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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 2716-2720

www.thepharmajournal.com
Received: 14-02-2023
Accepted: 18-03-2023

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Survival of lac insect on Berhost plant at different growth periods from BLI to maturity during 2020-21

Sushmita Kashyap, Piyush Kant Netam and Bhanu Pratap Katlam

Abstract
Survival of lac insect, *Kerria lacca* Kerr (Hemiptera: Tachardidae) indifferent cardinal directions of the host plant branches was examined for consecutive crops of *Kusumi* strain, uring 20-21. Survival of lac insect, density towards west (30.61/sq. cm) and east (35.19/sq. cm) was significantly low as compared to that towards north (54.58/sq. cm) and south (36.94/sq. cm respectively. The observed difference in the cardinal direction might be due to shade preference characteristic of the insect.

Keywords: Survival, *Kerria lacca*, cardinal direction, Kusumi, *Ziziphus* sp

Introduction

Lac is one of the most valuable gifts of nature and only resin of animal origin secreted by a tiny scale insect, *Kerria lacca* (Kerr.) belonging to the family Lacciferidae (Kerriidae), Superfamily Coccoidea and order Hemiptera (Pal, 2009; Mohanta and Mohanty, 2012). [12, 10] Among the two lac strains- *Rangeen*i and *Kusmi*, former is more vulnerable (Ramani, 2010) while the latter is superior (Kumar, 2002; Sharma and Jaiswal, 2002; Sharma *et al*., 2006) [7, 7, 19]. *K. lacca* is a phloem feeder and thrives on a range of 250 host plants (Sharma *et al.*, 2006; Pal, 2009; Mohanta *et al.*, 2012) [19, 12, 9]. However, Palas (*Butea monosperma),* Ber (*Ziziphus mauritiana*), Kusum (*Schleichera oleosa*) and *Flemingia semialata* (Roonwal, 1962; Kumar *et al.*, 2002; Pal, 2009; Mohanta *et al*., 2014) [15, 7, 9] are commercially preferred for lac production.

The life cycle of lac insect starts with first instar larval stage, the crawlers. The crawlers after settlement undergo three successive mounting 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, 2014) [10].

Males or females nymphs cannot be differentiated at the time of emergence. 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 summer crop, initial settlement density of lac crawlers towards west (31.2/sq. cm) and south (34.6/sq. cm) was significantly low as compared to that towards north (97.0/sq. cm) and east (89.2/sq. cm).Crawlers of lac insect prefer shade and escape from direct exposure to sunlight. Generally, towards north and east as well as the lower side of the branch, shade is more which might be the reason for the highest settlement density. In winter crop, highest settlement density was observed towards north (91.8/sq. cm) which differed significantly from that in the west direction (57.2/sq. cm). In case of horizontal branches, initial settlement density in the lower side of the branch was much higher (92.6/sq. cm and 77.2/sq. cm) then the upper side (26.8/sq. cm and 25.6/sq. cm) for both summer and winter crops, respectively. (Hazarika *et al.*, 2018) [3]

During the initial settlement period of the winter crop (Jun/Jul), the solar elevation angle reaches its peak values of about 82º - 85º and the sun appears away from the southern horizon which peaks out slightly south of overhead point. Therefore, all the sides of the branches receive almost equal sunlight with partial shadowing towards north in case of vertical branching and lower sides with respect to the horizontal branching. However, in case of summer crop, during the settlement period (Dec/Jan), the sun moves toward the southern

Horizon with the sun angle of about 39º - 41º. Hence, sunlight falls more towards the south and west direction which might be the reason for the lower settlement density of lac insect toward south and west.

An organisms survival, growth depends on the population density, food, and shelter or protection (Basiago, 1999) [1] available in the ecosystem. Lac production and productivity depends on its host management, quality of brood use (Shah *et al*., 2015) [17] and live lac insects settled (Khobragade *et al.*, 2012, Rathore 2011, Jhangel *et al*., 2013, Namdev *et al.*, 2015, Sharma *et al*., 2015, Ghugal *et al*., 2015 and Sahu *et al*., 2016) [5, 14, 4, 11, 18, 16] till the maturity of the lac crop. Quantity of brood lac to be used for effective inoculation of lac insect have been studied (Kumar *et al*., 2017) [6].

