RESEARCH ARTICLE Legume Research- An International Journal, Volume 47 Issue 2: 328-331 (Fabruary 2024)

Bioefficacy and Economics of Certain Novel Generation Insecticides against Spotted Pod Borer, *Maruca vitrata* (Geyer) in Greengram (*Vigna radiata* L.)

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10.18805/LR-4651

ABSTRACT

Background: Spotted pod borer, *Maruca vitrata*, cause greater damage by attacking flowers, pods in greengram plants. This study investigates the efficacy and economics of certain novel insecticides when sprayed against spotted pod borer in green gram.

Methods: The experiment was conducted at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, during *kharif 2019* in randomized block design with eight treatments (Emamectin benzoate, Spinosad, Chlorantroniliprole, Indoxacarb, Novaluron, Profenophos, Triazophos and control) and three replications on variety SML668. Observations were taken at three, seven and eleven days after the first and second spray and the data thus recorded were analyzed.

Result: The insecticide Chlorantraniliprole 20SC @ 0.025 ml/lit has shown the highest efficacy with low per cent pod damage (7.33) and maximum grain yield (8.61 q/ha) against *M. vitrata* from the first day of application followed by Spinosad 45SC @ 0.25 ml/lit with pod damage of 10.67 per cent and grain yield of 5.08 q/ha. The highest cost-benefit ratio was obtained in Emamectin benzoate treatment (1:8.54), followed by chlorantraniliprole (1: 6.76).

Key words: Bioefficacy, *Maruca virata,* Novel generation insecticides, Spotted pod borer.

INTRODUCTION

Pulses possess a unique position in India's agricultural economy, being a major source of protein in the diet, which is often regarded as poor man's meat due to densely packed with a protein percentage of 22-24, which are almost twice that of wheat and thrice that of rice. Among them, mung bean (*Vigna radiata* L.) is an important pulse crop and belongs to Leguminosae. It is believed to be indigenous of central Asia and India. Similar to other pulses, mung bean is primarily grown for its protein-rich seeds where it contains (24%) protein with a rich source of minerals, *i.e*., iron (0.0073%), carotene (0.00039%), phosphorous (0.326%), niacin (0.0021%) and energy 334 cal/100 g of mung bean (Singh *et al.,* 2020). During the year 2018 in India, mung bean accounts for a production of 2.45 million tons with average productivity of 516 kg/ hectare from an area of 4.75 million hectares, where it contributes about 10-13 per cent of the total pulses production of the country (Anonymous, 2018).

The average productivity of pulses is very low because of abiotic and biotic factors such as temperature, relative humidity, rainfall and diseases as well as insect pests, especially pod borers (War *et al*., 2017; Pandey *et al*., 2018). Among the pod borer complex spotted pod borer, *Maruca vitrata* (Crambidae: Lepidoptera) is the serious pest of grain legumes including mung bean, red bean, pigeon pea and common beans (Chandrayudu, 2008), with the grain yield losses estimated from 10 to 80 per cent in various crops (Kumar *et al.,* 2014) where it becomes a menace especially during the flowering to pod formation stages and has been reported to be a pest on 39 host plants in Asia (Yadav and Singh, 2014). Control of *M. vitrata* damage largely relies upon the availability and application of chemical insecticides. However, its effectiveness is holdback due to variable reasons like larval webbing, insecticide resistance, *etc*., that lowers pesticide exposure. The present study aimed to evaluate the efficacy of some novel insecticides against spotted pod borer infesting green gram.

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How to cite this article: Sireesha, E., Singh, G., Singh, R. and Singh, B. (2024). Bioefficacy and Economics of Certain Novel Generation Insecticides against Spotted Pod Borer, *Maruca vitrata* (Geyer) in Greengram (*Vigna radiata* L.). Legume Research. 47(2): 328-331. doi: 10.18805/LR-4651.

Submitted: 04-05-2021 **Accepted:** 16-08-2021 **Online:** 06-09-2021

MATERIALS AND METHODS

The experiment was conducted during *kharif* 2019, at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, to evaluate the efficacy of insecticides against spotted pod borer in green gram. The crop was grown with a spacing of

30 cm × 10 cm with three replications in a randomized block design. The incidence of spotted pod borer was monitored at weekly intervals to observe the economic threshold level. Application of insecticides was made with a motor-operated knapsack sprayer twice during the crop period, one at the flowering stage and another at 15 days after the first spray. Based on the active ingredient and required concentration of the insecticide, the insecticide's desired amount is measured and subsequently mixed with water (500 L/ha). Population density of spotted pod borer, *M. vitrata* was recorded by randomly picking ten plants per plot from each treatment one day before spray and three, seven and eleven days after first and second sprays, respectively and analyzed.

