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## Effect of different insecticides on survival of lac insect *K. lacca* (Kerr.) and increase in productivity on *Schleichera oleosa*

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### Abstract

The present investigation on “Effect of different insecticides on survival of lac insect *K. lacca* (Kerr.) on *Schleichera oleosa*” was conducted farmers field at Raigarh district of Chhattisgarh during *aghani* season 2020-21 to 2021-22. Four insecticides with different doses, Spinosad @ 0.005, 0.020, Fipronil @ 0.005, 0.020, Emamectin Benzoate @ 0.002, 0.003, and Rynaxypyr @ 0.005 and 0.010, were tested for lac insect safety on *aghani* kusmi lac crop, along with the check insecticide Indoxacarb @ 0.007 percent. Overall impact of insecticidal application, emamectin benzoate @ 0.002 percent was found very much effective in survival percent of lac insect with 88.89, 86.87 and 85.98 percent survival of lac insect/2.5 sq.cm lac stick at first spray 30 day after BLI, second spray 60 day after BLI and 90 day after BLI, respectively and maximum scraped lac production 47.05 g/30 cm lac stick and maximum lac production increase 33.76 percent was recorded and rest of of the insecticides were significantly differed as compared to the untreated control.

**Keywords:** *Kerria lacca*, Insecticide, survival of lac insect and *Schleichera oleosa*, *aghani* season

### 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)<sup>[4]</sup> from its over more than 400 plant species (Ramani *et al.*, 2008)<sup>[15]</sup>. 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; Kumar *et al.*, 2007a; Pal, 2009; Singh *et al.*, 2009; Mohanta *et al.*, 2014; Shah *et al.*, 2018)<sup>[21, 10, 13, 18, 12, 20]</sup>. A survey indicates that on an average around 28 percent of total agriculture income is contributed by lac cultivation (Jaiswal *et al.*, 2006)<sup>[7]</sup>. About 3 to 4 million people are involved in Lac production in India (Rao and Singh, 1990)<sup>[14]</sup>.

The major districts in Chhattisgarh were Korba (960ton), Kanker (740ton), Bilaspur (225ton) and Bastar (115ton), consecutively, in terms of lac production scenario during 2011-12. Out of entire lac productions in the country, 80-85 % is from *Rangeeni* strain which is contributed mainly by Palas followed by Ber, the most widely spread hosts in India. However, Kusum produces the highest quality resin of the *Kusmi* strain, followed by Ber in India. Due to *Rangeeni's* limited distribution, its contribution to total production is only about 15-20%. Palas has a 60-65% lac output rate, while Ber has a 20-25 percent lac production rate.

The lac insect during its life cycle spends only few hours of active mobility and thereafter spends a complete sedentary life and hence they are prone to be attacked by many insect predators and parasitoids, causing substantial damage to the lac crop qualitatively and quantitatively (Singh *et al.*, 2011a)<sup>[19]</sup>. Predators cause around 35 to 40 percent loss to lac production (Jaiswal *et al.*, 2008)<sup>[8]</sup> while 5 to 10 percent damage by parasitoids (Varshney, 1976)<sup>[23]</sup>. Several management efforts to reduce the yield loss due to predators and parasitoids range from cultural and physical (Horn and Page, 2008; Bhattacharya *et al.*, 2006)<sup>[6, 2]</sup>, biological (Bhattacharya *et al.*, 2008; SiMing *et al.*, 2010)<sup>[3, 16]</sup> and chemical there (Singh *et al.*, 2009). Ever since the Government of India has banned Endosulfan, there is a felt need to evaluate newer and safer insecticides for the management of predators and parasitoids of lac insect (Arora *et al.*, 2009)<sup>[1]</sup>.

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## Materials and Methods

*Kusum* trees which were more than 10-20 years old, healthy, pruned by farmers and possessed sufficient succulent branches were selected for the present study. After 30, 60 and 90 days of brood *lac* inoculation first, second and third spray was carried out subsequently. In case of untreated control water treatment was done.

