

Development of bio-control based management package for the major insect pest of soybean

Rabiul Islam¹, Md. Mosiur Rahman^{2*}, Saiful Islam³, Md. Abdur Rajjak Choudhury⁴ and Md. Samsuzzaman⁵

¹Oilseed Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh

²Pulses Research Sub-center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh

³Biotechnology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh

⁴Department of Entomology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh

⁵Integrated Agricultural Productivity Project, Regional Agricultural Research Station, Burirhat, Rangpur-5400, Bangladesh

ARTICLE INFO

Article history

Received 9 May 2015

Accepted 30 May 2016

Online release 12 June 2016

Keyword

Bio-control agents

Management package

Major insect pest

Economic analysis

*Corresponding Author

M.M. Rahman

E-mail: mosiur1979@yahoo.com

Phone: +880-1719-541457

ABSTRACT

The experiment was conducted at the farmer's field in Nokahali district of Bangladesh. There were four management packages viz. IPM Package 1: Hand Picking + Pheromone trap + *Bracon hebetor* + *Trichogramma chilonis* + Bio neem Plus 1EC, IPM Package 2: Hand Picking + Pheromone trap + *Bracon hebetor* + *Trichogramma chilonis* + Tracer, Package 3: Farmer's practices: Nitro 505 EC and Package 4: Untreated control. The highest infestation reduction of pest complex (common cutworm, leaf roller, pod borer and hairy caterpillar) was 87.36 in IPM Package 2 treated plots i.e. hand picking + Sex pheromone of *Sodoptera litura* + release of *Bracon hebetor*, *Trychogramma chilonis* and Tracer. The IPM package 2 produced the highest seed yield (2.01 t/ha) with calculated the highest net return (Marginal Benefit Cost Ratio). Therefore, IPM package 2 viz. Hand picking + Pheromone trap of *Spodoptera litura* + release of bio-control agent was found effective (more than 87% infestation reduction) for managing pest complex (common cutworm, leaf roller, pod borer and hairy caterpillar) in soybean.

Introduction

Soybean [*Glycine max* (L.) Mirrill] is a unique crop with high nutritional value. Seeds of soybean contain about 42% protein and 20% oil and provide 60% of the world supply of vegetable protein and 30% of the edible oil (Fehr, 1989). It is playing an important role in augmenting both the production of edible oil and protein simultaneously under the circumstances in which the shortage of these commodities are being experienced by people. It also supports many industries; soybean oil is used as raw material in manufacturing of antibiotics, paints, varnishes, adhesives, lubricants etc. Soybean meal is used as protein supplement in human diet, cattle and poultry feed (Khanzada et al. 2013). Soybean is not only the prime source of vegetable oils and proteins, but is also enriching the soil fixing atmospheric nitrogen. It is also used for ensilage (Ashraf et al. 2001).

Cultivation of soybean covered about 55,000 hectares of land and produced about 90,000 metric tons of seeds during the period 2009-2010 in Bangladesh (Anonymous, 2011). Leaf roller (*Lamprosema indicata* Fab.), hairy caterpillar (*Spilarctia obliqua* Walk.) and common cutworm (*Spodoptera litura*) are the major and serious pests of soybean and acting as limiting factors for successful cultivation of this crop in recent years (Biswas et al. 2001). The green larvae of leaf roller fold and roll the leaves from tip downwards then feed inside. The pest infests about 70-90% soybean

plants which resulted in about 10% loss of yield (Singh, 1990). The hairy caterpillar and common cut worm are defoliated the leaves and feed voraciously and cause a great economic losses.

On the other hand, natural enemies play an important role in biological control of the pest. *Trichogramma* are minute wasp parasitic on eggs of Lepidopteron insect pests. *Trichogramma* lays, its eggs in the host insect eggs, multiply therein, thus preventing hatching of the host insect larvae. *Bracon hebetor* is an aggressive –parasitic wasp. Female wasp at first injects venom and thus paralyzes insect larvae. It lays its eggs on the host larvae: multiply therein and thus destroying the pests. Use of sex pheromone is a new dimension of a specific pest management. Sex pheromone of *Spodoptera* attracts the adult male of this insect. But suitable eco-friendly management technique against these pests is scanty. Therefore, the study was undertaken to develop a most effective management option for managing these pests.

Materials and Methods

Experimental site

The experiment was conducted at the farmer's field in Nokahali district of Bangladesh during growing season of 2014-2015. It is located in the Subornochar area where soybean is the main crop in this season.

Planting materials

Soybean [*Glycine max* (L.) Mirrill. var. BARI Soybean 5] was used as the planting material in this experiment. Seeds were collected from Oilseed Research Centre, Bangladesh Agricultural Research Institute. It is a popular variety for its high potentiality and also diseases tolerance to specially Soybean Yellow Mosaic Virus (SYMV).

