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Efficacy of Selected Insecticides and Botanicals against the Infestation of Gram Pod Borer, *Helicoverpa armigera* Hub. on Chickpea, *Cicer arientinum* L.

Khanjan Das [a*], Anoorag R. Tayde [a], Suman Mohanty [a] and Pedamallu Saiteja [a]

[a] *Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj - 211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The present research was conducted at the Central Research Field of Department of Agricultural Entomology, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj during the Rabi season of 2021-22. The treatments used during the study were Metarhizium anisopliae, *Beauveria bassiana*, Karanj Oil, Neem Oil, Spinosad, Emamectin benzoate + Indoxacarb and Indoxacarb. The results revealed that highest percent reduction in larval population was observed in Emamectin benzoate 5% SG + Indoxacarb 14.5% SC (73.57%) and was most successful in bringing down the larval population. It is then followed by Spinosad 45% SC (65.03%), Indoxacarb 14.5% SC (59.02%), *Beauveria bassiana* (1x108 cfu) (54.87%), Metarhizium anisopliae (1x108 cfu) (50.92%), Neem Oil 2% (45.81%). While, Karanj Oil 2% prove to be the least effective treatment in reducing the larval population (37.53%).

Keywords: Benefit cost ratio; biopesticides; insecticides; pod borer; treatments; yield.

**Corresponding author: E-mail: khanjandas3@gmail.com;*

1. INTRODUCTION

Chickpea, *Cicer arientinum* (L.) belongs to the family Leguminosae (Fabaceae) [1] which is basically a diploid plant with 2n=2x=16 no. of chromosomes. Chickpea has its origin from South-eastern part of Turkey and which later spreaded to different regions of the world [2-7]. Chickpea or Bengal gram, commonly known as 'Chana' is also considered to be the third most important pulse crop around the world. However, India is also considered to be the highest producer of chickpea, thus attaining the title of 'king of pulses' [8]. Some of the most important chickpea producing countries are India, Turkey, Iran, Ethiopia, Myanmar, Pakistan, Australia, Canada, Mexico etc. It has been estimated that the cultivated area under the chickpea is around 10.91 million ha with an annual production and productivity of approximately 9.78 million tones and 929 kg/ha respectively [9]. Chickpea can be used both as nutritional leguminous food for human and feed for the cattle [10-14]. Moreover, the chickpea consumption can be linked to many health benefits such as affecting the markers of both metabolic syndrome and cardiovascular diseases in human as wells as animals [15].

Among the major pests attacking chickpea viz. *Helicoverpa armigera, Spodoptera litura, Plusia orichalchea, Agrotis ipsilon, Aphis cracivorea, Bemisia tabaci* etc., *Helicoverpa armigera* (Gram pod borer) causes more damage and yield losses to the crop [16]. The larval stage of gram pod borer is the most damaging one. The larva feeds on the flowers, pods, developing seeds and leaves of the chickpea plant. Gram pod borer causes an yield loss of about 200 million US dollar to chickpea and pigeon pea in India [17].

2. MATERIALS AND METHODS

The present experiment was carried out in Randomised Block Design replicated thrice at the Central Research Field of department of Entomology of SHUATS, Prayagraj during *rabi* 2021-22. The chickpea variety used in the experiment was 'Pusa 362'. The larval population count of *Helicoverpa armigera* on chickpea was accomplished by observing 5 randomly selected plants per plot at weekly intervals in each treatment. The mean larval population was worked out and the transform value was taken to analyze the data as per standard statistical methods. In order to know the most effective treatment in reducing the larval population percent larval reduction was worked out [18-24].

$$\text{Percent Larval Reduction} = [(C - T) / C] \times 100$$

Where,

C= Controlled Plot
T= Treated Plot

The desired concentration of insecticidal spray solution for each treatment was freshly prepared each and every time at the site of experiment, just before the start of spraying operations [25-31].

The spray solution of desired concentration was prepared by adopting the following formula:

$$V = \frac{(C \times A)}{\%\ a.i.}$$

Where,

V= Volume of a formulated pesticide required
C= Concentration required
A= Volume of the total solution to be prepared
% a.i. = Given Percentage strength of a formulated pesticide.

3. RESULTS AND DISCUSSION

The results obtained on the larval population of *Helicoverpa armigera* on third day after 1st spray revealed that Emamectin benzoate + Indoxacarb (220gm/ha + 0.2 ml/l) proved to be most effective in reducing the larval population by 71.59%, followed by Spinosad (0.5ml/l) 58.83%, Indoxacarb (1ml/l) 50.61%, *Beauveria bassiana* (2gm/l) 45.84%, *Metarhizium anisopliae* (5gm/l) 38.7%, Neem oil (2%) 37.57% and Karanj oil (2%) 29.32%. On seventh day after 1st spray, Emamectin benzoate + Indoxacarb showed the maximum larval reduction by 77.05%, followed by Spinosad (69.44%), Indoxacarb (65.10%), *Beauveria bassiana* (57.58%), *Metarhizium anisopliae* (54.32%), Neem oil (47.62%) and Karanj oil (38.90%). On fourteenth day after 1st spray, Emamectin benzoate + Indoxacarb showed the maximum larval reduction by 62.77%, followed by Spinosad (52.71%), Indoxacarb (49.5%), *Beauveria bassiana* (48.8%), *Metarhizium anisopliae* (42.52%), Neem oil (37.17%) and Karanj oil (31.81%).

