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# Efficacy of Bio-Pesticides and Chemicals against Gram Pod Borer [*Helicoverpa armigera* (Hubner)] on Greengram (*Vigna radiata* (L.) Wilczek)

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

A field experiment was conducted in the *rabi* season of 2022-2023 at Central Research Farm (CRF), SHUATS, Uttar Pradesh, India. The experiment was laid in Randomized Block Design with eight treatments each replicated thrice *viz.,*(T1)Indoxacarb14.5%SC, (T2) Spinosad 45% SC, (T3),*Beauveria bassiana* 1x10$^8$(T4), Neem oil 2% (T5) Emamectin benzoate 5% SG ,(T6) Chlorantraniliprole 18.5% SC, (T7) *Bacillus thuringiensis* and (T8) control plot . The data on the larval population of *Helicoverpa armigera* after first and second spray revealed that all the treatments were significantly superior over the control. Among all the treatments,the plot treated with (T6) chlorantraniliprole18.5%SC (1.122) recorded minimum larval population followed by (T2) Spinosad 45%SC (1.289) (T1) Indoxacarb (1.467), (T4) Emamectin benzoate (1.645) and (T7) *Bacillus thuringiensis* 1x10$^8$CFU (1.822),(T3) *Beauveria bassiana* (1.989) In this the maximum

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larval population was recorded in (T5) Neem oil (2.134). Among all treatments with pod borer infestation respectively. While, the highest yield (16.9q/ha) was obtained from the treatment Chlorantraniliprole 18.5% SC as well as B:C ratio (1:4.13) obtained high from this treatment. It was followed by Spinosad 45%SC (1:3.99), Indoxacarb14.5SC (1:3:94), Neem oil 2% (1:3.52), Emamectin benzoate (1:3.59),*Bacillus thuringiensis* 4% WSP (1:3.39), *Beauveria bassiana* 1.15% WP (1:3.18) as compared to control plot (1:1:19).

*Keywords: Beauveria bassiana; Bio-pesticides 1.15%WP (1x108CFU); Bacillus thuringiensis 1x108; Chemicals; green gram; Helicoverpa armigera, indoxacarb.*

## 1. INTRODUCTION

Mung bean (*Vigna radiata*) is a plant species of Fabaceae which is also known as green gram. It is sometimes confused with black gram (*Vigna mungo*) for their similar morphology, though they are two different species. 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 grayish yellow or brown [1].

Mung beans are recognized for their high nutritive value. Mung beans contain about 55%- 65% carbohydrates and are rich in protein, fat, vitamins and minerals. It is composed of about 20% to 50% protein of total dry weight, among which globulin (60%) and albumin (25%) are the primary storage proteins Mung bean is considered to be a substantive source of dietary proteins. The proteolytic cleavage of these protein are even higher during sprouting. Mung bean carbohydrates are easily digestible, which causes less flatulence in humans compared to other forms of legumes. Both seeds and sprouts of mung bean produce lower calories compared to other cereals, which makes it more attractive to obese and diabetic individuals [2].

The total area under green gram cultivation was about 30.48 lakh hectares with an annual production of 13.45 lakh tones It is the largest producer of grain legumes (pulses) in the world. India ranks first in Green gram production (70% of the total world production). It produces about 1.5 to 2.0 million tonnes of Mung annually from about 3 to 4 million hectares of area, with an average productivity of 798 kg per hectare. In Uttar Pradesh, the total area and production of pulses is 5.70 million hectares, 3.27 million tonnes but greengram occupied 2443.21 thousand hectares, 1130.29thousand tonnes [3].

Gram pod borer, *Helicoverpa armigera*, is considered as a notorious pest of chickpea. Gram pod borer-*Helicoverpa armigera*(Hubner) (Lepidoptera: Noctuidae), a global and polyphagous pest equipped with multivoltine, diapauses is magnified due to its attack on reproductive stages, primarily on fruiting bodies, highly mobile and nocturnal in nature spread quickly in wide areas, found to cause economic damage to several cultivated crops *viz*., chickpea, pigeonpea, tomato, chilli, okra, etc throughout the year in India and sub-continent. The pest lays eggs on chickpea seedlings at second and third leaf stage of crop in Orissa. Its larvae appeared on chickpea crop after 15 days of germination at Dharwad, Karnataka. Singh and Ali, [4] reported *H. armigera* larvae found active throughout the chickpea crop period at Faizabad, Uttar Pradesh.