Ber (*Ziziphus mauritiana*) along with kusum (*Schleichera oleosa*) and palas (*Butea monosperma*) is considered as a major lac host-plant in India. kusum and palas are suitable for kusumi and rangini strains of lac insect, Kerria lacca (Kerr), respectively but for both the strains of lac-insect Ber can be utilized, which is the most preferred host-plant for lac cultivation due to its faster growth and very good pruning response among the three major hosts. The development of lac-insect on host plant is dependent and influenced by abiotic and biotic factors. The abiotic factors emanate from the environment and comprise climatic influences. Influence of different abiotic factors like weather, soil fertility etc. on ber plant has been reported earlier in different form in this institute (Ghosal, 2012 a, b and 2013). Relative performance of traits of genotype measured in two or more environments can be assessed by genotype to environment interaction. It refers to instances where the joint effects of genotype and environmental risk factors are significantly greater than would be predicted from the sum of the separate effects. The fluctuation in lac yield can be attributed to a certain extent by changes in weather.

Materials and Methods

The experimental site were conducted at farmer field village Duspur of Kanker Districts Chhattisgarh, during 2020-21. The Survivability of lac insect on Ber (*Zyziphus mauritiana*) host plant in three twigs/tree (Upper, Middle and lower) from different directions (N, E, and W, S) recorded from 20 trees on Ber host plant for *Kusmi* strain of *Aghani* crop. The experiment was carried out in Randomized Block Design (RBD) with the five replications, each replication in four plants was selected.The population density of *Kerria lacca* recorded with the help of hand lense by counting insects (later lac cells) per 2.5 sq cm measured with the help of vernier callipers on three randomly selected branches per plant at 30, 45, 60, 90, 110, 130, 150, 170 day intervals, respectively, after BLI (Brood lac inoculation) till the harvesting, as per techniques used by Mohanasundaram *et al.*,2016 [8].

Table 1: Survival of lac insect *Kerria lacca* (Kerr.) from different directions of ber host plant at different growth periods from BLI to maturity during 2020-21.

Directions	Number of mean lac insects /2.5 cm^2 of stick lac (2020-21)								
	Number of days after BLI								
	30	45	60	70	90	110	130	150	172
	89.28	78.11	67.09	58.39	52.17	46.85	42.93	36.95	19.41
	(9.44)	(8.83)	(8.19)	(7.64)	(7.22)	(6.84)	(6.55)	(6.08)	(4.41)
North (T1)	63.20	53.10	43.98	37.17	33.92	32.63	29.17	25.56	13.72
South (T2)	(7.94)	(7.28)	(6.63)	(6.10)	(5.82)	(5.71)	(5.40)	(5.06)	(3.70)
East (T3)	61.00	51.2	41.50	35.72	32.79	29.68	27.70	24.44	12.67
	(7.81)	(7.15)	(6.44)	(5.98)	(5.73)	(5.45)	(5.26)	(4.94)	(3.56)
West (T4)	57.92	45.02	33.29	29.42	26.73	25.47	24.65	22.56	10.42
	(7.61)	(6.70)	(5.76)	(5.42)	(5.17)	(5.05)	(4.96)	(4.75)	(3.23)
S.Em.±	0.66	2.88	0.83	2.61	3.18	2.34	1.70	2.16	0.58
C.D.at 5 %	2.05	8.88	2.57	8.06	9.82	7.22	5.24	6.66	1.81

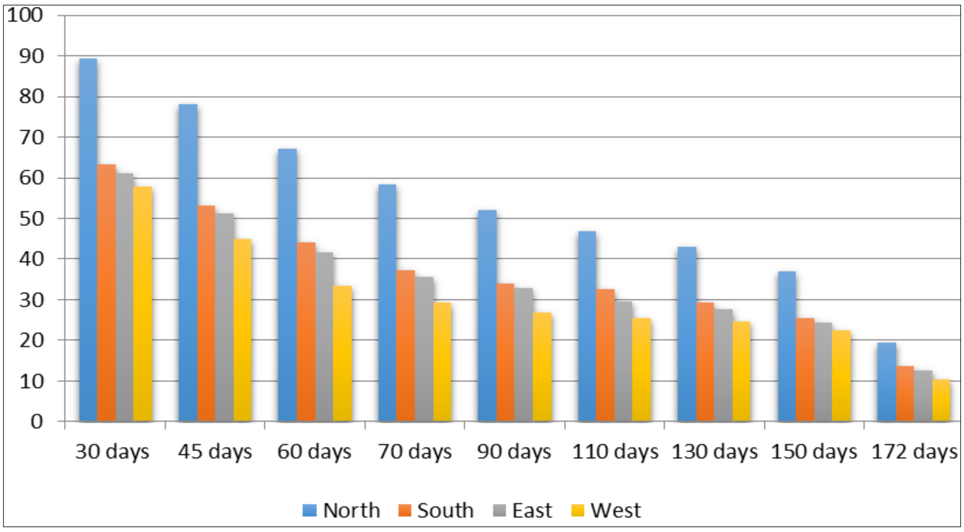

Fig 1: Survival of lac insect *Kerria lacca* (Kerr.) from different directions of be host plant at different growth periods from BLI to maturity during 2020

