Comparative insecticidal applications to check gram pod borer *Helicoverpa armigera* (Hubner) on green gram at Allahabad

Abstract

An experiment was conducted during *kharif* season of 2022-2023 to evaluate the cost benefit ratio by using different insecticidal applications *viz.*, Chlorantraniliprole 18.5 SC (0.5ml/l), Spinosad 45 SC (0.4ml/l), Nisco sixer plus (2ml/l), *Bacillus thuringiensis* 4% WSP (2gm/l), *Beauveria bassiana* 1.15% WP (5gm/l), Neem oil @2% (5ml/l), ½ dose Chlorantraniliprole + Nisco sixer plus (2.25ml/l) and Control plot against gram pod borer, *Helicoverpa armigera* (Lepidoptera, Noctuidae) on the green gram with three replications. Results revealed that the highest grain yield was recorded in (T_1) Chlorantraniliprole 18.5 SC (15.6 q/ha) followed by (T_2) Spinosad 45 SC (14.8 q/ha), (T_7) Half dose Chlorantraniliprole + Nisco sixer plus (13.8 q/ha). Insecticidal treatment with (T_1) Chlorantraniliprole 18.5 SC (1:2.87), followed by (T_2) Spinosad 45 SC (1:2.79), (T_7) Half dose Chlorantraniliprole + Nisco sixer plus (1:2.45), Nisco sixer plus (1:2.36), *Beauveria bassiana* 1.15% WP (1:2.30), *Bacillus thuringiensis* 4% WSP (1:2.00) and Neem oil @2% (1:1.83) are found to be least effective but comparatively superior over the control (1:1.51). End of the experiment it was reported that Chlorantraniliprole is the best for the management of gram pod borer.

KEY WORDS: Biopesticides, Chlorantraniliprole, Cost benefit ratio, green gram, *Helicoverpa armigera,* Insecticides.

INTRODUCTION

Pulses, also known as legumes, are the edible seeds of leguminous plants cultivated for food. Pulses constitute an excellent supplement of protein in the vegetarian diet of human being and play a significant role in correcting the widespread malnutrition all over the world. Pulses are known as the “poor man’s meat” because they are rich in nutrition and low in cost [1].

Mung bean (*Vigna radiata*) is a plant species of Fabaceae which is also known as green gram. The green gram is an annual vine with yellow flowers and fuzzy brown pods. There are three subgroups of *Vigna radiata*, including one cultivated (*Vigna radiata* subsp. *radiata*) and two wild ones (*Vigna radiata* subsp. *sublobata* and *Vigna radiata* subsp. *glabra*). It has a height of about 15–125 cm. Mung bean has a well-developed root system. The lateral roots are many and slender, with root nodules grown. Stems are much branched, sometimes twining at the tips. Young stems are purple or green, and mature stems are greyish yellow or brown [2].

Green gram is a highly nutritious containing 24 per cent of high-quality protein, 1.3 per cent fats, 56.6 per cent carbohydrates and 3 per cent dietary fibres. It is rich in minerals having 140 mg calcium, 8.4 per cent iron and 280 mg phosphorous. It also contains 0.47 mg vitamin B1, 0.39 mg vitamin B2 and 2 mg niacin. It has calorific value of 334 calories per 100 g of edible protein [3].

India is the world's largest producer as well as consumer of green gram. It produces about 1.5 to 2.0 million tonnes of mung bean annually from about 3 to 4 million hectares of area with average productivity of 500 kg per hectare. Green gram output accounts for about 10- 12% of total pulse production in the country. the mung bean production in India was 1.39 million tonnes in which, Maharashtra's contribution was about 20%, while Rajasthan was the highest having 26% of the total production. Mung bean production in the country is largely concentrated in five states *viz.*, Rajasthan, Maharashtra, Andhra Pradesh, Gujarat and Bihar. These five states together contribute to about 70% of total Mung production in the country. It is one of the most widely cultivated pulse crop after chickpea and pigeon pea [4].

