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Comparative Efficacy and Economics of Selected Chemicals and Biopesticides against Pod Borer [*Helicoverpa armigera* (Hubner)] on Chickpea (*Cicer arietinum* L.)

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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

The research work was undertaken at Central Research Farm (CRF) Sam Higginbottom University of Agriculture Technology and Sciences, SHUATS, Naini, Prayagraj during winter Season of 2023-24. The treatments consists of eight including control *viz*, *Beauveria bassiana* 1.15% WP, Chlorantraniliprole 18.5 SC, Emamectin benzoate 5 SG, *Bacillus thuringiensis* 1x109 CFU/ml, Azadirachtin 00.03% WSP, NSKE 5%, Spinosad 45 SC and untreated control arranged in Randomized Block Design (RBD) with three replications targeting to evaluate the efficacy of

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selected insecticides on the larval population of *H. armigera* on Chickpea. The larval population of gram pod borer, *Helicoverpa armigera* on third, seven and fourteen days after spray revealed that among all the treatment Chlorantraniliprole 18.5 SC found superior with larval population of (1.05), and with highest cost benefit ratio (1:3.78), followed by Emamectin benzoate 5 SG with a larval population of (1.17) and cost benefit ratio (1:3.53), Spinosad 45 SC with a larval population of (1.24) and cost benefit ratio (1:3.16), *Beauveria bassiana* 1.15 % WP with a larval population of (1.32) and cost benefit ratio *(*1:3.00*), Bacillus thuringiensis* 1x109 CFU/ml with a larval population(1.35) and cost benefit ratio (1:2.76), Azadirachtin 00.03% WSP with a larval population(1.42) and cost benefit ratio (3.49, 1:2.25), NSKE 5% with a larval population (1.47) and cost benefit ratio (1:1.77), NSKE 5% was least effective among the treatments and control plot with a larval population (2.07) and cost benefit ratio (1:1.51).

Keywords: Biopesticides; chemicals; chickpea; cost benefit ratio; efficacy; Helicoverpa armigera.

1. INTRODUCTION

“Gram commonly known as a ‘chickpea’ or chana is a self-pollinating diploid (2n=2x=16) plant. It is originated in South-eastern Turkey and spread to other parts of the world. A very important pulse crop grows as a seed of a plant named *Cicer arietinum* (L.) in the Leguminosae family. According to De Candolle, “Chanaka” which is the Sanskrit name of chickpea gives the indication of being cultivated in India from a very long duration compared to other countries in the world” [1].

“India ranks first in the production and consumption of chickpea (*Cicer arietinum* L.) in the world. Chickpea is a most important pulse crop of India, which is mostly grown under dry land condition with heavy cloudy soil. It is a rich source of nutritional values in the diet of Indian people because of containing 21.5 per cent protein, 64.5 per cent carbohydrates and 4.5 per cent fat which is comparatively deficient in the cereals and oilseeds. The people in their daily meals use its green leaves and pods as green vegetables and germinated grains for breakfast and other delicious dishes”. [2].

“Several pests, mainly insects, attack chickpea. Sarwar, recorded “57 insect species, namely Lepidoptera as *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), commonly known as gram pod borer is a major polyphagous and noctuid pest in Asia, causing heavy damage to agricultural, horticultural and ornamental crops”. “In India, the extent of losses due to *H. armigera* in chickpea is up to 27.9 per cent in North West Plain Zone, 13.2 per cent in North East Plain Zone, 24.3 per cent in Central Zone and 36.4 per cent in South Zone. The crops have been noticed to suffer an avoidable loss of 9 to 60 per cent by this insect. In Uttar Pradesh, alone 15.3 per cent of the chickpea crop worth ₹.462.5 million is lost annually due to *H. armigera* attack, 17.2 per cent in Karnataka and 28.5per cent in Delhi: [3].

