Efficacy and economics of selected insecticides against pod borer [*Helicoverpa armigera* (Hubner)] on cowpea [*Vigna unguiculata* (L.)Walp.]

ABSTRACT

A field trail was conducted at CRF, SHUATS, Naini, Prayagraj during *Kharif* season 2022. Eight treatments were evaluated against *Helicoverpa armigera i.e*. of Chlorantraniliprole 18.5 SC, Emamectin benzoate 5 SG, Flubendiamide 480 SC, Spinosad 45 SC, Thiamethoxam 25 WG, Lambda cyhalothrin5 EC, Indoxacarb 14.5 SC and untreated Control. Results revealed that, among the different treatments lowest larval population of cowpea pod borer was recorded in Chlorantraniliprole 18.5 SC (1.323). Lambda cyhalothrin5 EC (1.478) was found tobe the next best treatment followed by Emamectin benzoate 5 SG (1.589), Indoxacarb 14.5 SC (1.734) and Flubendiamide 480 SC (1.922).The least effective treatments were Spinosad 45 SC (2.089) where as Thiamethoxam 25 WG (2.200) was found to be least effective. The plot treated with Chlorantraniliprole 18.5 SC show highest yield (19.46 q/ha) followed Lambda cyhalothrin5 EC (17.82 q/ha) the best and most economical treatment was Chlorantraniliprole 18.5 SC (1: 3.89). Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5 SC (1: 3.89) followed by Lambda cyhalothrin 5 EC (1:3.67), Emamectin benzoate 5 SG (1:3.41), Indoxacarb 14.5 SC (1:2.95), Flubendiamide 480 SC (1:2.56), Spinosad 45 SC (1:2.27) and Thiamethoxam 25 WG (1:2.17) as compared to untreated control plot (1:1.60).

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

Introduction

"Cowpea [*Vigna unguiculata* (L.) Walp.] is an important grain legume mainly grown in tropical and subtropical regions for vegetables, grains, and fodder. Cowpea belongs to the family Fabaceae and sub-family Faboidea, and it is a self-pollinating crop with low and narrow genetic diversity, making it susceptible to various environmental factors" **(Horn *et al*., 2022) [9]. "**It requires very few inputs, as the plants root nodules are able to fix atmospheric nitrogen, making it a valuable crop for resource poor farmers and well suited to intercropping with other crops" **(Lakshmikanth and Kumar 2018) [13]. "**Cowpea is known as vegetable meat due to high amount of protein in the grain with better biological value on dry weight basis. The grain contains 26.61% protein, 3.99% lipid, 56.24% carbohydrates, 8.60% moisture, 3.84 % ash, 1.38% crude fibre, 1.51 % gross energy, and 54.85% nitrogen free extract" **(Oyewale and Bamaiyi, 2013) [18]. "**There are about 21 insect pests of different groups have been recorded damaging the cowpea crop from germination to maturity. The avoidable losses in yield due to insect pests have been recorded in the range of 66 to 100 per cent in cowpea". [21] "The podborer complex posing serious threat to cowpea cultivation includes Bean pod borer (*Maruca vitrata)* (Fabricius), Blue butterfly (*Lampides boeticus)* (L.), Cow pea pod borer (*Helicoverpa armigera)* (Hubner), Pulse pod borer moth (*Etiella zinckenella*), *Field bean pos borer (Adisura atkinsoni)* and Red gram pod fly (*Exelastis atomosa)* (Walsingham)" **(Kumar and Tayde 2017)**
[12].

"Helicoverpa armigera (Hubner) is a major pest that attacks wide range of different vegetable crops and causes serious economic damage and yield loss. The caterpillars of gram pod borer not only defoliate the leaves but also feed on seeds.While feeding on the developing seeds it's nearly half of the anterior body portion remains inside while the rest of the half portion remains hanging outside. A single larva may destroy 30-40 pods before it reaches maturity. The caterpillars feed on their fellows if suitablevegetation is not available i.e., cannibalism. They pupate in the soil. The pod damage due to *Helicoverpa armigera* on cowpea crop could increase up to 100% in India. The best way to overcome this damage is to destroy the pest at its initial stage of the life cycle". **(Ahmed and Awan, 2013) [1].**

Despite all the drawbacks that come with chemical control of pests, there are still many reasons that can persuade farmers to still choose to use them. Regardless of several control strategies that were found effective in managing this pest the chemical control plays a vital role because of quick action, readily available and very easy to use unlike alternative methods, such as biological control and other similar methods which can take a long while to plan and often don't have an immediate effect on pests. 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, Sam Higginbottom University of Agriculture Technology And Sciences, during the *Kharif* season of 2022, in a Randomized Block Design with eight treatments replicated three times using variety Kashi kanchan seeds in a plot size of 2m×1m at a spacing of 30 cm × 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 $25^0$27” North latitude $80^0$05”East longitudes and at an altitude of 98meter above sea level. The maximum temperature reaches upto 47^0C in summer and drops down to 2^0C 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 3^{rd}, 7^{th} and 14^{th} days after each application. The larval population over control against pod borer (*H. armigera*) was calculated by considering the mean of three observations recordedat 3^{rd}, 7^{th} and 14^{th} 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 expenseswas 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 wasobtained by subtracting the income of the control treatment from that of each sprayedtreatment”. [21] The C:B ratio was calculated by formula:

$$\text{Gross return} = \text{Marketable yield} \times \text{Market price}$$

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

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 (1.645) was found significantly superior in reducing the larval population which was followed by Lambda cyhalothrin5 EC (1.755) was found to be the next best treatment followed Emamectin benzoate 5 SG (1.845), Indoxacarb 14.5 SC (2.000), Flubendiamide 480 SC (2.133), Spinosad 45 SC (2.244) and Thiamethoxam25 WG (2.333). After second spray, all the insecticides were found superior over untreated control. The overall mean analysis showed that Chlorantraniliprole 18.5% SC (1.323) and Lambda cyhalothrin5 EC (1.478) were significantly superior than other treatments followed by Emamectin benzoate 5 SG (1.589), Indoxacarb 14.5 SC (1.734), Flubendiamide 480 SC (1.922), Spinosad 45 SC (2.089) whereas Thiamethoxam25 WG (2.200). The treatments were found to be statistically at par with each other.