The major insect pests during different growth stages are thrips, whitefly, leafhopper and stem fly caused appreciable damage. But, worldwide, over 30 species of Lepidoptera feed on pods and seeds [5].

Besides gram pod borer, it is also known as cotton bollworm, gram caterpillar, tomato fruit worm and tobacco bud worm. Per cent larval survival and pupation were the maximum on chickpea as compared to other host plants [6].

Insect pests are one of the major biotic constraints for a reduced yield of green gram. About 17 insect pests which are regarded as key pests are reported to cause significant yield losses in green gram [7]. Pod borer, *Helicoverpa armigera* (Hubner), is a key pest found to cause pod damage upto 27.49 % [8].

Materials and Methods:

The experiment was conducted during *kharif* season 2022 at Sam Higginbottom University of Agriculture Technology And Sciences Prayagraj UP, Central research farm (CRF), Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using Malini variety in a plot size of (2m×1m) at a spacing of

(30×10cm) with a recommended package of practices excluding plant protection. The treatments used in experiment are *viz.*, Chlorantraniliprole 18.5SC (0.5ml/l), Spinosad 45 SC (0.4ml/l), Nisco sixer plus (2ml/l), *Bacillus thuringiensis* 4% WSP (2gm/l), *Beauveria bassiana* 1.15% WP (5gm/l), Neem oil @2% (5ml/l), ½ dose Chlorantraniliprole + Nisco sixer plus (2.25ml/l) and Control were evaluated against gram pod borer. Each treatment was replicated thrice. All the agronomic practices were followed as per the recommended package of practices. Two sprays were given for all treatments when the crop is at 25 days old except the control plot and the second spray 15 days later. The observations were recorded on five randomly selected plants in each replication.

2.1 Yield: (q/ha)

The green gram pods were picked from all the plants per plot and pods were shelled. The average weight of picked pods was used to calculated by the following formula

$$Yield = \frac{Yield\ per\ plot}{Plot\ size}\ x\ 100$$

2.2 Benefit Cost Ratio:

Gross return was calculated by multiplying total yield with the market price of the produce. Cost benefit ratio by following formula

$$B{:}C\ Ratio = \frac{Gross\ returns}{Total\ Cost\ of\ cultivation}$$

Where,

B: C = Benefit Cost Ratio

Results and Discussion:

The yield among the different treatments were significant. All the treatments were superior over the control. The highest increased yield over control was recorded in Chlorantraniliprole 18.5 SC (15.6q/ha) followed by Spinosad 45 SC (14.8 q/ha), ½ dose Chlorantraniliprole + Nisco sixer plus (13.8q/ha), Nisco sixer plus (12.5 q/ha), *Beauveria bassiana* 1.15% WP

(11.4 q/ha), *Bacillus thuringiensis* 4% WSP (10.8 q/ha) and Neem oil (10.3 q/ha) is found to be least effective but comparatively superior over the control (7.1 q/ha).

The increased percent yield over control treatment was different. All treatments were superior over control. The highest increase yield over control was recorded in Chlorantraniliprole 18.5 SC (8.7 q/ha) followed by Spinosad 45 SC (7.7 q/ha), ½ dose Chlorantraniliprole + Nisco sixer plus (6.7 q/ha), Nisco sixer plus (5.4 q/ha), *Beauveria bassiana* 1.15% WP (4.3 q/ha), *Bacillus thuringiensis* 4% WSP (3.7 q/ha) and Neem oil (3.2 q/ha).

When cost benefit ratio was worked out, an interesting result was achieved. Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5 SC (1:2.87). The similar finding made by [9]**,** followed by Spinosad 45 SC (1:2.79) is found to be the next best treatment which is in line with the findings of [10], ½ dose Chlorantraniliprole + Nisco sixer plus (1:2.45), Nisco sixer plus (1:2.36), *Beauveria bassiana* 1.15% WP (1:2.30), *Bacillus thuringiensis* 4% WSP (1:2.00) and Neem oil (1:1.83) is found to be least effective and this finding is supported [11], but comparatively superior over the control (1:1.51)**.**

From the Table 3. It shows that higher yield comes from Chlorantraniliprole insecticides and also more benefit is seen as compared to other treatments used in the experiment. Among all the treatments Chlorantraniliprole is effective.

