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Mandapuram Sravangoud
M.Sc. (Ag.) Entomology,
Department of Entomology,
Naini Agricultural Institute,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Ashwani Kumar
Associate Professor,
Department of Entomology,
Naini Agricultural Institute,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Corresponding Author
Mandapuram Sravangoud
M.Sc. (Ag.) Entomology,
Department of Entomology,
Naini Agricultural Institute,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Efficacy and economics of selected insecticides and biopesticides against spotted pod borer [*Maruca vitrata* (Geyer)] on green gram [*Vigna radiata* (L.) Wilczek]

Mandapuram Sravangoud and Ashwani Kumar

Abstract

The present experiment was undertaken at central research field, SHUATS, Prayagraj, Uttar Pradesh, India during *kharif* season, 2021, Eight treatments including control viz, *Beauveria bassiana* (T_1), NPV (T_2), NSKE 5% (T_3), Emamectin Benzoate 5SG (T_4), Chlorantraniliprole 18.5SC (T_5), Spinosad 45%SC (T_6), Flubendamide 480SC (T_7) and untreated Control (T_0) in RBD with three replications were evaluate against spotted pod borer, *Maruca vitrata*. The mean larval reduction of greengram pod borer *Maruca vitrata* on third, seventh and fourteen days after spraying revealed that the treatments *Beauveria bassiana* (T_1) (1.685), NPV (T_2) (2.022), NSKE 5% (T_3) (1.788), Emamectin Benzoate 5SG (T_4) (1.288), Chlorantraniliprole 18.5SC (T_5) (0.933), Spinosad 45%SC (T_6) (1.555), Flubendamide 480SC (T_7) (1.344) were found superior over all the treatment first and second sprays respectively. Insecticide Chlorantraniliprole 18.5SC (T5) (0.933) gave maximum larval mean reduction followed by Emamectin Benzoate 5SG (T4) (1.266). When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Emamectin Benzoate 5SG (1:2.94) followed by Chlorantraniliprole 18.5SC (1:2.86), Flubendiamide 20SG (1:2.68), Spinosad 45SC (1:2.23), *Beauveria bassiana* (1:2.06), NSKE 5% (1:1.83) and NPV (1:1.59), as compared to control plot (1:1.08).

Keywords: Biopesticide, economics, efficacy, green gram, insecticides, *Maruca vitrata*, spotted pod borer, *Vigna radiata*

Introduction

Greengram [*Vigna radiata* (L.)Wilczek] is also known as mungbean or moong, is a leguminous plant species belonging to the Fabaceae family. It is a self-pollinated diploid (2n=2x=22) crop with typical papilionaceous flower bearing 5 sepals, 5 petals, 10 diadelphous (9+1) stamens and monocarpellary ovary with hairy style. In India, In India, mungbean is grown in about 4.5 million hectares with the total production of 2.64 million tonnes and productivity of 548 kg/ha (Bisti *et al*., 2022) [2]. Pulses are one of the important segments of Indian agriculture after cereals in production. It requires a hot climate and can tolerate drought also. It is also suitable as a summer crop. The *kharif* season is the most prevalent and traditional green gram growing period in India. The pulses have the ability to fix atmospheric nitrogen (N2) in their root nodules in association with specific Rhizobium/Bradyrhizobium species. In greengram, nitrogen derived from N2 fixation (Pfix) is 15-17% and total nitrogen fixed is 9-137 kg/ha (Singh and Sekhon 2005). the genetically complex *M. vitrata* (Lepidoptera: Crambidae) is considered as one of the severe legume pests having high damage potential and a wider host range (Jackai 1990[5]; Sharma *et al*., 1999 [16]; Margam *et al*., 2011 [11]; Periasamy *et al.*, 2015) [15]. Green gram is heavily damaged by Maruca vitrata (Fabricius) under field conditions. Spotted pod borer, also known as legume pod borer. Pod borer infestations are largely responsible for the low yield of green gram (Singh and Srivastava, 2017) [18]. It became a persistent pest in green gram due to the wide range of hosts as well as the destructiveness of its behavior. It is known to cause an economic loss of 20 - 25%, yield loss of 2 - 84% and pod damage of 20 - 60% in green gram (Vishakanthaiah and Babu, 1980 [23]; Zahid *et al.*, 2008) [25] and accounting to US$ 30 million. A loss of 20 to 60% is estimated in grain yield pulses caused by *Maruca vitrata* damage. It is imperative to develop alternatives that are more effective, more respectful of the environment, and more economically viable than these control methods. Ganapathy (2010) [4]. According to Ganapathy (2010 [4]) the major cause of mungbean's low productivity is the damage caused by insect pests. There are more than 60 insect pests found attacking mungbean in India, but a few are economically damaging and are prevalent in large areas. It is a common observation that the population of pod borers is brought down by the application of insecticides. In recent decades various types of insecticides belonging to the different chemical groups were used as a spray to manage the major pest complex. Sometimes we don't know about the best insecticide for pod borer control. so to know the best insectides management of pod borer in greengram by periodical evaluation of selected insecticide through their efficacy of selected insecticide.

