

Effect of foliar nutrient application of lac insect *Kerria lacca* (Kerr.) on *Schleichera oleosa*

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Research Article

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Abstract

The effect of foliar nutrient application on lac insect populations and lac production in *Schleichera oleosa* was studied on a lac grower's field during the 2020-21 and 2021-22 cropping seasons in the Aghani Kusmi lac crop at Raigarh district, Chhattisgarh. The study included five treatments: Micronutrients, Plant Growth Regulator (Chlormequat chloride 50% SL), Zinc, Boron, and Humic acid. Each treatment involved three foliar sprays applied at 30, 45, and 60 days after Brood Lac Inoculation (BLI). The results showed that the highest number of lac insects settled in the PGR treatment, followed by Zinc, Boron, Micronutrients, and Humic acid. There was a significant difference between PGR, Micronutrients, and Humic acid, while the Zinc and Boron treatments were comparable to PGR in terms of lac insect density at 30 days after BLI. The PGR treatment also recorded the highest survival percentage of lac insects, followed by Zinc, Boron, Micronutrients, and Humic acid. The mean fresh weight of sticklac and scrapped lac per 30 cm of stick length was highest in the PGR treatment, followed by Zinc, Boron, Micronutrients, and Humic acid. In conclusion, the application of PGR significantly enhanced lac insect settlement, survival, and lac production on *Schleichera oleosa*. Zinc and Boron also produced favorable results, though not as pronounced as PGR. Micronutrients and Humic acid treatments yielded lower results in terms of lac insect density and overall yield.

Introduction

The lac insect *Kerria lacca* (Kerr), a commercially significant species belonging to the family –Lacciferidae, order- Hemiptera, supper family- Coccidae and family- Lacciferidae is known for secreting lac resin, which is widely used in varnishes, dyes, food additives, and pharmaceuticals. From its over more than 400 plant species (Ramani et al., 2008), the most common host trees for lac cultivation are *Palash* (*Butea monosperma*), *Ber* (*Zyziphus mauritiana*), *Kusum* (*Schleichera oleosa*) and *Flemingia semialata* besides there are several trees of regional importance (Sharma et al., 1997; Pal, 2009; Singh et al., 2009; Mohanta et al., 2014). This insect feeds on, sometimes petiole, of host plant and is considered as phloem or salivary sheath feeder (Ahmad et al., 2012; Shah et al., 2014). Like other phytophagous insects it sucks cell sap, but unlike many homopterans which suck plant sap, throughout its life-cycle lac insect inserts its mouthparts only once and remains sedentary and continuous feeding on the same host plant (Imms and Chatterjee, 1915). Therefore, lac insect solely depends on host plant for its dietary requirements and causes depletion of nutrients and vigour in plants leading to few succulent branches and ultimately low productivity of lac in subsequent years (Shah et al., 2014).

Host plant nutrition is a key determinant of *K. lacca* productivity. Nutrient deficiencies can lead to poor resin secretion and reduced insect survival rates. Foliar nutrient application is advantageous as it allows direct and rapid nutrient absorption, improving the physiological health of host plants and enhancing lac insect performance (Sharma et al., 2020).

Foliar nutrient application has emerged as an effective method to supplement essential macro- and micronutrients directly to host plants, thereby influencing the growth and productivity of *K. lacca*. (Kumar & Mishra, 2018). Studies have shown that foliar sprays of nitrogen, phosphorus, potassium, and micronutrients such as zinc and iron contribute to better host plant health, which in turn provides an enriched substrate for lac insect colonization and resin production (Gupta et al., 2017). This review aims to explore the effects of foliar nutrient application on the lac insect *K. lacca*, focusing on its impact on insect growth, survival, and resin yield, with supporting evidence from recent studies.

