



# Management of Brinjal Fruit and Shoot Borer (*Leucinodes orbonalis* Guenee) Using Biopesticides and Botanicals

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The field experiment was carried out during *Kharif* season of 2023 at the Organic Research Farm Karguaji, Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University Jhansi (U.P.). Nine treatments were tested: neem oil, garlic bulb extract, *Bacillus thuringiensis*, karanj oil, panchgavya, neem seed kernel extract (NSKE), *Beauveria bassiana*, *Metarhizium*

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*anisopliae*, and a control, under a randomized block design. Three sprays of treatments were applied. The results showed that neem oil at 2 ml/L resulted in the minimum shoot damage (7.82%), followed by *Bacillus thuringiensis* at 5 gm/L and NSKE at 5 ml/L. To manage fruit infestation caused by brinjal fruit and shoot borer, *Bacillus thuringiensis* and neem oil were the most effective treatments, followed by *Beauveria bassiana* and *Metarhizium anisopliae*. The maximum yield and highest cost benefit ratio were found with *Bacillus thuringiensis* (1:3.15), followed by *Metarhizium anisopliae* (1:3.07) and *Beauveria bassiana* (1:3.04).

**Keywords:** Bio-pesticides; brinjal shoot and fruit borer; *Bacillus thuringiensis*; neem oil; *Metarhizium anisopliae*.

## 1. INTRODUCTION

Brinjal (*Solanum melongena* L.) also known as eggplant belongs to Solanaceae family is important crop among all vegetables that widely grown in world and India is the largest producer of brinjal worldwide, it is generally used in culinary purpose in Indian vegetarian diet. It can be grown in all season with any weather condition. It has a lot of nutrition and minerals that quality is make it a nutritive vegetable, it has contains iron, phosphorus, calcium and vitamin like A, B and C, it also have ayurvedic meditational properties that used to cure diabetes, and liver problem where it also a tonic for cardio muscles, good appetizer, and laxative to suffer from constipation. The fruit of brinjal consumed as raw or used for pickle making. Charansingh et al., [1] The brinjal crop was attacked by various insect like leafhopper, white fly, aphid, hadda beetle, Brinjal fruit and shoot borer and red mites, among these brinjal fruit and shoot borer is a serious pest of crop that caused shoot damage as well as fruit damage that lead to heavy economic loss (70-94 percent yield loss) to grower. This pest found throughout the area where brinjal has cultivated [2,3]. The larvae of borer start infestation with bore in newly emerged shoot resulted drying of infested part and after initiation of the fruit it attacked on fruit and by boracious nature caused holes inside fruit filled with their excreta and finally the market value of fruit degraded and not also fit for human consumption. It can cause 0.46-3.80 quintals/hectare yield loss Ashadul et al., [4] and up to 79 percent shoot damage [5]. Therefore the present study and experiment was carried out to evaluate the bio-pesticides to management of brinjal fruit and shoot borer by eco-friendly measures [6,7].

## 2. MATERIALS AND METHODS

The experiment was conducted in *kharif* season 2023 at Organic Research Farm, Karguaji,

Bundelkhand University Jhansi, (U.P.) with nine treatments viz. Neem oil, Garlic bulb extract, *Bacillus thuringiensis*, Karanj oil, Panchgavya, Neem seed kernel extract (NSKE), *Beauveria bassiana*, *Metarhizium anisopliae*, and control [8]. The experiment was conducted in three replications under randomized block design and application of treatment was carried out in three times in total crop period.

## 3. OBSERVATIONS

To take observation of borer infestation in each plot 5 plants were randomly tagged for observations. Where, observations were taken after every spray of treatments and data were collected at 3DAS, 7DAS and 14 days after spraying in every plot of each replication. The infestation of shoot and fruit were calculated based on percentage method with following formulae

Percent shoot infestation = (Total no. of infested plant/ total plants) \*100

Prevent fruit infestation = (Total infested fruit/total fruit) \*100

## 4. RESULTS AND DISCUSSION

### 4.1 Shoot Infestation

The observation taken before and after the spray of treatments resulted that before spray 12.44 to 16.04 % shoot infestation was recorded and after first spray of treatments at 3DAS, 7DAS and 14 DAS, Neem oil @2ml/L recorded lowest 7.82 mean shoot infestation found superior to control shoot infestation on brinjal plant caused by borer as per with *Bacillus thuringiensis*@5gm/L and NSKE @5ml/L that resulted 9.35% and 10.77 % shoot infestation respectively.

