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Field efficacy of insecticides with neem products against chickpea pod borer [*Helicoverpa armigera* (Hubner)]

Thouday Sunil Kumar and Ashwani Kumar

Abstract
Experiment was conducted at Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, U.P. during the *rabi* season of 2021-2022. Two applications of seven insecticides were used against *Helicoverpa armigera*. Results revealed that treatments T6-Lambda cyhalothrin 0.005% LE is most effective treatment with lowest Mean larval population of gram pod borer with (0.73) followed by T3-Emamectin Benzoate 5% SG (1.13), T7- Indoxacarb 14.5% SC (1.29), T5-Cypermethrin 25 EC (1.36), T4- Spinosad 45% SC (1.38), T1-NSKE 5% (1.45), T2-Neem oil 3% (1.66) as compare to T0-control (Water spray). Cost benefit ratio were found highest in T6-Lambda cyhalothrin 0.005% LE (1:4.5) followed by T3-Emamectin Benzoate 5% SG (1:4.5), T7- Indoxacarb 14.5% SC (1:4.0), T4- Spinosad 45% SC (1:4.0), T5-Cypermethrin 25 EC (1:3.8), T1-NSKE 5% (1:3.8), T2-Neem oil 3% (1:3.6) and control T0 (1:2.3).

Keywords: Chickpea, cost benefit ratio, efficacy, *Helicoverpa armigera*, insecticides

Introduction

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops of India. India is the largest producer with 75% of world acreage and production of gram. India produces 5.3 mt of chickpea from 6.67 m ha with an average production of 844 kg ha-1. The survey conducted from time to time by various agencies in different parts of the country revealed that there are many factors which influence the production of chickpea. Among the insect pests particularly pod borer. (Bhushan *et al*., 2011) [1]. chickpea (*Cicer arietinum* L.) is the third most important pulse crop in the world, after dry beans and field peas. (Sarnaik and Chiranjeevi., 2017) [11].

Chickpea the only cultivated species within genus Cicer. Its considerable nutritive value makes it a valuable source for both food and feed it also play an important role in maintaining soil fertility. In India where most of the population is primarily vegetarian chickpea has a special place in the daily diet of people and major source of high protein for human as well as animal consumption. (Singh *et al*., 2015) [12].

Chickpea is generally grown under rain fed or residual soil moisture conditions in rabi season after harvest of rice during October-March. Among the major pulses grown chickpea ranks fifth in area and production but second in consumption priority. It is a popular pulse crop in High Barind Tract (HBT) in the north-west of Bangladesh. (Hossain *et al*., 2010) [7].

It causes on average 30-40% damage to pods that can increase up to 80-90% under favourable environmental conditions. (Chitralekha *et al*., 2018) [3].

According to De Candolle, the fact that gram has a Sanskrit name “Chanaka” which indicates that the crop was under cultivation in India longer than in any other country in the world. It is adapted to relatively cooler climates. The largest area of adaptation is in the Indian sub-continent. In recent years its cultivation has spread to Australia. Gram commonly 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 mha with an average production of 844 kg per ha. (Lavanya and Kumar 2022) [10].

Materials and Methods

The experiment was conducted during *rabi* season 2021 at Central Research Field (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety PUSA 362 seeds in a plot size of 2m×2m at a spacing of 30cm ×10cm with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high.

The population of gram pod borer recorded one day before spraying and on 3rd day, 7th day and 14th day after insecticidal application. The populations of gram pod borer were recorded on 5 randomly selected and tagged plants from each plot and then it was converted into percent of damage by following formula.

Percentage pod damage was calculated with the following formula suggested by Kumar *et al.,* (2013) [9].

$$\text{Percent of pod damage} = \frac{\text{number of infected pods}}{\text{Total number of pods}} \times 100$$

Cost Benefit ratio: Cost effectiveness of each treatment was assessed on net returns. Net return of each treatment was worked out by deducting total cost of the treatment from gross returns. Total cost of production included both cultivation as well as plant protection charges.

