International Journal of Plant & Soil Science

Volume 35, Issue 13, Page 127-133, 2023; Article no.IJPSS.100097
ISSN: 2320-7035

Efficacy of Selected Insecticides against Shoot and Fruit Borer, *Earias vittella* (Fabricius.) on Okra

Mangali Sowjanya [a++*] and Ashwani Kumar [a#]

[a] *Department of Entomology, Faculty of Agriculture, Naini Agricultural Institute, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i132996

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/100097

Original Research Article

Received: 11/03/2023
Accepted: 14/05/2023
Published: 20/05/2023

ABSTRACT

A field experiment was carried out at Central Research Farm (CRF), SHUATS, Uttar Pradesh, India, during the Kharif season (autumn reap) for a total of three months, from mid-July to mid-October, 2022. The seven treatments—Indoxacarb 14.5% SC (T1), Deltamethrin 2.8% EC (T2), Karanjin oil (T3), *Metarhizium anisopliae* 1*108 CFU (T4), Neem oil 5% (T5), Emamectin benzoate 5% SG (T6), Spinosad 45% SC (T7), and control plot (T8)—were each replicated thrice in the experiment. Data regarding *Earias vittella* infection percentage of the first and second sprays showed that all treatments were much better than the control. The lowest percent infestation of *Earias vittella* was recorded by Deltamethrin 2.8% EC (17.745% & 13.608%), which was followed by Emamectin benzoate 5% SG (18.837% & 15.777%), Spinosad 45% SC (19.610% & 16.565%), Indoxacarb 14.5% SC (20.092% & 18.147%), Neem oil 5% (20.602% & 18.900%), Karanjin oil 5% (22.080% & 21.639%), *Metarhizium anisopliae* $1*10^8$ CFU (22.710% & 21.837%). Deltamethrin 2.8% EC produced the largest output, 129 q/ha, as well as the highest B:C ratio (1:5.45). It was

[++] *M.Sc. Scholar;*
[#] *Associate Professor and Head;*
**Corresponding author: E-mail: sowjanyakrishna855@gmail.com;*

followed by Emamectin benzoate 5% SG (1:5.31), Spinosad 45% SC (1:5.19), Indoxacarb 14.5% SC (1:4.93), Neem oil 5% (1:4.76), Karanjin oil 5% (1:4.64), and *Metarhizium anisopliae* $1*10^8$CFU (1:4.58) when compared to control plot (1:3.01) whose B:C ratio is very low.

Keywords: Okra; Metarhizium anisopliae $1*10^8$ *CFU; Earias vittella; chemical pesticides; botanicals.*

1. INTRODUCTION

Abelmoschus esculentus L., a South African native and often referred to as "Bhendi," is an annual malvaceous vegetable crop that does well in tropical and subtropical regions. It is a highly well-liked summer vegetable for home cultivation. Because of the favourable climatic conditions for its production, it is grown extensively throughout the year with the exception of one or two cold months. This is especially true in the states of Maharashtra, Uttar Pradesh, Madhya Pradesh, and Karnataka. The production of okra is mostly high all over in India. There are a nine species of okra which are cultivated in India *i.e. Abelmoschus angulosus, Abelmoschus cancellatus, Abelmoschus crinitures, Abelmoschus ficulneus, Abelmoschus manihot tetraphyllus, Abelmoschus manihot* spp*., tetraphyllus* var. *Pungens, Abelmoschus moschatus* spp. *moschatus, Abelmoschus moschatus* spp. *Tuberosus* [1].

After China, India is the second-largest vegetable grower. Indians make up the majority of vegetarians, with a per capita intake of 135 g daily compared to the required 300 g. It is still far below the level of the recommended diet [2].