Material Methods

The trial was conducted. Eighteen *Schleichera oleosa* host plants with succulent branches were marked to the study. The RBD format trial consisted of four replications and six treatments viz., Micro-nutrients, Zinc, Boron, PGR, Humic acid and Control i.e. water spray (Table 1). Three foliar sprays of each treatment at an interval of 15 days from the date of 1st spray were carried with a rocker sprayer. Lac insects were counted at 30, 45, 60 and 105 days after BLI from 3 randomly selected lac settled branches per plant at five fixed slots of 2.5 cm² per branch. The number of lac insect at the different observation dates compared with that at 30 days BLI for calculating the percentage survivability of lac insect using the formula-

$$\% \text{Survival of lac insect} = \frac{\text{Number of live cell per 2.5 cm}^2 \text{ succulent branch}}{\text{Total no. of cells per 2.5 cm}^2 \text{ succulent branch}} \times 100$$

Table 1
Foliar application of micronutrients, zinc, boron, PGR and Humic acid on *Kusumtree*

S. No.	Treatments	Dose/lit.	Spray schedule		
			1st spray (30DABLI)	2nd spray (45 DABLI)	3rd spray (60 DABLI)
T1	Micronutrients	2.5ml			
T2	Zinc	1gm			
T3	Boron	2gm			
T4	PGR	1ml			
T5	Humic acid	30ml			
T6	Control <i>i.e</i> (water spray)	-			
*Prophylactic spray of Indoxacarb 14.5%SC 30 days after broodlac inoculation in all treatments to minimize the incidence of predators and parasites of <i>K. lacca</i> , ** Three spray @ 15day interval from first spray					

Result and Discussion

Population Density of Aghani Kusmi Lac

From 30 days after Brood Lac Inoculation (BLI) until harvest, the mean settlement of lac insects was recorded per 2.5 sq. cm of succulent branches—specifically at 30, 45, 60, and 105 days after BLI (Table 2).

Table 2
Performance of micronutrient in settlement of Lac insect per 2.5 sq cm during 2020-21 and 2021-22

S.N	Nutrient	30 DABLI		Pooled	45 DABLI		Pooled	60 DABLI		Pooled	105 DABLI		Pooled
		2020-21	2021-22		2020-21	2021-22		2020-21	2021-22		2020-21	2021-22	
T1	Micronutrient (Zinc 3% + Manganese 0.50%+ Boran 0.10%)	48.40 (44.06)	47.95 (43.81)	48.17 (43.93)	44.45 (41.79)	43.65 (41.33)	44.05 (41.56)	38.20 (38.16)	37.55 (37.77)	37.87 (37.96)	22.75 (28.47)	21.45 (27.58)	22.10 (28.02)
T2	Zinc 12%	50.10 (45.04)	49.05 (44.44)	49.57 (44.74)	45.95 (42.66)	46.00 (42.69)	45.97 (42.67)	43.10 (41.02)	43.20 (41.07)	43.15 (41.04)	26.80 (31.16)	26.40 (30.90)	26.60 (31.03)
T3	Boron 20%	49.55 (44.72)	49.10 (44.45)	49.32 (44.58)	45.25 (42.26)	45.15 (42.19)	45.20 (42.22)	41.30 (39.97)	42.25 (40.52)	41.77 (40.24)	25.35 (30.22)	22.60 (28.37)	23.97 (29.29)
T4	PGR (Chlormequet Chloride 50% SL)	50.55 (45.29)	50.35 (45.18)	50.45 (45.23)	47.15 (43.35)	46.90 (43.20)	47.02 (43.27)	44.35 (41.74)	44.15 (41.62)	44.25 (41.68)	29.25 (32.72)	27.30 (31.49)	28.27 (32.10)
T5	Humic acid 5%	48.80 (44.29)	47.60 (43.61)	48.20 (43.95)	43.65 (41.33)	43.10 (41.02)	43.37 (41.17)	37.30 (37.62)	36.05 (36.88)	36.67 (37.25)	20.05 (26.59)	20.15 (26.67)	20.10 (26.63)
T6	Control (Water)	48.20 (43.95)	46.40 (42.92)	47.30 (43.43)	42.20 (40.49)	41.75 (40.23)	41.97 (40.36)	32.90 (34.99)	31.40 (34.07)	32.15 (34.53)	18.70 (25.61)	18.25 (25.28)	18.47 (25.44)
	CD (P = 0.005)	0.49	0.92		0.31	0.39		0.76	0.43		0.76	0.58	
	SEm =	0.16	0.30		0.10	0.13		0.25	0.14		0.25	0.19	
Note: Figures in parentheses are arc sign transformed value													