Three 30cm *lac* stick from each treatment were collected after 10 days of insecticides application and the settlement of *lac* insect larvae and mortality of *lac* insects were recorded in order to assess safety of the insecticides towards *lac* insect and counted the live and dead cells of *lac* insect 2.5 cm<sup>2</sup> of selected twigs (upper middle and lower), 2.5 cm<sup>2</sup> lengths was measured by using the Vernier calliper scale. Number of live and dead *lac* insect cell were counted and converted into percentage survival of *lac* insects.

$$\% \text{ survival of } lac \text{ insect} = \frac{\text{Number of live } lac \text{ cell}}{\text{Number of total } lac \text{ cell}} \times 100$$

The effect of insecticidal treatment on *lac* productivity was assessed on the basis of dry weight of scrap *lac* per 30cm *lac* encrustation at maturity. The *lac* was scraped from matured *lac* bearing twigs (*lac* stick) and weight of scraped *lac* per 30cm *lac* encrustation was recorded from each treatment. The percent increase in *lac* productivity over controlled was calculated.

$$\% \text{ increase in productivity} = \frac{\text{Insecticide treated value} - \text{untreated value}}{\text{Insecticide treated value}} \times 100$$

## Result and Discussion

### First insecticidal application (30 DABLI)

Four insecticides with different doses, Spinosad @ 0.005, 0.020, Fipronil @ 0.005, 0.020, Emamectin Benzoate @ 0.002, 0.003, and Rynaxypyr @ 0.005 and 0.010, were tested for *lac* insect safety on *aghani kusmi lac* crop, along with the check insecticide Indoxacarb @ 0.007 percent. These insecticides were found to be less harmful to *lac* insects and had no negative effects on *lac* culture, while *lac* insect survival ranged from 62.14 to 88.65 percent. Emamectin Benzoate @ 0.002 percent received maximum *lac* insect survival percent of 88.65 which was found at par with Emamectin Benzoate @ 0.003 percent, Spinosad @ 0.020 percent, Rynaxypyr @ 0.010 percent which were received survival percent of 83.28, 80.78 and 80.29 after 1st treatment of insecticides but differed significantly from rest of the treatments, so far as the survival of *lac* insect is concerned. Rynaxypyr @ 0.005 percent and Spinosad @ 0.005 percent were the most harmful to *lac* insect survival, with only 62.14 and 62.19 percent survival, respectively, and were on par with fipronil @ 0.020 (76.59 percent), check insecticide Indoxacarb @ 0.007 percent (75.93 percent and fipronil @ 0.005 percent (69.49 percent). Significant reductions in *lac* insect survival were observed with the application of various insecticides, indicating a negative effect on *lac* culture; therefore, they cannot be recommended at the crop development stage during 2020-21.

Similarly, in 2021-22, Emamectin benzoate @ 0.002 percent was the least harmful to *lac* insect survival, with a maximum of 89.13 percent survival. It was comparable to Emamectin

Benzoate at 0.003 percent (83.73 percent), Rynaxypyr at 0.010 percent (80.41 percent), Spinosad at 0.020 percent (80.17 percent), and Check insecticide Indoxacarb at 0.007 percent (75.83 percent), but it differed significantly from the other treatments in terms of *lac* insect survival. Rynaxypyr @ 0.005 percent had the lowest survival percentage. It was most harmful to the *lac* insect, with least 62.41 percent survival.

The overall pooled mean survival percentage of *lac* insect among all treatments ranged from 62.27 to 88.89 percent. Emamectin benzoate @ 0.002 percent had the highest maximum survival rate of 88.89 percent, followed by Emamectin Benzoate @ 0.003 percent (80.50 percent), Spinosad @ 0.020 percent (80.47 percent), and Rynaxypyr @ 0.010 percent (80.35 percent), while Rynaxypyr @ 0.005 percent (62.27 percent) had the lowest minimum survival rate.

