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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating 2017: 5.03
TPI 2017; 6(8): 320-324

www.thepharmajournal.com
Received: 15-06-2017
Accepted: 16-07-2017

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Effect of nutrition in Palas (*Butea monosperma* Lam.) on the survivability of lac insect

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Abstract

The population density of Lac insect was recorded by counting insects (later lac cells) per 2.5 sq cm on three branches per tree and at three fixed points per branches at 50, 62, 76 and 94 days after BLI. At 50 days after BLI, the mean population density of *K lacca*per varied from 44.95 to 50.28 in different treatments. There was significant difference in the mean population density of Lac insect in T_3, T_5 and T_8 over T_6. The former three were at par with each other. It was highest (50.28) in T_3 Multiplex and lowest (44.95) in T_6 Humic acid + Bolt acid + Bolt. At 62 days after BLI, the mean population density of Lac insect varied from 37.05 to 39.34 in different treatments but was at par among the treatments. It was highest (39.34) in T_3 -Multiplex and lowest (37.05) in T_2-Auskelp super. The mean population density of lac insects reduced at 76 days after BLI and it varied from 28.37 to 33.46. At 94 days after the BLI, the mean population density of lac also reduced in comparison to that on 50th day after BLI. It varied from 20.86 to 26.05 per 2.5 sq. cm. The mean population density of lac insect differed significantly in case of T_3 – Multiplex over the Control (T_8). It was highest (26.05) in case of T_3, lowest (20.86) in T_8.

Keywords: Population density, Lac insect, Humic acid, Nutrient, BLI

1. Introduction

The Indian lac insect, *Kerria lacca* (Kerr) (order- Hemiptera, suborder- Homoptera, super family- Coccoidea and family- Lacciferidae,) with its piercing and sucking mouth parts sucks plant sap (Colton, 1984) [8] and secrets resin from their body. Lac insect completes its life cycle on several host taxa where it exclusively feed on phloem sap but *Schleichera oleosa* (Lour.) Oken, *Butea monosperma* (Lam.) and *Ziziphus mauritiana* (Lam.) are its major host. Lac is a minor forest produce, produced by Lac insect- *K. lacca* while feeding on host trees (Olge *et al.,* 2006) [22]. *B. monosperma* is a moderate sized deciduous tree which is widely distributed throughout India, Burma and Ceylon. This is popularly and commonly known as '*dhak*' or '*palas*' and 'Flame of forest'. The family Fabaceae comprises of 630 genera and 18,000 species (Mishra, 2012) [20]. In India lac is mainly produced by two strains of lac insect viz., "*Rangeeni* and *Kusmi*". *Rangeeni* lac is produced on the tree of *B. monosperma* and *Z. mauritiana*. *Kusmi* lac is mainly produced on *S. oleosa* and to some extend on Ber tree (Jaiswal and Singh, 2014) [14].

The total Lac production was 21,008 tons in India and 2,497 tons in M.P during 2013-14**.** During the year 2013-2014, Jharkhand (12207 tons) was the highest lac producer in the country followed by Chhattisgarh, Madhya Pradesh, Maharashtra and West Odisha (Yogi *et al.,* 2014) [26]. As nutrients deficient plants are weak and vulnerable to incidence of plant disease and insect pest attack (Marschner, 1995; Huber and Thompson 2007) [19, 13]. Low nitrogen content in the plant enhance the resistance of plants against pest but high nitrogen contents cause vigorous growth along with consequent decrease in resistance of plants against pest.(Bhinde, 1993[5]; Huber and Thompson 2007[13]). The potential of organic amendments in suppression of insect pest population over synthetic inorganic fertilizer has long been recognized. Evidence of suppression of insect attack by various forms of organic amendments has been reported by different researchers (Ramesh, 2000 and Biradar *et al*., 1998) [23, 6].

Though relatively small amount of micronutrient is required as compared to those of primary nutrient, but these are equally important for plant metabolism (Katyal, 2004) [18]. Humic acid foliar spray has remarkable effect on vegetative growth of plant and increase photosynthetic activity and leaf area index (Ghorbani *et al.,* 2010) [11]. Sap feeders often had long-lasting physiological impacts on their host plant. Physiological changes are driven by both changes in plant nutrients and the production of secondary chemicals (Haukioja *et al.,* 1990; Karban and Myers 1989) [12, 17]. Highest survivability of *K. lacca* on the *Z. mauritiana* treated with NP may be due to increase in succulence and more availability of phloem sap (Shah *et al.,* 2014) [25].Similarly Boron has an effect on cell wall structure and also has a major effect on cell elongation, root growth and transfer of sugar (Abdollahi *et al.,* 2010) [1].

