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EFFECT OF INSECTICIDES ON THE OVIPOSITION OF *BRAHMINA CORIACEA* (HOPE)

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ABSTRACT

Six insecticides were evaluated with *Brahmina coriacea* (Hope) for their effect on oviposition. Of these chlorantraniliprole was found to be highly effective. The order of toxicity was chlorantraniliprole> bifenthrin> clothianidin> thiamethoxam> chlorpyriphos> imidacloprid. All insecticides at low doses (1.20- 0.15x 10^{-4} g a.i./ kg soil) induced reduction in oviposition and it was dose dependent. The number of eggs laid ranged from 28.4- 44.8/ 3 females- maximum reduction being with bifenthrin (82.06%), followed by chlorpyriphos (79.28%).

Key words: *Brahmina coriacea*, insecticides, toxicity, oviposition, LD_{50}, chlorantraniliprole, bifenthrin, chlorpyriphos, reduction, dose effect, soil application

The scarabaeid beetles are most common defoliators and their larvae, commonly known as white grubs, are among the most destructive soil pests, feeding on roots of many plants. They feed on wide variety of cultivated as well as uncultivated plants. Almost all field crops grown during rainy season viz., potato, vegetables, groundnut, sugarcane, maize, pearl millet, sorghum, cowpea, pigeon pea, cluster bean, soybean, wheat, rajmash, upland rice, ginger etc. and majority of horticultural crops are damaged (Mishra, 2001). In Himachal Pradesh, *Brahmina coriacea* (Hope) is one of the most important of these, and infesting to an extent of about 90% in apple orchards (Chandel and Kashyap, 1997). It is known from most parts of the north western Indian hills, including Himachal Pradesh (Chandel et al., 1995; Chandra, 2005), Uttarakhand (Dixit and Sharma, 2010) and Jammu and Kashmir (Bhat et al., 2005). These beetles voraciously feed on pome, stone, and other fruit trees (Pathania, 2014). Due to deforestation, these beetles infest shrubs/ fruit trees with egg laying in the cultivated areas and becoming a major pest (Mehta et al., 2010). Very few studies had been done on the management of adults of *B. coriacea*. The present study evaluates some soil insecticides on the oviposition by the adult beetles.

MATERIALS AND METHODS

Six insecticides viz. chlorantraniliprole (@ 0.005, 0.01, 0.02, 0.04, 0.08, 0 g a.i./ kg soil), bifenthrin (@ 0.005, 0.01, 0.02, 0.04, 0.08, 0 g a.i./ kg soil), clothianidin (@ 0.005, 0.01, 0.02, 0.04, 0.08, 0 g a.i./ kg soil), thiamethoxam (@ 0.01, 0.02, 0.04, 0.08, 0.16, 0 g a.i./ kg soil), imidacloprid (@ 0.01, 0.02, 0.04, 0.08, 0.16, 0 g a.i./ kg soil), chloropyriphos (@ 0.01, 0.02, 0.04, 0.08, 0.16, 0 g a.i./ kg soil) were evaluated under laboratory conditions at the Department of Entomology, CSK Himachal Pradesh Agricultural University, Palampur during June-October 2017. For toxicity studies, calculated doses of insecticides were thoroughly mixed in one kg of moist soil obtained from the area where UV light trap for collection of beetles was installed, and the treated soil was filled in glass jars. Fresh apple twigs were taken, put straight in the glass jars and 10 beetles (5 pairs) of same age were released in each. Each jar (10.5x 15.5cm) was covered with a glass chimney to provide enough space for beetles to feed. The data on % mortality of beetles were taken after 48 hr of treatment and corrected using Abbott's formula (Abbott 1925) and were subjected to probit analysis to determine the LD_{50} and LD_{90} values. Relative toxicity was worked out by comparing the LD_{50} value of the least effective one. Their effect of insecticides on oviposition, was analysed with soil, which was contaminated with sublethal doses of insecticides ranging from 1.2 - 0.15x 10^{-4} g a.i./ kg soil and the treated soil was filled in glass jars. In each glass jar, one kg soil was added along with apple twigs. Three pairs of beetles were releases in each (28± 5ºC, 65%RH). Each treatment was replicated four times. This experiment was run for 10 days and the twigs were replaced with new ones every day. After 10 days, eggs laid were counted and % decrease was computed.

RESULTS AND DISCUSSION

Comparison of LD_{50} values of insecticides revealed variations in toxicity to adults of *B. coriacea*- chlorantraniliprole was found to be highly effective

