

Comparative efficacy and economics of selected chemicals and neem oil against gram pod borer [*Helicoverpa armigera* (Hubner)] on cowpea [*Vigna unguiculata* (L.) Walp.]

ABSTRACT

A field trail was conducted at Naini, Prayagraj during *Kharif* season 2022. Eight treatments were evaluated against *Helicoverpa armigera* i.e. Spinosad 45% SC, Chlorantraniliprole 18.5 % SC, Half dose of Spinosad 45% SC + Neem oil 5% , Indoxacarb 14.5% SC , Imidacloprid 18.5% SC , Neem oil 5% ,Half dose of Imidacloprid 18.5% SC + Neem oil 5% and untreated Control. Results revealed that, among the different treatments lowest larval population of cowpea pod borer was recorded in Chlorantraniliprole 18.5 % SC (1.300). Indoxacarb 14.5% SC (1.467) was found to be the next best treatment followed by Half dose of Spinosad 45% SC +Neem oil 5% (1.678), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (1.823), Spinosad 45% SC (1.945), Imidacloprid 18.5% SC (2.055) where as Neem oil 5% (2.334) was found to be least effective against this pest. The best and most economical treatment was Chlorantraniliprole 18.5 % SC (1:3.63) followed by Indoxacarb 14.5% SC (1:3.41). The yield of plot treated with Chlorantraniliprole 18.5 % SC with (17.40 q/ha) followed by Indoxacarb 14.5% SC (16.22 q/ha),Half dose of Spinosad 45% SC +Neem oil 5% (14.90 q/ha), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (12.68 q/ha), Spinosad 45% SC (11.86 q/ha), Imidacloprid 18.5% SC (11.10 q/ha) and Neem oil 5% (10 q/ha) as compared to untreated control (8.20 q/ha).

Key words: Cost- Benefit ratio, Efficacy, *Helicoverpa armigera*, Insecticides, Larval population.

Introduction

Cowpea (*Vigna unguiculata*) is an important pulse crop which can be cultivated throughout the year. It is one of the most ancient food crops known to man. It is cultivated for green pods as vegetables or for grain or for fodder purposes. They are highly photosensitive, late maturing and are characterized by trailing growth habit associated with heavy spreading branches. The indeterminate growth habit makes it difficult to fit into any successful multicropping systems (Bindu *et al.*, 2011) ^[6]. Cowpea, *Vigna unguiculata* (L.), is an important grain legume grown in the tropics where it constitutes a valuable source of protein

in the diets of millions of people. Cowpea is a diploid with $2n = 22$ and a genome size of about 620 million base pairs (**Bouker et al., 2019**)^[7]. It is drought tolerant like all legumes. Cowpea requires a temperature of not less than 20°C with an optimum range of 18- 32°C for good growth and development. Cowpea is just gaining prominence and gradually graduating to being a major factor among crops that are grown in the zone (**Bayei and Banta, 2021**)^[3].

The grain contains 26.61 percent protein, 3.99 percent lipid, 56.24 percent carbohydrates, 8.60 percent moisture, 3.84 percent ash, 1.38 percent crude fibre, 1.51 percent gross energy, and 54.85 percent nitrogen free extract (**Kumar and Tayde, 2017**)^[14]. Rough estimates indicate that annual global production is around 2 mt from an area of 5m.ha. India accounts for about 0.5 mt production from around 1.5 m.ha. In India, the major area under grain cowpea is mainly confined to the states of Uttar Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala where, it is mainly sown as a mixed crop with other pulses and cereals (**Kumar and Tayde, 2017**)^[14]. The major insect pests attacking cowpea are pod borer *Helicoverpa armigera*, leaf feeding caterpillar *Spodoptera exigua* (Hubner), black cutworm *Agrotis ipsilon*, aphid *Aphis craccivora* and semilooper *Autographa nigrisigna*. Gram Pod borer *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is one of the major insect pests of cowpea and has great economic importance. *Helicoverpa armigera* (Lepidoptera, Noctuidae) is the most serious pest harboring over 181 plant species belonging to 45 families (**Ali et al., 2009**)^[2]. A single caterpillar of this insect can damage 25-40 pods. It causes on average 30-40% damage to pods that can increase upto 80-90% under favourable environmental conditions (**Chithraleka et al., 2018**)^[8].