Vegetables possess high nutritive value, supply vitamins and minerals which are deficient in other food materials. Vitamins, minerals, and other nutritious components are abundant in okra. Its seeds are rich in protein and contain high-quality edible oil. The okra pod contains carbohydrate and mucilage, a pectin combination utilised as a thickening in the culinary industry. Ca, K, Mg, Fe, Na, and other elements are the main substances present in this vegetable. Fresh fruits provide 90.17 g of water, 703 g of carbohydrate, 2 g of protein, 81 mg of calcium, 1.20 g of sugar, 0.04 mg of phosphorus, 0.0051 mg of iron, 3.2 g of dietary fibre, 0.10 g of fat, 58 IU of vitamin A, 63 IU of vitamin B, and 16 mg of vitamin C per 100 g [3]. Potash and iodine are also present.

India is the top producer of okra in the world, producing 5794 thousand tonnes (72% of the global output), across 564 thousand ha per year, with a productivity of 12.9 million tonnes per ha. The crop is farmed all throughout India, but Andhra Pradesh is the top producing state with an annual yield of 884.2 thousand tonnes from an area of 79.9 thousand hectares, or 15 tonnes per ha. West Bengal is in second place (862.1 thousand tonnes from 74 thousand with 11.7 tons/ha productivity). Okra is produced in 48.2 thousand ha, 177.26 thousand tonnes, and 8 tons/ha in the Uttar Pradesh region, correspondingly [4].

Numerous factors contribute to low yield, but severe damage caused by insect pests was a major one [5] found that okra is attacked by more than thirty different insect pests. Pests like the *E. vittella* (Fab.), shoot and fruit borer and jassid are among them. Major biotic obstacles stand in the way of obtaining the potential yield, including a *A*. *biguttula biguttula* Ishida. Other insect pests, such as the fruit borers and the aphid, *Aphis gossypii* Glover, also harm the okra crop. Whiteflies, *Bemisia tabaci* Genn.; the sporadic red spider mite, *Tetranychus cinnabaris*; and *Helicoverpa armigera* Hub. A sucking insect pest infestation hinders agricultural development in addition to spreading harmful illnesses.

Summer and Kharif are the two growing seasons for okra. One of the major pest inflicting 40–50% damage to okra fruits throughout both seasons, is shoot and fruit borer. According to Pareek and Bhargava [6], the damage caused by *Earias* spp. alone ranges from 52.33 to 70.75 percent.

Okra had major pest infestation of 31.31 percent on a weight basis and 32.14 percent on a number basis, according to Kamble et al. [7]. Individual eggs are laid by *Earias vittella* on leaves, flower buds, and fragile fruits. Prior to fruit production, little brown caterpillars eat within the top stalk by boring into it. The injured portion of the plant shows the wilting and drying of the stalk. Later, caterpillars eat within the fruits, producing smaller and misshapen pods as a result. A larva attacks many stems and pods sequentially. Microorganisms that cause illness, such fungus, enter damaged plant tissues. The moth is light longitudinal green with a short yellow-green stripe.

1.1 Objectives

1. To evaluate the efficacy of selected insecticides against shoot and fruit borer, *Earias vittella* (Fabricius.) on okra during kharif season 2022.
2. To Calculate Benefit – cost ratio [B: C ratio] of treatments

2. MATERIALS AND METHODS

The experiment was carried out in RBD (randomised block design) using the variety Arka Anamika in a plot size of (2m×1m) with the spacing of (45×30cm) and a recommended set of practises excluding plant protection during the kharif (Autumn reap) season 2022 at Central Research Farm (CRF), Uttar Pradesh, India. The experimental site's soil is medium high and well drained. The experimental site has a subtropical environment with typical rainfall. Prayagraj is located at 25.87° North, 81.15° East, and has an elevation of 78 metres above sea level. The South-East portion of the U.P. has a subtropical climate, which includes both the winter and summer temperature extremes. Sometimes in the chilly winter months of December and January, the temperature drops as low as 32°F, while in the sweltering summer months of May and June, it may be as hot as 115°F. Both frosts in the winter and hot, sweltering breezes in the summer are frequent occurrences. The annual average precipitation is around 1013.4 centimetres, with the heaviest rainfall occurring from July to September and sporadic showers throughout the winter.

