RESEARCH ARTICLE

EFFICACY OF COMMERCIAL INSECTICIDE FOR THE MANAGEMENT OF COWPEA POD BORER (MARUCA VITRATA) ON COWPEA (VIGNA UNGUICULATA (L.) WALP) UNDER FIELD CONDITION IN CHITWAN, NEPAL

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ABSTRACT

A field experiment was conducted to evaluate the efficacy of commercially available insecticides for management of cowpea pod borer to know about the effective and safe chemical insecticide to manage the cow pea pod borer. A total of five treatments; (i. Neemix (2ml/L), ii. Flubendamide 48% SC (2ml/L), iii. Spinosad 45% SC (3ml/L), iv. Chlorantraniliprole 18.5% SC(2ml/L) and v. control) were tested using Randomized Complete Block Design (RCBD) with four replications for each treatment. The results showed that the Chlorantraniliprole 18.5% SC was most effective to reduce cowpea pod borer larva followed by Flubendamide 48% SC and Spinosad 45% SC. The damage of pod by cowpea pod borer was recorded the highest control plot (20.53%) whereas lowest fruit damage was recorded Chlorantraniliprole (5.18%) followed by Flubendamide (5.44%). Among the treatments, the highest yield was obtained with Chlorantraniliprole (11.22mt/ha) followed by Flubendamide (9.21mt/ha) and Spinosad (8.27/ha). Whereas the lowest yield was obtained with control plot (6.59mt/ha) followed by Neemix (7.09mt/ha) treated plots. The benefit-cost (B:C) ratio for all the treatments revealed that chlorantraniliprole @ 0.2ml/L was highly economical with a B:C of 1:62.14 followed by spinosad with 1: 21.91. The chlorantraniliprole resulted the lowest larval count, lowest fruit damage, highest yield and highest marginal B: C thus could be the best insecticide to manage cowpea pod borer.

KEYWORDS

Cowpea, Damage, Insecticides, Management, Pod borer.

1. INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) popularly known as black pea or Lobia or Barbati or southern pea. It is grown both as summer and in rainy season crop in Nepal. It belongs to the family leguminosae, sub family fabaceae and genus *Vigna*. It is one of the ancient crops known to man. It has multiple uses like food, feed, forage, fodder, green manuring and vegetable. Dry seeds are rich in protein (22%-24%). called as vegetable meat. Cowpea is a heat-loving and drought-tolerant crop. This crop is known as drought hardy nature, its wide and droopy leaves keeps soils and soil moisture conserved due to shading effect.

The productivity of this crop is under threats by many biotic and abiotic factors (Ehlers and Hall, 1997). The key pests of cowpea include Pod borers, Aphids, leafhoppers and Sucking bugs which affect 90% plants of total according to the field study reduction in the quantity produced

degradation in quality as well as spread of diseases is high in cowpea due to these insect pests (Jackai et al., 1992; Karungi, et al., 2000). The legume pod-borer (*M. vitrata*) is one of the most important pests of grain legume throughout the tropics and sub-tropics of world (Jackai and Daoust, 1986). The production of cowpea has continued to decline due to activities of wide spectra of insect pests, notably damage caused by *M. vitrata*. Severe infestation by the borer can cause 20-80% yield losses (Singh and Allen, 1980). The caterpillar rolls the leaves and web these with the top shoot. Caterpillar bore into the pods and feed on the seeds, if flower and pods are not available larvae feed on foliage (Singh and Jackai, 1988). One of the way for managing the insect is application of insecticides (Perkins, 1982). The improper application of insecticides has resulted in environmental, human health problems and insect resistance (Palumbo et al., 2001).

Farmers are using chemical pesticides frequently to manage this insect. But, the awareness level regarding pesticide use and safety among the

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farmers was very low and some fruits and vegetable samples were contaminated even with banned pesticide in Nepal (Giri, 2010). The use of chemical pesticides degrades soil health, water condition and affects human health (Vinutha et al., 2013). Still farmers are in state of confusion which insecticide would effectively control the Cowpea pod borer. So, this study was conducted to evaluate efficacy of bio-pesticides and novel insecticide against legume pod borer for identification of effective safe insecticide against Cowpea pod borer.

