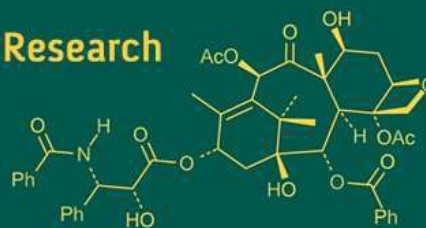


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Field efficacy of neem products and selected chemicals against shoot and fruit borer (*Leucinodes orbonalis* Guenee) on brinjal (*Solanum melongena* L.)

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Abstract

The present investigation was carried out during *rabi* season 2023-2024 at the Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh. There were eight treatments including an untreated control and each was replicated thrice in the randomized block design. Seven treatments viz. T₁ NSKE 5% @ 5 ml/lit, T₂ Neem Oil 5% @ 5ml/lit, T₃ Acephate 75% SP @ 1.5 gm/lit, T₄ Indoxacarb 14.5% SC @ 1 ml/lit, T₅ Chlorantraniliprole 18.5% SC @ 0.4 ml/lit, T₆ Spinosad 45% SC @ 0.5ml/lit, T₇ Emamectin Benzoate 5% SG 0.4 gm/lit were evaluated against shoot and fruit borer (*Leucinodes orbonalis*). The result showed that the treatments lowest percent shoot and fruit, infestation was recorded in T₅ Chlorantraniliprole 18.5% SC (14.29, 14.06), followed by T₇ Emamectin Benzoate 5% SG (15.58, 15.29), T₆ Spinosad 45% SC (16.46, 16.48), T₄ Indoxacarb 14.5% SC (9), T₃ Acephate 75% SP (17.71, 17.52), T₂ Neem Oil 5% (19.29, 17.93) and T₁ NSKE 5% (21.35, 18.60). The treatment T₁ NSKE 5% (21.35, 18.60) was least effective among all the treatments against *Leucinodes orbonalis*. The plot treated with Chlorantraniliprole 18.5% SC showed highest yield and Cost-Benefit Ratio (216.66 q/ha, 1:6.80) and found to be most effective treatment next to which Emamectin Benzoate 5% SG (185 q/ha, 1:6.09) was more effective among all other treatments, followed by Spinosad 45% SC (163.50 q/ha, 1:4.99), Indoxacarb 14.5% SC (142.83 q/ha, 1:4.66), Acephate 75% SP (120.50 q/ha, 1:3.99), Neem Oil 5% (90.50 q/ha, 1:2.93), NSKE 5% (85.16 q/ha, 1:2.74) as compared to untreated Control plot (57.50 q/ha, 1:1.97).

Keywords: Brinjal, cost-benefit ratio, efficacy, chemicals, *Leucinodes orbonalis*, chlorantraniliprole

Introduction

Brinjal (*Solanum melongena* Linn.) or eggplant comes under the crop family Solanaceae (Nightshade) and it is native to Indian Sub-continent. It is also known as eggplant in US, Australia. In UK it is called as Aubergine and in South Asia and South Africa it is called as Brinjal. It is one of the widely used solanaceous vegetable crop by people and is being cultivated in India for the last 4000 years. Though brinjal is a summer crop, it is grown throughout the year under irrigated conditions. The crop is generally sown twice or thrice in a year, depending upon the irrigation facilities. Brinjal is the most popular and principal vegetable crop regarded as the "King of Vegetables." India is the second largest producer of brinjal in the world next to China. It is also grown as commercial and kitchen garden crop in India. It is highly cosmopolitan and popular vegetable grown as "Poor man's crop" in India. It is the most consumed and most sprayed vegetable in India, where it is grown on more than 5 lakh hectares, making it one of the main sources of cash for many farmers (Abhishek and Dwivedi, 2021) [1].

It is important due to its nutritional, medicinal, as well as commercial value, 100gm edible portion of brinjal supplies 40 gm carbohydrates, 1.40 gm of proteins, 0.30gm of mineral and vitamins A, B and C. The fruits of brinjal are the reasonable sources of vitamins and minerals and it is rich in total water-soluble sugars, free reducing sugars, amide proteins among other nutrients (Abhishek and Dwivedi, 2021) [1].

