ORIGINAL ARTICLE

Determination of lethal concentration (LC_{50}) for different insecticides against third instar larvae of *Helicoverpa armigera* (Hubner) (LEPIDOPTERA: NOCTUIDAE)

Rashid A. Khan[1], M. Hamed[2] and Farhat Fatima Jamil[3]

Abstract

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Determination of lethal concentration (LC_{50}) for different insecticides against third instar larvae of *Helicoverpa armigera* (Hubner) (LEPIDOPTERA: NOCTUIDAE)
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The efficacy of Lorsban™, Alpha-cypermethrin™ and Karate™ was assessed by larval dip bioassay against third instar larvae of American bollworm, *Helicoverpa armigera* (Hub.) collected from a cotton field at Faisalabad and reared in the laboratory until F1 generation. Third instar larvae were used to assess the toxicity of insecticides after 48 hrs of insecticide treatments. Results showed that toxicity of Karate was above all with LC_{50} of 71.31ppm followed by Alpha-cypermethrin with LC_{50} 287.87 and Lorsban 464.85, respectively. These results showed the increased resistance of *H. armigera* against Lorsban in F1 generation under laboratory conditions.

Key words : bioassay, third instar, toxicity, resistance

[1]M.Sc.(Plant Protection), Senior Scientist, [2]Ph.D.(Entomology), Principal Scientist, [3]Ph.D.(Plant Pathology), Deputy Chief Scientisit, Plant Protection Division, Nuclear Institute for Agriculture and Biology (NIAB), P.O. Box No. 128, Jhang Road, Faisalabad, Pakistan.
Corresponding e-mail: rashidpp2004@yahoo.co.uk
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In Pakistan, the average seed cotton yield is 511 kg/hectare, which is still lower than those in the countries like Australia, USA, Egypt and Turkey (Ahmed 1999a). It suffers heavy yield losses due to insect pests, diseases and weeds. Insect pest alone can cause 20-40 per cent loss in potential yield (Ahmed, 1999b).

Cotton is attacked by a number of sucking and chewing pests in Pakistan; amongst the latter, cotton bollworm, *H. armigera* is currently the most important in economic terms. It is a highly polyphagous agriculture pest. Host species for *H. armigera* come from a broad spectrum of families and include important agricultural crops such as cotton, maize, chickpea, pigeonpea, sorghum, sunflower, soyabean and groundnuts (Fitt, 1989). Like most other cotton producing countries, pest control has largely relied on chemical insecticides. The indiscriminate use of insecticides, particularly during 1980s and 1990s contributed to the emergence of the cotton bollworm, *Helicoverpa armigera*, as a primary pest of cotton in recent years. It became the major cause of cotton reduction in Pakistan. Control of this pest has not always been adequate probably due to the development of resistance. Moderate to high levels of resistance to pyrethroid and organophosphorus insecticides were recorded in a field population of *H. armigera* (Ahmed *et al*., 1995).

This study was aimed at determination of LC_{50} of test insecticides and insecticide efficacy comparison against *H. armigera*.

Material and Methods

Test insects:

Cotton bollworms were reared in the laboratory on modified semi-synthetic diet (Ahmed and McCaffery, 1991), under laboratory conditions of 27±2ºC, 65±5% RH and 14:10 hrs light: dark. A homogeneous stock of third instar larvae was obtained for respective insecticidal treatments.

Larval dip bioassay

Aqueous dilutions of formulated (emulsion concentrates) insecticides were prepared and batches of third instar larvae were submerged for 5 seconds as described by Watkinson *et al*. (1984). Each group of 20 larvae was dropped into 100 ml of each appropriate insecticide dilution in 500 ml beaker and gently swirled for 5 seconds to ensure complete wetting. The solution plus larvae were then poured through a fine nylon mesh suspended over an empty beaker. The solution was decanted and larvae separated by this process. After shade drying for about 5 min. the treated larvae were then transferred individually into semi synthetic diet. Control insects were treated with water alone.

Laboratory conditions and test insecticides:

Bioassays were carried out at 26±1ºC under approximately 12h : 12h LD photo period. Mortality was recorded after 48h interval. Serial dilutions of the formulated test insecticides (Table 1) were prepared as ppm of the active ingredient.

