Efficacy of certain insecticides against shoot and fruit borer, *Leucinodes orbonalis* (Gueenee) on brinjal crop *Solanum melongena* (L)

ABSTRACT

A field experiment was conducted at the Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during *Kharif* season 2023. The experiment was laid in Randomized Block Design with eight treatments replicated thrice along with untreated control plot. Eight treatments *viz*. Novaluron @ 10% EC 0.5ml/lit, Spinetoram 11.7% SC @0.4g/lit, Emamectin benzoate 5% SG @0.4g/lit, Chlorantraniliprole 18.5SC@0.5ml/lit, Flubendiamide 39.35% SC @0.5 ml/lit, Neem oil 2% @20ml/lit, *Beauveria bassiana*1x10^8 CFU @ 2.5g/lit and untreated control were evaluated against shoot and fruit borer. During the investigation, it was revealed that the lowest percent shoot and fruit borer (*Leucinodes orbonalis*) infestation after 1^{st} and 2^{nd} spray was observed in the treatment Chlorantraniliprole 18.5 % SC *i.e*. 2.32% and 2.16%, followedby Emamectin benzoate 5% SG (3.21 and 2.97), Spinetoram 11.7% SC (3.81 and (3.30), Novaluron 10% EC (4.62 and 4.05), Flubendiamide 39.35% SC 5.39 and 4.903, Neem oil 2% 5.98 and 5.38 and *Beauveria bassiana* 1x10^8 CFU 6.35 and 5.48. The treatment *Beauveria bassiana* 1x10^8 CFU 6.35 and 5.48 was found to be least effective among all the treatments against *Leucinodes orbonalis.* The plot treated with Chlorantraniliprole 18.5% SC (241.75 q/ha, 1:13.14) was found most effective with highest yield and cost benefit ratio among all the treatment followed by Emamectin benzoate 5% SG (190.61 q/ha, 1:10.34), Spinetoram 11.7% SC (150.58 q/ha,1:7.92), Novaluron 10% EC (124.49 q/ha, 1:6.38), Flubendiamide 39.35% SC (104.34 q/ha, 1:4.34), Neem oil 2% @ (85.81 q/ha, 1:3.01) and *Beauveria bassiana* 1x10^8 CFU @ (65.83 q/ha1:2.80) as compared to untreated control plot (59.06 q/ha, 1:2.68).

Keywords*:* Botanicals, Brinjal, Chemicals, Cost Benefit Ratio, Efficacy, *Leucinodes orbonalis*

1. INRTODUCTION

“Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred as the “King of vegetables” originated from India and now grown as a vegetable throughout the tropical, sub- tropical and warm temperate areas of the world” (**Roy *et al.,* 2016**). It is an indigenous vegetable (**Jat and Srivastava, 2023**).

“Nutritional value per 100 g of edible portion contains calories (24.0), sodium (3.0 mg), moisture content (92.7%), copper (0.12 mg), carbohydrates (4.0%), potassium (2.0 mg), protein (1.4 g), sulphury (44.0 mg), fat (0.3 g), chlorine (52.0 mg), fibre (1.3 g), vitamin A (124.0 I.U.), oxalic acid (18.0 mg), folic acid (34.0 μ g), calcium (18.0 mg), thiamine (0.04 mg), magnesium (15.0 mg), riboflavin (0.11 mg), phosphorus (47.0 mg), B-carotene (0.74 μ g), iron (0.38 mg), vitamin C (12.0 mg), zinc (0.22 mg) and amino acids (0.22)” (**Gopalan *et al*., 2007**). “It contains potassium, which maintains electrolyte balance in the body. Thus, help in neutralizing the effects of sodium in the entire human body and thus aiding in blood pressure control” (**Jat and Shrivastava, 2023**).

