

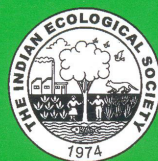
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## Host and Location Mediated Variation in Life Cycle and Biological Attributes of Indian Lac Insect, *Kerria lacca* (Kerr.)

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**Abstract:** A significant variation in pre sexual maturity, duration of male emergence and total life cycle period between hosts and locations was observed during 2011-12. Whereas, during summer *rangeeni* (2012-13) crop variation in pre sexual maturity was significantly different between the locations only whereas duration of male emergence and total life cycle period differ significantly between host and location. Time taken to complete the life cycle was more on *ber* as compared to *palas* at both locations. The biological attributes of *rangeeni* lac insect viz., initial mortality and sex ratio differed significantly between hosts, locations and interaction between location and host, whereas, initial density of settlement showed significant difference only between locations. There was significant difference in survival of lac insect at maturity between hosts, locations and their interaction, whereas, fecundity and resin weight showed significant variation only between locations. Initial mortality showed considerable differences between hosts, locations and interaction between location and host whereas broodlac yield and sex ratio showed significant difference only between hosts.

**Key Words:** Biological attributes, *Butea monosperma*, Lac insect, Rangeeni strain, *Ziziphus mauritiana*

The Indian lac insect, *Kerria lacca* (Kerr.) secretes lac, a resinous compound of great economic importance, which finds application in diverse areas such as food, pharmaceuticals, cosmetics, paints and varnishes (Ramani *et al.*, 2007). Lac derived products are biodegradable, non-toxic and environment friendly. In addition to this, the lac insect-host association contributes to the conservation of biodiversity, viz., soil flora, fauna, and soil microorganisms (Sharma *et al.*, 2006). The life cycle of *K. lacca* starts with first instar larval stage, the crawlers and there after settlement undergo three successive moulting to become the adult. The first instar is mobile and crawls over the shoot of host trees. It settles and feeds on phloem sap by piercing its proboscis into phloem region of shoot. The duration of each stage depends on the host tree species on which it feeds and prevailing environmental conditions. Invariably lac production varies from host to host and season to season (Kumar *et al.*, 2007). Quantitative and qualitative variation in biological attributes of the lac insect, viz., sex ratio, fecundity and yield of resin have been reported (Chauhan and Teotia, 1973). The present study was therefore undertaken to determine the location and host mediated variation in various stages of life cycle and biological attributes of the lac insect under two climatically distinct locations i.e., Jharkhand and West Bengal on two commercial lac host trees viz., *Ziziphus mauritiana* (*ber*) and *Butea monosperma* (*palas*) during summer season (*baisakhi*) crops, 2011-12 and 2012-13 to enable reliable comparison in the productivity linked attributes of *rangeeni* lac insect and their life cycle.

### MATERIAL AND METHODS

The *rangeeni* strain broodlac was cultured on *Ziziphus mauritiana* and *Butea monosperma* during two consecutive years, *baisakhi* crops were raised during 2011-12 and 2012-13 at Institute Research Farm, Ranchi (Jharkhand) and Farmers field at Putidih, Jhalda (West Bengal). Duration of pre sexual stage (time elapsed between date of inoculation to male and female of lac insect differentiation), duration of male emergence (time elapsed between emergence of first to last male emergence) and life period of female (time elapsed between date of inoculation and crop harvesting) were recorded from *Z. mauritiana* and *B. monosperma* (Fig. 1). To determine the productivity linked attributes one square cm area was randomly selected and numbers of lac larvae settled were counted for initial density of settlement after 21-days of inoculation. Simultaneously, counting of dead larvae was also recorded for initial mortality. Nine such sites were selected from the same host plant and average taken as mean density of settlement and mean mortality and was replicated thrice. The process (as in initial density of settlement) was repeated 14-16 weeks of inoculation for determination of sex ratio (% of male insects). The resin output by an individual female was recorded by weighing individual matured female lac insect after removing the dead insect body from the cell after larval emergence. Ten individual matured female were taken for observations of fecundity and resin weight and were replicate three times. Fecundity was assessed by storing individual matured female into glass vials for about a month and the emerged

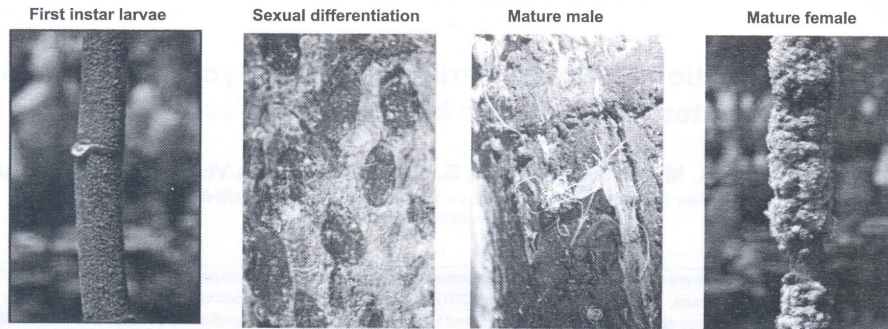


Fig. 1. Stages of lac insect development

larvae were counted. The cells then were broken open and larvae, which could not emerged out were also counted and taken into consideration as fecundity of the lac insect. Broodlac yield ratio (input: output) was recorded from ten trees of both the hosts wherein each tree represent one replication.