#### 4.2 Fruit Infestation (After Second Spray)

The observation taken before second application of treatments found 9-15 mean percent fruit were damaged in all plot and after second spray data represented the Neem oil was effective at 3DAS and 7 DAS but after 14 days *Bacillus thuringiensis* was best among all treatment followed by Neem oil and *Beauvaria bassiana*, and data based on mean of at 3DAS, 7DAS and 14 DAS revealed that Neem oil @2ml/L was effective with 5.97 minimum fruit damage nearly same *Bacillus thuringiensis*@5gm/L resulted 6.07 mean fruit damage followed by *Beauvaria bassiana* @5gm/L, *Metarhizium anisopliae*@5gm/L, NSKE @5ml/L, Panchagavya @5ml/L, Karanj oil @5ml/L and

Garlic bulb extract @5ml/L with fruit infestation of 7.80, 9.65, 11.07, 13.22, 13.95 and 14.34 per cent respectively [9].

#### 4.3 Fruit Infestation (After Third Spray)

The data collected before third spray found 6.5-13.7 per fruits were infested and after the spray at 3DAS, 7DAS and 14 DAS resulted 4.02 minimum fruit infestation was found with *Bacillus thuringiensis* @5gm/L followed by Neem oil @ 2ml/L and *Beauvaria bassiana* @5gm/L those resulted 4.55 and 6.38 mean fruit infestation and remain all treatments were effective over water control that showed 17.38 mean fruit infestation after third application of treatments.

**Table 1. Effect of treatments against *Leucinodes orbonalis* Guenee on shoot infestation (first spray)**

T.no	Treatments	Doses	Mean Shoot Damage Percent				Mean
			Before	3DAS	7DAS	14DAS	
T <sub>1</sub>	Neem oil	2%	12.44	9.68	7.68	6.10	7.82
T <sub>2</sub>	Garlic bulb extract	5%	16.07	15.13	14.19	14.02	14.45
T <sub>3</sub>	<i>Bacillus thuringiensis</i> var. kurstaki	5gm/liter	11.04	10.79	9.96	7.29	9.35
T <sub>4</sub>	Karanj oil	5%	15.12	14.62	14.07	13.59	14.09
T <sub>5</sub>	Panchagavya	5%	14.78	13.69	13.26	12.92	13.29
T <sub>6</sub>	NSKE	5%	14.06	11.51	10.95	9.84	10.77
T <sub>7</sub>	<i>Beauvaria bassiana</i>	5gm/liter	13.25	13.02	11.34	9.37	11.25
T <sub>8</sub>	<i>Metarhizium anisopliae</i>	5gm/liter	14.21	13.98	12.92	10.58	12.49
T <sub>9</sub>	Water control	-----	12.06	12.84	13.39	13.84	13.36
<b>C.D. (5%)</b>			<b>1.681</b>	<b>1.641</b>	<b>1.432</b>	<b>1.298</b>	<b>1.498</b>
<b>SE(m)</b>			<b>0.556</b>	<b>0.543</b>	<b>0.474</b>	<b>0.429</b>	<b>0.496</b>
<b>SE(d)</b>			<b>0.786</b>	<b>0.768</b>	<b>0.670</b>	<b>0.607</b>	<b>0.701</b>
<b>C.V.</b>			<b>7.043</b>	<b>7.340</b>	<b>6.849</b>	<b>6.803</b>	<b>7.229</b>

**Table 2. Effect of treatments against *Leucinodes orbonalis* Guenee on fruit infestation (second spray)**

T.no	Treatments	Doses	Mean fruit damage percent				Mean
			Before	3DAS	7DAS	14DAS	
T <sub>1</sub>	Neem oil	2%	8.78	6.95	5.86	5.10	5.97
T <sub>2</sub>	Garlic bulb extract	5%	15.14	14.81	14.20	14.00	14.34
T <sub>3</sub>	<i>Bacillus thuringiensis</i> var. kurstaki	5gm/liter	9.11	7.39	6.02	4.80	6.07
T <sub>4</sub>	Karanj oil	5%	14.78	14.32	14.08	13.47	13.95
T <sub>5</sub>	Panchagavya	5%	13.87	13.66	13.48	12.53	13.22
T <sub>6</sub>	NSKE	5%	12.29	12.00	11.07	10.15	11.07
T <sub>7</sub>	<i>Beauvaria bassiana</i>	5gm/liter	10.59	9.28	8.04	6.08	7.80
T <sub>8</sub>	<i>Metarhizium anisopliae</i>	5gm/liter	11.56	11.04	9.80	8.11	9.65
T <sub>9</sub>	Water control	-----	14.75	15.23	15.46	16.03	15.57
<b>C.D.(5%)</b>			<b>0.854</b>	<b>1.032</b>	<b>0.728</b>	<b>0.819</b>	<b>1.120</b>
<b>SE(m)</b>			<b>0.282</b>	<b>0.341</b>	<b>0.241</b>	<b>0.271</b>	<b>0.371</b>
<b>SE(d)</b>			<b>0.399</b>	<b>0.483</b>	<b>0.341</b>	<b>0.383</b>	<b>0.524</b>
<b>C.V.</b>			<b>3.970</b>	<b>5.084</b>	<b>3.829</b>	<b>4.680</b>	<b>5.914</b>