### Second insecticidal application (60 DABLI)

The second spraying was given 60 days after inoculation, and the percent survival of the *lac* insect was recorded. It was discovered that all insecticide concentrations differed significantly from the untreated crop. Emamectin benzoate @ 0.002 percent was least harmful to *lac* insect with maximum 86.67 percent survival, which was found to be comparable to Emamectin Benzoate @ 0.003 percent (84.62 percent) and Spinosad @ 0.020 percent (80.24 percent), whereas Spinosad @ 0.005 percent (62.31 percent) had the most detrimental effect on *lac* insect in the year 2020-21.

Similarly, in 2021-22, Emamectin benzoate @ 0.002 percent was the least harmful to *lac* insect survival, with a maximum of 87.08 percent survival. It was comparable to Emamectin Benzoate at 0.003 percent (85.01 percent), Rynaxypyr at 0.010 percent (80.08 percent), and Spinosad at 0.020 percent (80.00 percent), but it differed significantly from the other treatments in terms of *lac* insect survival. Spinosad had the lowest survival rate (0.005 percent), and it was the most harmful to the *lac* insect, with a minimum survival rate of 62.99 percent.

The overall pooled mean survival rate of *lac* insect among all treatments ranged from 62.65 to 86.87 percent. Emamectin benzoate @ 0.002 percent was found to have the highest maximum survival rate of 86.87 percent, followed by Emamectin Benzoate @ 0.003 percent (84.81 percent) and Spinosad @ 0.020 percent (80.12 percent), while Spinosad @ 0.005 percent (62.65 percent) had the lowest minimum survival rate.

### Third insecticidal application (90 DABLI)

The third spraying was given 90 days after inoculation, after which the percent survival of the *lac* insect was recorded, and it was discovered that all insecticide concentrations differed significantly from the untreated crop. Emamectin benzoate @ 0.002 percent was least harmful to *lac* insect with maximum 85.69 percent survival, which was found to be comparable to Emamectin Benzoate @ 0.003 percent (84.74 percent) and Spinosad @ 0.020 percent (79.85 percent), whereas Spinosad @ 0.005 percent (62.50 percent) had the most detrimental effect on *lac* insect in the year 2020-21.

Similarly, in 2021-22, Emamectin benzoate @ 0.002 percent was the least harmful to *lac* insect survival, with a maximum of 86.27 percent survival. It was comparable to Emamectin Benzoate at 0.003 percent (85.25 percent), Fipronil at 0.020 percent (80.04 percent), and Rynaxypyr at 0.010 percent (80.02 percent) in terms of *lac* insect survival, but it differed

significantly from the other treatments. Rynaxypyr @ 0.005 percent had the lowest survival rate and it was the most harmful to lac insects, with a minimum survival rate of 62.60 percent.

The overall pooled mean survival percentage of lac insect among all treatments ranged from 62.67 to 85.98 percent. Emamectin benzoate @ 0.002 percent was found to have the highest maximum survival rate of 85.98 percent followed by Emamectin Benzoate @ 0.003 percent (84.99 percent), Fipronil @ 0.020 percent (79.87 percent), Rynaxypyr @ 0.010 percent (79.80 percent) and Spinosad @ 0.020 percent (79.78 percent) whereas minimum survival percent was recorded in Rynaxypyr @ 0.005 percent (62.67 percent), indicating its most detrimental effect on lac insect.

### Effect of insecticides on productivity of scrap lac

The mean weight of scrap lac per 30 cm lac stick varied from 43.15 to 47.22 g in different treatments when compared to the untreated control (31.22 g per 30 cm lac stick). Maximum scraped lac was 47.22 g for emamectin benzoate @ 0.002 percent, followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, fipronil @ 0.020 percent, rynaxypyr @ 0.010 percent, spinosad @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent, rynaxypyr @ 0.005 per with 46.11 g, 45.84 g, 45.72 g, 45.60 g, 45.33 g, 44.84 g, 43.78 g and 43.15 g, respectively during the year 2020-21.