30 days after BLI

The mean number of lac insects settled per 2.5 sq. cm ranged from 48.40 to 50.55 across different treatments, compared to the untreated control (48.20 insects per 2.5 sq. cm of lac stick). The highest number of settled lac insects was observed in the PGR treatment (50.55), followed by Zinc (50.10), Boron (49.55), Humic Acid (48.80), and Micronutrient (48.40). During the 2020–21 season, there was no significant difference in the mean insect settlement among the five treatments. Similarly, during the 2021–22 season, the mean number of lac insects settled per 2.5 sq. cm ranged from 47.60 to 50.35 in various treatments, compared to the untreated control (46.40 insects per 2.5 sq. cm of lac stick). Once again, the PGR treatment recorded the highest insect count (50.35), followed by Boron (49.10), Zinc (49.05), Micronutrient (47.95), and Humic Acid (47.60). No significant differences were observed in insect settlement among the treatments during this season as well.

Based on the pooled mean across both years, the average number of insects settled per 2.5 sq. cm ranged between 48.17 and 50.45, in comparison to the untreated control (47.30 insects per 2.5 sq. cm). The PGR treatment recorded the highest insect settlement (50.45), followed by Zinc (49.57), Boron (49.32), Humic Acid (48.20), and Micronutrients (48.17), in descending order.

45 days after BLI

The second observation was recorded 15 days after the first spray. By this stage, lac insects had developed into individual lac cells after secreting resin over their bodies. At 45 days after BLI, the mean lac cell count per 2.5 sq. cm ranged from 43.65 to 47.15 across different treatments. The highest mean live lac cell count was observed in the PGR treatment (47.15), followed by Zinc (45.95), Boron (45.25), Micronutrient (44.45), and Humic Acid (43.65). There was no statistically significant difference among the five treatments. When comparing lac insect density from 30 to 45 days after BLI during the 2020–21 season, a slight reduction was observed at 45 days. In the 2021–22 season, the mean lac cell count per 2.5 sq. cm at 45 days after BLI ranged from 43.10 to 46.90 among the treatments, compared to the untreated control (41.75 insects per 2.5 sq. cm of lac stick). The PGR treatment again recorded the highest mean live lac cell count (46.90), followed by Zinc (46.00), Boron (45.15), Micronutrient (43.65), and Humic Acid (43.10). No significant differences were found among the treatments.

Based on the pooled mean across both years, the average number of lac insects settled per 2.5 sq. cm in different treatments ranged from 43.37 to 47.02, in comparison to the untreated control (41.97 insects per 2.5 sq. cm). The PGR treatment had the highest insect settlement (47.02), followed by Zinc (45.97), Boron (45.20), Micronutrient (44.05), and Humic Acid (43.37).

60 days after BLI

The third observation was recorded 15 days after the second spray. Compared to the untreated control (32.90 insects per 2.5 sq. cm lac stick), the mean live lac cell count at 60 days after BLI ranged from 37.30 to 44.35 across different treatments. The highest mean live lac cell count was observed in the PGR treatment (44.35), followed by Zinc (43.10), Boron (41.30), Micronutrient (38.20), and Humic Acid (36.05). During the 2020–21 season, there was no significant difference in lac insect density among the five treatments at 60 days after BLI. Similarly, in the 2021–22 season, the mean lac cell count per 2.5 sq. cm at 60 days after BLI ranged from 36.05 to 44.15 across treatments, compared to the untreated control (31.40 insects per 2.5 sq. cm lac stick). The PGR treatment recorded the highest mean live lac cell count (44.15), followed by Zinc (43.20), Boron (42.25), Micronutrient (37.55), and Humic Acid (36.05).

Based on the pooled mean from both years, the average number of insects settled per 2.5 sq. cm in different treatments ranged from 36.67 to 44.25, in comparison to the untreated control (32.15 insects per 2.5 sq. cm). The PGR treatment recorded the highest insect settlement (44.25), followed by Zinc (43.15), Boron (41.77), Micronutrient (37.87), and Humic Acid (36.67).

