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Diksha Garg
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, India

BP Katlam
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, India

Vikas singh
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, India

Corresponding Author:
Diksha Garg
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, India

Bio efficacy of insecticide molecules against lac insect (*Kerria lacca*) parasitoid *Tachardiaephagus tachardiae*

Diksha Garg, BP Katlam and Vikas singh

Abstract
Bio efficacy of different doses of Emamectin benzoate (0.001, 0.002 and 0.003 percent), Indoxacarb (0.001, 0.002 and 0.003 percent) and Rynaxypyr (0.001, 0.002 and 0.003 percent) were evaluated by dipping of brood lac in different insecticidal formulations for 5, 10 and 15 minute time period against the parasitoid of lac insect *Tachardiaephagus tachardiae* in aghani lac crop in host plant *Flemingia semialata* at Dau Kalyan Singh Collage of Agriculture and Research Station, Bhatapara, Chhattisgarh during 2019. Overall impact of different doses of insecticides, Emamectin benzoate 0.003 was best insecticide at 15-minute time period with reduction percent of 91.38 percent for the management of lac insect *Kerria lacca* parasitoid *T. tachardiae* as compared to control. Treatment of broodlac in insecticidal formulations for 5, 10 and 15 min durations exerted significant reduction in the population of lepidopteron parasitoid, *Tachardiaephagus tachardiae.*

Keywords: *Tachardiaephagus tachardiae*, emamectin benzoate, Indoxacarb, Rynaxypyr

Introduction
Lac is hard resinous, nontoxic, tasteless, biodegradable substance which is secreted by resin gland of lac insect, Kerria lacca (Kerr), which comes under order- Hemiptera, suborder– Homoptera, super family- Coccoidea and family-Tachardiidae.
Two strains of lac insect are Rangeeni and Kusmi. The crop cycle of kusmi lac insect is January-February to June-July (summer) and June-July to January-February (winter), known as jethwi and aghani crop, respectively (Singh *et al*., 2018) [7].
Indigenous host plant for lac insect are Kusum (*Schleichera oleosa* Oken), Palas (*Butea monosperma* Taub) and Ber (*Ziziphus mauritiana* Lam) etc. These plant species take long time for establishment whereas bushy host plant *Flemingia semialata* Roxb. (Family: Fabaceae) found to be more suitable than other tree species and it can be utilized for lac cultivation after one year of planting.
Major two factors which are responsible for reduction in yield of lac crop *viz*: Biotic and abiotic factors. Biotic factor includes Predators and Parasitoids while abiotic factor includes weather factors.

Methods and Materials
Field experimentation was carried out at Rajadhar industrial farm, Dau Kalyan Singh Collage of Agriculture and Research Station, Bhatapara, Chhattisgarh during 2019. This site is located at 21˚ 7 N latitude and 81˚ 93 E longitude and is at an elevation of 261 m above mean sea level (MSL). The harvested broodlac was treated by dipping in different insecticidal formulations for 5, 10 and 15-minute time period and the Kusmi Broodlac were inoculated in Flemingia semialata plant during July.
The different doses insecticides Emamectin Benzoate 5% SG @ (0.001, 0.002% and 0.003%), Indoxacarb 14.7% SC @ (0.001, 0.002% and 0.003%) and Rynaxypyr 20% SC @ (0.001, 0.002 and 0.003% a.i. equivalent to a quantity ranging from 0.2 to 0.15 g or ml/L with check insecticide Ethefenprox 10% EC @ 0.02% as check and water as control.
The bio-efficacy potential was assessed on the basis of reduction in population of insect parasitoid *Tachardiaephagus tachardiae* from treated broodlac. There were 11 treatments including check and control with three replications for kusmi. Randomly selected broodlac weighing 25 g each bundle was treated and assessed for safety on lac insect as reported by Jaiswal *et al* (2017) [6].