“The observations on infestation of *Earias vittella* were recorded visually per plant from five randomly selected plants and tagged plants in each plot. The insecticides were sprayed at recommended doses when percent infestation reaches ETL (5% of shoot damage and 10% fruit damage) level” [8]. After a comprehensive investigation for the presence of borer and excreta at both vegetative and reproductive stage, which was then translated into % infestation, the number of infected shoots and fruits from randomly selected plants per plot were tallied and recorded at weekly intervals. On the seventh and fourteenth days after spraying observations were made on the amount of infested shoots and fruits on selected plants in each plot.

The insecticides used in this field trial are Indoxacarb 14.55 SC @ 0.25ml/L, Deltamethrin 2.8%EC @ 1.25ml/L, Karanjin oil 5% @ 5ml/L, Metarhizium anisopliae (1×10^{8} CFU) @ 4g/L, Neem oil 5% @ 5ml/L, Emamectin benzoate 5%SG @ 0.25g/L, Spinosad 45%SC @ 0.4ml/L along with control plot. The basal application of fertilizers was done manually and insecticides were applied with the help of knapsack sprayer by considering ETL level for making spray decisions.

The healthy marketable yield that was achieved from the various treatments was gathered and weighed separately. Insecticide costs for this experiment were calculated for the 2022 kharif season. The price of the used botanicals was acquired from a neighbouring market. The cost of treatments, rent for burrowing the sprayer, and manpower costs for the spraying made up the entire cost of plant protection. During the research period, there were two sprays, and the total cost of plant protection was estimated. The net benefit is calculated by deducting the total cost of plant protection from total income, which was calculated by multiplying the total yield per hectare by the going market rate. The benefit over the control for each sprayed treatment was derived by deducting the income of the control treatment from that of each sprayed treatment.

2.1 Formulae Used

Percent shoot infestation:

$$\text{Per cent shoot damage} = \frac{\text{Number of infested shoots} \times 100}{\text{Total number of shoots}}$$

Percent fruit infestation:

$$\text{Per cent fruit damage} = \frac{\text{Number of damaged fruits} \times 100}{\text{Total number of fruits}}$$

Benefit cost Ratio:

Benefit cost ratio = Gross Returns /Total cost incurred

3. RESULTS AND DISCUSSION

The effectiveness of various insecticides on the percent infestation of the okra shoot and fruit borer revealed that all treatments were significantly more effective than controls at reducing the infestation of the shoot and fruit borer and, as a result, significantly increased yield. On 7th and 14th day of first spray lowest percentage infestation was recorded in Deltamethrin 2.8% EC (17.30 and 18.19) followed by Emamectin benzoate 5%SG (18.33 and 19.34) and Spinosad 45%SC (19.60 and 19.62) treated plots respectively that differed significantly with other treatment plots but statistically at par with each other (Table 1).

The lowest percent infestation was seen in plots treated with Deltamethrin 2.8%EC on the seventh and fourteenth days after the second spray (13.80 and 13.41), followed by Emamectin benzoate 5%SG (16.44 and 15.16) and Spinosad 45%SC (16.88 and 16.25). These findings are corroborated by Mane [9] and Shinde et al. [10], who found that Deltamethrin 2.8% EC outperformed other insecticides in lowering the percentage of okra shoot and fruit borer infection. Emamectin benzoate 5%SG was discovered to be the most effective therapy by Govindan et al. [11] and Shyamrao et al. [12].

The yields for the various treatments were substantial. Compared to the control plot (68.33 q/ha), Deltamethrin 2.8%EC (129 q/ha) produced the highest yield, followed by Emamectin benzoate 5%SG (126 q/ha), Spinosad 45% SC (123.33 q/ha), Indoxacarb 14.5%SC (117.5 q/ha), Neem oil 5% (113.33 q/ha), Karanjin oil 5% (110.17 q/ha) and *Metarhizium anisopliae* 1*10^{8} CFU (106.91 q/ha). Sandip et al. [13] and Maurya et al. [14] also confirm these findings.