IPM Packages

Four insect pest management packages were used in this experiment. The packages were IPM package 1: Hand picking of infested leaf with larvae + use of sex pheromone of *S. litura* + release of *Bracon hebetor* @ 1 bunker/ week/ha and *Trichogramma chilonis* and azadirachtin (Bioneem plus 1 EC @1 ml/L), IPM package 2: Hand picking of infested leaf with larvae + use of sex pheromone of *S. litura* + release of *Bracon hebetor* @ 1 bunker/ week/ha and *Trichogramma chilonis* and Spinosad (Tracer 0.4 ml/L), IPM package 3: Farmer's practice (use of Nitro @ 2ml/l) and IPM package 4: Untreated control.

Cultivation procedure

Seeds of the soybean (var. BARI Soybean 5) were sown on 18 February, 2015 in 3 m × 4 m plots with the spacing of 30 cm × 30 cm following randomized complete block design with three replications. Fertilizers and other intercultural operations were done uniformly as per recommendation of Oilseeds Research Centre, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. All fertilizers were applied as basal during final land preparation. Weeding, irrigation and insecticides were sprayed as and when required to maintain an optimum growth condition for the crop. It was harvested after 95 Days after sowing when the pods were turned to yellowish color and leaves were fallen down.

Data taken

Number of *Spodoptera* adult was collected from the pheromone trap in every 7 days intervals from 1st

week March to 3rd week of April 2015. Percent leaf infestation were counted from the different treatments 7 days (after spray) intervals during crop growing season in 3 frequencies. The crop was harvested on 1st week of May, 2015. Yield data and benefit cost ratio (BCR) of the packages applied were calculated.

Statistical analysis

Data were analyzed statistically using MSTAT software. Means were separated by DMRT test at 5% level of probability.

Results and Discussion

The pale green caterpillar damages the plants by rolling together to the top of the leaves and shoots and feed inside. Leaf roller infestation was observed in the soybean crop on the 2nd week of March, 2015 at the seedling stage and up to vegetative stage to flowering stage of the crop. The green color of the common cutworm larvae damage the leaves and shoots by feeding voraciously. Infested leaves become irregular holes, growth of the plant is arrested, flower and pod formation in hindered. Common cut worm and hairy caterpillar infestation were observed during at the vegetative, flowering, pod formation and pod maturity stage. The pod borer infestation was observed in pod formation and pod maturity stage. But this year pod borer infestation was very little. The highest number of *Spodoptera litura* adult (60/trap) captured in the sex pheromone trap during last week of March 2015 at the vegetative stage and then declined gradually (Fig.1).

The highest pest complex (common cutworm, leaf roller, hairy caterpillar and pod borer) infestation reduction was recorded 87.36% from IPM Package 2 (Table 1). The highest seed yield (2.01 t/ha) was obtained from IPM Package 2 with calculated the highest net income with the BCR (2.21) followed by and farmers practices (Table 2). In IPM package 2 gave the lower BCR due to the high price of Spinosad (Tracer).

Table 1. Efficacy of different management package for managing the major insect pests during 2014-2015 in Subornochar, Noakhali, Bangladesh.

Management package	Percent leaf infestation			Mean infestation	Percent reduction over control
	7 days after 1 st spray	7 days after 1 st spray	7 days after 1 st spray		
IPM Package 1	25.25 b	30.21 b	28.00 b	27.82	49.78
IPM Package 2	8.45 c	6.32 c	6.43 c	6.73	87.36
IPM Package 3	30.25 b	29.32 b	22.43 b	27.33	51.09
IPM Package 4	42.30 a	59.40 a	70.12 a	55.88	-
CV	12.11	9.08	10.12	-	-

Means followed by the same letters in a column do not differ significantly at 5% level by DMRT. Data were recorded on average of 5 plants /plot/ m².

IPM Package 1: Hand Picking + Pheromone trapping of *Spodoptera litura* + *Bracon* + *Trichogramma* + Bioneem plus 1 EC,
 IPM Package 2: Hand Picking + Pheromone trapping of *Spodoptera litura* + *Bracon* + *Trichogramma* + Tracer,
 IPM Package 3: Farmer's practices (Nitro 505 EC @ 2 ml/L),
 IPM Package 4: Untreated control.

