbricans* ranged from 30 to 36 days, had four instars with total nymphal period occupying 152 to 164 days. The scale *Parasaissetia nigra* had incubation period of 4-8 days with two nymphal instars lasting for 7-11 and 21-25 days respectively. Adult longevity was 43-61 days with a total life cycle of 75-105 days<sup>[7]</sup>. This deviation reported in both the studies is due to difference in scale species studied.

The life cycle of *Saissetia oleae* and found it to be temperature dependent as it recorded 45 and 20 days of total developmental period at 20 and 25°C, respectively<sup>[8]</sup>. The number of eggs laid by the female was more at 25°C (51 eggs/female) than 20°C (25 eggs/female), indicating 25°C as the optimum temperature for oviposition<sup>[9]</sup>. The peak oviposition (933eggs/female) and the maximum number of crawlers (821/female) were observed during the month of June. These findings are in close agreement with present report where in total nymphal period ranged from 152 to 164 days, the fecundity per female ranged from 878 to 1024 eggs per female at room temperature of 24 to 26°C and relative humidity of 60 to 70 per cent. These similarities may be due to more or less the same environmental conditions especially temperature and relative humidity prevailing during study period.

Further, the fecundity of *S. coffeae* to be varying between 942-2714 eggs, with an average of 1827 eggs per female. Incubation period was 9-12 days with three nymphal instars<sup>[10]</sup> and as compared to present study the fecundity is on higher side and incubation period is on lower side which might be due to variation of the species studied.

The biology of *Ceroplastes floridensis* Comstock. 3 or 4 instars in the females and 5 instars in the male<sup>[11]</sup>. The durations of different developmental stages of averaged  $17.8 \pm 0.18$  and  $24.1 \pm 1.4$  days, for the first and second nymphal instars, respectively. The mean durations for the pre-oviposition, oviposition and post-oviposition periods were  $26.6 \pm 1.1$ ,  $128.6 \pm 6.3$  and 19.8 days, respectively. However, in the present study there were four nymphal instars in females and two instars in male with an additional prepupal stage. The pre-oviposition, oviposition and postoviposition periods were more or less similar to this report.

The biology of *Insulaspis pallidula* (Green) under field conditions. The egg production varied in different months of the year. The largest batches of eggs were obtained in May and August being  $32.5 \pm 6.2$  and  $31.9 \pm 4.10$  eggs female, respectively, at temperature ranging from 23.4-25.7° C and 49-67 per cent relative humidity range<sup>[12]</sup>. In the present study, October was the oviposition months and eggs per female varied from 800-1000 per female.

The biology of the fig scale, *A. pustulans* on fig and peach trees in Alexandria district. In winter, the female laid on an average of 113.13 eggs on peach twigs and about 90.33 eggs on fig trees<sup>[13]</sup> and is in close agreement with present study since *H. imbricans* egg laying was noticed during October-November months. In summer, the average number of eggs

produced on fig trees was as high as 194.73. Under natural conditions, the duration of the whole life cycle comprised of 250.4 days in the over wintering brood fully confirming the report of life cycle of *H. imbricans* in the present study while it was 105.4 days in the summer. Two annual generations were recorded for the fig scale, the first lasted from October until May and the second began in June and lasted until October unlike the present study where *H.imbricans* has only one generation per year.

The biology of olive scale insect, *Leucaspis riccae* Targ under laboratory conditions. They found that pre-oviposition period of the insect took an average of  $32.2 \pm 0.81$  days is in corroboration with present study with respect to preoviposition period. Mean number of eggs laid by a female was  $19.4 \pm 0.51$ . The incubation and oviposition periods averaged  $4.2 \pm 0.79$  and  $30.8 \pm 0.68$  days, respectively with 86.57 per cent egg hatching. The life span of the adult male of *Leucaspis riccae* averaged only  $4.2 \pm 0.35$  hours. Males usually die after mating. On the other hand, adult females lived for longer period viz.,  $78.5 \pm 1.36$  and  $216.6 \pm 1.20$  days in the two generations, respectively [14]. Similar results were observed in present study with respect to male, female longevity but with only one generation.