The bags containing kusmi broodlac were inoculated on plants of Flemingia semialata plant. The quantification of living and dead lac insect was carried out 30 days after inoculation (DAI) The 60 mesh net bags used as broodlac container were removed from host plant and it was keep it in the laboratory under well aerated condition. These bags were opened after two months of treatment and number of adult lepidopteron parasitoid emerged from treated broodlac were quantified. Percent reduction in emergence over control was calculated for each treatment to assess the bio- efficacy potential of different insecticide on parasitoid (*Tachardiaephagus tachardiae*) of lac insect. Statistical analysis was carried out using standard analysis of variance (ANOVA) in randomized block design. Treatment means were compared at $p<0.05$ level of significance.

Results and Discussion

The bio-efficacy of various doses of Emamectin benzoate, Indoxacarb and Rynaxypyr was studied to check efficacy of insecticides against parasitoid of lac insect and lac insect survival. The kusmi broodlac was treated by dipping in different insecticidal formulations of "Emamectin benzoate" (0.001, 0.002. and 0.003 percent), Indoxacarb (0.001, 0.002 and 0.003 percent) and Rynaxypyr (0.001, 0.002 and 0.003 percent) for 5, 10 and 15-minute time period are presented in table no.1 Ethefenprox was taken as check insecticide during the preset investigation.

The broodlac was treated for 5-minute time period and inoculated in semialata plant there after incidence of *Tachardiaephagus tachardiae* was recorded which are presented in table 1. All concentrations of insecticides were effective against the *T. tachardiae* as compared control.

In the entire treatments minimum *Tachardiaephagus tachardiae* incidence was recorded in Emamectin benzoate @ 0.003 percent with minimum population of 1.33 during the aghani crop 2018. Thus showed its importance from remainder of the doses of insecticides but it was discovered to be at par with Emamectin benzoate @ 0.002 percent which got mean population of 1.66 with 75.07 reduction percent. Other treatments were less efficient but found superior as compared to control. Population reduction of *Tachardiaephagus tachardiae* was noticed at the tune of 80.03 percent in Emamectin benzoate @ 0.003 percent over control. Rest of the insecticides showed less effective with the population varied from 2.00 to 3.33 as compared to control which was recorded mean *Tachardiaephagus tachardiae* population of 6.66 numbers and percent reduction over control with tune of range from 50 to 69.96 percent.

Broodlac was treated for 10-minute time period and inoculated in semialata plant after that *Tachardiaephagus tachardiae* incidence was recorded. All concentrations of insecticides were found effective against the *T. tachardiae*.

Regarding, *Tachardiaephagus tachardiae* minimum incidence was noticed in Emamectin benzoate @ 0.003 percent having minimum population of 1.00. Which differed significantly from the rest of the doses of insecticides but it was found at par with Emamectin benzoate @ 0.002 percent which received mean number of 1.33 with reduction percent of 81.00. Other treatments were less effective but found superior as compared to control. Population reduction of *Tachardiaephagus tachardiae* was noticed the tune of 85.71 percent in Emamectin benzoate @ 0.003 percent over control. Rest of the insecticides showed less effective with the population varied from 1.66 to 2.33 as compared to control which was recorded mean *Tachardiaephagus tachardiae* population of 7.00 numbers and percent reduction over control with tune of ranged from 52.42 to 66.28 percent.

Then broodlac was treated for 15-minute time period and inoculated in semialata plant after that *Tachardiaephagus tachardiae* incidence was noticed. All concentrations of insecticides were found effective against the *T. tachardiae* as compared to control.

In the entire treatments minimum *Tachardiaephagus tachardiae* incidence was noticed in Emamectin benzoate @ 0.003 percent having minimum population of 0.66 followed by Emamectin benzoate @ 0.002 having population of 1.33 with percent reduction of 82.63. Thus showed its significance from the other doses of insecticides. Other treatments were least effective but found superior as compared to control. Population reduction of *Tachardiaephagus tachardiae* was noticed the tune of 91.38 percent in Emamectin benzoate @ 0.003 percent over control. Rest of the insecticides showed least effective with the population varied from 1.66 to 3.00 as compared to control which was recorded mean *Tachardiaephagus tachardiae* population of 7.66 numbers and percent reduction over control ranges from 60.83 to 78 32.