Table.1. Cost of agronomical practices of cultivation/ha

S.No	Particular	Requirement	Rate/unit (₹)	Cost (₹)

(A)	Land preparation Ploughing Harrow Layout of field	2.5 hours 2 hours 10 labours 2 labours	500₹ /hours 500₹ /hours 340₹ /labour 340₹ /labour	1250 1000 3400 680
(B)	Manures and fertilizer			
	FYM	10 tons	200₹ /ton	2000
	Urea	30 Kg	10₹ /Kg	300
	SSP	60 Kg	24₹ /Kg	1440
	MOP	30 Kg	18₹ /Kg	480
	Labour	4 labours	340₹ /Labour	1360
(C)	Seed sowing			
	Seed material	30 Kg	160₹ /Kg	4800
	Sowing and transplanting	7 labours	340₹ /Labour	2380
(D)	Weed management	8 labours x 2 times	340₹ /labour	5440
(E)	Water management	4 labours x 3 times	340₹ /labour	4080
(F)	Harvesting	8 labours	340₹ /labour	2720
(G)	Total cost of cultivation			**31330**

Table.2. Economics of the Treatments

S.No	Treatments	Use of Chemical (2 times spray)	Cost of Chemical (₹)	Total Cost of Chemical (₹/ha)	Total labour cost (₹)	Total cost of treatment (₹)
1	Chlorantraniliprole 18.5 SC	500ml/ha	8800 ₹/lit	4400	680	5080
2	Spinosad 45 SC	400ml/ha	8800 ₹/lit	3520	680	4200
3	Nisco sixer plus	2 Litre/ha	1700 ₹/lit	3400	680	4080
4	*Bacillus thuringiensis* 4% WSP	2kg/ha	435 ₹/kg	870	680	1550
5	*Beauveria bassiana* 1.15%WP ($1X10^8$ CFU/gm)	4kg/ha	550₹/kg	1100	680	1780
6	Neem oil 2%	5litre/ha	320 ₹/lit	1600	680	3030
7	½ dose Chlorantraniliprole + Nisco sixer plus	250ml+ 2 litre/ha	8800 + 1700 ₹/lit	5600	680	5668
8	Control	–	–	–	–	–

Table.3. Effect of treatments on green gram

S.NO	TREATMENTS	Yield Q/ha	Increase yield over control Q/ha
T_1	Chlorantraniliprole 18.5SC	15.6	8.7
T_2	Spinosad 45SC	14.8	7.7
T_3	Nisco sixer plus	12.5	5.4
T_4	*Bacillus thuringiensis* 4% WSP	10.8	3.7
T_5	*Beauveria bassiana* 1.15%WP ($1X10^8$ CFU/gm)	11.4	4.3
T_6	Neem oil 2%	10.3	3.2
T_7	½ dose Chlorantraniliprole + Nisco sixer plus	13.8	6.7
T_8	Control	7.1	___