Biology of *Parlatoria ziziphi* (Lucas) on sour orange. The nymphal stage varied from 23.5 to 34.8 days for females and from 28.6 to 49.4 days for males and the adult lifespan from 50.8 to 88.2 days for females and from 1.4 to 3.4 days for males [15] and does not agree with present report since the whole life cycle occupied almost 240 days.

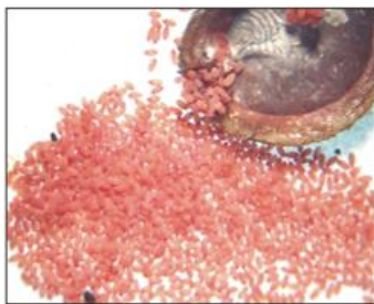
Similar results with respect to first instar crawlers were supported by [16] described the first instar nymph of *Etienna villiersi* as follows, body margins surrounded by sharp spines. Differentiated stigmatic spines and sub marginal glandular tubercles absent, unusual presence of four circular areas, as observed in the present study with *H.imbricans*. Further, he described clear delineation, and filled with quadric locular pores, one pair dorso-thoracic and one pair dorso-abdominal, antennae 6 segmented, and cleft present. In the adult female, the presence of similar dorsal tubular duct with a funnel like

aperture in the adult females suggests the *Hemilecanium theobromae* and *Etienna villiersi* are closely related.

The present findings are in line with [17] who studied life history of *Coccus hesperidum* L. on squash and mentioned the crawlers live beneath the mother scale to protect themselves without feeding for 3-4 days; they settled on the squash within 1-2 days as being reported in the present study on pumpkin. The average duration of the total development period of *C. hesperidum* was 41.4 days. *C. hesperidum* had a short generation cycle as compared to many other coccids. The average pre-oviposition, oviposition and post-oviposition periods were 7.85, 5.61 and 9.59 days respectively. The total duration was 41.4 days. The daily egg production of *C. hesperidum* is small (about 8.6 eggs) unlike in the present study which is due to difference in the species studied.

**Nature of Injury**

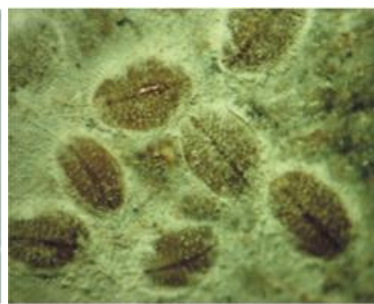
Once eggs hatched from the encrusted cups the newly hatched young ones (Crawlers) they crawled and preferred to settle on new tender succulent shoots by inserting their hairy thread like sharp stylet. Continuous sucking lead to whitening of all infested parts and development of sooty mold. Pest can be recognized by the presence of white mealy wax/powdery coating on the stem and tender branches. These findings are close agreement with [1] who reported *Hemilecanium mangiferae* on mango to cause serious infestation with sooty mold. On some trees, the surface of the twigs and branches were completely covered by the insects as being reported with *H.imbricans*. Present findings are in line with [18] who reported that *Pulvinaria psidii* is the most important pest on mango and guava which attack trees and result in a poor crop quantity and quality. These insects secrete honey dew to cover the upper surface of the leaves and prevent the photosynthesis and respiration. These results are in full agreement with the findings of [19] who reported that, *H. imbricans* was mainly found on ornamental shrubs and the infestations can be recognized by the presence of white mealy wax/powdery coating on the stem.



a. Eggs of *H. imbricans*

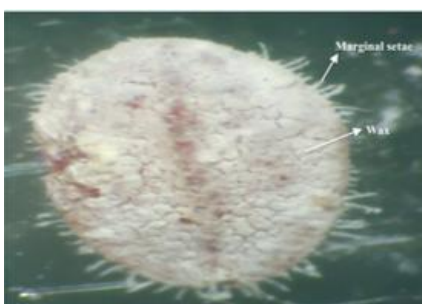


b. First instar crawler



c. Settled first instars

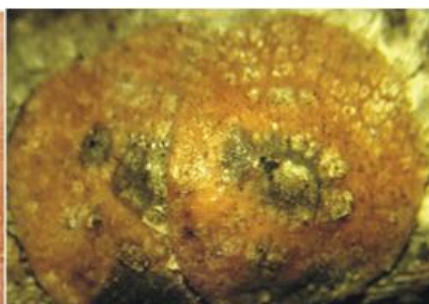
Different life stages of *Hemilecanium imbricans*



