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Development of biorational-based integrated pest management package against pod borer, *Helicoverpa armigera* Hubner infesting chickpea

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ABSTRACT

Chickpea, (*Cicer arietinum* L.) is an important pulse crop world-wide. There are many constraints in the production of the crop, of which pod borer, *Helicoverpa armigera* Hubner is the notorious one which causes both quantitative and qualitative loss. Therefore, an experiment was conducted during rabi 2012-13 to evaluate different biorational based IPM packages *viz.*, IPM package 1 (P_1) comprising pheromone trapping of *H. armigera* along with sequential release of biocontrol agents (*Trichograma evanescens* @ gm/ha/week + *Bracon hebetor* @ 1 jar (1000-1200 adults)/ha/week) and spraying of *Bacillus thuringiensis* (Bt) @ 0.4g/ litre of water; IPM package 2 (P_2) consists of pheromone trapping in addition to sequential release of bio-control agents and spraying of Helicoverpa nuclear polyhedrosis virus (HNPV) @ 0.1g/litre of water against this pest attacking chickpea. Results indicate that the IPM package (P_2) revealed the best performance reducing 68.20% pod damage over control and provided significantly the highest yield (1832.20 kg/ha). Consequently, the highest benefit cost ratio (BCR) (2.11) was also recorded from this package. Hence, biocontrol agent release along with installation of sex pheromone traps and spraying of HNPV may be recommended for effective management of pod borer attacking chickpea.

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INTRODUCTION

Chickpea, (*Cicer arietinum* L.) is an important pulse crop in Bangladesh. There are many constraints in the production of the crop, of which pod borer, *Helicoverpa armigera* Hubner is the notorious one which causes both quantitative and qualitative loss. On an average, 30 – 40% pods were found to be damaged by this pest and an average of 400 kg/ha grain was lost by the borer (Rahman, 1990). In favourable condition, pod damage goes upto 90-95 per cent (Shengal and Ujagir, 1990). Preference of insecticides depends on their easy availability and applicability, but their excessive and indiscriminate use has resulted in the development of insecticidal resistance in the pests and environmental pollution (Phokela *et al.*, 1990). Recently, *H. armigera* is reported to have developed resistance to many commonly used insecticides (Phokela *et al*. 1990). The increasing concern for environmental awareness of pesticide hazards has evoked worldwide interest.

There is a need to explore alternatives, encompassing available pest control methods and techniques in order to reduce the sole dependence on insecticides. For this purpose, integrated pest management seems to be the most appropriate approach to achieve sustainability in chickpea production. Ahmed and Khalique (2002) did experimentation and reported forecasting adult populations of *H. armigera* on chickpea through pheromone traps and its role in management of this insect. Khalique and Ahmed (2005) reported compatibility of bio-pesticide with chemical insecticide for management of *H. armigera* (Hubner). Bt field test results indicated that microbial insecticides can be used (with and without adjuvants) for management of *H. armigera* populations infesting chickpea and their use would reduce reliance on toxic chemicals (Ahmed *et al.*, 2012). The biologically-derived insecticides or microbial insecticides such as Bt, HNPV can be used as component of integrated pest management (IPM) approach because of their specificity in killing target insect pest to provide an environmentally safe and suitable alternative to generally hazardous, broad spectrum chemical insecticides used against *H. armigera*. As far as environmental protection is concerned, there is a need for complimentary use of microbial insecticides in support of IPM. In view of the above facts, the present study was planned to evaluate the efficacy of different biorational based IPM package (s) against chickpea pod borer.

MATERIALS AND METHODS

The experiment was conducted at Entomology division, BARI, Gazipur, during Rabi 2012-13 to evaluate different biorational based IPM packages against pod borer infesting chickpea. The treatments were: IPM package 1 (P_1) [sex pheromone trapping + sequential release of biocontrol agents (*Trichograma evanescens* + *Bracon hebetor*) + spraying of Bt @ 0.4g/ litre of water], IPM package 2 (P_2) [sex pheromone trapping + sequential release of biocontrol agents (*Trichograma evanescens* + *Bracon hebetor*) + Spraying of HNPV @ 0.1g/litre of water] along with the farmers practice (P_3) [spraying of Nitro 505EC (Cypermethrin+Chlorpyriphos) @ 2ml/litre of water] and an untreated control.

The experiment was laid out in a randomized complete block design with three replications (dispersed). The treatments were randomly allotted in each block. The unit plot size was 8m x 4m. The seeds of BARIchola-5 were sown on November 15, 2012 in rows with a spacing of 50 cm. Plant to plant distance was maintained at 10 cm. Standard agronomic practices were followed as recommended. Sex pheromone traps were installed in the experimental field at 45 days after sowing (DAS) maintaining 25 m distance among the traps. Sex pheromone lures of *H. armigera* were placed in BARI developed water traps for capturing adult moths. The pheromone traps were placed just above the crop canopy by means of bamboo support. The traps were kept in the chickpea field throughout the cropping season. Treatment wise sequential release of bio control agents (*T. evanescens* @ gm/ha/week + *B. hebetor* @ 1 jar (1000-1200 adults)/ha/week) was started at flowering stage and continued up to pod maturity stage. Spraying of HNPV @ 0.1g/litre of water, Bt @ 0.4g/ litre of water and Nitro 505EC (Cypermethrin + Chlorpyriphos) @ 2ml/litre of water were done twice at an interval of 7 days starting from pod formation stage.

