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Efficacy of Some Synthetic and Biopesticides Against Pod Borer, *Helicoverpa armigera* (Hubner) in Chickpea

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ABSTRACT

Efficacy of some synthetic and biopesticides against pod borer, *Helicoverpa armigera* (Hubner) damage in chickpea was studied at the Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during rabi cropping season of 2004-05. Synthetic and biopesticides reduced pod borer damage significantly. Significantly lowest pod damage was observed in cypermethrin (5.75%) and HNPV (5.86%) sprayed plots followed by carbaryl (6.05%) and dimethoate (7.92%) treated plots. The bio-control agent, HNPV, showed equally the best performance like synthetic insecticides and also showed higher efficacy than neem based insecticides like nimbicidine (azadiractin 0.03% EC). Pod damage reduction by synthetic insecticides and biopesticides over untreated control ranged from 24.98 to 64.08%. It ranged from 50.53 to 64.08% in synthetic insecticides and 24.98 to 63.40% in bio-pesticides. Significantly the highest yield (1,856 kg/ha) obtained from HNPV sprayed plots which was statistically identical to cypermethrin followed by azadiractin 0.03% EC. The highest net income ($ 105/ha) and marginal benefit cost ratio (3.35) was recorded from HNPV spray followed by cypermethrin ($ 87/ha) and (2.12), respectively. Hence, it might be concluded that HNPV is the best tool in managing pod borer in chickpea considering efficacy, profitability and environment friendly.

***Keywords*:** chickpea, pod borer, pod damage, biopesticides, yield

INTRODUCTION

Chickpea, *Cicer arietinum* L., also known as gram, is one of the important pulse crops in Bangladesh. It is attacked by eleven species of insect pests (Rahman *et al.*, 1982). Among these pests, the pod borer, *Helicoverpa armigera* (Hubner) is the most serious insect pest in most of the chickpea growing areas of the country (Begum *et al.*, 1992). On average about 30 to 40% pods were found to be damaged by the pod borer resulting in the yield loss of 400 kg/ha due to pod borer damage (Rahman, 1990). Under favourable weather condition the damage to pods could increase upto 90-95% (Shengal and Ujagir, 1990; Sachan and Katti, 1994). In this scenario, pod borer can be considered as the most important constraint in chickpea cultivation. Farmers are reluctant to cultivate chickpea because of heavy yield loss caused by this pest.

The recommended management strategies of this obnoxious pest in Bangladesh are primarily based on synthetic insecticides (Rahman, 1991). These insecticides are very effective against the target insect pest but brutally eliminate other non target arthropods in the field (Roach and Hopkins, 1981). Recently, *H. armigera* is reported to have developed resistance to many commonly used insecticides (Phokela *et al*., 1990 and Lande, 1992). Therefore, synthetic insecticides should be used cautiously for controlling insect pests in chickpea.

The increasing concern for environmental awareness of pesticide hazards has evoked a worldwide interest in the use of pest control agents of bio and plant origin. These biocontrol agents and botanical pesticides are safer to be used in pest control programmes and may prevent several adverse effects caused by synthetic insecticidal application (Rajasekaran and Kumarswamy, 1985). Hence, the present studies reported in this paper were carried out to investigate the efficacy of synthetic insecticides and biopesticides for the management of *H. armigera* in chickpea that can be used as a substitute to the synthetic insecticides.

MATERIALS AND METHODS

Experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during rabi season of 2004-05. Application of synthetic insecticides and biopesticides considered as treatments of the experiments which were: T_1=Spraying with cypermethrin 10EC @ 1ml/litre water, T_2= Spray ing with dimethoate 40EC @ 2ml/litre water, T_3=Spraying with carbaryl 85SP @ 2g/litre water, T_4=Spraying with azadiractin 0.03%EC @ 4 ml/litre water, T_5=Spraying with neem oil+ trix @ (10 + 5) ml/l water, T_6=Spraying with *Helicoverpa* nuclear polyhedrosis viruses (HNPV) @ 500 Larval Equivalent /ha, T_7= Spraying with tobacco leaf extract @ 3 leaf/ litre water and T_8=Untreated control.

