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Field Efficacy and Economics of Selected Insecticides and Bio-pesticides against Chickpea Pod Borer [*Helicoverpa armigera* (Hubner)] on Chickpea (*Cicer arietinum* L.) at Prayagraj

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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

At the Central Research Farm of Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, an experiment on chickpea was carried out to test the "Field efficacy and economics of selected insecticides and bio-Pesticides against chickpea pod borer [*Helicoverpa armigera* (Hubner)] on chickpea (*Cicer arietinum* L.) at Prayagraj" during *rabi* season of 2022-2023. Effectiveness of biopesticides and insecticides *viz*., T1 Chlorantraniliprole 18.5% SC 0.5ml ml/lit of water, T2 Emamectin benzoate 5% SG 0.4 gm/lit of water, T3 Novaluron 10% EC 1.5 ml/lit of water, T4 Spinosad 45% SC 0.5 ml/lit of water, T5 *Beauveria bassiana* WP 5 gm/lit of water, T6 Nisco

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sixer plus 1ml/lit of water and T7 Neem oil 5% @ 5 ml/lit of water and treatment of T8 Untreated control were tested against chickpea pod borer *Helicoverpa armigera* (Hubner). The different insecticides and biopesticides treatments revealed that all the treatments were superior over control, T1 Chlorantraniliprole 18.5% SC (0.66) which found most effective followed by T2 Emamectin benzoate 5% SG (0.87), T4 Spinosad 45% SC (0.98), T3 Novaluron 10% EC (1.11), T6 Nisco sixer plus (1.30), T5 *Beauveria bassiana* WP (1.48), T7 Neem oil 5% (2.15) and T8 Untreated control (6.02). The crop with the highest average yield, T_1 Chlorantraniliprole 18.5% SC, produced 22.01 q/ha, and its cost-benefit ratio was 1:2.26. followed by T2 Emamectin benzoate 5% SG (21.09 q/ha) with 1:2.55 C:B ratio, T4 Spinosad 45% SC (19.75 q/ha) with 1:2.32 C:B ratio, T3 Novaluron 10% EC (17.5 q/ha) with 1:2.14 C:B ratio, T6 Nisco sixer plus (16.16 q/ha) with 1:2.02 C:B ratio, T5 *Beauveria bassiana* WP (13.29 q/ha) with 1:1.72 C:B ratio, T7 Neem oil 5% (13.03 q/ha) with 1:1.67 C:B ratio and T_8 Control (9.5 q/ha) with 1:1.29 C:B ratio.

Keywords: Biopesticides; chickpea; cost benefit; efficacy; Helicoverpa armigera; insecticides.

1. INTRODUCTION

In the Fabaceae family, the chickpea (*Cicer arietinum*) is a historically self-pollinated leguminous plant. Chickpea is mostly grown in soils that are poor in fertility and moisture retention capacity. The most significant pulse crop grown in India during the *Rabi* season is the gram, also known as chickpea, Bengal gram or garbanzo. In India it is also known as "King of pulses". It is the third most significant legume food in the world and is currently grown on about 11 million hectors, 96% of which are in developing nations [1].

There is a growing demand for chickpea due to its nutritional value. In the semi-arid tropics, chickpea is an important component of the diets of those individuals who cannot afford animal proteins or those who are vegetarian by choice. Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass [2] in comparison with other pulses. Chickpea is cholesterol free and is a good source of dietary fibre (DF), vitamins and minerals [3].

India is the principal producer and consumer of chickpeas in the globe with cultivable area of 9.68 million hectares and 11.08 million tons of production and 1142 kg/ha productivity [4].

