J. Biol. Control, 11: 1-4, 1997

Effectiveness of *Helicoverpa armigera* nuclear polyhedrosis virus against insecticide resistant strains of *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) *

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ABSTRACT: Larvae of cotton bollworm, *Helicoverpa armigera* (Hübner) resistant and susceptible to fenvalerate and endosulfan were tested for susceptibility to a nuclear polyhedrosis virus. The LC_{50} values were less in resistant strains than in susceptible. The resistance ratio to *Ha*NPV was highest in fenvalerate resistant strain (0.88) followed by endosulfan resistant (0.64) strain.

KEY WORDS : *Ha*NPV, *Helicoverpa armigera*, insect resistance

Increased use of chemical pesticides has led to several serious concerns in the management of cotton bollworm. This has resulted in development of alternative methods for pest control. The microbial insecticides are now used to control the insect pests and also to lessen pesticide residues in crops. Since use of pesticides can not be dispensed with for suppression of cotton bollworm, it is imperative to know whether the insecticide resistant population of the insect pest is more, less or equally susceptible to an entomopathogen than in a non-insecticide selected population. Since the modes of action of entomopathogens are different from those of chemical insecticides, one would not expect physiological cross resistance between a chemical and a entomopathogen. Hence, the present investigation has been taken up to manage the insecticide resistance by employing entomopathogen, *Ha*NPV.

MATERIALS AND METHODS

Maintenance of insect strain

About 300 larvae of *H. armigera* collected from cotton fields from Sindhnur

*Part of Ph. D. thesis submitted by the senior author to the University of Agricultural Sciences, Dharwad

during September, 1993 were reared in glass vials on artificial diet individually following the procedure of Rabindra and Dhandapani (1988). One set of next generation larvae were used for bioassay study. The susceptible strain obtained from Tamil Nadu Agricultural University, Coimbatore was reared in the laboratory following the similar procedure and used for comparison, with the field strain in assessing the resistant level to fenvalerate and endofulfan.

Insecticide bioassay procedure

Third instar larvae of F1 generation were used for bioassay to estimate the LD_{50}. The insecticides used were fenvalerate and endosulfan. Serial dilutions of above two insecticides in acetone were prepared separately such that each was one half of the previous concentration to obtain mortality ranging from 20 to 80 per cent. One µl of each insecticide solution was applied to the thoracic dorsum of the third instar larva using Arnold microapplicator. Control insects were dosed with acetone alone. Each treatment was replicated four times having ten insects per replication. Treated larvae were reared individually in glass vials on artificial diet. The mortality was assessed 72 h after treatment. The data on mortality were corrected by Abbott's formula and subjected to statistical analysis following the method of Finney (1952). LD_{50} values were worked out separately for two insecticides including the susceptible. The resistance level for each insecticide was worked out by dividing the LD_{50} value of test strain by LD_{50} value of susceptible strain to a given toxicant.

Entomopathogen bioassay

With the second set of larvae, a diet surface treatment bioassay was used to determine the susceptibility of insecticide resistant and susceptible strains of *H. armigera* to nuclear polyhedrosis virus obtained from Pest Control (India) Pvt. Limited, Bangalore. Fifty microlitre of *Ha*NPV was spread evenly on the surface of the artificial diet. After 15 minutes of air drying, one third instar larva was released into each vial for microbial ingestion. Forty larvae were treated with each concentration (treatment) in four replications of ten each. Larval mortality was recorded from third day after treatment till pupation or death. LC_{50} values were determined from the corrected mortality values according to Finney (1952) for the pathogen in resistant and susceptible strains.

RESULTS AND DISCUSSION

The level of resistance evaluated in the laboratory for the field collected *H. armigera* larvae at the beginning of the experiment to fenvalerate and endosulfan was 30.74 and 7.73 folds, respectively (Table 1).

The virus proved to be the most effective in mitigating the resistance to insecticide in *H. armigera*. It is surprising to note that the LC_{50} was less in fenvalerate resistant (0.88 times) and endosulfan resistant (0.64 times) strains than susceptibile strain (Table 2). Though,

there are several reports on the utility of NPV in the *H. armigera* management, only in 1989 NPV was demonstrated for *H. armigera* control in many crop in India (Jayaraj *et al.*, 1989). The present findings

The practical utility of the present findings is in confirmity in respect of NPV with the results of Listov and Nesterov (1976), Rud and Bellonik (1984) and Rabindra and Jayaraj (1985) who reported

Table 1. Levels of insecticide resistance in *H. armigera* strain

Insecticide	*H. armigera* strain	LD_{50} (µg/larva)	Fiducial limits	Resistance Ratio*
Fenvalerate	Field	0.913020	0.69240 - 1.19820	30.74
	Susceptible	0.029700	0.02680 - 0.04920	
Endosulfan	Field	0.404320	0.30870 - 0.52395	7.73
	Susceptible	0.052325	0.03885 - 0.06895	

* Resistance Ratio = LD_{50} of resistant strain/LD_{50} of susceptible strain

Table 2. Pathogenicity of *Ha*NPV in resistant and susceptible strains

H. armigera strains	LC_{50} (POB/ml)	Resistance Ratio*	Fiducial limits (POB/ml)
I. Susceptible	1.46×10^7	-	6.10×10^6 - 3.62×10^7
ii. Resistant			
a. Fenvelrate	1.29×10^7	0.88	5.12×10^6 - 3.30×10^7
b. Endosulfan	9.26×10^6	0.64	3.93×10^6 - 2.08×10^7

* Resistance Ratio = LC_{50} of resistant strain / LC_{50} of susceptible strain

slightly differ from the work of Ignoffo and Roush (1986) who stated that insecticide resistant strains were as sensitive to the NPV as insecticide susceptible strains of *H. virescens*.

The above findings indicate varied effectiveness of organisms in differentially responsive strain to pesticide action. The response to the action of entomopathogen in the test insect was altered by differetial level of pesticide resistance existing in the populations.

that entomopathogens can break insecticide resistance when properly introduced into the population.

Based on the relative efficacy of *Ha*NPV in resistant and susceptible strains, it may be concluded that NPV, apparently becomes an obvious choice and hence its usage can become viable proposition in mitigating the pesticide resistance problem in *H. armigera*.

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