

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 treatments 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 T₃ Spinosad 45 SC @ 0.3ml/lit (1.87), followed by T₁ Imidachloprid 17.8 SL @ 0.5ml/lit, (2.28), T₇ Flubendiamide 480 SC @ 0.4ml/lit (2.74), T₆ Indoxacarb 14.5 SC @ 1ml/lit (3.71), T₅ Neem oil 2% @ 3ml/l + flubendiamide @ 0.4ml (4.31), T₂ Neem seed kernel extract 5% @ 4 ml/l (4.52) and T₄ Neem oil 2% (4.77). The treatments T₄ Neem oil 2% (4.77) was least effective among all the treatments against *Leucinodes orbonalis*. The highest yield was recorded in T₃ Spinosad 45 SC (195.30 q/ha 1:8.4), followed by T₁ Imidachloprid 17.8 SL (170 q/ha 1:7.9), T₇ flubendiamide (145 q/ha 1:6.1), T₆ Indoxacarb 14.5 % SC (130 q/ha 1:5.9), T₅ Neem oil 2% + flubendiamide (120.5 q/ha 1.46), T₂ Neem seed Kernel extract 5% (115.5 q/ha 1:4.4) and T₄ Neem oil 2% (90.4 q/ha 1:3.9). Control plot T₈ (55.14 q/ha 1:2.7) yield.

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

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”. Machhindra et al., (2023) 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 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” 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 *Bemisia 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 Pylidae*) 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).

MATERIALS AND METHOD

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 time and 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 7th and 14th 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 7th, and 14th day after first and second spray.

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 of desired concentration was prepared by adopting the following formula,

$$V = (C \times A) / \% \text{ a.i.}$$

Where,

V= Volume of a formulated pesticide required.

C= Concentration required.

A= Volume of total solution to be prepared.

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

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).

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

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).

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

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”. [10]

$$\text{C:B Ratio} = \frac{\text{Gross returns Rs/ha}}{\text{Total Cost}} \quad (\text{Lavanya and Kumar, 2022})$$

Where,

C:B Ratio = Cost Benefit Ratio

RESULT 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 T₃ Spinosad 45 SC (2.17), followed by T₁ Imidacloprid 17.8 SL (2.79), T₇ flubendiamide (3.19), T₆ indoxacarb 14.5% SC (4.16), T₅ Neem oil 2% + flubendiamide (4.85), T₂ Neem seed kernel extract 5% (5.06) and T₄ Neem oil 2% (5.30). The treatment T₄ Neem oil 2% (5.30) was least effective among all the treatments. Control plot T₈ (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 T₃ Spinosad 45 SC (1.58), followed by T₁ Imidacloprid 17.8 SL (1.77), T₇ flubendiamide (2.29), T₆ indoxacarb 14.5% SC (3.27), T₅ Neem oil 2% + flubendiamide (3.78), T₂ Neem seed kernel extract 5% (3.99) and T₄ Neem oil 2% (4.24). The treatment T₄ 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 T₃ Spinosad 45 SC (1:8.4), followed by T₁ Imidacloprid 17.8 SL (1:7.9), T₇ flubendiamide (1:6.1), T₆ indoxacarb 14.5% SC (1:5.9), T₅ Neem oil 2% + flubendiamide (1:4.6), T₂ Neem seed kernel extract 5% (1:4.4) and T₄ Neem oil 2% (1:3.9). The treatment T₄ Neem oil 2% (1:3.9) was least effective among all the treatments. Control plot T₈ (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 T₃ Spinosad 45 SC (2.17), followed by T₁ Imidacloprid 17.8 SL (2.79), T₇ flubendiamide (3.19), T₆ indoxacarb 14.5% SC (4.16), T₅ Neem oil 2% + flubendiamide (4.85), T₂ Neem seed kernel extract 5% (5.06) and T₄ Neem oil 2% (5.30). The treatment T₄ Neem oil 2% (5.30) was least effective among all the treatments. Control plot T₈ (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 T₃ Spinosad 45 SC (1.58), followed by T₁ Imidacloprid 17.8 SL (1.77), T₇ flubendiamide (2.29), T₆ indoxacarb 14.5% SC (3.27), T₅ Neem oil 2% + flubendiamide (3.78), T₂ Neem seed kernel extract 5% (3.99) and T₄ Neem oil 2% (4.24). The

treatment T₄ Neem oil 2% (4.24) was least effective among all the treatments. Control plot T₈ (7.68) infestation.

