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Short Communication

Evaluation of novel insecticides against *Leucinodes orbonalis* Guenee

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Abstract

The insecticides such as chlorantraniliprole, diafenthiuron, emamectin benzoate, lambda-cyhalothrin, spinosad, and biopesticides like azadirachtin, *Bacillus thuringiensis* var *kurstaki* were evaluated against neonate larvae of *Leucinodes orbonalis* Guenee field populations collected from Palampur (Kangra). The results revealed that lowest LC_{50} value was obtained for chlorantraniliprole (0.565 ppm) followed by spinosad (0.692 ppm) and emamectin benzoate (0.933 ppm). The highest LC_{50} value was obtained for lambda-cyhalothrin (11.680 ppm) against neonate larvae of *L. orbonalis*. The order of toxicity was chlorantraniliprole > spinosad > emamectin benzoate > azadirachtin > *Bacillus thuringiensis* var *kurstaki* > diafenthiuron > lambda-cyhalothrin. The baseline suceptibility data obtained during the present investigations indicated that *L. orbonalis* neonate larvae were highly susceptible to new chemistry insecticides like chlorantraniliprole and spinosad.

Key words: Bioassay, biopesticides, novel insecticides, *Leucinodes orbonalis*

Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee is a monophagous pest that is among the most significant to the brinjal plant due to its internal feeding habitat and ability to harm fragile shoots and fruits. The pest poses a serious problem because of its high reproductive potential, rapid turnover of generations and intensive cultivation of brinjal both in wet and dry seasons of the year. In India, extreme losses were recorded during the rainy season when weather conditions interfere with protection measures (Das, 2016) and the yield reduction by this pest has been to the tune of 70-92 per cent (Chakraborti and Sarkar 2011).

The growers mostly depend on pesticides to combat this obnoxious pest. Available reports revealed that synthetic chemical insecticides dominate the other means for pest control (Duara *et al*. 2003; Singh and Singh 2003; Rahman *et al.* 2006). The persistent use of pesticides has led to development of insecticide resistance in *L. orbonalis* (Kodandaram *et al.* 2015; Kariyanna *et al*. 2019).

The increased dependence on pesticides, calendar based sprays by the farmer and/or short residual action of certain group of insecticides has not only led to higher costs of production but also did not provide adequate control of the pest. While several insecticides have been recommended to manage shoot and fruit borer infestations in brinjal, changing agricultural and environmental conditions make it necessary to study and evaluate recently introduced insecticidal compounds for their effectiveness in control. Hence, the present studies were undertaken during 2022-23 in the Toxicology laboratory of Department of Entomology, College of Agriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur.

Infested fruits and shoots were collected from field and were brought to the laboratory in perforated polythene bags secured with a rubber band. The larvae were separated and raised on brinjal fruits in perforated aluminium cages (15 cm x 15 cm x 15 cm) and the pupae were obtained. To avoid fungal growth, the brinjal fruits were replaced at regular intervals. The pupae that formed on the filter papers were removed and individually placed in aluminium cages. The newly emerged moths were placed in clean circular glass jars (20 cm x 15 cm) for mating, covered with a black muslin cloth, and tightly secured with a rubber band. The adults were given folded pieces of white paper and were provided with a 10% honey solution on a cotton swab. The eggs were observed on a regular basis to get neonate larvae for testing.

To prepare the required concentrations of each insecticide for experimentation, initial stock solutions of the insecticides were prepared using the formulated products in distilled water. Using these initial stock solutions, a range of concentrations for the insecticides was generated through serial dilutions with distilled water. Fresh concentrations were prepared each time before conducting an experiment. The toxicity of novel insecticides *viz.*, chlorantraniliprole, diafenthiuron, emamectin benzoate, lambda-cyhalothrin, spinosad, and biopesticides like azadirachtin, *Bacillus thuringiensis* var. *kurstaki* against neonate larvae of first generation progeny of *L. orbonalis* was evaluated by topical method of bioassay under laboratory conditions. The thoroughly washed healthy potato fruits were cut into small discs (25 mm thickness) and three discs were sprayed with 1 mL of different concentrations of the test insecticides using hand atomizer. The treated discs were then dried for 15 minutes and placed in petri plate. The neonate larvae were released on treated potato discs. Each concentration was replicated thrice. Ten larvae in each replication were exposed to individual treated disc. The mortality data were recorded after 24 hours of release in case of insecticides and after 72 hours of release in case of biopesticides.