“It is a most important vegetable in the Indian Subcontinent that accounts for almost 50% of the world’s area under its cultivation. In India, brinjal is grown in an area of 730.4 thousand ha with the production of 12801 thousand metric tons and productivity with 17.5 metric tons/ha. In Madhya Pradesh, it is grown in an area of 51.35 thousand hectares, with a production of 1073.63 metric tons. It is consumed by different people in many countries viz., Central, South and South East Asia, some parts of Africa and Central America” **(Harish *et al*., 2011).**

“Leucinodes orbonalis Guenee (Lepidoptera: Pyralidae), causes significant losses to the tune of 70%. The apparent yield loss varies from 20-90% in various parts of the country. 85– 90% have been reported. The larvae of this pest cause 12-16% damage to shoots and 20- 60% damage to fruits. The pest is very active during rainy and summer season and often causes more than up to 95% in India. It is also reported that the infestation of fruit borer causes reduction in Vitamin C content to an extent of 68% in the infested fruits” (**Anwar *et al.,* 2015, 16-17**).

In the framework of ecologically friendly management strategies as well as to reduce the negative impact on the entire environment, newer pesticide molecules are a superior alternative to conventional synthetic insecticides. Alternative or environmentally friendly methods of insect management frequently provide an appropriate level of pest control with less risk and no harm to organisms that are not the intended targets.

2. MATERIALS AND METHODS

The present investigation was conducted at the experimental research plot of the Department of Entomology, Central Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. It took place during the Kharif season of 2023, employing a Randomized Block Design (RBD) with 8 treatments and 3 replications. The experiment utilized Pusa Purple Round variety with a plot size of 2m × 1m, spaced at 60 cm x 45 cm, and followed recommended package practices excluding plant protection. Application of the two rounds of insecticidal treatments were applied at 15 days interval.

The population of brinjal shoot and fruit borer was recorded one day before spraying, and on the 3rd, 7th, and 14th days after insecticidal application. This data was collected from 5 randomly selected and tagged plants within each plot. Subsequently, the recorded populations was converted into percentages of infestation using predetermined formulas.

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

(**Yadav *et al.*, 2015**)

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

(**Yadav *et al.*, 2015**)

Based on the yield data, the gross returns and net returns were calculated for each treatment. Gross returns were calculated by multiplying total yield with the market price of the produce. The ratio of gross return and cost of cultivation was worked for each treatment and was used as cost:benefit ratio (CBR) to compare the performance of different treatments. cost benefit ratio was calculated by using the following equation.

$$Gross\ return = Total\ yield \times Market\ price$$

$$\text{C: B Ratio} = \frac{\text{Gross returns}}{\text{Total Cost}}$$

(**Lavanya and Kumar, 2022)**

RESULTS AND DISCUSSION

The data on (Table 1) the mean (3rd, 7th, and 14th DAS) of first spray for shoot percent infestation of *Leucinodes orbonalis* revealed that among all the treatments lowest mean percent shoot infestation was recorded in Chlorantraniliprole 18.5% SC (2.353), followed by Emamectin benzoate5% SG (3.217), Spinetoram 11.7% SC (3.813), Novaluron 10% EC (4.623), Flubendiamide 39.35% SC (5.393), neem oil 2% (5.980) and *Beauveria bassiana* $1x10^8$ CFU (6.353). The treatments *Beauveria bassiana* $1x10^8$ CFU (6.353) was least effective among all the treatments. Control plot (6.830) infestation.

The data on the mean (3rd, 7th and 14th DAS) of second spray for fruit percent infestation of *Leucinodes orbonalis* revealed that among all the treatments lowest percent fruit infestation was recorded in Chlorantraniliprole 18.5% SC (2.163), followed by Emamectin benzoate 5% SG (2.973), Spinetoram 11.7% SC (3.307), Novaluron 10% EC (4.053), Flubendiamide 39.35% SC (4.903), neem oil 2% (5.383) and *Beauveria bassiana* $1x10^8$ CFU (5.477). The treatments *Beauveria bassiana* $1x10^8$ CFU (5.477) was least effective among all the treatments. Control plot (7.407) infestation.