Resin production by *K. lacca*is likely to be dependent on quality and quantity of phloem sap of its host. The sap content of phloem is highly correlated with nutrients status of the plants. Therefore, a trial was conducted to see the effect of nutrients in palas on survivability of lac insect.

2. Material and Methods

The present investigation was carried out from July 2015 to November 2015 on standing *B. monosperma* trees in Lac growers' field. The location of study was Malhara village, Barghat Block Seoni district. Geographically, the area forms a part of Maikal range of northern and eastern parts of Satpura Hills tending N-S, NE-SW and E-W. The highest topographic elevation in the district is 756 m above sea level in Seoni-Lakhanadon plateau region and the lowest is 430m above sea level in the plains of Wainganga-Hirri River.

Table 1: Details of the Experiment

Host trees	**Palash (*B. monosperma*)**
Design	R.B.D.
No. of replications	3
Number of treatments	8
Number of trees per replications	3 trees
Total number of trees/treatments	9 trees
Treatment details	
T_1	Spraying of Humic acid 5%at 51, 63 days and 77 days after BLI*
T_2	Spraying of Auskelp super(N-0.59%, P-0.39%, K-3.19%, Ca-0.017%, S-0.64%,Fe-0.87%,Zn-14.2ppm,Mn-4.4ppm,Cu-4.2ppm,B-64ppm, Mg-0.46%,Na-0.20%,Co-0.14ppm, Mo-10ppm)at 51, 63 days and 77 days after BLI*
T_3	Spraying ofMultiplex (Zn-3%,B-0.1%,Mn-0.5%,N,Mg,S,Ca,Mn, Fe,Cu,B)at 51, 63 days and 77 days after BLI*
T_4	Spraying of Bolt (Humic acids-39%, Cold water kelp extracts-25%, Vitamin C-20%, E-1%, and B1-2%, Amino acids-9% and Myo- Inositol-14%)at51, 63 days and 77 days after BLI*
T_5	Spraying ofHumic acid + Multiplex at 51, 63 days and 77 days after BLI*
T_6	Spraying of Humic acid + Bolt at51, 63 days and 77 days after BLI*
T_7	Spraying of Humic acid + Auskelpat51, 63 days and 77 days after BLI*
T_8	Control (Lac growers practice i.e. no use of micronutrients)

*BLI- Broodlac Inoculation

2.1 Broodlac inoculation

2.1.1 Brood inoculation

Healthy Broodlac weighing 600g to 1200g were used per *B. monosperma* tree for inoculation. Depending on the branch of the tree, the brood lac where divided into six to seven bundles for its inoculation in the month of July 2015. **2.2.2**

2.2.3

2.1.2 Shifting

The Broodlac bundles were shifted carefully to different branches on the same tree after 7- 8 days of inoculation. This was to ensure uniform distribution of the brood on branches where there was no or insufficient larval settlement.

2.1.3*Phunki* removal

Larvae of lac insect from Broodlac settle on the tree in three weeks of its inoculation. The Broodlac without brood is called *phunki* is in fact sticklac. *Phunki* usually consists of predators. It was removed after 21 days of Broodlac inoculation and scrapped to recover raw lac, and in this process the predators are removed.

2.2 Spraying of Humic acid and micronutrients

2.2.1 Preparation of spray solution

The solution of Humic acid and micronutrients was prepared by adding its desired quantity (@5ml of Humic acid/litre of water, in case of bolt @ 1g/litre of water, Auskelp @ 2ml/litre of water, Multiplex @ 3g/litre) in a small container followed by brisk stirring with a piece of stick. This concentrate solution was further diluted with clear water to make the spray solution.

2.2.2 Spraying

Spraying of Humic acid and micronutrients with a foot sprayer required two persons. One operated the pedal of the foot sprayer while other holding the lance of the sprayer sprayed the solution.

Spraying schedule

After 51-52, 63-64 and 77-78 days of BLI, first, second and third spray was done respectively.

2.3 Harvesting of sticklac

At maturity, the sticklac was harvested on 31thOctober to 3th November 2015for estimation of lac yield.

2.4 Statistical Analysis

Analysis of Variance

Sources of variance	***Df***	**S.S.**	**M.S.S.**	***F Cal***	***F Tab***
Replications	(r-1)	SSR	VR	-	
Treatments	(t-1)	SST	VT	VT / VE	*F* at 5% (t-1), (r-1) (t-1)
Errors	(r-1) (t-1)	SSE	VE		
Total	(r.t-1)				

where

r = number of replications

t = number of treatments

VR= replication mean sum of square

VT=treatment mean sum of square

VE= error mean sum of square

The significance among different treatment means was judged by critical difference (C.D) at 5% level of significance for comparison among the treatments, the marginal means of each treatment was considered. The following formula was used for various estimations

i. Standard error of mean

$$S.\ Em \pm = \sqrt{\frac{E.\ ms}{r}}$$

ii. Critical difference (C.D) = SEm x √ 2 x t 0.05

where,

Ems = error mean sum of square

t =‘*t*’ value at 5 % level at error *d.f.*

r = number of replications

3. Results and Discussion
3.1 Population density of *K Lacca*
The population density of Lac insect was recorded by counting insects (later lac cells) per 2.5 sq cm on three branches per tree and at three fixed points per branchesat 50, 62, 76 and 94 days after BLI. The Lac crop was harvested on 110 days after BLI. Ramani *et al.* (2010) reported that fairly large populations of the lac insects of good density observed on the hosts as indicative of good survival of the lac insect. They also discussed the plant characteristics for their suitability from lac cultivation stand point.

