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Impact of nutrient management in *Zizyphus mauritiana* (Lamb.) on the survivability of lac insect and the yield of Aghani crop of *Kusmi* lac.

Tahir Hussain Shah, Moni Thomas and Rita Bhandari

Abstract
Kerria lacca (Kerr) is a phloem feeder and secretes lac over its body. Lac serves as a cash crop to forest dependents, rainfed and resource poor farmers. Lac productivity is low, as nutrient management of host trees of *K. lacca* is rarely followed. Impact study in *K. lacca* inoculated *Zizyphus mauritiana* (Lamb.) conducted during 2013-14, revealed that there was an increase in both the survivability of *K. lacca* as well as resin production by it. The mean percentage survivability of *K. lacca* at maturity of the lac crop was highest (17.21%) over control in case of plants treated with NPK. It was followed by N and NP treatments (12% and 10.71%, respectively). Similarly, the mean fresh weight (g) of 100 cells of lac insect was also highest in case of NPK (21.39%) over control, followed by N and NP treatments (15.84% and 14.25%, respectively). The mean dry weight (g) of 100 cell of lac insects was highest in case of NPK (19.71%) followed by NP (14.50%) and N (13.57%).

Keywords: *K. lacca*, lac yield, nutrients application, survival percentage.

1. Introduction
Lac, a resinous exudation from the body of female scale insect *Kerria lacca* Kerr belonging to the family Tachardiidae (Kerriidae) and order Hemiptera [1], consist of resin, wax and dye. Hence it has a wide range of applications in food, pharmaceuticals, cosmetics, perfumes, varnishes, paints, polishes, adhesives, jewellery and textile dyes, since ancient times [2]. *K. lacca* feeds on phloem sap by piercing its proboscis into the succulent phloem region of shoots, loss of plant nutrients inducing stress resulting in low vigour and few succulent branches and ultimately low productivity of lac in subsequent years. The morphological and physiological changes in plants under stress may affect the performance of insect herbivores feeding on them [3]. The use of fertilizers as a yield booster has been reported [4]. Fertilizers not only improve crop yield, but also influence crop suitability for insect development, depending on the type of fertilizer and pest species. Nutrient management improves plant health, which enables the plant to tolerate the incidence of herbivores - sucking as well as chewing insect-pests [5]. An excessive dose of nitrogen fertilizer on cotton plant results in heavy attack of sucking pests [6]. Potassium is essential for plant growth [7] and plays a vital role in the opening and closing of stomata [8], translocation of photosynthates, mobilizes the stored material and has a beneficial effect on ATP synthesis [9]. Higher phosphorous levels are associated with higher insect levels [10, 11]. So, there is opportunity of changing the preference of insects by optimal plant nutritional requirement via altering the fertilizer level of a soil [12]. Nutrient application results in the overall growth of the Ber plant, due to availability of more nutrients in the phloem sap. Qualitative increase in plant sap may result in better growth of *K. lacca* and secretion of the resin. Present research was therefore conducted to evaluate the effect of nutrient management in *Zizyphus mauritiana* on the yield of lac.

2. Materials and Methods
The study was conducted during the year 2013-14 on *Z. mauritiana* trees in lac grower's field in the village Panwas Tolla, Block Barghat, District Seoni, Madhya Pradesh to evaluate the effect of nitrogen, phosphorous and potassium on *Z. mauritiana* plantation for *kusmi* lac production in winter season, 2013. Geographically the village is located between 21°55'51"N latitude and 79°45'49"E longitude. Pruning of *Z. mauritiana* was done in the month of February, 2013 and basal application of N, NP,

NPK through urea, single super phosphate and muriate of potash was done in June, 2013. The experiment was planned in randomized block design (RBD) with four treatments (N, NP, NPK and control) having six replications. The fertilizers were applied as per recommendation [13] one month before the broodlac inoculation *i.e*. in June, 2013. Healthy Broodlac with minimum signs of predator and parasite infestation was divided into 100 g bundles and 400-600 g of broodlac and inoculated per *Z. mauritiana* tree, depending on the size of the plant. Shifting of the broodlac bundles was done after 6 days of inoculation to ensure uniform distribution of the brood on branches and phunki (empty broodlac sticks after insect emergence) was removed after 21 days of broodlac inoculation. Crop protection schedule as per recommendations i.e. first spray (Cartap hydrochloride + Mancozeb) was done one month after the inoculation while second spray was conducted one month after the first spray. Harvesting was done at Lac crop maturity which was identified based on development of yellow spot on the Lac encrustation. Larval insect settlement count and the ratio of insect settlement to harvest was recorded from 3 branches/plant at 5 fixed spots of 2.5 sq cm/branch to study the survival percentage of lac insects. The mean fresh and dry weight (g) of 100 cell of lac insect was also recorded after harvest. Data recorded on various aspects were tabulated and statistically analyzed through randomized block design (RBD) [14]. The significance among different treatment means was judged at 5% level of significance for comparison among the treatments.

3. Results

The effect of fertilizers on larval settlement and the survival rate of lac insects is presented in Table-1. The results indicate that the mean larval settlement after 30 days of broodlac inoculation was more in the host plants treated with fertilizers as compared to the control. The survival percentage of *K. lacca* at harvest of the lac crop varied in different treatments. It was 20.66, 20.36, 21.96 and 18.18 in case of N, NP, NPK and control respectively. The mean percentage survivability of *K. lacca* at maturity of the lac crop was highest (17.21%) over control in plants treated with NPK, followed by N (12%) and NP (10.71%) treatments. Analysis of variance at 5% level of significance showed significant difference amid different treatments. Mean fresh weight (g) of 100 cells of lac insect (Table- 2) was 7.51, 7.37, 8.04, and 6.32 in case of N, NP, NPK and control respectively while the mean dry weight (g) of 100 cells of lac insects was 6.41, 6.48, 6.90 and 5.54 g in N, NP, NPK treatments and control (Table-3) respectively. The percent increase in mean fresh weight (g) of 100 cells of lac insect was also highest in case of NPK treatment (21.39%) over control, followed by N (15.84%) and NP (14.25%) treatments (Table-4). The percent increase in mean dry weight (g) of 100 cells of lac insects was highest in case of NPK treatment (19.71%) over control, followed by NP (14.50%) and N treatments (13.57%) (Table-5).