Table 1. Effect of selected insecticides and biopesticides against *Helicoverpa armigera* (Hub.) on chickpea during *Rabi* season of 2021-22

Treatments		Percent reduction of larval population of *H. armigera*										
		1st spray				2nd spray				1st Spray Mean	2nd Spray Mean	Overall Mean
		3DAS*	7DAS	14DAS	Mean	3DAS	7DAS	14DAS	Mean			
T_1	*Metarhizium anisopliae* ($1x10^8$ cfu)	38.81	54.32	42.52	45.17	53.51	63.38	52.80	56.57	45.17	56.57	50.87
T_2	*Beauveria bassiana* ($1x10^8$ cfu)	45.84	57.58	48.80	50.75	57.49	64.57	54.79	59.28	50.75	59.28	55.01
T_3	Karanj Oil 2%	29.32	38.90	31.81	33.40	39.33	45.38	40.17	41.63	33.4	41.63	37.53
T_4	Neem Oil 2%	37.57	47.62	37.17	41.29	48.52	55.46	46.91	50.29	41.29	50.3	45.80
T_5	Spinosad 45% SC	58.83	69.44	52.71	60.42	66.60	74.67	67.57	69.64	60.4	69.64	65.02
T_6	Emamectin benzoate 5% SG + Indoxocarb 14.5% SC	71.59	77.05	62.77	70.54	72.83	83.79	73.49	76.71	70.54	76.71	73.62
T_7	Indoxacarb 14.5% SC	50.61	65.10	49.5	55.07	58.62	69.7	60.6	62.97	49.5	62.97	56.23
T_0	Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F-test		*S	S	S	S	S	S	S	S	S	S	S
CV		5.71	5.42	7.66	7.89	6.09	4.96	6.68	4.16	7.89	4.16	5.87
Cd(0.05)		4.16	4.87	5.45	6.15	5.34	4.97	5.80	3.81	6.15	3.81	6.65

**DAS= Days after Spray, *S= Significant, CV= Coefficient of variation, CD= Critical difference*

The results obtained from the third day after 2nd spray revealed that Emamectin benzoate + Indoxacarb (220gm/ha + 0.2 ml/l) proved to be most effective in reducing the larval population by 72.83%, followed by followed by Spinosad (66.60%) (0.5ml/l), Indoxacarb (58.62%) (1ml/l), *Beauveria bassiana* (57.49%) (2gm/l), *Metarhizium anisopliae* (53.51%) (5gm/l), Neem oil (48.52%) 2% and Karanj oil (39.33%) 2%. Seventh day after 2nd spray revealed that Emamectin benzoate + Indoxacarb proved to be most effective in reducing the larval population by 83.79%, followed by followed by Spinosad (74.67%), Indoxacarb (69.7%), *Beauveria bassiana* (64.57%), *Metarhizium anisopliae* (63.38%), Neem oil (55.46%) and Karanj oil (45.38%). Fourteenth day after 2nd spray revealed that Emamectin benzoate + Indoxacarb proved to be most effective in reducing the larval population by 73.49%, followed by followed by Spinosad (67.57%), Indoxacarb (60.6%), *Beauveria bassiana* (54.79%), *Metarhizium anisopliae* (52.80%), Neem oil (46.91%) and Karanj oil (40.17%).

In case of the mean of 1st spray, the results revealed that Emamectin benzoate + Indoxacarb was most effective in reducing the larval population by 70.54%, followed by followed by Spinosad (60.42%), Indoxacarb (55.07%), *Beauveria bassiana* (50.75%), *Metarhizium anisopliae* (45.17%), Neem oil (41.29%) and Karanj oil (33.4%).

In case of the mean of 2nd spray, , the results revealed that Emamectin benzoate + Indoxacarb was most effective in reducing the larval population by 76.71%, followed by followed by Spinosad (69.64%), Indoxacarb (62.97%), *Beauveria bassiana* (59.28%), *Metarhizium anisopliae* (56.57%), Neem oil (50.29%) and Karanj oil (41.63%).

The results obtained from the overall mean of the 1st and 2nd sprays revealed that, Emamectin benzoate + Indoxacarb was most effective in reducing the larval population by 73.62%, followed by followed by Spinosad (65.02%), Indoxacarb (56.23%), *Beauveria bassiana* (55.01%), *Metarhizium anisopliae* (50.87%), Neem oil (45.80%) and Karanj oil (37.53%).

Thus, from Table 1 it is clear that all the treatments used in the experiment were found to be significantly superior over control. These results are similar to the findings of Sai et al. [8] where the highest yield was recorded in Emamectin benzoate (5% SG) + Indoxacarb (14.5%). These results were supported by Chandrasekhar et al. [9] where highest reduction in larval population of gram pod borer (72.12%) was observed with spinosad 45 SC @ 0.5 ml/l. The results reported by Kumar et al. [32] proved that Indoxacarb 14.5% SC was the best insecticide followed by spinosad 45 SC. Similar findings were also recorded by Goutham and Tayde [33] which showed lowest percent infestation of gram pod borer was recorded in chloropyriphos (2.39%), followed by NSKE (2.94%), Neem oil (3.36%) Neem leaf extract (3.58%) and Garlic extract (3.90%), Pongamia oil (4.45%) and Papaya leaf extract (4.61%). Choudhary et al. (2017), Harshita et al. (2018), Regmi et al. (2018) and Singh et al. (2017) also supports the results [34].

4. CONCLUSION

From the analysis of the present findings, it can be concluded that among all the treatments used in the experiment, Emamectin benzoate (220 gm/ha) + Indoxacarb (0.2 ml/l) has proved to be the most effective in reducing the larval population of *Helicoverpa armigera*, being followed by Spinosad (0.5ml/l), Indoxacarb (1ml/l), *Beauveria bassiana* (2gm/l), *Metarhizium anisopliae* (5gm/l), Neem oil (2%) and Karanj oil (2%). Thus, Karanj Oil 2% prove to be the least effective treatment in reducing the larval population.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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