2. MATERIALS AND METHODS

The experiment was conducted at the experimental research plot of the Department of Entomology, Central Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences, during the winter season of 2023-24. The Research field is situated at 25°27 North Latitude 80°50East Longitudes and at an altitude of 98 meter above sea level. The climate is typically semi- arid and sub-tropical. The maximum temperature reaches up to 47°C in summer and drops down to 2.5°C in winter. The experimental design was Randomized Block Design with eight treatments, each replicated thrice. The plot size was (2m × 1m) with a spacing of (30×10 cm).The treatments included - *Beauveria bassiana* 1.15 % WP (Bevroz) , Chlorantraniliprole 18.5 SC (Coragen) , Emamectin benzoate 5 SG (Proclaim), *Bacillus thuringiensis* 1x10^9 CFU/ml (Thuricide), Azardirachtin 00.03% WSP (Neemaura), NSKE 5% (Neemicide), Spinosad 45 SC (Tracer), and a control.

The numbers of larva were counted on five randomly selected plants in each plot. The pre-treatment count was made a day before the spray whereas, the post-treatment counts were made on 3rd, 7th and 14th day after each spray. The larval population over control against gram pod borer was calculated by considering the mean of three observations recorded at 3rd ,7th, and 14th day after spray.

3. RESULT S AND DISCUSSION

3.1 Efficacy of *Helicoverpa armigera* after First Spray

3.1.1Third days after spraying

The data of gram pod borer (Table 1) after three spray days revealed that all treatments was significantly superior over the control. Among all the treatments, the lowest number of larval populations was recorded in Chlorantraniliprole 18.5 SC (1.40) found superior over other treatments followed by Emamectin benzoate (1.53), Spinosad 45 SC (1.60), *Beauveria bassiana* (1.67), *Bacillus thuringiensis* 1×10^{9} CFU/ml (1.67), Azardirachtin 00.03% WSP (1.80) and Neem seed kernel extract 5% (1.80) is found to be least effective among all the treatments as compared to control (2.00).

3.1.2 Sevan days after spraying

The data of gram pod borer (Table 1) after three spray days revealed that all treatments was significantly superior over the control. Among all the treatments, Chlorantraniliprole 18.5 SC (1.07) found superior over other treatments followed by Emamectin benzoate (1.13), Spinosad 45 SC (1.20), *Beauveria bassiana* (1.27), *Bacillus thuringiensis* 1×10^{9} CFU/ml (1.27), Azardirachtin 00.03% WSP (1.33) and Neem seed kernel extract 5% (1.40) is found to be least effective among all the treatments as compared to control (2.07).

3.1.3 Fourteen days after spraying

The data of gram pod borer(Table 1) after three spray days revealed that all treatments was significantly superior over the control. Among all the treatments, Chlorantraniliprole 18.5 SC (0.67) found superior over other treatments followed by Emamectin benzoate (0.87), Spinosad 45 SC (0.93), *Beauveria bassiana* (1.00), *Bacillus thuringiensis* 1×10^{9} CFU/ml (1.07), Azardirachtin 00.03% WSP (1.13), and neem seed kernel extract 5% (1.20) is found to be least effective among all the treatments as compared to the control (2.13).

