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THE PUPAL AND PRE-PUPAL STAGES OF THE MALE SIND LAC-INSECT

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Lac is the product of the female insect and to forecast a lac crop the sex-ratio has to be established as early as possible. The study describes the larval stages of the lac insect with special reference to the pupal and prepupal stages of the male Sind lac insect.

On account of the commercial importance of lac (shellac), its insect is artificially propagated. In Sind the species of the insect is *Kerria Sindica*, Madh, which grows mostly on *Acacia arabica*; no other lac insect is known to feed on this host plant. Lac being the product of the female insect, it is necessary to know the ratio between the sexes at a reasonably early period to foretell the quantity of a lac crop. The earliest time would be when the young larvae have just settled on the plant. During this period, however, mortality is high so that in practice the best time of predicting the lac crop is after the first moult or when the larvae are during their second stage. It has, however, escaped observation that during the second larval stage the male is the larger and thus easier to determine. For this reason attention was diverted to the study of the larval stages of the male insect or in other words the pupal and pre-pupal stages of the male lac insect.

Majority of the coccids have only winged males. This is also the case with pseudo-lac insects of the genus *Tachardina*. But the genuine lac insects have both winged and wingless males. It was observed that in a generation if the winged males are sufficiently numerous, then the females are scarce. It, therefore, follows that during the second larval stage if the ratio of winged and wingless males is ascertained the yield of the forthcoming crop can be predicted. On account of such great importance a detailed study has been carried out of the second larval stages of the winged and wingless male lac insect. This is described in the present communication.

Plate 1, Fig. 1 shows a fully developed second stage larva of wingless male of *Kerria Sindica*. The posterior upper

surface shows a depression corresponding to the opercular lid of the pupal cell. The empty pupal cell of the wingless male is seen in Fig. 4. In Fig. 1 several body segments of the larval body are seen clearly. The row of dark spots on either side shows the places where the muscles are attached from within the upper surface of the body. A little behind the anterior end, on each side are conspicuous large white spots. These represent soft wax secreted from a chitinous disc of fused pores, close to the major spiracles. This disc is called brachial plate and is characteristic of lac insects. The anal end shows a brush of ten anal ring hairs smeared with soft wax a feature shown earlier in the female lac insect [1]. Nearly full grown second stage larva is seen side ways in Fig. 10, the row of muscular attachments is quite obvious here. Fig. 10 incidentally shows a subtle feature; the insect was alive having been carefully removed from the cell. The brush of anal ring hairs have collected themselves bearing a drop of honey dew at the extreme end. The second stage wingless male larva is larger (Figs. 1 and 2) than the female larva (Fig. 9) and excretes more honey dew.

Fig. 2 shows the lac cell being transparent though coloured. The occupant of this cell is the male larva which has moulted and is now a pupa, for its posterior end shows the absence of anal ring hairs. The opercular lid of the cell has also been dropped and the cell opening is free for the exit of the adult male. This is the device for the adult male to leave its cell by moving backwards. Fig. 5 shows an adult though not yet fully formed. This represents a stage later than that of Fig. 2. The male sex organ is clearly seen as a pointed needle; the corresponding structure is

