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LIFE CYCLE OF LAC INSECT ON DIFFERENT HOSTS

SHIVANI SHARMA, HEMANT SWAMI, LEKHA, CHANDRA BHAN AND H.L. BAIRWA
Department of Entomology, Maharana Pratap University of Agriculture and Technology, (MPUAT), Udaipur-313001, Rajasthan, India.
*E-mail: hemantswamy@gmail.com

ABSTRACT

The present investigation on life cycle of *Rangeeni* strain of lac insect *Kerria lacca* (Kerr) on ber, pigeonpea and *Flemingia* was carried out at the lac insect gene bank and lac laboratory, situated in Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during *Katki* season, 2017. The mean duration of pre-sexual stages of *Rangeeni* strain lasts 46.77, 47.53 and 48.93 days from the inoculation of broodlac with 11.50, 12.73 and 13.27 days mean duration of male emergence on ber, *Flemingia* and pigeonpea, respectively and 10.51, 11.02 and 11.17; 11.33, 13.23 and 13.59; 10.78, 11.17 and 11.86 per sq. cm of per cent male in upper, middle and lower portion of host plant in three sets of experiment, respectively. The total life period of *Rangeeni* strain of lac insect in *Katki* crop season on ber, *Flemingia* and pigeonpea was recorded 115, 118 and 120 days, respectively. The fecundity of female cell was recorded to have 443.37, 387.70 and 336.07 crawlers (per female cell) on ber, *Flemingia* and pigeonpea, respectively. The mean of scrapped lac yield recorded was 0.74, 0.35 and 0.22 kg for ber, pigeonpea and *Flemingia*, respectively.

Key words: *Kerria lacca*, *Rangeeni* strain, Ber, *Cajanus cajan*, fecundity, life period.

INTRODUCTION

Lac insect, *Kerria lacca* (Kerr) belonging to the family Tachardiidae (Kerriidae), super family Coccoidea of the order Hemiptera is an important soft bodied insect as it secrets resin in the form of lac to protect its body. The lac insect with its piercing and sucking mouth parts sucks plant sap from over more than 400 hosts throughout the world.

The life cycle of lac insect starts with first instar larval stage, the crawlers. The crawlers 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. During its feeding phase it secrets a resin to protect its body which on drying is recovered in the form of lac. To avoid covering of body holes by resin, the lac insect secretes wax, which is white thread-like structure. The duration of each stage depends on the host tree species on which it feeds, lac crop and prevailing environmental conditions (Mohanta *et al.*, 2014).

Despite abundant prevalence of lac insect and availability of host plants in the state, the commercial production of lac is negligible due to lack of knowledge about biology and host preference. A complete knowledge of the biology of lac insect and its host preference may be of great importance for promoting lac production in the area.

MATERIAL AND METHODS

The investigations to study the life cycle of the lac insect on the different hosts were carried out at the lac gene bank and lac laboratory situated in the Department of Entomology, RCA, MPUAT, Udaipur. The life cycle of *Rangeeni* strain of lac insect was studied on randomly selected 10 plants of three hosts *viz.,* ber, pigeonpea, *F. macrophylla* during *Katki* season, 2017. To study the life cycle of lac insect, the observations on duration of pre sexual stages (days), duration of male emergence (days), sex ratio, and density at crop maturity (per sq. cm), life period (days), weight of female lac cell (mg), resin weight (mg) and fecundity of females (per cell) and total yield (kg) were recorded as per the prescribed procedure suggested by Mohan sundaram *et al.* (2016).

Observations:

(i) Duration of pre sexual stages (Days):

The observations on time elapsed between date of inoculation to male and female of lac insect differentiation were recorded for the three hosts ber, pigeonpea and Flemingia.

(ii) Duration of male emergence (Days):

The observations were recorded on date of male emergence initiation to male emergence completion to record the duration of male emergence for the three hosts.

(iii) Sex ratio (% male insect):

At the time of emergence, nymphs cannot be differentiated as males or females. After a certain period of growth, larvae can be differentiated into male and female lac insects based on their morphological differences (male cells are elongated and female cells are round shaped). The number of male and female cells per square cm was counted by placing the graph paper with a cut window of one square cm on the stem of host plant. One square cm area was selected at random and numbers of male cells were counted at 45 days after inoculation.

(iv) Density at crop maturity (number per square cm):

The surviving female lac insects remained on the host after initial mortality and emergence of male lac insects were counted at crop maturity on appearance of yellow spot on the three hosts ber, pigeonpea and *Flemingia* separately.

(v) Life period (in days) of the female cell:

To record the life period of female cells the total time elapsed between date of inoculation and crop harvesting were counted and recorded as life duration of the female lac insect for the three hosts *viz*. ber, pigeonpea and *Flemingia* separately.

