ISSN 0258-7122
Bangladesh J. Agril. Res. 35(2) : 201-206, June 2010

DEVELOPMENT OF AN INTEGRATED MANAGEMENT APPROACH FOR POD BORER, *Helicoverpa armigera* (Hubner) ON CHICKPEA*

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Abstract

An experiment was conducted to develop an 1PM approach for the management of pod borer, *Helicoverpa armigera* (Hubner) in chickpea field. Out of seven modules studied, module 5 consisting of sequential first spray with *Helicoverpa* nuclear polyhedrosis viruses (HNPV) @ 500 LE/ha and second spray after seven days interval with Cypermethrin @ 1 ml/ litre gave the best protection with the lowest pod borer damage (4.62%) and provided the highest yield (2096 kg/ha) and maximum net return (Tk. 43746/ha) followed by module 3 where only RNPV was sprayed twice. But the most economic module for pod borer management was M_2 where chickpea intercropped with mustard was sown on 15 November. For best protection against pod borer, the most effective 1PM module was chickpea sown on 15 November and first spraying with HNPV @ 500 LE/ha just at 100% plant pod formation stage and second spray after 7 days with Cermethrin @ 1 ml/L, ensuring higher yield and return.

Keywords : Integrated management, pod borer, chickpea.

Introduction

Chickpea, *Cicer arietinum* L. commonly 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* (= *Heliothis) armigera* (Hubner) is a major and most serious one in most of the chickpea growing areas of the country (Begum *et al.*, 1992). On an average, 30 to 40 percent pods were found to be damaged by pod borer and on an average, 400 kg/ha grains were lost by the borer (Rahman, 1990). In favourable condition to pod borer, pod damage goes 90-95 percent (Shengal and Ujagir, 1990; Sachan and Katti, 1994). The management of this noxious pest in Bangladesh is primarily based on synthetic insecticides (Rahman, 1991). Preference of insecticides due to their easy availability and applicability and their excessive and indiscriminate use has resulted in the development of insecticidal resistance in the pests and environmental pollution (Phokela *et al.,* 1990). Recently,

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* Part of Ph. D. Thesis of first Author submitted to Bangladesh Agricultural University, Mymensingh 2202.

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H. armigera is reported to have developed resistance to many commonly used insecticides (Phokela *et al.*, 1990 and Lande, 1992). Keeping this in view, attempts have been made to developing integrated management approach using cultural practices, host plant resistance, synthetic insecticides and biopesticides.

Materials and Method

The experiment was conducted with four management components in seven treatment modules at Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during *rabi* season of 2005-06. These modules were selected from the previous experiment carried out on the pod borer. The 1PM treatment modules were: M_1 = The optimum date of sowing (15 November) + the best line (ICCV-95 138) + the most economic NPK fertilizer dose (NPK 40-20-20 kg/ha), M_2 = M_1 + mustard intercropping, M_3 = M_1 + HNPV *(Helicoverpa* Nuclear Polyhedrosis Virus) spray @ 500 LE/ha, M_4 = M_1 + Cypermethrin spray @ l ml/L, M_5 = M_1 + (HNPV @ 500 LE/ha + Cypermethrin @ 1 ml/L) spray, M_6 = M_1 + mustard intercropping + HNPV spray @ 500 LE/ha and M_7 = M_1 + mustard intercropping + Cypermethrin spray @ 1 ml/L.

The experiments were laid out in randomized complete block design with four replications. The treatments were randomly distributed in each block. The unit plot size was 4m × 4m in sole cropping and 3.6m × 4m in mustard intercropping treatments with a distance of 100 cm between the plots and 150 cm between the replications. In unit plots, row to row planting distance of chickpea-chickpea was 50 cm and chickpea-mustard was 30 cm and plant to plant was 10 cm. Fertilizer NPK @ 40, 20, and 20 kg/ha in the form of urea, triple super phosphate and muriate of potash, respectively were applied as basal at the time of sowing seeds. The seeds of the best line (ICCV-95138) considering pod borer resistance and potential yield were sown on 15 November 2005 in rows with spacing of chickpea-chickpea 50 cm and chickpea-mustard 30 cm and plant to plant distance 10 cm.

Module wise HNPV and Cypermethrin were sprayed first just at 100% plants pod formation stage and second spray was done after 7 days interval. 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 percent pod damage was determined using the following formula:

$$\text{\% Pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

In case of both sole and intercropping, crops of whole plot were harvested. The harvested crops were then threshed; grains of chickpea and intercrops were collected and dried in the bright sunshine. The grain yield of chickpea and intercrops were then obtained from each plot and converted into per hectare. The chickpea equivalent yield was computed by converting the yield of intercrops (coriander, linseed, mustard, wheat, and safflower) into the yield of chickpea on the basis of prevailing market prices using following formula:

$$\text{Chickpea equivalent yield (in case of intercrops)} = \frac{Yi \times Pi}{Pc}$$

Where, Yi Yield of intercrops, Pi = Price of intercrops and Pc = Price of chickpea

The benefit cost ratio was calculated on the basis of prevailing market prices of chickpea, mustard, cypermethrin, HNPV, spraying and cultivation cost etc.

Benefit cost ratio was calculated as follows:

$$BCR = \frac{\text{Gross return}}{\text{Total variable cost}}$$

The experimental data were analyzed by MSTAT-C software. The per cent data were transformed by square root transformation for statistical analysis.

