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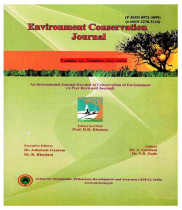

Evaluation of IPM module against major insect pests of green gram, *Vigna radiata* (L.) Wilczek in lower Gangetic plains of West Bengal

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ABSTRACT

An experiment was carried out to evaluate the efficacy of integrated management practices over farmers' practices against insect pest complex of green gram (*Vigna radiata* L. Wilczek) during kharif season in the 'A-B' Block Farm of Bidhan Chandra Krishi Viswavidyalaya in 2019. The results revealed that the incidence of all of the insect pests viz. whitefly, pulse aphid, jassid, flower thrips, gram pod borer, spotted pod borer, blue butterfly, plant bug and pod bug was recorded comparatively less in Integrated Pest Management (IPM) plot as compared to farmers' practices. The seed yield of green gram was also recorded a higher (1382.22 kg ha^{-1}) in plots treated with integrated approaches as compared to farmer's practices (476.94 kg ha^{-1}). IPM module recorded maximum cost benefit ratio along with higher gross return and net profit as against farmers' practices.

Introduction

Green gram (*Vigna radiata* L. Wilczek) also referred as mung bean or mung, is a self-pollinated crop belonging to family Leguminosae. It is considered as one of the oldest pulse crop and is adapted to a wide range of climatic conditions. A warm humid climate with optimum temperature and rainfall is suitable for its cultivation. This crop can be successfully grown in certain locations where other crops may not be grown as it is considered to be hardiest among all pulse crops and can tolerate drought to a great extent. Hence, it is successfully grown in any adverse conditions and particularly in drought prone areas during *kharif* season. Therefore, the crop is regularly grown on marginal and sub-marginal rainfed soils as sole crop, mixed/ inter-cropping system, crop rotation and dry farming. The global area under green gram cultivation is about 7.3 million ha with a global output of about 5.3 million tons (AVRDC, 2016). India produced 15.91 lakh tonnes of green gram from an area of 34.50 lakh hectares with a productivity of 461 kg ha^{-1} (Ann. Report, AICRP on MULLaRP, 2015). Depending on the crop phenology the insect pests of green gram can be classified and these are stem feeders, foliage feeders, pod feeders, sap suckers and storage pests. This classification is expedient in judging the economic importance of the pest, especially their impact on seed yield and to work out control measures. Among the 64 species of insect pests reported on the green gram (Siddadappaji *et al.*, 1979), the aphid (*Aphis craccivora)*, whitefly (*Bemisia tabaci)*, flower thrips (*Megalurothrips distalis*), spotted pod borer (*Maruca vitrata*), gram pod borer (*Helicoverpa armigera*), plant bug (*Riptortus pedestris*), pod bug (*Clavigralla gibbosa*) and blue butterfly (*Catochrysops strabo*) were found to be the major insect pests in West Bengal condition (Biswas and Banerjee, 2019). In most cases, farmers are not interested to take any control measures for the insect pests due to their less return (Machocho *et al.*, 2012). However, with recent advancements in developing high yielding and short duration varieties as well as better market

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value of this pulse crop, farmers have started paying attention to growing green gram following appropriate pest management practices. Farmers usually control crop pests by using synthetic insecticides due to the easy access of those molecules. However, some bio-rational tools and eco-friendly pesticides are on hand to reduce pest load which is relatively safer than synthetic insecticides. Integrated pest management (IPM) has been developed over the years to deal with the undesirable impacts of synthetic chemical pesticides on the ecosystem ultimately upsetting the interests of the farmers. Therefore, an integrated pest management module may be evaluated to manage insect pests of green gram especially sucking pests like aphid, whitefly, flower thrips, pod borers and bugs, and to reduce the loss of crop yield. On the other hand, limited resources are available on the efficacy of IPM modules for managing green gram pests especially in West Bengal conditions. Keeping this information in mind, an attempt has been made to evaluate the efficacy of the integrated management module along with its economics.