The results are in support with **Sakharam *et al.*, (2020)** and **Machhindra *et al.*, (2023)**. reported that the treatment T₃ Spinosad 45 SC was superior in reducing the population of shoot and fruit borer. Next most effective treatment was T₁ Imidacloprid 17.8 SL which was similar with **Sakharam *et al.*, (2020)**. Next effective treatment was recorded in T₇ flubendiamide which is similar to **Naik and kumar (2023)**. Followed by T₆ Indoxacarb 14.5% SC which is similar to **Singh and Murya (2020)**. Next effective was T₂ Neem seed Kernel extract 5% which is similar to **Bhagwan and Kumar (2017) and Sakharam *et al.*, (2020)**. Next least effective was T₄ 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 and second spray with yield and C:B ratio.

Treatments		Per cent shoots and fruits infestation								Yield (q/ha)	C: B Ratio
		1 st spray				2 nd spray					
		One day before spray	7 DAS	14 DAS	Mean	7 DAS	14 DAS	Mean	Overall mean (1&2 spray)		
T₁	Imidachloprid 17.8 SL	6.38	2.54	3.04	2.79	2.08	1.46	1.77	2.28	170	1:7.9
T₂	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
T₃	Spinosad 45% SC	5.89	1.94	2.40	2.17	1.81	1.36	1.58	1.87	195.30	1:8.4
T₄	Neem oil @ 2%	6.20	4.71	5.89	5.30	4.66	3.83	4.24	4.77	90.4	1:3.9
T₅	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
T₆	Indoxacarb 14.5% SC	6.53	3.86	4.47	4.16	3.71	2.83	3.27	3.71	130	1:5.9
T₇	Flubendiamide 480 SC	6.54	3.04	3.35	3.19	2.97	1.61	2.29	2.74	145	1:6.1
T₈	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		