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

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determined using the following formula: % Pod damage = Number of damaged pods/ Total number of pods x 100
Crops of the four central rows were harvested and then threshed. The grains were cleaned and dried in the bright sunshine. The grain yield obtained from each plot was converted into yield per hectare. Moreover, benefit cost ratios of different treatments were also calculated following Ali *et al.* (1996). Catch of adult *H. armigera* moths were also recorded weekly from each sex pheromone trap. The experimental data were analyzed by MSTAT-C software. Mean comparisons for treatment parameters were made by least significance difference test at 5% level of significance.

RESULTS AND DISCUSSION

The infested pods ranged from 5.19 to 16.32% and differed significantly among the treatments (Table 1). The lowest pod borer damage (5.19%) was attained from P_2 (pheromone trapping + sequential release of bio-control agents + Spraying of HNPV @ 0.1g/ litre of water) followed by P_1 (pheromone trapping + sequential release of bio-control agents + Spraying of Bt @ 0.4g /litre of water). However, the highest pod borer damage was found in untreated control plots. Weekly catch of adult *Helicoverpa armigera* moths by pheromone trap was 2.48/trap, which slightly contributed in bringing down pod infestation in P_1 and P_2. The pod borer damage reduction over control by different IPM treatments ranged from 32.12% to 68.20%. The highest pod damage reduction over control was observed in P_2 and the lowest in farmer's practiced plot.

Table 1. Effect of different management packages on pod borer damage in chickpea during Rabi 2012-2013

Treatments	**Pod damage (%)**	**Damage reduction over control (%)**
P_1=Pheromone trap + sequential release of bioontrol agents + Bt spray	8.19c	49.84
P_2=Pheromone trap + sequential release of biocontrol agents + HNPV spray	5.19d	68.20
P_3=Farmers practice: Nitro 505EC (Cypermethrin +Chlorpyriphos) spray	11.08b	32.12
Untreated control	16.32a	-

Means in a column followed by same letter(s) are not significantly different ($P < 0.05$); *****Average of 13 observations

This result of the present study is more or less in conformity with Hossain (2007) who reported that the lowest pod damage was observed in cypermethrin and HNPV sprayed plots followed by carbaryl and dimethoate treated plots. Pod damage reduction by synthetic insecticides and bio-pesticides over untreated control ranged from 24.98 to 64.08%. 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 which are partly in agreement with the present findings.

The yield of chickpea in different treatments varied remarkably. Significantly ($P < 0.05$) the highest yield (1832.20 kg/ha) was obtained from P_2 comprising pheromone trapping + sequential release of bio-control agents + Spraying of HNPV followed by P_1 comprising pheromone trapping + sequential release of bio-control agents + spraying of Bt (1598.33 kg/ha) which was statistically ($P < 0.05$) at par with P_3 (Spraying of Nitro 505EC). Similarly, the highest yield increase over control (64.08%) was obtained from P_2. However, the lowest yield (1137.25 kg/ha) was obtained from untreated control. This result of the present study is more or less in conformity with Hossain (2007) who obtained significantly the highest yield (1,856 kg/ha) from HNPV sprayed plots which was statistically identical to cypermethrin followed by Azadirachtin 0.03% EC.

Table 2. Benefit cost analysis after application of different management options for the control of chickpea pod borer.

Treatment packages	Seed yield (kg/ha)	[1]Gross return (Tk/ha)	[2]Cost of Treatment (Tk/ha)	Net return (Tk/ha)	Adjusted net return (Tk/ha)	Benefit /Cost Ratio (BCR)
P_1= Pheromone trap + sequential release of bio-control agents + Bt spray	1598.33	79916.5	8320	71596.5	15763	1.89
P_2= Pheromone trap + release of bio-control agents + HNPV spray	1832.2	91610	11520	80090	24256.5	2.11
P_3=Farmers practice: Nitro 505EC (Cypermethrin+ Chlorpyriphos) spray	1541.67	77083.5	12960	64123.5	8290	0.64
Untreated control	1116.67	55833.5	0	55833.5	0	-

Cost of relevant materials/activities: [1]Farmgate price of Chickpea @ Tk. 50.00 per kg, [2][Cost of *Helicoverpa* pheromone: @ Tk 50/lure; Cost of trap and soap water management: @ Tk 100/trap; Cost of Biocontrol agents: *Bracon* @ Tk 150/jar, *Trichogramma* @ Tk 100/g; Cost of Bt @ Tk 1500/kg; Cost of HNPV @ Tk 38000/kg; Cost of spray : 2 laborers/spray/ha @ Tk 180.00/labour/day; Spray volume required: 500L /ha.]

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