The percentage increase in scrap lac production over the untreated control in different treatments ranged from 27.65 to 33.88. The maximum scrap lac production increased over the untreated control by 33.88 percent in emamectin benzoate @ 0.002 percent, followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, fipronil @ 0.020 percent, rynaxypyr @ 0.010 percent, spinosad @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent

and rynaxypyr @ 0.005 percent with 32.29, 31.89, 31.71, 31.53, 31.13, 31.71, 30.37, 28.69 and 27.65 percent, respectively.

Similarly 2021-22, the mean weight of 30 cm scraped lac varied from 43.54 to 46.80 g in different treatments when compared to the untreated control (31.11 g per 30 cm lac stick). The highest scraped lac was recorded in emamectin benzoate @ 0.002 percent with 46.89 g followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, rynaxypyr @ 0.010 percent, spinosad @ 0.020 percent, fipronil @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent and rynaxypyr @ 0.005 per with 46.23 g, 45.67 g, 45.41 g, 45.21 g, 45.11 g, 44.65 g, 43.67 g and 43.54 g, respectively.

The percentage increase in scrap lac production from various treatments over the untreated control ranged from 28.55 to 33.65. The greatest increase in lac production (33.65 percent) was recorded in emamectin benzoate at 0.002 percent, followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, rynaxypyr @ 0.010 percent, spinosad @ 0.020 percent, fipronil @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent and rynaxypyr @ 0.005 percent with 32.71, 31.88, 31.49, 31.19, 31.03, 30.32, 28.76 and 28.55 percent, respectively.

Based on pooled means, the average weight of 30 cm scraped lac in various treatments ranged from 43.34 to 47.05 g as compared to the untreated control (31.16 g per 30 cm lac stick). The maximum scraped lac production was recorded from emamectin benzoate @ 0.002 percent with 47.05 g followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, rynaxypyr @ 0.010 percent, fipronil @ 0.020 percent, spinosad @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent and rynaxypyr @ 0.005 per with 46.11 g, 45.75 g, 45.50 g, 45.41 g, 45.27 g, 44.74 g, 43.72 g and 43.34 g, respectively.