After China, India is the second-biggest producer of vegetables globally. In India, during 2021-22 brinjal cultivation is estimated at 774 thousand hectares with production of 12768 thousand metric tons, respectively in Uttar Pradesh brinjal cultivation is Estimated at 8.82

thousand hectares with the production of 312.98 thousand tonnes which is share 2.45% in total production of India. The average yield of brinjal in India reported in around 749 thousand hectares with production of 12874 metric tons and in Uttar Pradesh brinjal production is 303.40 thousand tons. Brinjal is subjected to attack by a number of insect pest right from nursery stage till harvesting. Among the insect pests infesting brinjal, the major ones are shoot and fruit borer, *Leucinodes orbonalis* (Guen.), whitefly *Bemisia tabaci* (Genn.), leafhopper *Amrasca biguttula biguttula* (Ishida), and non-insect pest red spider mite *Tetranychus macfurlanei*. Of these, *L. orbonalis* 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 including Germany, Burma, USA, Srilanka and India. It is known to damage shoot and fruit of brinjal in all stages of its growth. The infested fruits become unfit for consumption due to loss of quality and hence lose their market value (Chandar *et al.*, 2020)^[4].

The larvae in early instars bore into petioles, midribs of large leaves and tender shoots, resulting in dead heart and dropping of plants is the typical symptom produced. Later they bore into developing fruits which become unmarketable. One larva damage four to six fruits during its complete larval development. A full-grown larva before going for pupation comes out from the fruit by making exit hole. Pupation take place in boat shaped silken cocoon in the fallen leaves or soil.

Objectives

1. To evaluate the field efficacy of neem products and selected chemicals against shoot and fruit borer on brinjal.
2. To calculate the cost-benefit ratio of the different treatments.

Materials and Methods

The present investigation was conducted during *rabi* season 2023-2024 to study the “Field efficacy of neem products and selected chemicals against shoot and fruit borer (*Leucinodes orbonalis* Guenee) on brinjal (*Solanum melongena* L.)” at Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) in a Randomized Block Design (RBD) with eight treatments and three replications using variety, *Vinayak Siliguri* in plot size of 2m X 1m at a spacing of 60 cm x 45 cm with a recommended package of practices excluding plant protection. The spraying was done after the population reached its ETL. From each plot, five plants were selected randomly and labelled for recording observations. As soon as the infestation of pest on the shoot was initiated, the observations on the total no of shoots and number of infested shoots (first spray) and Fruit infestation (second spray) of five observational plants from each treatment replication wise were recorded on one day before, 3, 7 and 14 days after imposing treatments. All the treatments were imposed by using hand compression sprayer. The spraying was done during evening hours and care was taken to avoid drift of insecticides. No sprays were given in untreated control.

Preparation of insecticidal spray solution: The insecticidal spray solution of the desired concentration as

per treatment was freshly prepared every time at the site of experiment just before the start of spraying operations. The spray solution of the desired concentration was prepared by adopting the following formula;
Verma and Chandra (2021)^[13]

$$V = \frac{C \times A}{a.i. \%}$$

Where,

V = Volume of a formulated pesticide required.

C = Concentration required.

A = Volume of total solution to be prepared.

a.i. % = given Percentage strength of a formulated pesticide.

Percent Shoot Infestation: The total number of shoots and number of shoots infested of five selected plants from each treatment replication wise were recorded at one day before, 3rd, 7th and 14th days after spraying.

Sankar and Kumar (2022)^[11]

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

Percent Fruit Infestation: During each picking, the total number of fruits and number of fruits infested of five selected plants from each treatment replication wise were recorded.

