Comparative Efficacy of Selected Chemical with Neem Products against Shoot and Fruit Borer [*Leucinodes orbonalis* (Guenee)] on Brinjal (*Solanum melongena* L.)

ABSTRACT

The present investigation was carried out at Central Research Farm (CRF), Department of Entomology, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh during *Kharif* season of 2023. The experiment was laid in Randomized Block Design with seven treatments replicated thrice along with untreated control plot. Eight treaments viz. Imidachloprid 17.8 SL @ 0.5ml, Neem seed kernel extract 5% @ 4ml/l, Spinosad 45 SC @ 0.3ml/lit, Neem oil 2% @ 3ml/lit, Neem oil 2% @ 3ml + Flubendiamide @ 0.4ml/lit, Indoxacarb 14.5 SC @ 1ml/lit, Flubendiamide 480 SC @ 0.4ml/lit were evaluated against shoot and fruit borer (*Leucinodes orbonalis*). Study revealed that all the treatments was found significantly superior over control. The result showed that the treatments lowest percent shoot and fruits, infestation was recorded in T_3 Spinosad 45 SC @ 0.3ml/lit (1.87), followed by T_1 Imidachloprid 17.8 SL @ 0.5ml/lit, (2.28), T_7 Flubendiamide 480 SC @ 0.4m/lit (2.74), T_6 Indoxacarb 14.5 SC @ 1ml/lit (3.71), T_5 Neem oil 2% @ 3ml/l + flubendiamide @ 0.4ml (4.31), T_2 Neem seed kernel extract 5% @ 4 ml/l (4.52) and T_4 Neem oil 2% (4.77). The treatments T_4 Neem oil 2% (4.77) was least effective among all the treatments against Leucinodes orbonalis. The highest yield was recorded in T_3 Spinosad 45 SC (195.30 q/ha 1:8.4), followed by T_1 Imidachloprid 17.8 SL (170 q/ha 1:7.9), T_7 flubendiamide (145 q/ha 1:6.1), T_6 Indoxacarb 14.5 % SC (130 q/ha 1:5.9), T_5 Neem oil 2% + flubendiamide (120.5 q/ha 1.46), T_2 Neem seed Kernel extract 5% (115.5 q/ha 1:4.4) and T_4 Neem oil 2% (90.4 q/ha 1:3.9). Control plot T_8 (55.14 q/ha 1:2.7) yield.

Keywords: Botanicals; brinjal; cost benefit ratio chemicals; Leucinodes orbonalis.

1. INTRODUCTION

Brinjal (*Solanum melongena* L.) or eggplant comes under the crop family Solanaceae (Nightshade) and it is native to the Indian Subcontinent. It is also known as eggplant in the US, Australia. In the UK it is called Aubergine and in South Asia and South Africa it is called Brinjal. Brinjal (*Solanum melongena* L.) also known as eggplant is referred to as the “King of vegetables” Machhindra *et al.,* (2023). It is one of the most important vegetables in the Indian subcontinent where it is grown over almost 50% of the world's area under its cultivation (Alam *et al.,* 2003). Due to its nutritive value, consisting of minerals like iron, phosphorus, calcium and vitamins like A, B and C, unripe fruits are used primarily as vegetables in the country. It is also used as a raw material in pickle making and as an excellent remedy for those suffering from liver complaints. It has been reported as Ayurveda medicine for curing diabetes. In addition, it is used as a good appetiser, good aphrodisiac, cardio tonic, laxative and reliever of inflammation Machhindra *et al.,* (2023). It has 100 gm edible portions of brinjal supplies 40 gm carbohydrates, 1.40 gm of proteins, 0.30 gm of mineral and vitamins A, B and C (68,69). The fruits of brinjal are 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). 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 illion 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 2017-2018 However, U.P. is at the apex in productivity over India Vyas and Tayde (2022). 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 *Bemicia tabaci* (Genn.), leafhopper *Amrasca biguttula biguttula* (Ishida) and non-insect pest red spider mite *Tetranychus macfurlanei*, out of these, *L. orbonalis* is considered the main constraint as it damages the crop throughout the year Naik and Kumar (2023). Shoot and fruit borer, *L. orbonalis* (Lepidopetera *L Pyralidae*) is the key pest throughout Asia. In India, this pest has a countrywide distribution and has been categorised as the most destructive and most serious pest causing huge 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. The pest has been reported to inflict losses to the tune of 20.7 - 60.0 percent in Tamil Nadu. 70 percent Andhra Pradesh. 80 percent in Gujarat and 41 percent in Himachal Pradesh. (Machhindra *et al.,* 2023).