(1.26, 1.56, 2.12, 2.63 and 3.02x more toxic as compared to bifenthrin, clothianidin, thiamethoxam, chlorpyriphos and imidacloprid, respectively). There was 1.24 and 1.42x increase in LD_{50} values of thiamethoxam with chlorpyriphos and imidacloprid, respectively and 1.14x for chlorpyriphos with respect to imidacloprid. As compared with imidacloprid, chlorantraniliprole was 3.01x more toxic followed by bifenthrin (2.38x), clothianidin (1.93x), thiamethoxam (1.42x) and chlorpyriphos (1.14x) (Table 1). Adults forms earthen cell during April- May, and remain confined in soil during day time (Pathania and Chandel, 2016). Billeisen and Brandenburg (2016) evaluated the toxicity of five products against sugarcane beetle, *Euetheola rugiceps* Leconte, and reported significant effects with bifenthrin. Bifenthrin and clothianidin were at par with each other in their efficacy. The beetles are nocturnal and come out of soil at dusk for feeding and mating on fruit or forest trees. Therefore, beetles are vulnerable to application of chemicals, both in soil and on trees. Martinez et al. (2014) conducted bioassays to compare toxicity of imidacloprid and thiamethoxam under laboratory conditions against *Strategus aloeus* L. in a semi-solid diet. They reported 1.83x higher LC_{50} value of thiamethoxam as compared to imidacloprid, whereas in the present study, imidacloprid showed 1.33x higher value as compared to thiamethoxam.

In ovipositional studies, insecticides revealed dose dependent effect (Table 2); eggs laid in soils treated with insecticides ranged from 28.40-44.80/ 3 females; with maximum effect being with bifenthrin, followed by chlorpyriphos, chlorantraniliprole, clothianidin and thiamethoxam. Imidacloprid was the least effective. Bifenthrin differed significantly (p=0.05) from chlorpyriphos and all others; chlorpyriphos @ 1.2-$0.15x10^{-4}$ g a.i./ kg soil was observed with 13.00- 32.50 eggs/ 3 females resulting in 48.21- 79.28% reduction. Imidacloprid led to the minimum oviposition (44.8 eggs/ 3 females). Both thiamethoxam and imidacloprid were statistically at par with each other.

Selection of oviposition sites by *B. coriacea* beetles may be influenced by soil moisture, texture, and organic matter (Thakur, 2016). The proximity of adult before and after digging into the soil also affects selection of oviposition sites. The adults of *B. coriacea* prefer to feed on fruit trees during night (Chandel et al., 1997) and enter into nearby potato fields where they lay eggs in soil during May - June (Chandel et al., 1995). George et al. (2007) suggested that females of *P. japonica* lay few eggs in soil with fresh allectus residues (imidacloprid + bifenthrin) when they have equal access to non-treated turf. The bifenthrin component likely caused that effect because imidacloprid alone did not consistently

Table 1. Toxicity of insecticides against adults of *B. coriacea*

Insecticides	LD_{50} (g a.i./kg soil)	Relative toxicity	Fiducial limits	LD_{90} (g a.i./kg soil)	Fiducial limits	χ^2_{cal}
Chlorantraniliprole	0.022	3.01	0.018 - 0.028	0.140	0.102 - 0.178	4.60
Bifenthrin	0.028	2.38	0.024 - 0.033	0.150	0.115 - 0.186	0.46
Clothianidin	0.034	1.93	0.021 - 0.041	0.230	0.164 - 0.298	0.11
Thiamethoxam	0.047	1.42	0.031 - 0.056	0.259	0.196 - 0.320	0.85
Chlorpyriphos	0.058	1.14	0.051 - 0.068	0.321	0.243 - 0.399	1.02
Imidacloprid	0.066	1	0.057 - 0.080	0.453	0.320 - 0.586	0.48

Table 2. Effect of insecticides on oviposition of *B. coriacea*

Dose (g a.i.)	No. of eggs laid						
	Chlorantraniliprole	Bifenthrin	Chlorpyriphos	Clothianidin	Thiamethoxam	Imidacloprid	Mean
$1.2x\ 10^{-4}$	15.50 (4.06) *	11.75 (3.60)	13.00 (3.73)	19.25 (4.50)	23.75 (4.10)	24.50 (5.05)	18.16 (4.31)
$0.6x\ 10^{-4}$	17.50 (4.30)	13.50 (3.80)	22.25 (4.82)	29.50 (5.52)	26.00 (5.19)	27.75 (5.36)	24.79 (4.83)
$0.3x\ 10^{-4}$	25.25 (5.11)	18.50 (4.41)	24.75 (5.07)	30.50 (5.60)	40.5 (6.44)	42.50 (6.60)	31.25 (5.54)
0.15×10^{-4}	46.50 (6.90)	32.75 (5.80)	32.50 (5.80)	37.75 (6.22)	46.50 (6.90)	46.00 (6.85)	41.08 (6.40)
Control	63.50 (8.03)	65.50 (8.15)	62.75 (7.10)	60.50 (7.83)	61.50 (7.90)	59.75 (7.77)	62.25 (7.94)
Mean	33.65 (5.67)	28.4 (5.14)	31.05 (5.47)	35.5 (5.93)	39.65 (6.27)	44.8 (6.32)	

*Figures in parentheses square root transformed; CD (p=0.05): Treatment (A) = 0.17; Concentration (B) = 0.15; A×B = 0.38

reduce oviposition. In the present study, maximum reduction in oviposition occurred in bifenthrin treated soil, thereby corroborating to our findings. Thus, soil application of chlorantraniliprole and bifenthrin gave better resutls against adults of *B. coriacea* in soil, and bifenthrin induced maximum reduction in oviposition of *B. coriacea*.

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