



Biology of major lepidopteran predators of Lac Insect

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Abstract— Investigations on “Biology of Major Lepidopteran Predators of Lac Insect, *Kerria lacca* (Kerr)” was carried out in the Department of Entomology, Rajasthan college of Agriculture, MPUAT, Udaipur, during 2021 with a view to record biological parameters viz., incubation period, larval and pupal period, pre-oviposition period, oviposition period, post-oviposition period, adult longevity, total life cycle, and fecundity and evaluate the bio-efficacy of organic treatments against major lepidopteran predators of lac insect. The incubation period of *E. amabilis* ranged from 3 to 5 days, the total larval-pupal period ranged from 22 to 38 days, the pre-oviposition period ranged from 4 to 6 days, the oviposition period lasted 5 to 7 days, and the post-oviposition period lasted between 3 and 6 days. The total life cycle of a female is 48-54 days. Adult male longevity ranged from 6 to 11 days. Female longevity ranged from 7 to 11 days, the Total life cycle of the female was 48-54 days, and the total lifespan of the male *E. amabilis* was 43 to 50 days. The average number of eggs laid by *E. amabilis* was 103.60. The Incubation period of *P. pulverea* ranged from 5 to 6 days. The total larval-pupal period ranged from 23 to 39 days, the pre-oviposition period ranged from 5 to 6 days, and the oviposition period ranged from 7 to 9 days. The post-oviposition period lasted between 5 and 8 days; male longevity ranged from 7 to 14 days. Female longevity ranged from 9 to 18 days, with a total life cycle of 49 to 59 days. The average number of eggs laid by *P. pulverea* was 92 eggs.



Keywords— *Lac insect, lepidopteran predators, biology, life cycle, organic treatments*

I. INTRODUCTION

Lac is a valuable natural resin secreted by the tiny scale insect *Kerria lacca* (Kerr), cultivated primarily on host plants such as *Butea monosperma* (palash), *Ziziphus mauritiana* (ber), and *Schleichera oleosa* (kusum) (Sharma *et al.*, 2006; Jaiswal *et al.*, 2010). India is the leading global producer and exporter of lac, with the crop serving as an important source of livelihood for rural and tribal communities (Singh & Singh, 2011). Despite its economic significance, lac cultivation is hampered by several biotic stresses, chief among them being predation by insect pests (Thakur *et al.*, 2013). Lepidopteran predators pose a major threat to lac insects, particularly during the *Baisakhi* season (summer crop), which provides favorable environmental

conditions for pest proliferation (Ghosh *et al.*, 2014). Two of the most damaging lepidopteran predators are *Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyrick. These insects feed on lac cells or developing lac insects, causing significant damage to the crop and ultimately reducing resin yield (Meena *et al.*, 2017; Singh *et al.*, 2019). Understanding the biology, feeding behavior, and seasonal incidence of these predators is critical for devising timely and effective management strategies. In response to the limitations of chemical pesticides—such as environmental contamination, development of pest resistance, and negative effects on non-target organisms—organic treatments have emerged as a promising alternative (Verma & Karnatak, 2015). Organic pest control methods are gaining popularity for their eco-friendliness, sustainability,

and compatibility with traditional agricultural practices. However, scientific validation of the effectiveness of organic treatments against major lac predators, especially under field conditions during the *Baisakhi* season, remains limited (Patel et al., 2020).

II. MATERIALS AND METHODS

The present investigation on the “Biology of Major Lepidopteran Predators of Lac Insect (*Kerria lacca*),” was carried out on the *Baisakhi* crop of *Rangeeni* strain on Ber during 2021-22 at lac insect field gene bank, Department of Entomology, Rajasthan Collage of Agriculture, Udaipur. The materials used and methodologies adopted are described as under:

1.1 Biology of major lepidopteran predators of lac insect

The biology of two major predators of lac insect viz. (*Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyr) were studied on broodlac inoculated ten ber host plants, five plant for each predator at the Lac insect field gene bank, Department of Entomology, Rajasthan College of Agriculture, Udaipur. On these broodlac inoculated ber plants four branches on each plant were selected randomly and tagged after the proper initial settlement of crawlers and at middle part 50 cm of branch was covered with 60 mesh nylon net to avoid any external infestation of predators and parasitoids. To study the biology of major lepidopteran predators of lac insect the infested broodlac were collected from natural host and were kept in rearing cages (30cm X 30cm X 40cm) for the emergence of predators. The emerged moths of *E. amabilis* and *P. pulverea* were collected daily from the open end of the cages fitted with glass tubes. The five pairs of moths for each predator were kept in egg laying chamber for mating and to lay eggs. The newly hatched larvae thus collected were released inside the nylon net on the tagged branches having live lac cells and were regularly observed till the emergence of the adults. The larval-pupal duration (in days) was recorded after hatching till the emergence of adults from lac encrustations inside the nylon mesh on tagged branches for each predator, the moths emerged inside the nylon mesh were collected gently by opening the covering from one end, brought to the laboratory and kept in pairs (male and female) for each predator in different glass jars provided with 10% honey solution soaked cotton wicks in halves of small petri plates to record the duration (in days) for the survival of male, female and to record the fecundity of female for each predator.