105 days after BLI

At 105 days after BLI, the mean live lac cell count per 2.5 sq. cm ranged from 20.05 to 29.25 across different treatments, compared to the untreated control (18.70 insects per 2.5 sq. cm lac stick). The highest mean live lac cell count was recorded in the PGR treatment (29.25), followed by Zinc (26.80), Boron (25.35), Micronutrient (22.75), and Humic Acid (18.70). All treatments showed a significant increase in live lac cell count per 2.5 sq. cm compared to the control. A significant difference was also observed among PGR, Micronutrient, and Humic Acid treatments, while Zinc and Boron treatments were statistically at par with PGR in terms of lac insect density compared to that observed at 30 days after BLI during the 2020–21 season. Similarly, during the 2020–21 season, the mean live lac cell count per 2.5 sq. cm at 105 days after BLI ranged from 20.15 to 27.30 across treatments, compared to the untreated control (18.25 insects per 2.5 sq. cm lac stick). The PGR treatment recorded the highest count (27.30), followed by Zinc (26.40), Boron (22.60), Micronutrient (21.45), and Humic Acid (20.15). There was a significant difference among PGR, Micronutrient, and Humic Acid, while Zinc and Boron remained statistically comparable to PGR in terms of lac insect density, as was also observed at 30 days after BLI.

Based on the pooled mean from both years, the average number of lac insects settled per 2.5 sq. cm ranged from 20.10 to 28.27 in various treatments, compared to the untreated control (18.47 insects per 2.5 sq. cm lac stick). The PGR treatment had the highest insect settlement (28.27), followed by Zinc (26.60), Boron (23.97), Micronutrient (22.10), and Humic Acid (20.10). There was a significant difference among PGR, Micronutrient, and Humic Acid treatments, while Zinc and Boron were statistically at par with PGR in terms of lac insect density at 30 days after BLI.

Survival of Lac insect (Per cent) per 2.5 sq cm

Survival of lac insect (per cent) at 45 days after BLI

The percent survival of lac insects under different treatments was calculated at 45 days after BLI, compared to the untreated control (87.55%). The highest survival rate was observed in the PGR treatment (93.27%), followed by Micronutrient (91.84%), Zinc (91.72%), Boron (91.32%), and Humic Acid (89.45%). The percent survival of lac insects differed significantly among the treatments. PGR recorded a significantly higher survival rate than all other treatments. However, Micronutrient, Zinc, Boron, and Humic Acid were statistically at par with each other during the 2020–21 season. Similarly, in the 2021–22 season, the survival percentage at 45 days after BLI was higher in all treatments compared to the untreated control (87.71%). Zinc recorded the highest survival rate (93.78%), followed by PGR (93.15%), Humic Acid (92.89%), Boron (91.95%), and Micronutrient (91.03%). A significant difference in survival rates was observed among the treatments. Zinc had a significantly higher survival percentage than all others, while PGR, Humic Acid, Boron, and Micronutrient were statistically comparable (Table 3).

Table 3
Survival of Lac insect (per cent) per 2.5 sq cm during 2020-21 and 2021-22

S.N	Nutrient	Survival of Lac insect (per cent) per 2.5 sq cm during 2020-21 and 2021-22								
		Survival of Lac insect (per cent) per 2.5 sq								
		45 DABLI		Pooled	60 DABLI		Pooled	105 DABLI		
		2020-21	2021-22		2020-21	2021-22		2020-21	2021-22	
T1	Micronutrient (Zinc 3% + Manganese 0.50%+ Boran0.10%)	91.84 (73.39)	91.03 (72.60)	91.43 (72.99)	78.92 (62.67)	78.31 (62.23)	78.61 (62.45)	47.00 (43.26)	44.73 (41.96)	45.86 (42.61)
T2	Zinc 12%	91.72 (73.27)	93.78 (75.34)	92.75 (74.30)	86.03 (68.03)	88.07 (69.77)	87.05 (68.90)	53.49 (46.98)	53.82 (47.23)	53.65 (47.10)
T3	Boron 20%	91.32 (72.85)	91.95 (73.61)	91.63 (73.23)	83.35 (65.89)	86.05 (68.04)	84.70 (66.96)	51.16 (45.65)	46.03 (42.70)	48.59 (44.17)
T4	PGR (Chlormequet Chloride 50% SL)	93.27 (74.98)	93.15 (74.80)	93.21 (74.89)	87.73 (69.48)	87.69 (69.43)	87.71 (69.45)	57.86 (49.51)	54.22 (47.40)	56.04 (48.45)
T5	Humic acid 5%	89.45 (71.02)	92.89 (74.55)	91.17 (72.78)	76.43 (60.97)	77.69 (61.79)	77.06 (61.38)	41.09 (39.85)	43.43 (41.20)	42.26 (40.52)
T6	Control (Water)	87.55 (69.31)	87.71 (69.46)	87.63 (69.38)	68.26 (55.68)	65.97 (54.29)	67.11 (54.98)	38.79 (38.51)	38.34 (38.24)	38.56 (38.37)
	CD (P = 0.05)	1.15	1.56		1.87	1.04		1.32	0.43	
	SEm =	0.38	0.51		0.61	0.48		0.43	0.14	
Note: Figures in parentheses are arc sign transformed value										