Table 2: Transmission loss lac insect

	Transmission loss of number of lac insects from BLI to harvest (Lac insect per 2.5 sq cm succulent branch)							
	Survival (%)				Transmission loss (%)			
No. of days after BLI	T1 North	T2 South	T3 East	T4 West	T1 North	T2 South	T3 East	T4 West
45 days after BLI	87.48	84.01	83.96	77.72	12.52	15.99	16.04	22.28
60 days after BLI	75.14	69.58	68.03	57.47	24.86	30.42	31.97	42.53
70 days after BLI	65.40	58.81	58.55	50.79	34.6	41.19	41.55	49.21
90 days after BLI	58.43	53.67	53.75	46.14	41.57	46.33	46.25	53.86
110 days after BLI	52.47	51.62	48.65	43.97	47.53	48.38	51.35	56.03
130 days after BLI	48.08	46.15	45.40	42.55	51.92	53.85	54.6	57.45
150 days after BLI	41.38	40.44	40.06	38.95	58.62	59.56	59.94	61.05
172 days after BLI	21.74	21.70	20.77	17.99	78.26	78.3	79.23	82.01

Result and Discussion

30 Days after BLI, the number of lac insects were recorded in 2.5 cm^2 area of branches. The mean number of lac insects varied from 54.97 to 90.11/cm^2 in the all directions of the plants. The highest survival density was observed towards north (89.28/cm^2) which differed significantly from that in the west direction (57.92/cm^2). Survival of lac insect was recorded from the east (61.00/cm^2), was low as compared to the south direction (63.20/cm^2). In case of horizontal branches, initial survival density in the lower side of the branch was much higher than the upper side. There was significant difference in mean number of lac insects survival in 2.5 cm^2 on different cardinal directions, are presented in Table No. 1 & Fig 1.

45 days after BLI, the lac insect *Kerria lacca* (Kerr.) started to secret resin over the body and grow individual lac cell. Based on the mean number of lac insects, the survival on 2.5 cm^{2}ofbranches was varied from34.98 to 81.33/cm^2 in the all direction of the plants. The maximum survival of lac insect was recorded from the north (78.11/cm^2), south (53.10/cm^2) and east direction (51.22 cm^2) as compared to west (45.02/cm^2). There was significant difference in mean number of lac insects survival in 2.5cm^2 in different directions of the plants.

After 60 days of BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) was recorded which varied from30.76 to 69.44/cm^2 in the all directions of the plants. The maximum number was recorded from north (67.09/cm^2) which differed significantly from that in the west direction (33.29/cm^2). Survival of lac insect was recorded from the east (41.50/cm^2) was low as compared to the south direction (43.98/cm^2). There was significant difference in mean number of lac insect survival on different cardinal directions.

70 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) Per 2.5 cm^2 stick lac was recorded during 2020-21, varied from 21.98to 67.55/cm^2 in the all directions of the plants. The maximum was recorded from north (58.39/cm^2) which differed significantly from that in the west direction 29.42/cm^2. Survival of lac insect was recorded from the east (35.72/cm^2) was low as compared to the south direction (37.17/cm^2). There was significant difference in mean number of lac insect survival from different cardinal directions.

90 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) survival per 2.5 cm^2 stick lac was recorded it varied from 19.06 to 56.66/cm^2 in the all directions of the plants. The highest survival density was observed towards north (52.17/cm^2) which differed significantly from that in the west direction (26.73/cm^2). Survival of lac insect was recorded from the east (32.79/cm^2) was low as compared to the south direction (33.92/cm^2). There was significant difference in mean number of lac insect survival on different cardinal directions.

