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Cost: Benefit analysis of botanicals and insecticides against gram pod borer (*Helicoverpa armigera* Hub.) in chickpea

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ABSTRACT

The present studies on incremental cost: benefit analysis of botanicals and insecticides were carred out at Students' Instructional Farm (SIF) of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, India, during *Rabi* 2022-23 and 2023-24 with nine treatments *viz.*T_1- NSKE 5%, T_2 - Custard Apple leaf 5%, T_3 - Dashparni Ark 5%, T_4 - HaNPV 250 LE/ha, T_5- *Bacillus thuringiensis* (Bt.) 1000 ml/ha, T_6- Spinosad 45 SC 150 ml a.i./ha, T_7 - Emamectin benzoate 5% SG 220 g a.i./ha, T_8 - Flubendiamide 39.35 % SC 100 ml a.i./ha and T_9 - Control (Water spray). The economic of insecticides and botanicals against gram borer in chickpea was investigated, and when the data from both year of experiment were combined, it was concluded that Emamectin benzoate 5% SG @ 220 g a.i./ha (1:4.70) was the most effective insecticide among all the treatments, with maximum population reduction over control. Flubendiamide 39.35 SC @ 100 ml a.i./ha was the second best treatment gram pod borer. Among the botanicals NSKE @ 5% (1:1.32) was the most efficient against gram pod borer infestation in chickpea and could be as an eco-frendly alternative to conventional pesticides of gram pod borer management in chickpea.

Keywords: Economic, Gram pod borer, *Helicoverpa armigera, Rabi,* Chickpea.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a legume crop of the Fabaceae family. It is also known as gram or Bengal gram, and it is commonly known as "King of Pulses". Pulses, the food legumes, have been grown by farmers since millennia providing nutritionally balanced food to the people of India and many other countries in the world. In India, pulses have been described as a "poor man's meat and rich man's vegetable". The importance of vegetables protein has been well recognized during the world (Bahadur *et al.,* 2018). Among them the *Helicoverpa armigera* Hubner (Noctuidae: Lepidoptera) has attained status of the most serious pest in current years in terms of economic damage caused to different agricultural crops throughout India including chickpea (Ojha *et al.,* 2017).

Chickpea is the main significant pulse crop growing in India under irrigated and dryland situation. India positions first in the production chickpea in the world. In India, pulses are grown in an area of 23.47 million ha with overall production of 18.45 with productivity of 786 kg/ha (Galav *et al.,* 2021). It is grown in six major states, Maharashtra, Madhya Pradesh, Rajasthan, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka and Chhattisgarh altogether contribute 97.15 per cent of the production and 96.95 per cent of the area (Singh *et al.,* 2023).In U.P. chickpea is grown an area of 0.57 million hectare with production of 0.73 million tones and productivity 1272 kg/ha (Raj *et al.,* 2022). A single larva of *Helicoverpa armigera* can damage 25-30

pods of gram in its life time. It feeds on tender shoots and young pods. It makes holes in pods and insert its semi body inside the pod to eat the developing seeds (Gautam *et al.,* 2018). Chickpea seed contains 18-22 per cent protein, 61-62 percent carbohydrates, 47 per cent starch, 5 per cent fat, 6 per cent crude fiber, 6 per cent soluble sugar and 3 per cent ash. (Sharma *et al.,* 2020). It is a major supplement of protein (19g), calories 364 g), carbohydrate (61g), iron (34%), magnesium (28%) Vitamin B6 (25%), vitamin C (6%) and contain various amino acids and medicinal properties (Alok *et al.,* 2022). Chickpea has great nutritional value and plays vital role in human diet but as per study per capita availability of chickpea declines from 24g/day to 16 g/day due to reduction in productivity of chickpea. The productivity of chickpea reductions due to abiotic factors, weeds and most important insects and pest. Total Eight to Eleven insect pests recorded on chickpea crop like cutworms (*Agrotis ipsilon* Hufnagel), semilooper (*Autographa nigrisigna*) and termite (*Odontotermes obesus*) but most destructive major pest is Gram pod borer (*Helicoverpa armigera* Hubner) (Basugade *et al.,* 2023).