2. METHODOLOGY

2.1 Experimental Site and Design

The experiment was carried out at horticultural research field of Agriculture and Forestry University, Rampur, Chitwan, Nepal in randomized complete block design (RCBD) with five treatments and was replicated four times. The geographical location of the experimental field was 27°37' N latitude, 84°25' E longitude at an altitude of 256 meter above sea level and has a sub-tropical climate (Thapa and Dangol, 1988). The experiment was carried out under field condition during summer season. The seed was sown on 30th March and crop growing period was about 3 months. The maximum and minimum temperatures of 34.5°C and 22.5°C respectively, relative humidity of 80-85% and rainfall of 90-120 mm were detected during the crop growing period. The soil type was sandy loam with adequate drainage channels.

2.2 Treatment details

Table 1: Details of Treatments			
Treatment number	Treatments	Trade name	Concentration (%) / Dose
T ₁	Neem extract	Neemix	2ml/L
T ₂	Flubendiamide 48 % SC	Fame	0.2ml/L
T ₃	Spinosad 45 % SC	Tracer	0.3ml/L
T ₄	Chlorantraniliprole 18.5 % SC	Alcora	0.2ml/L
T ₅	Untreated control (water)	-----	-----

2.3 Physico-Chemical Properties of Experimental Soil

Composite soil sample were randomly taken from different spot using screw auger to record the initial soil physico-chemical properties of the experimental site. Soil pH that affects the availability of mineral nutrients was 7.06. The total carbon and nitrogen was 0.70 and 0.086 percent respectively. Soil texture of the field was sandy loam.

2.4 Cultivation Practice

Karma stick-less variety of cowpea was used to carry out experiment. During sowing, plot size of 9 sq. m. area maintaining plant to plant distance of 60 cm and row to row distance of 60 cm was made. 50 cm wide border was left around the experimental field and 1m in between the blocks. About 20 numbers of seed were sown in each plot. For the prevention of weed infestation and for the moisture retention in the field, mulching was practiced (Schonbeck, 2015). Different intercultural practices like gap filling, thinning, weeding, irrigation practices were done in the field in the required time according to the need of the crop. Different treatments were sprayed using Knapsack sprayer at late afternoon in the experimental plot.

2.5 Data Collection and Analysis

For the collection of data, six sample plants were selected and tagged from each plot containing twenty-five plant populations. The data regarding to the Number of normal pod, Wt. of normal pod, Number of damaged pod,

wt. of damaged pod and number of larva in damaged fruit were taken from those sample plants. Data of number of larva in ten flowers before treatment and six days after successive spray from non-sample plants was recorded. The crop was harvested at the maturity stage and pod yield of the sample plant in the plot was recorded then the pod yield was converted into ton per hectare and economic analysis was also done.

The data obtained were taken into consideration to calculate the percentage reduction in the population which was determined by applying a correction factor given by Henderson and Tilton referring it to Abbott modification (Püntener, 1981).

$$\text{Percentage reduction} = 100 \times [1 - \{(T_a \times C_b) / (T_b \times C_a)\}]$$

Where; T_a = Number of insects after treatment.

T_b = Number of insects before treatment.

C_a = Number of insects in untreated control after treatment.

C_b = Number of insects in untreated control before treatment.

2.6 Statistical Analysis

The data collected in the experiment were statistically analysed with Genstat and MS-Excel. Analysis of variance (ANOVA) was done on every measured parameter to determine the significance of differences between means of treatments. Means for each parameter were separated by the Duncan's multiple range test (DMRT) and the treatment means were compared by the Least Significant Difference (LSD) test at 5% level (Gomez and Gomez, 1984; Shrestha, 2019).

3. RESULT AND DISCUSSION

3.1 Effect of Insecticides on Cowpea Pod Borer Larva Count

After the insecticide's application, cowpea pod borer larva population was significantly decreased in all treated plots after application in comparison to untreated control (Table 2). At the sixth day after first spray, the effect of Chlorantraniliprole 18.5 SC at 0.2 ml/L was found significantly higher for cowpea pod borer larva population reduction (90.83%) as compared to untreated plot. The cowpea pod borer larva was statistically similar in Flubendiamide and Spinosad with value of 3.75 and 5.25 cowpea pod borer larva count per ten flowers and they provided 70.26 and 61.62 per cent reduction in population over untreated control in six days after 1st spray, respectively. The treatment with Chlorantraniliprole 18.5 SC at 0.2 ml/L result in significantly lower cowpea pod borer larval count in all the spray with the value of 1.00, 0.50 and 0.25 in 2nd, 3rd and 4th spray respectively. Similarly, Flubendiamide 48% SC and Spinosad 45% SC result in intermediate larval population count with value of 1.25 & 3.00, 0.50 & 0.50, 0.50 & 0.75 in 2nd, 3rd and 4th spray respectively. But Neem extract treated plot results in highest larval count as compared to other plot with value of 6.50, 3.00, 0.75 and 1.00 in 1st, 2nd, 3rd and 4th spray respectively.