1.1.1 Observation

- i. **Incubation period:** The time (in days) taken by the eggs to hatch was recorded. The hatching of

eggs was determined by the change in colour of the eggs.

- ii. **Larval-pupal period:** Larval-pupal period (in days) within the lac cells were recorded by observing the number of days taken by larvae to complete its larval-pupal period and the number of days were recorded till the emergence of the adult.
- iii. **Pre-oviposition period of female:** The duration in days from emergence to initiation of egg laying was recorded as pre-oviposition period of females.
- iv. **Oviposition period of female:** The duration in days from the initiation of egg laying by female to the cease of egg laying was recorded as oviposition period of females.
- v. **Post-oviposition period:** The duration (in days) after the cease to oviposition till the death of adult female was recorded.
- vi. **Adult longevity:** The longevity of male and female adults (in days) after the emergence up to their death was recorded.
- vii. **Life cycle completed (days):** Single generation time period from egg to death was calculated.
- viii. **Fecundity:** The total number of eggs laid by each adult female during the life span of females was recorded.

Statistical analysis:-

The data recorded for efficacy of different treatments were statistically analyzed using standard procedure for analysis of variance (ANOVA) of CRD in order to test the significance of experimental. The CD for treatments was also worked out. Survival percentage of lac insect was worked out using the formula.

$$\text{Survival percentage} = \frac{\text{No. of live cells/cm}^2}{\text{Total no. of cells/cm}^2} \times 100$$

III. RESULTS AND DISCUSSION

Biology of major lepidopteran predators of lac insect

The experiment to study the biology of major lepidopteran predator of lac i.e. *E. amabilis* Moore and *P. pulverea* in terms of incubation period, larval and pupal period, pre-oviposition period, oviposition period, post-oviposition period, adult longevity, total life cycle and fecundity was carried out under maintained laboratory conditions. The observation recorded on various parameters of biology of two predators are presented in Table 1.1

Incubation period (days)

The time (in days) taken by the eggs of the two lepidopteran predators to hatch was recorded by regular observation on the colour of eggs. The observations of incubation period recorded for the *E. amabilis* ranged from 3 to 5 days

whereas, it ranged from 5 to 6 days for *P. pulverea*. The mean incubation period of 4.60 and 5.20 days was recorded for *E. amabilis* and *P. pulverea*, respectively during the experimentation.

Total larval-pupal period (days)

Larval-pupal period (in days) within the lac cells were recorded by observing the number of days taken by larvae to complete its larval-pupal period and the number of days were recorded till the emergence of the adult. The total larval-pupal period ranged from 22 to 38 days with the mean larval-pupal period of 25.88 days for *E. amabilis* and it ranged from 23 to 39 days with the mean larval period of 26.88 days for *P. pulverea*.

Pre-oviposition period (days)

The pre-oviposition period for the *E. amabilis* ranged from 4 to 6 days whereas, it ranged from 5 to 6 days for *P. pulverea*. The mean pre-oviposition period of 4.6 and 5.6 days was recorded for *E. amabilis* and *P. pulverea*, respectively during the experimentation.

Oviposition period (days)

The oviposition period for the *E. amabilis* ranged from 5 to 7 days whereas, it ranged from 7 to 9 days for *P. pulverea*. The mean oviposition period of 5.8 and 8.6 days was recorded for *E. amabilis* and *P. pulverea*, respectively during the experimentation.

Post-oviposition period (days)

The post-oviposition period for the *E. amabilis* ranged from 3 to 6 days whereas, it ranged from 5 to 8 days for *P. pulverea*. The mean post-oviposition period of 4.8 and 6.8 days was recorded for *E. amabilis* and *P. pulverea*, respectively during the experimentation.

Adult longevity period (Days)

Male The male longevity of *E. amabilis* ranged from 6 to 11 days with an average life period of 8.20 days when reared under laboratory conditions. In case of *P. pulverea*, the male longevity ranged from 7 to 14 days with an average life period of 11 days. Female The range of female longevity recorded was 7 to 11 days and 9 to 18 days for *E. amabilis* and *P. pulverea*, respectively. The average female longevity of 11.80 days was recorded for *E. amabilis* and 14 days for *P. pulverea* during the experiment.

Total life cycle (days)

Male The total life cycle of male of *E. amabilis* reared on lac ranged from 43 to 50 days with the average life span of 45 days under laboratory conditions. While, total life cycle of male of *P. pulverea* reared on lac ranged from 42 to 51 days with the average life span of 45.80 days. Female The total life cycle of female of *E. amabilis* reared on lac ranged from 43 to 50 days with the average life span of 45 days

under laboratory conditions. While, total life cycle of female of *P. pulverea* reared on lac ranged from 49 to 59 days with an average life span of 53-40 days.