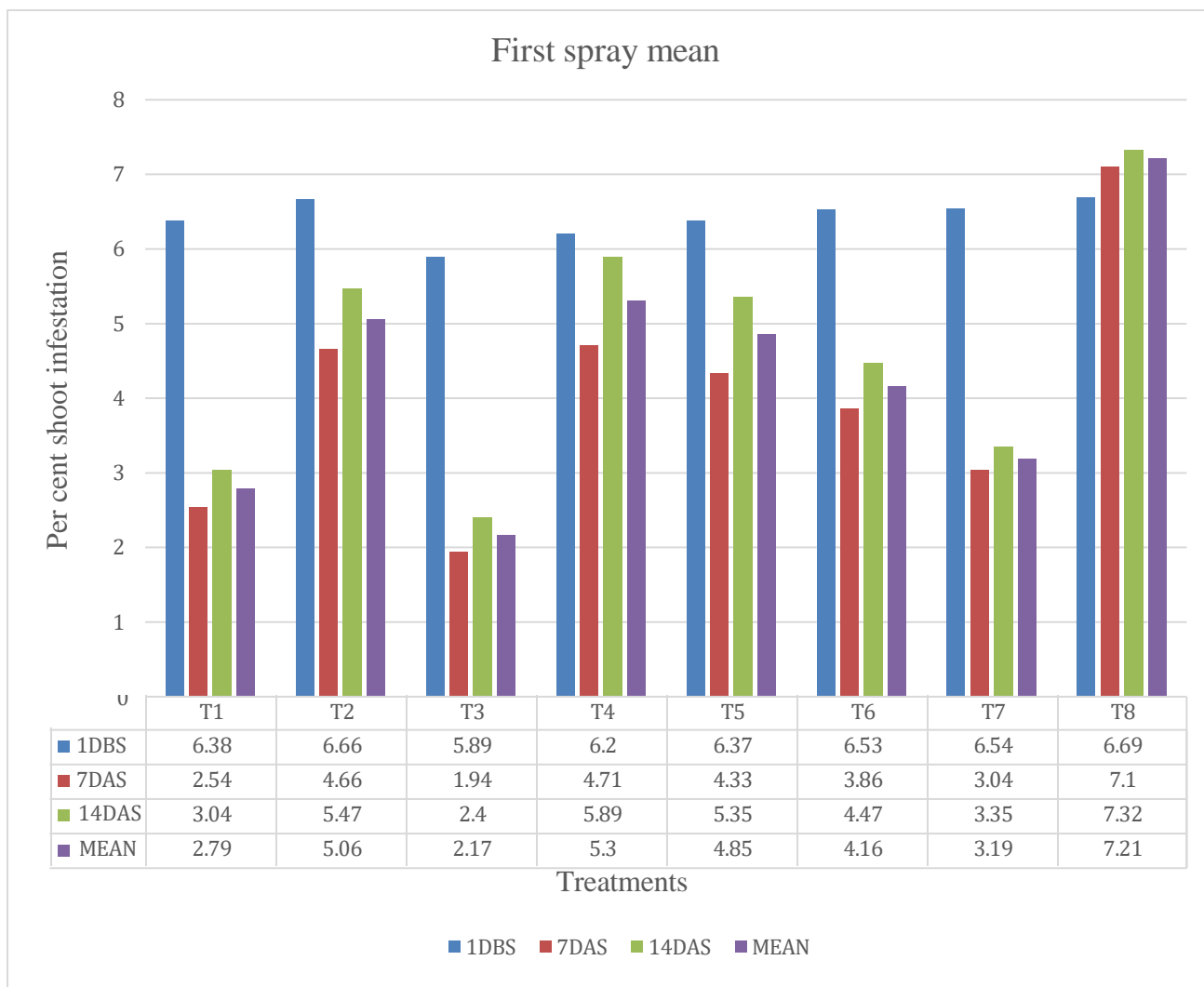


Fig. 1 Effect of treatments on infestation of shoot and fruit borer after first spray (Per cent shoot infestation).