(vi) Weight (in mg) of the female cell and resin output:

The weight of individual female cell was recorded after completion of larval emergence from mature female cell by using electronic balance. The resin produced by female cells was recorded after removing the dead insect body of the randomly selected ten cells from ten tagged plants in each three sets of experiments of three hosts.

(vii) Fecundity (number of young ones produced by the female insect):

To record the fecundity of females of lac insect the ten mature female cells collected from the ten tagged plants in each three sets of experiments of three hosts were stored in glass vials plugged with cotton for about a month and the number of larvae emerged were counted from each vial. The cells were then cut open opened and larvae, which did not emerge, were also counted and the total count was taken as fecundity of the female lac insect.

(viii) Total yield of scrapped lac (kg):

The lac sticks harvested were kept for drying and scrapped with knife. The total yield (kg) of scrapped lac per plant for each of the three hosts *viz*., ber, pigeonpea and *Flemingia* was recorded after harvesting.

Statistical analysis:

All the data were subjected to statistical analysis by adopting appropriate statistical tools as described in Panse and Sukhatme (1989).

I. Mean density

$$\text{Mean density} = \sum \frac{Xi}{N}$$

Where,

Xi = No. of insects settled per sq cm

N = Total No. of plant sampled.

II. Standard Deviation

$$\sigma = \sqrt{\frac{Xi}{N} \sum_{i=1}^{N} (x_i - \mu)^2}$$

Where,

Xi = Number of insects settle per sq cm

N = Total number of plant sampled.

μ = Mean density of crawlers settled per sq.cm

III. Range

Range = Lowest Value to Highest Value

IV. Standard Error

$$\text{Standard Error} = \frac{\text{Standard deviation}}{\sqrt{\text{Number of Samples}}}$$

RESULTS AND DISCUSSION

Duration of pre sexual stages (Days) : Lac insect after settlement on host undergoes pre-sexual stages before attaining male and female stages, which in turn decides the fecundity and quantity of lac produced. The results presented in Table (2) reveal that the minimum period which lac insect takes for male/female cell differentiation was 46.77 days in ber; whereas, the maximum period of cell differentiation was up to 48.93 days in pigeonpea. The results clearly indicate that in normal behaviour lac insect takes about 7 weeks for male/female differentiation. The present findings are in agreement with the findings of Sharma (1991) who also recorded 6 to 7 week duration for the cell differentiation in *Rangeeni* strain of lac insect after its settlement. Similarly Swami *et al*. (2017) reported that the mean duration of pre-sexual stages lasts 48.36 days from the inoculation of broodlac *Rangeeni* strain of lac insect in pigeonpea crop in *Katki* season.

Duration of male emergence (Days) : The male lac insect generally emerges 6-7 weeks after the settlement.

Table 1. Mean sex ratio per sq cm of first instar crawlers of *Rangeeni* strain of lac insect on different hosts during *Katki* season, 2017

Host plants		Sex ratio per sq. cm		
		Upper portion of plant	Middle portion of plant	Lower portion of plant
Ber	Mean ($\overline{\times}$)	10.51	11.02	11.17
	SD(σ)	1.09	1.07	0.39
	SE	0.63	0.62	0.23
Pigeonpea	Mean ($\overline{\times}$)	11.33	13.23	13.59
	SD(σ)	0.88	0.65	0.86
	SE	0.51	0.38	0.49
Flemingia	Mean ($\overline{\times}$)	10.78	11.17	11.86
	SD(σ)	0.63	0.38	0.67
	SE	0.36	0.22	0.38

The lifespan of males is very short as they fertilize the females and die. The longevity of male lac insects determines the fertilization of females for producing next generation. The results presented in Table (2) reveal that the mean duration for initiation of male emergence was 46.77, 47.53 and 48.93 days after the inoculation and emergence continues up to 11.50, 12.73 and 13.27 days, respectively on ber, *Flemingia* and pigeonpea during *Katki* season, 2017. The findings of present investigation are in conformity with results observed by Sharma (1991), who recorded the male emergence in *Rangeeni* strain of lac insect at 6-7 weeks after its inoculation, while Jaiswal and Sharma (2011) observed longevity of males as only 2 days in *Rangeeni* strain during *Katki* crop. Similarly, Swami *et al*. (2017) reported that the mean duration of male emergence was 11.50 days in *Rangeeni* strain of lac insect in pigeonpea crop in *Katki* season which conforms with the results of present study.