Sankar and Kumar (2022)^[11]

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

Benefit-Cost Ratio: Gross return was calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment imposition was deducted from the gross returns, to find out net returns and benefit-cost ratio by following formula,

Sankar and Kumar (2022)^[11]

$$B:C \text{ Ratio} = \frac{\text{Gross Return}}{\text{Total Cost of Cultivation}}$$

Results

The present study entitled, “Field efficacy of neem products and selected chemicals against shoot and fruit borer (*Leucinodes orbonalis* Guenee) on brinjal (*Solanum melongena* L.)” was undertaken at the Central Research Farm (CRF), SHUATS, Prayagraj. The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are tabulated in the following pages. Results, thus obtained are presented aspect wise here under.

First Spray- Percent Shoot Infestation

The data on the percent infestation of shoot and fruit borer on brinjal 3rd, 7th and 14th day after first spray revealed that all the treatments were significantly superior over control. Among all the treatments lowest percent shoot infestation was recorded in T₅ Chlorantraniliprole 18.5% SC (14.29), followed by T₇ Emamectin Benzoate 5% SG (15.58), T₆ Spinosad 45% SC (16.46), T₄ Indoxacarb 14.5% SC (17.30), T₃ Acephate 75% SP (17.71), T₂ Neem Oil 5% (19.29) and T₁ NSKE 5% (21.35). The treatments T₁ NSKE

5% (21.35) was least effective among all the treatments. Control plot T₈ (27.17) infestation was recorded.

Second Spray- Percent Fruit Infestation

The data on the percent infestation of shoot and fruit borer on brinjal after second spray revealed that all the treatments were significantly superior over control. Among all the treatments lowest percent fruit infestation was recorded in

T₅ Chlorantraniliprole 18.5% SC (14.06), followed by T₇ Emamectin Benzoate 5% SG (15.29), T₆ Spinosad 45% SC (16.48), T₄ Indoxacarb 14.5% SC (17.09), T₃ Acephate 75% SP (17.52), T₂ Neem Oil 5% (17.93) and T₁ NSKE 5% (18.60).

The treatments T₁ NSKE 5% (18.60) was least effective among all the treatments. Control plot T₈ (28.73) infestation was recorded.

Table 1. Field efficacy of neem products and selected chemicals against shoot and fruit borer (*Leucinodes orbonalis* Guenee) on brinjal.

Sr. No	Treatments	Dose			Percent shoot and fruit infestation of <i>Leucinodes orbonalis</i>								Overall Mean	Yield in q/ha	C:B ratio
					1st Spray			2nd Spray							
		1 DBS	3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean					
T ₁	NSKE 5%	5 ml/lit.	24.17a	22.76b	20.23b	21.06b	21.35b	19.29b	17.50b	19.02b	18.60b	19.97	85.16	1:2.74	
T ₂	Neem Oil 5%	5 ml/lit.	23.97a	19.69c	18.68c	19.52c	19.29c	18.54bc	17.03bc	18.23bc	17.93bc	18.61	90.50	1:2.93	
T ₃	Acephate 75% SP	1.5 gm/lit.	18.72c	18.42cd	17.09d	17.63d	17.71d	18.20c	16.52cd	17.85cd	17.52c	17.61	120.50	1:3.99	
T ₄	Indoxacarb 14.5% SC	1 ml/lit.	19.42c	17.81de	16.80de	17.31de	17.30de	17.85c	15.85d	17.59cd	17.09cd	17.19	142.83	1:4.66	
T ₅	Chlorantraniliprole 18.5% SC	0.4 ml/lit.	16.15d	14.89g	13.36g	14.63g	14.29g	15.39d	12.25f	14.56f	14.06f	14.17	216.66	1:6.80	
T ₆	Spinosad 45% SC	0.5 ml/lit.	18.46c	16.80ef	16.09e	16.51ef	16.46ef	17.57c	14.72e	17.16d	16.48d	16.47	163.50	1:4.99	
T ₇	Emamectin Benzoate 5% SG	0.4 gm/lit.	21.75b	16.14fg	14.89f	15.73f	15.58f	16.00d	14.16e	15.72e	15.29e	15.43	185.00	1:6.09	
T ₈	Control		25.11a	26.48a	27.18a	27.87a	27.17a	28.30a	28.70a	29.20a	28.73a	27.95	57.50	1:1.97	
	F-test		NS	S	S	S	S	S	S	S	S				
	S. Ed. (±)		0.98	0.67	0.45	0.50	0.42	0.47	0.44	0.46	0.44				
C. D. (P = 0.05)				1.447	0.966	1.075	0.910	1.018	0.948	0.997	0.946				

