



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

RADHA KORANGA*, R S CHANDEL AND VASU MEHTA

Department of Entomology, CSK Himachal Pradesh Agricultural University, Palampur 176062, India

*Email: radhakoranga33@gmail.com (corresponding author)

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 > chlorpyrifos > 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 chlorpyrifos (79.28%).

Key words: *Brahmina coriacea*, insecticides, toxicity, oviposition, LD₅₀, chlorantraniliprole, bifenthrin, chlorpyrifos, 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), chlorpyrifos (@ 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 LD₅₀ and LD₉₀ values. Relative toxicity was worked out by comparing the LD₅₀ 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± 5°C, 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 LD₅₀ 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, chlorpyrifos and imidacloprid, respectively). There was 1.24 and 1.42x increase in LD₅₀ values of thiamethoxam with chlorpyrifos and imidacloprid, respectively and 1.14x for chlorpyrifos 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 chlorpyrifos (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, *Euethola 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 LC₅₀ 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 chlorpyrifos, chlorantraniliprole, clothianidin and thiamethoxam. Imidacloprid was the least effective. Bifenthrin differed significantly ($p=0.05$) from chlorpyrifos and all others; chlorpyrifos @ 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 allecetus 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
Chlorpyrifos	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						Mean
	Chlorantraniliprole	Bifenthrin	Chlorpyrifos	Clothianidin	Thiamethoxam	Imidacloprid	
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)
0.15x 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 results against adults of *B. coriacea* in soil, and bifenthrin induced maximum reduction in oviposition of *B. coriacea*.

ACKNOWLEDGEMENTS

The authors thank the Head, Department of Entomology, CSK Himachal Pradesh Agricultural University, Palampur for providing laboratory facilities. The authors thank the reviewers for their critical inputs.

REFERENCES

- Abbott W S. 1925. A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology* 18: 265-267.
- Bhat O K, Bhat A A, Kaul V K. 2005. Faunistic studies of white grubs in Kashmir. *Insect Environment* 11(1): 14-15.
- Billeisen T, Brandenburg R. 2016. Efficacy of five insecticides targeting spring and fall populations of sugarcane beetle adults. *Florida Entomologist* 99(3): 563-565.
- Chandel R S, Kashyap N P. 1997. About white grubs and their management. *Farmer and Parliament* 37(10): 29-30.
- Chandel R S, Chander R, Gupta P R. 1995. Host preference of defoliating beetle, *Brahmina coriacea* (Hope) (Coleoptera: Scarabaeidae). *Pest Management and Economic Zoology* 3(2): 111-114.
- Chandel R S, Gupta P R, Thakur J R. 1997. Host preference and seasonal abundance of defoliating beetles infesting fruit trees in mid hills of Himachal Pradesh. *Journal of Soil biology and Ecology* 17: 140-146.
- Chandra K. 2005. Insect: Coleoptera: Scarabaeidae. *Zoological Survey of Indian Fauna of Western Himalaya* (2): 141-155.
- Dixit A K, Sharma S. 2010. Potato in Garhwal region of Uttarakhand: some issues and suggestions. *Potato Journal* 37(3-4): 157-163.
- George J, Redmond C T, Royalty N R, Potter D A. 2007. Residual effects of imidacloprid on Japanese beetle (Coleoptera: Scarabaeidae) Oviposition, egg hatch, and larval viability in Turfgrass. *Journal of Economic Entomology* 100(2): 431-439.
- Martinez L C, Angelica P R, Zanuncio J C, Serro J E. 2014. Comparative toxicity of six insecticides on the Rhinoceros beetle (Coleoptera: Scarabaeidae). *Florida Entomologist* 97(3): 1056-1062.
- Mehta P K, Chandel R S, Mathur Y S. 2010. Status of White grubs in north western Himalaya. *Journal of Insect Science* 23(1): 1-14.
- Mishra P N. 2001. Scarab fauna of Himalayan region and their management. pp. 74-85. Sharma G, Y S Mathur, R B L Gupta (eds.). *Indian Phytophagous Scarabs and their Management: Present Status and Future Strategies*. Agrobios, Jodhpur, India.
- Pathania M, Chandel R S. 2016. Life history strategy and behavior of white grub, *Brahmina coriacea* (Hope) (Coleoptera: Scarabaeidae: Melolonthinae) an invasive pest of potato and apple agro-ecosystem in north western India. *Oriental Insects* 51(1): 46-69.
- Pathania M. 2014. Studies on phytophagous white grubs of Himachal Pradesh. PhD Thesis, Department of Entomology, CSKHPKV Palampur. 258 pp.
- Thakur S. 2016. Biology of white grubs in relation to physico-chemical properties of soil. PhD Thesis, Department of Entomology, CSKHPKV Palampur. 199 pp.

(Manuscript Received: October, 2020; Revised: January, 2021;

Accepted: January, 2021; Online Published: March, 2021)

Online First in www.entosocindia.org and indianentomology.org Ref. No. e20362