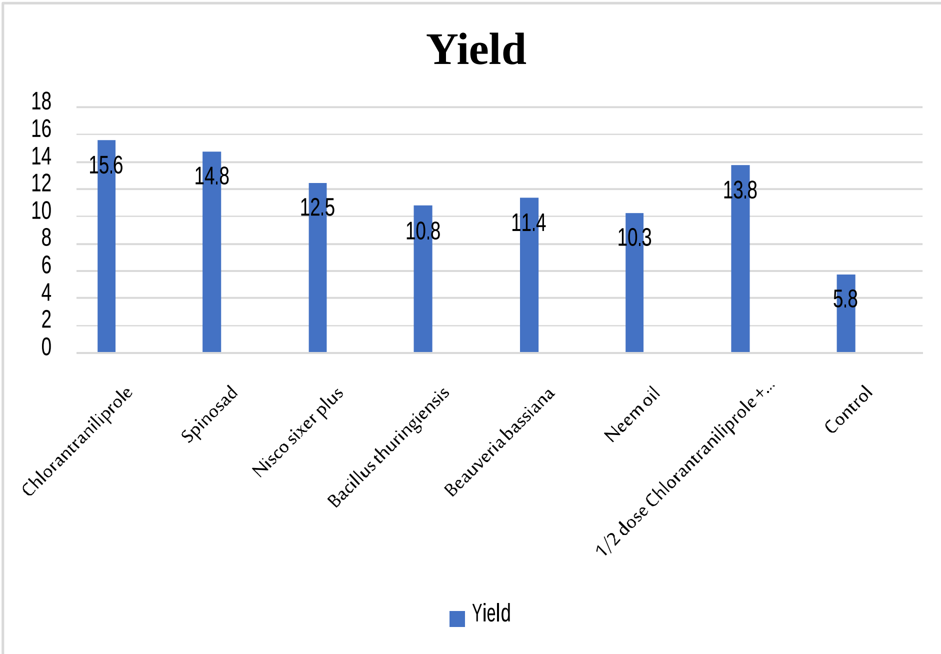

Fig.1. Assessment of yield on the efficacy of Chlorantraniliprole and biopesticides on gram pod borer

Table.4. Economics and cost benefit ratio of the cultivation

Treatment symbol	Treatment	Yield (q/ha)	Cost of yield q/₹	Total cost of yield in ₹	Common cost of cultivation (₹)	Total treatment cost (₹)	B:C Ratio
T_1	Chlorantraniliprole 18.5 SC	15.6	6700	104520	31330	5080	1:2.87
T_2	Spinosad 45 SC	14.8	6700	99160	31330	4200	1:2.79
T_3	Nisco sixer plus	12.5	6700	83750	31330	4080	1:2.36
T_4	*Bacillus thuringiensis* 4% WSP	10.8	6700	72360	31330	1550	1:2.00
T_5	*Beauveria bassiana* 1.15%WP ($1X10^8$ CFU/gm)	11.4	6700	76380	31330	1780	1:2.30
T_6	Neem oil 2%	10.3	6700	69010	31330	3030	1:1.83
T_7	½ dose Chlorantraniliprole + Nisco sixer plus	13.8	6700	92460	31330	5668	1:2.45
T_8	Control	7.1	6700	47570	31330	0	1:1.51