According to the pooled data, the survival rate of lac insects per 2.5 sq. cm ranged from 91.17–93.21% across treatments, compared to the untreated control (87.63%). The PGR treatment had the highest survival rate (93.21%), followed by Zinc (92.75%), Boron (91.63%), Micronutrient (91.43%), and Humic Acid (91.17%). However, there was no statistically significant difference in the percent survival of lac insects among the various treatments based on pooled analysis.

Survival of lac insect (per cent) at 60 days after BLI

At 60 days after BLI, the percent survival of lac insects in the various treatments was higher than in the untreated control (68.26%). The highest survival rate was observed in the PGR treatment (87.73%), followed by Zinc (86.03%), Boron (83.35%), Micronutrient (78.92%), and Humic Acid (76.43%). The percentage survival of lac insects differed significantly among the treatments. PGR showed a significantly higher survival rate than all other treatments. However, Zinc, Boron, Micronutrient, and Humic Acid were statistically at par with one another during the 2020–21 season. Similarly, in the 2021–22 season, the survival rate at 60 days after BLI was again higher in all treatments compared to the untreated control (68.26%). The highest survival rate was recorded in the Zinc treatment (88.07%), followed by PGR (87.69%), Boron (86.05%), Micronutrient (78.31%), and Humic Acid (77.69%). The differences in survival rates among the treatments were statistically significant. Zinc had a significantly higher survival percentage than all other treatments, while PGR, Boron, Micronutrient, and Humic Acid were statistically comparable (Table 3).

According to the pooled data, the survival rate of lac insects per 2.5 sq. cm ranged from 77.06–87.71% across treatments, compared to the untreated control (67.11%). The PGR treatment had the highest survival rate (87.71%), followed by Zinc (87.05%), Boron (84.70%), Micronutrient (78.61%), and Humic Acid (77.06%). The survival rate in PGR was significantly higher than in all other treatments, while Zinc, Boron, Micronutrient, and Humic Acid remained statistically at par with each other.

Survival of lac insect (per cent) at 105 days after BLI

At 105 days after BLI, the percent survival of lac insects in the various treatments was higher than in the untreated control (38.79%). The highest survival rate was recorded in the PGR treatment (57.86%), followed by Zinc (53.49%), Boron (51.16%), Micronutrient (47.00%), and Humic Acid (41.09%). The percent survival of lac insects differed significantly among treatments. PGR showed a significantly higher survival rate than all other treatments.

However, Zinc, Boron, Micronutrient, and Humic Acid were statistically at par with one another during the 2020–21 season. Similarly, during the 2021–22 season, the percent survival of lac insects at 105 days after BLI was again higher across all treatments compared to the untreated control (38.34%). PGR recorded the highest survival rate (54.22%), followed by Zinc (53.82%), Boron (46.03%), Micronutrient (44.73%), and Humic Acid (43.43%). Significant differences were observed in percent survival among the treatments. PGR again had a significantly higher survival rate than all other treatments, while Zinc, Boron, Micronutrient, and Humic Acid were statistically comparable (Table 3).