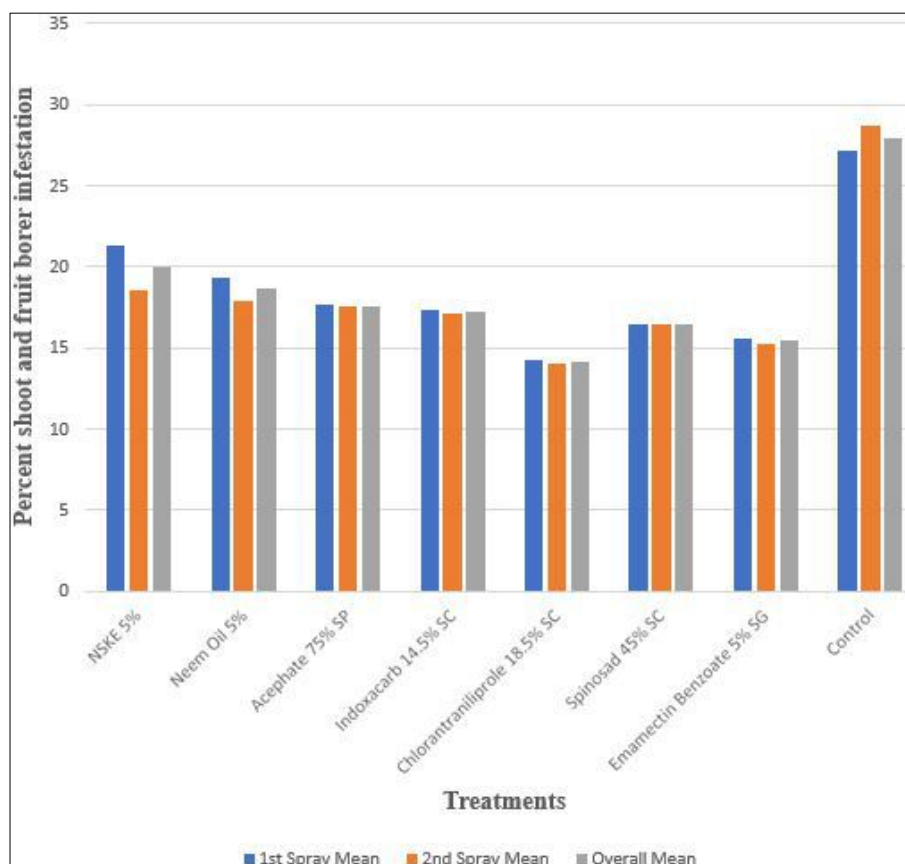


Fig 1: Field efficacy of neem products and selected chemicals against shoot and fruit borer on brinjal, (Over all mean- 1st and 2nd Spray)

Yield

The yields among the treatment were significant. Among all the treatments highest yield was recorded in T₅

Chlorantraniliprole 18.5% SC (216.66 q/ha), followed by T₇ Emamectin Benzoate 5% SG (185 q/ha), T₆ Spinosad 45% SC (163.50 q/ha), T₄ Indoxacarb 14.5% SC q/ha), T₃

Acephate 75% SP (120.50 q/ha), T₂ Neem Oil 5% (90.50 q/ha) and T₁ NSKE 5% (85.16 q/ha). The treatments T₁ NSKE 5% (85.16 q/ha) was least effective among all the treatments. Control plot T₈ (57.50 q/ha) yield was recorded.