MATERIALS AND METHODS

The experiments for this study were carried out in the field on chickpea variety PUSA-362 at Students' Instructional Farm (SIF) of Acharya Narendra Deva University of Agriculture &Technology Kumarganj, Ayodhya, Uttar Pradesh, India, during the season of *Rabi* 2022-23 and 2023-24. The experimental site is located at 26.47^0 N latitude and 82.12^0 E longitude, or 113 meters above mean sea level, and falls within the sub-tropical climate zone of the Indo-Gangetic plains. The area experiences chilly winters and scorching summers due to its subtropical climate. The months of July through September had the mostoverall rainfall. The experiment was laid out in Randomized Block Design with nine treatments replicated three in plot size of 4x3 m was sown 30 cm row to row and 10 cm plant to plant spacing by following recommended agronomic practices and fertilizer application to study the population build up of the Gram pod borer associated with chickpea. Systemic insecticides and botanicals were applied, according to the treatment plan. The treatment details are as follows: T_1 - NSKE 5%, T_2 - Custard Apple leaf 5%, T_3 - Dashparni Ark 5%, T_4 - HaNPV 250 LE/ha, T_5- *Bacillus thuringiensis* (Bt.) 1000 ml/ha, T_6- Spinosad 45 SC 150 ml a.i./ha, T_7 - Emamectin benzoate 5% SG 220 g a.i./ha, T_8 - Flubendiamide 39.35 % SC 100 ml a.i./ha and T_9 - Control (Water spray). Gram pod borer population was recorded on randomly selected 10 places.

RESULTS AND DISCUSSION

The data pertaining to economics of various treatments during *Rabi* 2022-23 are presented in Table 1 depicted data maximum net retum was found under the treatment T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (Rs. 31222) and minimum in T_3 - Dashparni Ark 5% (Rs. 2960). The cost: benefit ratio of different treatments revealed that T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (1:4.85), was the most economical treatment, followed, by T_6 - Spinosad 45 SC 150 ml a.i./ha (1:3.19), T_4 - HaNPV 250 LE/ha (1:2.99), T_5 - *Bacillus thuringiensis* (Bt.) 1000 ml/ha (1:2.87), T_8 - Flubendiamide 39.35 % SC 100 ml a.i./ha (1:2.63), T_1 - NSKE 5% (1:1.29), T_2 - Custard Apple leaf 5% (1:0.89), T_3 - Dashparni Ark 5% (1:0.40). (Table 1).

During *Rabi* 2023-24, the maximum net return was recorded from T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (Rs. 25966). The cost benefit ratio of different treatments revealed that T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (1:4.03), was the most economical treatment, followed by T_4 - HaNPV 250 LE/ha (1:3.04), T_5 - *Bacillus thuringiensis* (Bt.) 1000 ml/ha (1:1.94), T_8 - Flubendiamide 39.35 % SC 100 ml a.i./ha (1:1.90), T_6 - Spinosad 45 SC 150 ml a.i./ha (1:1.66), T_1 - NSKE 5% (1:1.34), T_3 - Dashparni Ark 5% (1:0.49), T_2 - Custard Apple leaf 5% (1:0.27). (Table 2).

The pooled data pertaining to the economics of various treatments are presented in (Table 3) where the highest net return was recorded T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (Rs. 30266). The cost benefit ratio of different treatments revealed that T_7 - Emamectin benzoate 5% SG 220 g a.i./ha (1:4.70), was the most economical treatment,followed by T_4 - HaNPV 250 LE/ha (1:2.92), T_5 - *Bacillus thuringiensis* (Bt.) 1000 ml/ha (1:2.29), T_8- Flubendiamide 39.35 % SC 100 ml a.i./ha (1:2.27), T_6- Spinosad 45 SC 150 ml a.i./ha (1:2.09), T_1- NSKE 5% (1:1.32), T_2- Custard Apple leaf 5% (1:0.58), T_3- DashparniArk5%(1:0.45).

These findings are in partially agreement with the findings of Upadhyay *et al.,* (2020) The highest yield was recorded in the treatment Flubendamide 39.35 EC 49g a.i. ha-1 (16.44 q ha-1) and Spinosad 45 SC 74g

a.i. ha-1 (15.55 q ha-1). Rajendra *et al.,* (2022)The treatment Spinosad 45 SC (7.25%) found superior followed by Flubendiamide 480 SC (11.49%), HaNPV (13.20%), Bacillus thuringiensis (14.48%) and NSKE 5% (14.81%) as compared to control (21.38%). When the cost benefit ratio was worked out, the results were quite interesting. Among the treatments studied, the best and most economical treatment was Spinosad 45 SC (1:2.41), Flubendiamide 480 SC (1:2.15), HaNPV (1:1.97), Bacillus thuringiensis (1:1.77) and NSKE 5% (1:1.69) as compared to Control (1:1.26).

CONCLUSION

The economics of certain insecticides and botanicals against gram borer in chickpea was investigated, and when the data from both year of experiment were combined, it was concluded that Emamectin benzoate 5% SG @ 220 g a.i./ha (1:4.70) was the most effective insecticide among all the treatments, with maximum population reduction over control. Flubendiamide 39.35 SC @ 100 ml a.i./ha was the second best treatment gram pod borer. Among the botanicals NSKE @ 5% (1:1.32) was the most efficient against gram pod borer infestation in chickpea and could be as an eco-frendly alternative to conventional pesticides of gram pod borer management in chickpea.