Table 1: Survival percentage of number of lac insects from Broodlac inoculation (BLI) to harvest.

(Replication/Treatment)	No. of lac insects per 2.5 sq cm branch 30 days after BLI*				No. of lac insects per 2.5 sq cm branch at harvest			
	N	NP	NPK	Control	N	NP	NPK	Control
R1	88.29	86.23	83.96	81.79	17.7	13.13	18.033	16.1
R2	86.93	81.66	83.73	82.49	13.46	17.87	18.27	16.63
R3	86.66	83.73	82.16	79.7	19.73	18.83	18.37	13.86
R4	87.74	87.56	83.73	80.93	19.76	17.53	18.03	13.8
R5	83.66	86	80.26	79	19.23	17.87	17.47	12.36
R6	87.97	84.5	85.66	83.29	17.83	18.57	19.53	15.83
Mean	86.87	84.94	83.25	81.2	17.95	17.3	18.28	14.76
Survival percentage (%)					20.66	20.36	21.96	18.18

*BLI- Brood lac inoculation

Table 2: Mean fresh weight (g) of 100 cells of lac insect

Mean fresh weight (g) of 100 cells of lac insect				
Replication/Treatment	**N**	**NP**	**NPK**	**Control**
R1	7.33	7.59	6.89	6.47
R2	7.38	7.72	8.35	6.31
R3	7.8	6.77	8.8	6.71
R4	7.59	7.34	7.31	6.34
R5	8.32	7.50	8.53	6.00
R6	6.66	7.29	8.38	6.08
Mean	7.51	7.37	8.04	6.32
Sem	Sed	CD (5%)	CD (1%)	CV
0.21	0.30	0.66	3.02	8.41

Significant at 5% level.

Table 3: Mean dry weight (g) of 100 cells of lac insect

Mean dry weight (g) of 100 cells of lac insects				
Replication/Treatment	**N**	**NP**	**NPK**	**Control**
R1	5.33	6.52	5.85	5.68
R2	6.38	6.90	6.60	5.49
R3	7.16	5.99	8.04	6.27
R4	6.52	6.56	6.30	5.44
R5	6.98	6.52	7.48	5.20
R6	6.04	6.38	7.11	5.17
Mean	6.41	6.48	6.90	5.54
Sem	Sed	CD (5%)	CD (1%)	CV
0.22	0.31	0.66	3.06	7.39

Significant at 5% level.

Table 4: Percent increase in mean fresh weight (g) of 100 cells of lac insect over control

Mean fresh weight (g) of 100 cells of lac insect				
Replication/Treatment	N	NP	NPK	Control
R1	7.33	7.59	6.89	6.47
R2	7.38	7.72	8.35	6.31
R3	7.8	6.77	8.8	6.71
R4	7.59	7.34	7.31	6.34
R5	8.32	7.50	8.53	6.00
R6	6.66	7.29	8.38	6.08
Mean	7.51	7.37	8.04	6.32
Percent increase in weight over control (%)	15.84	14.25	21.39	----

Table 5: Percentage increase in Mean dry weight (g) of 100 cells of lac insect over control

Mean dry weight (g) of 100 cells of lac insects				
Replication/Treatment	N	NP	NPK	Control
R1	5.33	6.52	5.85	5.68
R2	6.38	6.90	6.60	5.49
R3	7.16	5.99	8.04	6.27
R4	6.52	6.56	6.30	5.44
R5	6.98	6.52	7.48	5.20
R6	6.04	6.38	7.11	5.17
Mean	6.41	6.48	6.90	5.54
Percent increase in weight over control (%)	13.57	14.50	19.71	---

4. Discussion

Lac production is carried in Central Indian states by tribal communities. Lac production declined from 20,050 tons to 16,495 tons [15]. One of the major factors in the decline is poor management of lac host trees. A recent trial [16] confirmed that nutrient management of lac host trees increased the lac production. The phloem-feeding aphids, whitefly or scale insects reduces the vigor of their host plants [17, 18]. In the present investigation, the highest survival percentage of lac insects was found in the *Z. mauritiana* trees treated with NPK. Potassium application reduces dry matter per cent in shoot and make it more succulent. Succulence may be also due to increased water uptake [19]. Highest survivability of *K. lacca* on the *Z. mauritiana* treated with NPK may be due to increase in succulence and more availability of phloem sap. This may also be the reason for increase in the weight of 100 cells of lac insect. Similarly, Nitrogen increases level of nitrogen/protein and has positive correlation with the number of eggs laid by *Bemisia argentifolii* [20]. Increase in resin production may also be due to N in NPK. The weight of mature lac cell contributes to the productivity, as it depends on the quality of plant sap. Application of NPK improves plant nutrient status [21], thus maybe helping *K. lacca* to secrete more resin.

5. Conclusion

Lac production increase stress and loss of vigour in its host. Nutrient replenishment is therefore necessary to increase the vitality of the *Z. mauritiana* and increase the production of lac. Application of NPK as basal doze is therefore recommended for sustainable lac production.

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