d. Second Instar



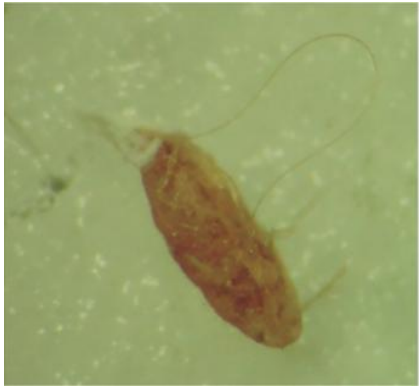
e. third instar



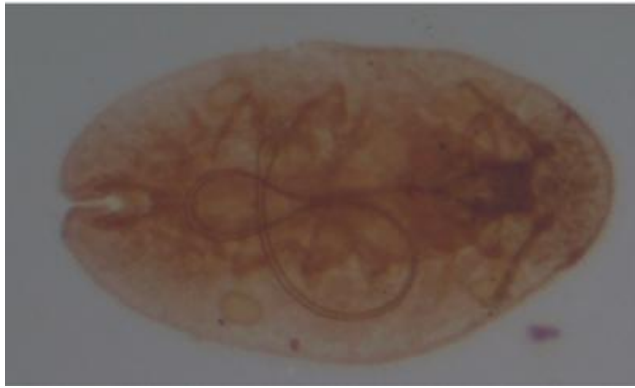
f. Fully developed Fourth Instar

Different life stages of *Hemilecanium imbricans*





g. Hairy long stylet in first instar crawler



h. Well-developed coiled hairy stylet

Different life stages of *Hemilecanium imbricans*



i pre-pupa



j. Winged males



k. Winged male (Dorsal view)

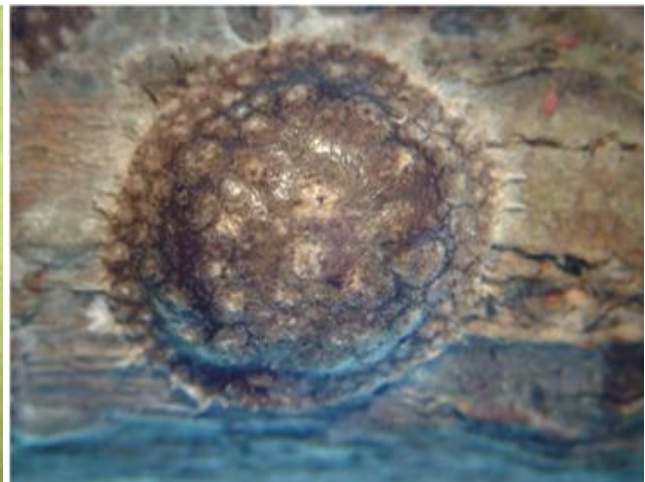


l. Winged male (Ventral view)

Different life stages of *Hemilecanium imbricans*



m. Well-developed ovisae of gravid female



n. Fully matured female

Different life stages of *Hemilecanium imbricans*

### Conclusion

The freshly laid eggs of *H. imbricans* were light pink in colour and oval shaped. The incubation period ranged from 30 to 36 days. First instar nymphs (Crawlers) were reddish pink in colour with nymphal period varied from 28 to 32 days. The second instar nymphal period varied from 36 to 42 days. The third instar nymphal period varied from 38 to 45 days and the fourth nymphal period varied from 43 to 48 days. In male an extra life stage was noticed as prepupal stage before emergence of adult male insect. The prepupal period varied from 8 to 11 days with a mean of  $10.50 \pm 1.38$  days.