Deltamethrin 2.8%EC (1:5.45), Emamectin benzoate 5%SG (1:5.31), Spinosad 45%SC (1:5.19), Indoxacarb 14.5%SC (1:4.93), Neem oil 5% (1:4.76), Karanjin oil 5% (1:4.64), and *Metarhizium anisopliae* 1*10^{8} CFU (1:4.58) were the most effective and cost-effective treatments out of those investigated, when compared to control plot (1:3.01). Lachattiwar and Meena [15] and Shinde et al. [10] validate these findings.

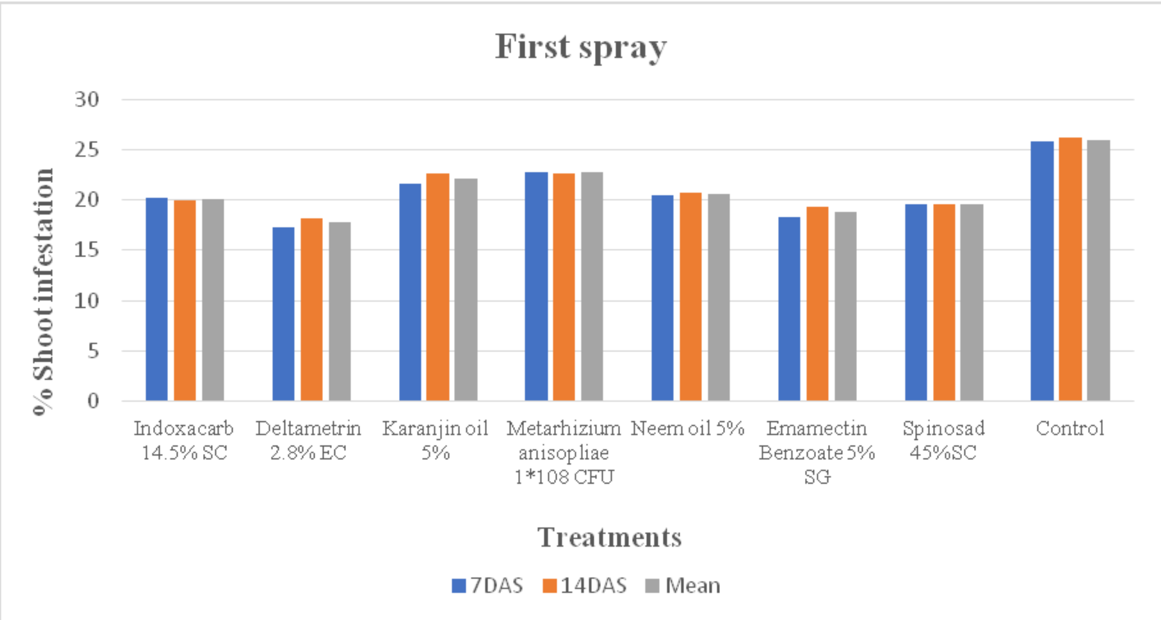

Fig. 1. Effectiveness of selected insecticides on percent shoot infestation due to shoot and fruit borer on okra (First spray)

Table 1. Yield and benefit cost ratios, effectiveness of chosen pesticides against shoot and fruit borer during first and second sprays

S. No.	Names of the Treatments	Okra's shoot and fruit borer infestation rate as a percentage				Yield (q/ha)	B:C Ratio
		First spray		Second spray			
		7 DAS	14 DAS	7 DAS	14 DAS		
T_1	Indoxacarb 14.5% SC	20.17	20.01	18.75	17.55	117.5	1:4.93
T_2	Deltamethrin 2.8% EC	17.30	18.19	13.80	13.41	129	1:5.45
T_3	Karanjin oil 5%	21.57	22.59	21.89	21.39	110.17	1:4.64
T_4	*Metarhizium anisopliae* $1*10^8$ CFU	22.78	22.64	22.17	21.51	106.91	1:4.58
T_5	Neem oil 5%	20.47	20.74	19.57	18.23	113.33	1:4.76
T_6	Emamectin Benzoate 5% SG	18.33	19.34	16.44	15.12	126	1:5.31
T_7	Spinosad 45%SC	19.60	19.62	16.88	16.25	123.33	1:5.19
T_0	Control	25.81	26.15	34.60	36.82	68.33	1:3.01
	F-test	S	S	S	S	…..	…..
	S. Ed (±)	1.02	0.98	1.04	1.58	…..	…..
	C.D. (P = 0.5)	3.089	2.982	3.160	4.785	…..	…..

