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DIMORPHISM IN LAC INSECTS

by

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The existence of dimorphism, viz., the red and yellow varieties, among lac insects was first recorded in the nineteenth century. Mahdihassan[1], while listing the complete literature on this subject, refers to the writer's earlier communication[2] and to the omission of classifying the two dimorphous varieties. He has also expressed doubts about the possibility of the two varieties breeding true to type. The following pages describe in detail the observations the writer has so far carried out in this problem.

Classification of lac insects—Lac is a commercial commodity of great importance. To have a correct knowledge of identity and performance of the different species of the lac insects reported to be occuring, a detailed study and a thorough re-examination is necessary. More so in the case of Indian lac insects which contribute the bulk of world produce of lac. Designating different species on superficial and easily variable characters causes confusion.

The growth and form of individual lac insects growing on the same branch and even on the same twig of every host differ greatly from season to season and crop to crop. This point was brought out and illustrated by me[3] and rightly emphasized by Glover[4] in his book under the heading 'species of lac insects'.

It is also a well known fact that there are differences in colour indices, etc., of lac produced even by the same insect on the same host in different climatic and other natural conditions.

The *Shorea talura* broodlac, having three life-cycles on *Shorea talura* in thirteen months in Mysore, has only two life cycles on the same host in Ranchi. This difference seems to be due to different climatic conditions and other natural factors in the two areas. The lac insect on *kusum* (*Schleichera oleosa*) in Bihar completes its two life cycles, one in January-February and the other in June-July but the same *kusum* broodlac from Bihar on *kusum* has no definite life cycle periods in the Vannathiparai forest in Mathurai district of Madras from 1932 to this day and has been completing its life cycles in different months in each crop in every succeeding year[6] due to equable climatic conditions in that area.

Hence colour, superficial characters subject to change in different climatic conditions and the growth and formation of lac encrustation on different kinds of hosts under different climatic and physical conditions do not seem to form a reliable guide for the classification of the lac insects.

Experiments on yellow and red lac insects—The crimson and yellow forms of lac insects were obtained from Jodhpur on *ber* (*Zizyphus mauritiana*) and from Jammu, Kashmir on *khair* (*Accacia catechu*). The supply from Jodhpur was received in June and November 1927 and from Kashmir in December 1932. However, detailed investigations could be taken up systematically under field conditions only in 1934 when two suitable brass wire-net cages

were made available to avoid interference from lac grown in the surroundings. One of these cages was used to study parthenogenesis in the lac insects and the other to study the yellow forms of the lac insects.

In the laboratory, counts of eggs laid by the females and of the larvae emerged were daily done under the binocular microscope. In the field, individual female lac insects ready to give rise to lac larvae were placed in small wire-net cages and tied on to twigs of the *caged tree* to rear the progeny; care being taken that the progeny of one female did not mix with that of the other. On some branches in certain crops collective infection from two or more females was also studied. Individual females, under study in the laboratory and field after completing egg laying and after emerging out of lac larvae, were examined in the laboratory and undelivered mature eggs left in their ovaries were counted.

COUNTS OF EGGS AND LARVAE IN THE PROGENY OF JODHPUR *BER* RED AND YELLOW FORMS OF FEMALES

	Red		Yellow	
	Fertilized	Asexually developed	Fertilized	Asexually developed
No. of generations for which observations taken	5	17	6	11
Total No. of healthy females under observations	34	79	40	30
No. of red eggs delivered ...	14,530	37,483	Nil	Nil
No. of yellow eggs delivered ...	Nil	Nil	20,177	14,542
No. of mature red eggs left undelivered in ovaries ...	3,984	3,171	Nil	Nil
No. of mature yellow eggs left undelivered in ovaries	Nil	Nil	3,477	1,024

In the progeny of Kashmir *khair* red and yellow lac insects, observations were taken only on two generations of fertilized red and yellow females. Six healthy red females laid 2,647 eggs and they were all red; in the ovaries 426 mature eggs were left undelivered and they too were all red. Seven healthy yellow females laid 2,939 eggs and they were all yellow; in the ovaries 600 mature undelivered eggs were left and they too were all yellow.

The above results show that each red female produces only red eggs, and the larvae that hatch are also red. The yellow females produce only yellow eggs and larvae that emerge are also yellow. In other words the colour of the new born young is the same as that of their mother.

II. Studies in Field

The experiments were conducted on *ber* and *khair* trees. The former proved a more convenient and a better host than the latter.

From 1928 to 1932, in each crop mass infections of yellow lac females of Jodhpur *ber* and their progeny were conducted. It was observed that

during development on the tree a good number of yellow larvae changed into red. The change in colour occurred during the larval instars. The predators and parasites also interfered. Cloth cage for the trees did not prove satisfactory.

