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Short Communication

Comparative toxicity of novel insecticides against *Spodoptera litura* (Fabricius)

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Abstract

The present investigation on comparative toxicity of novel insecticides against laboratory reared and field collected populations of *Spodoptera litura* (Fabricius) was undertaken during the year 2022-23 in Department of Entomology, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. Toxicity of eight different insecticides was evaluated by leaf dip method of bioassay against third instar larvae of *S. litura* laboratory reared population and field population collected from Sundernagar. On the basis of the LC_{50} values obtained, the results revealed that the toxicity order against *S. litura* laboratory reared population was emamectin benzoate > indoxacarb > thiodicarb > azadirachtin > novaluron > spinosad > flubendiamide > cypermethrin. Similar trend in toxicity order was observed against field collected population of *S. litura* i.e., emamectin benzoate > indoxacarb > azadirachtin > thiodicarb > novaluron > spinosad > flubendiamide > cypermethrin. The baseline toxicity data obtained during the present investigations indicated that emamectin benzoate and indoxacarb were the most toxic to *S. litura* third instar larvae when tested by leaf dip method of bioassay. Cypermethrin was found to be least toxic against both the laboratory reared and field population collected from Sundernagar.

Key words: Comparative efficacy, newer insecticides, *Spodoptera litura*

The tobacco caterpillar *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae) is one of the destructive insect pests causing heavy yield losses in different crops depending upon crop stage and its infestation level in the field (Cheng *et al*. 2017). Upto 71 per cent yield loss has been reported in groundnut in the irrigated tracts of the southern states of India (Maqsood *et al*. 2016). The pest accounts for upto 17.7 and 70.0 per cent losses in groundnut and black gram in Karnataka and Andhra Pradesh respectively (Grace *et al*. 2019).

The pest is polyphagous in nature, having high reproduction and high migrating ability (Fu *et al*. 2015). Hazards and harmful effects of insecticides as chemical control especially the wide use of conventional insecticides necessitates the use of novel insecticides which are more effective at low dosage, safer for humans and much less toxic to environment (Korrat *et al*. 2012). Different populations of *S. litura* have shown varying level of resistance/susceptibility to different group of insecticides (Shad *et al*. 2012).

The present study was conducted in the year 2022-2023 in the Toxicology Laboratory, Department of Entomology, College of Agriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur. *S. litura* egg masses, larvae and adults were collected from the field (open and protected). The eggs were kept in Petri dishes of 9 cm diameter and fastened with rubber bands. The larvae were raised in rearing glass jars, which were firmly covered with muslin cloth and fastened with rubber band. Fresh castor leaves were provided to the larvae daily. Adults were also kept in rearing glass jars. A folded piece of paper was provided for oviposition and a cotton swab dipped in 50 per cent honey solution (50 % honey, 50 % water) was hanged from the top of the rearing jars to serve as food for the adults. The honey solution was refreshed after every 24 hours. Petri plates containing *S. litura* eggs and rearing jars containing larvae and adults were kept in BOD incubator at 28±1^{0}C temperature and 70±5 per cent relative humidity. Male and female adults were kept in jars for mating in order to maintain the culture. The freshly laid eggs were collected on daily basis and kept in rearing jars under set conditions. Newly hatched larvae were transferred to fresh castor leaves in rearing jars by using a camel hair brush, and the jars were then covered with muslin cloth.

Every day, fresh castor leaves were offered to the larvae in order to maintain the culture. Larvae were reared on castor leaves upto G_3 generation under laboratory condition and population was labelled as laboratory reared population. *S. litura* field populations that were collected from Sundernagar were raised to G_1 generation in the lab. The toxicity of different insecticides *viz*. azadirachtin, cypermethrin, emamectin benzoate, flubendiamide, indoxacarb, novaluron, spinosad and thiodicarb to these populations was evaluated under laboratory conditions by leaf dip method of bioassay. The observations on mortality data were taken after 24 hours for insecticides and in case of biopesticides after 72 hours of treatment.

The data on relative toxicity of different insecticides against laboratory reared population of *S. litura* are given in Table 1. Minimum LC_{50} value was calculated for emamectin benzoate (0.115 ppm) followed by indoxacarb (0.491 ppm) and thiodicarb (7.484 ppm) and maximum LC_{50} value was calculated for cypermethrin (114.701 ppm) followed by flubendiamide (101.307 ppm) and spinosad (58.015 ppm). Similarly, minimum LC_{90} value was calculated for emamectin benzoate (0.880 ppm) followed by indoxacarb (3.453 ppm), thiodicarb (40.045 ppm), azadirachtin (49.412 ppm), novaluron (103.682 ppm), spinosad (376.309 ppm), cypermethrin (500.606 ppm) and flubendiamide (555.108 ppm).