**Table 3. Effect of treatments against *Leucinodes orbonalis* Guenee on fruit infestation (third spray)**

T.no	Treatments	Doses	Mean Fruit Damage Percent				Mean
			Before	3DAS	7DAS	14DAS	
T <sub>1</sub>	Neem oil	2%	6.26	5.06	4.61	3.98	4.55
T <sub>2</sub>	Garlic bulb extract	5%	14.73	14.17	13.83	13.70	13.90
T <sub>3</sub>	<i>Bacillus thuringiensis</i> var. kurstaki	5gm/liter	6.23	5.31	3.86	2.89	4.02
T <sub>4</sub>	Karanj oil	5%	13.77	13.07	12.80	12.69	12.85
T <sub>5</sub>	Panchagavya	5%	13.42	12.87	12.17	11.83	12.29
T <sub>6</sub>	NSKE	5%	12.09	10.85	10.09	9.30	10.08
T <sub>7</sub>	<i>Beauveria bassiana</i>	5gm/liter	8.09	7.39	6.83	4.93	6.38
T <sub>8</sub>	<i>Metarhizium anisopliae</i>	5gm/liter	9.77	9.03	8.02	5.78	7.61
T <sub>9</sub>	Water control	-----	16.30	16.82	17.42	17.91	17.38
	<b>C.D.(5%)</b>		<b>0.853</b>	<b>0.593</b>	<b>0.789</b>	<b>0.822</b>	<b>1.195</b>
	<b>SE(m)</b>		<b>0.282</b>	<b>0.196</b>	<b>0.261</b>	<b>0.272</b>	<b>0.395</b>
	<b>SE(d)</b>		<b>0.399</b>	<b>0.277</b>	<b>0.369</b>	<b>0.385</b>	<b>0.559</b>
	<b>C.V.</b>		<b>4.370</b>	<b>3.232</b>	<b>4.538</b>	<b>5.107</b>	<b>6.914</b>

Table 4. Economic of cultivation of brinjal

T. No.	Treatments	Yield Qt/h	Cost of yield (Rs)	Common cost(Rs)	Treatment cost(Rs)	Total cost (Rs)	Net Income (Rs)	C:B ratio
T <sub>1</sub>	Neem oil	212.12	381816	88800	16200	105000	276816	1:2.63
T <sub>2</sub>	Garlic bulb extract	175.32	315576	88800	3150	91950	223626	1:2.43
T <sub>3</sub>	<i>Bacillus thuringiensis</i> var. kurstaki	216.50	389700	88800	4950	93750	295950	1:3.15
T <sub>4</sub>	Karnaj oil	195.36	351648	88800	21240	110040	241608	1:2.19
T <sub>5</sub>	Panchgavya	185.03	333054	88800	10800	99600	233454	1:2.34
T <sub>6</sub>	NSKE	198.45	357210	88800	10800	99600	257610	1:2.58
T <sub>7</sub>	<i>Beauveria bassiana</i>	211.02	379836	88800	5175	93975	285861	1:3.04
T <sub>8</sub>	<i>Metarhizium anisopliae</i>	210.20	378360	88800	4050	92850	285510	1:3.07
T <sub>9</sub>	Water control	119.85	215730	88800		88800	126930	1:1.42

#### 4.4 Economics of Cultivation

The data presented Table 4 revealed that highest yield 212.12 qt/hac was obtained from *Bacillus thuringiensis* @5 gm/L treated plot followed by 212.12qt/hac and 211.02 qt/hac under Neem oil @3ml/L and *Beauveria bassiana*@5 gm/L respectively. And highest C:B ratio was obtained from *Bacillus thuringiensis* (1:3.15) followed by *Metarhizium anisopliae* (1:3.07) and *Beauveria bassiana* (1:3.04), were untreated plot showed lowest yield and also was found to be significantly at par with all other treatments [10-12].

#### 5. CONCLUSION

The above discussed experiment concluded with the bio-pesticides and botanicals also effective to brinjal fruit and shoot borer as insecticides, as we know chemicals are not safe for ecology and environment then the bio-pesticides are good alternate that manage damage with sustainable manner it can incorporate with in organic farming or in integrated pest management.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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