Preliminary experiments were conducted to standardize the approximate ranges which gave mortality between 10 to 90 per cent. Five concentrations used in the bioassay were kept within these upper and lower limits. The LC_{50} and LC_{90}, heterogeneity and fiducial limits were calculated by using Probit analysis (Finney 1971).

The data on relative toxicity of different insecticides against *L. orbonalis* are given in Table 1. The lowest LC_{50} value was observed for chlorantraniliprole (0.565 ppm) followed by spinosad (0.692 ppm), emamectin benzoate (0.933 ppm), azadirachtin (2.132 ppm), *Bacillus thuringiensis* (3.792 ppm) and difenthiuron (4.938 ppm). The highest LC_{50} value was obtained for lambda-cyhalothrin (11.680 ppm). Similarly, on the basis of LC_{90} values the order of toxicity was chlorantraniliprole (3.488 ppm) > spinosad (4.224 ppm) > emamectin benzoate (4.578 ppm) > azadirachtin (17.853 ppm) > Bt (26.820 ppm) > diafenthiuron (27.329 ppm) > lambda-cyhalothrin (73.714 ppm).

Botre *et al.* (2014) also reported chlorantraniliprole the most effective insecticide against different *L. orbonalis* populations collected from Vidharbha region. Similar results were reported by Munje *et al.*

Table 1. Toxicity of different insecticides/biopesticides against neonate larvae of *Leucinodes orbonalis*

Insecticides/biopesticides	LC_{50} (ppm)	Fiducial limits (ppm)	LC_{90} (ppm)	Fiducial limits (ppm)
Azadirachtin	2.132	1.195-3.069	17.853	10.122-25.583
Bacillus thuringiensis	3.792	2.274-5.311	26.820	16.568-37.072
Chlorantraniliprole	0.565	0.358-0.773	3.488	2.396-4.579
Diafenthiuron	4.938	3.236-6.640	27.329	18.705-35.954
Emamectin benzoate	0.933	0.634-1.231	4.578	3.287-5.870
Lambda-cyhalothrin	11.680	7.275-16.085	73.714	45.612-101.815
Spinosad	0.692	0.547-0.949	4.224	2.774-5.673

(2015) where chlorantraniliprole was found most effective among the insecticides used against *L. orbonalis*. The results obtained in the present studies are also similar to the findings of Kodandaram *et al.* (2017) who reported the susceptibility of *L. orbonalis* for chloratraniliprole. The high susceptibility of *L. orbonalis* to chlorantraniliprole may be linked to its special mode of action, which activates ryanodine receptors (RyRs) and causes an unregulated release of Ca^{2+} ions that results in muscle paralysis and death. Contrary to the present results, Negi *et al.* (2022) reported very low LC_{50} values of emamectin benzoate and spinosad against neonate larvae of *L. orbonalis*. The highest LC_{50} values of lambda-cyhalothrin (11.680 ppm) obtained in the present study may be due to more frequent use of this insecticide against *L. orbonalis*, which can lead to development of resistance in the pest. The results of low effectiveness of lambda-cyhalothrin and azadirachtin as compared to chlorantraniliprole, spinosad and emamectin benzoate are supported with the findings of Reddy and Kumar (2022).

Conclusion

From the present investigations, it can be concluded that new chemistry insecticides were found better against neonate larvae of *L. orbonalis* but chlorantraniliprole was superior followed by spinosad, emamectin benzoate and azadirachtin. Hence, for the effective control of *L. orbonalis*, insecticides like diafenthiuron and lambda-cyhalothrin can be substituted by chlorantraniliprole and spinosad. Alternatively, emamectin benzoate and azadirachtin can also be suggested for the management of the pest.

Conflict of interest: The authors declare that there is no conflict of interest in this research article.

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