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## Comparative studies of productivity linked parameters of Lac insect, *Kerria lacca* on different lac hosts prevailing in Southern Rajasthan

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### Abstract

The present investigation on “Comparative studies of productivity linked parameters of Lac insect, *Kerria lacca* on different lac hosts prevailing in Southern Rajasthan” was conducted on *Rangeeni* strain of lac insect in *Baisakhi* season at Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during 2020-21. The present investigation was carried out by *ex situ* inoculation of brood lac on various hosts *viz.*, Custard apple, Ber, Palas, Babool, Kikar, *Flemingia macrophylla* and *Flemingia semialata*. Among which Ber found to be most effective, preferred and superior host compared to other host. Initial, final settlement and mature female cell density recorded was 116.50, 106.03 crawlers and 4.93 cells per sq.cm, respectively; while, per cent settlement and per cent mortality was 90.55% and 8.84%. Which is followed by Babool, Palas, Custard apple, *Flemingia macrophylla* and Kikar. While the least effective and preferred host was *Flemingia semialata* in which initial, final settlement and mature female cell density recorded was 64.87, 54.70 crawlers and 2.80 cells per sq.cm, respectively with 83.56 per cent settlement and 15.64 per cent mortality.

**Keywords:** *Kerria lacca*, lac insect, host preference, cell density and mortality

### Introduction

Lac insect, *Kerria lacca* (Kerr) belongs to the family Tachardiidae (Kerriidae), super family Coccoidea of the order Hemiptera and is a beneficial soft bodied insect as it secretes resin through minute openings in the form of lac to protect its body. The life cycle of lac insect starts with the crawlers, after settlement the nymphs undergo three successive moults to become an adult. The first instar is mobile and crawls over the tender shoot of host trees and settles to feed on phloem sap by piercing its proboscis into phloem region of shoot. To avoid covering of these holes by resin, the lac insect secretes wax, which is white thread-like structure. The duration of each stage depends on the host plant species on which it feeds, lac crop and prevailing environmental conditions (Mohanta *et al.*, 2014) [3]. The lac insect basically yields three useful materials *viz.*, resin, dye and wax. The major constituent of lac is the resin (68%). Resin is commonly known as “lac” and is sold in the market as shellac or seedlac or button lac. Other constituents present are dye (1.2%), wax (6%), others (25%) like sugar, proteins, soluble salts, sand, woody matter, and insect body debris.

Lac has immense profitable significance as its derived products are biodegradable, non-toxic, ecofriendly and have tremendous export potential. 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) [4]. Lac has multipurpose uses such as in the manufacture of paints, cosmetics, inks, pharmaceuticals, goods for electrical industry, automobile industry, railways, marine, postal department, lac dye for textile industry, confectionery industry for fruit and vegetable coating, soft drinks, chocolate and candy coating, fertilizer coating (Mohanta *et al.*, 2014) [3].

India is the leader in production and export of lac in the world, accounting for more than 50 and 80 percent respectively. Jharkhand state ranks first in lac production with contribution of 57.20 percent followed by Chhattisgarh (17.87%), West Bengal (7.82%), Madhya Pradesh (7.26%) and Maharashtra (5.30%). The lac ecosystem fauna includes 87 species of lac insect belonging to nine genera recorded from all over the world. Though different lac hosts have been recorded in Rajasthan, but it is not cultivated commercially. In Rajasthan lac insect is naturally found in abundance on various hosts (Swami *et al.* 2017) [6].

## Materials and Methods

The experiment was conducted by *ex situ* inoculation of *Rangeeni* strain of lac insect on various hosts in *Baisakhi* season at Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during 2020-21.

The healthy natural host plants were found at different location like Barwara, Kunchauli, Kelwara, Kumbhalgarh, Sayra, Jaswantgarh, Gogunda and nearby areas. The brood lac needed for the experiment were collected from the mature *Katki* crop of *Rangeeni* strain prevailing in the region on its natural hosts bearing fully matured females. The brood lac were bundled and tied in the month of October-November on different host *viz.*, Custard apple, Ber, Palas, Babool, Kikar, *Flemingia macrophylla* and *Flemingia semialata*. Nymph/crawlers of the lac insect were allowed to settle on the succulent stem on different hosts.

## Observations

Observations were recorded on the following parameters:

### Initial density of settlement (number per square cm)

The initial density of settlement was recorded at 7 days after the inoculation of brood lac on the 10 tagged natural plants in each area where one square cm area was selected randomly and numbers of lac crawlers settled were counted visually by using magnifying glass and by placing a graph paper with one square cm area cut window on the stem of plant. Three such sites from inoculated one meter part were selected at lower, middle and upper part of plant and average was taken as initial density of settlement (number per square cm).