#### RESULTS AND DISCUSSION

##### Lac insect life cycle of summer rangeeni lac crops:

Variation in pre sexual maturity, duration of male emergence and total life cycle period differ significantly between hosts and locations. However, the interaction between location and host was significant only for pre sexual maturity period during summer rangeeni (2011-12) crop (Table 1). Difference in pre sexual maturity period in Jharkhand and West Bengal were

15 and 18 days and total life cycle period was 9 and 8 days on *palas* and *ber*, respectively whereas, the difference in duration of male emergence period was one day on both the hosts (Table 1). The duration of male emergence period ranged between 8 to 12 days in present study, whereas, Ogle *et al.* (2006) reported that the adult male lac insect lives only for 3-4 days. Variation in pre sexual maturity was significant between the locations only. The duration of male emergence and total life cycle period differ significantly between host and location during summer rangeeni (2012-13) crop (Table 2). Difference in pre sexual maturity (21 and 18 days), duration of male emergence (3 and 1 days) and total life cycle period (11 and 8 days) were observed between Jharkhand and West Bengal on *palas* and *ber*, respectively (Table 1). Lac insect takes more time to complete its life cycle on *ber* in

Table 1. Lac insect life cycle of summer (baisakhi) crops 2011-12 and 2012-13

| Location        | Lac insect life cycle (days) |       |         |            |                            |      |         |            |                       |       |         |            |
|-----------------|------------------------------|-------|---------|------------|----------------------------|------|---------|------------|-----------------------|-------|---------|------------|
|                 | Pre sexual maturity          |       |         |            | Duration of male emergence |      |         |            | Life period of female |       |         |            |
|                 | Palas                        | Ber   | Mean    | Difference | Palas                      | Ber  | Mean    | Difference | Palas                 | Ber   | Mean    | Difference |
| 2011-12         |                              |       |         |            |                            |      |         |            |                       |       |         |            |
| Jharkhand       | 118.0                        | 129.0 | 123.5   | 11         | 12                         | 9    | 10.5    | 3          | 267                   | 275   | 271.0   | 8          |
| West Bengal     | 103.0                        | 111.0 | 107.0   | 8          | 11                         | 8    | 9.5     | 3          | 258                   | 267   | 262.5   | 9          |
| Mean            | 110.5                        | 120.0 |         |            | 11.5                       | 8.5  |         |            | 262.5                 | 271.0 |         |            |
| Difference      | 15                           | 18    |         |            | 1                          | 1    |         |            | 9                     | 8     |         |            |
| 2012-13         |                              |       |         |            |                            |      |         |            |                       |       |         |            |
| Jharkhand       | 128.0                        | 125.0 | 126.5   | 3          | 13.0                       | 14.0 | 13.5    | 1          | 248.0                 | 257.0 | 252.5   | 9          |
| West Bengal     | 107.0                        | 107.0 | 107.0   | 0          | 10                         | 13.0 | 11.5    | 3          | 237.0                 | 249.0 | 243.0   | 12         |
| Mean            | 117.5                        | 116.0 |         |            | 11.5                       | 13.5 |         |            | 242.5                 | 253.0 |         |            |
| Difference      | 21                           | 18    |         |            | 3                          | 1    |         |            | 11                    | 8     |         |            |
| CD (p= 0.05)    |                              |       |         |            |                            |      |         |            |                       |       |         |            |
| Year            | 2011-12                      |       | 2012-13 |            | 2011-12                    |      | 2012-13 |            | 2011-12               |       | 2012-13 |            |
| Location        | 1.36                         |       | 1.9     |            | 0.67                       |      | 1.1     |            | 2.21                  |       | 2.5     |            |
| Host            | 1.36                         |       | NS      |            | 0.67                       |      | 1.1     |            | 2.21                  |       | 2.5     |            |
| Location × Host | 1.92                         |       | NS      |            | NS                         |      | NS      |            | NS                    |       | NS      |            |



comparison to *palas* at both locations during two consecutive crop years. Total lac insect life cycle period was shorter in West Bengal compare to Jharkhand which may be due to higher mean temperature during crop period. Mohanta *et al.* (2014) also observed the life cycle and life span of this insect was influence by temperature.

