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Microbial Control of *Helicoverpa (=Heliothis) armigera* on Chickpea*

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Helicoverpa (=Heliothis) armigera (Hubner) is a serious pest of chickpea (*Cicer arietinum* L.) in most parts of India. The larvae infest the crop almost throughout its growth phase, being low at the vegetative and flowering stages and high at the grain development stage (Yadava and Lal, 1988). In the state of Tamil Nadu, the loss caused by *H.armigera* to chickpea was 40 per cent in 1987-88 (Jayaraj, 1990). Rawat *et al.* (1979) reported 50-100 per cent loss in yield under field conditions. Several attempts have been made in the past to control the pest with chemical insecticides and also microbials. In the present study, an attempt was made to assess the efficacy of microbials, *Bacillus thuringiensis* and nuclear polyhedrosis virus (NPV) of *H.armigera* and a chemical insecticide, endosulfan and their combinations.

Bacillus thuringiensis (*B.t.*) var. *kurstaki* (Delfin) was obtained from Sandoz (India) Limited as a water dispersible microgranules formulation (dry flowable). The fresh nuclear polyhedrosis virus (NPV) propagated in fourth instar larvae of *H.armigera*, partially purified by differential centrifugation and standardised with a Neubauer haemocyto meter was used in the field experiments. The chemical insecticide, endosulfan was obtained from the market as Thiodan 35 EC. The field experiment was conducted on chickpea (cv.Shoba) in a farmer's field in Kurumbapalayam Village in Coimbatore district under rainfed conditions. The experiment was laid out in a randomised block design with a plot size of 20 m^2. The treatments (Table 1) were replicated thrice. The first round of treatments was given 23 days after sowing when early instar larvae of *H.armigera* were observed. The treatments were applied five times at weekly intervals with a hand-operated back-pack sprayer using a spray fluid of 600 litres/ha. The number of larvae of *H.armigera* were recorded on ten randomly-selected plants in each plot before each round of treatment and 7 days later. Damage to pods was assessed in ten randomly selected plants per plot by counting the total number of pods and number of pods damaged. At harvest, the pods from each plot were threshed separately and the grain yield was recorded. The data expressed in terms of percentage in the experiment were transformed to corresponding angles (arc sine $\sqrt{\text{percentage}}$) (Panse and Sukhatme, 1985). Data on larval population were transformed to $\sqrt{x+0.5}$. Analysis of variance was done and means were separated by Duncan's new multiple range test (DMRT) (Duncan, 1955; Steel and Torrie, 1960).

The data recorded 7 days after each round of spray (except the second) showed that the *B.t.* treatments were as effective as NPV in reducing the larval population of *H.armigera* (Table 1). There were no significant difference in efficacy between 0.75, 1.00 and 1.25 Kg *B.t.*/ha. A combination of *B.t.* and NPV did not give better result than either of them applied alone. A more or less similar trend was seen in pod damage and yield also. Though the combination treatment of *B.t.* 1.00 kg + endosulfan 175 g /ha did not

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Table 1. Field efficacy of *B.t.* (Delfin) alone and in combination with HaNPV and endosulfan on the larvae of *H.armigera*, pod damage and yield in chickpea

(Mean of three observations)

Treatments	Larvae/10 plants 7 days after treatment I Round**	II $ Round	III** Round	IV Round**	V Round**	Pod** Damage (%)	Grain** Yield (Kg/ha)
B.t. 0.75 Kg/ha	0.67 ab	0.67	1.33 bc	1.00 b	0.33 a	51.71 c	175.13 c
B.t. 1.00 Kg/ha	1.67 b	1.00	0.00 a	0.67 ab	0.33 a	52.91 c	180.34 c
B.t. 1.25 Kg/ha	1.33 b	0.00	1.67 c	0.33 ab	0.00 a	51.15 c	193.12 bc
Endosulfan 350 g/ha	0.33 a	0.67	1.67 c	0.00 a	0.00 a	46.11 b	209.68 ab
B.t. 1.00 Kg + endosulfan 175 g/ha	0.00 a	1.00	0.67 ab	0.00 a	0.00 a	39.38 a	222.94 a
HaNPV 250 LE/ha	1.33 b	0.33	1.67 c	0.33 ab	0.00 a	51.18 c	205.90 ab
B.t. 1.00 Kg+HaNPV 125 LE/ha	1.67 b	1.00	1.67 c	0.00 a	0.00 a	48.99 bc	212.05 ab
Untreated check	3.33 c	2.00	5.00 d	4.00 c	3.00 b	62.44 d	142.00 d

** Significant at P = 0.01
$ Differences between the means not significant
In vertical columns means followed by similar letters are not significantly different by DMRT (P = 0.05)

show better efficacy than *B.t.* 1.00 Kg applied alone in reducing the larval population, it was significantly better than *B.t.* 1.00 kg in reducing the pod damage and yield. The yield in the combination treatment was on par with those of endosulfan 350 g /ha, NPV 250 LE/ha and *B.t.* 1.00 kg + NPV 125 LE/ha.

Sundarababu (1969) indicated the possibility of using *B.t.* for the control of *H.armigera* and Dabi *et al.* (1979) reported the field efficacy of *B.t.* against *H.armigera* on chickpea. Kulkarni and Amonkar (1988) screened several *B.t.* varieties for spore and crystal toxicity to *H.armigera* and demonstrated the effectiveness against *H.armigera* on chickpea. The results of the present study have also indicated the usefulness of *B.t.* in the control of the pest on chickpea. *B.t.* at 1.00 kg + endosulfan 175 g/ha gave the highest yield. The present study revealed that HaNPV 250 LE/ha or a combination of *B.t.* 1.00 kg + HaNPV 125 LE/ha was equally effective. The use of NPV for the control of *H.armigera* on chickpea has been reported earlier by Santharam and Balasubramanian (1982), Rabindra and Jayaraj (1988) and Pawar *et al.* (1990). Since *B.t.* resistance has been reported in the diamond back moth, *Plutella xylostella,* a very highly *B.t.* susceptible insect (Tabashnik *et al.,* 1990), *B.t.* should be used with caution and wherever *B.t.* is applied extensively, a systematic screening for possible development of resistance should be done.

KEY WORDS : Microbial control, *Helicoverpa armigera,* chickpea, *Bacillus thuringiensis* var. *kurstaki,* endosulfan ,Nuclear Polyhedrosis Virus

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