Effect of selected Bio-pesticides and chemicals against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee.) in trans Yamuna region of Prayagraj, India

Abstract

The experiment was conducted at the Central Research Farm (CRF), SHUATS, Naini, Prayagraj during *Rabi* 2022. Seven treatments were evaluated against**,** *Leucinodes orbonalis i.e.*, Emamectin benzoate 5% SG @ 0.4ml/lit (T_1) (14.34), Neem oil 5% @ 5ml/lit (T_2) (20.71), Spinosad 45% SC @ 0.5ml/lit (T_3) (12.97), Chlorantraniliprole 20% SC @ 0.5ml/lit (T_4) (9.98), *Beauveria bassiana* @ 2gm/lit (T_5) (17.04), Indoxacarb 14.5% SC @ 0.5ml/lit (T_6) (15.67), *Metarhizium anisopliae* @ 4gm/lit (T_7) (18.51). The yields among the treatments were significant. The highest yield was recorded in T_4 Chlorantraniliprole 20 SC (168 q/ha) followed by, T_3 Spinosad 45 SC (159 q/ha), T_1 Emamectin Benzoate 5 SG (136 q/ha), T_6 Indoxacarb 14.5 SC (133 q/ha), T_5 *Beauveria bassiana* (112 q/ha), T_7 *Metarhizium anisopliae* (103 q/ha), and the treatments T_2 Neem oil 5% (100 q/ha) was least effective among all the treatments. Control plot T_8 (74 q/ha) yield. When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the best and most economical treatment recorded in T_4 Chlorantraniliprole 20 SC (1:7.10) followed by, T_3 Spinosad 45 SC (1:6.47), T_1 Emamectin Benzoate 5 SG (1:6.34), T_6 Indoxacarb 14.5 SC (1:5.71), T_5 *Beauveria bassiana* (1:5.65), T_7 *Metarhizium anisopliae* (1:5.11), and the treatments T_2 Neem oil 5% (1:4.99) was least effective among all the treatments. Control plot T_8 (1:3.86) was recorded.

Key words**:** Brinjal shoot and fruit borer, Biopesticides, Chemicals, Cost Benefit Ratio, Insecticides, *Leucinodes orbonalis*.

1. INTRODUCTION

The eggplant, aubergine, or brinjal (Solanum melongena) is one of the most significant solanaceous vegetables in south-east Asian countries such as India, Bangladesh, Sri Lanka, China, and Japan. It is indigenous to the Indo-Burma region and has been farmed in India since ancient times [1].

Brinjal (Solanum melongena L.) is a common vegetable crop in many regions, including Central, South, and Southeast Asia, as well as areas of Africa and Central America. It is indigenous to India and is widely grown throughout the country. It is a vital vegetable that is grown throughout the year. It is also used as a raw ingredient in the production of pickles and as a wonderful cure for individuals suffering from liver problems. It has been reported as an Ayurvedic medication for the treatment of diabetes [2]. India is the world's second largest producer of brinjal. China is the world's greatest producer of brinjal, accounting for around 68.7% of global production, with India accounting for 23.3%. However, the productivity of brinjal is quite low in India compared to that of other advanced countries. (Source: Food and Agriculture Organisation Corporate Statistical Database).

In this area, 27 insect pests that infest the brinjal crop have been identified. Brinjal shoot and fruit borer (BSFB) is one of the most damaging insect pests of eggplant in South and Southeast Asia. It is widespread throughout the tropics of Asia and Africa, where it can diminish yield by up to 70%. According to reports, the yield reduction ranges between 20 and 70 percent. The BSFB caused 26.3-62.5% fruit damage in the Khasi hills of Meghalaya [3]. This insect is found throughout India and has been labeled as the most destructive and dangerous pest, inflicting massive losses in brinjal. The larvae bore into tender shoots in the early stage resulting in drooping shoots, which are readily visible in the infested fields at the later stage, caterpillars bore into flower buds and fruits, rendering the fruits unfit for consumption and marketing, resulting in direct yield losses. In Tamil Nadu, the insect has been said to cause losses of between 20.7 and 60.0 percent [4]. The brinjal shoot and fruit borer is controlled with a number of insecticides. Leucindoes orbonalis was blamed for yield losses of brinjal fruits of between 48% and 57%. The necessity for the current effort to establish a strategy to control the shoot and fruit borer of brinjal was used to estimate percent losses in terms of brinjal fruits and fruit weight loss [5]. **2.**