Materials and Methods

During the *kharif* season of 2021, a field trial was conducted in Central Research Field (CRF), SHUATS, Uttar Pradesh, India. The experiment was set up using the cultivar Arkaanamika in a Randomized Block Design (RBD) with 8 treatments duplicated three times using a suggested package of practises excluding plant protection in a plot size of (2m x 2m) at a spacing of (30x10cm). With eight treatments, including control, the response of spotted pod borer to several chemicals, one biopesticide and one botanical was studied. *Beauveria bassiana* (T_1), NPV (T_2), NSKE 5% (T_3), Emamectin Benzoate 5SG (T_4), Chlorantraniliprole 18.5SC (T_5), Spinosad 45%SC (T_6), Flubendamide 480SC (T_7) and untreated Control (T_0).

Data was collected on many parameters in accordance with the study's requirements. After careful examination for the presence of spotted pod borer, the number of infested pods with larva from 5 randomly selected plants per plot were counted and recorded at weekly intervals. One day before spraying, three days after spraying, seven days after spraying, and fourteen days after spraying were recorded. Pods infested by larva from randomly selected five plants in three replications of each treatment were recorded at each picking. On a number basis, the mean larval population of greengram pods by greengram spotted pod borer was determined. Based on healthy pods, yield data was recorded at each picking. The data was then transformed appropriately, and the critical difference CD (p=0.05) level of significance was calculated using one-way ANOVA. For evaluating the yield performance, the increase in yield above the untreated control was also calculated. Finally, the benefit cost ratio (BCR) was estimated using market prices for greengram, pesticides, and spraying costs.

$$\text{B: C Ratio} = \frac{\text{Gross returns}}{\text{Total cost incurred}}$$

Where,
B:C Ratio = Benefit Cost Ratio

Results and Discussion

In the experiments, eight different treatments, consisting application of *Beauveria bassiana* (T_1), NPV (T_2), NSKE 5% (T_3), Emamectin Benzoate 5SG (T_4), Chlorantraniliprole 18.5SC (T_5), Spinosad 45SC (T_6), Flubendiamide 20SG (T_7) and untreated Control (T_0) were tested to compare the efficacy against *Maruca vitrata* and their influences on yield of greengram. The results obtained are discussed in the light of available relevant literature in this chapter as before.

The data on the mean (3, 7 and 14 DAS) larval population of first spray revealed that all the treatments except untreated control are effective and at par. Among all the treatments highest per cent reduction of greengram spotted podborer was recorded in Chlorantraniliprole 18.5SC (1.222) followed by Emamectin Benzoate 5SG (1.555), Flubendiamide 20SG (1.622), Spinosad 45SC (1.822), *Beauveria bassiana* (1.977), NSKE 5% (2.044) and NPV (2.267) as compared to control plot (3.244) is found to be least effective but comparatively superior over the control.

