The Pharma Innovation Journal 2022; 11(7): 3405-3410

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 3405-3410

www.thepharmajournal.com
Received: 09-04-2022
Accepted: 21-06-2022

Pawar Avinash Hanumant
M.Sc. Scholar, Department of Entomology, Faculty of Agriculture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Ashwani Kumar
Associate Professor and Head, Department of Entomology, Faculty of Agriculture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Pawar Avinash Hanumant
M.Sc. Scholar, Department of Entomology, Faculty of Agriculture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Field evaluation of chemicals and bio-pesticides against chickpea pod borer [*Helicoverpa armigera* (Hubner)]

Pawar Avinash Hanumant and Ashwani Kumar

Abstract
A field investigation was conducted to evaluate field evaluation of chemicals and bio-pesticides against chickpea pod borer [*Helicoverpa armigera* (Hubner)] at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The result revealed that insecticides were effective against pod borer even if they have slight per cent pod damage. Among all the treatments lowest per cent pod damage was recorded in T_4-Spinosad 45 SC (5.07%) followed by T_1-Chlorantraniliprole 18.5% SC (6.37%), T_2-Flubendiamide 480% SC (7.50%), T_3-Emamectin benzoate 05.00% SG (8.80%), T_6-Nisco sixer plus (10.16%), T_5-*Ha*NPV (11.34%). T_7-*Bacillus thuringiensis* (11.93%) which is statistically found be least effective but significantly superior over the control. The highest yield was recorded in Spinosad 45 SC (22.90 q/ha) followed by Chlorantraniliprole 18.5% SC (21.40 q/ha), Flubendiamide 480 SC (20.20 q/ha), Emamectin benzoate 05.00% SG (18.03 q/ha), Nisco sixer plus (17.45 q/ha), *Ha*NPV (13.70 q/ha) and *Bacillus thuringiensis* (12.40 q/ha) as compared to control (9.10 q/ha). When cost benefit ratio was worked out, interesting result was achieved. The cost effectiveness of Spinosad and Chlorantraniliprole was also high and very favourable with incremental cost-benefit ratios of 1:2.92 and 1:2.81 respectively, followed by Flubendiamide (1:2.51), Emamectin benzoate (1:2.47), Nisco sixer plus (1:2.28), *Ha*NPV (1:187) and *Bacillus thuringiensis* (1:1.68).

Keywords: Bio-pesticides, chemicals, evaluation, *Helicoverpa armigera,* spinosad

Introduction

Chickpea is an important pulse crop of India, known as king of pulses. It is the third most important pulse crop after dry bean and peas, produced in the world which is mostly grown under dry land condition with heavy and sandy soil. India is the major producing country for chickpea, contributing for over 75% of total production in the world. The majority of the world's chickpea is grown in South Asia, where India has the largest share in world's chickpea area (8.39 m ha) and production (7.06 mt), respectively. (Chitralekha *et al*., 2018) [5].

The per cent chickpea crop area covered in major states India is Madhya Pradesh (32.97%), Maharashtra (18.36%), Rajasthan (16.70%), Andra Pradesh (8.55%), Karnataka (8.21%), Uttar Pradesh (6.85%) and Gujarat (2.92%). In India, the area under chickpea was 7.37 million hectares with a production of 5.89 million tonnes with productivity of 799 kg/ha.In Karnataka, the crop is grown in an area of 6.05 lakh hectares with a productivity of 937 kg/ha. (Prasanna *et al*. 2020) [18].

It is one of the most important food legume plants in sustainable agriculture system because of its low production cost, wider adaptation, ability to fix atmostpheric nitrogen and fit in various crop rotations. Nutronal value per 100g of chickpea contains carbohydrates (27.42 g), protein (8.86g), total fat (2.59 g), dietary fibre (7.6g), folates (172 mcg), niacin (0.526 mg), pantothenic acid (0.245 mg), pyridoxine (0.215 mg), riboflavin (0.063), thiamine (0.200 mg), vitamin C (1.3 mg), vitamin A (27 IU), vitamin E (0.35 mg), vitamin K (4.0 mcg), sodium (7.0 mg), potassium (291 mg), calcium (49 mg), iron (2.89 mg), magnesium (48 mg), phosphorous (168 mg), zinc (1.53 mg). (Gayathri and Kumar. 2021) [8].

