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LABORATORY EVALUATION OF SOME INSECTICIDES AGAINST ADULTS OF *BRAHMINA CORIACEA* (HOPE)

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ABSTRACT

Five insecticides viz., dimethoate, indoxacarb, flubendiamide, spinosad and fenazaquin were evaluated for their toxicity against beetles of *Brahmina coriacea* (Hope) using leaf dip and topical application methods. In leaf dip method, LC_{50} values of these were 8.41, 165.20, 186.66, 246.09 and 460.60 ppm, respectively, while LC_{90} values were 45.07, 143.71, 1749.55, 1541.82 and 2687.70 respectively. The order of toxicity was dimethoate> indoxacarb> flubendiamide> spinosad> fenazaquin. In topical application method, LC_{50} values were 69.71, 201.90, 415.42, 474.66 and 492.19 ppm, respectively; and LC_{90} values were 300.30, 1077.32, 2121.14, 2672.20 and 3083.64 ppm, respectively. The order of toxicity was indoxacarb> dimethoate> flubendiamide> fenazaquin> spinosad. Irrespective of insecticides, leaf dip method of bioassay proved more effective (except indoxacarb).

Key words: Insecticide, leaf dip, topical application, *Brahmina coriacea*, Scarabaeidae, toxicity, LC_{50}, LC_{90}, dimethoate, indoxacarb, flubendiamide, spinosad, fenazaquin

White grubs are one of the most destructive insect pests. *Brahmina coriacea* Hope (Scarabaeidae; Coleoptera) is a dominant species of white grubs in Himachal Pradesh, especially in the hilly regions. Its incidence of *Brahmina* has been observed in hilly tracts of Mandi, Shimla, Kullu, Solan, Sirmour, Kinnaur, and Chamba districts (Mehta et al. 2008), and the genus *Brahmina* alone comprises 95% of the total scarab fauna in Kufri area of Himachal Pradesh (Chandel and Chandla, 2003). About 35 species of white grubs are known from the state, of which *Brahmina* spp., are >90% in apple orchards of Shimla hills (Chandel and Kashyap, 1997). It was reported for the first time from the Kullu valley of Himachal Pradesh, feeding on apple, walnut, pear, plum, grapewine and fig (Beeson, 1941) and peach and wild roses are its major hosts in Lahaul valley of the state (Chandel and Kashyap, 1997). Tuber infestation in potato at Potato Development Station was to the tune of 41.25-49.40% during 2009-2011 (Anonymous 2011). Beetles appear during May-June, just after the onset of monsoon and remain unseen throughout the year and are nocturnal (Chandel and Kashyap, 1997). Management of *B. coriacea* is more complex and very cumbersome method because the adults and grubs cause different types of damage. The adults are so mobile, therefore controlling one life stage will not necessarily preclude the problem caused by the others. Keeping in view the destructive potential of *B. coriacea*, the present study evaluated some new insecticides against its adults.

MATERIALS AND METHODS

Five insecticides were evaluated against adults of *B. coriacea* under laboratory conditions during 2018, at the Department of Entomology, CSK Himachal Pradesh Agricultural University, Palampur. Different concentrations of insecticides - dimethoate (@ 2.5, 5, 10, 20, 40, 0 ppm), indoxacarb (@ 40, 80, 160, 320, 640, 0 ppm), flubendiamide (@ 25, 50, 100, 200, 400, 0 ppm), spinosad (@ 50, 100, 200, 400, 800, 0 ppm) and fenazaquin (@ 100, 200, 400, 800, 1600, 0 ppm) were prepared in distilled water from their commercial formulations, with preliminary trials done before to fix the range of concentration causing mortality from 10.00-90.00%. The adult beetles were collected at dusk from the apple trees and were transported to laboratory in metal cages along with twigs of the host trees. The beetles were preconditioned under laboratory conditions (28±5ºC, 65% RH) in glass jars containing moist sand. The beetles were starved for 24 hr before treatment. In leaf dip method, the twigs having enough leaves were properly dipped in freshly prepared insecticide solutions and the treated shoots were positioned straight in glass jars which were covered with glass chimneys. In each glass jar, 15 beetles were released with each treatment replicated thrice. In topical application method, beetles were exposed to solutions of insecticides viz. dimethoate (@ 40, 80, 160, 320, 640, 0 ppm), indoxacarb (@ 20, 40, 80, 160, 320, 0 ppm), flubendiamide (@ 100, 200, 400, 800, 1600, 0 ppm), spinosad (@ 50, 100, 200, 400, 800, 0 ppm) and fenazaquin (@ 100, 200, 400, 800, 1600, 0 ppm) with a hand atomizer. Aftet 15-20 min, the beetles were again released in glass jars containing moist soil. Fresh twigs of apple were given ad libitum for feeding with twigs changed daily and optimum soil moisture being maintained. The soil was tipped out of glass jars after 24 hr, and mortality observed after 24 hr of treatment. Beetles were considered dead, if it failed to respond, when probed. These data were computed as % and corrected using Abbott's formula (Abbott, 1925). To calculate LC_{50} and LC_{90} values, the corrected % mortality was subjected to probit analysis (Finney, 1971). Relative toxicity was calculated by dividing LC_{50} value of a particular insecticide by lowest LC_{50} value among all the insecticides.

