## PART IX.

# THE INFLUENCE OF METEOROLOGICAL CONDITIONS ON THE LIFE-CYCLE OF THE MYSORE LAC INSECT.

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The influence of climatic factors on insect life is of great significance, especially among those species which are bi- or tri-voltine in character, since the conditions of climate under which each generation is reared vary according to the season. The Mysore lac insect is not strictly tri-voltine since three generations occur in little over thirteen months. Accordingly thirteen years must elapse before the conditions recur which obtain for any single generation which may be the subject of study. This period of thirteen years may be termed the grand life-cycle.

Fortunately there occur in Mysore several broods which swarm at intervals of a month, a fortnight and even a week and which thus represent the behaviour of successive generations in the course of the grand life-cycle of thirteen years. The necessary data for the study of this cycle can thus be obtained in a much shorter period of time than would otherwise be possible.

### METHODS OF OBSERVATION.

At Doraisanipalya trustworthy records of the dates of the swarming of larvae and emergence of males have been maintained since 1920. Tree No. 191 on the experimental area was inoculated for the purpose and kept under observation. Weekly visits were paid to the area and when it was seen, from the development of the cells, that the males would emerge, or the larvae would swarm within a day or two, an infected shoot was brought over from the area and kept in the laboratory under observation. The date was then noted on which the first male, or larva as the case might be, came out. The observed dates may be taken as being correct to a day.

At other centres, observations could not be carried out with great accuracy on account of distance and difficulty of access. Reliance had to be placed on the reports of field-men, checked in the laboratory by watching sticks brought in from these areas before the probable local date of swarming. The dates of male-emergence have not been recorded for these centres. The dates of swarming are believed to be correct to within four days.

## SELECTIONS OF DATA FROM GOVERNMENT METEOROLOGICAL REPORTS.

The meteorological data have been taken from the Annual Reports of the Government of Mysore. For the Doraisanipalya area the data for temperature and humidity recorded at the Bangalore Central Observatory have been adopted. The figures for rainfall have been taken from those of the Lalbagh Station, which is only four miles distant from Doraisanipalya.

For other centres the figures of the nearest recording stations have been adopted for rainfall, but for temperature data the figures of the Bangalore Observatory have been taken advisedly, since the localities under observation are all situated on the same plateau, and the temperature does not vary appreciably with a slight change of altitude. On the other hand, relative humidity figures, which are not available for these centres, are affected by local conditions such as the proximity of a tank, a river, a hill or high vegetation. No general data would have value, therefore, and consequently they have not been considered. The results of the observations are set out in tables I and II.

## DISCUSSION OF THE TABLES.

The various crops detailed in tables I and II may be broadly distinguished as pre-monsoon, monsoon, and post-monsoon. The pre-monsoon crops obtain an average monthly rainfall of 1·5 to 2·1 inches and pass through a mean temperature varying from 76° to 78° F. The range of temperature is high during this period. These crops receive sufficient rains during the post-embryonic period when the vital activities of the insect are at the highest point.[1] They generally take the least time to mature.

The monsoon crops receive abundant rainfall, the monthly average varying from 4 to 5 inches, the mean temperature for the whole period being 73° to 74°F. The range of temperature is low during this season and the average humidity high. These crops take about a week longer to mature than the preceding crop.

[1] Rate of secretion by the lac insect; by M. Sreenivasaya. This *Journal*, 1924, 7, 126.

The post-monsoon crop passes through a period of low humidity, low temperature and low rainfall, the respective averages for the season being: humidity 70 to 75, mean temperature $69^0$ to $70^0$ F., and rainfall 2·5 inches. These crops cover the longest period, being adversely influenced during the post-embryonic stage of development, the average rainfall after fertilisation being less than 0·5 inch. The temperature and humidity are also then at their lowest.

It must be emphasised that the post-embryonic period, being the most active in the life-history of the insect, is the most susceptible to climatic factors. It will be seen that although the average rainfall for the post-monsoon crop is higher than that for the pre-monsoon crop, yet the former is poor, because of the unfavourable conditions prevailing after the emergence of the males.

## CONCLUSIONS.

1. The life-cycle of the lac insect is mainly influenced by temperature. Low temperatures, particularly during the period of maturation, postpone the date of larval swarming, which is hastened with rise of temperature. The emergence of the males is similarly influenced.[1]

2. Although humidity profoundly influences lac secretion and sex determination, its specific and exclusive effect on the life-cycle is not easy to trace. In this connection, however, attention may be drawn to an interesting paper by T. C. Headlee,[2] who noted that with low humidity there was a prolongation of the life-cycle and a low reproductive activity in the case of bean-weevils. Our observations with regard to the Mysore lac insect are in close agreement with these.