Gram pod borer is a polyphagous insect belonging to the family Noctuidae and Order-Lepidoptera. It is also known as cotton bollworm, corn earworm, tomato fruit borer, and false budworm. It attacks more than 180 cultivated species from cereals, legumes, vegetables, fruits, forage and wild species. The chickpea crop is attacked by a number of insect pests from seedling to its maturity. The major insect pests attacking chickpea crop are *Helicoverpa armigera, Spodoptera litura, Agrotis ipsilon, Plusia orichalchea* and *Bemisia tabaci* during winter and summer seasons.

The chickpea pod borer, *Helicoverpa armigera* is polyphagous in nature which causes damage to several crops such as pigeonpea, groundnut, cotton, vegetables, pearl millets, sorghum, maize, sunflower etc. The young larvae often feed upon the tender foliage before attacking the pods by causing heavy losses to crop and sometimes whole crop failed due to severe infestation. (Kumar *et al*. 2019) [12].

Its life cycle involves four major developmental stages (eggs, larvae, pupae and adult). *H. armigera* completes its life cycle from egg to adult in about 30-34 days at an average temperature of 28 ^{0}C. 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. Unless the pest is controlled in the initial stages of infestation it takes the heavy toll of the crop. (Jayanth and Kumar., 2022) [10].

Pod borer larvae feed on both foliage and pods of chickpea, yield losses are mainly due to pod damage. In India, this pest has been reported to cause 32-100% damage to pods, while yield losses has been estimated to the extent of 4.2 to 77%. A single larva of *Helicoverpa armigera* can damage up to 25-30 pods of chickpea in its life time. (Kumar *et al*. 2018) [13].

Materials and Methods

The field trial was laid out at the Central Research Field in randomized block design with eight treatments including an untreated control, each with three replications. The Chirag variety of chickpea was used and a healthy crop was raised by following all the recommended agronomical practices. The plot size was 2m x 2m and the spacing between rows and plants was maintained at 30 and 10 cm, respectively. Sprays were initiated on reaching 4-5 larvae per plant and pod damage by the borer and repeated three times during the crop season as and when the pod damage exceeded 10-20 percent. Spraying was done with the help of a knapsack sprayer. Observations on pod damage by the borer were recorded daily on 5 randomly selected plants per plot during the vegetative stage of crop and later on number of damaged and total pods, from these data the percentage of pod damage was worked out and the data before subjecting to statistical analysis. The economics of the insecticidal treatments was also determined through cost benefit ratio analysis.

Preparation of insecticidal solution

The insecticidal spray solution of desired concentration as per treatment was freshly prepared every time at the time of experimentation just before the start of spraying operations.

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

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

Where,

V = Volume/ weight of commercial insecticide ml. or gm.

C = Concentration required.

A = Volume of solution to be prepared.

% a.i. = Percentage active ingredient

Per cent pod damage analysis

Per cent pod damage was calculated with the following formula suggested by (Kumar *et al*. 2019) [12].

$$\% \text{ Pod damage} = \frac{\text{No. of infected pod}}{\text{Total no. of pod}} \times 100$$

Cost benefit ratio

The value of C: B of different treatments was calculated by following formula. (Lavanya and Kumar. 2022) [14].

$$\text{B:C ratio} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

Results and Discussion

The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are tabulated in the following pages. Results, thus obtained are presented aspect wise here under.

