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

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ABSTRACT

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 (T1), Indoxacarb 14.5 % SC + Carbendazim 50 WP (T2) and Control (T3) was evaluated against the predators of the lac insect. Pesticides application significantly reduced the incidence of major predators Eublemma amabilis Moore and Pseudohypatopa pulverea Mayr in comparison to (T3). There was a reduction in the population of predatory insects 81.97 per cent in T1 and 77.78 per cent T2 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 pulverea Mayr and appeared as major problem of lac host plants and losses consideration level in most of the areas.

Keywords
Kusmi lac, Kerria lacca, Natural enemies of lac crop, New insecticide molecule

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 (Kerridae), superfamly 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. Chhattisgarh 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$_1$ [Emamectin benzoate 5 % SG @ 0.5 ml lit$^{-1}$ + Carbendazim 50 WP @ 3 gm sprayer$^{-1}$ at 30 days and 60 days after BLI (Brood lac inoculation)], T$_2$ [Indoxacarb 14.5 % SC @ 0.48ml lit$^{-1}$ + Carbendazim Carbendazim 50 WP @ 3 gm sprayer$^{-1}$ at 30 days and 60 days after BLI] and T$_3$ [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 (*Eublema 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.

\[
\text{Untreated value - Insecticide treatment value} \\
\% \text{Reduction of Predators} = \frac{\text{Untreated value}}{\text{Yield of protected treatment}} \times 100
\]

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.

\[
\text{Yield of protected treatment} - \text{Yield of unprotect treatment} \\
\text{Avoidable loss} (%) = \frac{\text{Yield of protected treatment}}{\text{Yield of protected treatment}} \times 100
\]
Results and Discussion

Efficacy of new insecticide molecules

The present study was conducted on *E. amabilis* Moore and *Pseudohypatopa pulverea* 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 T1 [Emamectin benzoate 5 % SG @ 0.5 ml lit⁻¹ + Carbendazim 50 WP @ 3 gm sprayer⁻¹] 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 T2 [Indoxacarb14.5 % SC @ 0.48 ml lit⁻¹ + Carbendazim Carbendazim 50 WP @ 3 gm sprayer⁻¹] 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 T3 [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. pulverea* in different treatments, it varied from 77.78 to 81.97 per cent over control. Among the treatment, T1 [Emamectin benzoate 5 % SG @ 0.5 ml lit⁻¹ + Carbendazim 50 WP @ 3 gm sprayer⁻¹] 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⁻³ trees and avoidable loss 49.30 per cent and average net return 17525 Rs. per three (03) in treated trees T1 [Emamectin benzoate 5 % SG @ 0.5 ml lit⁻¹ + Carbendazim 50 WP @ 3 gm sprayer⁻¹] and 2.01 q/3 trees average yield with 15570 Rs. per three (3) trees average net return in treated trees T2 [Indoxacarb14.5 % SC @ 0.48 ml lit⁻¹ + Carbendazim Carbendazim 50 WP @ 3 gm sprayer⁻¹] as compare to 1.73 q⁻³ 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 T1 [Emamectin benzoate 5 % SG @ 0.5 ml lit⁻¹ + Carbendazim 50 WP @ 3 gm sprayer⁻¹] (1:3.43) and (1:3.06) T2 [Indoxacarb14.5 % SC @ 0.48ml lit⁻¹ + Carbendazim Carbendazim 50 WP @ 3 gm sprayer⁻¹] 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 | % Reduction of Predators | % Reduction of Predators |
|        |                                                                             | 30 DABLI Pooled   | 60 DABLI Pooled    | 2015-16 2016-17 | 2015-16 2016-17 |
| T1     | Emamectin benzoate 5% SG@ 0.5ml/lit + Carbenazim 50WP @ 3gm/spreyer         | 1.94 1.87 1.90    | 1.36 1.64 1.5      | 83.81 80.12 81.97 |
| T2     | Indoxacarb 14.5% SC@0.48ml/lit + Carbenazim Carbenazim 50WP @ 3gm/spreyer  | 2.1 1.96 2.03    | 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    | 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 |
|--------|-----------------------------------------------------------------------------|-----------------------------|--------------------|------------------------------------------|----------------------------------|----------------------------------|-------------------|
| T1     | Emamectin benzoate 5% SG@ 0.5ml/lit + Carbenazim 50WP @ 3gm/spreyer         | 2.15                        | 49.30              | 7200                                     | 24725                            | 17525                            | 1: 3.43           |
| T2     | Indoxacarb 14.5% SC@0.48ml/lit + Carbenazim Carbenazim 50WP @ 3gm/spreyer  | 2.01                        | 45.77              | 7545                                     | 23115                            | 15570                            | 1: 3.06           |
| T3     | 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 |
|-------|----------------|--------|------|------|-------------------|------------------|-------------------|
|       |                |        |      |      |                   | Eublema amabilis | Pseudohypatopa pulverea | Chrysopa Sp. | Tachardiaephagous tachardiae |
| 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                |
|       | Average        |        |       |      |                   | 8.09             | 3.18              | 0.81             | 3.91             |

Among the predators *Eublema amabilis* was recorded as key predator from different lac growing area of Chhattisgarh viz. Kanker, Jagdalpur, 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 pulverea* was also recorded as major predator 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 Jagdalpur (2). Among the parasitoides of lac insect *Tachardiaephagous tachardiae* exhibited as major parasitoid with highest number of 7 in Kanker district fallowed 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 $T_1$ [Emamectin benzoate 5 % SG @ 0.5 ml lit$^{-1}$ + Carbendazim 50 WP @ 3 gm sprayer$^{-1}$] was the best treatment with maximum reduction 81.97 per cent during the investigation. From the economical point of view, the $T_1$ [Emamectin benzoate 5 % SG @ 0.5 ml lit$^{-1}$ + Carbendazim 50 WP @ 3 gm sprayer$^{-1}$]
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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