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Comparative Efficacy and Economics of Selected Chemicals and Neem Oil against Gram Pod Borer [*Helicoverpa armigera* (Hubner)] on Cowpea [*Vigna unguiculata* (L.) Walp.]

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field trial was conducted at Naini, Prayagraj, during *Kharif* season 2022. Eight treatments were evaluated against *Helicoverpa armigera* on cowpea *i.e*. Spinosad 45%SC, Chlorantraniliprole 18.5 % SC, a half dose of Spinosad 45% SC + Neem oil 5%, Indoxacarb 14.5% SC, Imidacloprid 18.5% SC, Neem oil 5%, a half dose of Imidacloprid 18.5% SC + Neem oil 5% and an 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 a half dose of Spinosad 45% SC + Neem oil 5% (1.678), a half dose of Imidacloprid 18.5% SC + Neem oil 5% (1.823), Spinosad 45% SC (1.945), Imidacloprid 18.5% SC (2.055) whereas Neem oil 5% (2.334) was found to be the least effective against this

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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 the treated with Chlorantraniliprole 18.5 % SC with (17.40 q/ha) followed by Indoxacarb 14.5% SC (16.22 q/ha), a half dose of Spinosad 45% SC + Neem oil 5% (14.90 q/ha), a 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 the untreated control (8.20 q/ha).

Keywords: Chlorantraniliprole; cost- benefit ratio; efficacy; Helicoverpa armigera; insecticides; larval population; neem oil.

1. INTRODUCTION

Cowpea (*Vigna unguiculata*) is an important pulse crop that can be cultivated throughout the year. It is one of the most oldest food crops known to man. It is cultivated for green pods as vegetables or for grain or for fodder purposes. **"**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. It is drought tolerant like all legumes. Cowpea requires a temperature of not less than 20℃ with an optimum range of 18- 32℃ 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" [1].

"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" [2]. "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" [2]. "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" [3]. "A single caterpillar of this insect can damage 25-40 pods. It causes on average 30-40% damage to pods, that can increase up to 80-90% under favourable environmental conditions" [4].

Conventionally, farmers use various types of synthetic chemical insecticides to control the 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 a common scenario. However, these chemicals in many cases invite the problems of pesticide resistance, resurgence, secondary pest outbreaks, environmental contamination, residual toxicity, phytotoxicity and toxicity to beneficial organisms like predator and parasitoids as well as disturbances in homeostasis of the natural population. Therefore, keeping in view the above facts the present investigation was carried out with the aim of developing a new management strategy for the economic control of pests on the farmer's farm**.**

2. 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 an untreated control 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. The Research field is at $25^0$27" North latitude $80^0$05"East longitudes and at an altitude of 98 meter above sea level. The maximum temperature reaches upto 47^0C in summer and drops down to 2^0C in winter.

"The Pest population was estimated by observing five plants selected randomly from each treatment for the presence of egg masses and larvae 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 sprayings" [5].

"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 a nearby market. The total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There were two sprays throughout the research period and the overall plant protection expenses were calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit was obtained by subtracting the total cost of plant protection from total income. The benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment" [5]. The C:B ratio was calculated by the formula:

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

3. RESULTS AND DISCUSSION

The results of the field trial with insecticides revealed that among the insecticides treated against gram pod borer after second spray at 14 DAS Chlorantraniliprole 18.5%SC (0.800) was found significantly superior in reducing the larval population which was followed by Indoxacarb 14.5% SC (0.933) was found to be the next best treatment followed by a half dose of Spinosad 45% SC +Neem oil 5% (1.200), a half dose of Imidacloprid 18.5% SC + Neem oil 5% (1.400), Spinosad 45%SC (1.533), Imidacloprid 18.5% SC (1.600) and Neem oil 5% (1.867). The overall mean analysis showed that Chlorantraniliprole 18.5%SC (1.300) and Indoxacarb 14.5%SC (1.467) were significantly superior than other treatments followed by a half dose of Spinosad 45% SC +Neem oil 5% (1.678), a 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).

Chlorantraniliprole was found to reduce the gram pod borer larval population by (1.300). Regarding the yield of cowpea, Chlorantraniliprole registered a significantly higher yield (17.40 q/ha) and C:B ratio of 1:3.63 (Table1.). The present finding is in line with observations on field application of Chlorantraniliprole 18.5%SC 0.5ml/l against cowpea pod borer and recorded the lowest larval population in cowpea [6-9].

Indoxacarb 14.5% SC, Spinosad 45% SC +Neem oil 5%, a 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 [10-15]. Present finding is in conformity with Konda and Kumar [16] reported that botanicals performed in reducing the highest percent of larval population and also reported that yield were higher in treated plots compared to the untreated control plots.

Sreekanth *et al.* [17] reported maximum control of gram pod borer with the application of Chlorantraniliprole followed by Indoxacarb 14.5% SC. Gayathri and Kumar [18] reported that Chlorantraniliprole gave the best performance with a minimum number of larvae followed by Indoxacarb 14.5% SC, which were at par with each other. The efficacy of newer insecticides for the management of *Helicoverpa armigera*, most effective were a half dose of Spinosad 45% SC +Neem oil 5% reported by [19,20].

The maximum cost benefit ratio (1:3.63) was obtained in Chlorantraniliprole 18.5% SC which was supported by Upadhyay *et al.* [6] who reported that Chlorantraniliprole recorded the highest yield. The next cost benefit ratio obtained in the treatment of Indoxacarb 14.5% SC (1:3.41) was supported by Sai *et al.* [21]. The least cost benefit ratio was observed in Neem oil 5% (1:2.09) similar findings made by Moosan and Kumar [22] but superior as compared to the untreated control plot (1:1.91).

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

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

S. No.	Treatments	Larval Population of *H. armigera* /five plants								Yield(q/ha)	C:B ratio
		First spray				Second spray			Overall mean		
		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		

4. CONCLUSION

From the analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5 % SC (1.300) is more effective in controlling the 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 a half dose of Spinosad 45% SC + Neem oil 5% (1.678), a 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), a half dose of Spinosad 45% SC + Neem oil 5% (1:3.03 and 14.90 q/ha), a 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 the future to validate the findings.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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