Conventionally farmers are using various types of synthetic chemical insecticides to control gram pod borer. The repeated use of systemic insecticides alone has resulted in the development of resistance in the insect pest, and disturbance to the agro-ecosystem by affecting the non-target ones. Farmers largely follow the chemical method as it gives quick results. High frequency application is the common scenario. However these chemicals in many cases invited the problems of pesticide resistance, resurgence, secondary pest outbreak, environmental contamination, residual toxicity, phytotoxicity and toxicity to beneficial organisms like predator and parasitoids as well as disturbance in homeostasis of natural population. Therefore, keeping in view the above facts the present investigation was carried out with the aim to develop a new management strategy for control of pest at farmer's farm economically.

Materials and methods:

The experiment was conducted at the experimental research plot of the Department of Entomology, Central Research Farm (CRF), Sam Higginbottom University of Agriculture Technology And Sciences, during the *Kharif* season of 2022, in a Randomized Block Design (RBD) with seven treatments and untreated control were replicated three times using variety Ankur gomati seeds in a plot size of 2m×1m at a spacing of 30cm × 15cm with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. Research field situated at 25°27' North latitude 80°05' East longitudes and at an altitude of 98 meter above sea level. The maximum temperature reaches upto 47°C in summer and drops down to 2°C in winter.

Pest population was estimated by observing five plants selected randomly from each treatment for presence of egg masses and larvae at one day prior to insecticide application and at 3rd, 7th and 14th days after each application. The larval population over control against pod borer (*H. armigera*) was calculated by considering the mean of three observations recorded at 3rd, 7th and 14th days after first and second spraying.

The healthy marketable yield obtained from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during *Kharif* season. The cost of botanicals used was obtained from nearby market. The total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment. The C:B ratio was calculated by formula:

Gross return = Marketable yield × Market price

$$\text{Cost : Benefit Ratio} = \frac{\text{Gross return}}{\text{Total cost of cultivation}}$$

Results and discussion

The results of the field trail with insecticides revealed that among the insecticides treated against gram pod borer after first spray Chlorantraniliprole 18.5%SC (1.689) was found significantly superior in reducing the larval population which was followed by Indoxacarb

14.5% SC (1.889) was found to be the next best treatment followed by Half dose of Spinosad 45% SC +Neem oil 5% (2.045), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (2.200), Spinosad 45%SC (2.289), Imidacloprid 18.5% SC (2.400) and Neem oil 5% (2.622). After second spray, all the insecticides were found superior over untreated control. The overall mean analysis showed that Chlorantraniliprole 18.5%SC (0.911) and Indoxacarb 14.5%SC (1.044) were significantly superior than other treatments followed by Half dose of Spinosad 45% SC +Neem oil 5% (1.311), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (1.444), Spinosad 45%SC (1.600), Imidacloprid 18.5% SC (1.711) where as Neem oil 5% (2.045). The treatments were found to be statistically at par with each other.

Chlorantraniliprole was found to reduce the gram pod borer larval population to a tune of (1.300). Regarding the yield of cowpea, Chlorantraniliprole registered significantly higher yield (17.40 q/ha) and C:B ratio of 3.63 (Table1.). The present finding is in line with observation on field application of Chlorantraniliprole 18.5%SC 0.5ml/l against cowpea pod borer and recorded lowest larval population in cowpea (**Upadhyay et al., 2020^[23]**, **Patil et al., 2018^[17]**, **Santhosh and Kumar, 2022^[20]** and **Rani et al., 2018^[18]**).

Indoxacarb 14.5% SC, Spinosad 45% SC +Neem oil 5%, Half dose of Imidacloprid 18.5% SC + Neem oil 5%, Spinosad 45% SC, Imidacloprid 18.5% SC along with Neem oil 5% was found effective in reducing larval population (**Meena et al., 2018^[15]**, **Gautam et al., 2018^[10]**, **Bharti et al., 2015^[4]**, **Singh et al., 2014^[22]**, **Deshmukh et al., 2010^[9]** and **Jagtap et al., 2020^[12]**). Present finding is in conformity with **Konda and Kumar (2022)^[13]** who reported that the (2.334) performed as the effective botanical in reducing the highest percent of larval population and also reported that yield and quality parameters recorded, were higher in treated plots compared to control plots.