The experiment was laid out in randomized complete block design (RCBD) with four replications. The treatments were randomly allotted in each block. The unit plot size was 3m x 4m with a distance of 100 cm between the plots and 150 cm between the replications. The seeds of BARI-chola 5 of chickpea were sown on November 20, 2004 in rows with the spacing of 50 cm. The populations of the plant were maintained constant by keeping plant to plant distance of 10 cm.

Treatments were sprayed first at 100% pod formation stage and then 2^{nd} and 3^{rd} sprayes were done at 7 days intervals. At maturity, all the pods were collected from 10 randomly selected plants from middle rows of each plot and examined. The damaged (bored) and total numbers of pods were counted and the per cent pod damage was determined using the following formula:

$$\%\text{Pod damage} = \frac{\text{No. of damaged pods X 100}}{\text{Total No. of pods}}$$

Plants of middle four rows avoiding border rows of each plot comprising 8m2 (2m x 4m) area was harvested. The pods were then threshed; grains were cleaned and dried in the bright sunshine.

The experimental data were analyzed by MSTAT-C software. The percent data were subjected to square root transformation for statistical analysis. Mean comparisons for treatment parameters were compared using Duncan's Multiple Range Test (Steel and Torrie, 1960) at 5% level of significance.

The marginal benefit cost ratio (MBCR) was calculated on the basis of prevailing market prices of chickpea, insecticides, bio-pesticides, and spraying cost. Marginal benefit cost ratio was calculated as follows:

$$\text{Marginal BCR} = \frac{\text{Benefit on control}}{\text{Cost of treatment}}$$

RESULTS AND DISCUSSION

Effect of synthetic and bio-pesticide on pod borer damage and yield

Synthetic insecticides and biopesticides reduced pod borer damage significantly (Table 1). The lowest pod borer damage (5.75%) was observed in cypermethrin sprayed plots which were statistically identical to HNPV (5.86%) sprayed plots followed by carbaryl (6.05%) and dimethoate (7.92%). This might be due to its high toxicity with fast acting activities produced quick knock down action to pod borer. Earlier Mehta et al. (1991), Naik et al. (1991), Datkhile et al. (1992), Chaudhary and Sachan (1995), Subbarayudu (1997) and Jadhav and Suryawanshi (1998) reported the highest effectiveness of cypermethrin against chickpea pod borer which are in agreement with the present findings. Again, HNPV was found to be as effective as cypermethrin in managing pod borer damage in chickpea. HNPV attacked the nuclei of blood cell of pod borer and hemolymph become turbid contains large number of polyhedra caused death of pod borer. Before death infected larvae climb up to the highest canopy of food plants and hanged from there. Pawar et al. (1987), Vyas and Lakhohaura (1996), Satish et al. (1998) Pokharkar et al. (1999) and Hossain et al. (2001) also reported the effectiveness of HNPV as good as standard chemical insecticides in controlling pod borer damage in chickpea.

Statistically the second lowest pod damage (8.5%) was observed in nimbicidine sprayed plots. Neem oil + trix and tobacco leaf extract treated plots ranked third position in efficacy against pod borer. Neem based insecticides like nimbicidine and phytoproducts like neem oil and tobacco leaf extract were moderately effective, although inferior to HNPV which was in partial agreement with Butani and Mittal (1993), Sarode *et al.* (1994) and Bajpai and Sehgal (2000). Pod borer damage reduction by

Table 1: Effect of synthetic and bio-pesticides on pod borer damage and yield in chickpea during rabi 2004-05 at Ishurdi, Pabna, Bangladesh

Treatments	Doses	No. of spray	Pod damage (%)	Yield (kg/ha)
Cypermethrin	1 ml/l	3	5.75 d	1,837 a
Dimethoate	2 ml/l	3	7.92 cd	1,692 bc
Carbaryl	2 g/l	3	6.05 d	1,687 bc
Nimbicidine	4 ml/l	3	8.50 c	1,781 ab
Neem oil+Trix	(10+5) ml/l	3	11.63 b	1,585 cd
HNPV	500 LE/ha	3	5.86 d	1,856 a
Tobacco leaf extract	3 leaf/ l	3	12.01 b	1,686 bc
Untreated control	-	-	16.01 a	1,532 d
CV%	-	-	8.66	4.62

Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level. Values are the Means of four replications. Figures in the parentheses are the square root transformed mean values. HNPV = *Helicoverpa* nuclear polyhedrosis virus , LE = Larval Equivalent

synthetic insecticides and bio-pesticides over untreated control ranged from 24.98 to 64.08%.