3. Rainfall influences the insect indirectly through its host, by providing abundant nutritive material.

In conclusion we wish to express our grateful thanks to Mr. C. R. Seshachar, Meteorological Reporter to the Government of Mysore for many critical suggestions and for kindly placing at our disposal some unpublished data.

[1] One of us has completed the life-cycle of the insect reared under experimental control in the laboratory within three-and-a-half months, the data being given in Table III.
[2] *Journ. Econ. Ent.*, 1917, **10**, 31.

## DORAISANIPALYA

## TABLE

| Year | 1920 | | | | | | | 1921 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Rainfall : Inches | Relative Humidity | Mean Temperature | Dates of swarming, emergence, etc. | Male-emergence, days after inoculation | Swarming, days after emergence | Swarming, days after inoculation | Rainfall : Inches | Relative Humidity | Mean Temperature | Dates of swarming, emergence, etc. | Male-emergence, days after inoculation | Swarming, days after emergence | Swarming, days after inoculation |
| January ... | ... | 83 | 69·2° | ... | ... | ... | ... | ... | 80 | 71·8° | 24th | ... | 97 | 152 |
| February ... | ... | 72 | 74·7 | ... | ... | ... | ... | ... | 67 | 73·3 | ... | ... | ... | ... |
| March ... | 0·08 | 63 | 79·4 | ... | ... | ... | ... | ... | 60 | 79·3 | 29th ↑ | 64 | ... | ... |
| April ... | ... | 71 | 81·2 | 29th | ... | ... | ... | 3·35 | 73 | 80·4 | ... | ... | ... | ... |
| May ... | 0·93 | 69 | 81·7 | ... | ... | ... | ... | 2·74 | 70 | 82·2 | 19th | ... | 51 | 115 |
| June ... | 2·13 | 81 | 76·5 | ... | ... | ... | ... | 4·54 | 83 | 76·3 | ... | ... | ... | ... |
| July ... | 0·25 | 83 | 74·8 | ... | ... | ... | ... | 6·35 | 87 | 74·6 | 10th ↑ | 52 | ... | ... |
| August ... | 5·40 | 85 | 74·4 | 25th | ... | ... | 118 | 7·08 | 87 | 74·3 | ... | ... | ... | ... |
| September. | 8·62 | 86 | 74·6 | ... | ... | ... | ... | 4·76 | 86 | 73·1 | 23rd | ... | 75 | 127 |
| October ... | 3·34 | 82 | 74·4 | 19th ↑ | 55 | ... | ... | 5·40 | 81 | 73·6 | ... | ... | ... | ... |
| November... | 1·88 | 83 | 72·0 | ... | ... | ... | ... | 4·91 | 76 | 70·1 | ... | ... | ... | ... |
| December... | ... | 75 | 68·7 | ... | ... | ... | ... | ... | 79 | 68·4 | 7th ↑ | 75 | ... | ... |

Dates marked thus ↑ are

## OBSERVATIONS.

I.

| 1922 | | | | | | | 1923 | | | | | | | Byaba (Hassan) 1922 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall : Inches | Relative Humidity | Mean Temperature | Dates of swarming, emergence, etc. | Male-emergence, days after inoculation | Swarming, days after emergence | Swarming, days after inoculation | Rainfall : Inches | Relative Humidity | Mean Temperature | Dates of swarming, emergence, etc. | Male-emergence, days after inoculation | Swarming, days after emergence | Swarming, days after inoculation | Rainfall : Inches | Temperature | Dates of swarming | Swarming, days after inoculation |
| 0·45 | 80 | 70·6° | ... | ... | ... | ... | 0·38 | 75 | 69·1° | ... | ... | ... | ... | 1·28 | 71·0 | ... | ... |
| ... | 62 | 72·9 | 14th | ... | 69 | 142 | ... | 69 | 73·1 | ... | ... | ... | ... | ... | 73·3 | ... | ... |
| ... | 60 | 79·4 | ... | ... | ... | ... | 1·93 | 71 | 77·1 | 20th | ... | 85 | 158 | ... | 78·1 | ... | ... |
| 0·93 | 68 | 82·0 | 16th↑ | 61 | ... | ... | 3·87 | 71 | 81·1 | ... | ... | ... | ... | 3·16 | 80·2 | ... | ... |
| 3·91 | 76 | 79·9 | ... | ... | ... | ... | 3·02 | 69 | 80·7 | 11th↑ | 52 | ... | ... | 6·25 | 77·2 | ... | ... |
| 3·30 | 82 | 76·0 | 17th | ... | 62 | 123 | 2·25 | 79 | 77·2 | ... | . | ... | ... | 1·95 | 73·7 | 26th | ... |
| 2·85 | 85 | 73·8 | ... | ... | ... | ... | 3·64 | 87 | 72·5 | 23rd | ... | 73 | 125 | 3·13 | 71·6 | ... | ... |
| 3·48 | 87 | 74·0 | 7th↑ | 51 | ... | ... | 3·93 | 84 | 73·7 | ... | ... | ... | ... | 0·78 | 72·3 | ... | ... |
| 3·34 | 83 | 74·5 | ... | ... | ... | ... | 9·27 | 87 | 72·6 | 23rd↑ | 62 | ... | ... | 3·13 | 73·5 | 23rd | 119 |
| 9 87 | 82 | 73·3 | 18th | ... | 67 | 118 | 2·54 | 82 | 74·6 | ... | ... | ... | ... | 4·44 | 71·2 | ... | ... |
| 4 05 | 85 | 71·1 | ... | ... | ... | ... | ... | 70 | 73·3 | ... | ... | ... | ... | ... | 67·2 | ... | ... |
| 0 13 | 75 | 67·6 | 25th↑ | 73 | ... | ... | ... | 74 | 71·5 | 2nd | ... | 70 | 132 | ... | ... | ... | ... |