110 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) Per 2.5 cm^2 stick lac was recorded, it varied from 20.34 to 49.89/cm^2 in the all directions of the plants. The highest survival density was observed towards north (46.85cm^2/) which differed significantly from that in the west direction (25.47/cm^2). Survival of lac insect was recorded from the east (29.68/cm^2) was low as compared to the south direction (32.63/cm^2). There was significant difference in mean number of lac insect survival on different cardinal directions.

130 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) survival per 2.5 cm^2 stick lac was recorded, it varied from 17.67to 49.66/cm^2 in the all directions of the plants. The highest survival density was observed towards north (42.93/cm^2) which differed significantly from that in the west direction (24.65/cm^2). Survival of lac insect was recorded from the east (27.70/cm^2) was low as compared to the south direction (29.17/cm^2). There was significant difference in mean number of lac insect survival on different cardinal directions.

150 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) Survival per 2.5 cm^2 stick lac was recorded that was varied from 16.9to 42.44/cm^2 in the all directions of the plants. The highest survival density was observed towards north (36.95/cm^2) which differed significantly from that in the west direction (22.56/cm^2).Survival of lac insect was recorded from the east (24.44/cm^2) was low as compared to the south direction (25.56/cm^2).

Significant difference in mean number of lac insect survival on different cardinal directions.

170 days after BLI, the mean number of lac insect, *Kerria lacca* (Kerr.) Survival per 2.5 cm^2 stick lac, was recorded that was varied from 10.05to 19.66/cm^2 in the all directions of the plants. The highest survival density was observed towards north (19.41/cm^2) which differed significantly from that in the west direction (10.42/cm^2). Survival of lac insect was recorded from the east (12.67/cm^2) was low as compared to the south direction (13.72/cm^2). There was significant difference in mean number of lac insect survival on different cardinal directions.

Transmission loss of lac insects

Transmission losses (TL) defined as the loss in the number of lac insect per 2.5 sq. cm from BLI to harvest. Survival percent and transmission losses of lac insects were recorded from all direction with 45 to 172 days after BLI at frequent interval are presented in table no 1. Maximum Survival percent at 45 days after BLI were recorded in North direction inoculated twigs. Survival percent was observed in gradually decreasing manner of survival percent ranged between 87.48 to 21.74 percent in North directions. Similar decreasing survival percent trends were observed in South, East and West directions at 60, 70, 90, 110, 130, 150 and 172 days with percent decreasing survival of ranged between 84.01 to 21.70, 83.96 to 20.77 and 77.72 to 19.99. Regarding the transmission losses opposite trends with increasing pattern were recorded in all the treatments. Transmission losses found ranged between 12.52 to 82.01 in different treatment. The data were presented in Table No. 2.

Mohanta *et al.* (2014) [10] observed that the initial survival of lac insect *kusmi* strain on kusum and ber plants ranged from 92.58 to 126.74 larva/sq. cm and 93.12 to 109.62 larva/sq. cm, respectively. It ranged from 82.67 to 118.32 larva/sq. cmin *rangeeni*.

Namdev (2014) [11] Suggested that the performance of *kusmi* lac strain on *aghani* crop and nutrient management in *Z. mauritiana* host plant under heavy rainfall condition. The mean number of lac insect settlement per 2.5 sq cm varied from 79.93 to 90.02 in different treatments in 30 days after BLI. After 172 days at harvest it varied 15.57 to 18.43 per 2.5 sq cm. There was a significant increase in number of settlement lac insect per 2.5 sq. cm as compared to control.

Present research findings were more or less in accordance with Hazarika *et al.* (2018). They reported that highest settlement density towards north (91.8/sq. cm) which was very high as compared to west direction (52.2/sq. cm) for *aghan*i (winter) crop. Density of survival was more or less equal in all directions except north.

Netam *et al.* (2019) [21] reported that initial survival of lac insectvaried from 70.29 to 100.37 during the year 2015-16 and mean number of lac insects varied from 71.63 to 101.65 per 2.5 sq cm branches during the year 2016-17in both the strain, *rangeeni* and *kusmi*.

Conclusion

The survival of lac insect on Ber host plant at different growth periods from BLI to maturity in the farmer field Daspur village of Kanker District during 2020-21. During the study of survival of lac insect, the effect of all direct effectively survival of lac insect. Comparatively in north direction temperature is lower than the other directions generally, towards north and east as well as the lower side of the branch, shade is more which might be the reason for the highest survival density in the north direction.

Acknowledgement

The Authors are thankful to the Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur and Dr. Piyush Netam Assistant professor of entomology CoA Kanker.

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