2. MATERIALS AND METHODS

The experiment was conducted during the *Kharif* season of 2023 in Central Research farm (CRF), Uttar Pradesh, India. All the facilities necessary for cultivation, including labour, were made available in the department. The site selected was uniform, cultivable with typical Sandy loam soil having good drainage. The experiment was conducted in Randomised Block Design (RBD) with eight treatments including control with three replications. The plot size taken was 2m×1m. The crops of Brinjal (*Solanum melongena* L.) Variety Indam Supriya were used for sowing by maintaining 45 cm inter-row and 60 cm intra-row distance. The spray solution was applied with the help of a hand compression sprayer. Spraying was done at dawn and dusk timeand there must not be much wind currents.

The Bio Pesticides and Chemicals used for spraying are Imidacloprid 17.8 SL @ 0.5ml/l, Neem seed kernel extract 5% @ 4ml/l, Spinosad 45 SC @ 0.3ml/lit, Neem oil 2% @ 3ml/lit, Neem oil 2% @ 3ml/lit + Flubendiamide @ 0.4ml/lit, Indoxacarb 14.5 SC @ 1ml/lit, Flubendiamide 480 SC @ 0.4ml/lit and untreated control.

The numbers of damaged fruit were counted on 5 randomly selected plants in each plot. The pre-treatment count was made a day before the first spray and second spray whereas, the post-treatment counts were made on the 7^{th} and 14^{th} day after each spray. The damaged fruit over control against Brinjal fruit and shoot borer (*Leucinodes orbonalis*) was calculated by considering the mean of two observations recorded at 7^{th}, and14^{th} day after first and second spray.

2.1 Preparation of Insecticidal Spray Solutions

The Insecticidal spray solution of desired concentration as per treatment was freshly prepared every time at the site of experimentation just before the start of spraying operations. The spray solutions fade sired concentration was preparing by adopting the following formula,

V = (C x 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.

2.2 On Shoot

Number Basis: At each picking the total number of shoots and number of shoots infested of five selected plants from each treatment replication wise was recorded. (Yadav *et al.,* 2015).

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

2.3 On Fruit

Number Basis: At each picking the total number of fruit and number of fruit infestation five selected plants from each treatment replication wise was recorded. (Yadav *et al.,* 2015).

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

2.4 Cost Benefit Ratio of Treatments

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.

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

(Lavanya and Kumar, 2022)

Where,

C:B Ratio = Cost Benefit Ratio

3. RESULTS AND DISCUSSION

The data after first spray Table 1, revealed that all the treatments were significantly superior over control. Among all the treatments lowest percent shoot, infestation was recorded in T_3 Spinosad 45 SC (2.17), followed by T_1 Imidacloprid 17.8 SL (2.79), T_7 flubendiamide (3.19), T_6 indoxacarb 14.5% SC (4.16), T_5 Neem oil 2% + flubendiamide (4.85), T_2 Neem seed kernel extract 5% (5.06) and T_4 Neem oil 2% (5.30). The treatment T_4 Neem oil 2% (5.30) was least effective among all the treatments. Control plot T_8 (7.21) infestation.

The data on the percent infestation of shoot and fruit borer in brinjal 7 days after second spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest percent shoot, infestation was recorded in T_3 Spinosad 45 SC (1.58), followed by T_1 Imidacloprid 17.8 SL (1.77), T_7 flubendiamide (2.29), T_6 indoxacarb 14.5% SC (3.27), T_5 Neem oil 2% + flubendiamide (3.78), T_2 Neem seed kernel extract 5% (3.99) and T_4 Neem oil 2% (4.24). The treatment T_4 Neem oil 2% (4.24) was least effective among all the treatments.