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Table 1: Economics of treatments against *Helicoverpa armigera* during *Rabi,* 2022-23

Tr. No.	Treatments	Dose/ha	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	No. of Sprays	Total cost of Treatments (Rs/ha)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	NSKE	5%	4200	2	8400	17.10	1.93	19300	10900	1:1.29
T_2	Custard Apple leaf	5%	3700	2	7400	16.57	1.4	14000	6600	1:0.89
T_3	Dashparni Ark	5%	3670	2	7340	16.20	1.03	10300	2960	1:0.40
T_4	HaNPV	250 LE/ha	2423	2	4846	17.00	1.83	18300	14500	1:2.99
T_5	*Bacillus thuringiensis* (Bt.)	1000 ml/ha	3519	2	7038	17.73	2.56	25600	20218	1:2.87
T_6	Spinosad 45 SC	150 ml a.i./ha	4880	2	9760	18.60	3.43	34300	31226	1:3.19
T_7	Emamectin benzoate 5 SG	220 g a.i./ha	3217	2	6434	19.27	4.1	41000	31222	1: 4.85
T_8	Flubendiamide 39.35 SC	100 ml a.i./ha	5224	2	10448	18.97	3.8	38000	27552	1:2.63
T_9	control (Water spray)	-	-	2	-	15.17	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/-, Labour charge @ Rs. 250/day = Rs. 500/-, Cost of produce Rs. 10000/q

Table 2: Economics of treatments against *Helicoverpa armigera* during *Rabi,* 2023-24

Tr. No.	Treatments	Dose/ha	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	No. of Spray	Total cost of Treatments (Rs/ha)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	NSKE	5%	4200	2	8400	18.50	1.97	19700	11300	1:1.34
T_2	Custard Apple leaf	5%	3700	2	7400	17.47	0.94	9400	2000	1:0.27
T_3	Dashparni Ark	5%	3670	2	7340	17.63	1.1	11000	3660	1:0.49
T_4	HaNPV	250 LE/ha	2423	2	4846	18.47	1.94	19400	14774	1:3.04
T_5	*Bacillus thuringiensis* (Bt.)	1000 ml/ha	3519	2	7038	18.60	2.07	20700	13662	1:1.94
T_6	Spinosad 45 SC	150 ml a.i./ha	4880	2	9760	19.13	2.6	26000	16240	1:1.66
T_7	Emamectin benzoate 5 SG	220 g a.i./ha	3217	2	6434	19.77	3.24	32400	25966	1:4.03
T_8	Flubendiamide 39.35 SC	100 ml a.i./ha	5224	2	10448	19.57	3.04	30400	19952	1:1.90
T_9	control (Water spray)	-	-	2	-	16.53	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/-, Labour charge @ Rs. 250/day = Rs. 500/-, Cost of produce Rs. 10000/q

Table 3: Economics of treatments against *Helicoverpa armigera* during *Rabi,* 2022-23& 2023-24 (Pooled)

Tr. No.	Treatments	Dose/ha	Total cost of Treatments (Rs/ha) (labour + sprayer charge + insecticides cost)	No. of Spray	Total cost of Treatments (Rs/ha)	Grain Yield (q/ha)	Saved Yield (q/ha)	Value of Saved Yield (Rs/ha)	Net Returns	Cost Benefit Ratio (C:B)
T_1	NSKE	5%	4200	2	8400	17.80	1.95	19500	11100	1:1.32
T_2	Custard Apple leaf	5%	3700	2	7400	17.02	1.17	11700	4300	1:0.58
T_3	Dashparni Ark	5%	3670	2	7340	16.92	1.07	10700	3360	1:0.45
T_4	HaNPV	250 LE/ha	2423	2	4846	17.73	1.88	18800	14174	1:2.92
T_5	*Bacillus thuringiensis* (Bt.)	1000 ml/ha	3519	2	7038	18.17	2.32	23200	16162	1:2.29
T_6	Spinosad 45 SC	150 ml a.i./ha	4880	2	9760	18.87	3.02	30200	20440	1:2.09
T_7	Emamectin benzoate 5 SG	220 g a.i./ha	3217	2	6434	19.52	3.67	36700	30266	1:4.70
T_8	Flubendiamide 39.35 SC	100 ml a.i./ha	5224	2	10448	19.27	3.42	34200	23752	1:2.27
T_9	control (Water spray)	-	-	2	-	15.85	-	-	-	-

Rent of sprayer @ Rs. 100/day = Rs.200/-, Labour charge @ Rs. 250/day = Rs. 500/-, Cost of produce Rs. 10000/q

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