J. Biol. Control, 2(1), 62—63, 1988

Interaction of Nuclear Polyhedrosis Virus with the Microsporidian *Vairimorpha* sp. against *Heliothis armigera* (Hbn.)

N. SATHIAH, S. JAYARAJ AND R. J. RABINDRA
Centre for Plant Protection Studies
Tamil Nadu Agricultural University, Coimbatore 641 003

The nuclear polyhedrosis virus (NPV) of *Heliothis armigera* (Hbn.) was first isolated in India by Patel *et al.* (1968). Since then, the virus has been studied extensively and found effective against the pest on several crops (Jayaraj *et al.*, 1985). The microsporidian *Vairimorpha* sp. was reported from *H. armigera* by Narayanan (1987). The pathogen was identified by Dr. W.M. Brooks of North Carolina State University. U.S.A. This communication deals with results of laboratory experiments on the efficacy of NPV - *Vairimorpha* sp. combinations against second instar larvae of *H. armigera*.

H. armigera was cultured in the laboratory on a modified French bean diet (Shorey and Hale, 1965). Nuclear polyhedrosis virus was multiplied by inoculating fourth instar larvae of *H. armigera* and after extraction and purification by centrifugation, the strength of polyhedral occlusion bodies (POB) in the virus suspension was assessed with the help of a new improved Neubauer haemocytometer (Weber, England). Spores of *Vairimorpha* sp. were extracted from laboratory - infected final instar larvae of *H. armigera* and separated by centrifugation. The strength of spores was determined with the haemocytometer.

Two laboratory experiments were conducted using second instar larvae of *H.armigera*. Chickpea shoots washed in running tap water and dried were dipped in different treatments (Table 1, 2) and allowed to air-dry. Triton X-100 was added to all the treatments at 0.01%. The treated shoots were placed in glass vials containing water to avoid drying and the whole set-up placed in plastic containers (20 × 15 cm). Second instar *H. armigera* larvae were allowed to feed on the treated shoots for 24 h. Then they were transferred to vials containing semisynthetic diet without formalin. This method ensured uniform acquisition feeding by the larvae in the different trearments and avoided cannibalism and contamination which otherwise would vitiate the results. Suitable controls were maintained. Observations on the mortality were recorded daily.

The treatments were replicated four times and each treatment carried 10-15 larvae. The percentage mortality data were transformed to angles and after analysis of variance, the means were separated by Duncan's Multiple Range Test. The time-mortality data were subjected to probit analysis (Finney, 1962).

Simultaneous application of NPV at 0.5×10^3 POB/ml or 0.5×10^4 POB/ml with *Vairimorpha* sp. at 1×10^5 spores/ml was found to give 26.39 and 33.33% mortality respectively (Table 1). Independently, these

TABLE 1. Effect of NPV - *Vairimorpha* sp. combination on the second instar larvae of *Heliothis armigera*

Treatments*	% mortality	S.E. of the* mean
NPV alone 0.5×10^3 POB/ml	20.83b	± 1.19
NPV alone 0.5×10^4 POB/ml	32.14a	± 1.47
Vairimorpha sp. alone 1×10^5 spores/ml	16.07b	± 1.08
NPV 0.5×10^3 POB/ml + *Vairimorpha* sp. 1×10^5 spores/ml	26.39a	± 1.14
NPV 0.5×10^4 POB/ml + *Vairimorpha* sp. 1×10^5 spores/ml	33.33a	± 1.70

*Means followed by similar letters are not statistically different (P = 0.05) by DMRT.