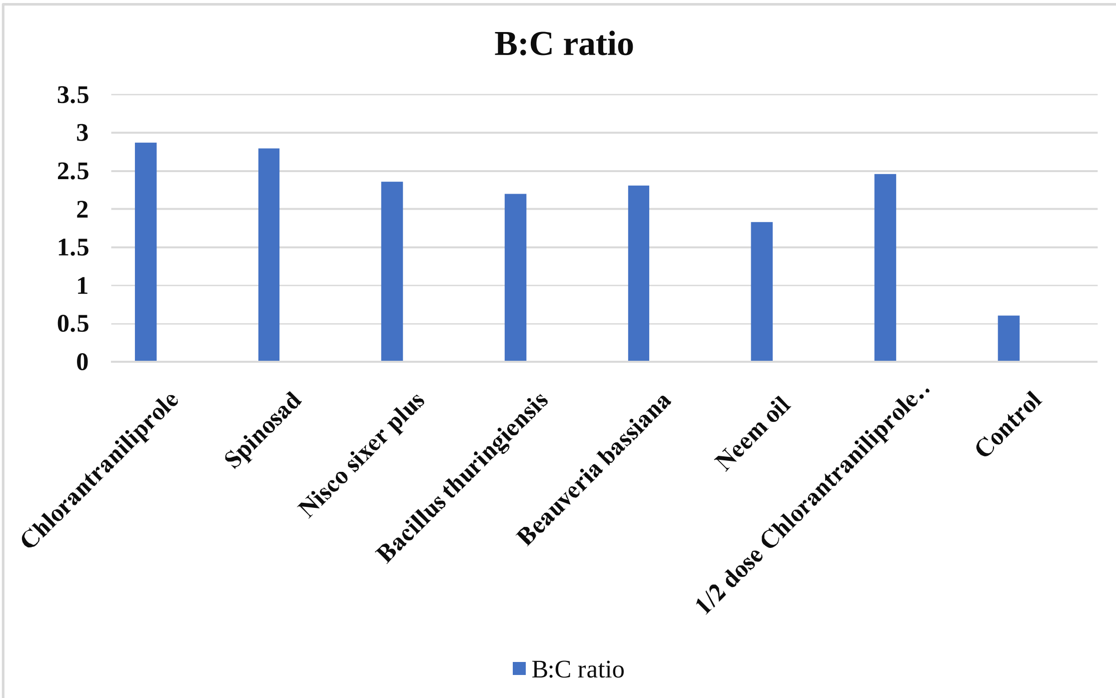

Fig.2. Cost benefit ratio of treatments

4. Conclusion:

Results revealed that the maximum yield and cost benefit ratio is recorded at Chlorantraniliprole 18.5 SC, followed by Spinosad 45 SC, half dose of Chlorantraniliprole + Nisco sixer plus can be suitably incorporated in pest management schedule against gram pod borer as an effective tool under chemical control.

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References:

1. Umbarkar, P. S., Parsana, G. J. and Jethva, D. M. Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) on greengram: *Legume Research-An International Journal,* 2010; 33(2): 148-149.
2. Meena, V. P., Khinchi, S. K., Kumawat, K. C. and Choudhary, S. Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) and spotted pod borer, *Maruca testulalis* (Geyer) on green gram in relation to weather parameters: *Journal of Experimental Agriculture International,* 2022; 19(1), 1-8.
3. Baldev, B., Ramanujan S. and Jain H.K. Chemical composition of green gram: *Pulse Crops*, 2003; 363.
4. Swaminathan, R., Singh, K. and Nepalia, V. Insect pests of greengram (*Vigna radiata (L.)* Wilczek) and their management: *Agricultural Science,* 2012; 10: 197-222.
5. Shanower, T. G., Romeis, J. M. E. M. and Minja, E. M. Insect pests of pigeon pea and their management: *Annual review of entomology*, 1999; 44(1), 77-96.
6. Ullah, F., Ali, M., Ahmad, S. and Badshah, H. Impact of light traps on population density of gram pod borer, *Helicoverpa armigera* (Hub.) and its larval parasitoid (*Campoletis chlorideae Uchida*) in Rod Kohi area of Dera Ismail Khan: *Journal of Entomology and Zoology,* 2015; 3: 203-207.
7. Cheema, H.K., Pratap, A. and Sujayanand, G. K. Breeding for Insect Resistance in Mung Bean and Urd Bean: *In: Breeding Insect Resistant Crops for Sustainable Agriculture Springer,* Singapore, 2017; 353-385.
8. Joshi, N., Shera, P., Sangha, K. and Sharma, S. Bioformulations for management of pod borer, *Helicoverpa armigera* (Hübner) in Mungbean (*Vigna radiata* L.): *Journal of Biological Control,* 2019; 33(1): 76-79.
9. Hanumant, P. A. and Kumar, A. Field evaluation of chemicals and bio-pesticides against chickpea pod borer [*Helicoverpa armigera* (Hubner)]: *The Pharma Innovation Journal,* 2022; 11(7): 3405-3410.
10. Lakshmikanth, R. and Kumar, A. Comparative efficacy of selected chemicals and Biopesticides against gram pod borer [*Helicoverpa armigera* (Hubner)] (Lepidoptera: Noctuidae) on cowpea [*Vigna unguiculata (L.)* Walp.]: *Journal of pharmacognosy and phytochemistry,* 2018; 7(3): 3307-3309.

11. Sravani, M. and Kumar, A. Field efficacy and economics of selected insecticides against pod borer [*Helicoverpa armigera* (Hubner)] on green gram [*Vigna radiata (L.)* Wilczek]: *The Pharma Innovation Journal*, 2022; 11(7): 3920-3923.