### Initial mortality (%)

Observations on initial density were repeated at 21-days after inoculation of brood lac following the same procedure as described earlier. The process of crawlers' emergence continues up to 2-3 weeks. The crawlers which were not able to find suitable sites for settlement die due to starvation. Observation at this stage is the true indication of the number of crawlers actually settled and that have started feeding.

$$\text{Initial natural mortality (\%)} = \frac{\text{Initial density} - \text{Density after 21 days of settlement}}{\text{Initial density}} \times 100$$

### Final density of settlement (number per square cm)

The final density of settlement of crawlers was calculated by the following formula:

Final density of settlement = Initial density of settlement – Initial mortality

### Per cent settlement

The per cent settlement of crawlers was calculated by the following formula:

$$\text{Per cent settlement} = \frac{\text{Final density of settlement}}{\text{Initial density of settlement}} \times 100$$

### Density at crop maturity (number per square cm)

To study the density of lac insect at crop maturity, the numbers of surviving female cells were counted at maturity when the lac crop matures with appearance of yellow spot on female cell. The numbers of mature females per square cm were counted by following the procedure of placing of graph paper with one square cm cut window.

### 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 different hosts.

### 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 different hosts.

### Female cell size (mm)

The size of the individual female cell (mm) was recorded for randomly selected ten cells from ten tagged plants in each different natural hosts. The female cells were collected at harvest for each host and cell size was measured by the vernier caliper.

### 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 different natural hosts *viz.* Custard apple, Ber, Palas, Babool, Kikar, *Flemingia macrophylla* and *Flemingia semialata* separately.

### 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 different 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 broken opened and larvae, which did not emerge, were also counted and the total count was taken as fecundity of the female lac insect.

## Results and Discussion

### Initial density of settlement (number per sq.cm)

The observed overall mean initial density of settlement on lower, middle and upper portion of host plant of first instar crawlers of *Rangeeni* strain of lac insect on different host in *Katki* season during 2020-21 has been presented in Table (1). Ber host recorded the maximum overall mean initial density of settlement *i.e.*, 116.50 crawlers per sq.cm and found superior to all other host. It was at par with Babool (113.70), which is followed by Palas (98.67). The next best host was *Flemingia macrophylla* with 90.70 initial density, followed by Custard apple and Kikar which recorded 86.67 and 68.57 crawlers per sq.cm, respectively. While the lowest initial settlement was recorded on *Flemingia semialata i.e.* 64.87 crawlers per sq.cm.

### Initial Mortality (%)

The data (Table 1) revealed that the first instar crawlers of lac insect, which were not able to find suitable sites for settlement, died due to starvation and remaining population at this stage were the true number of crawlers actually settled. Ber host recorded the minimum mean per cent mortality *i.e.*, 8.84 per cent mortality of first instar crawlers and found superior to all other host. It was at par with Babool on which 9.39 mean per cent mortality was recorded, followed by Palas, Custard apple, *Flemingia macrophylla* and Kikar which recorded 9.51%, 9.92%, 11.40% and 14.61% mean mortality of first instar crawlers, respectively. While the highest per cent mortality (15.64) was recorded on *Flemingia semialata*.

### Final density of settlement (number per sq.cm)

The maximum mean final density of settlement was recorded on Ber host *i.e.*, 106.03 crawlers per sq.cm and it was superior to all other host. It was found at par with Babool (103.07 crawlers per sq.cm), followed by Palas with 89.30 crawlers per sq.cm. The next best host was *Flemingia macrophylla* (80.37), followed by Custard apple and Kikar which recorded 78.03 and 58.53 crawlers per sq.cm, respectively. While the lowest final settlement was recorded in *Flemingia semialata i.e.* 54.70 crawlers per sq.cm. (Table 1)

The results of present investigations are in alignment with the findings of Mohanta *et al.* (2014) [3] who reported that initial density of settlement of crawlers ranged between 92.58-126.74 crawlers per sq.cm and 93.12-109.62 crawlers per sq.cm of *Kusmi* strain on Kusum and Ber trees respectively. The findings of the present investigations are in line with the observations of Mishra *et al.* (2000) [2] who studied inter trait relationship and found highly significant positive correlation between cell weight, fecundity and life period with the diameter of cells.

### Mature female cells density (number per square cm)

The maximum mature female cells density *i.e.* 4.93 cells per sq.cm was found on Ber and was found superior to all other host. It was at par with Babool with 4.07 female cells density, followed by Palas, Custard apple, *Flemingia macrophylla* and Kikar which recorded 3.77, 3.57, 3.20 and 2.93 cells per sq.cm, respectively. While the lowest mature female cells density was recorded in *Flemingia semialata i.e.* 2.80 cells per sq.cm. (Table 1)

### Per cent settlement of crawlers

The data presented in Table (1) revealed that the maximum mean per cent settlement of crawlers was recorded on Ber host *i.e.* 90.55 per cent settlement of first instar crawlers and it was at par with Babool (90.46%). The next best effective host was Palas followed by Custard apple, *Flemingia macrophylla* and Kikar which recorded 90.48%, 89.91%, 88.56% and 84.68% overall mean settlement of first instar crawlers, respectively. While the lowest per cent settlement was recorded on *Flemingia semialata i.e.* 83.56 overall mean per cent settlement of first instar crawlers.