"Chlorantraniliprole was found to reduce the pod borer larval population to a tune of (1.323). Regarding the yield of cowpea, Chlorantraniliprole registered significantly higher yield (19.46 q/ha) and B:C ratio of 3.89 (Table 1.). The present finding is in line with observation on field application of Chlorantraniliprole 18.5% EC 0.5ml/l against cowpea pod borer and recorded lowest larval population in cowpea" (**Sreekanth *et al.*, 2014[20], Iqbal *et al.*, 2014[10], Chitralekha *et al*., 2018[2]** and **Patil *et al.*, 2018[19]).**

Lambda cyhalothrin5 EC, Emamectin benzoate 5 SG, Indoxacarb 14.5 SC, Flubendiamide 480 SC, Spinosad 45 SC along with Thiamethoxam25 WG was found effective in reducing larval population **(Lekha *et al*., 2017[14], Moosan and Kumar (2022) [16], Game *et al*., 2018[6] and Dinesh *et al*., 2017[4].**

Dadas *et al.* (2019) [3] who reported maximum control of gram pod borer with the application of Chlorantraniliprole followed by Lambda cyhalothrin 5 EC**. Gudipati and Mondal (2020) [8]** who reported that Chlorantraniliprole gave the best performance with minimum (1.323) number of larvae followed by Lambda cyhalothrin 5 EC (1.478 larvae), which were at par with each other. The efficacy of newer insecticide for the management of *Helicoverpa armigera*, most effective was Emamectin benzoate 5 SG followed by Indoxacarb 14.5 SC reported by **Fakhouri *et al*., (2022) [5] and Meena *et al.*, (2018) [15].**

Maximum cost benefit ratio (1:3.89) was obtained in Chlorantraniliprole 18.5% SC which was supported by **Iqbal *et al.* (2014) [10]** who reported that Chlorantraniliprole recorded the highest yield. The next cost benefit ratio obtained in the treatment Lambda cyhalothrin5 EC (1:3.67) was supported by **Jagtap and Kumar (2022)** [11]. The least costbenefit ratio was observed in Thiamethoxam25 WG (1:2.17) similar findings made by **Nithish *et al*. (2015)**[17] but superior as compared to control plot (1:1.60).

Conclusion:

From the analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5 SC is more effective in controlling population of cowpea pod borer followed by Lambda cyhalothrin 5 EC was found to be the next best treatment followed by Emamectin benzoate 5 SG, Indoxacarb 14.5 SC, Flubendiamide 480 SC, Spinosad 45 SC and Thiamethoxam 25 WG in managing *Helicoverpa armigera*. Among the treatments studied, Chlorantraniliprole 18.5 SC gave the highest cost benefit ratio (1:3.89) and marketing yield (19.46 q/ha) followed by Lambda cyhalothrin 5 EC (1:3.67 and 17.82 q/ha), Emamectin benzoate 5 SG (1:3.41 and 16.20 q/ha), Indoxacarb 14.5 SC (1:2.95 and 14.60 q/ha), Flubendiamide 480 SC (1:2.56 and 12.45 q/ha), Spinosad 45 SC (1:2.27 and 11.40 q/ha) and Thiamethoxam 25 WG (1:2.17 and 10.24 q/ha) as such more trials are required in future to validate the findings.

TABLE 1. Efficacy of certain insecticides against pod borer [*Helicoverpa armigera* (Hubner)] on cowpea [*Vigna unguiculata* (L.) Walp.] 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	Chlorantraniliprole 18.5 SC	2.467	1.800	1.467	1.667	1.400	0.733	0.867	1.323	19.46	**1:3.89**
T_2	Emamectin benzoate 5 SG	2.533	2.000	1.667	1.867	1.667	1.133	1.200	1.589	16.20	**1:3.41**
T_3	Flubendiamide480 SC	2.400	2.267	1.933	2.200	2.000	1.467	1.667	1.922	12.45	**1:2.56**
T_4	Spinosad 45 SC	2.600	2.333	2.000	2.400	2.200	1.733	1.867	2.089	11.40	**1:2.27**
T_5	Thiamethoxam25 WG	2.667	2.400	2.133	2.467	2.333	1.867	2.000	2.200	10.24	**1:2.17**
T_6	Lambda cyhalothrin5 EC	2.333	1.933	1.533	1.800	1.533	0.933	1.133	1.478	17.82	**1:3.67**
T_7	Indoxacarb 14.5 SC	2.467	2.200	1.867	1.933	1.800	1.200	1.400	1.734	14.60	**1:2.95**
T_8	Control	2.400	2.533	2.600	2.667	2.733	2.800	2.933	2.711	7.10	**1:1.60**
	F-test	NS	S	S	S	S	S	S	S		
	S. Ed (±)	------	0.089	0.057	0.077	0.067	0.057	0.063	0.024		
	C.D. (P = 0.5)	-------	0.189	0.124	0.177	0.143	0.130	0.140	0.063		

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