Yield of chickpea varied significantly with the level of pod borer damage depending on efficacy of different synthetic and bio-pesticidal application (Table 2). Significantly the highest yield (1,856 kg/ha) obtained from HNPV sprayed plots which was statistically identical to cypermethrin followed by nimbicidine. The highest yield of HNPV treated plots might be due to the effect of most selectivity of HNPV to pod borer and friendlyness to plant. Among insecticides and bio-pesticides, neem oil + trix treated plots provided the lowest yield (1,585 kg/ha). The remaining other treatments gave statistically identical yield. Among all the treatments, significantly the lowest yield (1,532 kg/ha) was recorded from untreated control plots.

Income and marginal benefit cost ratio

The net income and marginal benefit cost ratio was varied depending on cost of pesticidal application (Table 2). The highest net income ($ 105/ha) was recorded from HNPV sprayed treatment followed by cypermethrin ($ 87/ha) and nimbicidine ($ 38/ha). This was due to the lowest cost involved in HNPV application along with highest yield. The lowest net income ($ -22/ha) was recorded from neem oil + trix applied treatment.

The marginal benefit cost analysis of insecticidal application revealed the highest monetary benefit from HNPV sprayed treatment. For each US dollar spent, HNPV gave on an average the profit of $ 3.35 as against $ 2.12, $ 1.10, $ 0.78, $ 0.58 and $ 0.35 in cypermethrin, dimethoate, tobacco leaf extract, nimbicidine and carbaryl. The neem oil + trix application incurred loss.

These profit findings of HNPV spraying corroborate with Butani *et al.* (1997) who computed the MBCR of 3.82 in case of HNPV

Table 2. Effect of synthetic and bio-pesticides application on net income and marginal benefit cost ratio in chickpea during rabi 2004-05 at Ishurdi, Pabna, Bangladesh

Treatments	Yield (kg/ha)	Addl. yield over control (kg/ha)	Addl. income over control ($/ha)	Cost of insecticide appl. ($/ha)	Net income ($/ha)	Marginal benefit cost ratio (MBCR)
Cypermethrin	1,837	305	127	41	87	2.12
Dimethoate	1,692	160	67	32	35	1.10
Carbaryl	1,687	155	65	48	17	0.35
Nimbicidine	1,781	249	104	66	38	0.58
Neem oil + Trix	1,585	53	22	42	-20	-0.47
HNPV	1,856	324	135	31	104	3.35
Tobacco leaf ext.	1,686	154	64	36	28	0.78
Untreated control	1,532	-	-	-	-	-

Addl. = Additional, appl. = application, ext. = extract, For calculating income and benefit the following market prices were used: Cypermethrin 10 EC = $ 2/100 ml, Dimethoate 40 EC = $ 0.7/100 ml, Carbaryl 85 SP = $ 1.25/100 g, Azadiractin 0.03% = $ 0.92/100 ml, Neem oil = $ 1.33/litre, Trix = $ 1.5/litre, HNPV = $ 6.67/ha, Tobacco leaf = $ 0.017 per 3 leaf and Chickpea = $ 0.42/kg, Labour wage for spraying pesticides = $ 1.17/day/labourer (work 8 h/day) spraying in chickpea. Cypermethrin application provided lower marginal benefit cost ratio (2.12) than HNPV (3.35) application due to high cost of cypermethrin. Hence, HNPV determined to be the best tool in managing pod borer in chickpea considering efficacy, profitability and environment friendly nature.

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