Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(5): 1648-1650

Received: 30-07-2017
Accepted: 31-08-2017

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Biology of *Rangeeni* strain of lac insect (*Kerria lacca* Kerr.) on Pigeonpea (*C. Cajan* Linn.)

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Abstract
The investigation on biology of *Rangeeni* strain of lac insect on pigeonpea was carried out in the lac insect gene bank cum garden situated at Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur during *Katki* season 2016 with an aim to study the biological parameters *viz.*, duration of pre-sexual stages (days), duration of male emergence (days), sex ratio (per cent male insect) and life period of female lac insect (days) on pigeonpea. The mean duration of pre-sexual stages lasts 48.36 days from the inoculation of broodlac with 11.50 days mean duration of male emergence and 11.33, 7.33, 4.02; 17.75, 10.63, 6.23 and 17.75, 11.73, 11.56 per cent male in lower, middle and upper portion of plant in three plots respectively. The total life period of *Rangeeni* strain of lac insect in *Katki* crop season on pigeonpea recorded 117 days.

Keywords: Lac insect, *Rangeeni* strain, pre sexual days, male emergence**,** life period.

1. Introduction
Lac is the only resin of animal origin, being truly the discharge of a tiny scale insect, *Kerria lacca* Kerr belonging to the family Tachardiidae (=Kerriidae), super family Coccoidea of the order Hemiptera. It is major source of livelihood of millions of backward population especially tribles in many states of country. Indian lac insect *Kerria lacca* Kerr alone contributes more than 80% of total lac production [1]. Lac insect is naturally found in abundance on its natural hosts in urban as well as in forest areas and is cultivated commercially on preferred hosts; Ber (*Ziziphus mauritiana),* Palas (*Butea monosperma*) and Kusum (*Schleichera oleosa*) etc. The pigeonpea (*Cajanus cajan*) has also been identified as a favourite host for lac insect long back in 1950's and has emerged as a promising host for cultivation of *Rangeeni* strain of lac insect [2]. It is cultivated widely in different states of country and it could be better exploited for commercial production of lac in the region particularly southern Rajasthan provided a complete knowledge about bio ecology and life cycle of lac insect is made available. Therefore present investigation under taken to study the biology parameters of lac insect *Kerria lacca* Kerr on pigeonpea (*Cajanus cajan*) for *Rangeeni* strain best suited to agro-ecological conditions of southern parts of Rajasthan. A complete knowledge of lac insect and its life cycle on pigeonpea will overcome the hindrance in development of lac production and will bring about impetus to the lac cultivation in the area particularly in southern Rajasthan.

2. Materials and Methods
The study on the "biology of *Rangeeni* strain of lac insect *Kerria lacca* Kerr on pigeonpea (*Cajanus cajan*)" was carried out in the *Katki* season during 2016 at lac insect gene bank cum garden situated at Department of Entomology, Rajasthan College of Agriculture, Udaipur (Rajasthan). The host plants were raised by following the all the agronomic practices. Perennial variety of Arhar was sown to get healthy plants of proper age for lac inoculation with broodlac sticks. The crop was sown in the last week of April 2016 with row to row spacing of 100 cm and plant to plant spacing of 40 cm in plot size measuring 2.0 × 10 sq m. There were 30 plants in each plot replicated thrice. The brood lac of *Rangeeni* strain needed for the experiment were collected from the *Katki* crop of *Rangeeni* strain prevailing in the region on natural hosts bearing fully matured females. The brood lac were bundled and tied on host plants at 1-1.5ft above the ground level to provide succulent stem for crawlers to settle down. The brood lac bundles were tied in a 60 mesh nylon cage which allows only crawlers to move out retaining the parasitoids inside if any emerges simultaneously with the lac insect crawlers. The nymphs were allowed to emerge from mature females for about two weeks.

After the emergence of newly hatched nymphs the phunki lac stick bundles were removed from host plants. The observation on biological parameters *viz.*, duration of pre sexual stages (days), duration of male emergence (days), sex ratio and life period (in days) of the female cells were recorded on ten plants in three sets of plots as per the standard procedure prescribed by Mohanta *et al*. (2014) [1].

2.1. Duration of pre sexual stages (Days)
Time elapsed between date of inoculation to male and female differentiation of lac insect was recorded as duration of pre sexual stages (days).

2.2. Duration of male emergence (Days)
Time elapsed between date of male emergence till male emergence is completed was recorded as duration of male emergence (days)

2.3. Sex ratio (per cent male lac insect)
At the time of emergence, larvae cannot be differentiated into 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 while female cells are round shaped). The total number of the male and female cells per square cm was recorded on three sites of plant i.e. lower, middle, upper on ten plants in each plot.

2.4. Life period (in days) of the female cell
Time elapsed between date of inoculation and maturity of females showing yellow spot at crop harvesting stage was recorded (in days) as life period (in days) of the female cell.

3. Results and Discussions
The results obtained on investigations to study the biology of *Rangeeni* strain of lac insect on Pigeonpea (*Cajanus cajan*) in *Katki* season during 2016 to establish the biology of lac insect have been presented in Table 1-2 and discussed in the light of available literature.