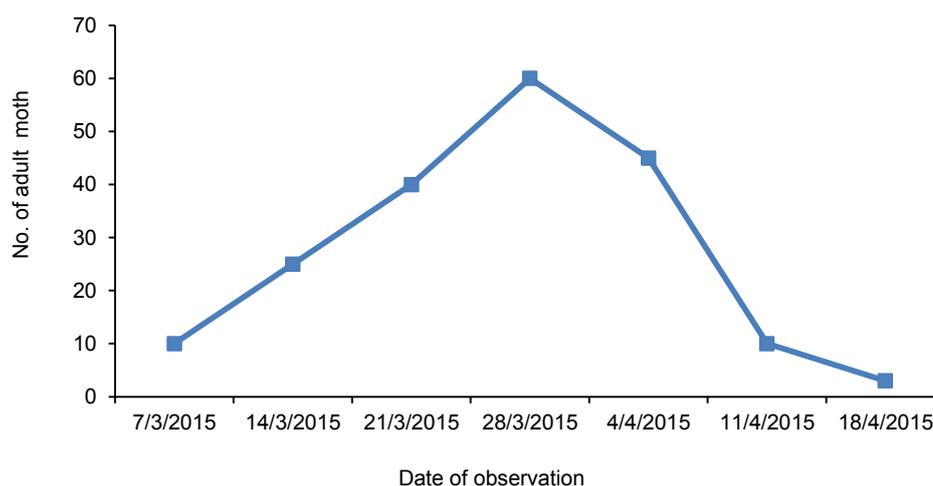


Fig. 1. Mean number of adult *Spodoptera litura* captured in sex pheromone trap in Noakhali district of Bangladesh during 2014-2015.

Table 2. Economics of different treatments spraying against major pests of soybean during winter cropping season of 2014-2015 at Subornochar, Noakhali, Bangladesh.

Management packages	Seed yield (t/ha)	Increased in yield over untreated	Additional income (TK./ha)	Cost of insecticides & spray	Net income (TK./ha)	MBCR
IPM Package 1	1.33b	0.43	17200/-	7760/-	13860/-	1.78
IPM Package 2	2.01 a	1.21	48400/-	1509/-	32908/-	2.18
IPM Package 3	1.4b	0.7	28000/-	5400/-	22600/-	4.18
IPM Package 4	0.8c	-	-	-	-	-

Means followed by the same letters in a column do not differ significantly at 5% level by DMRT.

IPM Package 1: Hand Picking + Pheromone trapping of *Spodoptera litura* + *Bracon* + *Trichogramma* + Bioneem plus 1 EC,
 IPM Package 2: Hand Picking + Pheromone trapping of *Spodoptera litura* + *Bracon* + *Trichogramma* + Tracer,
 IPM Package 3: Farmer's practices (Nitro 505 EC @ 2 ml/L),
 IPM Package 4: Untreated control.

Cost of sex pheromone trap = TK. 50.00/trap, Cost of *Bracon hebetor* = 150 TK/jar and *Trichogramma chilonis* = 100 TK./container, cost of Nitro 505 EC = 200 TK./7ml. Cost of labour = 200TK./head/day. Price of soybean seed = 40 Tk./kg. 500 litre spray required 1 ha of land and other variable costs were same in all the treatments. MBCR=Marginal Cost Benefit Ratio.

Conclusion

IPM package 2 viz , Hand picking + Pheromone trap of *Spodoptera litura* + release of bio-control agent was found effective (more than 87% infestation reduction) for managing pest complex (common cutworm, leaf roller, pod borer and hairy caterpillar) in soybean crop and also observed highest net income. Therefore, this package can be recommended for effective management of major insect pest of soybean.

References

Anonymous, (2011). Krishi Diary 2011, Agricultural Information Service, Khamarbari, Farm Gate, Dhaka 1215, pp. 573.

Ashraf, M., Sohail, M., Khokhar, M. A., & Soomro, A. F. (2001). Evaluation of promising varieties/strains of soybean. *J. Agric. Res.* 39, 203-209.

Biswas, G. C. (2001). Screening of some soybean entries for resistance to stem flies (*Ophiomyia phaseoli* Tryon and *Melanagromyza sozae* Zehntner) and their incidence. *J. Asiat. Soc. Bangladesh*, 27, 1, 93-100.

Fehr, W. R. (1989). Soybean, importance and distribution pp. 283-300. In: Robblen. G. R. K. Downy & Ashri (ed). Oilcrops of the world. Mc-Grow-Hill Pub. Com. New York.

Khanzada, S. R., Khanzada, M. S., Abro, G. H., Syed, T. S., Soomro, K., Khanzada, A. M., Anwar, S. & Shakeel, N. (2013). Relative resistance of soybean cultivars against sucking insect pests. *Pakistan J. Sci.* 65, 2, 97-201.

Singh, S. R. (1990). Insect Pest of Tropical Food Legumes. John Willy & Sons. Inc. New York, USA. pp. 451.