The data on larval population of greengram spotted podborer over control on second spray revealed that all the treatments were significantly superior over control. Among all treatments, Chlorantraniliprole 18.5SC (0.644) and Emamectin Benzoate 5SG (0.977) recorded least larval population which was significantly superior over control followed by Flubendiamide 20SG (1.066), Spinosad 45SC (1.289), *Beauveria bassiana* (1.4), NSKE 5% (1.533) and NPV (1.777) was the least effective among all treatments.

The data on the mean larval population of first spray and second spray, overall mean revealed that all the treatments except untreated control are effective and at par. Among all the treatments least larval population of Greengram spotted podborer was recorded in Chlorantraniliprole 18.5SC (0.933). Similar findings made by Dadas *et al.*, 2015 [3] with 0.48 larva/plant and Sreekanth *et al.*, 2015 [20] with 2.08 per cent pod damage. Emamectin Benzoate 5SG (1.266) is found to be the next best treatment which is in line with the findings of Kumar and Sarada (2015) [7] and Ahmed *et al*., 2020 [1] they reported that Emamectin Benzoate 5SG was found most effective in reducing per cent population reduction of Greengram spotted podborer as well as increasing the yield with 79.1 per cent reduction over control and 68.37 pod infestation respectively. Flubendiamide 20SG (1.344) is found to be the next best treatment which is in line with the findings of Meena *et al.*, 2006 [12] which proved to be the best for reducing the pod damage (9.2%) and Singh *et al*., 2020 [17] (4.79%) was observed significantly higher, in reducing the damage caused by the spotted pod borer in cowpea. Spinosad 45SC (1.555) is found to be next best treatments is found to be the next effective treatment which is in line with the findings of Koushik et *al.*, 2016 [8] Proved that Spinosad 45 SC caused highest mortality (68 to 71%) mortality of *Maruca vitrata* over control and Swamy et *al.*, 2010 [21]. *Beauveria bassiana* (1.685) is found to be the next effective treatment which is in line with the findings of Sreekanth and Seshamahalakshmi 2012 [19] with 42.9 per cent reduction over control and and Meena *et al.*, 2022 [13]. The result of NSKE 5% (1.788) which is in support with Kanhere *et al*., 2009 [6] with 85 to 83% mortality. NPV (2.022) is found to be least effective but comparatively superior over the control, these findings are supported by Mutlag *et al.*, 2019 [14].

Table 1: Efficacy of selected insecticides and biopesticides against spotted pod borer, *Maruca vitrata* on green gram.

S. No	Treatments	Larval Population of *Maruca vitrata* (First spray)					Larval Population of *Maruca vitrata* (Second spray)					
		Before spray	3DAS	7DAS	14DAS	Mean	DBS	3DAS	7DAS	14DAS	Mean	Overall Mean
T0	Control	2.667	3.133	3.267	3.333	3.244	3.333	3.667	3.800	4.067	3.844	3.544
T1	*Beauveria bassiana*	2.333	2.267	1.733	1.933	1.977	1.933	1.533	1.200	1.467	1.4	1.685
T2	NPV	2.667	2.467	2.067	2.267	2.267	2.267	1.867	1.533	1.933	1.777	2.022
T3	NSKE 5%	2.533	2.333	1.800	2.000	2.044	2.000	1.733	1.267	1.600	1.533	1.788
T4	Emamectin Benzoate 5SG	2.333	2.067	1.200	1.400	1.555	1.400	1.200	0.733	1.000	0.977	1.266
T5	Chlorantraniliprole 18.5SC	2.600	1.733	0.867	1.067	1.222	1.067	0.733	0.533	0.667	0.644	0.933
T6	Spinosad 45SC	2.267	2.200	1.533	1.733	1.822	1.733	1.467	1.067	1.333	1.289	1.555
T7	Flubendiamide 20SG	2.467	2.133	1.267	1.467	1.622	1.467	1.333	0.800	1.067	1.066	1.344
	F-test	NS	S	S	S	S	NS	S	S	S	S	S
	S. Ed. (±)	0.15	0.12	0.25	0.24	0.20	0.24	0.25	0.18	0.26	0.23	0.21
	C.D. (P = 0.05)	____	0.249	0.527	0.523	0.433	____	0.282	0.389	0.557	0.409	0.421