Keeping in view the above, a study entitled “Efficacy of biopesticides and chemicals against gram pod borer *Helicoverpaarmigera* (Hubner) on green gram” was be carried out with

### 1.1 Following Objectives

1. To study the effect of biopesticides and chemicals on the larval population of gram pod borer [*Helicoverpa armigera* (Hubner)] on green gram
2. To calculate the cost benefit ratio of the treated crop

## 2. MATERIALS AND METHODS

The experiment was conducted during *rabi* season 2022 at Central Research Farm (CRF), Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety Krishna in a plot size of

(2m×1m) at a spacing of (30×10cm) with a recommended package of practices excluding plant protection. The soil of the experimental site is well drained and medium high. The climate of the experimental site is sub-tropical characterized by normal rainfall. The experiment was conducted at Central Research Farm (CRF), Uttar Pradesh, during the *rabi* season of 2022-23. Prayagraj is situated at an elevation of 78 meters above sea level at 25.87 North latitude and 81.15° E longitudes. This region has a sub-tropical climate prevailing in the South-East part of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winters, the temperature sometimes is low as 32°F in December-January and very hot summer with temperature reaching up to 115°F in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4(cm) with maximum concentration during July to September months with occasional showers in winters.

“The observations on larval population of *Helicoverpa armigera* were recorded visually per plant from five randomly selected plants and tagged plants in each plot. The insecticides were sprayed at recommended doses when larval population reaches ETL (10% of pod damage). Number of infested pods are randomly selected plants per plot was counted and recorded at weekly interval after careful examination on the presence of pod damage at both vegetative and reproductive stage.

The following insecticides used in this field trail are (T1) Indoxacarb14.5%SC, (T2) Spinosad 45% SC, (T3),*Beauveria bassiana* $1x10^8$(T4), Neem oil 2% (T5) Emamectin benzoate 5% SG ,(T6) Chlorantraniliprole 18.5% SC , (T7) *Bacillus thuringiensis* and (T8) control plot The basal application of fertilizers was done manually and insecticides were applied with the help of knapsack sprayer by considering ETL level for making spray decisions.

The healthy marketable yield obtained from different treatments was collected separately from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during rabi season of 2022.The total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There were two sprays throughout the research period and the overall plant protection expenses were calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from thatof each sprayed treatment.

**Formulae used:**

**Number Basis:**

Larval population= Number of larves / Total number of plants

Kumar et al*.* [5]

**Benefit Cost Ratio**

B: C Ratio = Gross returns/ Total cost incurred

Where,

B:C Ratio = Benefit Cost Ratio

Kumar et al*.* [5]

## 3. RESULTS AND DISCUSSION

The data on the mean of 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, the plot treated with T6 chlorantraniliprole 18.5%SC (1.122) recorded minimum larval population followed by T2 Spinosad 45%SC (1.289), T1 Indoxicarb (1.467), T4 Emamectin benzoate (1.645) and T7 *Bacillus thuringiensis* $1x10^8$ CFU (1.822), T3 *Beauveria bessiana* (1.989) In this the maximum larval population was recorded in T5 Neem oil (2.134).

The data on the mean of 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 highest percent of larval population green gram pod borer was recorded in Chlorantraniliprole 18.5SC (1.122). Similar findings made by Rahman et al. [6], and Mahajan et al*.* [7]. Spinosad 45 SC (1.289) is found to be the next best treatment which is in line with the findings of Muhammad et al*.* [8], Singh et al. [9] and Meena et al. (2014) they reported that

Spinosad 45 SC was found most effective in reducing percent population reduction of greengram pod borer aswell as increasing the yield Indoxacarb 14.5 SC (1.467) is found to be the next best treatment which is in line with the findings of Rashid et al. [10], Singh et al. [11] and Babariya et al. [3].

The result of *Bacillus thuringiensis* 4% WSP (1.822) is found to be least effective which is in support with Kumar et al. [12] and Fite [13]. *Beauveria bassiana* 1.15% WP (1.989) is found to be least effective but comparatively superior over the control, these findings are supported by Choudhary et al. (2017) and Mahajan et al. [7]. Neem oil 2% (2.134) is found to be the maximum larval population among all treatment which is in line with the findings of Moraly et al. [14] and Chandra et al (2018).