The results presented in Table.1 revealed that three days after first spray, T_4-Spinosad 45 SC (5.54%) followed by T_1-Chlorantraniliprole 18.5% SC (7.92%), T_2-Flubendiamide 480% SC (9.01%),T_3-Emamectin benzoate 05.00% SG (10.42%), T_6-Nisco sixer plus (11.64%),T_5-*Ha*NPV (12.72%) and T_7-*Bacillus thuringiensis* (13.09%). Seventh days after first spray, T_4-Spinosad 45 SC (4.64%) followed by T_1-Chlorantraniliprole 18.5% SC (6.10%), T_2-Flubendiamide 480% SC (7.48%),T_3-Emamectin benzoate 05.00% SG (8.63%), T_6-Nisco sixer plus (10.12%),T_5-*Ha*NPV (11.48%) and T_7-*Bacillus thuringiensis* (11.90%). Fourteen days after first spray, T_4-Spinosad 45 SC (6.10%) followed by T_2-Chlorantraniliprole 18.5% SC (7.03%),T_2-Flubendiamide 480% SC (8.10%),T_3-Emamectin benzoate 05.00% SG (9.65%),T_6-Nisco sixer plus (11.49%),T_5-HaNPV (12.33%) and T_7- *Bacillus thuringiensis* (12.76%). The results revealed the mean of first spray, T_4-Spinosad 45 SC (5.42%) followed by T_1-Chlorantraniliprole 18.5% SC (7.02%), T_2-Flubendiamide 480% SC (8.200%),T_3-Emamectin benzoate 05.00% SG (9.57%), T_6-Nisco sixer plus (11.08%),T_5-*Ha*NPV (12.18%) and T_7-*Bacillus thuringiensis*(12.87%).

Table 1: Efficacy of selected insecticides on the incidence of chickpea pod borer, *H.armigera* on chickpea during *rabi* season of 2021 (First Spray): (Per cent pod damage)

Treatments		Per cent pod damage/five plant				
		One day before spray	After first spray			
			3rd DAS	7th DAS	14th DAS	Mean
T_1	Chlorantraniliprole 18.5 SC	14.40	7.92	6.10	7.03	7.02
T_2	Flubendiamide 480 SC	14.36	9.01	7.48	8.10	8.20
T_3	Emamectin benzoate 05.00 SG	14.42	10.42	8.63	9.65	9.57
T_4	Spinosad 45 SC	14.27	5.54	4.64	6.10	5.42
T_5	*Ha*NPV	14.56	12.72	11.48	12.33	12.18
T_6	Nisco Sixer Plus	14.33	11.64	10.12	11.49	11.08
T_7	*Bacillus thuringiensis*	14.74	13.09	11.90	12.76	12.58

T_0	Control	15.21	15.45	15.81	16.21	15.82
Overall Mean		14.53	10.72	9.52	10.45	10.23
F- test		NS	S	S	S	S
S. Ed. (±)		0.443	0.589	0.741	0.517	0.337
C. D. (P = 0.05)		-	1.26	1.59	1.11	0.724

*DAS-Day after spray, *NS- Non significant, *S – Significant

The results presented in Table.2 revealed that three days after second spray, T_4-Spinosad 45 SC (5.05%) followed by T_1-Chlorantraniliprole 18.5% SC (6.20%), T_2-Flubendiamide 480%SC (7.27%),T_3-Emamectin benzoate 05.00% SG (8.03%),T_6-Nisco sixer plus (8.86%),T_5-*Ha*NPV (10.44%) and T_7-*Bacillus thuringiensis* (10.91%). Seventh days after second spray, T_4-Spinosad 45 SC (4.70%) followed by T_1-Chlorantraniliprole 18.5% SC (5.87%), T_2-Flubendiamide 480% SC (7.19%),T_3-Emamectin benzoate 05.00% SG (8.66%),T_6- Nisco sixer plus (9.91%),T_5-*Ha*NPV (11.13%) and T_7-*Bacillus thuringiensis*(17.10%). Fourteen days after second spray, T_4-Spinosad 45 SC (4.37%) followed by T_1-Chlorantraniliprole 18.5% SC (5.10%), T_2-Flubendiamide 480% SC (5.95%),T_3-Emamectin benzoate 05.00% SG (7.40%),T_6-Nisco sixer plus (8.98%),T_5-*Ha*NPV (9.92%) and T_7-*Bacillus thuringiensis*(11.07%)

Mean of second spray, T_4-Spinosad 45 SC (4.71%) followed by T_1-Chlorantraniliprole 18.5% SC (5.72%), T_2-Flubendiamide 480% SC (11.6.80%), T_3-Emamectin benzoate 05.00% SG (8.03%), T_6-Nisco sixer plus (9.25%), T_5-*Ha*NPV (10.50%) and T_7-*Bacillus thuringiensis* (11.27%).