On the basis of LC_{50} values, the toxicity order of these insecticides against third instar larvae of *S. litura* laboratory reared population was emamectin benzoate > indoxacarb > thiodicarb > azadirachtin > novaluron > spinosad > flubendiamide > cypermethrin.

The data on relative toxicity of different insecticides

Table 1. Comparative toxicity of different insecticides against laboratory reared population of *S. litura*

Sr. No.	Insecticide	LC_{50} (ppm)	Fiducial limits (ppm)	LC_{90} (ppm)	Fiducial limits (ppm)
1.	Azadirachtin	8.454	6.501-10.408	49.412	38.397-60.427
2.	Cypermethrin	114.701	91.673-137.729	500.606	404.472-596.739
3.	Emamectin benzoate	0.115	0.084-0.145	0.880	0.611-1.149
4.	Flubendiamide	101.307	78.496-124.118	555.108	428.216-682.000
5.	Indoxacarb	0.491	0.363-0.619	3.453	2.525-4.382
6.	Novaluron	16.597	12.624-20.570	103.682	79.258-128.106
7.	Spinosad	58.015	43.840-72.189	376.309	281.672-470.947
8.	Thiodicarb	7.484	5.831-9.137	40.045	31.459-48.631

against Sundernagar population of *S. litura* are given in Table 2. Minimum LC_{50} value was calculated for emamectin benzoate (0.256 ppm) followed by indoxacarb (1.219 ppm) and azadirachtin (14.371 ppm) and maximum LC_{50} value was calculated for cypermethrin (155.325 ppm) followed by flubendiamide (143.799 ppm) and spinosad (85.388 ppm) for Sundernagar population. Similarly, minimum LC_{90} value was calculated for emamectin benzoate (1.492 ppm) followed by indoxacarb (6.942 ppm), azadirachtin (71.932 ppm), thiodicarb (114.469 ppm), novaluron (136.673 ppm), spinosad (521.928 ppm), cypermethrin (822.490 ppm) and flubendiamide (966.454 ppm).

On the basis of LC_{50} values obtained, the toxicity order trend for Sundernagar population of *S. litura* remained almost the same as it was for laboratory reared population.

In the present investigations, the minimum LC_{50} value against third instar larvae of *S. litura* laboratory reared and field collected populations was calculated for emamectin benzoate (0.115 to 0.256 ppm) followed by indoxacarb (0.491 to 1.219 ppm) and maximum LC_{50} value was calculated for cypermethrin (114.701 to 155. 325 ppm). These LC_{50} values indicates that emamectin benzoate and indoxacarb were the most toxic to *S. litura* third instar larvae when tested by leaf dip method of bioassay. Cypermethrin was found to be least toxic against laboratory reared and field collected strain of the *S. litura*.

The results of the present investigation are supported by Ramzan *et al*. (2021) who reported the emamectin benzoate as the most toxic insecticide against *S. litura* when tested by leaf dip method of bioassay. Xie *et al*. (2010) also proved that emamectin benzoate and indoxacarb were highly effective against *S. litura*. Emamectin benzoate and indoxacarb were also proved to be most toxic against *S. litura* (Khan *et al*. 2011). Emamectin benzoate has also been reported to be the most toxic insecticide against *S. litura* (Sharma and Pathania 2015; Sharma and Sharma 2018; Kong *et al*. 2021 and Ahmad *et al*. 2022).

Conclusion

Emamectin benzoate was most toxic insecticide against *S. litura* followed by other new chemistry insecticides like indoxacarb, novaluron and thiodicarb. Both the *S. litura* laboratory reared and field collected

Table 2. Comparative Toxicity of different insecticides against *S. litura*, Sundernagar population

Sr. No.	Insecticide	LC_{50} (ppm)	Fiducial limits (ppm)	LC_{90} (ppm)	Fiducial limits (ppm)
1.	Azadirachtin	14.371	11.250-17.493	71.932	55.124-88.739
2.	Cypermethrin	155.325	120.576-190.074	822.490	629.404-1015.577
3.	Emamectin benzoate	0.256	0.196-0.316	1.492	1.111-1.873
4.	Flubendiamide	143.799	107.926-179.671	966.454	699.197-1233.712
5.	Indoxacarb	1.219	0.940-1.499	6.942	5.224-8.660
6.	Novaluron	31.211	24.991-37.431	136.673	109.883-163.462
7.	Spinosad	85.388	65.033-105.743	521.928	394.534-649.323
8.	Thiodicarb	18.073	13.715-22.430	114.469	84.798-144.141

populations were less susceptible to cypermethrin and flubendiamide.

Conflict of interest: There is no conflict of interest in this research paper.

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