



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(6): 1267-1269

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Received: 01-09-2018

Accepted: 03-10-2018

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## Settlement behavior of lac insect, *Kerria lacca* crawlers

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### Abstract

Initial settlement density of the crawlers of lac insect, *Kerria lacca* Kerr (Hemiptera: Tachardidae) in different cardinal directions of the host plant branches was examined for two consecutive crops of *Kusumi* strain, summer and winter crop, during 2016-17. For the summer crop, initial settlement density 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). For 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. The observed difference in the cardinal direction might be due to shade preference characteristic of the insect.

**Keywords:** Settlement density, *Kerria lacca*, cardinal direction, *Kusumi*, *Flemingia semialata*, *Ziziphus* sp.

### Introduction

Lac insect, *Kerria lacca* Kerr (Hemiptera: Tachardidae) is known for its elite biological harvests, resin, wax and dye, which are commercially utilized in a versatile manner in the current day world. Utilization of lac for the benefit of mankind is known since ancient period and its earliest documented record is found in the *Atherva Veda*, where, the insect was termed as 'Laksha' [1]. At present, India ranks first in lac production accounting for more than 50 per cent of the total global production and also holds the first position on its export of 8153.10 tons worth Rs. 568.53 crores during 2013-14 [2]. Lac is used as varnish for wooden material, cosmetic products such as lipstick, nail polish etc., manufacturing of glazed paper, printing and water proofing inks, bangles, dry mounting tissue paper, dental plates, optical frames, in electrical industry as coating of insulator, spark plugs, cement of sockets in electrical lamp etc. [3]. Due to its non-toxic and biodegradable nature, lac has presently gained its reputation in pharmaceutical industries as coating of medicated drugs, micro-encapsulation of vitamins and in packaging industries as coating of fruits, chocolate etc. that enhances the self life and provide a fresh appearance of the products.

Though the insect has great economic importance and diverse industrial utilization, its scientific research and ecological description is very limited. The settlement density of lac insect (*Rangeeni* strain) ranged between 20-121 crawlers per sq. cm on *Cajanus cajan* [4]. The initial density of settlement of *Kusumi* strain ranged between 92.58-126.74 and 93.12-109.62 crawlers per sq.cm on host plants, *Schleichera oleosa* and *Butea monosperma*, respectively [5]. But, there is no any scientific study describing its directional preference for settlement in the host plants. Hence, the present investigation was undertaken to find out directional preference for settlement of *Kusumi* strain of *K. lacca* considering cardinal directions of branches of *Flemingia semialata* and *Ziziphus* sp. under climatic conditions of Assam.

### Materials and methods

The investigation was conducted at the Lac Park, Assam Agricultural University, Jorhat, situated at 26°43.260' N latitude and 94°11.649' N longitude, which has been utilizing for insect rearing since 2014. For counting the settlement density of lac insect in the prime cardinal directions, viz., east, west, north and south, *F. semialata* plantations were selected, as it is the most suitable quick growing host which produces vertical branches.

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Ten plants were randomly selected from the experimental block and twenty days after brood lac inoculation, settlement density was counted visually using magnifying glass from all the four directions of the branches. *Ziziphus* sp., another important host plant of lac insect which produces horizontal branches was also selected to record the settlement density in the upper and lower sides of the branches. Ten different branches of *Ziziphus* sp. were selected to count the density of settlement of lac crawlers on its upper and lower sides. Plants are selected in such a way that all directions receive an almost equal amount of sunlight. The experiment was done for two consecutive *Kusumi* crop seasons, viz., winter (Dec/Jan-Jun/Jul) and summer (June/Jul-Dec/Jan) during 2016-17. One way ANOVA was performed to find out the significant difference of settlement in the cardinal directions and independent sample t-test was carried out to find out whether a significant difference of settlement density exist between the upper and lower side of horizontal branches.

**Results**

Direction wise settlement of crawlers of lac insect (Fig. 1) was recorded highest in the north direction (97.0 crawlers/sq. cm. and 91.8 crawlers/sq. cm.) and lowest settlement density (31.2 crawlers/sq. cm. and 57.2 crawlers/sq. cm.) was recorded in west direction for both summer and winter crop, respectively (Table 1). In case of summer crop, density of settlement towards west (31.2 crawlers/sq. cm.) and south (34.6 crawlers/sq. cm.) was very low as compared to north (97.0 crawlers/sq. cm.) and east (89.2 crawlers/sq. cm.) direction. Settlement density towards east and north differed

significantly from west and south at 0.05 per cent probability level. While, in case of winter crop, the density of settlement was more or less equal in all the direction except north. Towards north, highest settlement density (91.8 crawlers/sq. cm.) was recorded which differed significantly from the settlement density in the west (57.2 crawlers/sq. cm.) at 0.05 per cent probability level.