Table 2: Efficacy of selected insecticides on the incidence of chickpea pod borer, *H. armigera* on chickpea during *rab*i season of 2021 (Second Spray): (Per cent pod damage)

Treatments		**Per cent pod damage/five plant**				
		One day before spray	**After second spray**			
			3rd DAS	**7th DAS**	**14th DAS**	**Mean**
T1	Chlorantraniliprole 18.5 SC	7.03	6.20	5.87	5.10	5.72
T_2	Flubendiamide 480 SC	8.10	7.27	7.19	5.95	6.80
T_3	Emamectin benzoate 05.00 SG	9.65	8.03	8.66	7.40	8.03
T_4	Spinosad 45 SC	6.10	5.05	4.70	4.37	4.71
T_5	*Ha*NPV	12.33	10.44	11.13	9.92	10.50
T_6	Nisco sixer plus	11.49	8.86	9.91	8.98	9.25
T_7	*Bacillus thuringiensis*	12.76	10.91	11.83	11.07	11.27
T_0	Control	16.21	16.44	17.10	17.60	17.05
Overall Mean		10.45	9.15	9.54	8.79	9.16
F- test		S	S	S	S	S
S. Ed. (±)		0.517	0.768	0.648	0.449	1.216
C. D. (P = 0.05)		1.11	1.64	1.39	0.963	0.821

*DAS-Day after spray, *S – Significant

Overall mean of per cent pod damage (3rd, 7th and 14th DAS) of two sprays

The data on the mean (3rd, 7th & 14th) Overall mean per cent pod damage of two spray revealed that few treatments T_4-Spinosad 45 SC (5.07%) was most effective treatment against gram pod borer followed by T_1-Chlorantraniliprole 18.5% SC (6.37%), T_2-Flubendiamide 480% SC (7.50%), T_3-Emamectin benzoate 05.00% SG (8.80%), T_6-Nisco sixer plus (10.16%), T_5-*Ha*NPV (11.34%). Among all the treatments T_7-*Bacillus thuringiensis* (11.93%) was least effective treatment against gram pod borer (11.93%).

Table 3: Efficacy of selected insecticides on the incidence of chickpea pod borer, *H.armigera* on chickpea during *rab*i season of 2021 (First and Second Spray): (Per cent pod damage)

Treatment No.	**Treatments**	**Per cent pod damage/five plant Overall mean**		
		First spray Mean	**Second Spray Mean**	**Overall Mean**
T0	Control	15.82	17.05	16.43
T1	Chlorantraniliprole 18.5% SC	7.02	5.72	6.37
T2	Flubendiamide 480% SC	8.20	6.80	7.50
T3	Emamectin benzoate 05.00 SG	9.57	8.03	8.80
T4	Spinosad 45 SC	5.42	4.71	5.07
T5	*Ha*NPV	12.18	10.50	11.34
T6	Nisco sixer plus	11.08	9.25	10.16
T7	*Bacillus thuringiensis*	12.58	11.27	11.93
	Overall Mean	10.23	9.11	9.70
	F-test	S	S	S
	S. Ed. (±)	0.337	1.216	0.568
	C. D. (P=0.05)	0.724	0.821	1.645