Material and Methods

The field experiment was carried out during kharif season at 'A-B' Block Farm of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, Nadia, West Bengal in 2019. For determination of the effect of IPM practices on the green gram, observations were made in two plots; one plot was treated with IPM practices considering variety 'IPM 2-3' and another plot with conventional Farmers' practices sowing variety 'Samrat'. Normal agronomic measures with row to row distance of 30 cm and plant to plant distance within the row of 10 cm along with recommended doses of fertilizers were followed in both cases. In IPM plot, the seeds were treated with carbendazim 50% WP @ 2.0 g kg^{-1}, thiamethoxam 35 FS @ 5.0 g kg^{-1} and inoculated with *Rhizobium* @ 200 g $bigha^{-1}$ (1 ha = 7.5 bigha), maize cv. Pioneer has been grown around the field as barrier crop, yellow sticky traps were installed @ 50 ha^{-1} for monitoring of whitefly, pheromone traps were installed @10 ha^{-1} for monitoring of *Helicoverpa* from flowering initiation stage, foliar sprays were carried out with botanicals (NSKE @ 5%) at 35 days after sowing (DAS) followed by a new generation insecticide (Chlorantraniliprole 18.5 SC @ 20 g a.i.ha^{-1}) at 25 days after application of NSKE). In Farmers' practices, only three rounds of spraying with Cypermethrin 10 EC @ 1.5 ml l^{-1} at 35 DAS, 50 DAS and 60 DAS were carried out. No seed treatment, no use of barrier crop as well as monitoring devices were followed in Farmers' practices. Ten plants were randomly chosen as sample plants from each plot and were marked with the help of bamboo sticks. The observation was taken at weekly intervals. The first observation was taken at 21 DAS and continued up to the harvest of the crop. Nine numbers of observations were taken till harvest. The sampled plants were disturbed as little as possible to avoid the faster mobility of sucking pests particularly whitefly and bugs. Observations were taken during early morning hours when most insects are less active. Data on insect pest population in test plot was recorded following the methodology adopted by Biswas (2017). Afterwards, the mean population was calculated. All the plants were harvested to get the seed yield of each plot and afterwards those were converted to yield on a hectare basis. For economics study, the cost of treatments, gross return, net profit and cost: benefit ratio have been calculated considering each of the expenditures involved in both the practices viz. IPM module and farmers' practices.

Results and Discussion

The results of the comparative evaluation of IPM module and farmers' practices on insect pests of green gram revealed that the incidence of all of the insect pests viz. whitefly, pulse aphid, jassid, flower thrips, gram pod borer, spotted pod borer, blue butterfly, plant bug and pod bug was recorded relatively less in the IPM plot as compared to farmer's practices (Table 1). In the IPM plot, the number of whitefly (1.70 $leaf^{-1}$) was less as against (4.08 $leaf^{-1}$) in farmers' practices. The incidence of pulse aphid was also recorded minimum in the IPM plot (7.35 $twig^{-1}$) as compared to farmers' practices (22.07 $twig^{-1}$). Based on insect count, jassid population was less in the IPM plot (2.95 $leaf^{-1}$) and more in farmers' practices (6.47 $leaf^{-1}$). The population of flower thrips was less in the IPM plot (5.70 ten $flowers^{-1}$) as compared to farmers' practices (13.37 ten $flowers^{-1}$). The incidence of gram pod borer was recorded minimum in the IPM

Table 1. Variation in insect pest occurrence in IPM module and Farmers' practices in green gram

Adopted pest management practices	Insect pest population (Mean of nine observations)								
	Whitefly (Adults/ trifoliate leaf)	Pulse aphid (Adults + nymphs/ top 5 cm twig)	Jassid (Adults + nymphs/ leaf)	Flower thrips (Adults/ 10 flowers)	Gram pod borer (larvae/ plant)	Spotted pod borer (larvae/ plant)	Blue butterfly (larvae/ plant)	Plant bug (Adults + nymphs/ plant)	Pod bug (Adults + nymphs/ plant)
IPM	1.70	7.35	2.95	5.70	0.40	1.00	0.15	1.45	0.05
Farmers' practices	4.08	22.07	6.47	13.37	3.70	3.77	0.87	4.80	2.12

Table 2. Economics of IPM module in comparison with Farmers' practices in green gram

Adopted pest management practices	Yield (kg ha^{-1})	Increased yield in IPM over Farmers' practices (kg ha^{-1})	*Cost of treatment (Rs. ha^{-1})	Return from green gram (Rs. ha^{-1})	Additional return from maize (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	**Cost: Benefit Ratio
IPM	1382.22	905.28	22,070.00	96,755.40	12,920.00	1,09,675.40	87,605.40	1:3.97
Farmers' practices	476.94	-	6,950.00	33,385.80	0.00	33,385.80	26,435.80	1:3.80