**Table 1:** Survival of lac insect as affected by different insecticides during 2020-21 and 2021-22

S.N	Insecticide	Conc.	Percent survival of lac insect per 2.5 sq cm lac stick									Mean weight of scrap lac (g) 30cm lac stick		Production of scrap lac increase over control (%)			
			30 DABLI		Pooled	60 DABLI		Pooled	90 DABLI		Pooled	Pooled	Pooled				
			2020-21	2021-22		2020-21	2021-22		2020-21	2021-22				2020-21	2021-22		
T1	Spinosad 45%SC	0.005%	62.19 (52.04)	63.97 (53.09)	63.08 (52.56)	62.31 (52.11)	62.99 (52.51)	62.65 (52.31)	62.50 (52.22)	63.07 (52.55)	62.78 (52.38)	43.78	43.67	43.72	28.69	28.76	28.72
T2	Spinosad 45%SC	0.020%	80.78 (63.98)	80.17 (63.53)	80.47 (63.75)	80.24 (63.59)	80.00 (63.41)	80.12 (63.50)	79.85 (63.32)	79.72 (63.21)	79.78 (63.26)	45.33	45.21	45.27	31.13	31.19	31.16
T3	Fipronil 5%SC	0.005%	69.49 (56.45)	70.43 (57.04)	69.96 (56.74)	76.60 (61.07)	76.88 (61.24)	76.74 (61.15)	76.85 (61.24)	76.96 (61.29)	76.90 (61.26)	44.84	44.65	44.74	30.37	30.32	30.34
T4	Fipronil 5%SC	0.020%	76.59 (61.05)	75.67 (60.43)	76.13 (60.74)	77.31 (61.53)	77.12 (61.39)	77.21 (61.46)	79.71 (63.20)	80.04 (63.45)	79.87 (63.32)	45.72	45.11	45.41	31.71	31.03	31.37
T5	Emamectin Benzoate 5%SG	0.002%	88.65 (70.29)	89.13 (70.73)	88.89 (70.51)	86.67 (68.57)	87.08 (68.93)	86.87 (68.75)	85.69 (67.75)	86.27 (68.22)	85.98 (67.98)	47.22	46.89	47.05	33.88	33.65	33.76
T6	Emamectin Benzoate 5%SG	0.003%	83.28 (65.84)	83.73 (66.19)	80.50 (66.01)	84.62 (66.91)	85.01 (67.19)	84.81 (67.05)	84.74 (67.00)	85.25 (67.39)	84.99 (67.19)	46.11	46.23	46.11	32.29	32.71	32.50
T7	Rynaxypyr 20%SC	0.005%	62.14 (52.01)	62.41 (52.17)	62.27 (52.09)	63.24 (52.66)	63.22 (52.64)	63.23 (52.65)	62.74 (52.36)	62.60 (52.28)	62.67 (52.32)	43.15	43.54	43.34	27.65	28.55	28.10
T8	Rynaxypyr 20%SC	0.010%	80.29 (63.62)	80.41 (63.71)	80.35 (63.66)	79.89 (63.34)	80.08 (63.47)	79.98 (63.40)	79.58 (63.12)	80.02 (63.43)	79.80 (63.27)	45.60	45.41	45.50	31.53	31.49	31.51
T9	Indoxacarb 14.5%SC (Check)	0.007%	75.93 (60.59)	75.83 (60.53)	75.88 (60.56)	76.39 (60.91)	76.99 (61.31)	76.69 (61.11)	78.17 (62.12)	78.19 (62.13)	78.18 (62.12)	45.84	45.67	45.75	31.89	31.88	31.88

T10	Control (Water)	-	80.02 (63.43)	79.10 (62.77)	79.56 (63.10)	68.89 (56.08)	67.45 (55.39)	68.17 (55.73)	65.67 (54.10)	63.79 (53.01)	64.73 (53.55)	31.22	31.11	31.16	0.00	0.00	0.00
	CD (P=0.005)		1.38	1.38		1.94	3.74		1.79	1.61							
	SEm =		0.46	0.46		0.65	1.25		0.60	0.54							
	CV (%)		1.31	1.30		1.85	3.56		1.71	1.53							