The yields (Table 1) among the treatment were significant. The highest yield was recorded in T4 Chlorantraniliprole 18.5% SC (241.75 q/ha), followed by T3 Emamectin benzoate 5% SG (19.061 q/ha), T2 Spinetoram 11.7% SC (150.58 q/ha), T1 Novaluron 10% EC (124.49 q/ha), T5 Flubendiamide 39.35% SC (104.34q/ha), T6 neem oil 2% (85.81 q/ha) and T7 *Beauveria bassiana* $1x10^8$ CFU (65.83 q/ha) over the control plot T8 (59.06q/ha).

The best and most economical treatment was Chlorantraniliprole 18.5% SC (1:13.14), followed by Emamectin benzoate 5% SG (1:10.34), Spinetoram 11.7% SC (1:7.92), Novaluron 10%EC (1:6.38), Flubendiamide 39.35% SC (1:1.43), Neem oil 2% (1:3.01) and *Beauveria bassiana* $1x10^8$ CFU (1:2.80) over the control plot (1:2.68).

Table 1. Bio efficacy and economics of selected biopesticides against shoot and fruit borer [*Leucinodesorbonalis*(G.)] on brinjal

S. No.	Treatments	Percent shoot and fruit infestation of *Leucinodesorbonalis*										Yield (q/ha)	C:B ratio
		First spray (Percent Shoot infestation)					Second spray (Percent Fruit infestation)						
		1 DBS	3 DAS	7 DAS	14 DAS	Mean	1 DBS	3 DAS	7DAS	14 DAS	Mean		
T1	Novaluron 10% EC @ 0.5 ml/l	6.39	4.65^{cd}	4.47^{bc}	4.73^{cd}	4.62^{d}	4.73^{cd}	4.28^{cd}	3.85^{c}	4.03^{c}	4.05^{d}	124.49	1:6.38
T2	Spinetoram 11.7 % SC @ 0.4gm/l	6.08	4.34^{d}	3.45^{cd}	3.65^{de}	3.81^{e}	3.65^{de}	3.74^{d}	2.97^{d}	3.21^{d}	3.30^{e}	150.58	1:7.92
T3	Emamectin benzoate5%SG @ 0.4gm/l	6.09	3.43^{e}	3.06^{cd}	3.16^{e}	3.21^{f}	3.16^{e}	3.35^{de}	2.60^{d}	2.97^{d}	2.97^{e}	190.61	1:10.34
T4	Chlorantraniliprole 18.5 % SC @0.5ml/l	6.18	2.86^{e}	1.97^{d}	2.23^{e}	2.32^{g}	2.23^{e}	2.54^{e}	1.87^{e}	2.08^{e}	2.16^{f}	241.75	1:13.14
T5	Flubendiamide 39.35 %SC @ 2gm/l	5.45	5.41^{bc}	5.35^{ab}	5.42^{bc}	5.39^{c}	5.42^{bc}	5.07^{bc}	4.66^{b}	4.99^{b}	4.90^{c}	104.34	1:4.34
T6	Neem oil 2% @ 2 ml/l	5.92	5.89^{ab}	5.84^{ab}	6.21^{abc}	5.98^{b}	6.21^{abc}	5.82^{b}	5.09^{b}	5.24^{b}	5.38^{b}	85.81	1:3.01
T7	*Beauveria bassiana* $1x10^{8}$ CFU @ 2.5gm/l	6.52	6.09^{ab}	6.44^{a}	6.53^{ab}	6.35^{ab}	6.53^{ab}	5.91^{b}	5.14^{b}	5.38^{b}	5.47^{b}	65.83	1:2.80
T0	**Control**	6.03	6.37^{a}	6.97^{a}	7.15^{a}	6.83^{a}	7.15^{a}	7.15^{a}	7.46^{a}	7.61^{a}	7.40^{a}	59.06	1:2.68
	F- test	**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**		
	CD.at 0.05%		**2.75**	**2.74**	**1.84**	**0.53**	**1.84**	**1.16**	**0.62**	**0.66**	**0.367**		
	S. Ed. (+)		**1.19**	**1.64**	**1.63**	**1.75**	**1.63**	**1.43**	**1.66**	**1.63**	**1.57**		