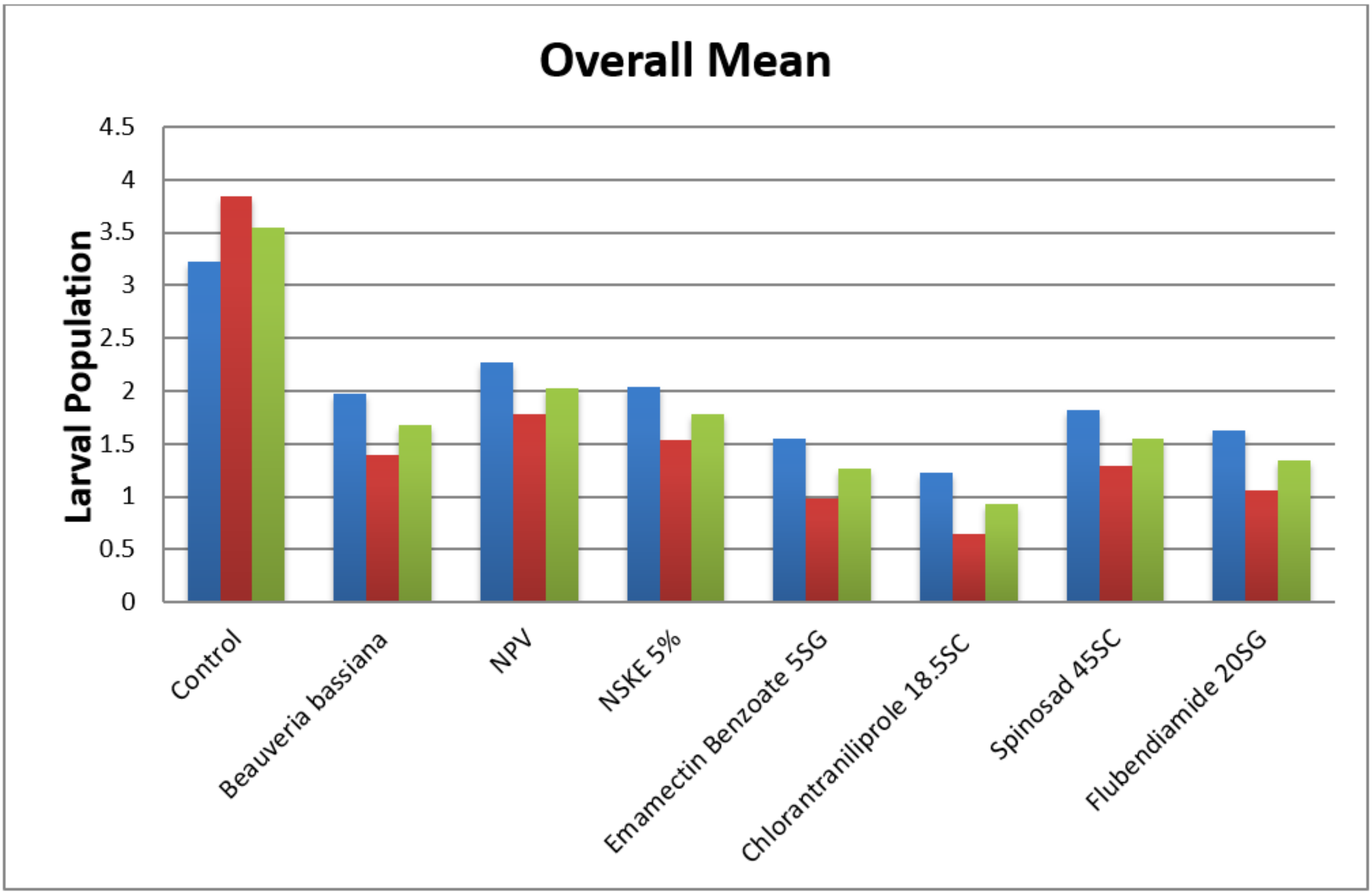

Fig 1: Efficacy of selected insecticides and biopesticides against spotted pod borer, *Maruca vitrata* on green gram. (Mean)