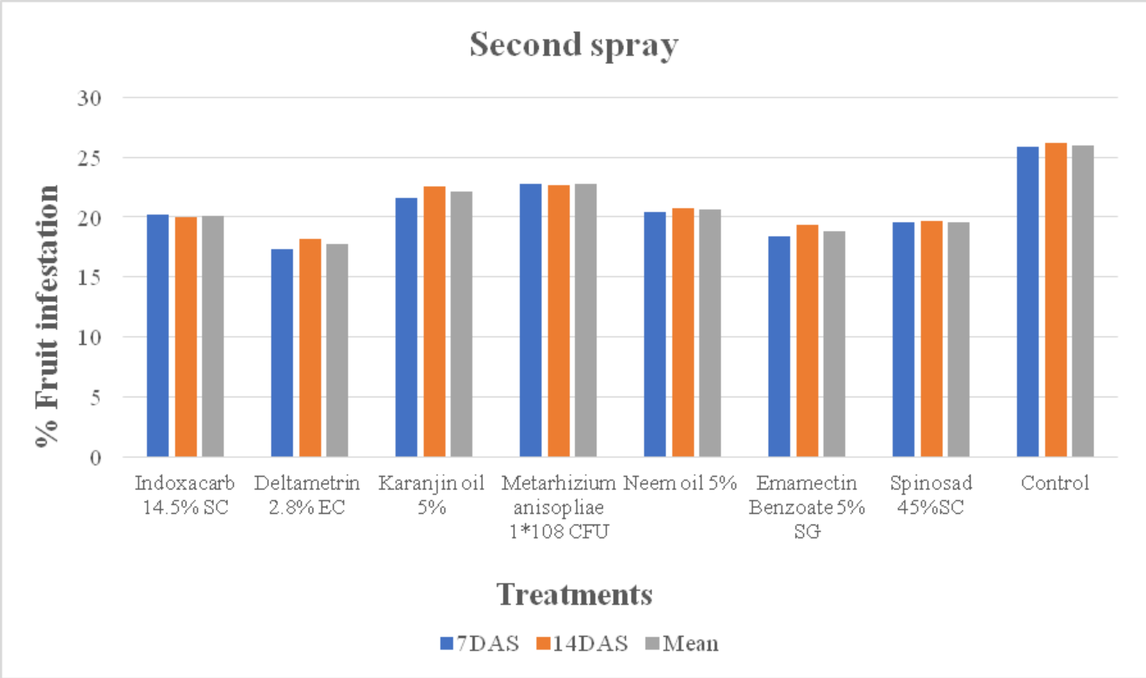

Fig. 2. Effectiveness of selected insecticides on percent fruit infestation due to shoot and fruit on okra (Second spray)

4. CONCLUSION

A conclusion that can be drawn from a critical evaluation of the results that among all the treatments,Deltamethrin 2.8%EC is the most effective at reducing the percentage of okra shoot and fruit borer infestations, followed by Emamectin benzoate 5%SG,Spinosad 45%SC , Indoxacarb 14.5%SC , Neem oil 5%, Karanjin oil 5%, *Metarhizium anisopliae* $1*10^8$ CFU. Deltamethrin 2.8%EC had the highest cost benefit ratio (1:5.45) and marketing yield (129 q/ha) of the other treatments examined, followed by Emamectin benzoate 5%SG (1:5.31 and 126 q/ha), Spinosad 45%SC (1:5.19 and 123.33 q/ha), Indoxacarb 14.5%SC (1:4.93 and 117.5 q/ha), Neem oil 5% (1:4.76 and 113.33 q/ha), Karanjin oil 5% (1:4.64 and 110.17 q/ha) and *Metarhizium anisopliae* $1*10^8$ CFU(1:4.58 and 106.91 q/ha) respectively. Therefore more field trials are required in future to validate the results.