Materials and Methods:

The experiment was carried out at the Central Research Field of Sam Higginbottom University of Agriculture, Technology And Sciences, Naini, Prayagraj, UP. The research field was situated at the right side of Rewa road at 25° 22’ 15.888” North Latitude and 81° 51’ 31.4712” East

Longitude and is about 98m above mean sea level. The climate at Prayagraj is typical subtropical which prevails in the eastern part of UP. The extremes of both summer and winter are experienced here. The maximum temperature was recorded during summer up to 47°C and the minimum temperature was recorded during winter up to 1.5°C. All necessary facilities for cultivation of crop were available at the research farm. The treatments used in experiment are *viz.*, Emamectin benzoate 5% SG @ 0.4ml/lit, Neem oil 5% @ 5 ml/lit, Spinosad 45% SC @ 0.5ml/lit, Chlorantraniliprole 20% SC @ 0.5ml/lit, *Beauveria bassiana* @ 2gm/lit, Indoxacarb 14.5% SC @ 0.5ml/lit, *Metarhizium anisopliae* @ 4gm/lit and Control.

The population of brinjal shoot and fruit borer was recorded before 1 day of spraying and on 3rd day, 7th day and 14th day after insecticidal application. On five randomly chosen and marked plants from each plot, the populations of the brinjal shoot and fruit borer were counted, and the percentage of infestation was calculated using the formula below.

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

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

Gross returns were calculated by multiplying total yield with market price of the produce. Cost of cultivation and cost of treatments was deducted from the gross returns, to find out returns and cost benefit of ratio by following formula

$$\text{BCR} = \frac{\text{Gross returns}}{\text{Total cost}}$$

3. Result and Discussion:

The results (Table: 1) after 1st and 2nd spray revealed that all the treatments were significantly superior over the control in managing the pest infestation of *Earias vittella* in okra. The data on the percent infestation of shoot and fruit borer in brinjal 3rd, 7th and 14th day after first spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest per cent shoot, infestation was recorded in T_4

Chlorantraniliprole 20 SC (9.42) followed by, T_3 Spinosad 45 SC (11.74), T_1 Emamectin Benzoate 5 SG (13.47), T_6 Indoxacarb 14.5 SC (15.04), T_5 *Beauveria bassiana* (16.31), T_7 *Metarhizium anisopliae* (17.96), and the treatments T_2 Neem oil 5% (19.87) was least effective among all the treatments over Control plot T_8 (24.54) infestation.

The data on the percent infestation of shoot and fruit borer in brinjal 3rd, 7th and 14th day after second spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest per cent fruit, infestation was recorded in T_4 Chlorantraniliprole 20 SC (10.54) followed by, T_3 Spinosad 45 SC (14.20), T_1 Emamectin Benzoate 5 SG (15.21), T_6 Indoxacarb 14.5 SC (16.31), T_5 *Beauveria bassiana* (17.77), T_7 *Metarhizium anisopliae* (19.07), and the treatments T_2 Neem oil 5% (21.55) was least effective among all the treatments. Control plot T_8 (27.14) infestation.

The yield and cost benefit ratio among the treatments were significant. The highest being in T_4 Chlorantraniliprole 20 SC (168 q/ha), (1:7.10) followed by T_3 Spinosad 45 SC (159 q/ha), (1:6.47), T_1 Emamectin Benzoate 5 SG (136 q/ha), (1:6.34), T_6 Indoxacarb 14.5 SC (133 q/ha), (1:5.71), T_5 *Beauveria bassiana* (112 q/ha), (1:5.65), T_7 *Metarhizium anisopliae* (103 q/ha), (1:5.11) and the treatments T_2 Neem oil 5% (100 q/ha), (1:4.99) was least effective among all the treatments but superior over Control plot T_8 (74 q/ha), (1:3.86).