3.1 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 data presented in Table 1 reveal that male/female differentiation period i.e. time elapsed between date of inoculation to male and female differentiation of lac insect recorded as duration of pre sexual stages (days) varied from 47 to 51 days on 10 pigeon pea plants in three set of plots. The mean duration of pre-sexual stages recorded was 47.90, 48.50 and 48.70 days respectively for the three plots. The results clearly indicate that in normal behaviour lac insect takes about 6 to 7 weeks for male/female differentiation. The present findings are in agreement with the findings of Sharma (1991) [3] who also recorded 6 to 7 week duration for the cell differentiation in *Rangeeni* strain of lac insect after its settlement.

3.2 Duration of male emergence (Days)
The male lac insect generally emerges 6-7 weeks after the settlement. They may be winged or wingless and the relative number of two forms varies considerably in different seasons of the lac crops. The life span of males is very short as it fertilizes the females and dies. The longevity of male lac insects determines the fertilization of females for producing next generation. The time elapsed between date of initiation of male emergence to the completion of male emergence was recorded as duration of male emergence (days) has been presented in Table 1 reveal that male emergence on pigeonpea in *Katki* season during 2016 lasts from 10-14 days. The mean duration of male emergence (days) was 11.30, 11.60 and 11.60 days in three plots respectively. The observations reveal that the emergence of male started 48.43 days after the inoculation of broodlac sticks and was continued for two weeks on the plants observed in the three set of plots which are in conformity with the observations by Sharma (1991) [3] who recorded the male emergence in *Rangeeni* strain of lac insect at 6-7 weeks after its inoculation while Jaiswal and Sharma (2011) [4] observed longevity of males as only 2 days in *Rangeeni* strain during *Katki* crop.

3.3. Sex ratio (% male insect)
The lac cell cannot be differentiated into male/female at the time of emergence but after a period of certain growth cells can easily differentiated into male/female based on their shape (males are elongated while females are round) and other morphological differences. At this stage the females are sexually mature and fertilized by the males after the emergence of male lac insect from the cell. The observations on the total number of the male and female cells per square cm recorded by placing a graph paper with one square cm area cut window on three sites of plant i.e. lower, middle, upper portion of plant on ten plants in each plot as mean per cent male lac insect of *Rangeeni* strain in *Katki* season during 2016 have been presented in Table 2 reveal that it ranged from 4.02 per cent in lower portion to 17.75 per cent in upper portion. There was a difference in mean per cent male lac insect of *Rangeeni* strain with 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 plant in three plots respectively. The data on per cent male emergence reveals that a higher per cent male lac insect were recorded from upper portion (17.75, 11.73 and 11.56%) of plant stem compared to middle (17.75, 10.63 and 6.23%) and lower portion (11.33, 7.33 and 4.02%).The findings of present investigation are almost similar results were observed by Divakara (2013) [5] who recorded highest per cent of male insect on Ber (26.86%) followed by *F. semialata* (24.84%) and Kusum (17.82%). According to Kong *et al*. (1984) [6] (1984) 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.

3.4. 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 are the chief sources 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 life period of female cell recorded as time elapsed between date of inoculation and maturity of females showing yellow spot at crop harvesting stage. A difference of days was observed in life period of female cells though were inoculated at the same time. The results have been presented in Table 1 reveal that life period of female cells of *Rangeeni* strain of lac insect in *Katki* season on pigeonpea ranged from 116 to 118 days with an average of 117 days from the date of inoculation to date of harvesting which are in conformity with the findings of Mohanasundaram *et al*. (2016) [7] who reported that *Rangeeni*

strain on palas (*Butea monosperma*) took 3 months 16 days to complete their life cycle however according to Sharma (1991) [3] *Rangeeni* strain of lac insect took 120-137 days to mature.

Table 1: Mean duration of pre sexual stages, male emergence and life period of female lac insect (Days) on pigeonpea during *Katki* season, 2016

S. No.	Parameters	Set of experiment I	Set of experiment II	Set of experiment III	Over all mean days
1.	Duration of pre sexual stages	47.90	48.50	48.70	48.36
2.	Duration of male emergence	11.30	11.60	11.60	11.50
3.	Life period of female cell	116	117	118	117

Table 2: Mean per cent male cells of *Rangeeni* strain lac insect on pigeonpea during *Katki* season, 2016

	Per cent male lac insect		
	Lower portion of plant	**Middle portion of plant**	**Upper portion of plant**
Set of experiment I	11.33	17.75	17.75
Set of experiment II	7.33	10.63	11.73
Set of experiment III	4.02	6.23	11.56

3.5 Conclusion
On the basis of results recorded in the present investigation it could be inferred that the *Rangeeni* strain of lac insect completes all the life stages of life cycle on the pigeonpea host and thrives well till maturity hence in order to promote the cultivation of lac insect in tribal belt of southern Rajasthan, apart from ber and palas, the traditionally growing perennial pigeonpea crop could also be better utilized as the preferred host for its cultivation however there is a need to carry out further investigations on the different related aspects. Thus the result of the present findings will not only help in understanding the life stages of lac insect during lac cultivation but will also provide an opportunity for further research in the subject.

4. Acknowledgement
The authors are thankful to project coordinator under ICAR network project on "Conservation of lac insect genetic resources" (NP-CLIGR) at lac insect gene bank cum museum and Dean, Rajasthan College of Agriculture, Udaipur, Rajasthan for providing the necessary facilities.

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