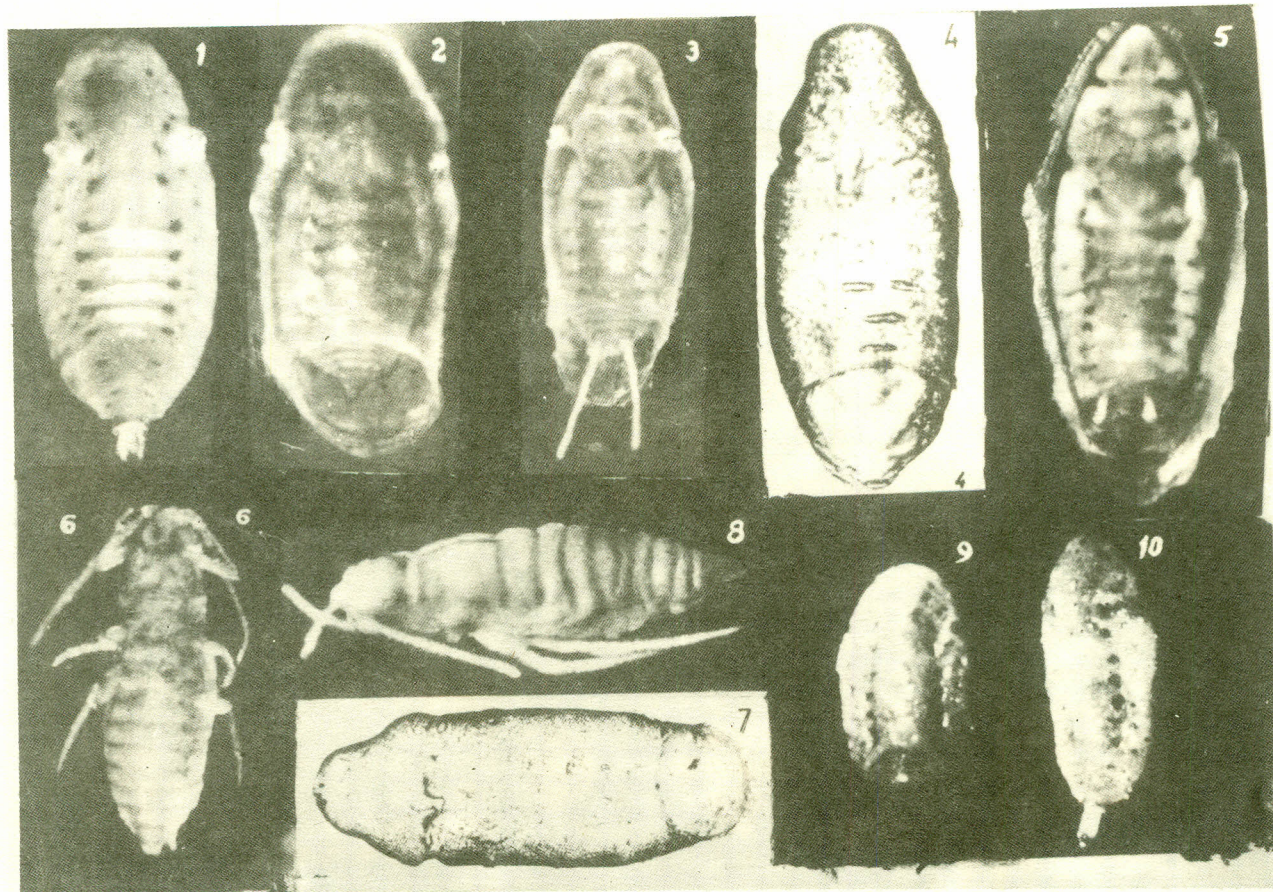


Plate I: Figs. (1). Second stage larva of wingless male (2). As pupa within its cell. (4). Cell of the wingless male after it has been evacuated. (5+3). Male adults within cell. (7). The empty cell of a wingless male. (9) Female larva. (6+8). Free pupa outside the cell. (10). Fully developed second stage male larva.

rudimentary and under developed in the pupa (Fig. 2). The male carries two long wax filaments projecting from the posterior end. These filaments are short, but conspicuous as in Fig. 5. In the pupa (Fig. 2) these filaments are absent which represents a less mature male. In Fig. 5 the partitions between head, thorax and the main body are well brought out. In Fig. 2 the above spot, on the left, has a cleft and appears as a slit, being the opening in the cell where the major spiracle is situated on the body beneath. This slit is better seen as eye-shaped on either side in the anterior region of cell (Fig. 3). The propupa is not seen in either of Figs. 1, 2, 3 and 5. The pupa is seen on its back exposing its ventral aspect, in Fig. 6, and on its abdomen in Fig. 8. Thus, the stages in the development of the insect are seen in the following order, Fig. 1, as second stage larva, next Fig. 2, as pupa within its cell, then Figs. 6 and 8 as free pupae outside the cell, and in Figs. 5 and 3 immature adult, within the cells. Fig. 4 shows the cell of the wingless male after it has been evacuated, and Fig. 7, the empty cell of a winged male. In most scale insects the cell of the male is formed of material which is opaque. On the

contrary the cell of the male lac insect is translucent though colored. This allows the insect body to be seen within its cell as is the case in Figs. 2, 5 and 3. The elongated empty cell of the winged male, (Fig. 7) and the relatively shorter one of the wingless male (Fig. 4) are self evident. The emphasis is on establishing the identity of the wingless male, as illustrated in Figs. 1 and 2, for when there is the preponderance of the female the same generation shows males to be wingless. On the contrary if it be found that between males themselves, the winged males predominate, it indirectly means that females are few, and the future crop of lac would be poor. Here the study of Sind lac - insect is most helpful since it often tends to show preponderance of males, when males are invariably winged.

Plate. II is devoted to the pre-adult stages of the winged male. The fully grown second stage larva is seen in Fig. 1. This belongs to winged male and shows a sufficiently elongated body in contrast to the shorter one, of the wingless male (Fig. 1, Pl. I). In explaining Fig. 1, Pl. I, it was pointed out that the posterior upper portion of the larval body shows a depression which corresponds to the opercu-