All the treatments are found to be superiorly over control on first and second spray and revealed that Chlorantraniliprole 20 SC was more effective in per cent infestation of fruit and shoot borer with (9.42 and 10.54) infestation over control respectively. Similar findings made by [6 and 7]. After that, Spinosad 45 SC is found to be next effective (12.97) which is in line with the findings of [8] shoot infestation of first spray (11.74) and fruit infestation (14.20), [9] (14.03) reported that Emamectin Benzoate 5 SG was found most effective in reducing first spray (13.47) and fruit infestation (15.21) per cent infestation of *Leucinodes orbonalis* in similar findings with [10] (7.96).

The yield and cost benefit ratio among the treatments were significant and the highest yield and CBR was recorded in Chlorantraniliprole 20 SC (168 q/ha), (1:7.10) finding with [7] (230q/ha), Spinosad 45 SC (159 q/ha), (1:6.47) in similar findings with [8] (145.75q/ha), Emamectin Benzoate 5 SG (136 q/ha), (1:6.34) in similar findings of [11].

Table: 1 Efficacy of Selected insecticides and Bio-pesticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee.)"

S.No	Treatments	Doses	Percent shoot and fruit infestation of *Leucinodes orbonalis*										Yield	B:C ratio
			First spray (Shoot infestation)					Second spray (Fruit infestation)						
			1DBS	3 DAS	7 DAS	14 DAS	Mean	1DBS	3 DAS	7 DAS	14 DAS	Mean		
T_1	Emamectin benzoate 5% SG	0.4g/l	20.74	12.13e	g13.1^{ef}	15.1^{de}	13.47^{f}	20.66	13.86^{e}	15.7^{de}	16.03^{d}	15.21^{ef}	136	1:6.34
T_2	Neem oil 5%	5 ml/l	20.74	18.88^{b}	19.8^{b}	20.8^{b}	19.87^{b}	21.05	20.03^{b}	21.68^{b}	22.94^{b}	21.55^{b}	100	1:4.99
T_3	Spinosad 45% SC	0.5ml/l	21.44	10.01^{ef}	11.8^{f}	13.3^{ef}	11.74^{g}	20.35	12.22^{ef}	14.54^{e}	15.84^{d}	14.20^{f}	159	1:6.47
T_4	Chlorantraniliprole 20% SC	0.5ml/l	20.91	8.62^{f}	9.19^{g}	10.4^{f}	9.42^{h}	20.70	10.26^{f}	10.71^{f}	10.65^{e}	10.54^{g}	168	1:7.10
T_5	*Beauveria bassiana*	2gm/l	20.35	15.59^{cd}	16.3^{cd}	16.9^{cd}	16.31^{d}	21.40	16.73^{cd}	17.79^{cd}	18.80^{cd}	17.77^{d}	112	1:5.65
T_6	Indoxacarb 14.5% SC	0.5ml/l	21.95	14.61^{d}	14.6^{de}	15.8^{de}	15.04^{e}	20.66	14.48^{de}	16.97^{cde}	17.50^{cd}	16.31^{e}	133	1:5.71
T_7	*Metarhizium anisopliae*	4gm/l	20.74	16.85^{bc}	17.8^{bc}	19.2^{bc}	17.96^{c}	23.33	18.12^{bc}	19.27^{bc}	19.81^{c}	19.07^{c}	103	1:5.11
T_8	Control	-	20.40	23.43^{a}	24.0^{a}	26.1^{a}	24.54^{a}	26.02	25.11a	28.59^{a}	29.47^{a}	27.14^{a}	74	1:3.86
	F- test		NS	S	S	S	S	NS	S	S	S	S		
	CD.at 0.05%		-	2.17	2.42	2.91	0.74	-	2.55	2.61	3.12	1.11		
	S. Ed. ($\pm$)		1.07	1.24	1.38	1.66	0.42	2.38	1.45	1.49	1.78	0.63		