ACKNOWLEDGEMENT

The author expresses her heartful gratitude to Dr. Ashwani Kumar, Associate Professor and Head , Department of Entomology, and I am greatful to Prof. (Dr.) Rajendra B. Lal Hon'ble Vice Chancellor, SHUATS, Prof. (Dr.) Shailesh Marker, Director of Research, Dr. Deepak Lal, Dean of PG studies, Prof. (Dr.) Gautam Gosh, Dean, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, technology and Sciences, Prayagraj for making their keen interest and encouragement to carry out this research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dhaka SS, Rai MK, Kumar A. Relative efficacy of novel insecticides and bio-pesticides against *Earias vittella* in okra. Ann Plant Prot Sci. 2016;24(2): 271-5.
2. Dhandapani N, Shlkar UR, Murugan M. Bio-intensive pest management (BIPM) in major vegetables crops. *A perspective Food*. Agric Environ. 2003;4(2):333-9.
3. U.S. Department of Agriculture (USDA) National Nutrient database; 2021. Available:https://www.ams.usda.gov/grades-standards/okra-grades-and-standards
4. National Horticultural Board (NHB); 2021-2022. Available:https://www.nhb.gov.in/

5. Nayar KK, Annthakrishnan TN, David BV. General and applied entomology. Tata Mc. Graw hill Publ. Co. Ltd., New Delhi. 1976;4(2):489-91.
6. Pareek BL, Bhargava MC. Estimation of avoidable losses in vegetable crops caused by borers under semi-arid conditions of Rajasthan. Insect Environ. 2009;9:59-60.
7. Kamble Kulkarni SR, Patil SK. Pest Manag Hortic Ecosyst. Efficacy of newer combination insecticides against shoot and fruit borer, *Earias vittella* (Fabricius) on okra. 2014;20(2):242-4.
8. Shirale D, Patil M, Zehr U, Parimi S. Newer insecticides for the management of brinjal shoot and fruit borer, Leucinodes Orbona lis. Indian J Plant Prot. 2012; 40(4):273-5.
9. Mane SA. Bioefficacy of some newer insecticides against fruit borer (*Earais vittella* fab). J. on okra (*A. esculentus* Moench) [Ph. D dissertation] submitted to MAU Parbhani; 2007.
10. Shinde BD, Sarkate MB, Nemade PW, Sable YR. Bio efficacy of botanical, microbial and synthetic insecticides against okra fruit borer. Pestology. 2007; 31(3):19-22.
11. Govindan K, Gunasekaran K, Kuttalam K. Field efficacy of emamectin benzoate 5 SG against shoot and fruit borer, *Earias vittella* in okra. Indian J Plant Prot. 2011; 39(3):175-9.
12. Shyamrao NJ, Kumar A, Patil AA, Narode MK. Efficacy of certain insecticides and bio-pesticides against brinjal shoot and fruit borer (*Leucinodes Orbona lis* Guenee). J Entomol Zool Stud. 2018; 6(5):292-5.
13. Sandip P, Mondal S, Samanta A, Chatterjee ML. Bioefficacy of some new insecticides against the okra shoot and fruit borer, *Earias vittella* (f.). Pest Manag Econ Zool. 2007;15(1):53-6.
14. Maurya KK, Singh S, Singh RS, Maurya SP, Singh A. The evaluation of different insecticides against shoot and fruit borer (*Earias vittella*) on okra crop. J Exp Zool. 2014;17(2):843-7.
15. Laichattiwar MA, Meena RS. Efficacy of various insecticides against okra shoot and fruit borer, *Earias vitella* (Fab.). J Entomol Res. 2014;38(2):121-4.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/100097