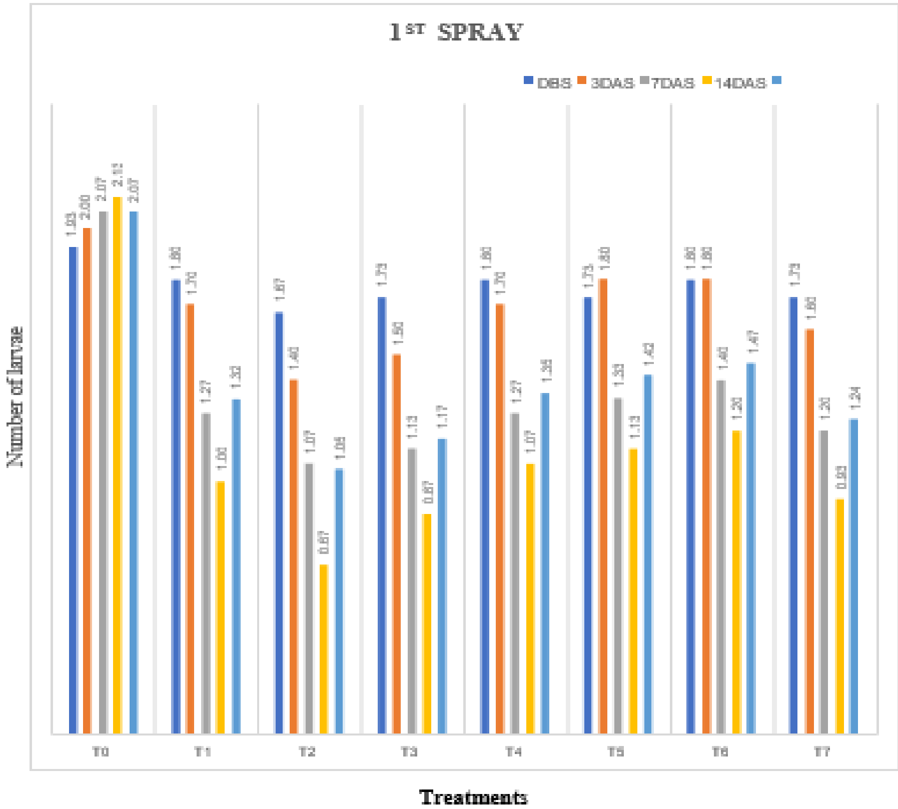

Fig. 1. Efficacy of selected chemicals and biopesticides against larval population of gram pod borer (*H. armigera*) on chickpea

Table 1. Effect of certain insecticides and biopesticides on the larval population of *Helicoverpa armigera* on chickpea during *rabi* season 2023: 24

Treatments		Number of larvae / 5 plants				
		1DBS	After spray			
			3rd Day	7th Day	14th Day	Mean
T_0	Control	1.93	2.00	2.07	2.13	2.07
T_1	*Beauveria bassiana* 1.15 % WP	1.80	1.70	1.27	1.00	1.32
T_2	Chlorantraniliprole 18.5 SC	1.67	1.40	1.07	0.67	1.05
T_3	Emamectin benzoate 5 SG	1.73	1.50	1.13	0.87	1.17
T_4	*Bacillus thuringiensis* 1x10^9 CFU/ml	1.80	1.70	1.27	1.07	1.35
T_5	Azardirachtin 00.03% WSP	1.73	1.80	1.33	1.13	1.42
T_6	NSKE 5%	1.80	1.80	1.40	1.20	1.47
T_7	Spinosad 45 SC	1.73	1.60	1.20	0.93	1.24
Overall Mean		1.77	1.69	1.34	1.13	1.39
F- test		NS	S	S	S	S
S. Ed. (±)			0.08	0.10	0.10	0.05
C. D. (P = 0.05)			0.185	0.228	0.224	0.255

Table 2. Economics of cultivation

Sr. No:	Treatment	Yield (q./ha.)	B:C ratio
T_0	Control	11.00	1:1.51
T_1	*Beauveria bassiana* 1.15% WP	22.50	1:3.00
T_2	Chlorantraniliprole 18.5 SC	29.10	1:3.78
T_3	Emamectin benzoate 5 SG	26.65	1:3.53
T_4	*Bacillus thuringiensis* 1x10^9 CFU/ml	21.24	1:2.76
T_5	Azardirachtin 00.03% WSP	17.08	1:2.25
T_6	NSKE 5%	13.50	1:1.77
T_7	Spinosad 45 SC	25.8	1:3.16

3.1.4 Overall mean of first spray

The data on the larval population of gram pod borer (Table 1) on mean (3rd, 7th, 14th DAS) days after spray revealed that all the treatments was significantly superior over control. Among all the treatments, Chlorantraniliprole 18.5 SC (1.05) found superior over other treatments followed by Emamectin benzoate (1.17), Spinosad 45 SC (1.24), *Beauveria bassiana* (1.32), *Bacillus thuringiensis* 1×10^{9}CFU/ml (1.35), Azardirachtin 00.03% WSP (1.42) and Neem seed kernel extract 5% (1.47) is found to be least effective among all the treatments as compared to control (2.07).