Sreekanth et al. (2014)^[21] who reported maximum control of gram pod borer with the application of Chlorantraniliprole followed by Indoxacarb 14.5% SC. **Gayathri and Kumar (2021)^[11]** who reported that Chlorantraniliprole gave the best performance with minimum (1.300) number of larvae followed by Indoxacarb 14.5% SC (1.467 larvae), which were at par with each other. The efficacy of newer insecticide for the management of *Helicoverpa armigera*, most effective was Half dose of Spinosad 45% SC +Neem oil 5% followed by Half dose of Imidacloprid 18.5%SC + Neem oil 5% reported by (**Abbas et al., 2021^[1]** and **Bhati et al., 2020^[5]**).

Maximum cost benefit ratio (1:3.63) was obtained in Chlorantraniliprole 18.5% SC which was supported by **Upadhyay et al. (2020)** ^[23] who reported that Chlorantraniliprole recorded the highest yield. The next cost benefit ratio obtained in the treatment Indoxacarb 14.5% SC (1:3.41) was supported by **Sai et al. (2021)** ^[19]. The least cost benefit ratio was observed in Neem oil 5% (1:2.09) similar findings made by **Moosan and Kumar (2022)** ^[16] but superior as compared to control plot (1:1.91).

From the above discussion it may be concluded that among the tested insecticides, Chlorantraniliprole 18.5% SC may be recommended for most and economic and effective management of gram pod borer, *Helicoverpa armigera* on cowpea.

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TABLE 1. Efficacy of certain insecticides against larval population of gram pod borer on cowpea (overall mean)

S.No.	Treatments	Larval Population of <i>H. armigera</i> /five plants							Overall mean	Yield (q/ha)	C:B ratio
		First spray				Second spray					
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T ₁	Spinosad 45% SC	2.800	2.467	2.133	2.267	2.067	1.200	1.533	1.945	11.86	1:2.52
T ₂	Chlorantraniliprole 18.5 % SC	2.667	1.933	1.533	1.600	1.267	0.667	0.800	1.300	17.40	1:3.63
T ₃	Half dose of Spinosad 45% SC +Neem oil 5%	2.867	2.200	1.867	2.067	1.667	1.067	1.200	1.678	14.90	1:3.03
T ₄	Indoxacarb 14.5% SC	2.933	2.067	1.733	1.867	1.400	0.800	0.933	1.467	16.22	1:3.41
T ₅	Imidacloprid 18.5% SC	3.000	2.533	2.267	2.400	2.133	1.400	1.600	2.055	11.10	1:2.35
T ₆	Neem oil 5%	2.933	2.733	2.467	2.667	2.467	1.800	1.867	2.334	10	1:2.09
T ₇	Half dose of Imidacloprid 18.5% SC + Neem oil 5%	2.800	2.400	2.067	2.133	1.800	1.133	1.400	1.823	12.68	1:2.62
T ₈	Control	3.067	3.200	3.333	3.467	3.600	3.733	4.133	3.578	8.20	1:1.91
	F-test	NS	S	S	S	S	S	S	S		
	S. Ed (±)	0.0324	0.089	0.077	0.073	0.068	0.057	0.068	0.251		
	C.D. (P = 0.5)		0.193	0.164	0.153	0.150	0.121	0.143	0.067		

Conclusion

From the analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5 % SC (1.300) is more effective in controlling larval population of gram pod borer in cowpea followed by Indoxacarb 14.5% SC (1.467) was found to be the next best treatment followed by Half dose of Spinosad 45% SC + Neem oil 5% (1.678), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (1.823), Spinosad 45% SC (1.945), Imidacloprid 18.5% SC (2.055) and Neem oil 5% (2.334) in managing *Helicoverpa armigera*. Among the treatments studied, Chlorantraniliprole 18.5 % SC gave the highest cost benefit ratio (1:3.63) and marketing yield (17.40 q/ha) followed by Indoxacarb 14.5% SC (1:3.41 and 16.22 q/ha), Half dose of Spinosad 45% SC + Neem oil 5% (1:3.03 and 14.90 q/ha), Half dose of Imidacloprid 18.5% SC + Neem oil 5% (1:2.62 and 12.68 q/ha), Spinosad 45% SC (1:2.52 and 11.86 q/ha), Imidacloprid 18.5%SC (1:2.35 and 11.10 q/ha) and Neem oil 5% (1:2.09 and 10 q/ha) as such more trials are required in future to validate the findings.

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