When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the best and most economical treatment T_3 Spinosad 45 SC (1:8.4), followed by T_1 Imidacloprid 17.8 SL (1:7.9), T_7 flubendiamide (1:6.1), T_6 indoxacarb 14.5% SC (1:5.9), T_5 Neem oil 2% + flubendiamide (1:4.6), T_2 Neem seed kernel extract 5% (1:4.4) and T_4 Neem oil 2% (1:3.9). The treatment T_4 Neem oil 2% (1:3.9) was least effective among all the treatments. Control plot T_8 (1:2.7).

The data on the percent infestation of shoot borer in brinjal (7, 14 DAS) of first spray for population of *Leucinodes orbonalis* revealed that among all the treatments lowest percent shoot, infestation was recorded in T_3 Spinosad 45 SC (2.17), followed by T_1 Imidacloprid 17.8 SL (2.79), T_7 flubendiamide (3.19), T_6 indoxacarb 14.5% SC (4.16), T_5 Neem oil 2% + flubendiamide (4.85), T_2 Neem seed kernel extract 5% (5.06) and T_4 Neem oil 2% (5.30). The treatment T_4 Neem oil 2% (5.30) was least effective among all the treatments. Control plot T_8 (7.21) infestation.

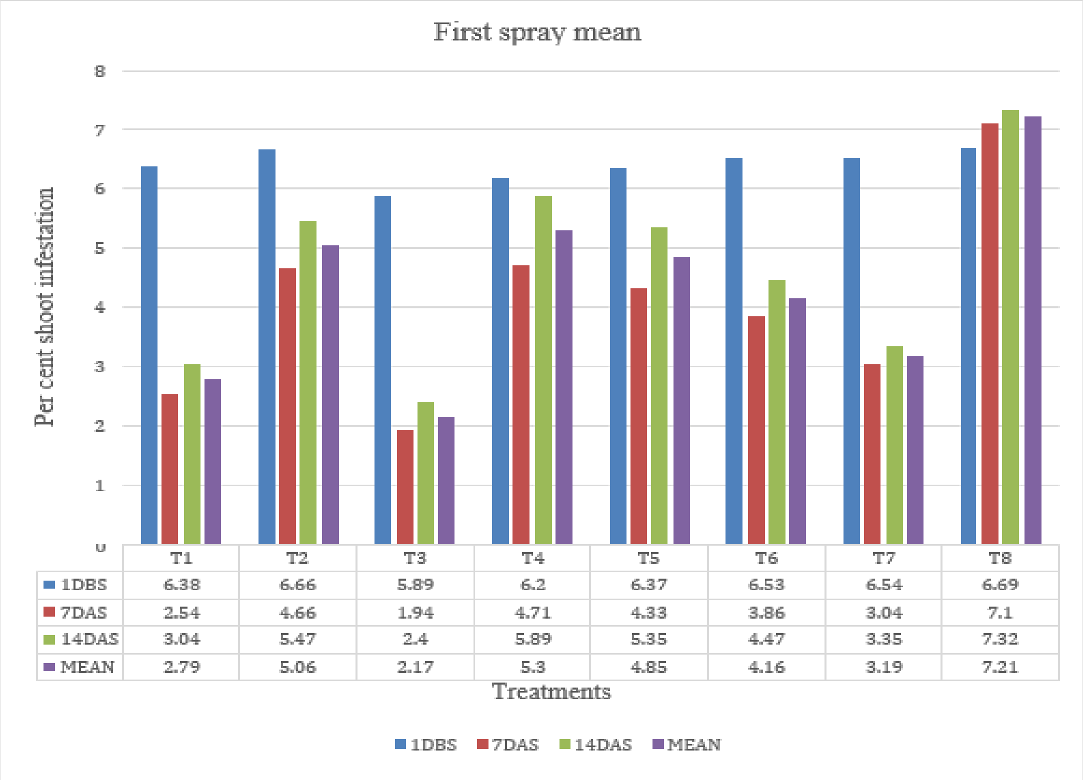
The data on the percent infestation of fruit borer in brinjal (7, 14 DAS) of second spray for population of *Leucinodes orbonalis* revealed that among all the treatments lowest percent fruit, infestation was recorded in T_3 Spinosad 45 SC (1.58), followed by T_1 Imidacloprid 17.8 SL (1.77), T_7 flubendiamide (2.29), T_6 indoxacarb 14.5% SC (3.27), T_5 Neem oil 2% + flubendiamide (3.78), T_2 Neem seed kernel extract 5% (3.99) and T_4 Neem oil 2% (4.24). The treatment T_4 Neem oil 2% (4.24) was least effective among all the treatments. Control plot T_8 (7.68) infestation.