**Biological attributes of summer rangeeni lac crops:** Biological attributes of rangeeni lac insect raised on ber and palas tress at Jharkhand and West Bengal reveals significant differences in pre harvest (initial density settlement, initial mortality, and sex ratio) parameters and post-harvest (survival at maturity, fecundity and resin weight) parameters.

Initial density of settlement showed significant difference only between locations. Initial mortality and sex ratio differs significantly between hosts, locations and interaction between location and host during summer lac crop 2011-12 (Table 2). The minimum and maximum values of various pre harvest parameters *viz.*, initial density of settlement (80.4 to 125.2 cm<sup>2</sup>), initial mortality (26.9 to 62.2 %) and sex ratio (23.5 to 39.7 % male) showed very high range. Mishra *et al.* (1996) also reported variation in initial density of settlement and initial mortality. Survival at maturity differs significantly between hosts, locations and interaction between location and host, whereas, fecundity and resin weight were

**Table 2.** Pre-harvest parameters of summer rangeeni lac insect during 2011-12 and 2012-13

| Location        | Pre-harvest parameters                           |        |         |                       |       |         |                    |       |         |
|-----------------|--|--------|---------|-----------------------|-------|---------|--------------------|-------|---------|
|                 | Initial settlement density (No.cm <sup>2</sup> ) |        |         | Initial mortality (%) |       |         | Sex ratio (% male) |       |         |
|                 | Palas  | Ber    | Mean    | Palas                 | Ber   | Mean    | Palas              | Ber   | Mean    |
| 2011-12         |  |        |         |                       |       |         |                    |       |         |
| Jharkhand       | 80.39  | 102.81 | 91.60   | 33.47                 | 26.85 | 30.16   | 23.75              | 39.67 | 31.71   |
| West Bengal     | 117.83   | 125.17 | 121.50  | 62.23                 | 30.35 | 46.29   | 22.20              | 23.47 | 22.83   |
| Mean            | 99.11  | 113.99 |         | 47.85                 | 28.60 |         | 22.97              | 31.57 |         |
| 2012-13         |  |        |         |                       |       |         |                    |       |         |
| Jharkhand       | 117.74   | 131.70 | 124.72  | 20.40                 | 14.77 | 17.59   | 38.55              | 30.90 | 34.72   |
| West Bengal     | 106.88   | 122.96 | 114.93  | 10.31                 | 10.96 | 10.64   | 43.17              | 28.53 | 35.85   |
| Mean            | 112.31   | 127.33 |         | 15.36                 | 12.86 |         | 40.86              | 29.72 |         |
| CD (p= 0.05)    |  |        |         |                       |       |         |                    |       |         |
| Year            | 2011-12  |        | 2012-13 | 2011-12               |       | 2012-13 | 2011-12            |       | 2012-13 |
| Location        | 18.45  |        | NS      | 6.09                  |       | 2.32    | 5.51               |       | NS      |
| Host            | NS   |        | NS      | 6.09                  |       | 2.32    | 5.51               |       | 3.90    |
| Location × Host | NS   |        | NS      | 8.61                  |       | 3.29    | 7.79               |       | NS      |

**Table 3.** Post harvest parameters of summer rangeeni lac insect during 2011-12 and 2012-13

| Location        | Post harvest parameters                     |       |         |                  |        |         |                   |       |         |                                |      |         |
|-----------------|---|-------|---------|------------------|--------|---------|-------------------|-------|---------|--------------------------------|------|---------|
|                 | Survival at maturity (No. cm <sup>2</sup> ) |       |         | Fecundity (Nos.) |        |         | Resin weight (mg) |       |         | Brood lac ratio (output/input) |      |         |
|                 | Palas                                       | Ber   | Mean    | Palas            | Ber    | Mean    | Palas             | Ber   | Mean    | Palas                          | Ber  | Mean    |
| 2011-12         |   |       |         |                  |        |         |                   |       |         |                                |      |         |
| Jharkhand       | 10.03                                       | 15.25 | 12.64   | 318.37           | 353.23 | 335.80  | 16.10             | 14.80 | 15.45   | 1.81                           | 1.19 | 1.50    |
| West Bengal     | 4.39  | 5.53  | 4.96    | 271.17           | 295.30 | 283.23  | 17.83             | 17.27 | 17.55   | 1.58                           | 1.27 | 1.42    |
| Mean            | 7.21  | 10.39 |         | 294.77           | 324.27 |         | 16.97             | 16.03 |         | 1.70                           | 1.22 |         |
| 2012-13         |   |       |         |                  |        |         |                   |       |         |                                |      |         |
| Jharkhand       | 7.15  | 8.22  | 7.69    | 438.83           | 344.90 | 391.87  | 17.04             | 14.80 | 15.92   | 3.52                           | 2.12 | 2.82    |
| West Bengal     | 8.41  | 9.11  | 8.76    | 325.60           | 294.87 | 310.23  | 13.77             | 11.67 | 12.72   | 2.76                           | 2.49 | 2.63    |
| Mean            | 7.78  | 8.67  |         | 382.21           | 319.88 |         | 15.40             | 13.24 |         | 3.14                           | 2.30 |         |
| CD (p= 0.05)    |   |       |         |                  |        |         |                   |       |         |                                |      |         |
| Year            | 2011-12                                     |       | 2012-13 | 2011-12          |        | 2012-13 | 2011-12           |       | 2012-13 | 2011-12                        |      | 2012-13 |
| Location        | 1.05  |       | NS      | 50.41            |        | 37.84   | 1.66              |       | 1.32    | NS                             |      | NS      |
| Host            | 1.05  |       | NS      | NS               |        | 37.84   | NS                |       | 1.32    | 0.16                           |      | 0.40    |
| Location × Host | 1.49  |       | NS      | NS               |        | NS      | NS                |       | 1.87    | NS                             |      | 0.57    |