Gross return = Marketable yield x Market price

Net return = Gross return – Total cost

$$\text{B: C ratio} = \frac{\text{Gross returns}}{\text{Total cost of Cultivation}}$$

Result and Discussion

All the insecticides were found effective and significantly superior over untreated control. The minimum larval population was recorded in T_6-Lambda cyhalothrin with a minimum per cent of infestation of pod borer (0.73) as the similar findings was reported by Hossain *et al.,* (2010) [7] (0.68), Sarnaik *et al.,* (2017) [11] (0.63). T_3-Emamectin benzoate was found to be the next best treatment with a minimum per cent of infestation of pod borer (1.13) as the similar findings was made by Chaukikar *et al.,* (2017) [2] (1.33), Sarnaik *et al.,* (2017) [11] (1.23). T_7-Indoxacarb was found as the next effective treatment with a minimum per cent of infestation (1.29) as the similar findings was made by Yogeeswarudu *et al.,* (2014) [14] (1.53). T_5-Cypermethrin was found to be the next best treatment with a minimum per cent of infestation of pod borer (1.36) as the similar findings was made by Lavanya and Kumar (2022) [10] (0.42 larvae/plant). T_4-Spinosad was the next effective treatment with a minimum per cent of infestation (1.38) as the similar findings was made by Upadhyay *et al.,* (2020) [13] (0.95).

The maximum yield was recorded in T_6-Lambda cyhalothrin (20.50 q/ha) as the similar findings were made by Hossain *et al.,* (2010) [7] (1883 kq/ha). T_3-Emamectin benzoate was found to be the next best treatment with a maximum yield (19.66 q/ha) as the similar findings were made by Dodia *et al.,* (2009) [6] (1761 kq/ha), Chaukikar *et al.,* (2017) [2] (2260 kq/ha), Sarnaik *et al.,* (2017) [11] (1748 kq/ha), T_7-Indoxacarb was found as the next effective treatment with a minimum yield of (18.83 q/ha) as the similar findings were made by Deshmukh *et al.,* (2010) [5] (1805 kq/ha), Dabhi *et al.,* (2015) [4] (1753 kq/ha), T_5-Cypermethrin was found to be the next best treatment with a minimum yield of (18.00 q/ha) as the similar findings were made by Khape *et al.,* (2020) [8] (1460 kq/ha). T_4-Spinosad was the next effective treatment with a minimum yield of (17.16 q/ha) as the similar findings were made by Dodia *et al.,* (2009) [6] (1717 kq/ha), Deshmukh *et al.,* (2010) [5] (1760 kq/ha), Upadhyay *et al.,* (2020) [13] (15.55 q/ha). T_1-NSKE 5% was found to be the effective treatment with a yield of (16.33 q/ha) as the similar findings were made by Bhushan *et al.,* (2011) [1] (1100 kq/ha).

Higher cost benefit ratio (1:4.5) was obtained from T_6-Lambda cyhalothrin as the similar finding was made by Sarnaik *et al.,* (2017) [11] (1:2.02), the study revealed the treatment T_3- Emamectin benzoate 5 WG @ 15.0 g a.i./ha has the cost benefit ratio of (1:4.5) as the similar findings were made by Sarnaik *et al.,* (2017) [11] (1:3.72), the treatment T_5-Cypermethrin 25 EC exhibited the benefit cost ratio of (1:3.8) as the similar findings were made by Lavanya and Kumar (2022) [10] (1:2.85). The minimum cost benefit ratio (C: B) was recorded in T_7- Indoxacarb (1:4.0) followed by T_4-Spinosad (1:4.1) as the similar findings were made by Lavanya and Kumar (2022) [10] (1:3.07) (1:3.01) respectively, Upadhyay *et al.,* (2020) [13] (1:7.78).

Table 1: Field efficacy of insecticides with neem products against chickpea pod borer [*Helicoverpa armigera*] during *rabi* season 2021-2022 (1st spray)

	Treatment	Larval population of *Helicoverpa armigera*/five plants				Mean
		Before spraying	3DAS	7DAS	14DAS	
T_0	Control	2.27	2.37	2.37	2.47	2.37
T_1	NSKE 5%	2.27	2.07	1.80	1.73	1.96
T_2	Neem oil	2.20	2.13	1.87	1.73	1.98
T_3	Emamectin Benzoate	2.13	1.67	1.53	1.40	1.68
T_4	Spinosad	2.27	1.80	1.73	1.66	1.86
T_5	Cypermethrin	2.33	1.67	1.53	1.49	1.75
T_6	Lambda cyhalothrin	2.33	1.40	1.33	1.27	1.58
T_7	Indoxacarb	2.27	1.67	1.55	1.47	1.74
	F-Test	NS	S	S	S	-
	S.Ed (+)	N/A	0.097	0.233	0.103	-
	C.D(5%)		0.269	0.645	0.285	-