Fresh weight (g) of 30 cm sticklac and scrapped lac

Fresh weight (g) of 30 cm sticklac

Sticklac refers to the branches of lac host trees that are encrusted with mature lac insects and are ready for harvest. Compared to the untreated control (27.89 g per 30 cm lac stick), the mean fresh weight of sticklac per 30 cm ranged from 37.45 to 61.28 g during the 2020–21 season. The highest mean fresh weight was recorded in the PGR treatment (61.28 g), followed by Zinc (57.65 g), Boron (55.87 g), Micronutrient (45.27 g), and Humic Acid (37.45 g). The fresh weight was significantly higher in the PGR treatment than in all other treatments. However, the Zinc, Boron, Micronutrient, and Humic Acid treatments were statistically at par with one another. Similarly, during the 2021–22 season, the mean fresh weight of sticklac per 30 cm stick varied from 39.61 to 61.22 g, as compared to the untreated control (27.57 g per 30 cm lac stick). The PGR treatment again recorded the highest fresh weight (61.22 g), followed by Zinc (59.09 g), Boron (55.94 g), Micronutrient (45.45 g), and Humic Acid (39.61 g). As in the previous year, the PGR treatment had a significantly higher fresh weight than all other treatments, while Zinc, Boron, Micronutrient, and Humic Acid were statistically at par with one another (Table 4).

Table 4
Mean fresh weight (g) of 30 cm stick lac and scrapped lac of *Kusmi strain* of lac insect on Kusum tree (*Schleichera oleosa*) during 2020-21 to 2021-22.

S.N	Nutrient	Mean fresh weight (g) of lac stick per 30 cm			Mean fresh weight (g) of scrapped lac per 30 cm		
		2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
T1	Micronutrient (Zinc 3% + Manganese 0.50%+ Boran0.10%)	45.27 (42.27)	45.45 (42.37)	45.36 (42.32)	29.08 (32.62)	29.58 (32.93)	29.33 (32.77)
T2	Zinc 12%	57.65 (49.39)	59.09 (50.22)	58.37 (49.80)	44.73 (41.96)	44.03 (41.56)	44.38 (41.76)
T3	Boron 20%	55.87 (48.35)	55.94 (48.39)	55.91 (48.37)	40.50 (39.51)	40.47 (39.49)	40.49 (39.50)
T4	PGR (Chlormequet Chloride 50% SL)	61.28 (51.50)	61.22 (51.46)	61.25 (51.48)	45.62 (42.47)	45.88 (42.62)	45.75 (42.54)
T5	Humic acid 5%	37.45 (37.71)	39.61 (38.99)	38.53 (38.35)	21.17 (27.38)	21.59 (27.68)	21.38 (25.53)
T6	Control (Water)	27.89 (31.80)	27.57 (31.66)	27.68 (31.73)	17.97 (25.07)	18.95 (25.79)	18.46 (25.43)
CD (P = 0.05)		1.86	0.36		0.45	0.36	
SEm =		0.61	0.12		0.15	0.12	

According to the pooled data, the fresh weight of sticklac per 30 cm ranged from 38.53 to 61.25 g across treatments, compared to the untreated control (27.68 g per 30 cm lac stick). The highest fresh weight was observed in the PGR treatment (61.25 g), followed by Zinc (58.37 g), Boron (55.91 g), Micronutrient (45.36 g), and Humic Acid (38.53 g). The difference was statistically significant, with the PGR treatment yielding the highest fresh weight among all.

Fresh weight (g) of scraped lac per 30 cm

The mean fresh weight of scraped lac per 30 cm stick ranged from 21.17 to 45.62 g, as compared to the untreated control (21.17 g per 30 cm lac stick) during the 2020–21 season. The highest fresh weight was recorded in the PGR treatment (45.62 g), followed by Zinc (44.73 g), Boron (40.50 g), Micronutrient (29.08 g), and Humic Acid (21.17 g). The fresh weight was significantly higher in the PGR treatment than in all other treatments. However, Zinc, Boron, Micronutrient, and Humic Acid were statistically at par with one another. Similarly, during the 2021–22 season, the mean fresh weight of scraped lac per 30 cm stick followed the same trend. PGR again recorded the highest value (45.62 g), followed by Zinc (44.73 g), Boron (40.50 g), Micronutrient (29.08 g), and Humic Acid (21.17 g). As in the previous year, the PGR treatment showed a significantly higher fresh weight than all others (Table 4).

