

STUDIES OF SIND-LAC HELPFUL IN ITS CULTIVATION

Part III. Sex Identification in Full Grown First Stage Larval Cells of Sind Lac Insect

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(Received January 3, 1989; revised April 19, 1989)

The crawling larva of the lac insect as male has a narrow "V" shaped posterior part. The corresponding portion in the female larva is broader and "U" shaped. While settling on its host plant it secretes from its dorsal surface a shield of hard transparent wax which is a replica of the body segments which produced it. This wax shield shows 11 segments corresponding to body segments which produced it. This wax shield can also identify the sex of the larva to which it belongs. The larva of the male insect grows lengthwise with the result that the segments of the dorsal shield are disrupted. Segments 1 and 2 remain in the anterior portion while segments 3 to 7, as the middle portion, remain far behind the anterior portion. At the same time the posterior portion comprising of segments 8 to 11 are pushed for towards the end. Thus there are two places where the wax shield shows marked separation. One in the anterior, with segments 1 and 2, the other in posterior region, with segments 8 to 11. It speaks of lengthwise growth of the male cell. The female grows vertically so that the wax shield is not disrupted to such an extent. In this case very often the anterior segments, 1 and 2, remain close enough to the segments in the middle, numbered 3 to 7. Then the anterior portion may show a broad head in the case of female larva while it is much narrower in that of the male. The posterior region in the male alone is pointed or "V" shaped.

Key words: Lac, Insect, Cultivation

Lac, which appears in its refined form as shellac on the market, has become considerably costly. Apparently for some of its uses no synthetic substitute has yet been found. This has stimulated its cultivation to increase production, an industry well known to have existed in some parts of India, specially Bihar. Only a few years ago China sent a delegation to inspect lac cultivation in Sind and I was asked to be present at the occasion. If China should show much enterprize it should inspire us to further promote our own industry. The following article has been written as helpful to lac cultivator. In as much as only the crawling larvae remains mobile and is not yet enclosed in a cell of lac, as soon as it is settled on a twig it is the male and female cell of the first stage larvae that have to be identified with regard to their sex.

Since only the female lives long enough to form an appreciable encrustation of lac to determine the sex-ratio would be to anticipate the lac crop expected at the end of a life cycle. Of this there are two. Roughly stated one generation takes five months and grows during the humid period of the year, from July to October, the other takes seven months of the drier part of the year, from November to June. The generation that grows during the drier parts of the year gives as issues which comprise mostly of females, so that these growing subsequently, during the humid sea-

son, produce a larger crop at the end of October. On the contrary mother insects growing during the monsoon give rise to a generation with preponderance of males and growing during the drier season give a much smaller crop. It has been experimentally established that host-plants well watered enable the insects to grow well but as mother insects they give rise to issues which preponderate as males. Thus what favours the "vegetative" growth of female lac insects is detrimental to female sex determination. This biological phenomenon of sex determination has further remained unstudied.

In as much as rainfall would be an indirect factor in determining sex ratio in a lac colony data relating to rainfall and the yield of lac crops would bear out the fact that plant moisture at the time of fertilization of female insect is most important in sex ratio determination and the yield of lac crops. However it would interest every lac cultivation to know as early as possible what to expect as the final yield. In effect it refers to the earliest time when one can determine the sex-ratio or when the larvae had just fixed themselves to the plants. The significance of sex differentiation was first pointed out by me in 1925 and how it could be observed even when the crawling larvae had just fixed themselves on the host plant was shown with due illustrations in 1926. Now this required magnifying the insects about 30

times which could be done only under a low power binocular microscope.

It however seems possible to examine the sex ratio at a magnification of ten times which would require only a magnifying lens giving that enlargement. In effect it meant that insects had to be examined when they were half grown first stage larvae and there had been no mortality among them. Then any forest ranger can use a pocket lens and examine different trees infected with lac and ascertain the sex-ratio among lac insects at a magnification of 10.