### References

1. Suresh S, Kavitha CP. Seasonal incidence of economically important coccid in Tamil Nadu. XII Int. Symp. Scale Insect Stud, Chania, Hellas, 2010, 6-9.
2. Kondo T, Michael L. Description of new pest species of *Hemilecanium* Newstead (Hemiptera: Coccidae) on

3. Chacko MJ, Bhat PK, Ananda Rao LV, Deepak Singh MB, Ramanarayan EP *et al.* The use of the lady bird beetle, *Cryptolaemus montrouzieri* for the control of coffee mealy bugs. *J Coffee Res.* 1978; 8:14-19.
4. Singh SP. Propagation of a coccinellid beetle for the biological control of citrus and coffee mealybugs. *Scient. Conf. CPA.* December. 1978, 2.
5. Hull WJ. Observations on the Coccidae of southern Rhodesia. - IV. Stylops. 1935; 4:73-84.
6. Marin LR, Cisneros VFH. La queresa negra del chirimoyo: *Saissetia nigra* (Nietner) (Homoptera: Coccidae) [The black scale-insect of cherimoya: *Saissetia nigra* (Nietner) (Homoptera: Coccidae)]. *Revista Peruana de Entomologia.* 1979; 22(1):103-110.
7. Jadhav SS, Ajri DS. Biology of *Parasaissetia nigra* (Nietner) (Coccidae: Hemiptera), a pest of pomegranate

- in Maharashtra. Maharashtra J Hort. 1992; 6(1):25-28.
8. Briales MJ, Campos M. Study of the biology of *Saissetia oleae* (Olivier, 1791) (Hom. Coccidae) in Granada (Spain). Boletin de la Asociacion Espanola de Entomologia. 1986; 10:249-256.
  9. Lenfant C, Marro JP. Biological control against the black scale *Saissetia oleae* Olivier (Homoptera: Coccidae) by *Metaphycus bartletti* Annecke and Mynhardt (Hymenoptera: Encyrtidae). Quatrieme Conference Internationale sur les Ravageurs en Agriculture, 6-8 janvier 1997, le Corum, Montpellier, France. Tome. 1997; 2:291-298.
  10. Samuel SD, Balakrishnan MM, Bhat K. A review on brown scale (*Saissetia coffeae*) in India. Indian Coffee. 1993; 57(1-2):23-24.
  11. Habib A, Salama HS, Amin AH. Population studies on scale insects infesting citrus trees in Egypt. Z. Ang. Ent. 1971; 69(3):318-330.
  12. Salama HS, Hamdy MK. Studies on the population dynamics of *Lepidosaphes pallida* (Green). I. Distribution on mango trees. Z Angew. Ent. 1973; 73:82-92.
  13. El-Minshawy AM, Osman OA. Biological and ecological studies on the masked scale insect, *Mycetaspis personata* (Costock) in Alexandria area (Coccoidea: Diaspididae). Bull. Lab. Ent. Agric. 1974; 31:152-172.
  14. Rizk GN, Ahmed OS. Studies on the biology of olive scale insect, *Leucaspis riccae* Targ. (Hemiptera: Homoptera: Diaspididae). Bull. Fac. Agric., Ain- Shams Univ. 1981; 1655:1-12.
  15. Sweilem SM, El-Bolok MM, Abdel Aleem RY. Biological studies on *Parlatroia ziziphus* (Lucas) (Homoptera: Diaspididae). Bull. Soc. Ent. Egypt. 1985; 65:301-317.
  16. Matile-Ferrero D. *Etiennae* Villiersi, ng., n. sp. du Senegal Meridional (Homoptera Coccoidea: Coccidae). Revue Francaise d'Entomologie. 1984; 6:99-103.
  17. Serag AM. Biological studies on certain scale insects in Egypt. M. Sc. Thesis, Fac. of Sci, Benha Branch, Univ. Zagazig, 1998, 172.
  18. El-Minshawy AM, Hammad SM, Moursi KH. Seasonal abundance of scale insects and mealybugs attacking guava trees in Alexandria district, 2<sup>nd</sup> Egypt. Pest. Conf., Alexandria. 1974, 571-586.
  19. Vijay, Suresh. Coccid pests of flower and medicinal crops in Tamil Nadu, Karnataka J Agric. Sci. 2013; 26(1):46-53.