Based on pooled data, the fresh weight of scraped lac per 30 cm ranged from 21.59 to 45.88 g across treatments, compared to the untreated control (18.95 g per 30 cm lac stick). The PGR treatment had the highest mean fresh weight (45.88 g), followed by Zinc (44.03 g), Boron (40.47 g), Micronutrient (29.58 g), and Humic Acid (21.59 g). The difference was statistically significant, with PGR yielding the highest scraped lac weight among all treatments.

Discussion

Plants require a minimum amount of nutrients for survival, growth, and propagation, which they generally absorb from the soil. However, when the soil lacks the capacity to supply adequate nutrients, supplemental application becomes necessary. Furthermore, if another organism—such as lac insects—derives its nourishment from the plant, additional nutrients must also be provided to support both the host and the dependent organism. In the current study, it was observed that the application of Plant Growth Regulators (PGRs), which tend to suppress plant growth, may reduce the utilization of primary metabolites for vegetative growth. This, in turn, could result in a higher concentration of these metabolites in the phloem sap, thereby supporting increased survivability of *Kerria lacca*.

The yield of raw lac on *Schleichera oleosa* with foliar application of nutrient treatments showed a significant increase over the untreated control. This improvement is likely due to enhanced nutrient management of the host plant. These findings align with those of Ghugal et al. (2016b), Sharma et al. (2015a), Kumar et al. (2017b), Shah and Thomas (2017), and Namdev (2014), who reported that nutrient management of host trees significantly improves mean lac cell number, insect survivability, and lac stick weight when compared to untreated controls. Overall, the present study confirms that proper nutrient management of the host plant not only boosts lac productivity but also promotes better host plant health and growth.

Conclusion

Foliar nutrient application plays a crucial role in enhancing the health and vigor of host plants, which subsequently leads to improved lac insect productivity and increased resin yield. To ensure sustainable and efficient lac production, future research should aim at optimizing nutrient formulations and determining the most effective application schedules.