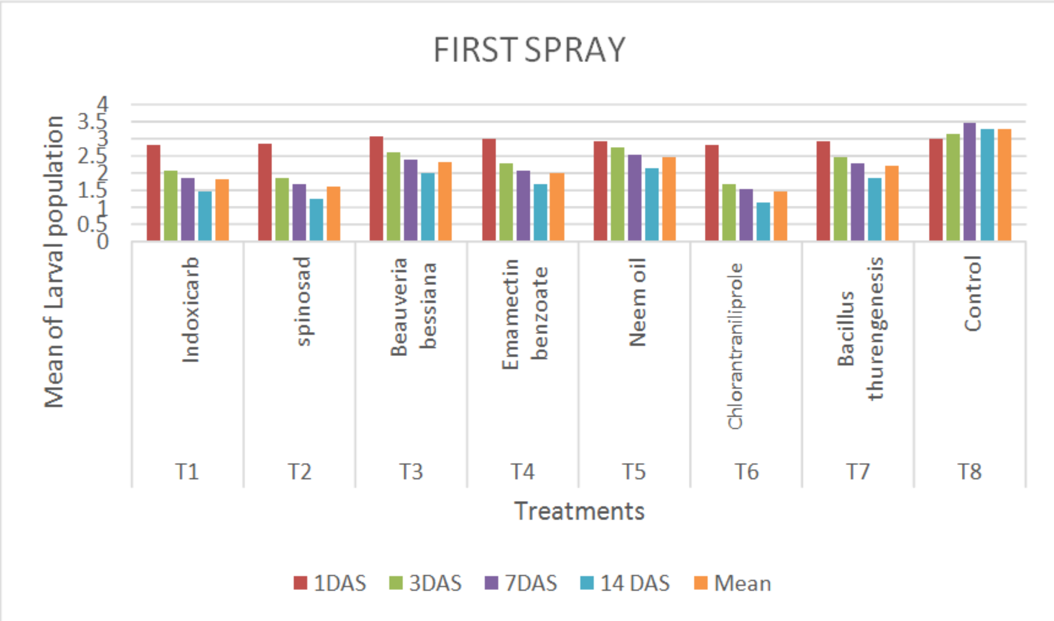


**Fig. 1. Efficacy of bio pesticides and chemicals on the larval population of podborer *H.armigera* on green gram (first spray)**

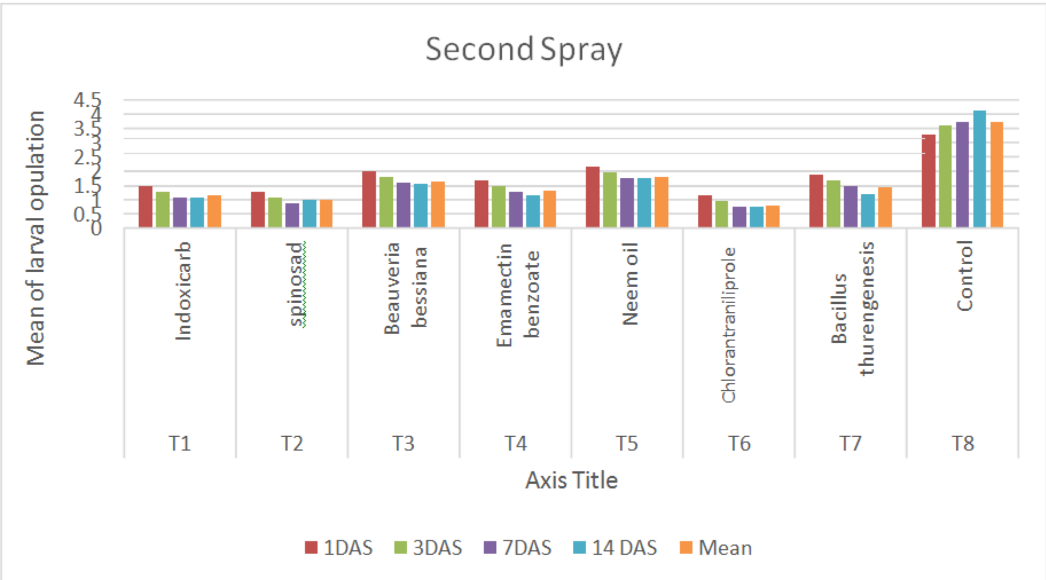


**Fig. 2. Efficacy of bio pesticides and chemicals on the larval population of podborer *H.armigera* on green gram (second spray)**

**Table 1. Efficacy of bio pesticides and chemicals on the larval population of pod borer *H. armigera* on green gram (Meanof first and second Spray) and Yeild and B:C Ratio**