Per cent infestation of pods was also considered where randomly 100 pods were collected from each treatment before harvesting. All the pods showing pod damage were counted and per cent pod damage was calculated based on the following formula:

Per cent pod damage =

$$\frac{\text{Total number of damaged pods}}{\text{The total number of pods observed}} \times 100$$

The grain yield, economics and cost-benefit ratio of all the insecticidal treatments were calculated.

RESULTS AND DISCUSSION

The results of the experiment are presented in Table 1, where the larval population before spraying was uniformly distributed all over the experimental field and it ranged from 13.33 to 14.00 larvae/ ten plants. All the treatments were effective against *Maruca* when compared with the untreated control. The data at 3 DAS showed that the minimum larval population of *M. vitrata* was noticed in the treatment of chlorantraniliprole 10 g a.i / ha (3.33 larvae / ten plants) followed by Spinosad 56 g a.i / ha (4.33 larvae / ten plants) and the maximum larval population was found in treatment of triazophos 400 a.i / ha (7.33 larvae/ ten plants). At 7DAS same trend was observed and that the minimum larval population of *M. vitrata* was noticed in the treatment of chlorantraniliprole 10 g a.i / ha (2.67 larvae / ten plants) followed by Spinosad 56 g a.i / ha (3.00 larvae / ten plants) and the maximum was found in triazophos 400 a.i / ha (6.67 larvae/ ten plants). The data recorded at 11 DAS showed the minimum larval population in treatment chlorantraniliprole 10g a.i / ha (3.67 larvae / ten plants) followed by Spinosad 56 g a.i / ha (4.00 larvae / ten plants) and the maximum larval population was recorded in treatment of triazophos 400 a.i / ha (10.00 larvae/ ten plants).

The data of the second spray revealed that the larval population during the 3DAS was ranged from 1.67 to 17.33 and it follows the same trend as the first spray. The treatment chlorantraniliprole 10 g a.i / ha (1.67 larvae / ten plants) showed minimum larval population and was followed by treatment of Spinosad 56 g a.i / ha (2.00 larvae / 10 plants) and the maximum population was noticed in -triazophos 400 a.i / ha (6.00 larvae/ plant). The treatments comprises of chlorantraniliprole 10 g a.i / ha and Spinosad 56 g a.i / ha has showed minimum larval population of 1.00 larvae / ten plants, 1.33 larvae / ten plants, respectively followed by maximum larval population of treatment-triazophos 400 a.i / ha with 4.00 larvae/ ten plant at 7 DAS. At 11 DAS, the treatments chlorantraniliprole 10 g a.i / ha and Spinosad 56 g a.i / ha has shown minimum larval population of 0.33 larvae / ten plants and 0.67 larvae / ten plants, respectively whereas maximum larval population was noticed in treatment comprises of triazophos 400 a.i / ha (2.67 larvae/ ten plants). On the basis of present trial it can be concluded that the treatment chlorantraniliprole 10g a.i / ha was most effective in managing the *Maruca* population and was followed by Spinosad 56 g a.i / ha. Among all the treatments, triazophos was found least effective in managing the larval population. Other workers also reported chlorantraniliprole as most effective against this pest (Mahalakshmi *et al*. (2013); Swami *et al.* (2017); Parvina *et al.* (2018). Further, Swathi *et al.* (2018) also reported that treatment spinosad was effective against the *Maruca*. Thus, support the present findings.

The data presented in Table 1 also revealed per cent pod damage to the mung bean due to the legume pod borer ranging from 7.33 to 22.67 in the various treatments, while the maximum pod damage was noticed in the control plot with 28.67 per cent. Among all the treatments, Chlorantraniliprole 20SC recorded with minimum pod damage of 7.33 per cent and followed by Spinosad 45 SC, Emamectin benzoate 5SG, Indoxacarb 14.5 SC, Novaluron and Profenophos and Triazophos 40 EC @ 4.0 gm per liter of water with 10.67, 11.67, 14.00, 16.67, 18.67 and 22.67 per cent pod damage, respectively. These findings are supported by Kumar *et al*. (2015) reported that chlorantraniliprole 18.5 SC 30 g a.i/ ha recorded mimimum larval incidence of *Helicoverpa armigera* in red gram. Parvina *et al.* (2018), who observed that chlorantraniliprole 18.5 SC 0.01 per cent recorded minimum pod damage against lepidopteran pests and registered as the most effective treatment in managing lepidopteran pests. Regmi *et al.* (2014) also found similar results with emamectin benzoate 5 SG @ 0.25 g per litre decreased pod damage (5.76 per cent) and increased net yield of green pod on yard long bean. Singh and Singh (2017) also reported that spinosad 60 g a.i./ ha and emamectin benzoate 8 g a.i./ ha were the most effective treatments in reducing *M. vitrata* larval population on green gram.