To boost up the production of chickpea, one of the most practical resorts of increasing chickpea production is to minimize losses caused by the biotic constraints, which include insect-pests, diseases and weeds under field conditions. Among the prevalent biotic factors about 36 different species of insect pests has been reported to attack chickpea during different growth stages of the crop in India [5]. Among these Gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is a major and prominent pest in different chickpea growing areas of the country [6] and it is considered as major cause for low production of the crop [7]. Further, it is very serious pest and assumed a status of national pest in India with its nature of damage on various crops and feeding habits [8]. The gram pod borer, *Helicoverpa armigera* is a potential and polyphagous pest, with various characteristic features like high fecundity, migratory behaviour, high adaptations to various agro-climatic conditions and development of resistance to various insecticides, extensively damaging many crops including chickpea [9]. Further, in recent times *Helicoverpa armigera* developed resistance to various insecticides and became acute in India. The caterpillar not only defoliates the tender leaves but also makes holes in the pods and feed upon the developing seeds the anterior body portion of the caterpillar remains inside the pod and rest half or so hanging outside. When seeds of one pod are finished, it moves to the next. Unless the pest is controlled in the initial stages of infestation it takes the heavy toll of the crop [10].

2. MATERIALS AND METHODS

In order to control pest chickpea pod borer, present experiment was conducted in Randomized block design (RBD) with 3 replications and 8 treatments including control in each replication at the Central Research Farm of Sam Higginbottom University of Agriculture, Technology And Sciences, Naini, Prayagraj, Uttar Pradesh, during the *rabi* season of 2022-23. The chick pea seeds (shulab-45) were planted in a 2 × 1 m plot in November with a 30 x 10 cm spacing. Treatments *viz.,* Chlorantraniliprole 18.5% SC, Emamectin

benzoate 5% SG, Novaluron 10% EC, Spinosad 45% SC, *Beauveria bassiana* WP, Nisco sixer plus, Neem oil 5% and Untreated control. The entire agronomic package of procedures advised for successful crop cultivation was followed. Five plants from each plot will be randomly chosen and tagged after 69 days of sowing. With the exception of the untreated check, all treatments received two sprays, the first at 107 days and the second at 15 days after first spray. Observation of larval population was recorded at day before and 3rd, 7th, 14th day after spraying. Mean larval population was calculated by following formula:

Mean larval population = Total number of larva / Total number of plants

At 15 days after physiological maturity, the crop from each net plot was harvested separately, packaged, and labelled. Each plot's harvest was threshed separately. Each net plot's seed yield was weighed individually. Yield of seeds was measured and given in q/ha. The Benefit: cost ratio was calculated by the following formula:

Benifit: Cost ratio = Gross Returns / Total cost of cultivation

Where the total yield was multiplied by the market price of the produce to determine gross returns. The cost of cultivation and the cost of treatments were added to determine the total cost of cultivation.

3. RESULTS AND DISCUSSION

The data on population of *Helicoverpa armigera* over control on mean (3,7 and 14 days after spraying) 1st spray revealed that all the treatments were significantly superior over T_8 control (5.08). Among all the treatments lowest larval population was recorded in T_1 Chlorantraniliprole 18.5% SC (0.93) followed by T_2 Emamectin benzoate 5% SG (1.17), T_4 Spinosad 45% SC (1.28), T_3 Novaluron 10% EC (1.39), T_6 Nisco sixer plus (1.53), T_5 *Beauveria bassiana* WP (1.75) and T_7 Neem oil 5% (2.44).

The data on population of *Helicoverpa armigera* over control on mean (3,7 and 14 days after spraying) 2nd spray revealed that all the treatments were significantly superior over T_8 control (6.96). Among all the treatments lowest larval population of infestation was recorded in T_1 Chlorantraniliprole 18.5% SC (0.39), followed by T_2 Emamectin benzoate 5% SG (0.57), T_4 Spinosad 45% SC (0.68), T_3 Novaluron 10% EC (0.84), T_6 Nisco sixer plus (1.08), T_5 *Beauveria bassiana* WP (1.22) and T_7 Neem oil 5% (1.86).