Chlorantraniliprole 9.3% + λ cyhalothrin 4.6% @ 0.5 ml/L was found to be most effective with 75.91 percentage reduction in mean larval population of *M. vitrata* over control, followed by chlorantraniliprole 18.5 SC @ 0.0037% and flubendiamide @ 39.35 SC 0.00787% with 72.04 and 67.30 per cent overall reduction in mean larval population of *M. vitrata* over untreated control (Swathi et al., 2018). The present results are in agreement with the findings of against *M. vitrata* recording 90.21 per cent reduction over control (Baskaran et al., 2012). Flubendiamide 48% SC and Spinosad 45% SC were found to intermediate effective in reducing the *Maruca vitrata* Geyer (Aktar et al., 2020). Flubendiamide 48% SC recorded high larval population reduction (84.45%) in *M. testulalis* on blackgram (Shivaraju et al., 2011). A group researcher against *M. vitrata* conforming the outcome of the present study pertaining the efficacy of flubendiamide (Mahalakshmi et al., 2012; Priyadarshini et al., 2013; Anusha et al., 2014). Neem extract treated plot was found to be least effective in the research carried (Stanikzi and Thakur, 2016).

Table 2: Effects of insecticides on cowpea pod borer larva population in ten flowers before and six days after successive spray in Chitwan, 2019.

Treatments	Before Treatment	Six days after 1 st spray	Six days after 2 nd spray	Six days after 3 rd spray	Six days after 4 th spray
Neem extract	14.50 (3.862)	6.50 ^{ab} (2.637)	3.00 ^{ab} (1.851)	0.75 ^{ab} (1.095)	1.00 ^b (1.225)
Flubendiamide 48 % SC	15.25 (3.959)	3.75 ^{ab} (2.052)	1.25 ^{bc} (1.314)	0.50 ^b (0.966)	0.50 ^b (0.966)
Spinosad 45 % SC	16.50 (4.121)	5.25 ^{ab} (2.383)	3.00 ^{ab} (1.861)	0.50 ^b (0.996)	0.75 ^b (1.095)
Chlorantraniliprole 18.5 % SC	16.50 (4.117)	1.25 ^b (1.274)	1.00 ^c (1.225)	0.50 ^b (0.966)	0.25 ^b (0.837)
Untreated control (water)	13.00 (3.666)	10.75 ^a (3.348)	4.50 ^a (2.222)	3.0 ^a (1.861)	3.00 ^a (1.828)
CV	14.20	23.0	34.7	59.0	76.1
LSD	3.25	1.906***	1.334***	0.933***	1.261**

CV: Coefficient of Variation; LSD: Least Significance Difference; Values with the same letter in a column are not significantly different at 5% DMRT; SEM: standard error of means. The figures in the parentheses are the angular transformed values.

3.2 Effect of Insecticides on Fruit (Pod) Infestation of Cowpea

The field experiment showed that total fruit number and total fruit weight was similar among different treatment. The damage percentage of fruit by cowpea pod borer on number basis was the highest with control plot (20.43) and lowest fruit damage on number basis was found in Chlorantraniliprole 18.5 % SC (Table 3). Similar was the result of damage percent of fruit by cowpea pod borer on weight basis with highest damage in control plot (30.66%) followed by neem treated plot (11.24%) and lowest damage was observed in Chlorantraniliprole 18.5% SC plot (4.57%). A group researchers reported that the mean percent pod damage was found to be significantly low in plots treated with chlorantraniliprole (2.1%) and flubendiamide (3.6%), followed by spinosad (6.2%), while 31.2% damage was noticed in the untreated control (Sreekanth et al., 2015). The results obtained in the present investigation were in agreement with the findings of Haritha, (2008), who reported that chlorantraniliprole (0.009%) recorded least pod damage (1.6 %) due to M. vitrata on pigeonpea than control (5.3%).