DBS- Day Before Spraying, DAS- Day After Spraying

4. Conclusion

The findings of the current investigation showed that among all the treatments, lowest per cent shoot and fruit infestation was recorded in Chlorantraniliprole 20 SC *i.e.,* (9.98) which was significantly superior over control followed by (T_3) Spinosad 45 SC (12.97), (T_1) Emamectin Benzoate 5 SG, (T_6) Indoxacarb 14.5 SC , (T_5) *Beauveria bassiana* 1.15% WP, (T_7) *Metarhizium anisopliae*, (T_2) Neem oil 5% and untreated Control and T_2 Neem oil was least effective treatment against brinjal shoot and fruit borer with highest per cent shoot and fruit infestation (20.71) of *Leucinodes orbonalis* due to their mode of action compare to other selected Insecticide and biopesticides. the maximum yield and cost benefit ratio is recorded at Chlorantraniliprole 20 SC, followed by Spinosad 45 SC, Emamectin Benzoate 5 SG can be suitably incorporated in pest management schedule against gram pod borer as an effective tool under chemical control.

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Reference:

1) Warghat, A.N., Nimbalkar, D. and Tayde, A. R. (2020). Bioefficacy of some insecticides against brinjal shoot and fruit Borer *Leucinodes orbonalis* (Guenee) *Journal of Entomology and Zoological Studies,* 8*(1):932-936.*

2) Kalawate A. and Dethe M. D. (2012). Bioefficacy study of biorational insecticide on brinjal. *Journal of Biopest,* 5*(1): 75-80.*

3) Tripura, A., Chatterjee, M. L., Pande R. and Patra S. (2017). Biorational management of brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) in mid hills of meghalaya. *Journal of Entomology and Zoology Studies,* 5*(4): 41-45*.

4) Raja, J., Rajendran, B. and Pappiah, C.M. 1999. Management of brinjal shoot and fruit borer *(Leucinodes orbonalis Guen.). Vegetable Science,* 26: *167-69*.

5) Mane P. D. and Kumar R. (2020). Bio-efficacy of new chemicals against shoot and fruitborer of brinjal. *Journal of Entomology and Zoology Studies,* 8*(6): 1692-1693.*

6) Mainali R. P., Peneru R. B., Pokhrel P. and Giri Y. P. (2015). Field Bio-Efficacy of Newer Insecticides Against Eggplant Fruit and Shoot Borer, *Leucinodes Orbonalis (*Guenee.) *International Journal Applied Science Biotechnology,* 3*(4): 727-730.*

7) Shridhara, M., Hanchinal, S.G., Sreenivas, A.G., Hosamani, A. C. and Nidagundi, J. M. (2019). Evaluation of newer insecticides for the management of brinjal shoot and fruit Borer *Leucinodes orbonalis* (Guenee) *International journal of current, microbiology and applied sciences,* 8*(3):2582-2592.*

8) Devi, L.L., Ghule, T. M., Chatterjee, M.L. and Senapati, A. K. (2015) Effectiveness of biorational insecticides for the management of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee and on yield. *Eco. Env &cons,* 21*(2):783-788.*

9) Sharma, J. H. and Tayde, A. R. (2017). Evaluation of Bio-Rational Pesticides, against Brinjal Fruit and Shoot Borer, *Leucinodes orbonalis* (Guenee.) On Brinjal at Allahabad Agroclimatic Region. *International Journal Current Microbiology Applied Sciences,* 6*(6): 2049-2054.*

10) Patra, S. Thakur, A. and Firake, D. M. (2016) Evaluation of Bio-pesticides and Insecticides against Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis,* Guenee) in Meghalawya of North-Eastern India, *International Journal of Bio-resource and Stress Management,* 7*(5):1032-1036.*

11) Patra, S., Chatterjee, M. L., Mondal, S. and Samanta, A. (2009) Field evaluation of some new insecticides brinjal shoot and fruit borer, *Luecinodes orbonalis,* guenee. *Research Journal,* 21*(1): 58-60.*