Original Research Article

‘‘Comparative efficacy of selected biopesticides with chemicals against shoot and fruit borer, *Leucinodes orbonalis* (Guenee) on brinjal”

ABSTRACT

The present experiment was conducted during *Kharif* season of 2022 at Central Research Farm (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Total of two sprays were applied using eight treatments with three replications using Randomized Block Design (RBD), to evaluate the per cent infestation of shoot and fruit borer on brinjal. The results revealed that all the treatments were superior over the control against the infestation of brinjal shoot and fruit borer on third, seventh and fourteenth days after spraying. Among all the treatments, Chlorantraniliprole 18.5% SC @ 0.4ml/L was found to be the most effective treatment with (8.26%) infestation in shoot and (7.69%) infestation in fruit, followed by Emamectin benzoate 5% SG @ 0.4gm/L (14.19%) and (12.55%). The next best treatments were found to be Indoxacarb 14.5% SC @ 1ml/L (14.39%) and (13.67%), Chlorpyriphos 20 EC @ 0.25ml/L (17.42%) and (14.40%), *Metarhizium anisopliae* @ 2×10^8 CFU (18.16%) and (14.64%), *Beauveria bassiana* @ 2×10^8 CFU (19.40%) and (15.46%). Neem oil 2% @ 20ml/L (21.88%) and (16.41%) was found to be least effective. The highest yield and cost benefit ratio was recorded in Chlorantraniliprole 18.5% SC (210.6 q/ha) and (1:7.48) followed by Emamectin benzoate 5% SG (187.5 q/ha) and (1:6.88), Indoxacarb 14.5% SC (163.5 q/ha) and (1:5.87), Chlorpyriphos 20% EC (131.9 q/ha) and (1:4.82), *Metarhizium anisopliae* (121.5 q/ha) and (1:4.28), *Beauveria bassiana* (116.3 q/ha) and (1:4.13) and Neem oil 2% (104.2 q/ha) and (1:2.67).

Key words: Biopesticides, brinjal, chlorantraniliprole, cost benefit ratio, *Leucinodes orbonalis.*

INTRODUCTION

Brinjal (*Solanum melongena* Linnaeus), also known as Eggplant, is referred as the ‘‘King of Vegetables’’. It is originated from India and now grown as a vegetable throughout the tropical, sub-tropical and warm temperate areas of the world **(Kolhe *et al*., 2017)**.The egg plant continues to be an important domestic crop cultivated across the country accounting for 9% of total vegetable production and covering 8.14% of land under vegetable cultivation.

India is the second largest producer of brinjal in the world next to China (Tripura *et al*., 2017). The major brinjal growing states in India are West Bengal, Orissa, Gujarat, Bihar, Andhra Pradesh, Tamil nadu, Maharastra and Madhya Pradesh. In India, West Bengal contribute highest area 181.5 million hectare and production 2877 million tonnes, Karnataka has high productivity 25.4 million tonnes per hectare. In Uttar Pradesh, the area under cultivation of brinjal is 3430 hectare, producing 111.70 MT **(Yadav *et al*., 2015)**.

Though brinjal is a summer crop, it is been grown throughout the year under irrigated conditions. Hence it is subjected to attack by number of insect pest right from the nursery stage till harvesting **(Raghupathy *et al*., 1997)**. Brinjal is attacked by more than 70 insect pests, among the insect pests infesting brinjal, the major one is shoot and fruit borer, *Leucinodes orbonalis* (Guenee) **(Shridhara *et al*., 2019)**. It is an internal borer and known to damage shoot and fruit of brinjal. The pest is estimated to cause 70 to 92 percent yield loss.The larvae of this pest cause 12 to 16 percent damage to shoots and 20 to 60 percent damage to fruits. The pest is very active during rainy and summer season and often causes more than up to 95 percent in India **(Anwar *et al*., 2015)**.

There is a tremendous misuse of insecticides in an attempt to produce damage free marketable fruits. Insecticides have been reported effective against this pest but it is observed that this pest defies all the chemical control measures. Excessive dependence on huge quantities of insecticides, alone and in combinations, to control the pest is causing ecological pollution and pest resistance. It has become necessary to use preparations which are safe, effective and cheap. Hence present investigation was undertaken to evaluate the performance of certain insecticide at their recommended dosages against brinjal shoot and fruit borer.