The data revealed on population of *Helicoverpa armigera* over control on overall mean revealed that all the treatments were significantly superior over T_8 control (6.02). Among all the treatments minimum larval population was recorded in T_1 Chlorantraniliprole 18.5% SC (0.66) these findings are similar with Reddy and Kumar [11] with the result of 0.567 followed by T_2 Emamectin benzoate 5% SG (0.87) these findings are similar with Chaukikar et al. [12] with the result of 0.835, T_4 Spinosad 45% SC (0.98) these findings are lined with Reddy and Kumar [11] with the result of 1.11, T_3 Novaluron 10% EC (1.11) these findings are closed with Chitralekha et al. [13] with the result of 1.20, T_6 Nisco sixer plus (1.30) these findings are similar with Reddy and kumar [11] with the result of 1.311, T_5 *Beauveria bassiana* WP (1.48) these findings are similar Vijaykumar et al. [14] with the result of 1.96 and T_7 Neem oil 5% (2.15) these findings are closed with Santhosh and Kumar [15] with the result of 2.15.

The yields among the treatments were significant. The highest yield was recorded in T_1 chlorantraniliprole 18.5% SC (22.01 q/ha) these findings are similar with Hanumanth and kumar [16] with the result of 21.40 q/ha followed by T_2 Emamectin benzoate 5% SG (21.09 q/ha) these findings are similar with Chaukikar et al. [12] with the result of 21.88 q/ha, T_4 Spinosad 45% SC (19.75 q/ha) these findings are lined with Macchindra and Kumar [17] with the result of 18.5 q/ha, T_3 Novaluron 10% EC (17.5 q/ha) these findings are closed with Chitralekha et al. [13] with the result of 15.58 q/ha, T_6 Nisco Sixer Plus (16.16 q/ha) these findings are similar with Reddy and Kumar [11] with the result of 16.50 q/ha, T_5 *Beauveria bassiana* WP (13.29 q/ha) these findings are similar with Barwa and kumar [4] with the result of 14.83 q/ha and T_7 Neem oil 5% (13.03 q/ha) these findings are closed with Barwa and Kumar [4] with the result of 12.08 q/ha.

Table 1. Effect of selected insecticides and bio-pesticides against larval population of *Helicoverpa armigera,* chickpea yield and C:B ratio

