

Original Research Article

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## Efficacy of New Insecticide Molecules against Major Predatory Insects in Kusmi Lac

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### ABSTRACT

#### Keywords

Kusmi lac, *Kerria lacca*,  
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The study was carried out for the assessment of abundance of predatory insects associated with lac insect *Kerria lacca* (Kerr) and their management through new insecticide molecule in kusmi lac during July-October 2015-16 and 2016-17. A combination of Emamectin benzoate 5 % SG +Carbendazim 50 WP (T<sub>1</sub>), Indoxacarb 14.5 % SC + Carbendazim 50 WP (T<sub>2</sub>) and Control (T<sub>3</sub>) was evaluated against the predators of the lac insect. Pesticides application significantly reduced the incidence of major predators *Eublemma amabilis* Moore and *Pseudohypatopa pulvereana* Mayr in comparison to (T<sub>3</sub>). There was a reduction in the population of predatory insects 81.97 per cent in T<sub>1</sub> and 77.78 per cent T<sub>2</sub> respectively over the year. It was seen that the different samples of lac collected from different lac growing areas of Chhattisgarh and noted that not a single sample was free from the attack of predator *Eublemma amabilis* Moore and *Pseudohypatopa pulvereana* Mayr and appeared as major problem of lac host plants and losses consideration level in most of the areas.

### Introduction

Lac is a natural, biodegradable, non-toxic, odour less, taste less, hard resin, non-injurious to health and non- timber forest produce (NTFP). Lac is one of the most valuable gifts of nature and only resin of animal origin secreted by a tiny scale insect, *Kerria lacca* (Kerr.) belonging to the family *Lacciferidae* (*Kerriidae*), superfamily *Coccoidea* and order *Hemiptera* (Pal, 2009 and Mohanta *et al.*, 2012). Lac is an export oriented commodity, cultivated in the states of Jharkhand, Chhattisgarh, West Bengal, Madhya Pradesh, Odisha, Maharashtra, parts of Uttar Pradesh,

Andhra Pradesh, Gujarat and NEH region. Chattisgarh is today the major contributor of raw lac followed by Jharkhand. Lac cultivation is one of the important secondary sources of income for villagers and this is particularly more in the tribal districts. The important lac producing areas in the state are Kanker, Korba, Raigarh, Rajnandgaon and Bilaspur. On an average around 28 per cent of total agriculture income of the households is contributed by lac cultivation (Jaiswal *et al.*, 2006), and more than 80 per cent of lac produced in India is exported (Pal *et al.*, 2010; Ramani and Sharma, 2010). The lac insect is prone to attack by insect predators and

parasitoids. Among them, two Lepidopteron predators, *Eublemma amabilis* Moore (Lepidoptera: Noctuidae) and *Pseudohypatopa pulverea* Mayr (Lepidoptera: Blastobasidae) are key pests causing a loss due to bore into the lac encrustation where they remain confined while they feed on the lac insects. In case of severe infestation, these predators have been reported to cause complete crop failure and are severe bottlenecks in introducing lac culture in new areas. Predators cause around 35 to 40 per cent loss to lac production, while 5 to 10 per cent damage by parasitoids (Jaiswal *et al.*, 2008). 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), biological (Bhattacharya *et al.*, 2008; SiMing *et al.*, 2010), and chemical (Singh *et al.*, 2009). Ever since the Government of India has banned endosulfan, there was a felt need to evaluate newer and safer insecticides for the management of predators and parasitoids of lac insect (Arora *et al.*, 2009). Hence the present research entitled lac associated major predatory insects and their management through new insecticide molecule in kusmi lac of Chhattisgarh plains.

### Materials and Methods

The study was carried out on kusmi lac for predatory insects associated with lac insect *Kerria lacca* (Kerr) and their management through new insecticide molecule during July-October 2015-16 and 2016-17. The experimental site is located on the Northern part of Chhattisgarh and lies at 21°54'N latitude and 83°24' E longitude with an altitude of 215 m above the mean sea level (MSL). The field experiments was conducted on kusmi lac (*Schleichera oleosa*) crop with rocking Gator/Foot sprayer and will be targeted on lac bearing tender twigs to cover the lac encrustation with insecticidal spray. The experiment was laid out in randomized

block design comprising three treatments *i.e.* T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup> at 30 days and 60 days after BLI (Brood lac inoculation)], T<sub>2</sub> [Indoxacarb 14.5 % SC @ 0.48ml lit<sup>-1</sup> + Carbendazim Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup> at 30 days and 60 days after BLI] and T<sub>3</sub> [Control (Lac growers practice *i.e.* no use of insecticide)] with replicated three times and 10 nos. of women lac growers.