Declarations

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Figures

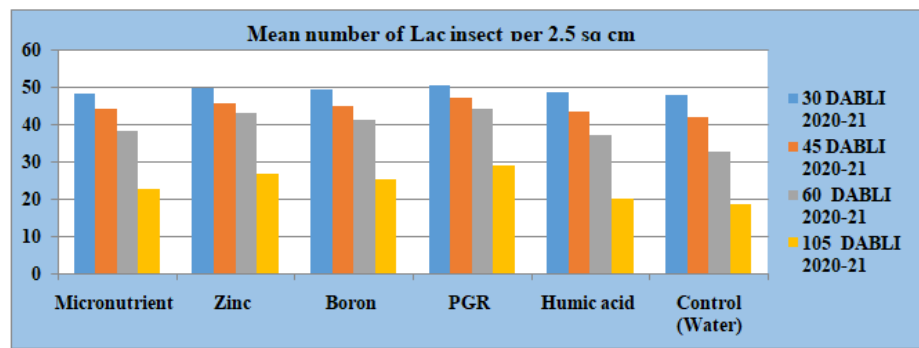


Fig 1: Performance of micronutrient in settlement of lac insect during 2020-21

Figure 1

Fig 1: Performance of micronutrient in settlement of lac insect during 2020-21

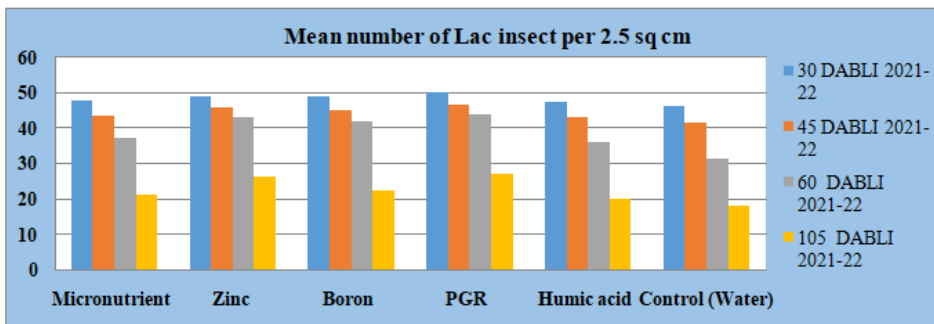


Fig 2: Performance of micronutrient in settlement of lac insect during 2021-22

Figure 2

Fig 2: Performance of micronutrient in settlement of lac insect during 2021-22

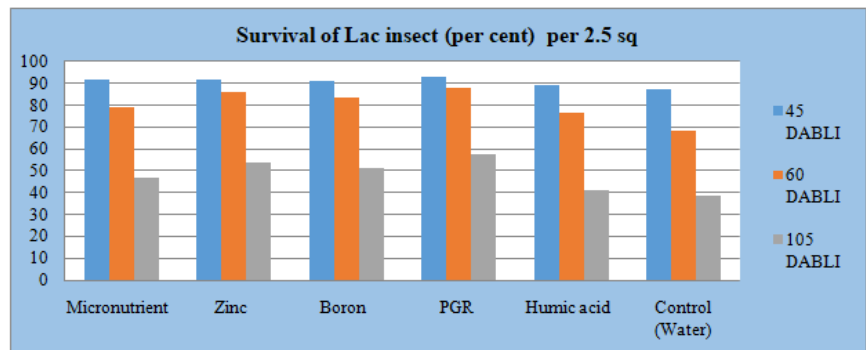


Fig 3: Survival of Lac insect (per cent) in different nutrient foliar application during 2020-21

Figure 3

Fig 3: Survival of Lac insect (per cent) in different nutrient foliar application during 2020-21

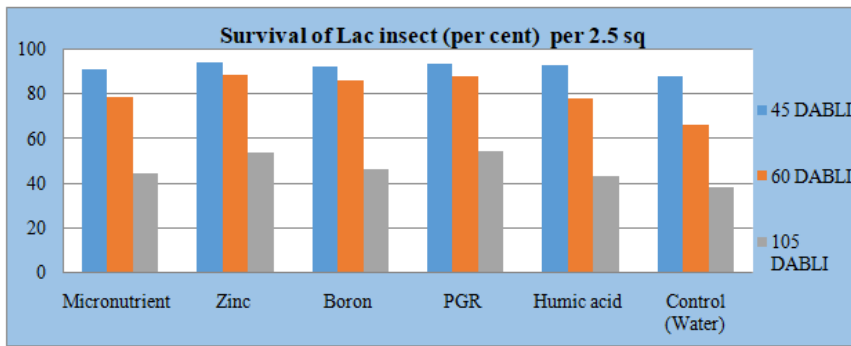


Fig 4: Survival of Lac insect (per cent) in different nutrient foliar application during 2021-22

Figure 4

Fig 4: Survival of Lac insect (per cent) in different nutrient foliar application during 2021-22

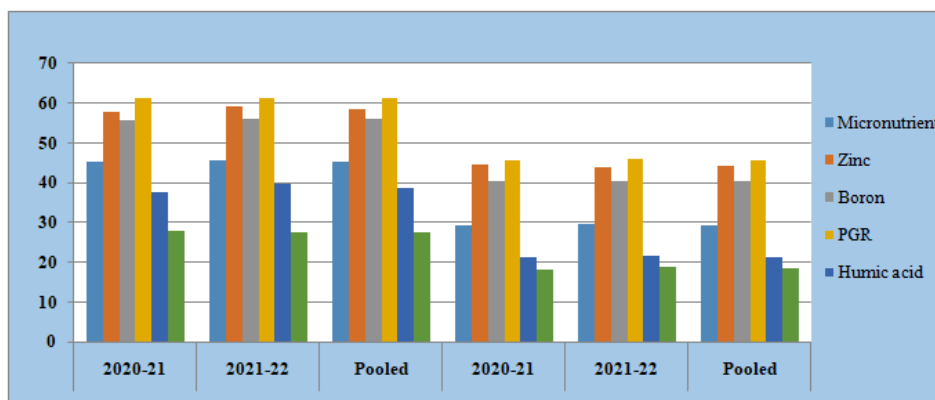


Fig 5: Fresh weight (g) of 30 cm stick lac and scrapped lac in different nutrient foliar application during 2020-21 to 2021-22

Figure 5

Fig 5: Fresh weight (g) of 30 cm stick lac and scrapped lac in different nutrient foliar application during 2020-21 to 2021-22

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