3.1.1.50 day after BLI
At 50 days after BLI the mean population density of *K lacca*per varied from 44.95 to 50.28 in different treatments (Table 2). There was significant difference in the mean population density of Lac insect in T_3, T_5 and T_8 over T_6. The former three were at par with each other. It was highest (50.28) in T_3 Multiplex and lowest (44.95) in T_6 Humic acid + Bolt (Table 2). Janghel (2012) [15] reported that the mean population density female lac cell count at 45 day after BLI varied from 39.75 to 43.90 in different treatments. The mean population density of lac insect was higher in the present study as compare to that reported by (Janghel, 2012) [15].

Table 2: Survival of the lac insects at 50th days after BLI

Mean no. of lac insects / 2.5 sq. cm. in different treatments								
Replication	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**
R_1	49.92 (7.10)	49.19 (7.05)	52.71 (7.29)	47.33 (6.92)	51.18 (7.19)	46.82 (6.88)	47.93 (6.96)	51.08 (7.18)
R_2	47.19 (6.91)	49.12 (7.04)	44.86 (6.73)	44.18 (6.68)	48.71 (7.01)	46.93 (6.89)	48.30 (6.99)	52.04 (7.25)
R_3	47.15 (6.90)	48.74 (7.02)	53.27 (7.33)	45.74 (6.80)	50.70 (7.16)	41.11 (6.45)	51.19 (7.19)	46.00 (6.82)
Mean	48.09 (6.97)	49.01 (7.04)	50.28 (7.12)	45.75 (6.80)	50.20 (7.12)	44.95 (6.74)	49.14 (7.04)	49.71 (7.08)
SEm±	0.1							
CD 5%	0.32							

( ) Fig. in parenthesis of square root transform value.

3.1.2.62 day after BLI
At 62 days after BLI the mean population density of Lac insect varied from 37.05 to 39.34 in different treatments but was at par among the treatments (Table 3). It was highest (39.34)inT_3 -Multiplex and lowest (37.05) in T_2-Auskelp super. This was far higher than that 29.29 to 34.43as reported by Janghel, (2012) [15].

Table 3: Survival of the lac insects at 62th days after BLI

Mean no. of lac insects / 2.5 sq. cm. in different treatments								
Replication	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**
R_1	43.15 (6.61)	36.63 (6.09)	42.30 (6.54)	40.83 (6.43)	35.23 (5.98)	36.82 (6.11)	39.15 (6.30)	35.41 (5.99)
R_2	34.23 (5.89)	36.00 (6.04)	36.71 (6.10)	36.12 (6.05)	37.96 (6.20)	37.23 (6.14)	37.74 (6.18)	40.82 (6.43)
R_3	35.30 (5.98)	38.52 (6.25)	39.00 (6.29)	37.37 (6.15)	38.56 (6.25)	38.67 (6.26)	38.67 (6.26)	36.52 (6.08)
Mean	37.56 (6.16)	37.05 (6.12)	39.34 (6.31)	38.11 (6.21)	37.25 (6.14)	37.57 (6.17)	38.52 (6.24)	37.58 (6.16)
SEm±	0.12							
CD 5%	0.36							

( ) Fig. in parenthesis of square root transform value.

3.1.3. 76 day after BLI
At 76 days after BLI themean population density of lac insectsper 2.5 square cm reduced and it varied from 28.37 to 33.46 (Table 4). There was significant difference in the mean population density of lac insect in T_3, T_5 andT_7,over T_8. Similarly there was a significance difference in T_1 overT_3 and T_5, It was highest (33.46) in T_3 - Multiplex and lowest (28.37) in T_8 -control.