For quantification of predators in lac culture, both treated and untreated lac bearing sticks of 15cm shoot length from each treatment will be collected 15 days after first and second spraying as well as the stage of crop maturity (brood harvesting) following the method of stratified destruction random sampling. The sample will be kept in 60 mesh nylon net bags to assess larvicidal action of the insecticides on lepidopteron predators (*Eublemma amabilis* and *Pseudohypatopa pulverea*) of lac insect. The number of living and dead larva as well as adult moths emerged from the caged samples will be quantified in terms of predators per 15 cm lac encrustation and percentage reduction in the incidence of predators will be calculated subsequently.

$$\% \text{ Reduction of Predators} = \frac{\text{Untreated value} - \text{Insecticide treatment value}}{\text{Untreated value}} \times 100$$

At harvest the yield was recorded kg/tree in each treatment. The comparative increase in lac yield and benefit cost ratio (increment lac yield and B:C ratio) was calculated by subtracting market value of lac yield in control taking into account the prevailing market price of product, input and labor charges.

$$\text{Avoidable loss (\%)} = \frac{\text{Yield of protected treatment} - \text{Yield of unprotect treatment}}{\text{Yield of protected treatment}} \times 100$$

## Results and Discussion

### Efficacy of new insecticide molecules

The present study was conducted on *E. amabilis* Moore and *Pseudohypatopa pulvereana* Mayr incidence was recorded from randomly selected 15 cm lac sticks of each treatment depicted in table 1. The insecticidal treatments were applied two times, first at 30 days of brood lac inoculation (BLI) and second 60 days of brood lac inoculation (BLI). After first spray among the treatments on the basis of pooled mean data recorded on 30 DABLI indicate T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] was recorded least infestation 1.90 insect / 15 cm lac stick and 1.5 insect / 15 cm lac stick recorded on 60 DABLI, respectively.

The next effective treatment in order of efficacy was T<sub>2</sub> [Indoxacarb 14.5 % SC @ 0.48 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] showed that 2.03 insect / 15 cm lac stick on 30 DABLI and 1.81 insect / 15 cm lac stick recorded after 60 DABLI as compare to farmers practices T<sub>3</sub> [Control (Lac growers practice i.e. no use of insecticide)] showed maximum predatory insects/15 cm lac stick 4.67 on 30 DABLI and 8.33 on 60 DABLI during the year 2015-16 to 2016-17.

The population of predatory insects was varied from 1.5 to 8.33 insect / 15 cm of lac stick. Regarding per cent reduction of the population of *E. amabilis* and *P. pulvereana* in different treatments, it varied from 77.78 to 81.97 per cent over control. Among the treatment, T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] was the best treatment with maximum reduction 81.97 per cent during both the year (Table 2). The present study evidenced by Jaiswal *et al.*, (2017) and Meshram *et al.*, (2018) evaluated the safety of Emamectin benzoate against lac insect *K. lacca* Kerr and bioefficacy against

associated lepidopteron predators in lac culture.

### Economic analysis

Economic performance of new molecules against lac predatory insects depicted in (Table 2). The results revealed that the higher average yield 2.15 q<sup>-3</sup> trees and avoidable loss 49.30 per cent and average net return 17525 Rs. per three (03) in treated trees T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] and 2.01 q/3 trees average yield with 15570 Rs. per three (3) trees average net return in treated trees T<sub>2</sub> [Indoxacarb 14.5 % SC @ 0.48 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] as compare to 1.73 q<sup>-3</sup> trees average yield and 13000 Rs. per three (3) trees average net return in farmer's practice. The highest cost benefit ratio (B: C) was obtained in T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] (1:3.43) and (1:3.06) T<sub>2</sub> [Indoxacarb 14.5 % SC @ 0.48 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] in treated trees. Application of these insecticides not only provides ensured lac production but also yielded quality brood lac with no or less predatory insect infestation and present result agreed with the result of Singh *et al.*, (2014).

After application of effective molecules, the increase in the weight of brood lac as well as scraped lac may be due to less infestation by the predators and parasitoids.

### Surveillance of lac associated insect fauna

Lac associated insect fauna (Predators/ parasitoid) in various lac growing areas of Chhattisgarh were collected from kusum host plants of kusumi rainy season crops from different parts of Chhattisgarh are presented on the basis of pooled data during both the year (Table 3).

**Table.1** Effect of new insecticide molecules against lac major predatory insects in kusmi lac

S. No.	Treatments	First Spray						Second Spray					
		Number of predatory insect/15 cm lac stick						Number of predatory insect/15 cm lac stick					
		30 DABLI		Pool ed	% Reduction of Predators		poole d	60 DABLI		pool ed	% Reduction of Predators		poole d
		2015-16	2016-17		2015-16	2016-17		2015-16	2016-17		2015-16	2016-17	
T1	Emamectin benzoatate 5%SG@ 0.5ml/lit +Carbendazim 50WP @3gm/spreyer	1.94	1.87	1.90	53.81	63.55	58.68	1.36	1.64	1.5	83.81	80.12	81.97
T2	Indoxacarb14.5% SC@0.48ml/lit+Car bendazim Carbendazim 50WP @3gm/spreyer	2.1	1.96	2.03	50.00	61.79	55.89	1.89	1.73	1.81	77.5	78.06	77.78
T3	Control (Lac growers practice i.e. no use of insecticide	4.2	5.13	4.67				8.4	8.25	8.33			
	Average	2.75	2.97	2.87	51.91	62.67	57.29	3.88	3.87	3.88	88.66	79.09	79.88

