Original Research Article

Comparative efficacy of certain chemicals and Biopesticides against pod borer, *Helicoverpa armigera* (Hubner) on chickpea

Comment [D1]: Give space

ABSTRACT

The present field investigation was carried out in the Prayagraj district of Uttar Pradesh. The experiment was conducted in *rabi* 2021 -22 at Central Research Farm, SHUATS, Naini, Prayagraj. The field replicated in RBD with seven treatments and one control plot. To check the comparative efficacy of certain chemicals and biopesticides against pod borer, *Helicoverpa armigera* (Hubner) on chickpea. The result of the efficacy of treatments showed that both chemicals and Biopesticides are effective against pod borer even if they have slight percent larval reductions. The different chemicals and Biopesticide treatments reveal that the most effective population infestation of pod borer, was recorded in, Chlorantraniliprole (0.46) followed by Spinosad (0.80), Emamectin benzoate (01.13), NSKE (01.46), *Beauveria bassiana* (01.66), *Metarhizium anisiopilae* (02.00), *Bacillus thurenginesis* (02.26) and the highest population of Pod borer was found in Control T_0 (5.2). In another parameter higher yield and benefit cost ratio was recorded in chlorantraniliprole (18.89 q/ha and 1:2.21) followed by Spinosad (17.30 q/ha and 1:2.18), Emamectin Benzoate (15.80 q/ha and 1:2.14), NSKE (14.90 q/ha and 1:1.88), *Beauveria bassiana* (13.50 q/ha and 1:2.01), *Metarhizium anisiopilae* (11.63 q/ha and 1:1.50), *Bacillus thurenginesis* (9.80 q/ha and 1:1.62) as compared to control (7.42 q/ha and 1:2.01).

Keywords: Bio-Pesticides, Cost benefit ratio, Efficacy, *Helicoverpa armigera*, Insecticides

INTRODUCTION

Gram commonly known as chickpea or Bengal gram is the most important pulse crop of India. In India it is also known as **'King of pulses'** India is the largest producer with 75% of world acreage and production of gram. India produces 5.3 MT of chickpea from 6.67 million ha with an average production of 844 kg per ha. Chickpea is used for human consumption as well as for feeding to animals. Its seeds eaten as green vegetable, fried, roasted, as snack food and ground to obtain flour and dhal **(Pachundkar *et al.*, 2013)**. *H. armigera* is the major damaging pest in areas where chickpea is grown. The attack of this pest begins right from vegetative stage and continue up to maturity. Young larvae of *H. armigera* feeds on leaflets, buds, flowers and pods of chickpea **(Mandal and Roy, 2012)**. Gram pod borer, *Helicoverpa armigera*, is considered as a notorious pest of chickpea. It also attacks pigeon pea, moong bean, lentil, soybean, okra, maize, berseem, sunflower, sorghum, tobacco and tomato. Besides gram pod borer, it is also known as cotton bollworm, gram caterpillar, tomato fruit worm and tobacco bud worm **(Ullah *et al.* 2015)**. In recent years, various types of insecticides belonging to different chemical group were used as spray to manage the pest complex Use of chemical pesticides has resulted in immediate high returns to farmers. However, their heavy and extensive use has created various health and environmental problems. To avoid these problems, use of environmentally safer bio-pesticides is gaining momentum these days (**Kaur *et al*. 2007)**.

Comment [D2]: Additional refernces needed

MATERIAL AND METHODS

The experiment was conducted during *rabi* season 2021 at Cental Research Farm, SHUATS, Naini, Prayagraj, Uttar Pradesh, India, in a Randomized Block Design with seven treatments along with controlled plot replicated three times using variety Ankur - Chirag in a plot size of (2m×2m) at a spacing of (30×10cm) with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. The climate of the experimental site is sub-tropical characterized by normal rainfall.

The population of chickpea pod borer was recorded before 1-day before spraying and on 3rd day, 7th day and 14th day after insecticidal application. The populations of chickpea pod borer was recorded on 5 randomly selected and tagged plants from each plot. At each picking the total number of pods infested of five selected plants from each treatment replication wise was recorded.

The healthy marketable yield obtained from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during season of 2021-2022. The cost of botanicals used was obtained from nearby market. The total cost of plant

Comment [D3]: Specify the treatments 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 that of each sprayed treatment.

Comment [D4]: Concentration details mention here

RESULTS AND DISCUSSION

All the treatments were significantly superior to the untreated control in reducing the population of *Helicoverpa armigera* on chick pea crop in both of insecticidal application. The larval population recorded one day prior to the 1st spray was in a range of 4.06 to 4.8 / 5 plants (Table 1). After 3 days of spray, T_1Chlorantraniliprole was recorded minimum larval count of pod borer (*Helicoverpa armigera*) (2.26) followed by T_3 Spinosad (2.6), T_2 Emamectin Benzoate (3.06), T_4 NSKE (3.26), T_7 *Beauveria bassiana* (3.53), T_5 *Metarhizium anisiopilae* (3.66), *Bacillus thurenginesis* (4) and the highest population of Pod borer was found in Control T_0 (6.13).

A significant reduction in mean larval population was observed on 7th and 14th days after 1st spray. In all treated plots mean larval population was minimum in T_1 Chlorantraniliprole (1.86 and 1.73 respectively) followed by Spinosad 45 SC (2.06 and 1.93). The overall mean of larval population after first insecticidal spray was lowest in $T_{1,}$ Chlorantraniliprole 18.5% SC (1.95).

