



ISSN (E): 2277-7695
 ISSN (P): 2349-8242
 NAAS Rating: 5.23
 TPI 2022; 11(10): 898-901
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www.thepharmajournal.com
 Received: 16-07-2022
 Accepted: 20-09-2022

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Evaluation of chemical insecticides and biopesticides in management of shoot and fruit borer *Leucinodes orbonalis* (Guenee) in brinjal *Solanum melongena* (L.)

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DOI: <https://doi.org/10.22271/tpi.2022.v11.i10k.16139>

Abstract

The present experiment was carried out to compare the efficacy against *Leucinodes Orbonalis* and its effect on the yield of Brinjal. The best and most economical treatment was Chlorantriliprole @ 18.5 EC (1:10.2) which was on par with Emamectin benzoate @ 5 SG (1:9.8) followed by Carbosulfan 25 EC (1:7.3), *Beauveria bassiana* (1:6.4) Spinosad @ 45 % SC (1:5.5), followed by *Bacillus thuringiensis* (1:5.2) and, Neem oil (1:4.3) as compared to control (1:3.1). The data on the percent infestation of the shoot and fruit borer on brinjal 3rd, 7th, and 14th day after the first spray reveal that all the chemical treatments were significantly superior over control. Chlorantriliprole @ 18.5 EC (5.94) was par with Emamectin benzoate @ 5 SG (8.49) followed by Carbosulfan 25 EC (10.71), *Beauveria bassiana* (12.91) Spinosad @ 45 % SC (13.13), followed by *Bacillus thuringiensis* (14.85) and, Neem oil (16.87). The yields among the treatment were significant. The highest yield was recorded in Chlorantriliprole @ 18.5 SC (207.50 q/ha), Emamectin benzoate @ 5 SG (183.83 q/ha), Carbosulfan 25 EC (137.9 q/ha), *Beauveria bassiana* (124.6 q/ha), Spinosad @ 45 % SC (106.5 q/ha), *Bacillus thuringiensis* (98.3 q/ha) and Neem oil (87 q/ha), as compared to control plot (56.6 q/ha).

Keywords: Biorationals, chlorantriliprole, cost benefit ratio, chemical insecticide, *Leucinodes orbonalis*

Introduction

Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred to as the “King of vegetables”. It is also called brinjal in India, and Aubergine in Europe. It belongs to the family “Solanaceae”, the name eggplant derives from the shape of the fruit of some varieties, which are white and shape very similar to chicken eggs. Among solanaceous vegetables, brinjal (*Solanum melongena* L.) is one of the important crops grown throughout India. Eggplant is adapted to a wide range of climatic conditions, such as high rainfall and high temperatures from North to South and West to East. It is also one of the few vegetables capable of high yields in hot-wet environments. Brinjal fruits are reasonable sources of vitamins and minerals. (Tripura *et al.*, 2017) [19]. It is the most important vegetable in the Indian Subcontinent that accounts for almost 50 % of the world's area under its cultivation. Under sustainable farming, brinjal provides regular daily income to meet the day-to-day expenditure. (Murugesan, 2009) [10]. It has become an important economic source for farmers and field labourers. It is also used as a raw material in pickle making and as an excellent remedy for curing diabetes. It is also used as a good appetizer. It is a good aphrodisiac, cardio tonic, laxative, and reliever of inflammation (Shridhara, 2019) [18].

The estimated total world production for eggplants in 2020 was 56,618,843 metric tonnes, up by 2.2 % from 55,376,521 tonnes in 2019 China is leading in production with 32.03 million tons, the area with 0.78 million ha, and productivity with 40.96 tons per ha, respectively in the whole world during the year 2016-17. India is the second largest producer of brinjal being cultivated over an area of 749,000 (ha), production of 12874,000 (MT) with an average annual production of 17.5 million tons per ha in the year 2017-18. In India, it is widely grown in West Bengal, Odisha, Gujarat, Madhya Pradesh, Chhattisgarh, Maharashtra, Andhra Pradesh, Haryana, Assam, Uttar Pradesh, Jharkhand, and Tamil Nadu. Brinjal crop is cultivated in Uttar Pradesh over an area of 8.82,000 ha with an annual production of 275.40 thousand tons) and productivity of 34.40 (MT/ha) in the year 2020-21, while West Bengal ranks 1st having an area and production of 163.15 (ha) and 3027.00 (million tons), respectively in the year 2017-18. However, U.P. is at the apex in productivity over India.

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It harbours more than 140 species of insect pests belonging to 50 families from 10 orders reported on the crop of the world. (Chowdury *et al.*, 2017) [22].