RESULTS AND DISCUSSION

In leaf dip method, the beetles of *B. coriacea* were found to be highly susceptible to dimethoate. Indoxacarb showed 19.6x more LC_{50}, and flubendiamide, spinosad and fenazaquin showed 22.19, 29.26 and 54.76x more LC_{50} as compared to dimethoate. Comparison of indoxacarb with flubendiamide or spinosad or fenazaquin revealed marginal differences in their toxicity. The increase in LC_{50} of flubendiamide, spinosad with respect to indoxacarb, in spinosad with respect to flubendiamide and in fenazaquin with respect to spinosad, varied from 1.12-1.87x. In fenazaquin, 2.78 and 2.46x more LC_{50} was observed in respect to indoxacarb and flubendiamide, respectively. The decreasing order of toxicity when fed on treated foliage and with LC_{50} value was: dimethoate > indoxacarb > flubendiamide > spinosad > fenazaquin. As compared with fenazaquin, dimethoate was 54.76x more toxic, followed by indoxacarb (2.78x toxic), flubendiamide (2.46x toxic), and spinosad (1.87x toxic) (Table 1).

In topical applications, indoxacarb was found to be highly toxic (LC_{50} value which was calculated to be minimum as compared with evaluated ones). The LC_{50} values of dimethoate, flubendiamide, fenazaquin and spinosad were 2.89, 5.95, 6.8 and 7.06x more than indoxacarb. Similarly, in case of flubendiamide, fenazaquin and spinosad, these values were 2.05, 2.35 and 2.43x more as compared to flubendiamide, whereas the LC_{50} of spinosad was 1.03x more in comparison to fenazaquin. The order of toxicity was observed on the

Table 1. Evaluation of insecticides against adults of *B. coriacea* using leaf dip and topical application method

Insecticides	Leaf dip						Topical application					
	LC_{50} (ppm)	Relative toxicity	Fiducial limits	LC_{90} (ppm)	Fiducial limits	χ^2_{cal}	LC_{50} (ppm)	Relative toxicity	Fiducial limits	LC_{90} (ppm)	Fiducial limits	χ^2_{cal}
Dimethoate	8.41	54.7	7.03 - 10.40	45.07	36.05 - 56.42	3.05	201.90	2.43	173.71-239.73	1077.32	831.22-1323.42	0.86
Indoxacarb	165.20	2.78	137.05 - 201.66	1043.71	767.26-1320.17	0.15	69.71	7.06	59.80-83.62	300.30	251.08-359.16	0.90
Flubendiamide	186.66	2.46	158.93 - 235.80	1749.55	1086.23-2412.90	1.63	415.42	1.18	355.45-492.70	2121.14	1658.60-2583.68	1.63
Spinosad	246.09	1.87	208.10 - 298. 62	1541.82	1130.86 - 1952.80	1.23	492.19	1.0	402.00-638.74	3083.64	2631.44-3344.15	1.23
Fenazaquin	460.60	1	391.31-552.74	2687.70	2031.21-3344.15	0.92	474.66	1.03	392.32-605.46	2672.20	2095.42-3407.75	1.26

basis of LC_{50} value was- indoxacarb > dimethoate > flubendiamide > fenazaquin > spinosad. As compared with spinosad, indoxacarb was 7.06x more toxic followed by dimethoate (2.43x toxic), flubendiamide (1.18x) and fenazaquin (1.03x) (Table 1).

Irrespective of insecticides, leaf dip method proved more effective, except for indoxacarb. Dimethoate demonstrated 24.0x more toxicity in leaf dip method; flubendiamide, spinosad and fenazaquin showed marginal increase in their LC_{50} values in leaf dip method (1.03- 2.22). Indoxacarb induced more mortality in topical method as compared to leaf dip method. The results indicated that dimethoate acts as strong stomach/ contact poison, whereas indoxacarb displayed more contact toxicity.

Gupta et al. (1979) recommended Rogor @ 100 ml/ 100 l of water against *B. coriacea* in apple in Himachal Pradesh. Kulkarni et al. (2012) observed 100% mortality of *Holotrichia rustica* Burmeister beetles after 72 hr with dimethoate (0.1 %) in Madhya Pradesh. Very little work has been done on the control of *B. coriacea* in adult stage. Martinez et al. (2014) conducted bioassay with rhinocerous beetle, *Strategus aloeus* L., and observed that in fopronil, imidacloprid, lambda-cyhalothrin and thiamethoxam mortality was higher, while spinosad and thiacloprid were less effective. Fenazaquin is an acaricide which is widely used to control mites and it has also caused desirable beetle mortality in the present study, thus can be effectively utilized to manage mites and beetles simultaneously, leading to reduction in number of sprays and pesticide usage. If specific intervention for control of *B. coriacea* in its endemic areas is required, then dimethoate can be the best choice.

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