Over all mean analysis of 3rd, 7th and 14 days after 1st insecticidal application indicated that all the insecticidal treatments were significantly effective in reducing the larval population of *Helicoverpa armigera* as compared to untreated plots. Chlorantraniliprole (1.73%) was found significantly superior these findings are supported by **Chitralekha *et al.*, (2018)**. Followed by Spinosad (1.93) similar findings also reported in chickpea by **Nitharwal *et al.*, (2017).** Emamectin benzoate (57.74%) is the next best treatment for reducing the population of gram pod borer. Similar reports were made by **Turkhade *et.al* (2015).** The treatment was showed by T4 NSKE 0.15% (2.37) and the similar reported by **Kumar *et al.* (2018).** The next best was which is in line with findings of Devi **and Tayde (2017**) *Beauveria bassiana* (3.2). T_5 *Metarhizium* *anisiopilae* (3.26) was next best treatment. T_6 *Bacillus thurenginesis* (3.8) which are supported by **Harika *et al.* (2019**).

3^{rd} day after second spray, all the treatment were superior with control plots and differed significantly with each other. Among all the treatments T_1 Chlorantraniliprole was recorded minimum larval count of pod borer (*Helicoverpa armigera*) (1.0) followed by T_3 Spinosad (1.26), T_2 Emamectin Benzoate (1.60), T_4 NSKE (1.8), T_7 *Beauveria bassiana* (2.06), T_5 *Metarhizium anisiopilae* (2.60), T_6 *Bacillus thurenginesis* (2.73) and the highest population of Pod borer was found in Control T_0 (6.13). A significant reduction in mean larval population was observed on 7^{th} and 14^{th} days after 2^{nd} spray. In all treated plots mean larval population was minimum in T_1 Chlorantraniliprole (0.8 and 0.46 respectively) followed by Spinosad 45 SC (1.13 and 0.8). The overall mean of larval population after 2^{nd} insecticidal spray was lowest in $T_{1,}$ Chlorantraniliprole 18.5% SC (0.75).

14^{th} days after insecticidal application indicated that all the insecticidal treatments were significantly effective in reducing the larval population of *Helicoverpa armigera* as compared to untreated plots. Chlorantraniliprole (0.46) was found significantly superior these findings are supported by **Kumar and Sarada (2015)**. Followed by Spinosad (0.80) similar findings also reported in chickpea by**.** followed by NSKE (1.46) in controlling gram pod borer similar results are recorded by **Vikrant *et al.*, (2018).** The next best was *Beauveria bassiana* (1.66) which is in line with findings of. T_5 *Metarhizium anisiopilae* (2) was next best treatment. T_6 *Bacillus thurenginesis* (2.26) which are supported **Chandravanshi *et al.* (2019).**

The highest yield and cost benefit ratio was recorded in Chlorantraniliprole (18.89 q/ha) and (1:2.21) as respectively, followed by spinosad (17.30 q/ha) and (1:2.18) this result supported by **Khare *et al.* (2021),** followed by Emamectin Benzoate (15.80 q/ha) and (1:2.14), followed by *Beauveria bassiana* (1:2.01) this result is supported by **Carneiro *et al.* (2014)**. Followed by NSKE (14.90 q/ha) and (1:1.88) similar findings were supported by **Bhushan *et al.*, (2011).** The next superior was T_6 *Bacillus thurenginesis* (1:1.62) and *Metarhizium anisiopilae* (11.63 q/ha) and (1:1.50).

Table 1: Efficacy of insecticides, NSKE and bio-pesticides on Larval Population of Gram pod borer at different days interval

S.N0	Treatments	Larval Population of Gram pod borer at different days interval									Yield (q/ha)	B:C Ratio
		First Spray					Second Spray					
		1 DBS	3 DAS	7 DAS	14DAS	Mean	3 DAS	7 DAS	14DAS	Mean		
T_0	Control	4.33	06.13	06.53	6.8	6.48	6.93	7.13	7.33	7.13	7.42	1:1.22
T_1	Chlorantraniliprole 18.5% SC	4.06	03.26	01.86	1.73	1.95	01.00	0.8	0.46	0.75	18.89	1:2.21
T_2	Emamectin Benzoate 5% SG	4.26	3.06	02.26	2.00	2.44	1.6	1.26	1.13	1.33	15.80	1:2.14
T_3	Spinosad 45 SC	4.6	2.6	02.06	1.93	2.19	1.26	1.13	0.8	1.06	17.30	1:2.18
T_4	NSKE 5%	4.4	3.26	2.73	2.13	2.70	1.8	1.66	1.46	1.64	14.90	1:1.88
T_5	*Metarhizium anisiopilae*	4.8	3.66	3.4	3.26	3.44	2.6	2.33	02.00	2.31	11.63	1:1.50
T_6	*Bacillus thurenginesis*	4.46	4	3.66	3.8	3.82	2.73	2.53	2.26	2.50	9.80	1:1.62
T_7	*Beauveria bassiana 1.5% L.F*	4.46	3.53	3	3.2	3.24	2.06	1.86	1.66	1.86	13.50	1:2.01
	C.D.(5%)	-	**0.41**	**0.80**	**1.11**	**0.51**	**0.41**	**0.22**	**0.32**	**0.28**	….	….
	SE.d ±	-	**0.19**	**0.37**	**0.51**	**0.24**	**0.19**	**0.10**	**0.15**	**0.13**	….	….

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