Table.4: Survival of the lac insects at 76th days after BLI

Mean no. of lac insects / 2.5 sq. cm. in different treatments								
Replication	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**
R_1	28.30 (5.37)	27.67 (5.31)	30.97 (5.61)	29.89 (5.51)	32.93 (5.78)	30.56 (5.57)	30.04 (5.53)	30.41 (5.56)
R_2	28.26 (5.36)	29.82 (5.51)	33.82 (5.86)	29.78 (5.50)	32.93 (5.78)	31.63 (5.67)	31.30 (5.64)	27.45 (5.29)
R_3	31.89 (5.69)	32.19 (5.72)	35.60 (6.01)	29.30 (5.46)	31.89 (5.69)	30.19 (5.54)	31.71 (5.68)	27.26 (5.27)
Mean	29.48 (5.47)	29.89 (5.51)	33.46 (5.82)	29.66 (5.49)	32.58 (5.75)	30.79 (5.59)	31.02 (5.61)	28.37 (5.37)
SEm±	0.08							
CD 5%	0.24							

( ) Fig. in parenthesis of square root transform value.

3.1.4 94 day after BLI (At harvest)

At 94 days after the BLI the mean population density of lac insect per 2.5 square cm also reduced in comparison to that on 50thday after BLI (Table 5). It varied from 20.86 to 26.05 per 2.5 sq. cm. The mean population density of lac insect differed significantly in case of T_3 - Multiplexover the Control (T_8).It was highest (26.05) in case of T_3, lowest (20.86) in T_8.

Table 5: Survival of the lac insects at 94th days after BLI

Mean no. of lac insects / 2.5 sq. cm. in different treatments								
Replication	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**
R_1	21.63 (4.70)	22.67 (4.81)	27.60 (5.30)	21.56 (4.70)	22.26 (4.77)	21.41 (4.68)	23.23 (4.87)	20.85 (4.62)
R_2	20.48 (4.58)	23.34 (4.88)	23.60 (4.91)	21.23 (4.66)	23.52 (4.90)	21.86 (4.73)	21.49 (4.69)	19.05 (4.42)
R_3	21.82 (4.72)	20.57 (4.59)	26.97 (5.24)	22.91 (4.84)	20.45 (4.58)	22.63 (4.81)	21.19 (4.66)	22.67 (4.81)
Mean	21.31 (4.67)	22.19 (4.76)	26.05 (5.15)	21.90 (4.73)	22.08 (4.75)	21.97 (4.74)	21.97 (4.74)	20.86 (4.61)
SEm±	0.08							
CD 5%	0.25							

( ) Fig. in parenthesis of square root transform value.

Mohanta *et al.* (2014) [21] observed that the initial density of settlement varied between 82.67- 118.32 sq cm which appears to be quite higher. In the present study in the lac insect population varied from 44.95 to 50.28 per 2.5 sq cm. The higher survival rate of lac insect on treatment T_3 (Multiplex) may be due to the cumulative action of foliar application of Multiplex. Foliar application of nutrients may be actually promoting root absorption of the nutrients through improving root growth thereby increasing nutrients uptake (Boogar *et al.*, 2014) [7].

Mineral status affects plant's physiology and the herbivores feeding on them, but mineral ions are also important to insect's physiology in at least three major processes: enzyme activation (K, Mg, Fe, Co, Mn) trigger and control mechanisms (Na, Ca, K), and structure formation (Mg). Insect's tissues have large quantities of three major mineral elements: P (10 g/ kg d.w.), K (1 g/kgd.w.) and Mg (2 g/kgd.w.) Thus herbivore interaction with host plants would be at least partially mediated by an interaction between minimal optimum nutrient requirements and the inherent variability of the plant contents of these nutrients.Detail study on the role of nutrients on lac insect growth is rarely studied. However there are numerous studies on the phloem feeders the aphid and whitefly. Several investigators (Auclair, 1965; Dadd and Mittler, 1965; Dadd, 1967; Akey and Beck, 1972; Auclair and Srivastava, 1972) [4, 9, 10, 2, 1] did show that macro and micro minerals are essential for aphid development, affecting significantly their biology on artificial diets. Mineral concentrations above optimum thresholds are usually toxic to aphids, e. g., high boron and molybdenum (Auclair and Srivastava, 1972) [3], phosphorus and potassium (Auclair, 1965) [4] to *Acyrthosiphon pisum*; magnesium to *A. pisum* (Auclair, 1965) [4] and *Myzus persicae* (Dadd and Mittler, 1965) [9] and nitrate to *Schizaphis graminum* (Salas *et al.*, 1990) [24]. Most sucking insects respond positively to N fertilization (Jansson and Ekbom, 2002) [16].

Conclusion

Lac production increase stress and loss of vigour in the host plants. Therefore application of nutrients is necessary to increase the health of the *B. monosperma* and survival of the lac insects. It is concluded that the mean population density was highest (50.28) in T_3 Multiplex and lowest (44.95) in T_6 Humic acid + Bolt acid + Bolt. The lac insect population varied from 44.95 to 50.28 per 2.5 sq cm. The higher survival rate of lac insect on treatment T_3 (Multiplex) may be due to the cumulative action of foliar application of Multiplex.

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