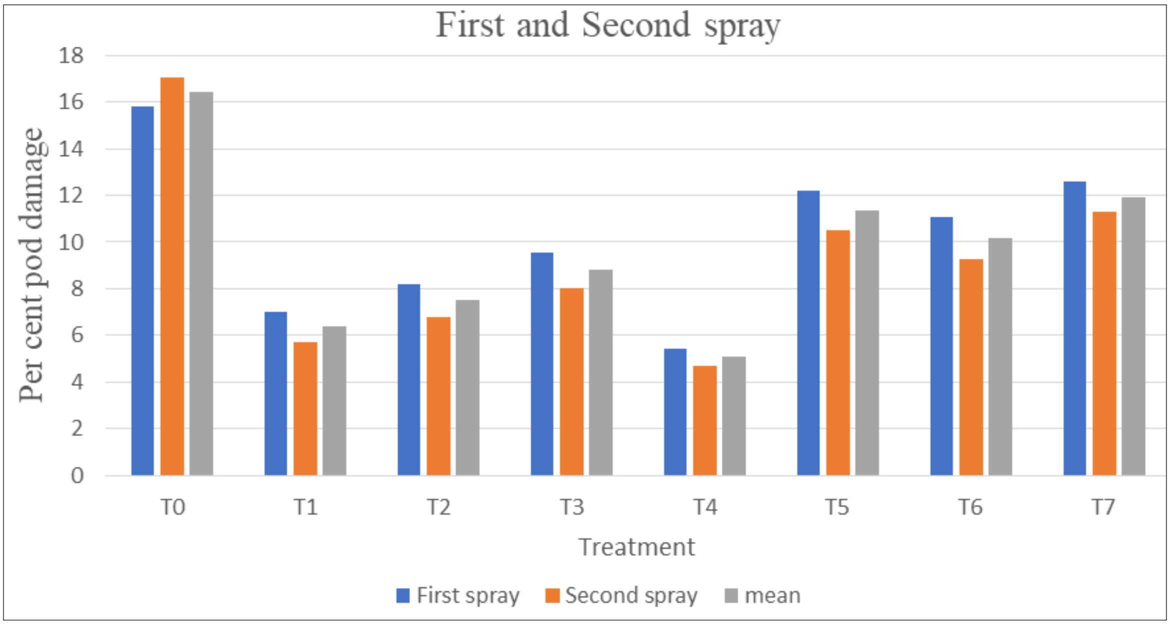

Fig 1: Graphical representation on efficacy of selected insecticides on the incidence of chickpea pod borer, *H.armigera* on chickpea during *rab*i season of 2021 (First and Second Spray): (Per cent pod damage)

Table 4: Cost benefit ratio of chickpea

Sr. No	Treatment	Yield (q/h)	Cost of yield (₹)	Total cost of yield (₹)	Common cost (₹)	Treat-ment cost (₹)	Total cost (₹)	B: C ratio
1	Chlorantraniliprole 18.5 SC	21.40	6000 ₹/q	130900	1370	4260	45630	1:2.81
2	Flubendiamide 480 SC	20.20	6000 ₹/q	128700	41370	6780	48150	1:2.51
3	Emamectin benzoate 05.00 SG	18.03	6000 ₹/q	114950	41370	2423	43793	1:2.47
4	Spinosad 45 SC	22.90	6000 ₹/q	135850	41370	5322	46692	1:2.92
5	*Ha*NPV	13.70	6000 ₹/q	96360	41370	2572	43942	1:1.87
6	Nisco sixer plus	17.45	6000 ₹/q	106535	41370	4200	45570	1:2.28
7	*Bacillus thuringiensis*	12.40	6000 ₹/q	91795	41370	2740	44110	1:1.68
8	Control	9.10	6000 ₹/q	60720	41370	-	41370	1:1.31