significantly different only between locations. The minimum and maximum values of various post harvest parameters viz., survival at maturity (4.4 to 15.3 cm<sup>3</sup>), and fecundity (271.2 to 353.2) showed very high range. Brood lac yield ratio (output/input) differs significantly only between the hosts during summer lac crop 2011-12 (Table 3). Initial mortality differs significantly between hosts, locations and interaction between location and host whereas sex ratio showed significant difference only between hosts during summer lac crop 2012-13 (Table 2). The minimum and maximum values were ranged between 0.3 to 20.4% and 28.5 to 43.2% in initial mortality and sex ratio, respectively. Fecundity and resin weight varied significantly between locations and hosts. The minimum and maximum values were ranged between 294.9 to 438.8 and 11.7 to 17.0 in survival at maturity and fecundity, respectively. Similar trend was observed in brood lac yield ratio during summer lac crop 2012-13 as compared to previous year (Table 3). The present findings are in accordance of earlier findings of Mishra *et al.* (1999, 2000). They also found differences in the preference of lac insect with respect to fecundity and resin weight on different hosts. Mohanta *et al.* (2014) observed that the initial density of settlement varied between 82.67-118.32 cm<sup>-2</sup> and the sex ratio was 1: 3. They also found that the range of resin output per cell was 18.72-23.00 mg for summer rangeeni crop.

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## REFERENCES

- Chauhan NS and Teotia TPS 1973. A new variant in the lac insect, *Kerria lacca* (Kerr). *Entomological Newsletter* 3: 33-34.
- Kumar A, Kumawat MM and Meena K 2007. Lac host plants recorded from Southern Rajasthan and their relative performance. Trivandrum, India: *Association for Advancement of Entomology* 32(2): 129-132.
- Mishra YD, Bhattacharya A and Naqvi AH 1996. Effect of plant differences on the initial mortality of lac insect, *Kerria lacca* (Kerr). *Indian Forester* 122(2): 189-190.
- Mishra YD, Sushil SN, Bhattacharya A, Kumar S, Mallick A and Sharma KK 1999. Intra specific variation in host - plants affecting productivity of Indian lac insect, *Kerria lacca* (Kerr). *Journal of Non Timber Forest Products* 6(3/4): 114-116.
- Mishra YD, Sushil SN, Kumar S and Bhattacharya A 2000. Variability of lac productivity and related attributes of *Kerria* spp. (Homoptera: Tachardidae) on *ber* (*Ziziphus mauritiana*). *Journal of Entomological Research* 24: 19-26.
- Mohanta J, Dey DG and Mohanty N 2014. Studies on lac insect (*Kerria lacca*) for conservation of biodiversity in Similipal Biosphere Reserve, Odisha, India. *Journal of Entomology and Zoology Studies* 2(1): 1-5.
- Ogle A, Thomas M and Tiwari LM 2006. Strategic development of lac in Madhya Pradesh. Final Report, Department for International Development (DFID), MPRLP-TCPSU, India, June 2006, pp: 1-34. [http://s3.amazonaws.com/zanran\\_storage/mprip.in/ContentPages/2505012699.pdf](http://s3.amazonaws.com/zanran_storage/mprip.in/ContentPages/2505012699.pdf).
- Ramani R, Baboo B and Goswami DN 2007. Lac: An Introduction. Indian Lac Research Institute, Ranchi, India, pp: 1-12.
- Sharma KK, Jaiswal AK and Kumar KK 2006. Role of lac culture in biodiversity conservation: issues at stake and conservation strategy. *Current Science* 91(7): 894-898.