Table 2: Economics of cultivation/ha

S. No	Treatments	Yield in q/ha	Cost of yield / ₹/ qtl	Total cost of yield (₹)	Common cost (₹)	Treatment cost (₹)	Total cost (₹)	C:B ratio
1	Control	4.3	6000	25800	23695	0	23695	1:1.08
2	*Beauveria bassiana*	8.8	6000	52800	23695	1850	25545	1:2.06
3	NPV	6.7	6000	40200	23695	1520	25215	1:1.59
4	NSKE 5%	7.6	6000	45600	23695	1100	24795	1:1.83
5	Emamectin Benzoate 5SG	12.25	6000	73500	23695	1300	24995	1:2.94
6	Chlorantraniliprole 18.5SC	13.4	6000	80400	23695	4400	28095	1:2.86
7	Spinosad 45SC	10.45	6000	62700	23695	4400	28095	1:2.23
8	Flubendiamide 20SG	11.15	6000	66900	23695	1200	24895	1:2.68

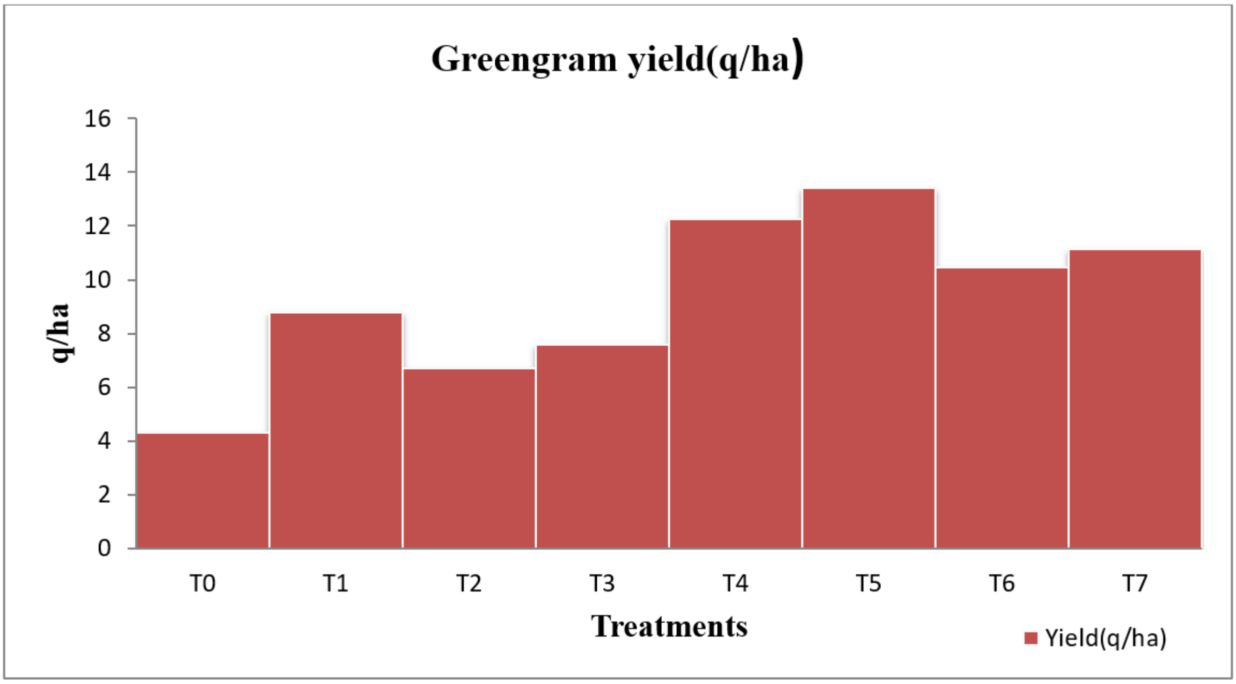

Fig 2: Efficacy of selected insecticides and biopesticides against spotted pod borer, *Maruca vitrata* on green gram. (Yield q/ha)