Statistical analysis

Larval mortalities were assessed after 48hrs of dipping. Results were expressed as percentage mortalities. Data were analyzed using computer-based probit analysis programme (Finney, 1971).

Result and Discussion

The results of toxicity of test insecticides to third instar larvae of *H. armigera* are presented in

Table 1. Details of different insecticides used for calculation of LC_{50}.

Trade name	Formulation	Active ingredient	Group	No. of conc.	Range
Lorsban	40 EC	Chlorpyriphos	Organophosphorus	7	50-500
Alpha-cypermethrin	5 EC	Alpha-cypermethrin	Pyrethroid	5	50-300
Karate	2.5 EC	Lambda cyclothrin	Pyrethroid	4	50-200

Table 2. The data revealed considerable variation in the responses of *H. armigera* larvae to the insecticides applied. Among the insecticides Lorsban 40EC proved to be the least toxic to *H. armigera* with highest LC_{50} (464.85 ppm) as compared to Alpha-cypermethrin and Karate.

LC_{50} of Alpha-cypermethrin was 287.87 ppm showing 1.61 times high effectiveness of Alpha-cypermethrin over Lorsban. LC_{50} value of Karate 71.31 ppm was found highly toxic to third instar larvae of *H. armigera* as compared to Lorsban and Alpha-cypermethrin. It was observed that LC_{50} value of Karate was 6.51 times less than the LC_{50} value of Lorsban and 2.80 times less that of Alpha-cypermethrin. This showed that Karate was much more effective as compared to both insecticides.

Similarly, Fakrudin *et al.* (2003) reported in their studies that maximum resistance to chlorpyriphos was recorded in Guntur followed by Nalgonda. Least resistance ratio against susceptible strain was found to be highest for the population of Guntur followed by that of Nalgonda and Raichur. The ratio was recorded in population from Kovilpatti and Madurai. Alpha-cypermethrin in this study was comparatively effective as compared to Lorsban. Similar results were obtained about the low resistance to Alpha-cypermethrin among various strains of *H. armigera* collected from different localities of Pakistan (Ahmed *et al.*, 1997a). The results were in agreement with the results of Ahmed *et al.* (1997b) that Karate was most effective and pests showed low resistance to it. One factor influencing the low resistance of *H. armigera* to Karate was that it is a derivative of different acid (3-(2-chloro-3,3,3-trifluoro-prop-1-enyl)-2, 2-dimethyl-cyclopropane-carboxylate). This difference in acid could be the reason for difference in resistance (Byrne *et al.*, 1994). The other factor could be the low use of Karate in Pakistan up to 1995 (Ahmed *et al.*, 1997c).

Conclusion

Information based on these results would help in precise calculation of candidate insecticides dosage for effective control of *H. armigera* and

Table 2. Toxicities of different insecticides on *H. armigera* (Hub.) after 48 hrs of dipping.

Insecticide	Dose ppm	n[a]	r[b]	M[c]	Slope±SE	LC_{50}	95% FL[d] of LC_{50}		X^2
							Lower	Upper	
Lorsban	50	20	0	0	8.48±2.38	**464.85**	427.03	535.10	1.70
	100	20	0	0					
	150	20	0	0					
	200	20	0	0					
	300	20	1	5					
	400	20	6	30					
	500	20	14	70					
Alpha-cypermethrin	50	20	2	10	1.78±0.56	**287.87**	231.86	409.59	0.28
	100	20	4	20					
	150	20	6	30					
	200	20	7	35					
	300	20	11	55					
Karate	50	20	8	40	1.37±0.03	**71.31**	25.44	101.32	0.22
	100	20	12	60					
	150	20	14	70					
	200	20	14	70					

[a] Number of larvae used. [b] Number of larvae died. [c] Per cent mortality [d] Fiducial limit

consequently help in avoiding economic loses because of insecticide dosage miscalculations. Furthermore, this information would also help in better integration of candidate insecticides into IPM program for the control of target pests in Pakistan.

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