those of male-emergence.

## TABLE II.

| Month | Kalkere West 1921 | | | | Kalkere West 1922 | | | | Kalkere East 1922 | | | | Kalkere East 1923 | | | | Kalkere East 1924 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rainfall | Temperature | Dates of swarming | Swarming, days after inoculation | Rainfall | Temperature | Dates of swarming | Swarming, days after inoculation | Rainfall | Temperature | Dates of swarming | Swarming, days after inoculation | Rainfall | Temperature | Dates of swarming | Swarming, days after inoculation | Dates of swarming | Swarming, days after inoculation |
| January ... ... | ... | ... | ... | ... | 0·45 | 70·6° | ... | ... | 0·45 | 70·6° | ... | ... | 0·36 | 69·1° | ... | ... | 7th | 144 |
| February ... ... | ... | ... | ... | ... | ... | 72·9 | ... | ... | ... | 72·9 | ... | ... | ... | 73·1 | ... | ... | ... | ... |
| March ... ... | ... | ... | ... | ... | ... | 79·4 | ... | ... | ... | 79·4 | ... | ... | 1·93 | 77·1 | ... | ... | ... | ... |
| April ... ... | ... | ... | ... | ... | 0·93 | 82·0 | 3rd | 147 | 0·93 | 82·0 | ... | ... | 3·87 | 81·1 | 21st | 160 | ... | ... |
| May ... ... | ... | ... | ... | ... | 3·91 | 79·9 | ... | ... | 3·91 | 79·9 | ... | ... | 3·02 | 80·7 | ... | ... | ... | ... |
| June ... ... | 4·34 | 76·3 | 16th | ... | 3·30 | 76·0 | ... | ... | 3·30 | 76·0 | ... | ... | 2·25 | 77·2 | ... | ... | ... | ... |
| July ... ... | 6·35 | 74·6 | ... | ... | 2·85 | 73·8 | ... | ... | 2·85 | 73·8 | 5th | ... | 3·64 | 72·5 | ... | ... | .. | ... |
| August ... ... | 7·08 | 74·3 | ... | ... | 3·48 | 74·0 | 1st | 110 | 3·48 | 74·0 | ... | ... | 3·93 | 73·7 | 16th | 108 | ... | ... |
| September ... | 4·76 | 73·1 | ... | ... | 3·34 | 74·5 | ... | ... | 3·34 | 74·5 | ... | ... | 9·27 | 73·6 | ... | ... | ... | ... |
| October ... ... | 5·40 | 73·6 | ... | ... | 9·87 | 73·3 | ... | ... | 9·87 | 73·3 | ... | ... | 2·54 | 74·6 | ... | ... | ... | ... |
| November ... | 4·91 | 70·1 | 7th | 144 | 4·05 | 71·1 | ... | ... | 4·05 | 71·1 | 21st | 139 | ... | 73·3 | ... | ... | ... | ... |
| December ... | ... | 68·4 | ... | ... | 0·13 | 67·6 | 26th | 147 | 0·13 | 67·6 | ... | ... | ... | 71·5 | ... | ... | ... | ... |

# TABLE III.

| No. Experiment | Dates: Inoculation | Dates: Emergence and swarming | Day: Emergence after inoculation | Day: Swarming after emergence | Day: Swarming after inoculation | Remarks |
|---|---|---|---|---|---|---|
| 1. *Acacia Farnesiana* under controlled conditions. | 26th July | Sept. 18th↑ Nov. 11th | 54 | 54 | 108 | The life-cycle of the insect has been shortened by 24 days under controlled laboratory conditions. |
| 2. Corresponding crops in the forest. | 23rd July | Sept. 23rd↑ Dec. 2nd | 62 | 70 | 132 | |

Dates marked thus ↑ are those of male-emergence.