Note: Figures in parentheses are arc sign transformed value

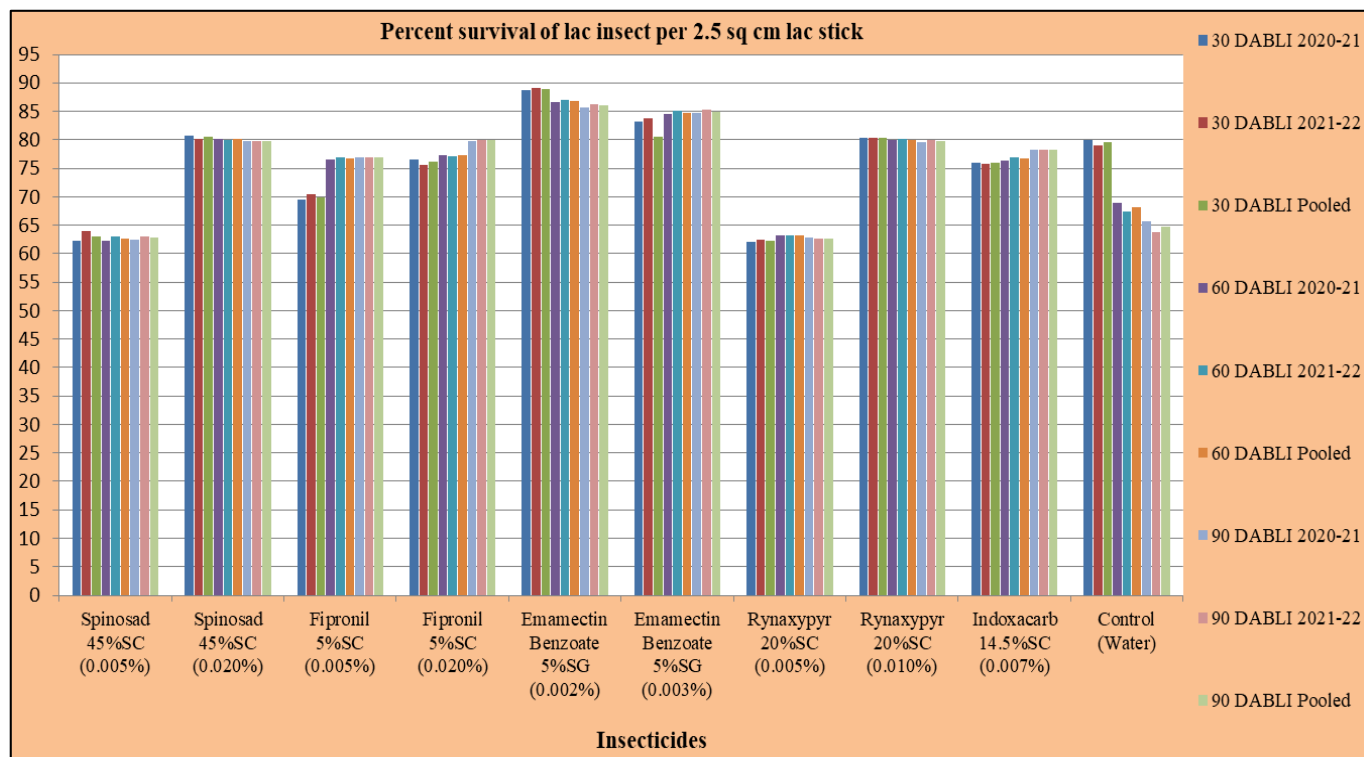


Fig: Percent survival of lac insect as affected by different insecticides

The overall increase in pooled scrap lac production per 30 cm lac stick over untreated control varied from 28.10 to 33.76 percent. The maximum lac production increase (33.76 percent) was recorded in emamectin benzoate @ 0.002 percent followed by emamectin benzoate @ 0.003 percent, indoxacarb @ 0.007 percent, rynaxypr @ 0.010 percent, fipronil @ 0.020 percent, spinosad @ 0.020 percent, fipronil @ 0.005 percent, spinosad @ 0.005 percent and rynaxypr @ 0.005 percent with 32.50, 31.88, 31.51, 31.37, 31.16, 30.34, 28.72 and 28.10 percent increase over untreated control.

The present investigation similar trend found by Meshram (2018) [11] how reported emamectin benzoate @ 0.002 percent most effective in suppressing the population of lac insect predators viz. *E. amabilis* (Moore) and *P. pulverea* (Mayrick) and parasitoid, *T. tachardi* (How) and relatively less toxic to lac insect. Singh (2013) [17] reported that insecticides viz. indoxacarb, fipronil, spinosad, ethofenprox, endosulfan, bifenthrin, lambda-cyhalothrin and carbosulfan suppressed parasitoids and predators of lac insect. Uike et al. (2016) [22] reported that different doses of rynaxypr (20SC @ 0.007-0.009 percent) and emamectin benzoate (5SG @ 0.0015-0.002 percent) were much effective in suppressing the population of lac predators. Jaiswal et al. (2017) [9] reported emamectin benzoate effective against lepidopteran predators, *E. amabilis* and *P. pulverea* at 0.00025 percent concentration for *rangeeni* brood lac and 0.0005 percent concentration for *kusmi* strain. It was found safe to lac insect and effective against lepidopteron predators of lac insect in integrated IPM programme of lac production system.

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