"Field efficacy of selected insecticides and bio-pesticides against chickpea pod borer[*Helicoverpa armigera* (Hubner)] on chickpea (*Cicer arietinum* L.) at prayagraj"

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 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. Effectiveness of biopesticides and insecticides *viz.*, T_1 Chlorantraniliprole 18.5% SC 0.5ml ml/lit of water, T_2 Emamectin benzoate 5% SG 0.4 gm/lit of water, T_3 Novaluron 10% EC 1.5 ml/lit of water, T_4 Spinosad 45% SC 0.5 ml/lit of water, T_5 *Beauveria bassiana* WP 5 gm/lit of water, T_6 Nisco sixer plus 1ml/lit of water and T_7 Neem oil 5% @ 5 ml/lit of water and treatment of T_8 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, T_1 Chlorantraniliprole 18.5% SC (0.66) which found most effective followed by T_2 Emamectin benzoate 5% SG (0.87), T_4 Spinosad 45% SC (0.98), T_3 Novaluron 10% EC (1.11), T_6 Nisco sixer plus (1.30), T_5 *Beauveria bassiana* WP (1.48), T_7 Neem oil 5% (2.15) and T_8 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 1.26.followed by T_2 Emamectin benzoate 5% SG (21.09 q/ha) with 1:2.55 C:B ratio, T_4 Spinosad 45% SC (19.75 q/ha) with 1:2.32 C:B ratio, T_3 Novaluron 10% EC (17.5 q/ha) with 1:2.14 C:B ratio, T_6 Nisco sixer plus (16.16 q/ha) with 1:2.02 C:B ratio, T_5 *Beauveria bassiana* WP (13.29q/ha) with 1:1.72 C:B ratio, T_7 Neem oil 5% (13.03 q/ha) with 1:1.67 C:B ratio and T8 Control(9.5 q/ha) with 1:1.29 C:B ratio.

KEYWORDS: biopesticides, chickpea, cost benefit, efficacy, *Helicoverpa armigera*, insecticides.

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 **(Sai *et al.*, 2021)** [14].

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 **(Chibbar *et al*., 2010)** [5] in comparison with other pulses. Chickpea is cholesterol free and is a good source of dietary fibre (DF), vitamins and minerals **(Wood *et al*., 2007)** [19].

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 **(AICRP on Chickpea, 2021)** [1].

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 **(Nayer *et al*., 1982)** [10]. Among these Gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is a major and prominent pest in different chickpea growing areas of the country **(Begum *et al*., 1992)**[3] and it is considered as major cause for low production of the crop **(Shrivastava and Shrivastava, 1990)** [15]. 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 **(Sachan and Katti, 1994)** [12]. 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 **(Kambrekar *et al*., 2009)** [8]. 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.

MATERIALS AND METHODS

The present experiment was conducted at the Central Research Farm of Sam Higginbottom University of Agriculture, Technology And Sciences, Naini, Prayagraj, Uttar Pradesh, during the *rabi* season of 2022. And experiment was carried out in Randomized block design (RBD) with 3 replications and 8 treatments including control in each replication. The chick peaseeds (shulab-45) were planted in a 2 × 1 m plot in november with a 30 x 10 cm spacing. 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

$$\text{Mean larval population} = \frac{\text{Total number of larva}}{\text{Total number of plants}}$$

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

$$\text{Benifit: Cost ratio} = \frac{\text{Gross Returns}}{\text{Total cost of cultivation}}$$

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.

RESULT 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 (6.96). 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 (2022)[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.* (2017)[4]** with the result of 0.835, T_4 Spinosad 45% SC (0.98) these findings are lined with **Reddy and kumar (2022)[11]** with the result of 1.11, T_3 Novaluron 10% EC (1.11) these findings are closed with **Chitralekha *et al.* (2017)[6]** with the result of 1.20, T_6 Nisco sixer plus (1.30) these findings are similar with **Reddy and kumar (2022)[11]** with the result of 1.311, T_5 *Beauveria bassiana* WP (1.48) these findings are similar **Vijaykumar *et al.* (2021)[18]** with the result of 1.96 and T_7 Neem oil 5% (2.15) these findings are closed with **Santhosh and Kumar (2022)[14]** 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 (2022)[7]** 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.* (2017)[4]** 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 (2022)[9]** 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.* (2017)[6]** 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 (2022)[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 (2022)**[2] 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 (2022)**[2] with the result of 12.08 q/ha.