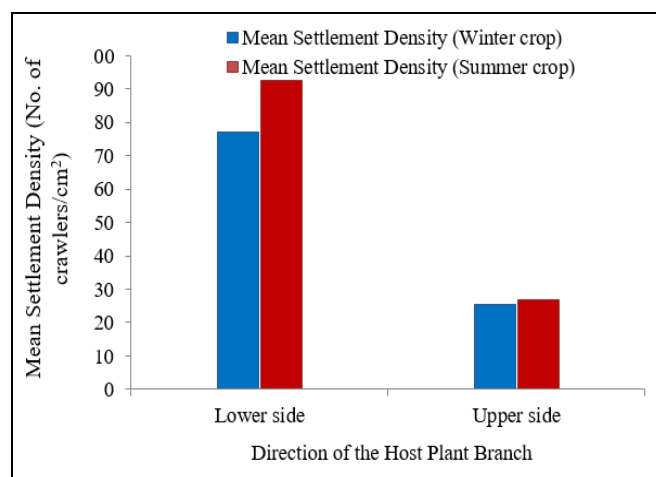
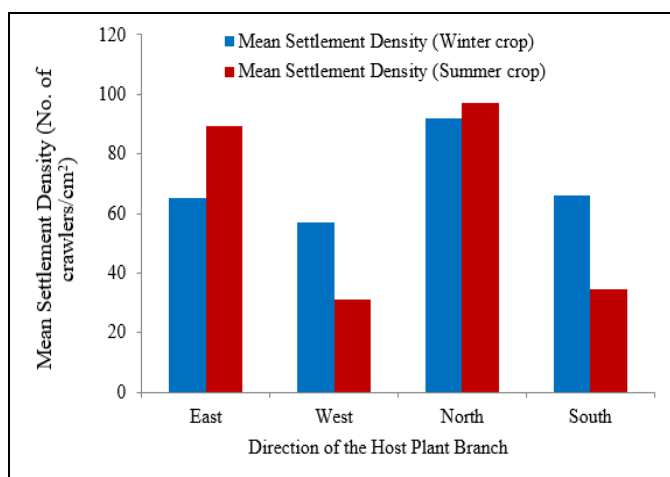
In horizontal branches (Table 2 and Fig. 2), settlement density was much higher in the lower side of the branch (92.6 crawlers/sq. cm. and 77.2 crawlers/sq. cm.) compared to the upper side (26.8 crawlers/sq. cm. and 25.6 crawlers/sq. cm.) for both summer and winter crops, respectively. Independent sample t- test showed that there was a significant difference between upper side and lower side with respect to settlement of the insect.

**Table 1:** Settlement density of lac insect in different cardinal directions of the branch

Direction	Mean Settlement density (No. of crawlers/cm <sup>2</sup> )	
	Winter crop (July-Jan)	Summer crop (Jan- July)
East	65.2	89.2
West	57.2	31.2
North	91.8	97
South	66.2	34.6
Standard deviation	25.325	32.033
Standard Error	5.663	7.163

**Table 2:** Settlement density of lac insect in upper and lower side of the branch

	Winter crop (July- Jan)		Summer crop (Jan- July)	
	Lower side	Upper side	Lower side	Upper side
Mean Settlement Density (No. of crawlers/cm <sup>2</sup> )	77.2	25.6	92.6	26.8
Calculated t	9.024		14.14	
Std. Error Mean	3.77		3.124	
Std. Error Diff	5.718		4.648	



**Fig 1:** Mean Settlement density in the four cardinal directions of the host plant branches

**Fig 2:** Mean Settlement Density in the upper and lower direction of the host plant branches

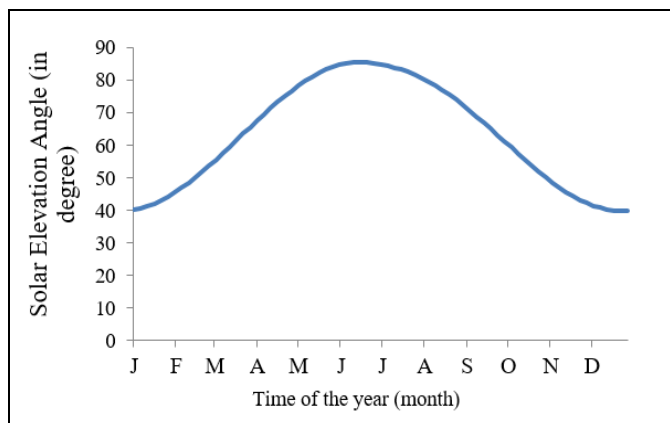


Fig 3: Annual Variation of Solar Elevation Angle

### Discussion

From the above observations, it could be concluded that, most possibly 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. During the initial settlement period of the winter crop (Jun/Jul), the solar elevation angle (Fig. 3) reaches its peak values of about  $82^{\circ}$  -  $85^{\circ}$  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  $39^{\circ}$  -  $41^{\circ}$ . 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 (Fig. 2). Shade-seeking is a thermoregulatory behavior for many insects including *Antheraea assama* Weshwood (Lepidoptera: Saturniidae) [6]. Earlier studies on scale insect also revealed that California red scale settles more densely in the shaded inner part of citrus in the hot Jordan Valley [7]. Florida red scale tends to settle in shaded parts of trees during hot summer months and on sunny parts during cooler periods of the year [8]. Therefore, partial shade may be provided in lac culture for uniform settlement of the crawlers in all the direction which might results in higher lac production.

### Acknowledgement

The authors are grateful to Dr. K. K. Sharma, Director and Project Co-ordinator, ICAR-IINRG for his support and encouragement.

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