There are 26 insect-pest species and a few noninsect-pests species infesting brinjal of which the shoot and fruit borer, (*Leucinodes orbonalis* Guen.); Budworms, (*Scrobipalpa blasigona*;) whitefly, (*Bemisia tabaci* Genn.) leafhopper, (*Amarasca devastations*) (Distant); jassid, A. (*biguttula biguttula* Ishida) Epilachna beetle, (*Henosepilachna vigintioctopunctata*) Fab.; aphid, (*Aphis gossypii* Glover.); mealy bug, (*Centroccocus insolitus* Guen), lacewing bug, (*Urentiushy stricellus* Richt). and non-insect pest, red spider mite, (*Tetranychus macfurlanei*) Andre cause severe damage, necessitating initiation of control measures quite frequently (Srinivasan, 2009) [23] of these, the brinjal shoot and fruit borer is considered the main constraint as it damages the crop throughout the year. This pest is reported from all brinjal growing areas of the world. It is known to damage shoots and fruits of brinjal in all stages of its growth. The yield loss by this pest varied from 0.081.11 q/ha based on the inconsumable pest of damaged fruits and 0.46- 3.80 q/ha when the whole of damaged fruits was taken into consideration

The Larvae of this pest cause 12-16 % damage to shoots and 20-60 % damage to fruits. The pest is very active during the rainy and summer season and often causes more than up 95 % in India. It is also reported that the infestation of fruit borer causes a reduction in Vitamin "C" content to an extent of 68 % in the infested fruits. Sarkar *et al.*, (2002) [24]. The yield loss in brinjal due to the pest complex are to the extent of 70-80 percent. It is estimated that the economic injury level equals 6 % infestation of shoot and fruit in India. (Anwar *et al.*, 2015) [2].

Materials and Methods

The experiment was conducted at the Central Research Farm, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, during the Rabi season of 2021-22. Prayagraj is situated at an elevation of 78 meters above sea level at 25.87 North latitude and 81.15° E longitudes.

Preparation of Insecticidal spray solution:

The desired concentration of insecticidal spray solution of desired concentration for each treatment was freshly prepared every time at the site of the experiment, just before the start of spraying operations. The number of spray materials required for the crop gradually increased as the crop advanced in age.

The spray solution of desired concentration was prepared by adopting the following formula:

$$V = \frac{(C \times A)}{\% \text{ A.I.}}$$

Where

V = Volume of a formulated pesticide required.

C = Concentration required.

A = Volume of total solution to be prepared

% A.I. = Given the Percentage strength of a formulated pesticide

The population of brinjal shoot and fruit borer was recorded before 1 - day spraying and on the 3rd day, 7th day, and 14th day after insecticidal application. The populations of brinjal shoot and fruit borer were recorded on 5 randomly selected and tagged plants from each plot and then it was converted as a percent of infestation by the following formula.

On Shoot

At each picking, the total number of shoots and number of shoots infested of five selected plants from each treatment replication-wise were recorded.

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

On Fruit

At each picking, the total number of fruits and number of fruits infested by five selected plants from each treatment replication-wise were recorded.

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

Results and Discussion

The data on the percent infestation of the shoot and fruit borer on the brinjal 3rd, 7th, and 14th day after the first spray revealed that all the chemical treatments were significantly superior to the control. Among all the treatments lowest percent shoot, the infestation was recorded in Chlorantraniliprole 18.5 SC (6.84), Emamectin benzoate 5 SG (9.78), Carbosulfan 25 EC (12.40), Spinosad 45 % SC (13.90), *Beauveria bassiana* (14.68), *Bacillus thuringiensis* (16.23), and Neem oil (19.08). The treatment of Neem oil (19.08) was the least effective among all the treatments. Control plot (24.31) infestation.

The data on the percent infestation of the shoot and fruit borer on the brinjal 3rd, 7th, and 14th day after the second spray revealed that all the chemical treatments were significantly superior to the control. Among all the treatments lowest percent shoot, the infestation was recorded in Chlorantraniliprole 18.5 SC (5.05), Emamectin benzoate 5 SG (7.29), Carbosulfan 25 EC (9.03), *Beauveria bassiana* (11.14), Spinosad 45 % SC (12.36), *Bacillus thuringiensis* (13.47) and Neem oil (14.67), was least effective among all the treatments. Control plot (28.33) infestation. The treatment of Neem oil (14.67) was the least effective among all the treatments. Control plot (28.33) infestation.

These results are in support of Tripura *et al.*, (2017) [19], Reddy and Kumar (2022) [12], and Jat *et al.*, (2020) [6] reported that the treatment of Chlorantraniliprole was superior in reducing the population of shoot and fruit borer. Vinayaka *et al.*, (2019) [20], Warghat *et al.* (2020) [21], and Goud *et al.*, (2019) [5] reported that Emamectin benzoate maximum protection and minimum shoot damage in brinjal, Chandar *et al.*, (2020) [3], Das *et al.*, (2016) [4], Mahla *et al.*, (2017) [9], and Anand *et al.*, (2014) [1] also reported that Carbosulfan 25 EC is the most effective chemical to control the brinjal shoot and fruit borer. Kumar and Thakur (2017) [8], and Soulakhe *et al.*, (2021) [17] also reported the next effective treatment in controlling the pest population of shoot and fruit borer. Sureshsing and Tayde (2017) [16], Kapuriya *et al.*, (2019) [17] Jat *et al.*, (2020) [6] also reported that Spinosad 45 % SC was effective in reducing the infestation of the shoot and fruit

borer, Rashid *et al.*, (2018) [11], Singh *et al.*, (2016) [15] reported that *Bacillus thuringiensis* SC was also effective in reducing the infestation of the shoot and fruit borer Sangma *et al.*, (2019) [13], Murugesan and Murugesan (2009) [10], also reported that Neem oil is effective in reducing the infestation of the shoot and fruit borer.