Sex ratio (% male insect) : The observations on sex ratio were recorded as mean per cent male lac insect of *Rangeeni* strain in *Katki* season during 2017 and results presented in Table (1) reveal that there was a difference in mean per cent male lac insect of *Rangeeni* strain on upper, middle and lower portion of ber, pigeonpea and *Flemingia* plants which were observed as 10.51, 11.02 and 11.17; 11.33, 13.23 and 13.59; 10.78, 11.17 and 11.86 per sq. cm per cent, respectively. According to Kong *et al*. (1984) the developmental stages of lac insect were greatly influenced by the local climate and conditions of host plant. He found that females were predominant in both the seasons of *Kerria lacca* with 75-80 per cent in first generation and 50-78 per cent in second generation. The results of present investigation are similar to observations by Divakara (2013) who recorded highest per cent of male insect on Ber (26.86%) followed by *F. semialata* (24.84%) and Kusum (17.82%). Swami *et al*. (2017) reported 11.33, 7.33, 4.02; 17.75, 10.63, 6.23 and 17.75, 11.73, 11.56 per cent male on lower, middle and upper portion of pigeonpea host in three plots, respectively in *Rangeeni* strain of lac insect during *Katki* season, which supports the findings of present investigation.

Life period (Days) of the female cells: The state of female cell activity lasts for varying number of weeks depending upon temperature, host plant and strains of lac insect. The female lac insect lives for relatively longer period and is the chief source of lac secretion. The duration of longevity or life period of female cells of lac insect depends on various factors such as species, strain, season of development and climatic conditions of area. The results presented in Table (2) reveal that mean life period of female cells of *Rangeeni* strain of lac insect in *Katki* season, 2017 on ber, *Flemingia* and pigeonpea was 115, 118 and 120 days, respectively. According to Sharma (1991) *Rangeeni* strain of lac insect took 120-137 days to mature. The present results are in conformity with the findings of Mohanta *et al*. (2014), who reported that *Rangeeni* strain on palas (*Butea monosperma*) took 3 months 16 days to complete life cycle, however, Swami *et al*. (2017) reported life period of 117 days of *Rangeeni* strain of lac insect on pigeonpea crop during *Katki* season.

Fecundity (number of young ones produced by the female insect): The eggs are laid by the female within the lac cell. Generally it lays about 200-500 eggs per female cell which may be fertilized or unfertilized. The female generally lays well developed eggs which hatch within few hours. The results reveal that the maximum crawlers emerged per female cell were 502 in ber while minimum 298 crawlers emerged per female cell in pigeonpea. The results presented in Table (2) reveal that the mean numbers of crawlers emerged from female cells of *Rangeeni* strain of lac insect on ber, pigeonpea

Table 2. Mean duration of pre sexual stages (days), duration of male emergence (days), life period of female cells (days), fecundity of first instar crawlers of *Rangeeni* strain of lac insect on different hosts during *Katki* season, 2017

Host plants	Duration of pre sexual stages (days)	Duration of male emergence (days)	Life period of female cell (days)	Fecundity (per female cell)
Ber	46.77	11.50	115	443.37
Pigeonpea	48.93	13.27	120	336.07
Flemingia	47.53	12.73	118	387.70

Table 3. Mean yield of scrapped lac of *Rangeeni* strain of lac insect on different host during *Katki* season, 2017

Host plants	Mean yield of scrapped lac (kg)			Mean
	R1	R2	R3	
Ber	0.82	0.77	0.64	0.74
Pigeonpea	0.39	0.35	0.30	0.35
Flemingia	0.21	0.20	0.24	0.22

and *Flemingia* were 443.37, 336.07 and 387.70 crawlers, respectively during *Katki* season 2017. The results of present investigation gets full support from the findings of Kong *et al*. (1984) who also reported that the reproductive potential of *Kerria lacca* ranged from 224-307 eggs in 1st generation and 160-240 eggs in 2nd generation. Mishra *et al*. (1999) evaluated the productivity of Indian lac insect (*Kerria lacca*) on *F. semialata* and *F. macrophylla* in terms of fecundity found that it varied from 253-565 and 297-477 crawlers per female cell on the two hosts under study. The present results are in line of earlier findings of Mishra *et al*. (1999) and Kumar *et al*. (2007).

Total yield of scrapped lac (kg): The data recorded on mean yield of scrapped lac of *Rangeeni* strain of lac insect on ber, pigeonpea and *Flemingia* in *Katki* crop season during 2017 presented in Table (3) reveal that mean scrapped lac yield was 0.74, 0.35 and 0.22 kg for ber, pigeonpea and *Flemingia*, respectively. A similar study to record the scrapped lac yield was conducted by Divakara (2013) who recorded scrapped lac yield per plant as 166.64 g in winter and 81.47 g in rainy season however Kalahal *et al*. (2017) reported that the yield of scrapped lac was 15.63 g of *Rangeeni* strain of lac insect in pigeonpea crop in *Katki* season. The variation of results with the findings of the present investigation in the yield may be attributed to the size, growth, length of the plants, strain of lac insect and climatic condition etc which may cause difference in the yield of scrapped lac.

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