Fecundity (no. of eggs/female)

The mean number of eggs laid by single female *E. amabilis* and *P. pulverea* recorded was 103.60 eggs and 92 eggs, respectively. The range of egg laid by female *E. amabilis* was 90 to 110 eggs, whereas, it ranged from 80 to 105 eggs in case of *P. pulverea*.

IV. DISCUSSION

The lac production faces significant losses due to predation of lac insect by an array of predators. A total of 11 species of associated fauna i.e. predators, primary parasites and hyper parasites have been recorded on lac insect under 8 different families of 3 orders from different locations; of these, 8 belong to Hymenoptera, 2 to Lepidoptera, and 1 to Neuroptera. The predator species are represented by *Eublema amabilis* Moore, *Pseudohypatopa pulverea* Meyr, and *Chrysopa zastrowi* (Esben Petersen) primary parasites of lac insect by *Tachardiaephagus tachardiae* Howard, *Aprostocetus pupureus* Cameron, *Parechthrodryinus clavicornis* Mashhood alam, *Erencyrtus dewitzi* Mahdihassan and hyper parasites *Apanteles fakhrulhajiae* Mahd, *Eupelmus tachardiae* Howard, *Bracon greeni* Ashmead, *Brachymeria tachardiae* Cam. Further analysis of the data revealed that 27.27 per cent of the genera as well as species belong to family Encyrtidae, 18.18 per cent to Braconidae and 9.09 per cent to each, Eupelmidae, Chalcididae, Noctuidae, Blastobasidae, Chrysopidae, and Eulophidae (Meena et al. 2018). Therefore, the study of biology of the major predator is essential to understand the trophic interactions of these associated lac fauna. The observations recorded from experiment to study the biology of major lepidopteran predator of lac i.e. *E. amabilis* and *P. pulverea* Meyr under laboratory conditions showed that the duration of complete life cycle of *E. amabilis* and *P. pulverea* ranged from 43-50 days and 42-51 days, respectively. The mean fecundity of *E. amabilis* was more i.e 103.60 eggs as compared to *P. pulverea* with 92.00 eggs. The mean incubation period, larval-pupal period of *E. amabilis* ranged from 22-38 days while it ranged from 23-39 days for *P. pulverea*. The results of present findings are in the conformity with the results of Mishra et al. (1930) who studied bionomics of the Noctuid, *E. amabilis* and reported that egg stage lasts from 1 to 10 days, the larval period from 16 to 128 days and the pupal period from 3 to 20 days and these stages varied according to the season. From November to February, the larvae are largely inactive.

Table 1.1: Different parameters of biology of lepidopteran lac predator *Eublemma amabilis* Moore during Baisakhi season 2021-22

S. No.	Life Stages	Mean	Range
1.	Incubation period (days)	5.20±0.84	5-6
2.	Total larval-Pupal period (days)	26.88±2.92	23-39
3.	Pupal period (days)	10.20±1.92	8-13
4.	Pre-oviposition period (days)	5.60±0.55	5-6
5.	Oviposition period (days)	8.60±1.14	7-9
6.	Post-oviposition period (days)	6.80±1.30	5-8
7.	Female adult longevity (days)	14.00±4.30	9-18
8.	Male adult longevity (days)	11.00±2.74	7-14
9.	Total life cycle of female (days)	53.40±4.16	49-59
10.	Total life cycle of male (days)	45.80±3.70	42-51
11.	Fecundity of female (No. of eggs)	92.00±10.93	80-105

1.2 Different parameters of biology of the lepidopteran lac predator *Pseudohypatopa pulvereana* during Baisakhi season 2021-22

S. No.	Life Stages	Mean	Range
1.	Incubation period (days)	4.60±1.14	3-5
2.	Total larval- Pupal period (days)	25.88±1.92	22-38
3.	Pre-oviposition period (days)	4.60±0.89	4-6
4.	Oviposition period (days)	5.80±0.84	5-7
5.	Post-oviposition period (days)	4.80±1.30	3-6

6.	Female adult longevity (days)	11.80±2.95	7-14
7.	Male adult longevity (days)	8.20±1.92	6-11
8.	Total life cycle of female (days)	52.20±2.49	48-54
9.	Total life cycle of male (days)	45.00±3.81	43-50
10.	Fecundity of female (No. of eggs)	103.60±7.92	90-110

V. CONCLUSION

The study on the biology of two major lepidopteran predators of the lac insect, *Eublemma amabilis* Moore and *Pseudohypatopa pulvereana*, revealed notable differences in their developmental and reproductive parameters under laboratory conditions. *E. amabilis* exhibited a slightly shorter incubation, larval-pupal, and total life cycle duration compared to *P. pulvereana*. It also showed a higher fecundity rate, averaging 103.6 eggs per female, as against 92 eggs in *P. pulvereana*. Additionally, the adult longevity and oviposition periods were generally longer in *P. pulvereana*. These findings contribute valuable insights into the life history traits of these predators, which are crucial for understanding their potential impact on lac cultivation and for developing integrated pest management strategies.

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