Table 3: Effect of treatments on the total number fruit, total fruit weight, percentage of damage fruit on number basis and weight basis in Chitwan, 2019

Treatments	Total fruit number/six plant	Total fruit weight/six plant(g)	Damage fruit	Percent
			number basis	weight basis(g)
Neem extract	224	1575	9.59 ^b	11.24 ^b
Flubendiamide 48 % SC	247	1997	5.44 ^{cd}	5.01 ^{cd}
Spinosad 45 % SC	245	1821	7.93 ^{bc}	7.86 ^c
Chlorantraniliprole 18.5 % SC	276	2054	5.18 ^d	4.57 ^d
Untreated control (water)	220	1540	20.53 ^a	20.66 ^a
CV	23.40	20.70	6.20	5.50
LSD	69.43	560.20	0.916***	0.820***

CV: Coefficient of Variation; LSD: Least Significance Difference; Values with the same letter in a column are not significantly different at 5% DMRT; SEM: standard error of means.

3.3 Effect of Insecticides on Yield of Cowpea

Among the treatment, the highest yield was obtained with Chlorantraniliprole (11.22mt/ha) followed by flubendiamide (9.21mt/ha) which was statically similar with spinosad (8.27mt/ha). The lowest yield was obtained in untreated control plot(6.59mt/ha). The novel insecticide like Chlorantraniliprole, Flubediamide and Spinosad were highly effective against Lepidopteran pests (Chatterjee and Mondal, 2012). A group researchers also reported highest yield of pigeonpea with use of Chlorantraniliprole followed by Flubendiamide (Sreekanth et al., 2015). Similar result was obtained in the research carried out (Mohanraj et al., 2012; Sapkal et al., 2018).

Table 4: Effects of insecticides on the yield of Cowpea in Chitwan, 2019.

Treatments	Yield (mt/ha)
Neem extract	7.09 ^{cd}
Flubendiamide 48 % SC	9.21 ^b
Spinosad 45 % SC	8.27 ^{bc}
Chlorantraniliprole 18.5 % SC	11.22 ^a
Untreated control (water)	6.59 ^d
LSD	1.59
CV(%)	12.4

CV: Coefficient of Variation; LSD: Least Significance Difference; Values with the same letter in a column are not significantly different at 5% DMRT; SEM: standard error of means.

3.4 ECONOMIC ANALYSIS

The marginal benefit cost ratios (CBR) among various insecticidal treatments varied between 1:62.14 and 1:2.75 which is the ratio of the value of yield gain to the cost of treatment. (table 5). Maximum BCR (1:62.14) was recorded with chlorantraniliprole 18.5 SC followed by spinosad 45 SC (1:21.91) and least cost - benefit ratio was recorded with Neem extract (1:2.75). The cost effectiveness of chlorantraniliprole 18.4% SC might be due to their lower doses against the pod borer coupled with their low market price. These treatments recorded higher benefit-cost ratio which was in accordance with (Kumar and Sarada, 2015; Singh, 2014).

Table 5: Economics of different insecticides applications against Cowpea pod borer on cowpea

Treatments	Dosage L / kg/ha	Cost of the insecticide Rs. /kg	Cost Rs L/kg ha -1	Yield (mt/ha)	Additional yield (mt/ha)	Inco me NRs.	Total Labour costs Rs	Total Cost of plant protection Rs. Ha	Net profit Rs.	Marginal B:C Ratio
Neem	1.5L/ha	1000	1500	7.09	0.5	7500	500	2000	5500	1:2.75
Flubendiamide 0.2ml/L	0.1L/ ha	30000	3000	9.21	2.62	39300	500	3500	35800	1:10.23
Spinosad 45 SC 0.3ml/L	0.15 L/ ha	4000	600	8.27	1.68	25200	500	1100	24100	1:21.91
Chlorantraniliprole 0.2ml/L	0.1L/ ha	6000	600	11.22	4.63	69450	500	1100	68350	1:62.14
Untreated control	-	-	-	6.59	-	-	-	-	-	-

4. CONCLUSION

The present findings conclude that the new generation insecticides like chlorantraniliprole 18.5 % SC, Flubendamide 48 % SC and Spinosad 45% SC were effective against cowpea pod borer (*M. vitrata*) along with an additional yield as compared to control plot. It was further observed that the benefit-cost ratio was also high with chlorantraniliprole and spinosad. Hence, it is suggested that the reduction in larval population is more or larval population was low with these chemicals and also reduces the risk of increased insecticidal resistance.

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