Results and Discussion

Effect of different 1PM modules on pod borer damage

The results showed that all 1PM modules tested were found significantly superior over the untreated (control) in terms of protection and production (Table 1). Among all the modules evaluated, module 5 containing sequential spray of *Helicoverpa* nuclear polyhedrosis viruses (HNPV) @ 500 LE/ha and cypermethrin 1 ml/L received the lowest pod borer damage (4.62%) and next by module 3 containing sequential double spray of only HNPV @ 500 LE/ha. This might be due to first spray given with HNPV killed effectively first appearing the smaller pod borer, and second spray after 7 days with Cypermethrin killed both the smaller and larger borers because of its quick knock down action and eventually gave the best protection. Module 3 stood second position in effectiveness and was statistically at par with other modules. The findings of the present study agreed with the findings of Suganthy and Kumar (2000). Vikram *et al.* (2000) who evaluated different 1PM modules comprising insecticides and bio-pesticides found superior to untreated control in protection and production. The higt pod borer damage (17.08%) was found in untreated check of module 1.

The pod borer damage reduction by different modules ranged from 29.45% to 72.95% compared to that in control. The highest pod damage reduction (72.95%) was found in module 5 followed by module 3 and the lowest of 29.45% reduction was in module 2.

Yield

The yield of chickpea and equivalent yield varied significantly depending on the level of pod borer damage. The lowest pod borer damage in the treatment module *5* (first spray with HNPV and second spray with Cypermethrin) provided the significantly highest yield (2096 kg/ha) (Table 2). Other modules provided statistically identical yield. The lowest yield (1764 kg/ha) was obtained from module 1 (untreated

Table 1. Treatment modules on pod borer damage in chickpea during *rabi* 2005-06.

Treatment modules		Pod damage (%)	Pod damage red^n over untreated control (%)
M_1 =	Nov. 15 + ICCL-95138 + fertilizer dose	17.08(4.1l) a	-
M_2 =	M_1 + mustard intercropping	12.05 (3.47) b	29.45
M_3=	M_1+HNPV spray	9.78 (3.10) b	42.74
M_4=	M_1 + Cypermethrin spray	10.66 (3.26) b	37.59
M_5=	M_1 + (HNPV + Cyp.) spray	4.62 (2.13) c	72.95
M_6 =	M_1 + mustard intercropping + HNPV spray	11.67(3.41) b	31.67
M_7 =	M_1 + mustard intercropping + Cyp. spray	10.72 (3.27) b	37.24

In a column, treatment means having the same letter are not significantly different by DMRT at 5% level

Figures in the parentheses are the square root transformed mean values.

Table 2. Treatment modules on yield of chickpea during *rabi* 2005-06.

Treatment modules		Yield (kg/ha)		Chickpea equivalent yield (kg/ha)
		Chickpea	Mustard	
M_1 =	Nov. 15 + ICCL-95138 + fertilizer dose	1764	-	1764 c
M_2 =	M_1 + mustard intercropping	1510	495	1947 b
M_3=	M_1 + HNPV spray	1992	-	1992 b
M_4=	M_1 + Cypermethrin spray	1978	-	1978 b
M_5=	M_1 + (HNPV + Cyp.) spray	2096	-	2096 a
M_6 =	M_1 + mustard intercropping+HNPV spray	1516	497	1954 b
M_7 =	M_1 + mustard intercropping+Cyp. spray	1520	490	1951 b

In a column, treatment means having the same letter are not significantly different by DMRT at 5% level.

Return and benefit cost ratio

The module 5 (first spray with HNPV and second spray with Cypermethrin) provided the highest gross return (Tk. 52400/ha). Remaining other modules provided statistically identical gross return. The lowest gross return (Tk. 44100/ha) was computed from untreated check.

Table 3. Return and benefit cost ratio of treatment modules for 1PM of pod borer in chickpea during *rabi* 2005-06.

Treatments	Chickpea equivalent yield (kg/ha)	Gross return (Tk!ha)	Total variable cost (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio (BCR)
M_1 = Nov. 15 + ICCL-95138 + fertilizer dose*	1764 c	44100c	7374	36726	5.98
M_2= M_1 + mustard intercropping	1947b	48675b	7254	41421	6.71
M_3=M_1+HNPV spray	1992b	49800b	8454	41346	5.89
M_4 = M_1 + Cypermethrin spray	1978b	49450b	8854	40596	5.59
M_5= M_1 + (HNPV + Cyp.) spray	2096 a	52400 a	8654	43746	6.05
M_6 = M_1 + mustard intercropping + HNPV spray	1954b	48850b	8334	40516	5.86
M_7 = M_1 + mustard intercropping + Cyp. spray	1951b	48775b	8734	40041	5.58

In a column, treatment means having the same letter are not significantly different by DMRT at 5% level

Although module 5 gave the maximum net return (Tk. 43746/ha), but highest benefit cost ratio (6.71) was obtained from module 2, where chickpea was intercropped with mustard only. This was due to no spraying in module 2. The second highest BCR (6.05) was recorded from module 5. In spite of providing the highest net return, module 5 could not give the highest BCR because of high cost involved in insecticide application against the moderate level of pod borer damage. The remaining other modules gave higher net return than that of untreated control (M_1) but offered less BCR due to insecticide application.

The most economic module for pod borer management was M_2 where chickpea intercropped with mustard sown on 15 November. To get best protection against pod borer, the most effective 1PM module was sowing chickpea on 15 November and first spraying with FINPV @ 500 LE/ha just at 100% plant pod formation stage and second spray after 7 days with Cypermethrin 1 ml/L, ensuring higher yield and return. The 1PM approach (M_5) might be useful where severe pod borer outbreak would occur and the 1PM approach (M_2) might be applicable under no serious problem of this pest.

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