### Duration of pre sexual stages (Days)

The data recorded on sex differentiation of *Rangeeni* strain of lac insect on overall mean from lower, middle and upper portion of different host revealed that Ber host recorded lowest mean duration of pre sexual stages *i.e.*, 48.47 days and it was at par with Babool with 49.53 days. It was followed by Palas, Custard apple, *Flemingia macrophylla* and Kikar which recorded 49.07, 49.73, 48.77 and 49.13 days of overall mean duration of pre sexual stages, respectively. While the highest duration of pre sexual stages was recorded on *Flemingia semialata* which was 50.07 days. (Table 1).

### Duration of male emergence (Days)

The data presented in Table (1) on the mean duration of male emergence (Days) revealed that shortest duration was recorded on *Flemingia macrophylla i.e.* 12.20 days, followed by Kikar, Babool, Ber, Palas and Custard apple which recorded 12.40, 12.43, 12.47, 12.93 and 13.07 days to emerge male, respectively. While the longest duration of male emergence was recorded on *Flemingia semialata i.e.* 13.20 days.

### Female cell size (mm)

Ber host recorded biggest overall mean of female cell size *i.e.*, 2.13 mm, which was found to be superior to all other host. It was at par with Babool with 1.84mm cell size, followed by Palas, Custard apple, *Flemingia macrophylla* and Kikar with 1.75 mm, 1.71 mm, 1.64 and 1.56mm cell size, respectively. While the smallest female cell size of 1.52mm was recorded on *Flemingia semialata*. (Table 1)

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

The results revealed that the mean fecundity of lac insect on Ber host was found to be the maximum with 413 number of young ones produced by the female insect and it was superior to all other host. The next best host was Babool with 392 number of young ones, followed by Custard apple (384 number of young ones), *Flemingia macrophylla* and Kikar which recorded 380 and 378 number of young ones produced by the female insect, respectively. While the lowest fecundity was recorded on *Flemingia semialata i.e.* 368 young ones. (Table 1).

### Life period (in days) of the female cell

The mean life period of female cell of *Rangeeni* strain of lac insect recorded on Ber host was shortest *i.e.*, 116 days and comparatively superior to all other host. The next best host was Babool with 118 days life period, followed by Palas, Custard apple, *Flemingia macrophylla* and Kikar with 121, 123, 125 and 127 days of life period, respectively. While the longest life period of female cell was recorded on *Flemingia semialata i.e.* 129 days. (Table 1)

The present results are also in conformity with the findings Kumar *et al.* (2007) [1] who evaluated 7 host plants of lac insect with reference to the cell weight and found that it ranged from 10.12-14.21 mg in ber and 9.40-13.60 mg in pigeonpea in *Baisakhi* season. Similarly Kalahal *et al.* (2017) [6] also reported that the initial density of settlement of first instar crawlers on host pigeonpea varied in different parts of plant and ranged from 20-121 crawlers per sq.cm of *Rangeeni* strain of lac insect in pigeonpea crop in *Katki* season. Swami *et al.* (2017) [6] also 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. The host preference in order of ber, *Flemingia macrophylla* and pigeonpea was also observed by Sharma *et al.* (2017).

**Table 1:** Productivity linked parameters of Lac insect, *Kerria lacca* on different lac during *Baisakhi* season, 2020-21

Overall Mean	Initial settlement of density	Final settlement of density	Mature female cells density	Percent settlement	Percent mortality	Duration of pre-sexual stages (Days)	Duration of male emergence (Days)	Female cell size (mm)	Fecundity/ female cell	Life period of female cells (Days)
Ber	116.50	106.03	4.93	90.55	8.84	48.47	12.47	2.13	413	116
Babool	113.70	103.07	4.07	90.46	9.39	49.53	12.43	1.84	392	118
Palas	98.67	89.30	3.77	90.48	9.51	49.07	12.93	1.75	390	121
Custard apple	86.67	78.03	3.57	89.91	9.92	49.73	13.07	1.71	384	123
<i>Flemingia macrophylla</i>	90.70	80.37	3.20	88.56	11.40	48.77	12.20	1.64	380	125

Kikar	68.57	58.53	2.93	84.68	14.61	49.13	12.40	1.56	376	127
<i>Flemingia semialata</i>	64.87	54.70	2.80	83.56	15.64	50.07	13.20	1.52	368	129
SEm±	1.14	0.52	0.02	0.77	0.10	0.44	0.08	0.02	-	-
CD at 5 %	3.52	1.60	0.05	2.39	0.31	0.04	0.26	0.05	-	-

### Conclusion

On the basis of different productivity linked parameters of Lac insect *K. lacca* on different lac hosts prevailing in Southern Rajasthan of arid western plains showed following order of host preference: Ber > Babool > Palas > Custard apple > *Flemingia macrophylla* > Kikar > *Flemingia semialata*.

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