With this view the present communications is being offered. It would represent the lac larvae in the first stage while an earlier article illustrated those of the second stage, published in 1964. In the first larval stage no feature specifying a certain species can be considered, but the material illustrated here belongs mostly to Sind lac insect Fig. 1 shows a female crawling larva on the left, which had just settled and a male to our right. Their bodies show eleven segments. These have been divided as follows: 1 and 2 as anterior, 3 to 7 as the middle and 8 to 11 as posterior. The crawling larva soon after it has settled on its host begins to secrete a shield of thin transparent hard wax which comprizes of 11 segments. This wax shield corresponds to the dorsal surface of the lac larva and each part corresponds to each segment of the body beneath. The wax shields then show the same morphological difference which characterize the female and male first stage larvae. The posterior segments, 8 to 11, in the female being broader have been conceived as being "U" shaped, while in the male they are narrower and "V" shaped. Fig. 2 represents a female crawling larva with its two legs on the right being visible. Body segment 7 ends where it is marked as such and likewise 10th and the 11th segment would be immediately below it. Fig. 3 represents a male larva which on comparison with Fig. 2 shows a relatively pointed or "V" shaped posterior part.

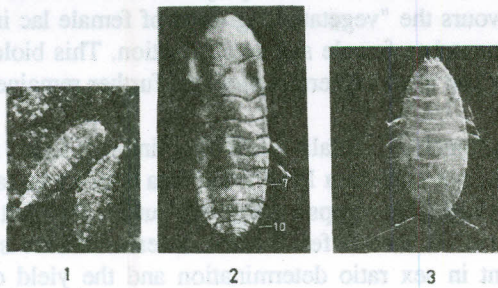


Fig. 1. Crawling larvae just settled. The posterior end of the male larva on the right is narrower or pointed and "V" shaped, that of the female, on the left, is broader and "U" shaped.

Fig. 2. Female larva showing its 11 body segments. Number 10 is marked to show where segment 10 ends and 11 begins. It has a broader posterior end.

Fig. 3. Male larva showing many body segments rather vaguely. It ends in a narrower posterior portion conceived as "V" shaped.

The corresponding difference is also seen in their dorsal wax shields. Fig. 4, belongs to the female and compares itself with Fig. 2. Figs. 5 and 6 belong to the same specimen which was male and contrast with Fig. 4, belonging to the female. In the central longitudinal region the wax is thick. Under polarized light this portion of dorsal wax shield becomes quite obvious. This is seen in Fig. 7 where the segments are selectively numbered. At No. 1 the anterior region begins, at 3 the middle portion and at 7 this ends, while 8 and 11 mark the posterior region. Fig. 7 with its markings has to be compared with Fig. 6. Figs. 5 and 6 belong to the same specimen but Fig. 7 comes from another, while 5, and 7 belong to the male. Apart from the secretion of wax from the dorsal surface, the first stage the larva secretes hard wax filaments or "pencils" from the sides. They constitute the skeleton on which the lac cell is formed by secretion of lac from glands distributed all over within the skin.

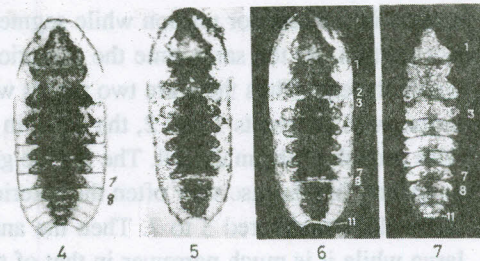


Fig. 4. Dorsal wax shield of a female first stage larva with a broader posterior region, "U" shaped.

Fig. 5. The wax shield of a female first stage larva with a relatively narrower posterior region.

Fig. 6. The same object as in Fig. 5 with the partition among segments indicated by numbers.

Fig. 7. The central vertical portion of the dorsal wax shield showing its own segments as marked. Figures 6 and 7 both belong to a male larva but not to the same insect.

Figure 10 shows an early stage of male and female first stage cells. The white flat filaments of wax from the right side are numbered in the male cell, Fig. 10. The cell on the left belongs to female so that it ends in a broader "U" shaped posterior part, while the corresponding region in the male is pointed or "V" shaped. The figures show an arrow between numbers marked 2 and 3. It points the region where the major spiracle is situated below and its upper end has a chitinous plate called the Brachial plate. It comprizes of pores that secrete thread like soft wax filaments. Figs. 8 and 9 represent the same specimen of a first stage female lac insect, with its legs still attached. The wax filaments on the right side are marked in Fig. 8. It shows the object under polarized light while Fig. 9 under ordinary light. Figure 11 shows an early first stage female larva. Another which had begun secreting filaments of hard wax from the sides is seen under polarized light in Fig. 12. The dorsal wax shield with its own segments may be observed in Fig. 12 and

comparand with that of Fig. 7, but Fig. 12 belongs to a female.