TABLE 2. Interacion of NPV with *Vairimorpha* sp. and insecticides and probit analysis of time-mortality responses in second instar larvae of *H. armigera*

Treatments	Mean % mortality	PROBIT ANALYSIS			
		X^2 (n-2)	Slope 'b'	LT_{50} (h)	Fiducial limits
NPV 0.5 × 10^3 POB/ml	21.5ab	0.547	4.622	154.94	141.32 169.89
NPV 0.5 × 10^4 POB/ml	40.7a	1.967	6.322	123.05	115.37 131.24
Vairimorpha sp. 1 × 10^6 spores/ml	16.7b	0.095	8.813	206.41	188.09 226.50
NPV 0.5 × 10^3 POB/ml + *Vairimorpha* sp. 1 × 10^6 spores/ml	25.9ab	0.216	15.820	122.72	117·17 128.54
NPV 0.5 × 10^4 POB/ml + *Vairimorpha* sp. 1 × 10^6 spores/ml	36.3ab	1.358	15.052	115.61	111.27 120.12

All lines are significantly a good fit ($P < 0.05$)
Means followed by similar letters are not different statistically ($P = 0.05$) by DMRT

treatments recorded 20.83, 32.14 and 16.07% mortality respectively. In the next experiment (Table 2), the increase in dosage of *Vairimorpha* sp. did not enhance the levels of mortality. In all the cases, the combinations produced only lower mortality rates due to antagonism. Antagonism in its simplest form is the resultant incompatibility of two mortality agents (Benz, 1971). Fuxa (1979) tested several combinations of NPV and *Vairimorpha necatrix* on *Heliothis zea* Boddie and found antagonism. However, at the highest concentration of *V. necatrix* (1320 spores/mm²) and *Virion-H* (66 ng/mm²), an additive effect was obtained and it was suggested that antagonism would have been due to the interference of one pathogen with other in the entry into the haemocoel. Simultaneous inoculation of *Hyphantrea cunea* L. with *Nosema* sp. and NPV had a sub-additive effect in some cases and antagonism in others (Nordin and Maddox, 1972). In the present investigation, eventhough the combination resulted in antagonism, the LT_{50} value for the combination was much lower than that of either of them alone (Table 2). A similar observation was made on the velvet bean caterpillar *Anticarsia gemmatalis* (Hubner) (Richter and Fuxa, 1984). The interaction of NPV and *Vairimorpha* sp. at higher concentration has to be tested, as the antogonism between the two lessened at higher concentrations (Fuxa, 1979).

KEY WORDS : NPV, *Vairimorpha* sp., interaction, *Heliothis armigera*.

REFERENCES

Benz, G. 1971. Synergism of micro organisms and Chemical insecticides. In : *Mibrobial control of insects and mites* (H.D. Burges and N.W. Hussey, eds.), pp. 327-355. Academic Press, New York.

Finney, D.J. 1962. "*Probit analysis : A statistical treatment of the sigmoid response curve*" 2nd ed. Cambridge University Press, London.

Fuxa, J.R. 1979. Interaction of the microsporidium *Vairimorpha necatrix* with a bacterium, virus and fungus in *Heliothis zea*. *J. Invertebr. Pathol.*, **33**, 316-323.

Jayaraj, S., Rabindra, R.J. and Narayanan, K. 1985. Development and use of microbial agents for the control of *Heliothis* spp. in India. Paper presented in the International Workshop on, "*Biological control of Heliothis : increasing the effectivanss of natural enemies*", Nov. 11-15, 1985, New Delhi.

Narayanan, K. 1987. Susceptibility of *Heliothis armigera* to *Vairimorpha* sp. *J. Biol. Control*, **1**, 148-149.

Nordin, G.L. and Maddox, J.V. 1972. Effects of simultaneous virus and microspordian infections on larvae of *Hyphantria cunea*. *J. Invertebr. Pathol.*, **20**, 66-69.

Patel, R.C., Singh, R. and Patel, P.B. 1968. Nuclear polyhedrosis of the gram pod borer, *Heliothis armigera*. *J. Econ. Entomol.*, **61**, 191-193.

Richter, A.R. and Fuxa, J.R. 1984. Pathogen - pathogen and pathogen-insecticide interaction in velvet bean caterpillar *Anticarsia gemmatalis* (Lepidoptera : Noctuidae). *J. Econ. Entomol.*, **58**, 522-524.

Shorey, H.H. and Hale, R.L. 1965. Mass rearing of the larvae of nine noctuid species on a simple artificial medium. *J. Econ. Entomol.*, **58**, 522-524.