*** It includes cost of seed of border crop, seed treating chemicals, seed inoculants, monitoring devices, pesticides and pesticide application charge**
**** Cost: Benefit Ratio is based on only cost of treatments for protection and seed yield.**

[Assumed costs: Seed cost of green gram = Rs. 150.00 per kg, Seed cost of maize = Rs. 537.50 per kg, Carbendazim 50% WP = Rs.500.00 per kg, Thiamethoxam 35 FS = Rs.28.00 per 5 g, *Rhizobium* = Rs. 45.00 per 200 g, Yellow sticky trap = Rs. 55.00 per piece, Pheromone trap with Helilure = Rs. 90.00 per set, NSKE = Rs. 360.00 per kg, Chlorantraniliprole 18.5 SC = Rs. 193.00 per 10 ml, Cypermethrin 10 EC = Rs. 35.00 per 50 ml, Spraying charge = Rs. 500.00 per ha, Sale price of green gram seed = Rs. 70.00 per kg, Sale price of maize = Rs. 17.00 per kg]

plots (0.40 plant^{-1}) and maximum to farmers' practices (3.70 plant^{-1}). In the IPM plot, the number of spotted pod borer was less (1.00 plant^{-1}) as against in farmers' practices (3.77 plant^{-1}). The incidence of the blue butterflies was also recorded minimum in the IPM plot (0.15 plant^{-1}) as compared to farmers' practices (0.87 plant^{-1}). Based on insect count, plant bug population was less in the IPM plot (1.45 plant^{-1}) and more in farmers' practices (4.80 plant^{-1}). The population of pod bugs was recorded less in the IPM plot (0.05 plant^{-1}) as compared to farmers' practices (2.12 plant^{-1}). The seed yield was also recorded higher in the IPM plots (1382.22 kg ha^{-1}) compared to farmers' practices (476.94 kg ha^{-1}) (Table 2). IPM module also recorded higher gross return (Rs. 1,09,675.40 ha^{-1}), net profit (Rs. 87,605.40 ha^{-1}) as well as cost benefit ratio (1:3.97) as compared to farmers' practices (gross return of Rs. 33,385.80 ha^{-1}, net profit of Rs.26,435.80 ha^{-1}and cost benefit ratio of 1:3.80) (Table 2). The present experiment on evaluation of IPM module in green gram with regard to the farmers' practice confirmed the merit of implementation of integrated module in terms of lowering insect pest pressure as well as getting a higher return. Seed treatment with thiamethoxam 25 WG was found most effective for controlling thrips in green gram as reported by Kansagara *et al.* (2018) which supports the present findings. Seed dressing with *Rhizobium* increased the green gram yield in the IPM module. Patil *et al.* (2015) also obtained similar findings. The efficiency of the yellow sticky trap as a monitoring tool for whitefly in green gram was proved earlier by Maurya and Tiwari (2018). In the present experiment, application of 5 per cent NSKE at the flowering stage amplified the insecticides efficiency. These findings are in harmony with the observations made by Gajendran *et al.* (2006) and Singh and Singh (2015). Relatively higher cost: benefit ratio in IPM plots compared to farmers' practice was also recorded by Gajendran *et al.* (2006), though their experimental crop was the black gram. Khajuria *et al.* (2015) also obtained higher cost: benefit ratio in neem treated IPM module on black gram. It may be concluded from the study that IPM practices significantly reduced insect pests infestation and gave higher yield as well as cost: benefit ratio compared to farmers' practices. This IPM practice may be replicated in different green gram growing areas of the country irrespective of soil or climatic conditions as the tools used in the module have no impact on those factors. In one hand IPM of green gram will be more remunerative (higher cost: benefit ratio) and in other hand it will be more environment friendly (less use of synthetic chemical pesticides).

Conclusion

It may be concluded from the present experiment that the incidence of all of the insect pests viz. whitefly, pulse aphid, jassid, flower thrips, gram pod borer, spotted pod borer, blue butterfly, plant bug and pod bug occurring on green gram would be comparatively less in IPM plot than that of farmer's practices. On the other hand, the plots treated with IPM practices may record higher grain yield as well as higher cost benefit ratios as compared to farmer's practices.

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