Now the male lac insect grows lengthwise and builds cell showing two stages. The female insect grows essentially vertically and finally assumes a shape, round like an apple, when growing singly but elongated like a pear with others together in a colony. Figure 13 a second stage fully grown cell of male larva showing its lengthwise growth by

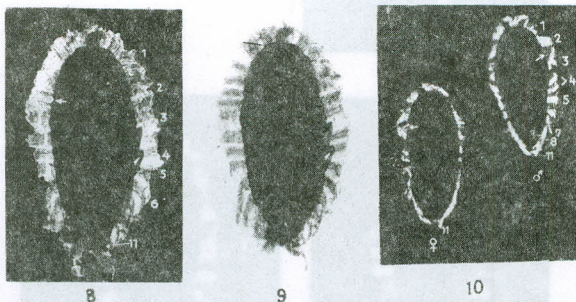


Fig. 8. The cell of a full grown first stage female larva showing filaments on hard wax secreted from the sides. Note the broad head. It was photographed under a polarizing microscope.

Fig. 9. The same specimen as Fig. 8 seen under ordinary light. Lac resin is transparent so that wax secreted from the sides, being opaque, can be seen as such.

Fig. 10. First stage larvae which have just started producing wax filaments from the sides. The cell to the left belongs to female and that to the right is male, with "V" shaped posterior part with segments 8 to 11.

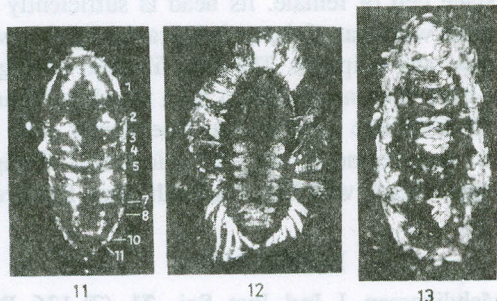


Fig. 11. A female larva only a few days after it had settled on the host plant. Its segments are marked.

Fig. 12. A female larva which has started secreting wax filaments from its sides. Note its dorsal wax shield has remained intact characterizing the cell of a female.

Fig. 13. Full grown second stage cell of a male larva showing its lengthwise development. The segments of dorsal wax shield are very dispersed characterizing the male.

the distinct separation of the segments of its dorsal wax shield. Shield segments 1 and 2 are in the anterior region of the cell while segments 3 to 7 are far behind in the middle, and segments 8 to 11 are no longer discernable. On the contrary as the female larva grows vertically the cell it had formed as the first stage is pushed upwards and still adheres to cells of later stages. In Fig. 19 the residual first stage cell appears as a relic on the back of the cell beneath. This is the cell of third stage female larva which means early adult cell of the female. On the sides are seen covered with lac, the

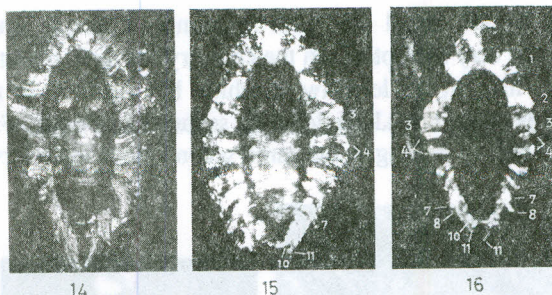


Fig. 14. A cell of a male larva in second stage. Note the disrupted dorsal wax shield and the elongated body.

Fig. 15. A second stage larva of male secreting wax filaments from its sides. Some are selectively marked and correspond to its body segments.

Fig. 16. Another second stage male larva showing a pointed posterior portion of the body. Wax filaments from the sides are marked.