The data on grain yield of different insecticidal treatments can also be obtained from Table 1 revealed that the maximum grain yield of 8.61 q/ha was recorded in Chlorantraniliprole 20 SC, which is superior over all other treatments and followed by Emamectin benzoate 5 SG, Spinosad 45 SC, Indoxacarb 14.5 SC, Novaluron 10 EC, Profenophos 50 EC and Triazophos 40 EC with grain yield of 7.77, 6.94, 5.00, 4.44, 3.61 and 3.33 q/ha, respectively. The lowest grain yield with 2.22 q/ha was obtained in untreated control compared with all other treatments.

Table 1: Comparative efficacy of different treatments against larval population and pod damage of *M. vitrata*, yield and cost-benefit ratio in green gram.

Treatments	Larval population / 10 plants							Pod damage	Yield	B: C ratio
	First spray				Second spray					
(gm/ml per liter of water)	DBS	3 DAFS	7 DAFS	11 DAFS	3 DASS	7 DASS	11 DASS			
Emamectin benzoate @ 0.4	13.33(3.65)	5.00(2.23)	4.00(1.99)	4.67(2.15)	2.33(1.49)	1.67(1.28)	1.00(1.22)	11.67(19.96)	7.77	8.54
Spinosad@0.25	14.00(3.74)	4.33(2.08)	3.00(1.72)	4.00(2.00)	2.00(1.41)	1.33(1.14)	0.67(1.05)	10.67(19.07)	6.94	5.08
Chlorantraniliprole@0.25	13.33(3.65)	3.33(1.82)	2.67(1.63)	3.67(1.91)	1.67(1.28)	1.00(1.00)	0.33(0.88)	7.33(15.71)	8.61	6.76
Indoxacarb@1.0	13.67(3.69)	5.33(2.31)	4.33(2.06)	5.00(2.23)	2.67(1.61)	2.33(1.52)	1.33(1.34)	14.00(21.97)	5.00	2.69
Novaluron@1.0	13.67(3.69)	5.67(2.35)	4.67(2.15)	7.00(2.64)	4.00(1.99)	3.00(1.72)	2.00(1.58)	16.67(24.09)	4.44	1.95
Profenophos@1.0	13.33(3.65)	7.00(2.64)	6.00(2.44)	9.00(3.00)	4.67(2.15)	3.67(1.91)	2.33(1.68)	18.67(25.42)	3.61	3.94
Triazophos @4.0	13.33(3.65)	7.33(2.71)	6.67(2.58)	10.00(3.16)	6.00(2.44)	4.00(1.99)	2.67(1.76)	22.67(28.42)	3.33	1.69
Control	14.00(3.74)	15.33(3.91)	16.33(4.04)	17.00(4.12)	17.33(4.16)	17.67(4.20)	18.67(4.38)	28.67(32.38)	2.22	-
SE(m)±	-	0.13	0.15	0.10	0.15	0.12	0.12	0.67	0.075	
CD at 5%	NS	0.39	0.45	0.31	0.45	0.35	0.37	2.02	0.227	

Figures in the parenthesis are square root transformed values, NS- non-significant.
DBS- Day before spraying, DBFS- Days after first spray, DBSS- Days after second spray.

The present findings were supported by Swathi *et al.* (2019), who observed that among all the insecticidal treatments, chlorantraniliprole 18.5 SC @ 0.0037 per cent recorded the highest grain yield. Patange *et al.* (2017) reported that the treatment rynaxypyr 18.5 SP @ 30 g a.i/ ha had recorded maximum grain yield. Considering the cost-benefit ratio, the highest was recorded in Emamectin benzoate 5SG with 1: 8.54 and followed by Chlorantraniliprole 20SC and Spinosad 45 SC with C: B ratio of 1: 6.76 and 1: 5.08, respectively. The minimum C: B ratio of 1:1.69 was observed in the treatment of Triazophos 40EC@ 4.0 gm/ liter of water. Babariya *et al.* (2010) and Vaibhav (2018) recorded the maximum yield from the treatment spinosad 45% SC @ 0.4 ml/ liter 15.77 q/ ha and the highest B: C ratio (1:10.07) with emamectin benzoate 5% SG @ 0.3 gm/ liter of water. Taggar *et al.* (2021) and Khinichi and Kumawat (2021) reported that with the lowest pest population and cumulative pod damage, chlorantraniliprole 18.5 SC @ 150 ml/ ha reported the highest grain yield. Thus, Emamectin benzoate 0.4 gm/ liter of water or Chlorantraniliprole 0.25 ml/ liter of water, or Spinosad 0.25 ml/ liter of water can be sprayed during the 30 DAS followed by 15 days after the first spray for controlling the spotted pod borer on the green gram and getting more benefit during *Kharif* season.

CONCLUSION

Many of the new molecules have outstanding toxicological profiles, unlike traditional ones and are generally recognized as effective compounds against Green gram pest. Chlorantraniliprole, Spinosad and Emamectin benzoate are all effective against *M. vitrata* field spray control shortly after application, but the triazophos is not as much effective when compared with other compounds.

Conflict of interest

All authors declared that there is no conflict of interest.

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