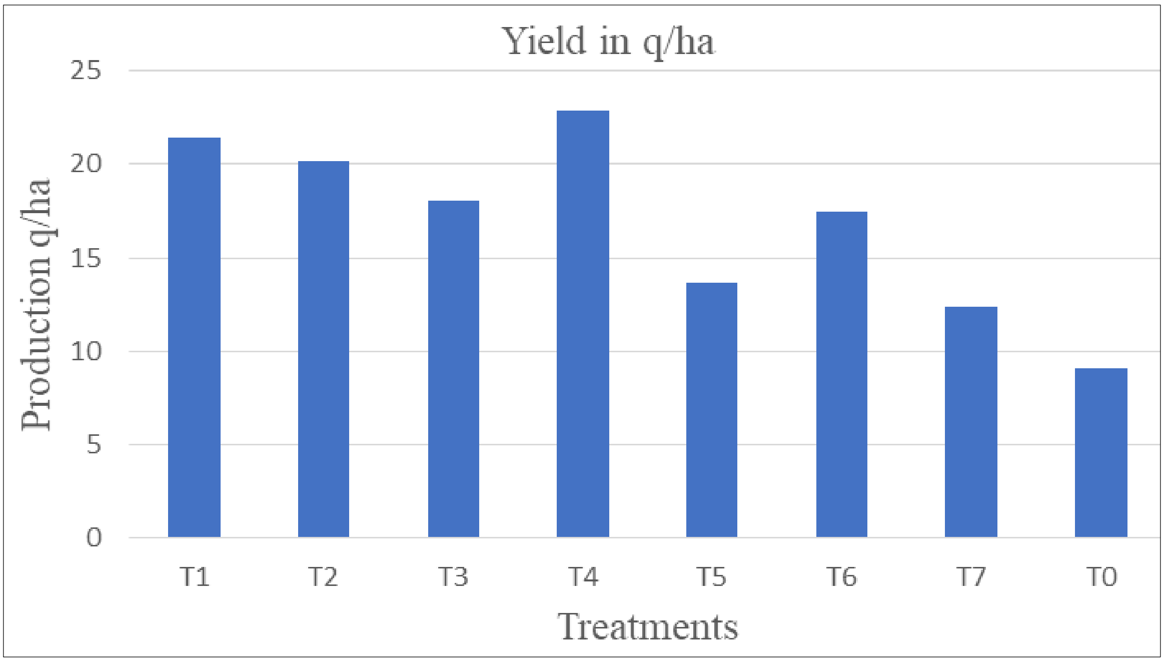

Fig 2: Graphical representation of yield of treatments.

The yields among the treatment were significant. The highest yield was recorded in T_1-Spinosad 45 SC (22.90 q/ha) followed by T_1-Chlorantroniliprole 18.5% SC (21.40 q/ha), T_2-Flubendiamide 480 SC (20.20 q/ha), T_3-Emamectin benzoate 05.00% SG (18.03 q/ha), T_6-Nisco sixer plus (17.45 q/ha), T_5- *Ha*NPV (13.70 q/ha) and T_7-*Bacillus thuringiensis* (12.40 q/ha) as compared to T_0-control (9.10 q/ha). When cost benefit ratio was worked out, interesting result was achieved.

Discussion

All the insecticides were found very effective and significantly superior over untreated control. The lowest per cent infestation of chickpea pod borer was recorded in T_4-Spinosad 45 SC (5.07%) as the similar findings was reported by Akhtar *et al*. (2022) [2] (6.5%), Mishra *et al*.(2014) [16] (3.3%), Singh *et al*.(2012) [20] (2.3%), T_1-Chlorantraniliprole 18.5% SC was found to be the next best treatment with a lowest per cent of infestation of pod borer (6.37%) as the similar findings was made by Upadhyay *et al*.(2020)[21](4.67%).T_2-Flubendiamide 480% SC was found as the next effective treatment with a lowest per cent of infestation (7.50%) as the similar findings was made by Deshmukh *et al.* (2010) [6] (5.67),Upadhyay *et al*.(2020) [21] (5.33%). T_3-Emamectin benzoate was found to be the next best treatment with a lowest per cent of infestation of pod borer (8.80%) as the similar findings was made by Akbar *et al.* (2018) [1] (6.61%), Sarnaik and Chiranjeevi (2017) [19] (7.00%). T_6-Nisco sixer plus was the next effective treatment with a minimum per cent of infestation (10.16%) as the similar findings was made by Gayathri and Kumar (2021) [8]. T_5-*Ha*NPV was the next effective treatment with a lowest per cent of infestation (11.34%) as the similar findings was made by Meena *et al.* (2018) [15] (11.83). T_7-*Bacillus thuringiensis* was the next effective treatment with a lowest per cent of infestation (11.93%) as the similar findings was made by Bhushan *et al.* (2011) [3] (11.40%), Kumar *et al.* (2019) [12] (13.38%).

The maximum yield was recorded in T_4-Spinosad 45 SC (22.90 q/ha) as the similar findings were made by Hossain *et al.* (2010) [9] (1883 kq/ha), Nitharwal *et al.* (2017) [17] (17.45q/ha).T_1-Chlorantraniliprole 18.5% SC was found to be the next best treatment with a maximum yield (21.40 q/ha) as the similar findings were made by Upadhyay *et al.* (2020) [21] (17.33 q/ha), Chaukikar *et al.* (2017) [4] (2260 kq/ha).T_2-Flubendiamide 480 SC (20.20 q/ha) as the similar findings were made by Deshmukh *et al*.(2010) [6] (1850 kg/ha). T_3-Emamectin benzoate 05.00% SG was found as the next effective treatment with a minimum yield of (18.03 q/ha) as the similar findings were made by Yadav *et al.* (2019) [22] (18.00 q/ha), Sarnaik and Chiranjeevi (2017) [19] (1844 kg/ha).T_6- Nisco sixer plus (17.45 q/ha) as the similar findings were made by Gayathri and Kumar (2021) [8],T_5-HaNPV was found to be the next best treatment with a minimum yield of (13.70 q/ha) as the similar findings were made by Khorasiya *et al.* (2020) [11] (1264 kg/ha), (Meena *et al*.(2018) [15] (11.41q/ha).T_7-*Bacillus thuringiensis* was the next effective treatment with a minimum yield of (12.40 q/ha) as the similar findings were made by Khorasiya *et al.* (2020) [11] (1231 kg/ha), Chitralekha, *et al*. (2018) [5] (1211 kg/ha).