| S. no. | Treatments | Number of larval population per 5 plants | | | | | | | | | Overall mean | Yield (q/ha) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dosage | First spray | | | | Second spray | | | | | | |
| | | | 1DBS | 3DAS | 7DAS | 14DAS | 1DBS | 3DAS | 7DAS | 14DAS | | | |
| $T_1$ | Indoxacarb 14.5% SC | 1 ml/L | 2.800 | 2.067 | 1.867 | 1.467 | 1.467 | 1.267 | 1.067 | 1.067 | 1.467 | 15.7 | 1:3.94 |
| $T_2$ | Spinosad 45%SC | 0.5 ml/L | 2.867 | 1.867 | 1.667 | 1.267 | 1.267 | 1.067 | 0.867 | 1.000 | 1.289 | 16.3 | 1:3.99 |
| $T_3$ | *Beauveria bassiana 1.15% WP 1×10$^8$ CFU* | 5 gm/L | 3.067 | 2.600 | 2.400 | 2.000 | 2.000 | 1.800 | 1.600 | 1.533 | 1.989 | 12.2 | 1:3.18 |
| $T_4$ | Emamectin benzoate 5% SG | 0.4 ml/L | 3.000 | 2.267 | 2.067 | 1.667 | 1.667 | 1.467 | 1.267 | 1.133 | 1.645 | 13.4 | 1:3.59 |
| $T_5$ | Neem oil 2% | 2 ml/L | 2.933 | 2.733 | 2.533 | 2.133 | 2.133 | 1.933 | 1.733 | 1.733 | 2.134 | 13.7 | 1:3.52 |
| $T_6$ | Chlorantraniliprole 18.5%SC | 0.5 ml/L | 2.800 | 1.667 | 1.533 | 1.133 | 1.133 | 0.933 | 0.733 | 0.733 | 1.122 | 16.9 | 1:4.13 |
| $T_7$ | *Bacillus thuringiensis* 1×10$^8$ CFU | 2 gm/L | 2.933 | 2.467 | 2.267 | 1.867 | 1.867 | 1.667 | 1.467 | 1.200 | 1.822 | 12.5 | 1:3.39 |
| $T_8$ | Control | …. | 3.000 | 3.133 | 3.467 | 3.267 | 3.267 | 3.600 | 3.733 | 4.133 | 3.500 | 4 | 1:1.19 |
| | F-test | | NS | S | S | S | S | S | S | S | S | ….. | ….. |
| | S. Ed (±) | | 6.756 | 2.707 | 4.441 | 4.000 | 4.000 | 6.162 | 10.338 | 16.333 | 14.799 | ….. | ….. |
| | C.D. (P = 0.5) | | _ | 0.111 | 0.173 | 0.130 | 0.130 | 0.185 | 0.282 | 0.448 | 0.655 | ….. | ….. |

*Note: *DBS (Day Before Spray) *DAS (Day After Spray) *B:C Ratio (Benefit Cost Ratio)*

The increased percent yield over control treatment was different. All the treatments were superior over control. The highest increased yield over control was recorded in Chlorantraniliprole 18.5SC (16.9 q/ha) followed by Spinosad 45SC (16.3q/ha), Indoxacarb 14.5 SC (15.7 q/ha), Neem oil 2% (13.7 q/ha), Emamectin benzoate (13.4 q/ha), *Bacillus thuringiensis* 4% WSP (12.5 q/ha) and *Beauveria bassiana* 1.15% WP (12.2 q/ha).

When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5SC (1:4.13) followed by Spinosad 45SC (1:3.99), Indoxacarb 14.5 SC (1:3.94), Neem oil 2% (1:3.52), Emamectin benzoate (1:3.59), *Bacillus thuringiensis* 4% WSP (1:3.39), *Beauveria bassiana* 1.15% WP (1:3.18), as compared to control plot (1:1.19). These findings are supported by Cherry [15] Singh et al. [11], Babariya et al. [3], Rashid et al. [10], Rahman et al*.* [6] and Vikrant et al*.* [16-19].

## 4. CONCLUSION

From the critical analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5SC is more effective in controlling larval population of green gram pod borer followed by Spinosad 45SC, Indoxacarb 14.5 SC, Neem oil 2%, Emamectin benzoate in managing green gram podborer. Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5SC gave the cost benefit ratio of (1:4.13) and marketing yield of (16.9 q/ha) followed by Spinosad 45SC ( 1:3.99 and 16.3q/ha), Indoxacarb 14.5 SC (1:3.94 and 15.7 q/ha), Neem oil 2% (1:3.52 and 13.7 q/ha), Emamectin bengate (1:3.59 and 13.4 q/ha), *Bacillus thuringiensis* 4% WSP (1:3.39 and 12.5 q/ha), *Beauveria bassiana* 1.15% WP (1:3.18 and 12.2 q/ha), as compared to control plot (1:1.19 and 4 q/ha). Hence this can be a part of integrated pest management in order to avoid indiscriminate use of pesticides for ecofriendly management and to balance flora and fauna from the ecosystem which causes pollution in the environment and also it was less harmful to beneficial insects and human beings. Respectively as such more trials are required in the future to validate the findings.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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