	Treatments	Dose	Population of *Helicoverpa armigeral* 5 plants									Overall mean	Grain yield (q/ha)	C:B Ratio
			First spray					Second spray						
			1 DBS	3DAS	7DAS	14DAS	Mean	3DAS	7DAS	14DAS	Mean			
T_1	Chlorantraniliprole18.5% SC	0.5 ml/lit	2.73 (1.65)*	1.13^{f} (1.06)*	0.73^{f} (0.85)*	0.93^{f} (0.96)*	0.93^{d} (0.96)*	0.80^{f} (0.89)*	0.13^{e} (0.79)*	0.26^{f} (0.50)*	0.39^{c} (0.58)*	0.66	22.01	1:2.60
T_2	Emamectin benzoate 5% SG	0.4 gm/lit	2.80 (1.67)*	1.40^{ef} (1.18)*	0.93^{ef} (0.95)*	1.20^{ef} (1.09)*	1.17^{cd} (1.08)*	0.86^{f} (0.93)*	0.33^{de} (0.91)*	0.53^{ef} (0.72)*	0.57^{c} (0.74)*	0.87	21.09	1:2.55
T_3	Novaluron 10% EC	1.5 ml/lit	2.73 (1.65)*	1.66^{de} (1.29)*	1.06^{cde} (1.03)*	1.46^{de} (1.21)*	1.39^{cd} (1.17)*	1.13^{de} (1.06)*	0.53^{d} (1.01)*	0.86^{cd} (0.93)*	0.84^{c} (0.90)*	1.11	17.5	1:2.14
T_4	Spinosad 45% SC	0.5 ml/lit	2.80 (1.67)*	1.60^{de} (1.26)*	1.00^{def} (1.00)*	1.26^{de} (1.12)*	1.28^{cd} (1.12)*	0.93^{ef} (0.96)*	0.46^{d} (0.98)*	0.66^{de} (0.81)*	0.68^{c} (0.81)*	0.98	19.75	1:2.32
T_5	*Beauveria bassiana* WP	5 gm/lit	2.66 (1.63)*	2.06^{c} (1.43)*	1.33^{c} (1.15)*	1.86^{c} (1.36)*	1.75^{c} (1.31)*	1.60^{c} (1.26)*	0.93^{c} (1.19)*	1.13^{c} (1.06)*	1.22^{bc} (1.09)*	1.48	13.29	1:1.72
T_6	Nisco sixer plus	1 ml/lit	2.80 (1.67)*	1.80^{cd} (1.34)*	1.26^{cd} (1.12)*	1.53^{d} (1.23)*	1.53^{cd} (1.23)*	1.33^{d} (1.15)*	0.86^{c} (1.16)*	1.06^{c} (1.03)*	1.08^{bc} (1.03)*	1.30	16.16	1:2.02
T_7	Neem oil 5%	5 ml/lit	2.86 (1.69)*	2.73^{b} (1.65)*	2.00^{b} (1.41)*	2.60^{b} (1.61)*	2.44^{b} (1.56)*	2.20^{b} (1.48)*	1.60^{b} (1.44)*	1.80^{b} (1.34)*	1.86^{b} (1.36)*	2.15	13.03	1:1.67
T_8	Control	-	2.53 (1.59)*	4.26^{a} (2.06)*	5.33^{a} (2.30)*	5.66^{a} (2.37)*	5.08^{a} (2.25)*	5.93^{a} (2.43)*	6.70^{a} (2.68)*	8.26^{a} (2.87)*	6.96^{a} (2.63)*	6.02	9.5	1:1.29
F-Test			NS	S	S	S	S	S	S	S	S	S	-	-
S.Ed (±)			0.12	0.15	0.13	0.15	0.28	0.12	0.15	0.14	0.39	0.33	-	-
C.D. at 0.05%			-	0.33	0.28	0.32	0.60	0.26	0.32	0.30	0.84	0.72	-	-

DBS = Day before Spaying; DAS = Day After Spaying; S= Significant; NS= Non Significant

**Figures are in parenthesis of square root transformation value*

When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the best and most economical treatment is T_1 Chlorantraniliprole 18.5% SC (1:2.60) followed by T_2 Emamectin benzoate 5% SG (1:2.55) these findings are similar with Hanumanth and kumar [16] with the results of 1:2.81 and 1:2.47 respectively, T_4 Spinosad 45% SC (1:2.32) these findings are lined with Shekhara [18] with the result of 1:2.36, T_3 Novaluron 10% EC (1:2.14) these findings are closed with Suneel et al. [19] with the result of 1:2.53, T_6 Nisco sixer plus (1:2.02) these findings are similar with Hanumanth and kumar [16] with the result of 1:2.28, T_5 *Beauveria bassiana* WP (1:1.72) and T_7 neem oil 5% (1:1.67) are similar with Barwa and Kumar [4] with the result of 1:2.02 and 1:1.64 respectively [20].