The yields among the treatment were significant. The highest yield was recorded in Chlorantraniliprole 18.5 SC (207.50 q/ha) these findings were supported by Jat *et al.*, (2020) [6], Emamectin benzoate 5 SG (183.83 q/ha) these findings were supported by Warghat *et al.* (2020) [21], Carbosulfan 25 EC (137.9 q/ha) these findings were supported by Mahla *et al.*,

(2017) [9], *Beauveria bassiana* (124.6 q/ha) Soulakhe *et al.*, (2021) [17], Spinosad 45 % SC (106.5 q/ha), *Bacillus thuringiensis* (98.3 q/ha) Jat *et al.*, (2020) [6] and Neem oil (87 q/ha) Sangma *et al.*, (2019) [13]. The treatment of Neem oil (87 q/ha) was the least effective among all the treatments. Control plot (56.6 q/ha) yield. Cost-benefit ratio revealed, interesting results such as Chlorantraniliprole 18.5 SC (1:10.8) the best and most economical treatment followed by Emamectin benzoate 5 SG (1:9.8), Carbosulfan 25 EC (1:7.3), *Beauveria bassiana* (1:6.4), Spinosad 45 % SC (1:5.5), *Bacillus thuringiensis* (1:5.2), and Neem oil (1:4.3) and control (1:3.1).

Table 1: Efficacy of biopesticides and chemicals on the damage of shoot and fruit borer, *Leucinodes Orbonalis* on brinjal

S. No.	Treatments	Percent shoots and fruit infestation of <i>Leucinodes Orbonalis</i>								Yield q/ha	B: C Ratio	
		First spray					Second spray					
		1DBS	3 DAS	7 DAS	14DAS	Mean	3DAS	7 DAS	14DAS			Mean
T ₁	<i>Beauveria bassiana</i> 1 % WP (1x10 ⁸ CFU/ml)	20.80	14.91	11.44	17.69	14.68	11.63	09.17	12.63	11.14	124.6	1:6.6
T ₂	<i>Bacillus thuringiensis</i> (1x10 ⁹ CFU/ml)	20.24	19.10	13.50	16.10	16.23	13.50	12.35	14.57	13.47	98.30	1:5.1
T ₃	Emamectin benzoate @ 5 % SG	20.81	12.51	07.33	09.52	09.79	07.33	05.18	09.38	07.20	183.83	1:9.8
T ₄	Spinosad 45 SC	20.97	16.02	12.49	13.21	13.90	12.39	11.15	13.54	12.36	106.5	1:5.5
T ₅	Carbosulfan 25 EC	19.77	13.26	09.38	14.56	12.40	08.37	08.31	10.39	09.02	137.9	1:7.3
T ₆	Chlorantraniliprole 18.5 SC	20.24	11.20	03.37	05.96	06.84	06.19	02.22	06.75	05.05	207.50	1:10.8
T ₇	Neem oil @ 2 %	20.70	20.71	14.69	21.85	19.08	14.69	13.50	15.84	14.67	87	1:4.3
T ₈	Control	20.41	24.22	22.98	25.73	24.31	28.30	27.07	29.63	28.33	56.6	1:3.1
	Overall Mean	20.49	16.48	11.89	15.57	14.65	12.08	11.11	14.09	12.65	-	-
	F- test	NS	S	S	S	S	S	S	S	S	-	-
	S. Ed. (±)	00.87	01.02	01.13	01.29	01.39	01.50	01.40	01.20	00.52	-	-
	C. D. (p = 0.05)	01.86	02.22	04.25	02.77	02.99	03.24	03.04	02.63	01.14	-	-

Conclusion

From the present study, the results showed that chlorantraniliprole @18.5 SC is the most effective treatment against brinjal fruit and shoot borer producing maximum yield and recording the highest Cost-Benefit ratio compared to other treatments. While Emamectin benzoate 5 % SG and Carbosulfan 25 EC have shown average results. Spinosad 45 % SC and *Beauveria bassiana* and *Bacillus thuringiensis* have proved to be the least effective chemicals. Botanical Neem oil 2 % was found to be least effective in managing *Leucinodes Orbonalis*. Botanicals are part of integrated pest management to avoid indiscriminate use of pesticides causing pollution in the environment and not much harm to beneficial insects.

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