DBS- Day Before Spraying; DAS- Day After Spraying; BCR-Benefit Cost Ratio

All the treatments were found to be significantly superior to control in reducing percent infestation on shoot. The minimum overall mean shoot percent infestation was recorded in Chlorantraniliprole 18.5 SC (2.32). The results were similar to be findings reported by **Narayan *et al.* (2019)** and **Shridhara *et al*. (2019)**. Emamectin benzoate 5%SG (3.21) was found to be next best treatment. The results of Emamectin benzoate 5%SG (3.21) was supported by **Sharma and Tayde (2017)** and **Saran *et al*.(2018).** Spinetoram 11.7% (3.81) found to be next best effective treatment. These results were similar finding of **Bade *et al*. (2017).**

The minimum overall mean fruit percent infestation was recorded in Chlorantraniliprole 18.5 SC (2.16). The results were similar to be findings reported by **Tripura *et al.* (2017)** and **Udikeri *et al*. (2024)**. Emamectin benzoate 5% SG (2.97) was found to be next best treatment. The results of Emamectin benzoate 5% SG (2.97) was supported by **Sharma and Tayde (2017)** and **Jat and Srivastava (2023).** Spinetoram 11.7% (3.30) found to be next best effective treatment. These results were similar finding of **Pandey *et al*. (2023).**

Among all the treatments the highest yield (241.75q/ha) and highest cost benefit ratio (1:13.14) was obtained from Chlorantraniliprole 18.5% SC and lowest in control plot (59.06 q/ha) (1:2.68). Similar findings made by **Reddy and Tayde (2023). Sharma and Tayde (2017)** reported that the Emamectin benzoate was the best and most economical treatment recorded (190.61q/ha) and cost benefit ratio (1:10.34). **Raj and Kumar (2023)** reported highest yield (150.58) and cost benefit ratio (1:7.92) in Spinetoram.

CONCLUSION

From the critical analysis of the present findings of “Field efficacy of certain insecticides against Shoot and Fruit Borer on Brinjal crop during *Kharif* season” can be conducted that among certain insecticides and bio-pesticides, treatment T_4 Chlorantraniliprole 18.5% SC was found to be most effective in managing brinjal shoot and fruit borer. Whereas T_7 *Beauveria bassiana* 1x10^8 CFU was found to be least effective. It was followed by, Emamectin benzoate 5% SG, Spinetoram11.7% SC, Novaluron10% EC, Flubendiamide39.35% SC, Neem Oil 2% was found most effective. The most economical treatment T_4 Chlorantraniliprole 18.5% SC with 1:13.14 ratio and 241.75 q/ha yield under Prayagraj agroclimatic conditions. Hence, it is suggested that the effective insecticides may be alternated in harmony with the existing integrated pest management programs to avoid the problems associated with insecticidal resistance, pest resurgence etc. Bio-pesticides are the part of integrated pest management to avoid in use of pesticides causing pollution in the environment and not much harmful.

Disclaimer (Artificial intelligence)
Option 1:
Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.
Option 2:
Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the

generative AI technology
Details of the AI usage are given below:
1.
2.
3.

REFERENCES

1. **Anwar, S., Mari, J. M., Khanzada, M. A. and Farman, Ulla. 2015.** Efficacy of insecticides against infestation of brinjal fruit borer, *Leucinodes orbonalis* (Guen.) (Pyralidae: Lepidoptera) underfield conditions. *Journal of Entomology and Zoology Studies***. 3**(3):292-295.

2. **Bade, B. A., Kharbade, S. B., Kadam, M. B. and Patil, A. S. (2017).** Bio-efficacy of novel pesticides against shoot and fruit borer, *Leucinodes orbonalis* (Guen.) on brinjal. *Trends in Biosciences*, **10**(4): 1179-1182.

3. **Harish, D. K., Agasimani, A. K., Imamsaheb, S. J. and Patil, S. S. 2011.** Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. *Research Journal of Agricultural Sciences*, **2**(2):221-225.