Yield (q/ha)

The yields among the different treatments were significant. All the treatments were superior over control. The highest yield was recorded in Chlorantraniliprole 18.5SC (13.4 q/ha) followed by Emamectin Benzoate 5SG(12.25 q/ha), Flubendiamide 20SG (11.15 q/ha), Spinosad 45SC (10.45 q/ha), *Beauveria bassiana* (8.8 q/ha), NSKE 5% (7.6 q/ha) and NPV (6.7 q/ha) as compared to control plot (4.3 q/ha).These findings are supported by Mallikarjuna *et al.*, 2010 [10] with a yield of 14.26q/ha and 14.94q/ha for flubendamide 480 SC and Emamectin benzoate 5SG respectively, Yadav *et al.*, 2014 [24] with a yield of 11.1q/ha for spinosad 45SC, Meena *et al.*, 2022 [25] with a yield of 9.13q/ha for spinosad 54SC, Mahalle *et al.*, 2018 [9] reviewed that Chloranthraniliprole 18.5SC results showed highest seed yield of 1278kg/ha.

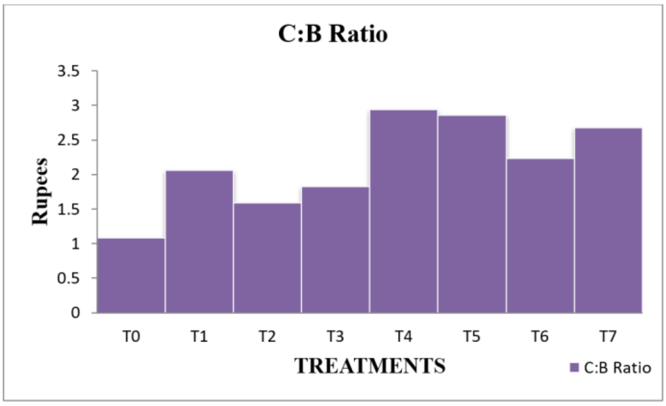

Fig 3: Cost benefit ratio of different treatments against spotted podborer, *Maruca vitrata* on green gram

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Emamectin Benzoate 5SG (1:2.94) with similar findings made by Sreekanth *et al.*, 2015 [42] with cost benefit ratio 1:3.13 followed by Chlorantraniliprole 18.5SC (1:2.86) with similar findings made by Dadas *et al.*, 2018 [8] with cost benefit ratio 1:2.26, Flubendiamide 20SG (1:2.68) with similar findings made by Swathi *et al.*, 2018 [47] with cost benefit ratio 1:3.64. The next best treatment Spinosad 45SC (1:2.23) with similar findings made by Sreekanth *et al.*, 2015 [42] with cost benefit ratio of 1:2.97.The next treatment was *Beauveria bassiana* (1:2.06), NSKE 5% (1:1.83) and NPV (1:1.59), as compared to control plot (1:1.08).

Conclusion

From the critical analysis of the present findings it can be concluded that insecticides like Chlorantraniliprole 18.5SC, Emamectin Benzoate 5SG, Flubendiamide 20SG, Spinosad 45SC can be suitably incorporated in pest management schedule against *Maruca vitrata* (Geyer) as an effective tool under chemical control, and selected biopesticide treatments like *Beauveria bassiana*, NSKE 5% and NPV are also to be incorporated in pest management in order to avoid indiscriminate use of pesticides which causes pollution in the environment and are not much harmful to the beneficial insects and in increasing cost effectiveness. And these synthetic chemicals are better than biopesticides in reducing pest population levels. However, future studies may be suggested to ensure it's better performance against greengram spotted pod borer.

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