Cost benefit ratio

After calculating the highest Cost: Benefit ratio was recorded in the treatment T_4-Spinosad 45 SC (1:2.92) as the similar finding was made by Upadhyay *et al*. (2020) [21] (1:3.10), Nitharwal *et al.* (2017) [17] (1:3.40) the study revealed the treatment T_1- Chlorantraniliprole 18.5% SC has the cost benefit ratio of (1:2.81) as the similar findings were made by Upadhyay *et al*. (2020) [21] (1:1.19), Jayanth and Kumar (2022) [11](1:3.42). The treatment T_2-Flubendiamide 480% SC exhibited the benefit cost ratio of (1:2.51) as the similar findings were made by Dinesh *et al.* (2017) [7] (1:1.26)), T_3-Emamectin benzoate 05.00 SG (1:2.47)) as the similar findings were made by Sarnaik and Chiranjeevi (2017) [19] (1:2.99), T_6-Nisco sixer plus (1:1.28) which was supported by Gayathri and Kumar (2021) [8]. The minimum cost benefit ratio (C: B) was recorded in T_6-HaNPV (1:1.87) as the similar findings were made by Dinesh *et al* (2017) [7] (1:1.24) and T_7-*Bacillus thuringiensis* (1:1.68) as the similar findings were made by Bhushan *et al*. (2011) [3] (1:2.28) respectively.

Conclusion

From the critical analysis of the present findings, it can conclude that certain treatments like Spinosad 45 SC and Chlorantraniliprole 18.5% SC, are showing good result against *H. armigera* and can be a part of integrated pest management. In second objective the incremental cost benefit ratio, the result revealed Spinosad 45 SC, followed by Chlorantraniliprole 18.5% SC, Flubendiamide 480% SC, Emamectin benzoate 05.00% SG, Nisco sixer plus, *Ha*NPV and *Bacillus thuringiensis.* All the insecticidal treatments that are used in the trail can be suitably incorporated in integrated pest management schedule against *H. armigera* as a recommended to effective management of the pest. However, through investigation are necessary to test their specificity environmental compatibility and insect pest resistance.

Acknowledgement

We are grateful to Honorable VC, Dean, Head, Department of Entomology and Director of Research, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. for providing facilities for this research work.

References

1. Akbar W, Asif MU, Memon RM, Bux M, Sohail M. Validation of some new chemistry and conventional insecticides against gram pod borer (*Helicoverpa armigera*) in chickpea. Pakistan Entomologist. 2018;40(1):45-49.
2. Akhtar M, Mahmood MT, Khalid MJ, Amin A, Zafar MN, Aziz A, *et al*. Efficacy of some new chemistry insecticides against the chickpea pod borer (*Helicoverpa armigera*) [Hubner]. Plant Cell Biotechnology and Molecular Biology. 2022;23(9-10):1-6.
3. Bhushan S, Singh RP, Shanker R. Bio-efficacy of neem and *Bt* against pod borer, *Helicoverpa armigera* in chickpea. Journal of Biopesticides. 2011;4(1):87.
4. Chaukikar K, Bhowmick AK, Das SB, Marabi RS, Tomar VS. Bioefficacy of Emamectin Benzoate Against *Helicoverpa armigera* Hubner and its Natural Enemies on chickpea (*Cicer arietinum*) Crop. International Journal of Bio-resource and Stress Management. 2017;8(5):716-720.
5. Chitralekha GS, Verma T. Efficacy of insecticides against *Helicoverpa armigera* on chickpea. Journal of Entomology and Zoology Studies. 2018;6(3):1058-1061.
6. Deshmukh SG, Sureja BV, Jethva DM, Chatar VP. Field efficacy of different insecticides against *Helicoverpa armigera* (Hubner) infesting chickpea. Legume Research-An International Journal. 2010;33(4):269-273.
7. Dinesh K, Singh RB, Kavita K, RS C. Relative efficacy of newer insecticides and biopesticides against *Helicoverpa armigera* (Hubner.) in chickpea. Journal of Entomology and Zoology Studies. 2017;5(3):455-462.
8. Gayathri L, Kumar A. Field efficacy of certain insecticides against pod borer, *Helicoverpa armigera*