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 (2022)**[7] 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 (2017)**[15] with the result of 1:2.36, T_3 Novaluron 10% EC (1:2.14) these findings are closed with **Suneel *et al.* (2015)**[17] with the result of 1:2.53, T_6 Nisco sixer plus (1:2.02) these findings are similar with **Hanumanth and kumar (2022)**[7] 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 (2022)**[2] with the result of 1:2.02 and 1:1.64 respectively.

Table.1. Effect of selected insecticides and bio-pesticides against larval population of *Helicoverpa armigera*

	Treatments	Dose	Population of *Helicoverpa armigera*/ 5 plants									Overall mean
			First spray					Second spray				
			1 DBS	3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean	
T_1	Chlorantraniliprole 18.5% 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
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
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
T_4	Spinosad 45% SC	0.5 ml/lit	2.80 (1.67)*	1.60^{de} (1.26)*	1.00^{ef} (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
T_5	*Beauveria bassiana* WP	5.0 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
T_6	Nisco sixer plus	1.0 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
T_7	Neem oil 5%	5.0 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
T_8	Control	-	2.5 (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
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

Figure:1. Efficacy of selected insecticides and bio-pesticides on larval population of *H. armigera* during *rabi* season, 2022-2023

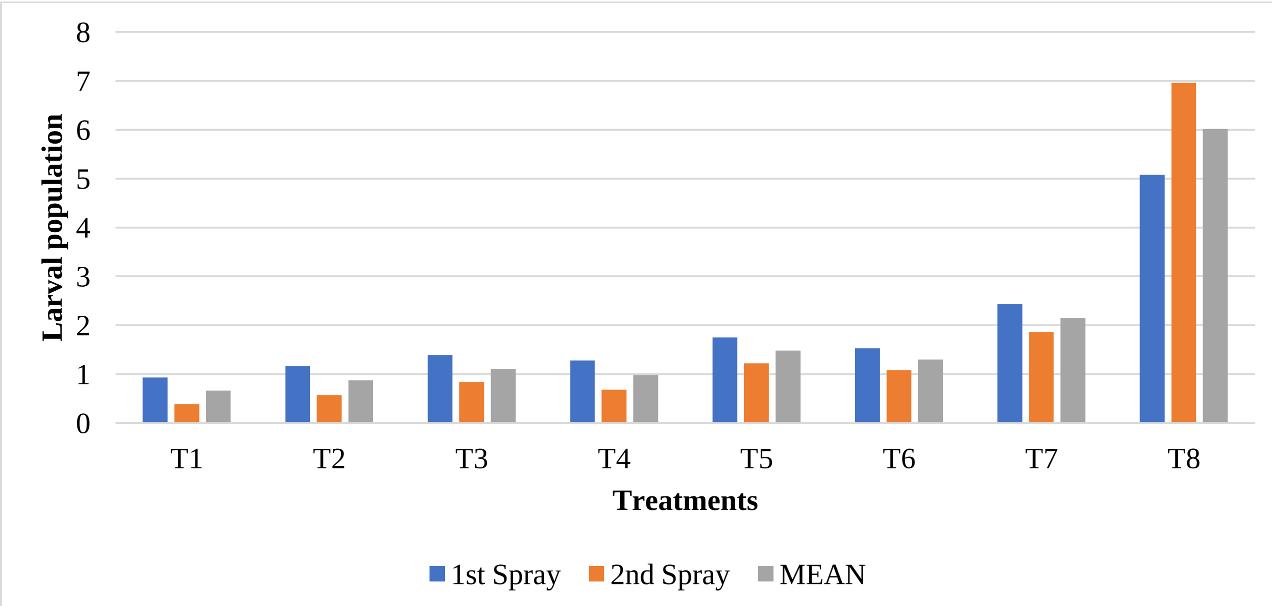

Table 2: Economics of cultivation

S.NO	Treatment	Yield (q/ha)	Cost of yield (₹/q)	Gross returns (₹)	Common cost of cultivation (₹)	Cost of treatment (₹)	Total cost of cultivation (₹)	C:B Ratio
T_1	Chlorantraniprole 18.5% SC	22.01	5,500	1,21,055	40,220	6,185	46,405	1:2.60
T_2	Emamectin benzoate 5% SG	21.09	5,500	1,15,995	40,220	5,110	45,330	1:2.55
T_3	Novaluron 10% EC	17.5	5,500	96,250	40,220	4,600	44,820	1:2.14
T_4	Spinosad 45% SC	19.75	5,500	1,08,625	40,220	6,550	46,770	1:2.32
T_5	*Beauveria bassiana* WP	13.29	5,500	73,095	40,220	2,260	42,480	1:1.72
T_6	Nisco sixer plus	16.16	5,500	88,880	40,220	3,660	43,880	1:2.02
T_7	Neem oil 5%	13.03	5,500	71,665	40,220	2,610	42,830	1:1.67
T_8	Control	9.5	5,500	52,250	40,220	0	40,220	1:1.29

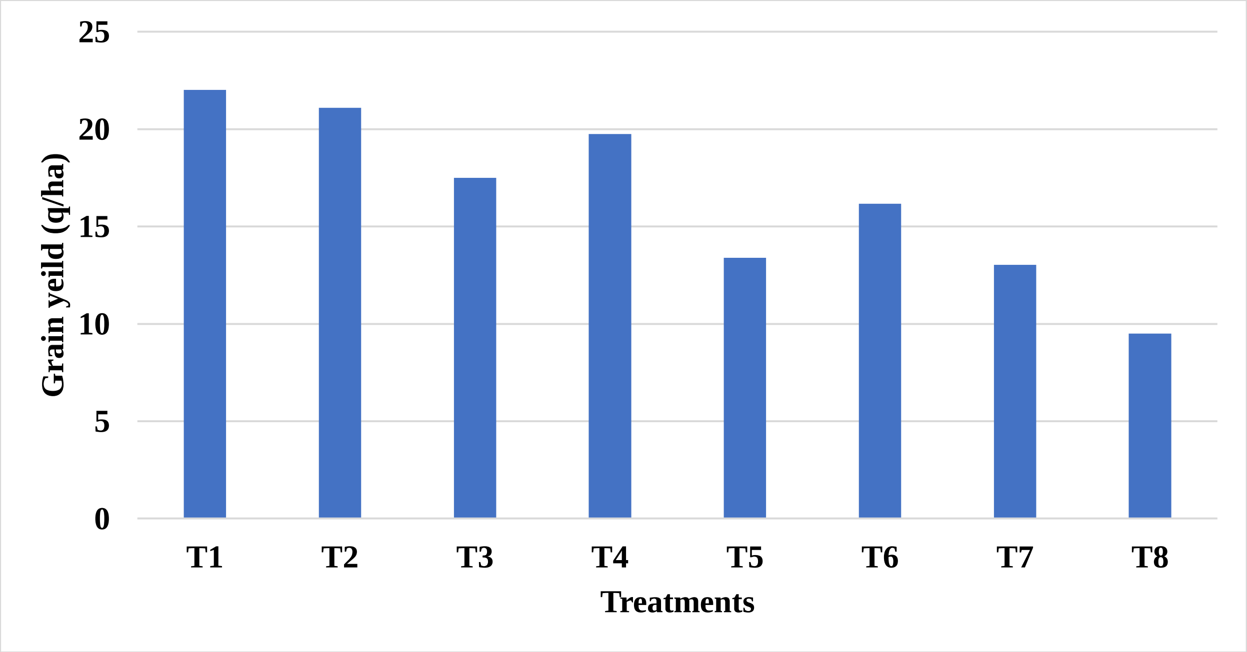

Figure:2. Influence of selected insecticides and bio-pesticides on yield of chickpea

CONCLUSION

From the above discussion, it was found that, spraying of insecticides significantly reduced thepod 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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