DABLI= Days after brood lac inoculation

**Table.2** Effect of new insecticide molecules against lac major predatory insects on economics of kusmi lac

S. No.	Treatments	Average Yield (q./3 trees)	(%) Avoidable loss	Average Cost of cultivation (Rs./3 trees)	Average Gross Return (Rs./3 trees)	Average Net Return (Rs./3 trees)	Benefit-Cost Ratio
T <sub>1</sub>	Emamectin benzoatate 5%SG@ 0.5ml/lit +Carbendazim 50WP @3gm/spreyer	2.15	49.30	7200	24725	17525	1: 3.43
T <sub>2</sub>	Indoxacarb14.5% SC@0.48ml/lit+Carbe ndazim Carbendazim 50WP @3gm/spreyer	2.01	45.77	7545	23115	15570	1: 3.06
T <sub>3</sub>	Control (Lac growers practice i.e. no use of insecticide	1.73		6895	19895	13000	1: 2.89
	Average	1.75	47.54	7213	22578	15365	1: 3.13

Note: MSP of lac@Rs.100.00/kg in 2015-16, Rs.130.00 /kg in 2016-17.

**Table.3** Lac associated insect fauna in Chhattisgarh

S. No.	District	strain	Crop	Host	Sample collection	No. Of Predators			No. Of parasitoid
						<i>Eublema amabilis</i>	<i>Pseudohypatopa pulvereae</i>	<i>Chrysopa Sp.</i>	<i>Tachardiaephagous tachardiae</i>
1	Gariyaband	Kusumi	Winter	Kusum	Oct. 2015 and 2016	10	1	3	6
2	Dhamtari	Kusumi	Winter	Kusum	Oct. 2015 and 2016	8	3	1	3
3	Jashpur	Kusumi	Winter	Kusum	Nov. 2015 and 2016	10	2	-	2
4	Raigarh	Kusumi	Winter	Kusum	Nov. 2015 and 2016	9	2	-	5
5	Korba	Kusumi	Winter	Kusum	Nov. 2015 and 2016	6	5	-	4
6	Kanker	Kusumi	Winter	Kusum	Oct. 2015 and 2016	12	6	1	7
7	Mahasamund	Kusumi	Winter	Kusum	Oct. 2015 and 2016	6	4	1	4
8	Jagdalpur	Kusumi	Winter	Kusum	Oct. 2015 and 2016	11	2	2	6
9	Bilashpur	Kusumi	Winter	Kusum	Oct. 2015 and 2016	7	3	-	2
10	Janjgir	Kusumi	Winter	Kusum	Oct. 2015 and 2016	5	2	-	1
11	Ambikapur	Kusumi	Winter	Kusum	Nov. 2015 and 2016	5	4	1	3
<b>Average</b>						<b>8.09</b>	<b>3.18</b>	<b>0.81</b>	<b>3.91</b>

Among the predators *Eublema amabilis* was recorded as key predator from different lac growing area of Chhattisgarh viz. Kanker, Jagadapur, Gariyaband, Jashpur, Raigah and Dhamtari with number of larvae/pupa/adult of 12, 11, 10, 9 and 8 in 15 cm collected twinges whereas, *Pseudohypatopa pulvereae* was also recorded as major predators at Kanker (6) followed by Korba (5) and Mahasamund (4) whereas *Chrysopa Sp.* Recorded as minor predator in samples collected from field of Gariyaband (3) followed by Jagadapur (2). Among the parasitoides of lac insect *Tachardiaephagous tachardiae* exhibited as major parasitoid with highest number of 7 in Kanker district followed by 6, 5 and 4 numbers of larvae/pupa/adult in collected

samples from Gariyaband, Jagdalpur, Raigarh and Manasamund. The abundance of lac associated fauna differs from crop to crop, place to place and during different month Jaiswal *et al.*, 2001 and Daharia *et al.*, 2013).

The present study revealed that efficacy of new insecticide molecules against lac major predatory insects on the basis of above findings it can be concluded that treatment T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>] was the best treatment with maximum reduction 81.97 per cent during the investigation. From the economical point of view, the T<sub>1</sub> [Emamectin benzoate 5 % SG @ 0.5 ml lit<sup>-1</sup> + Carbendazim 50 WP @ 3 gm sprayer<sup>-1</sup>]

treatment gave higher net return (17525.00 Rs. per three trees) and benefit: cost ratio (1:3.43) over rest of the treatments. The judicious use of recommended new insecticide molecules, not only provides ensured lac production but also yielded quality brood lac with no or less predatory insect infestation.

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