(Hubner) on chickpea in Prayagraj. Journal of Entomology and Zoology Studies. 2021;9(3):280-283.
9. Hossain MA, Haque MA, Ahmad M, Prodhan MZH. Development of an integrated management approach for pod borer, *Helicoverpa armigera* (Hubner) on chickpea. Bangladesh Journal of Agricultural Research. 2010;35(2):201-206.
10. Jayanth T, Kumar A. Field efficacy of selected insecticides with combination of neem oil against gram pod borer [Helicoverpa armigera (Hubner)]. The Pharma Innovation Journal. 2022;11(5):465-469
11. Khorasiya SG, Raghvani KL, Bharadiya AM, Jethva DM, Bhut JB. Efficacy of bio-pesticides, insecticides alone and their combination against pod damage caused by *Helicoverpa armigera* in chickpea. Journal of Entomology and Zoology Studies. 2018;6(1):928-933.
12. Kumar A, Tripathi MK, Chandra U, Veer R. Efficacy of botanicals and bio-pesticide against *Helicoverpa armigera* in chickpea. Journal of Entomology and Zoology Studies. 2019;7(1):54-57.
13. Kumar L, Bisht RS, Singh H, Kumar A, Pandey N, Kumar M. Bio-efficacy and economics of some newer insecticides and bio-pesticides against *Helicoverpa armigera* (Hub.) on chickpea (*Cicer arietinum* L.) crop. Journal of Pharmacognosy and Phytochemistry. 2018;1:1739-1744.
14. Lavanya V, Kumar A. Efficacy of certain chemicals against gram pod borer [*Helicoverpa armigera* (Hubner)] on chickpea (*Cicer arietinum* L.). The Pharma Innovation Journal. 2022;11(3):1293-1297.
15. Meena RK, Naqvi AR, Meena DS, Shivbhagvan. Evaluation of bio-pesticides and indoxacarb against gram pod borer on chickpea. Journal of Entomology and Zoology Studies. 2018;6(2):2208-2212.
16. Mishra VK, Singh NN, Singh SK, Kumari R. Efficacy of insecticides against *Helicoverpa armigera* on chickpea. Annals of Plant Protection Sciences. 2014;22(2):424-425.
17. Nitharwal RS, Kumar A, Jat SL, Chula MP. Efficacy of newer molecules against gram pod borer, *Helicoverpa armigera* (Hub.) on chickpea (*Cicer arietinum* L.). Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1224-1227.
18. Prasanna PM, Badiger B, Shivamurthy D. Bio-efficacy of insecticide, Cyclaniliprole 100 DC against gram pod borer, *Helicoverpa armigera* (Hubner.) infesting chickpea. International Journal of Chemical Studies. 2020;8(4):3070-3073.
19. Sarnaik S, Chiranjeevi B. Bio efficacy of newer insecticides against gram pod borer, *Helicoverpa armigera* (Hubner) on chickpea. An International Quarterly Journal of Life Science. 2017;12(1):65-69.
20. Singh PS, Shukla RK, Yadav NK. Bio-efficacy of some insecticides against *H. armigera* (Hubner) on chickpea (*Cicer arietinum* L.). Journal of food legumes. 2012;25(4):291-293.
21. Upadhyay RR, Singh PS, Singh SK. Comparative efficacy and economics of certain insecticides against gram pod borer, *Helicoverpa armigera* (Hubner) in chickpea. Indian Journal of Plant Protection. 2020;48(4):403-410.
22. Yadav RK, Chandra U, Veer R, Raj A, Gautam CPN, Kumar S, *et al*. Relative efficacy of newer insecticides against gram pod borer, *Helicoverpa armigera*. Journal of Pharmacognosy and Phytochemistry. 2019;8(4):599-601.