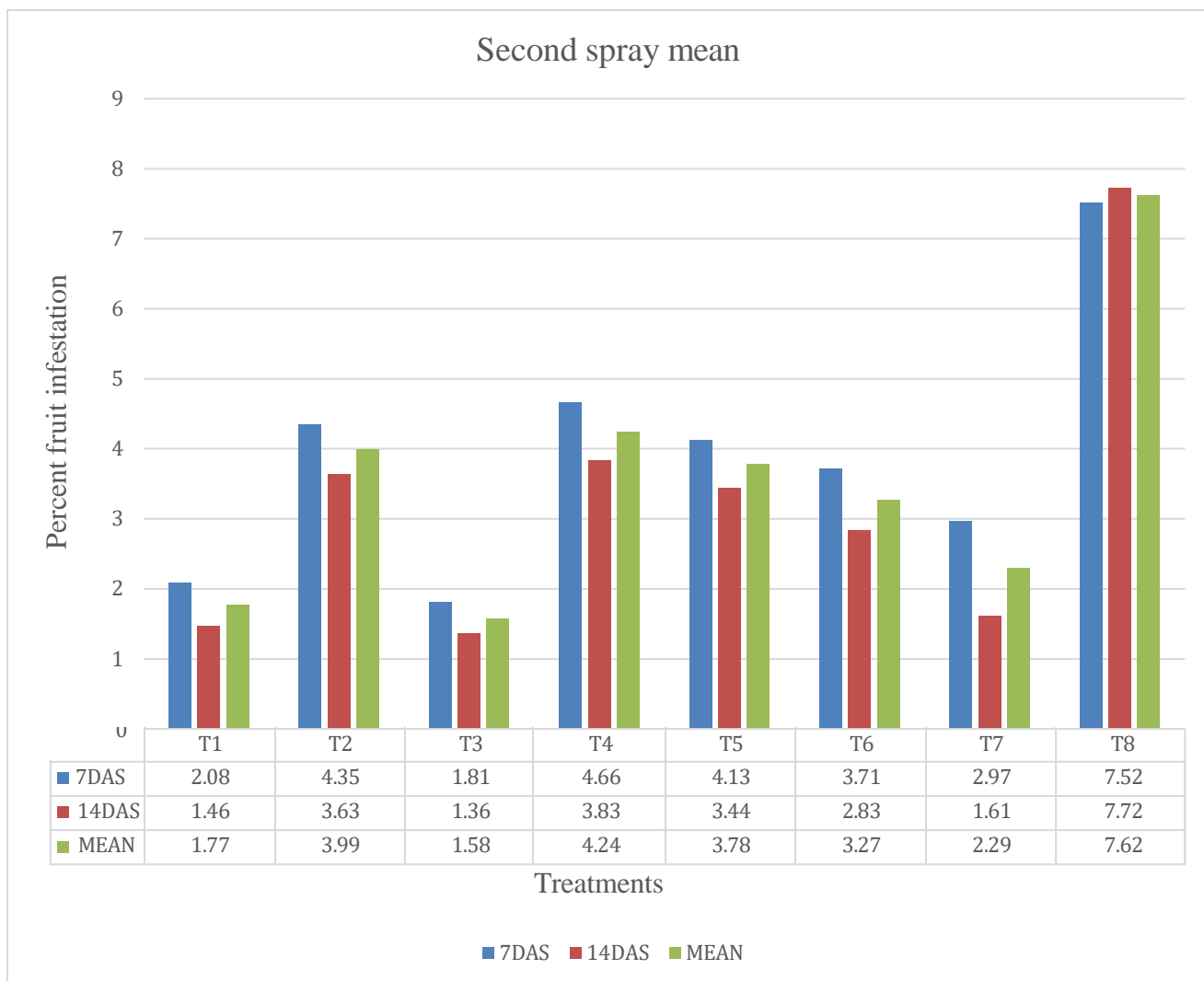


Fig. 2 Effect of treatments on infestation of shoot and fruit borer after second spray (Percent fruit infestation).

Conclusion

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.

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REFERENCES

1. **Abhishek, T. S. and Dwivedi, S. A. (2021).** Review on integrated management of brinjal shoots and fruit borer, *Leucinodes orbonalis* (Guenee). *Journal of entomology and zoology studies*, **9**(1): 181-189.
2. **Alam, S. N., M. A. Rashid, F. M. A. Rouf, R. C. Jhala, J. R. Patel, S. Satpathy, T. M. Shivalingaswamy, S. Rai, I. Wahundeniya, A. Cork, C. Ammaranan and N. S. Talekar. (2003).** Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia. *The World Vegetable Centre, Shanhua, Taiwan*. P-56.
3. **Bhagwan, D. S. and Kumar, A. (2017).** Field efficacy of cypermethrin and certain biopesticides against brinjal shoot and fruit borer, (*Leucinodes orbonalis* Guenee) on Brinjal (*solanum melongena* L.). *Journal of pharmacognosy and phytochemistry*, **6**(4): 1930-1933.
4. **Dwivedi, R. K., Tripathi, A., Pal, R. K. and Singh, D. K. (2014).** Effect and eco-friendly management of BSFB (*Leucinodes orbonalis* Guenee) on brinjal. *International Journal of Plant Protection*, **7**: 287-291.
5. **Lavanya, V. and Kumar, A. (2022).** Efficacy of certain chemicals against brinjal shoot and fruit borer (*Leucinodes orbonalis*) of Brinjal (*Solanum melongena* L.). *The Pharma Innovation Journal*, **11**(3): 1293-1297.
6. **Machhindra, P. N., Yadav, U., Nana, P. H., Ananda, N. S. and Sakharam, C. A. (2023).** Efficacy of chemicals and biopesticides against Shoot and fruit borer (*Leucinodes orbonalis* (Guenee)) on Brinjal. *International journal of plant pathology and microbiology*, **3**(1): 9-12.
7. **Naik, S. G. and kumar, A. (2023).** Field efficacy and economics of certain chemicals and biopesticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* (Guenee)). *The pharma innovation journal*. **21**(6): 2937-2940.
8. **Sakharam, C. A., Kumar, A., Singh, U., Kakade, A. A., Nawale, J. S., Narode, M. K. and Solanke, K. M. (2020).** Efficacy of certain chemicals and biopesticides against brinjal shoot and fruit borer *Leucinodes orbonalis* (Guenee). *Journal of entomology and zoology studies*, **8**(5): 220-223.

9. **Singh, U. K. and Maurya, K. K. (2020).** Seasonal abundance of brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee) on brinjal, *Solanum melongena* (L.) and its management. *Journal of Pharmacognosy and Phytochemistry*, **9**(5): 2657-2660.
10. **Vyas, P. and Tayde, A. R. (2022).** Evaluation of chemical insecticides and biopesticides in management of shoot and fruit borer *Leucinodes orbonalis* (Guenee) in brinjal *Solanum melongena* (L.). *The pharma innovation journal*. **11**(10): 898-901.
11. **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): 987-990.
12. **Yerrabala, S., Kumar, H. S. and Yadav, U. (2021).** Comparative efficacy of *Bacillus thuringiensis* with botanicals and chemicals against shoot and fruit borer in brinjal (*Solanum melongena* L.). *The Pharma Innovation Journal*, **10**(5): 709-712.