Hence from July 1934 experiments were conducted in each crop on one tree under a 80-mesh brass wire-net cage and a limited number (3–9) of yellow female cells of the progeny of Kashmir *khair* broodlac were used.

Here again for the first three generations some yellow larvae changed into red during different larval instars. As many as 57% yellow larvae of the first generation changed into red. The change was in the males as well as in the females. However, in the fourth generation there was no change in colour at any stage and all the insects retained their yellow colour. But in the fifth generation once again 4·6 per cent yellows changed into red; the red males were destroyed in the third instar. In the sixth generation there was no change in colour; all were yellow but in the seventh generation 1·3 per cent changed into red; the red males were again destroyed in the third instar and at crop maturity only yellow females were found living. To grow the eighth generation the selected 5 mothers failed to give birth to young.

In July 1938, the experiments were restarted with 5 yellow females of Jodhpur *ber* progeny selected from the seventeenth generation of asexually bred females. Each mother cell was tied on to a different branch of the *ber* tree. Here again in the progeny of two females during development there was change in colour from yellow to red in some larvae but not in the case of the other three females. In the second genertion there was no change in colour in the larval stages, however, some gravid females changed to red but they did not live to maturity. In the succeeding three generations the progeny was all yellow. Further experiments had to be stopped due to change in programme.

Some other instances of occurrence of red and yellow lac insects — In several seasons even in the Namkum Plantation, here and there yellow lac insects have been found amidst the red insects in *rangeeni* as well as in *kusmi* lac. In August 1935 in the *Katki* crop yellow lac cells were found in the progeny of *palas* (*Butea monosperma*) lac on *khair*, and in February 1936 in the progeny of *kusum* (*S. oleosa*) lac on *khair* in the *Aghani* 1935-36 (June to February) crop. In December 1942, in village Jamla of Chota-Udepur, I found yellow and red lac insects in the *Baisakhi* 1949-50 crop on *Ficus infectoria* locally called *pipli*. The villagers told me that the yellow insects change to red when the crop matures, this statement is in accord with my observations recorded earlier. In April 1950 in Pawagarh near Halol, Panchmahal Forest Division, Bombay, I found red and yellow lac on *ber* in the *Baisakhi* 1949-50 crop. In December 1950 I came across red and yellow lac insects on *pipal* (*F. religiosa*) in Avad Forest Division U.P. In March 1953, I found red and yellow lac naturally growing on *Ficus religiosa* trees in the compound of the Banaras Hindu University. There was no lac anywhere in the area when I left the University in 1925. In May 1953, Shri J. N. Singh of this Institute collected red and yellow lac insects naturally growing on *pipal* (*F. religiosa*) from Monghyr, Bihar. It was from Monghyr

that Mr. E. E. Green received his samples of *L. fici*. In June 1953, Shri Shyam Deogam brought some samples of *palas* lac from Konai near Panki in Palamau, Bihar and in one stick about nine inches long two mature yellow females were found at two different places amidst closely encrusted red females. In the same month, among samples received through Shri M. M. Srinivasan, Special Officer for Lac Cultivation, one stick of *palas* lac about six inches long from Shadol Range, Vindhya Pradesh was found to have a thick encrustation by pure yellow nearly mature female insects, while in another two bundles measuring a total length of about eight feet, received from Devacad-Baria, Poona Forest Division, Bombay, dead and parasitised closely set immature yellow insects intermingled with the red variety were also observed.

Conclusion—I could not complete the study of the problem but from whatever experience I have of the two forms, it is clear that crimson mothers give rise to crimson larvae and the yellow mothers to yellow, i.e., both breed young ones of their respective colours. It is during their growth on the tree that some of the yellow larvae change into red. However I have not actually seen any red larva changing into yellow. A critical study on change of colour in red larvae in the field has also not been carried out. But instances of the presence of yellow females among reds observed in *palas* and *kusum* brood on *khair*, at Namkum, in *palas* brood at Panki do indicate this possibility also.

This difference in colour beween the two forms may possibly be due to one of the following two reasons: (i) the colouring matter in the two may be chemically different and the yellow variety being biologically convertible into reddish one, or (ii) the colouring matter in the two may be chemically the same but may be present in different amounts in concentrations, so that when present in traces only it appears to be yellow whereas when present in sufficient quantity it appears to be red. A possible support for the latter view is available from the fact that both the colouring matters of yellow and of crimson insects give with alkali the same pinkish shade. However, there is room to suspect that there may be true mutants in some of the yellow forms and to discover this aspect a study of chromosomes in the two forms would be necessary. As sufficient quantity of sticklac produced by the yellow females could not be collected, chemical tests on the comparative qualities of lac produced by the two forms could not be arranged.

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