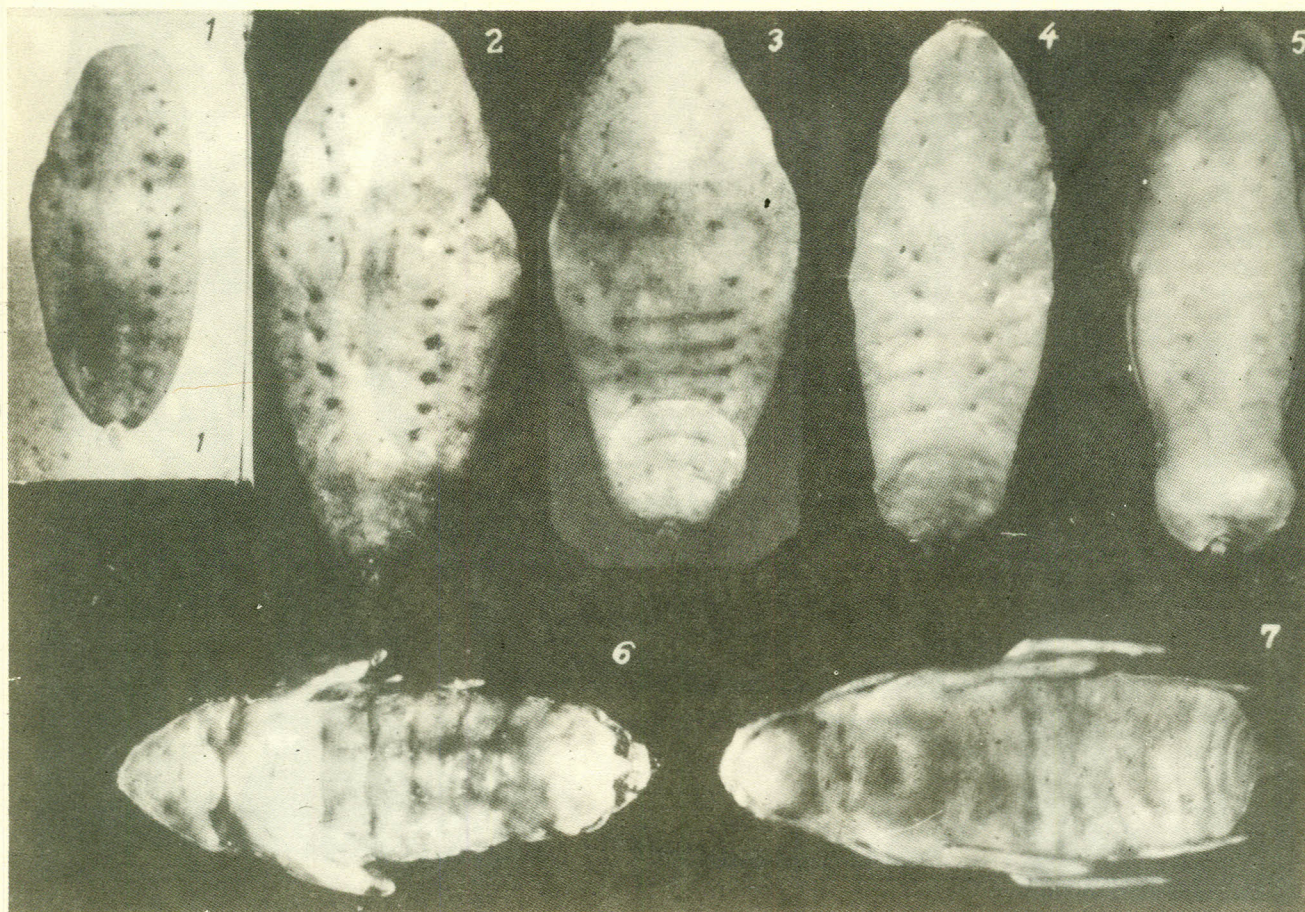


Plate. II: Figs. (1). Fully developed second stage larva of winged male. (2+3). Second stage winged male larva with conspicuous depressions corresponding to the opercular of the pupal cell. (4+5). Larva ready for the second moult: more clearly obvious in Fig. 5. (6). Propupa of the winged male. (7). Pupa of the winged male (dorsal view).

lar lid of the pupal cell or to the opening of the cell, seen best in Figs. 2 and 4, Pl. I. The corresponding depression is most conspicuous on the body of the second stage winged male larva, in Fig. 3, Pl. II, next in Fig. 4, but also discernable in Fig. 2. The second stage larva of winged male shows gradual development from Figs. 1-4. In Fig. 4, the larva is ready for the second moult while in Fig. 5 it is definitely so. When the second moult has occurred the propupa of the winged male appears as in Fig. 6. The corresponding propupal stage of the wingless male is not seen in Pl. I. The pupa of the winged male appears in Fig. 7, Pl. II, which is seen dorsally while the pupa of the wingless male is seen ventrally in Fig. 6, Pl. I.

A simple study of the pre - adult stages of the wingless and winged male easily allows each to be identified. Thus, in their fully mature second larval stage, it is quite easy to identify, what belongs to the female. Fig. 9, Pl. I; or to the wingless male. Figs. 1 and 10, Pl. I; or to the winged male, Figs. 1 to 4, Pl. II. Even by examining the empty cells of wingless male as Fig. 4, Pl. I and of winged male, Fig. 7, Pl. I their ratio can be established.

REFERENCE

1. S. Mahdihassan, *The Anal Ring Hairs of Coccids*, Eos. (Madrid), 51, 65 (1976).