MATERIALS AND METHODS

The present experimental work was carried out at Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during *Kharif* season of 2022.The experiment was laid out in Randomized Block Design (RBD) with three replications. Crop was raised with a spacing of 60×45cm, in plots measuring 2m×1m each. The treatments *viz*., Emamectin benzoate 5% SG @ 0.4gm/L, Indoxacarb 14.5% SC @ 1ml/L, Chlorpyriphos 20% EC @ 0.25ml/L, Chlorantraniprole 18.5% SC @ 0.4ml/L, Neem oil 2% @ 20ml/L, *Metarhizium anisopliae* (2×10^8 CFU) @ 2.5 gm/L, *Beauveria bassiana* (2×10^8 CFU) @ 2.5 gm/L were applied twice at an interval of 15 days. The count of per cent infested shoots and fruits were recorded from five randomly selected and tagged plants. The observations were drawn on before and three, seven, fourteen days after spray. The per cent infestation on shoot and on fruit were calculated by using the following formulae,

On shoot:

Shoot infestation was computed by counting the number of infested shoots and total number of shoots from five selected plants.

$$\%\ \text{Shoot infestation} = \frac{\text{No.of shoots infested}}{\text{Total no.of shoots}} \times 100$$

(Rahman *et al*., 2009)

On fruit:

Fruit infestation was computed by counting the number of infested fruits and total number of fruits from five selected plants.

$$\%\ \text{Fruit infestation} = \frac{\text{No.of fruits infested}}{\text{Total no.of fruits}} \times 100$$

(Rahman *et al*., 2009)

The data on per cent infestation of brinjal shoot and fruit borer on both shoot and fruit were pooled separately and assessed to statistical analysis **(Gomez and Gomez 1976)**. The fruit yield was harvested from each plot separately and the mean of marketable yield was recorded. Cost Benefit Ratio is also drawn by dividing the gross returns with the total cost of cultivation.

RESULTS AND DISCUSSION

The data on the pooled mean of per cent shoot infestation of brinjal shoot and fruit borer on 3^{rd}, 7^{th} and 14^{th} day after the first spray revealed that, all the chemical treatments were significantly superior over control. Among all the treatments (Table 1) , the lowest per cent shoot infestation was recorded in Chlorantaniliprole 18.5% SC (8.26%), Emamectin benzoate 5% SG (14.19%), Indoxacarb 14.5% SC (14.39), Chlorpyriphos 20% EC (17.42%), *Metarhizium anisopliae* (18.16%), *Beauveria bassiana* (19.40%) and Neem oil 2% (21.88%) was found to be least effective but significantly superior over the control (26.23%).

The data on the pooled mean (Table 1) of per cent fruit infestation of brinjal shoot and fruit borer on 3^{rd}, 7^{th} and 14^{th} day after the second spray revealed that, the lowest per cent of fruit infestation was recorded in Chlorantraniliprole 18.5% SC (7.69%), followed by Emamectin benzoate 5% SG (12.55%), Indoxacarb 14.5% SC (13.67%), Chlorpyriphos 20% EC (14.40%), *Metarhizium anisopliae* (14.64%), *Beauveria bassiana* (15.46%) and Neem oil 2% (16.41%) was found to be the least effective but significantly superior over the control (27.39%).

Similar results of Chlorantraniliprole 18.5% SC, the most effective of above results, was reported by **Tripura *et al*. (2017)**. The next best was Emamectin benzoate 5% SG , similar results were supported by **Patra *et al.* (2016)**, followed by Indoxacarb 14.5% SC, which lined with the findings of **Jagarlamudi and Kumar (2021)**, Chlorpyriphos 20% EC, supported with the findings of **Sanjana and Tayde (2019)**, *Metarhizium anisopliae*, which lined with the findings of **Sharma and Tayde (2017)**, *Beauveria bassiana*, similar results were supported by **Vyas and Tayde (2022)** and the results shown that the least effective was found to be Neem oil 2%, which lined with the findings of **Chandar *et al*. (2020)**.

The highest yield and cost benefit ratio were recorded in Chlorantraniliprole 18.5% SC (210.6 qt/ha) and (1:7.48), similar findings were supported by **Vyas and Tayde (2022)**, followed by Emamectin benzoate 5% SG (187.5 qt/ha) and (1:6.88), this result was supported by the findings of **Patra *et al*. (2016)**, **Sharma and Tayde (2017)**. Followed by Indoxacarb 14.5 SC (165.4 qt/ha) and (1:5.87), this result was supported by the findings of **Jagarlamudi and Kumar (2021)**, followed by Chlorpyriphos 20% EC (131.9 qt/ha) and

(1:4.82), this result is lined with the findings of **Sanjana and Tayde (2019)**, *Metarhizium anisopliae* (121.5 qt/ha) and (1:4.28) which is in the line with the findings of **Sharma and Tayde (2017)**, followed by *Beauveria bassiana* (116.3 qt/ha) and (1:4.13) which is in the line with the findings of **Tripura *et al.* (2017)**, followed by Neem oil 2% (104.2 qt/ha) and (1:3.79), these findings are in support with **Chandar *et al*. (2020)**.