The results are in support with Sakharam *et al.,* (2020) and Machhindra *et al.,* (2023). reported that the treatment T_3 Spinosad 45 SC was superior in reducing the population of shoot and fruit borer. Next most effective treatment was T_1 Imidacloprid 17.8 SL which was similar with Sakharam *et al.,* (2020). Next effective treatment was recorded in T_7 flubendiamide which is similar to Naik and kumar (2023). Followed by T_6 Indoxacarb 14.5% SC which is similar to Singh and Murya (2020). Next effective was T_2 Neem seed Kernel extract 5% which is similar to Bhagwan and Kumar (2017) and Sakharam *et al.,* (2020). Next least effective was T_4 Neem oil 5% similar with Vyas and Tayde (2022) and Machhindra *et al.,* (2023).

The highest yield and cost benefit ratio was recorded in Spinosad 45 SC (195.30 q/ha) and (1:8.4) as respectively. The result is supported by Sakharam *et al.,* (2020) and Machhindra *et al.,* (2023). followed by Imidachloprid 17.8 SL (170 q/ha) and (1:7.9) in similar findings Sakharam *et al.,* (2020). flubendiamide (145 q/ha) and (1:6.1) in similar findings Naik and kumar (2023). Indoxacarb 14.5% SC (130 q/ha) and (1:5.9) Dwivedi *et al.,* (2014). Neem oil 2% + flubendiamide (120.5 q/ha) and (1:4.6) similar to Yerrabala *et al., (*2021). Neem seed kernel extract 5% (115.5 q/ha) and (1:4.4) similar to Bhagwan and Kumar (2017) and Sakharam *et al.,* (2020). Neem oil 5% (90.4 q/ha) and (1:3.9) similar to Vyas and Tayde (2022) and Machhindra *et al.,* (2023).

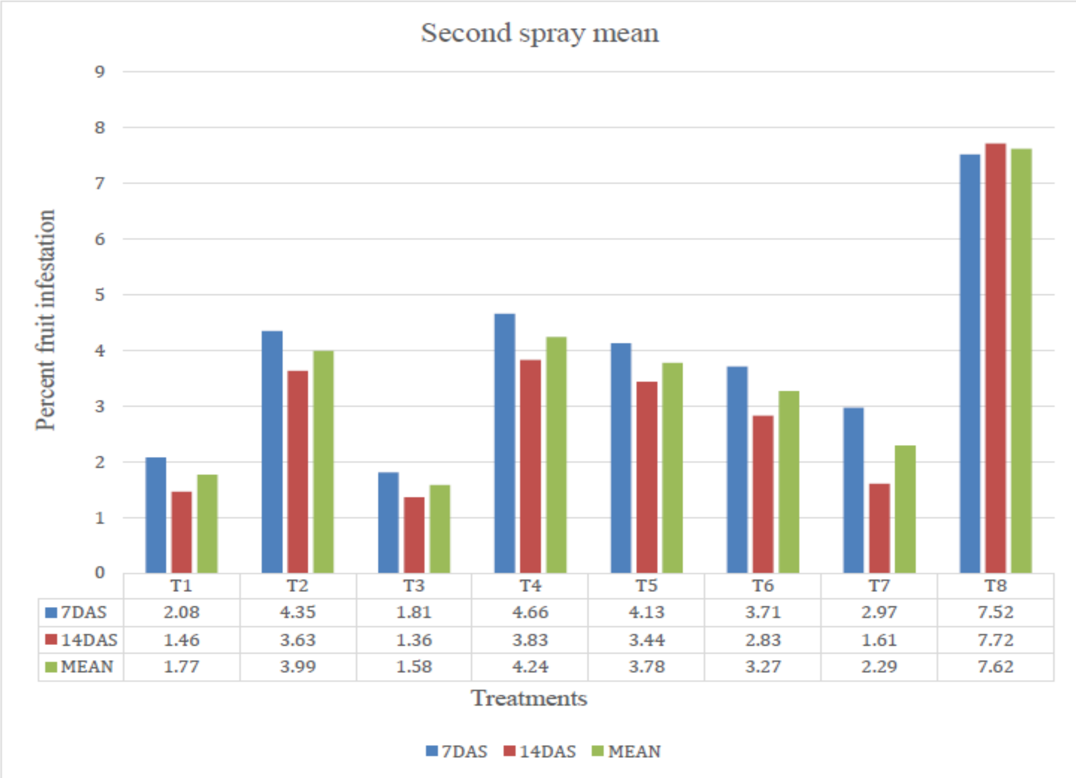
Table 1. Efficacy of selected chemical with neem products on shoots and fruit damage of brinjal (*Solanum melongena* L.) after first andsecond spray with yield and C:B ratio