"The data on mean population after spray revealed that all the insecticides were found very effective and significantly superior over untreated control". [18] Among all the treatments minimum number of larvae were found in T2 Chlorantraniliprole 18.5 SC (1.05) as the similar findings was reported by [4,3] to control *Helicoverpa armigera* larval population. T3-Emamectin benzoate 5SG (1.17) was found the next effective treatment with larval population (1.17). Abbas *et al.,* [5,6] reported similar finding, for reducing the larval population of *Helicoverpa armigera*. T7-Spinosad 45 SC (1.24) was found the next best effective treatments which was similarly found by Ravicharan and Tayde [7] who reported Spinosad 45 SC to be the next best and effective treatment in controlling larval population , T1- *Beauveria bassiana* 1.15 WP (1.32) was found the next most effective treatment with the same findings was done by Sai et al. [8,9], T4-*Bacillus thuringiensis* 1×10^{9}CFU/ml was found the next best effective treatment with a larval population of (1.35) as the same findings was done by Abbas *et al*., [5] and Yerrabala et al., [10] T2 Azardirachtin 00.03% WSP was foundthe next effective treatment with a larval population of (1.42) as the same findings was done by Santosh and Kumar [11] and Gautam *et al*., [12] ,T6 NSKE 5% was found the least effective treatment with a larval population of (1.47) and the same findings was done by Machindra and Kumar [13].

When the cost benefit ratio worked out, interesting result was achieved. Among all the treatments the higher cost benefit ratio was obtained from T_2 Chlorantraniliprole 18.5 SC (1:3.78), as the similar findings was done by Barwa and Kumar [14] (1:3.35), Bhati et al., [3] (1:3.49), followed by the T_3 Emamectin benzoate 5SG exhibited a cost benefit ratio of (1:3.53) as the similar finding was done by Bhati et al, [3] (1:2.66), followed by T7 Spinosad 45 SC with a cost benefit ratio of (1:3.16) as the similar finding was done by Chandra et al., [15], (1:2.36), which was followed by T1 *Beauvria bassiana* which exhibited cost benefit ratio of (1:3.00) which was supported by the finding of by Anil and Kumar [16] (1:2.96), followed by T_4 *Bacillus thuringiensis* exhibited cost benefit ratio of (1:2.76) it was supported by Sireesha and Kumar [9] (1:3.39), which was followed by T5 Azardirachtin 00.03% WSP with a cost benefit ratio of (1:2.25) as the similar finding was done Santosh and Kumar [11] (1:2.41), Followed by T6 NSKE 5% which obtained a cost benefit ratio of (1:1.77) which was supported by Sharma and Tayde [17-18](1:1.75).

4. CONCLUSION

From research it was found that, spraying of insecticides significantly reduced the pod borer population in chickpea. The present findings conclude that the new generation insecticides like TI *Beauveria bassiana* 1.15 WP, T2 Chlorantraniliprole 18.5% SC, T3 Emamectin benzoate 5%SG, T4 Bacillus thuringiensis 1×10^9 CFU/ml, T5 Azadirachtin 00.03 WSP, T6 NSKE 5%, T7 Spinosad 45 SC. T2 Chlorantraniliprole was found effective against lepidopteran caterpillar *Helicoverpa armigera* along with an additional yield level in chickpea. Further, it was observed that the cost benefit ratio was also high with Chlorantraniliprole 18.5% SC, Emamectin benzoate 5 SG and Spinosad 45% SC. Hence, it is suggested that the effective insecticides may be alternated in harmony with the existing integrated pest management programs in order to avoid the problems associated with insecticidal resistance, pest resurgence.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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