J.Biol.Control, 7 (2), 105-108, 1993

Use of a Baculovirus Mixture for the Control of *Helicoverpa armigera* (Hbn.) and *Spodoptera litura* F. on Groundnut*

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The groundnut, *Arachis hypogaea* L. is known to be attacked by nearly 52 species of insect pests including the gram pod borer, *Helicoverpa armigera* (Hbn.) and the tobacco cutworm, *Spodoptera litura* F. (Singh *et al.*, 1990). These two species of insects feed on leaves and cause considerable damage by defoliation. Since insecticide resistance has been reported in both *H. armigera* and *S. litura* in India (Mehrotra, 1989), baculoviruses, particularly the nuclear polyhedrosis viruses (NPV) have been tried as microbial insecticides for the control of these pests. The NPV of *H. armigera* (HaNPV) has been found to control *H.armigera* on crops like chickpea (Rabindra and Jayaraj, 1988), pigeonpea (Muthiah and Rabindra, 1991), cotton (Dhandapani *et al.*, 1987) and sunflower (Rabindra *et al.*, 1986). Similarly, successful control of *S. litura* with its NPV (SlNPV) has been reported on tobacco (Ramakrishnan *et al.*, 1981), banana (Santharam *et al.*, 1988), cauliflower (Chaudhari and Ramakrishnan, 1980) and cotton (Jayaraj *et al.*, 1981). But so far, the virus control of these pests has not been attempted on groundnut.

In the month of March 1992, mixed populations of *H. armigera* and *S. litura* were observed on groundnut in a farmer's field at Senbagapudur of Periyar district. This area comes under the Lower Bhavani Project and these pests were found to occur on groundnut in vast areas only in this irrigated tract but not in the adjoining fields irrigated by wells, probably due to higher level of relative humidity. In order to find out the efficacy of the mixture of HaNPV and SlNPV, a field experiment was conducted in an Exploded Block Design with the plot size of 160 square metres for each treatment. Fresh NPVs propagated in the respective host insects were semipurified by differential centrifugation and the concentration of polyhedra assessed with the help of a haemocytometer. The treatments consisted of mixture of HaNPV and SlNPV each @ 250 larval equivalents (LE)ha with or without a phagostimulant adjuvant mixture consisting of 10% cotton seed kernel extract (CSKE) and 10% crude sugar (CS). The virus mixture was also tested along with chlorpyriphos @ 125 g a.i./ha and compared with chlorpyriphos at both 125 and 250 g a.i./ha. Two rounds of treatment were applied with a hand-held controlled droplet applicator using a spray fluid volume of 12.5 litres/ha. Observations on the larval population were recorded in an area of 5 m^2 and replicated at random in three locations, before and after application of the treatments. Leaf damage was recorded in 20 randomly - selected plants in three replicates by counting the total number of leaves and leaves showing damage.

The pretreatment count showed that the population of *H. armigera* ranged from 8.00 to 12.66/5 m^2 as against the *S.litura* population of 1.00 to 3.66/5 m^2 (Table 1). Population of *H. armigera* was significantly higher than that of *S. litura*. The counts taken 7 days after the first round revealed that the treatments had a significant effect in reducing the population of both *H. armigera* and *S.litura*. Application of the baculovirus mixture along with cotton seed kernel extract 10% and crude sugar 10% was the most effective against *H. armigera* while only NPV-insecticide combination or

* Part of research project funded by USIF (PL 480) of the U.S.D.A

Table 1. Field efficacy of NPV mixture in the management of mixed populations of *H.armigera* and *S. litura* on groundnut