Treatments		Per cent shoots and fruits infestation								Yield (q/ha)	C: B Ratio
		1st spray				2nd spray					
		One day before spray	7 DAS	14 DAS	Mean	7 DAS	14 DAS	Mean	Overall mean (1&2 spray)		
T_1	Imidachloprid 17.8 SL	6.38	2.54	3.04	2.79	2.08	1.46	1.77	2.28	170	1:7.9
T_2	Neem seed kernel extract 5%	6.66	4.66	5.47	5.06	4.35	3.63	3.99	4.52	115.5	1:4.4
T_3	Spinosad 45% SC	5.89	1.94	2.40	2.17	1.81	1.36	1.58	1.87	195.30	1:8.4
T_4	Neem oil @ 2%	6.20	4.71	5.89	5.30	4.66	3.83	4.24	4.77	90.4	1:3.9
T_5	Neem oil 2% + Flubendiamide	6.37	4.33	5.35	4.85	4.13	3.44	3.78	4.31	120.5	1:4.6
T_6	Indoxacarb 14.5% SC	6.53	3.86	4.47	4.16	3.71	2.83	3.27	3.71	130	1:5.9
T_7	Flubendiamide 480 SC	6.54	3.04	3.35	3.19	2.97	1.61	2.29	2.74	145	1:6.1
T_8	Control	6.69	7.10	7.32	7.21	7.52	7.72	7.62	7.41	55.14	1:2.7
Overall Mean		6.40	4.02	4.66	4.34	3.90	3.23	3.56	3.95		
F- test		NS	S	S	S	S	S	S	S		
S. Ed. (±)		0.47	0.31	0.50	0.24	0.23	0.37	0.31	0.36		
C. D. (P = 0.05)		N/A	0.65	1.07	0.56	0.49	0.78	0.73	0.84		



	T1	T2	T3	T4	T5	T6	T7	T8
1DBS	6.38	6.66	5.89	6.2	6.37	6.53	6.54	6.69
7DAS	2.54	4.66	1.94	4.71	4.33	3.86	3.04	7.1
14DAS	3.04	5.47	2.4	5.89	5.35	4.47	3.35	7.32
MEAN	2.79	5.06	2.17	5.3	4.85	4.16	3.19	7.21

Fig. 1. Effect of treatments on infestation of shoot and fruit borer after first spray (Per cent shoot infestation)



	T1	T2	T3	T4	T5	T6	T7	T8
7DAS	2.08	4.35	1.81	4.66	4.13	3.71	2.97	7.52
14DAS	1.46	3.63	1.36	3.83	3.44	2.83	1.61	7.72
MEAN	1.77	3.99	1.58	4.24	3.78	3.27	2.29	7.62

Fig. 2. Effect of treatments on infestation of shoot and fruit borer after second spray (Per cent fruit infestation)

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