DAS: Day after spray

Table 2: Field efficacy of insecticides with neem products against chickpea pod borer [*Helicoverpa armigera*] during *rabi* season 2021-2022 (2nd spray)

	Treatments	Larval population of *Helicoverpa armigera*/five plants			
		3DAS	7DAS	14DAS	Mean
T_0	Control	3.33	3.67	3.87	3.62
T_1	NSKE 5%	1.60	1.43	1.33	1.45
T_2	Neem oil	1.73	1.67	1.60	1.66
T_3	Emamectinbenzoate	1.27	1.20	0.93	1.13
T_4	Spinosad	1.53	1.35	1.27	1.38
T_5	Cypermethrin	1.53	1.33	1.22	1.36
T_6	Lambda cyhalothrin	1.07	0.73	0.39	0.73
T_7	Indoxacarb	1.40	1.27	1.20	1.29
	F-test	S	S	S	-
	S.Ed (+)	0.231	0.169	0.138	-
	C.D. (5%)	0.639	0.468	0.383	-

DAS: Day after spraying

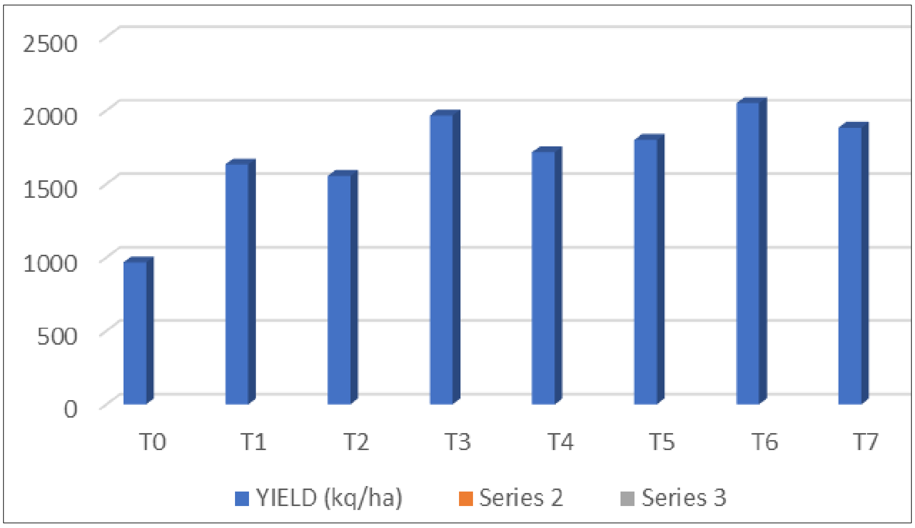

Fig 1: Graphical representation of Yield of Chickpea influenced by different treatments

Table 3: Field efficacy of insecticides with neem products against chickpea pod borer [*Helicoverpa armigera* (Hubner)] on cost benefit ratio of chickpea

Treatment symbols	Treatments	Yield (kg/ha)	Gross return (kg/ha)	Total cost of cultivation	Net return	B:C Ratio
T_0	Control	966	53130	22320	30810	1:2.3
T_1	NSKE 5%	1633	89815	23420	66395	1:3.8
T_2	Neem oil	1555	85525	23620	61905	1:3.6
T_3	Emamectin benzoate	1966	108130	23615	84515	1:4.5
T_4	Spinosad	1716	94380	23520	70860	1:4.0
T_5	Cypermethrin	1800	99000	25520	73480	1:3.8
T_6	Lambda cyhalothrin	2050	112750	24820	87930	1:4.5
T_7	Indoxacarb	1883	103565	25320	78245	1:4.0

Conclusion

From the above findings it can be concluded that the Lambda cyhalothrin is more effective with a maximum yield and highest benefit cost ratio followed by Emamectin benzoate, Indoxacarb, Cypermethrin, Spinosad and NSKE 5%, and Neem oil can be incorporated in Integrated Pest Management Programme as an effective tool against gram pod borer as their doses are very low.

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