Table 1. Efficacy of different biopesticides and chemicals against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee). (First spray: % shoot infestation) and (Second spray: % fruit infestation)

S. No	Treatments	Dose	First spray (% Shoot infestation)					Second spray (% Fruit infestation)					Yield (q/ha)	C:B ratio
			1DBS	3DAS	7DAS	14DAS	Mean	1DBS	3DAS	7DAS	14DAS	Mean		
T_1	Indoxacarb 14.5% SC	1ml/L	25.93 (30.59)	15.36^{c} (23.04)	13.31^{d} (21.39)	14.50^{b} (22.38)	14.39^{e}	16.94^{de} (24.30)	14.96^{bc} (22.74)	12.42^{bc} (20.61)	13.63^{bc} (21.67)	13.67^{cd}	163.5	1:5.87
T_2	Chlorpyriphos 20% EC	0.25ml/L	25.43 (30.26)	18.00^{b} (25.10)	17.05^{c} (24.30)	17.23^{cd} (24.45)	17.42^{d}	17.78^{d} (24.94)	15.62^{bc} (23.27)	13.01^{bc} (21.13)	14.59^{bc} (22.45)	14.40^{bcd}	131.9	1:4.82
T_3	Chlorantraniliprole 18.5% SC	0.4ml/L	22.33 (28.17)	9.11^{d} (17.55)	7.06^{e} (15.23)	8.62^{e} (16.97)	8.26^{f}	13.96^{f} (21.94)	9.10^{d} (17.55)	6.92^{d} (15.95)	7.06^{d} (15.23)	7.69^{e}	210.6	1:7.48
T_4	*Metarhizium anisopliae* 2×10^{8} CFU	2.5gm/L	26.49 (30.97)	19.31^{b} (26.06)	17.08^{c} (24.41)	18.11^{c} (25.18)	18.16^{d}	18.26^{cd} (25.29)	15.95^{bc} (23.52)	13.27^{bc} (21.24)	14.71^{bc} (22.51)	14.64^{bc}	121.5	1:4.45
T_5	Neem oil 2%	20ml/L	24.66 (29.76)	23.39^{a} (28.89)	21.18^{b} (27.39)	22.07^{b} (28.00)	21.88^{d}	21.40^{ab} (27.54)	17.15^{b} (24.41)	15.70^{b} (23.24)	16.38^{b} (23.86)	16.41^{b}	104.2	1:3.76
T_6	Emamectin benzoate 5% SG	0.4gm/L	22.48 (28.27)	15.20^{c} (22.91)	13.17^{d} (21.28)	14.20^{d} (22.13)	14.19^{e}	14.88^{ef} (22.69)	13.68^{c} (21.65)	11.00^{c} (19.29)	12.97^{c} (21.05)	12.55^{d}	187.5	1:6.88
T_7	*Beauveria bassiana* 2×10^{8} CFU	2.5gm/L	28.77 (32.41)	20.18^{b} (26.69)	18.07^{bc} (25.15)	19.96^{bc} (26.51)	19.40^{c}	20.17^{bc} (26.66)	16.93^{bc} (24.27)	14.32^{bc} (22.19)	15.14^{bc} (22.90)	15.46^{bc}	116.3	1:4.26
T_0	Control	-	23.51 (28.99)	25.30^{a} (30.20)	26.22^{a} (30.80)	27.16^{a} (31.40)	26.23^{a}	22.73^{a} (28.46)	25.05^{a} (30.03)	27.89^{a} (31.87)	29.23^{a} (32.72)	27.39^{a}	71	1:2.66
	F-test		NS	S	S	S	S	S	S	S	S	S	-	-
	S. Ed. (±)		2.09	1.17	1.45	1.64	0.62	1.00	1.51	1.89	1.40	1.14	-	-
	C. D. (P=0.05%)		-	2.51	3.12	3.52	1.09	2.16	3.25	4.06	3.00	2.00	-	-

*DBS=Day Before Spray, **DAS=Day After Spray, ***NS=Non-Significant, ****S=Significant

CONCLUSION:

From the present study, the results revealed that Chlorantraniliprole 18.5% SC was the most effective treatment against brinjal shoot and fruit borer producing maximum yield and recording the highest cost benefit ratio compared to other treatments. While Emamectin benzoate 5% SG and Indoxacarb 14.5% SC have shown average results and the least effective chemicals were found to be Chlorpyriphos 20% EC, *Metarhizium anisopliae* and *Beauveria bassiana.* Botanical Neem oil 2% was found to be the least effective among all the treatments.

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