4. **Jat, H. K., and Shrisvastva, V. K. (2023).** Cost: Benefit analysis of newer insecticides used in control of brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) at Gwalior region of Madhya Pradesh. *Journal of pharmaceutical innovation*, ***12***(3): 3091-3093.

5. **Lavanya, V. and Kumar, A. (2022).** Efficacy of certain chemicals against gram pod borer [*Helicoverpaarmigera*(Hubner)] on chickpea (*Cicer arietinum* L.). *The Pharma Innovation Journal*, **11**(3): 1293-1297.

6. **Narayan, H. A., Zanwar, P. R., Vinay, N. and Shubhash, A. S. (2019).** Bioefficacy of novel insecticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Journal of Entomology and Zoology Studies*, **7**(5): 600-605.

7. **Pandey, S. K., Mandloi, R., Singh, B. and Verma, A. K. (2023).** Bio-efficacy of newer insecticides against the shoot and fruit borer (*Leucinodes orbonalis*) of brinjal (*Solanum melongena* Linn.)Cv. Kavya. *The Pharma Innovation Journal*, **12**(9): 2451-2454.

8. **Raj, C. and Kumar, A. (2023).** Efficacy and economics of selected insecticides against brinjal shoot and fruit borer, [*Leucinodes orbonalis (Guenee*)]. *The Pharma Innovation Journal*,**12**(9): 1201-1204.

9. **Reddy, A. C., and Yadav, U. (2023).** Effect of Selected Bio-pesticides and Chemicals against Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* (Guenee.) in Trans Yamuna Region of Prayagraj, India. *International Journal of Environment and Climate Change*, **13**(9):1613-1617.

10. **Roy, G., Gazmer, R., Sarkar, S., Laskar, N., Das, G. and Samanta, A. (2016).** Comparative bio efficacy of different insecticides against fruit and shoot borer, *Leucinodes orbonalis* Guenee of brinjal and their effect on natural enemies, *International Journal of Green Pharmacy*, **10**(4):257.
11. **Saran, S., Singh, D. V., Sing, A., Kumar, S. and Kumar, U. (2018).** Bio-efficacy of selective eco-friendly insecticides and bio pesticides against shoot and fruit borer, *Leucinodes orbonalis* (Guenee) in brinjal. *Journal of Pharmacognosy and Phytochemistry*, **7**(6): 1690- 169.
12. **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) (Lepidoptera: Crambidae). *International Journal of Current Microbiology and Applied Science*, **8**(3): 25822592.
13. **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.
14. **Udikeri, S., Hanumantharaya, L., Hegde, J. N., Lakshmana, D. and Nadukeri, S. (2024).** Management of Fruit and Shoot Borer, *Leucinodes orbonalis* (Guenee) in Brinjal through Sequential Application of Selected Insecticides and Biorationals. *International Journal of Environment and Climate Change*, **14**(1), 704711.
15. **Yadav, R., Lyall, H., Kumar, S. and Sanp, R.K. (2015).** Efficacy of certain botanical insecticides against shoot and fruit borer, (*Leucinodes orbonalis* Guenee) on brinjal *(Solanum melongena*L.), *The Bioscan* **10**(2): 987-999.
16. Sowmya KH, Rajnikant TA. Field Efficacy of Different Insecticides Against Brinjal Shoot and Fruit Borer, Leucinodes orbonalis (Guenee). Int. J. Plant Soil Sci. [Internet]. 2023 Jul. 18 [cited 2024 Jun. 11];35(18):418-22. Available from: https://journalijpss.com/index.php/IJPSS/article/view/3305
17. Patidar R, Tayde AR, Tak A. Efficacy of Selected Insecticides Against Tomato Fruit Borer, Helicoverpa armigera (Hubner) in Tomato. J. Exp. Agric. Int. [Internet]. 2024 Jun. 7 [cited 2024 Jun. 11];46(7):144-8. Available from: https://journaljeai.com/index.php/JEAI/article/view/2566