4. CONCLUSION

From the above discussion, it was found that, spraying of insecticides significantly reduced the pod borer population in chickpea. It concludes that the new generation insecticides like Chlorantraniliprole, Emamectin benzoate, Spinosad, novaluron along with Nisco Sixer Plus were found effective against lepidopteran caterpillar *Helicoverpa armigera* along with an additional yield level in chickpea.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sai KP, Tayde AR, Reddy RD, Srivastava VK. Management of gram pod borer Helicoverpa armigera (Hubner) in chickpea with bio-pesticides and combination. Journal of Entomology and Zoology Studies. 2021;9(1):561-563.
2. Chibbar RN, Ambigaipalan P, Hoover R. Molecular diversity in pulse seed starch and complex carbohydrates and its role in human nutrition and health. Cereal chemistry. 2010;87(4):342-352.
3. Wood JA, Grusak MA. Nutritional value of chickpea. Chickpea Breeding and Management. 2007;101-142.
4. Barwa J, Kumar A. Field efficacy of chlorantraniliprole with some biopesticides against pod borer [*Helicoverpa armigera* (Hubner)] on chickpea (*Cicer arietinum* L.). The Pharma Innovation Journal. 2022;1912-1916.
5. Nayar KK, Ananthakrishnan TN, David BV. General and Appliedentomology; 1976.
6. Begum N, Hossian M, Chowdhury SI. Effect of sowing date and plant density of pod borer incidence and grain yield of chickpea in Bangladesh. International Chickpea Newsletter. 1992;27:19-21.
7. Shrivastava CP, Shrivastava RP. Antibiosis in chickpea (*Cicearietinum*) to gram pod borer, *Helicoverpa armigera* (Hubner) (*Noctuidae Lepidoptera*) in India. Entomology. 1990;15:89-94.
8. Sachan JM, Katti G. Integrated Pest Management In: Proceeding of International Symposium on Pulse Research, April 2-6, IARI New Delhi, India. 1994;23-30.
9. Kambrekar DN, Kulkarni KA, Giraddi RS, Kulkarni JH, Fakrudin B. Management of chickpea pod borer, *Helicoverpa armigera* (Hubner) through Nuclear Polyhedrosis Virus Isolates. Precision Agriculture. 2009;10:450-457.
10. Kaur L, Sandhu JS, Gupta SK. Inter and Intra-accession variation for resistance to botrytis gray mold of chickpea in wild Cicer species. Indian Journal of Agricultural Sciences. 2007;77:786-788.
11. Reddy TJ, Kumar A. Evaluation of selected insecticides on the incidence of gram pod borer [*Helicoverpa armigera* (Hubner)] on chickpea. The Pharma Innovation Journal. 2022;11(9):418-422.
12. Chaukikar K, Bhowmick AK, Das SB, Marabi RS, Tomar VS. Bioefficacy of emamectin benzoate against *Helicoverpa armigera* (Hubner) and its natural enemies on chickpea (*Cicer arietinum*) crop. International Journal of Bio- resource and Stress Management. 2017;8(5):716-720.
13. Chitralekha G, Yadav S, Verma T. Efficacy of insecticides against Helicoverpa armigera on chickpea. Journal of Entomology and Zoology Studies. 2018;6(3):1058-1061.

14. Vijaykumar L, Anusha SB, Ashwini SB, Divya B. Bio-efficacy of Beauveria bassiana against gram pod borer, *Helicoverpa armigera* (Hubner) (*Noctuidae: Lepidoptera*) in chickpea. Journal of Pharmacognosy and Phytochemistry. 2022;11(2):197- 201.
15. Santhosh K, Kumar A. Comparative efficacy of selected insecticides and neem products against chickpea pod borer [*Helicoverpa armigera*(Hubner)]. The Pharma Innovation Journal. 2022;11(6):1558-1562.
16. Hanumant PA, 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.
17. Macchindra JP, Kumar A. Field efficacy and economics of different chemicals and biopesticides against pod borer, *Helicoverpa armigera* (Hubner) on chickpea during Rabi season. The Pharma Innovation Journal. 2022;11(7): 3970-3975.
18. Shekhara GVC, Kumar A, Lavanya V, Rehaman SK. Efficacy of certain chemicals and neem products against Helicoverpa armigera (Hubner) on chickpea (*Cicer arietinum* L.). Journal of Entomology and Zoology Studies. 2017;5(2):01- 05.
19. Suneel GV, Sarada O. Field efficacy and economics of some new insecticide molecules against lepidopteran caterpillars in chickpea. Current Biotica. 2015;9(2): 153-158.
20. AICRP. Project Co-ordinator's Report, AICRP on Chickpea, 16-17, August, 2021. 2021;24-25.

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