Treatments	No. of larvae/5 m^2 1/						% Leaf damage
	Pre-treatment			7 days after treatment			
	H. armigera	*S. litura*	Mean	*H. armigera*	*S. litura*	Mean	
HaNPV + SlNPV both 250 LE/ha	8.66 (3.00)	3.66 (1.97)	6.16 (2.49)	3.66 (2.02)	1.00 (1.09)	2.33 (1.55)	69.47^{bc} (56.52)
HaNPV + SlNPV both 250 LE/ha + CSKE 10% + CS 10%	8.00 (2.91)	1.66 (1.46)	4.83 (2.19)	1.00 (1.16)	0.66 (1.04)	0.83 (1.10)	64.13^{ab} (53.28)
HaNPV + SlNPV both 250 LE/ha + Chlorpyriphos 125 g a.i./ha	9.33 (3.11)	2.33 (1.65)	5.83 (2.38)	3.66 (2.03)	0.33 (0.87)	3.99 (1.45)	53.90^{a} (47.25)
HaNPV + SlNPV both 250 LE/ha + CSKE 10% + CS 10% + Chlorpyriphos 125 g a.i./ha	12.33 (3.55)	2.33 (1.68)	7.33 (2.62)	2.33 (1.65)	0.00 (0.70)	1.16 (1.17)	64.93^{ab} (53.69)
Chlorpyriphos 125 g a.i./ha	11.33 (3.43)	2.33 (1.68)	6.83 (2.56)	4.00 (2.12)	0.33 (0.87)	2.16 (1.49)	58.13^{ab} (49.68)
Chlorpyriphos 250 g a.i./ha	8.00 (2.89)	1.00 (1.27)	4.50 (2.08)	2.33 (1.64)	0.00 (0.70)	1.16 (1.17)	67.13^{b} (55.30)
Control	12.66 (3.63)	1.33 (1.29)	6.99 (2.46)	12.00 (3.53)	2.00 (1.55)	7.00 (2.54)	79.30^{c} (62.95)
Mean	10.04 (3.22)	2.09 (1.57)		4.14 (2.02)	0.62 (0.97)		
C.D. for treatments		NS			0.40**		7.18
C.D. for insects		0.27**			0.21**		-
C.D. for interaction		NS			0.56**		-

Figures in parentheses represent angles corresponding to percentages

1/ Mean of three replications

insecticides alone were effective against *S. litura*. Considering the total population of both the species, virus mixture with cotton seed kernel extract and crude suger was as effective as virus-chlorpyriphos combination or chlorpyriphos alone. Application of virus mixture with cotton seed kernel extract and crude sugar gave better control of the combined population of *H. armigera* and *S. litura* than the virus mixture without adjuvants. The observation on the larval population 7 days after the second spray could not be recorded since the farmer had irrigated the field then and it was not possible to enter the field without damage to the pegs.

Data on leaf damage recorded after the second spray showed that the treatments had a significant effect on leaf damage. The leaf damage ranged from 53.9 to 79.3 per cent in the different treatments. It was lowest in NPV mixture + chlorpyriphos and was on par with NPV + adjuvants, NPV + adjuvants + chlorpyriphos and chlorpyriphos 125 g a.i./ha. There was no significant difference between 125 and 250 g a.i./ha of chlorpyriphos. Application of the viruses without either the adjuvants or the insecticides was not effective in reducing the leaf damage.

These data have clearly shown that populations of *H. armigera* and *S. litura* can be successfully controlled on groundnut by applying the NPV mixture either with an adjuvant carrying cotton seed kernel extract 10% and crude sugar 10% or chlorpyriphos at 125 g a.i./ha. The efficacy of cotton seed kernel extract and crude sugar as adjuvants to increase the NPV mortality of *H. armigera* has been reported on cotton (Dhandapani *et al.*, 1987). Similarly, NPV-chlorpyriphos combination was found to give better control of *S. litura* populations than application of virus alone (Jayaraj *et al.*, 1981). There is no earlier attempt to use baculovirus mixture for the control of mixed populations of *H. armigera* and *S. litura*. The NPV of *H. armigera* is not infective to *S. litura* and vice-versa but, foreign viruses can activate latent virus infections in insects (Longworth and Cunningham, 1968). The same phenomenon of foreign viruses activating latent virus infections might have occurred with *H. armigera* and *S. litura* supplementing the effect of artificially augmented virus. There are only a very few reports on the use of baculovirus mixtures for the management of mixed pest populations. Jaques (1973) was able to get additive effect by applying a mixture of *Trichoplusia ni* NPV + *Pieris rapae* GV + *B. t.* in the field control of mixed populations of *T. ni* and *P. rapae*. This report indicates the possibility of integrating *B.t.* with virus mixture on groundnut so that other lepidopterous pests like the leaf miner, *Aproaerema modicella* Deventer may also be successfully managed along with *H. armigera* and *S. litura*.

KEYWORDS : *Helicoverpa armigera, Spodoptera litura,* Nuclear polyhedrosis virus, control, groundunt

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