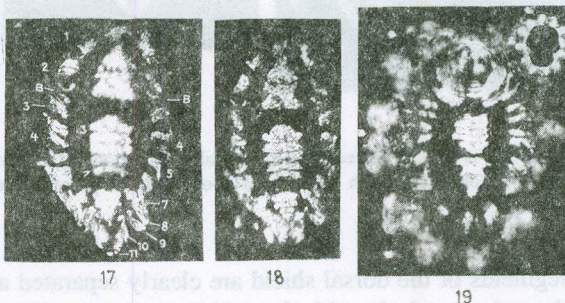


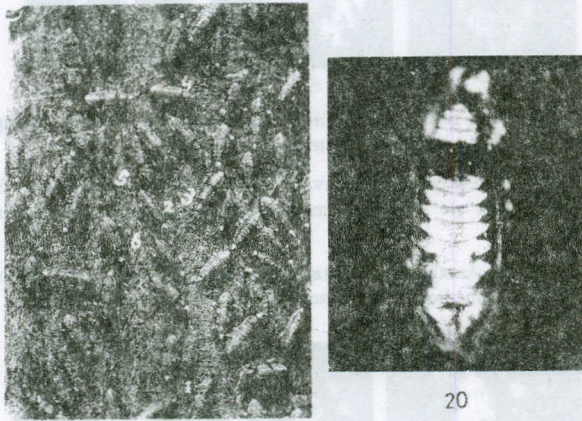
Fig. 17. The cell of an early second stage larva of male showing its dorsal wax shield disrupted anteriorly and posteriorly in contrast to that of the female, Fig. 12. "B" indicates Brachial plate on the dorsal surface with the major spiracle below.

Fig. 18. The same specimen showing its dorsal wax shield separated as three parts. Its segments would be 1 and 2, 3 to 7 and 8 to 11, the later are quite clear.

Fig. 19. Third stage female larva which means early adult female. It has grown vertically carrying on its back the fully grown second stage cell as relic. Here the dorsal wax shield is not disrupted in the anterior region, its segments 1 and 2 being very near to those of the middle, 3 to 7. The posterior segments along are separated. From the sides it secretes at three places a pair of hard wax filaments covered with lac. These three regions are indicated by white spots added for the purpose. As insect, bottom left, is an early adult female showing its three pairs of wax filaments on each side pointed by three white dots like those in the main cell Fig. 19.

wax filaments it has secreted. There are three such regions on the sides indicated here by three white spots. An insect shows as similar cell with wax-filaments secreted from the sides visible under polarized light. When the insect was to be covered with lac secretion it would appear as the main cell, Fig. 19. Figure 19 was photographed to show as relic the full grown second stage cell, and its dorsal wax-shield. It speaks of vertical growth of the female larva. In Fig. 19 the segments of dorsal wax shield show that those which can be numbered 1 and 2 are very close to others which constitute the middle portion or segments 3 to 7. The posterior segments can also be clearly seen as being three or 8, 9 and 10, while the 11th is poorly visible. Figure 19 shows an

earlier female larval cell with segments of dorsal wax-shield not very disrupted. On the contrary the male insect in Fig. 13 had grown lengthwise which has resulted in the segments of the dorsal shield being separated far apart. Figures 17 and 18 belong to the same second stage male larva.



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Fig. 20. It is the cell of second stage female larva showing its dorsal wax shield almost intact with slight separation from its posterior segments 7 and 8.

The segments of the dorsal shield are clearly separated anteriorly and posteriorly with the middle segments, 3 to 7, separate by itself. The wax shield in Figures 17 and 18 has responded to longitudinal growth of the male larva which is not the case in Fig. 12 representing the female larva. Figures 17 and 18 show the secretion of wax from the sides in Fig. 17 and the dorsal wax shield better still in Fig. 18. They both belong to the same second stage male larva. Figures 15 and 16 represent second stage male larval cells but as different insects. So does Fig. 14 which shows the elongated body of the male second stage larva. Figures 20 and 21 both belong to second stage larva, but Fig. 20 of female, and Fig. 21 of male. Focussing attention on the dorsal wax shield its segments 7 and 8 are far apart in cell Fig. 21 of the male which is by no means so in the cell of the female, Fig. 30. Cell Fig. 21 had grown lengthwise which was not



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Fig. 21. A cell of second stage male larva showing lengthwise growth. Its dorsal wax shield shows great separation between its segments 7 and 8, unlike Fig. 20 belonging to female.



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Fig. 22. A second stage female larva showing broad head never seen in male larva.



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Fig. 23. A second stage male larva showing a narrow head unlike that of Fig. 22, which is also of the same age.

the case with cell Fig. 20, of a female. Figure 22 represents second stage cell of female. Its head is sufficiently broad and contrasts with that of the male larva, in Fig. 23, with its head narrow and elliptical. The wax filament arising from the sides have been numbered in both the cells Figures 22 and 23 to facilitate comparison. The dorsal wax shield shows its own segments very conspicuously in Fig. 21. This compares itself with Fig. 7 as both come from cells of male larva.

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