In the entire treatments the best group for reducing the *Tachardiaephagus tachardiae* incidence was Emamectin benzoate @0.003 percent and Emamectin benzoate @ 0.002 percent which was reduced over control with tune of 91.38 and 82.63 percent respectively. Thus showed its significance from the rest of the insecticides which received reduction percent varied from 60.83 to 78.3.

Present investigation agreed with the finding of Jaiswal *et al*., (2017) [6] that Emamectin benzoate 0.003 was best insecticide at 15-minute time period with reduction percent of 91.38 percent for the management of lac insect Kerria lacca parasitoid *T. tachardiae* as compared to control.

Table 1: Effect of different concentration of insecticide on parasitoid *Tachardiaephagus tachardiae* of lac insect *Kerria lacca*

			Population of *Pseudohypatopa pulverea* at					
Treatments	**Insecticide**	**Conc.**	**5 minute dipping**	**% Reduction Over control**	**10 minute dipping**	**% Reduction over control**	**15 minute dipping**	**% Reduction over control**
T_1	Emamectin benzoate 5% SG	0.001%	2.00 (1.73)	69.96	1.66 (1.62)	76.28	1.66 (1.62)	78.32
T_2	Emamectin benzoate 5% SG	0.002%	1.66 (1.52)	75.07	1.33 (1.59)	81.00	1.33 (1.69)	82.63
T_3	Emamectin benzoate 5% SG	0.003%	1.33 (1.66)	80.03	1.00 (1.66)	85.71	0.66 (1.55)	91.38
T4	Indoxacarb 14.7% SC	0.001%	3.33 (1.45)	50.00	3.00 (1.27)	52.42	2.66 (1.23)	65.27
T_5	Indoxacarb 14.7% SC	0.002%	2.66 (2.07)	60.06	2.33 (2.00)	66.71	2.33 (1.91)	69.58
T_6	Indoxacarb 14.7% SC	0.003%	2.00 (2.02)	69.96	1.66 (1.91)	76.28	1.66 (1.79)	78.32
T_7	Rynaxypyr 20.0% SC	0.001%	3.33 (1.79)	50.00	3.33 (1.76)	52.42	3.00 (1.89)	60.83
T_8	Rynaxypyr 20.0% SC	0.002%	2.66 (1.71)	60.09	2.33 (1.59)	66.71	2.33 (1.59)	69.58
T_9	Rynaxypyr 20.0% SC	0.003%	2.00 (2.07)	69.96	2.33 (2.07)	71.42	1.66 (2.00)	78.32
T_{10}	Ethefenprox 10% SC (Check)	0.20%	1.66 (1.93)	75.07	1.66 (1.93)	76.28	1.33 (1.91)	82.63

T_{11}	Control (water)	-	6.66 (1.88)	0.00	7.00 (1.76)	0.00	7.66 (1.65)	0.00
	CD		0.25		0.25		0.26	
	CV		8.33		8.40		9.08	
	SEm±		0.08		0.08		0.09	

Note: Figures in parentheses are root square transformed value, BLI Brood lac Inoculation

Conclusion

The bio-efficacy of various doses of Emamectin benzoate, Indoxacarb and Rynaxypyr was studied to check efficacy of insecticides against parasitoid of lac insect and lac insect survival.

The kusmi broodlac was treated by dipping in different insecticidal formulations of "Emamectin benzoate" (0.001, 0.002. and 0.003 percent), Indoxacarb (0.001, 0.002 and 0.003 percent) and Rynaxypyr (0.001, 0.002 and 0.003 percent) for 5, 10 and 15-minute time period are presented in table no. 1 Ethefenprox was taken as check insecticide during the preset investigation.

In all the treatments Emamectin benzoate 0.003 was best insecticide at 15-minute time period with reduction percent of 91.38 percent for the management of lac insect *Kerria lacca* parasitoid *T. tachardiae* as compared to control.

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