Cost-Benefit Ratio

When cost-benefit ratio worked out, interesting result achieved among the treatment studied, the best and most economical treatment was found T₅ Chlorantraniliprole 18.5% SC (1:6.80), followed by T₇ Emamectin Benzoate 5% SG (1:6.09), T₆ Spinosad 45% SC (1:4.99), T₄ Indoxacarb 14.5% SC (1:4.66), T₃ Acephate 75% SP (1:3.99), T₂ Neem Oil 5% (1:2.93) and T₁ NSKE 5% (1:2.74). The treatments T₁ NSKE 5% (1:2.74) was least effective among all the treatments. Control plot T₈ (1:1.97).

Discussion

The data on mean population after first and second spray revealed that all the insecticides were found very effective and significantly superior over untreated control. Among all seven treatments minimum Larva number found in T₅ Chlorantraniliprole 18.5% SC (14.17) as the similar findings was reported by Tripura and Patra (2017) [12] who reported that Chlorantraniliprole 18.5% SC was the most effective treatment to control (*Leucinodes orbonalis*) larval population. T₇ Emamectin Benzoate 5% SG was found the next effective treatment with larval number (15.43) similar finding was reported by Biswas and Mishra (2020) [3] who reported that Emamectin Benzoate 5% SG was found to be the next best treatment for reducing the larval population of (*Leucinodes orbonalis*). T₆ Spinosad 45% SC was found the next best effective treatments with the larval number (16.47) which was similarly found by Chandar *et al.*, (2020) [4] who reported Spinosad 45% SC to be the next best and effective treatment in controlling larval population, T₄ Indoxacarb 14.5% SC was found the next most effective treatment with a minimum larval number of (17.19) as the same findings was done by Kushwaha and Painkra (2016) [6], T₃ Acephate 75% SP was found the next best effective treatment with a larval population of (17.61) as the same findings was done by Yadav and Singh (2015) [15], T₂ Neem Oil 5% was found the next effective treatment with a larval population of (18.61) as the same findings was done by Naik and Kumar (2023) [7], T₁ NSKE 5% was found the next effective treatment with a larval population of (19.97) and the same findings was done by Verma and Chandra (2021) [13].

When the cost-benefit ratio worked out, interesting result was achieved. Among all the treatments the higher cost-benefit ratio was obtained from T₅ Chlorantraniliprole 18.5% SC (1:6.80) as the similar findings was done by Pooja and Kumar (2022) [9], followed by the T₇ Emamectin Benzoate 5% SG exhibited a cost-benefit ratio of (1:6.09) as the similar finding was done by Sanjana and Tayde (2019) [10], followed by T₆ Spinosad 45% SC with a cost-benefit ratio of (1:4.99) as the similar finding was done by Sankar and Kumar (2022) [11], which was followed by T₄ Indoxacarb 14.5% SC which exhibited cost-benefit ratio of (1:4.66) which was supported by the finding of Kushwaha and Painkra (2016) [6], followed by T₃ Acephate 75% SP exhibited cost-benefit ratio of (1:3.99) it was supported by Yadav and Singh (2015) [14], which was followed by T₂ Neem Oil 5% with a cost-benefit ratio of (1:2.93) as the similar finding was done by Kumar and Thakur (2017) [5], followed by T₁ NSKE 5% which obtained a cost-benefit

ratio of (1:2.74) which was supported by Phopase and Yadav (2023) [8].

Conclusion

From the critical analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5% SC was found to be most effective when considered from view point of lowest percent infestation of shoot and fruit borer (14.17) with highest yield (216.66 q/ha) and cost-benefit ratio (1:6.80), which was followed by Emamectin Benzoate 5% SG, Spinosad 45% SC, Indoxacarb 14.5% SC and Acephate 75% SP. Among neem products Neem Oil 5% followed by NSKE 5% found least effective against *Leucinodes orbonalis*. Use of neem products such as NSKE 5% and Neem Oil 5% can be a part of integrated pest management in order to avoid indiscriminate use of pesticides causing pollution in the environment and not harmful to beneficial insects and human beings and in increasing cost effectiveness. On the basis of reduced borer infestation and high yield, Chlorantraniliprole 18.5% SC could be recommended in successful management of shoot and fruit borer.

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