Vegetable Science (2025) 52(1): 50-57

doi: 10.61180/vegsci.2025.v52.i1.07

ISSN- 0970-6585 (Print), ISSN- 2455-7552 (Online)

www.isvsvegsci.in

RESEARCH ARTICLE

Assessing the bio-efficacy of novel insecticides against shoot and fruit borer *Earias vitella* (Fabricus) in okra

Nahida Afreen, Arvind Nath Singh*, Pratap A. Divekar, Sujan Majumder, Shailja Jaiswal and Nagendra Rai

Abstract

Okra (*Abelmoschus esculentus L.*), known as lady's finger and part of the Malvaceae family, is cultivated in tropical and subtropical regions. To assess pest control measures, field studies were conducted during the Summer of 2024 and *Kharif* 2024 at the ICAR-Indian Institute of Vegetable Research, Varanasi, using okra var (Kashi Pragati). The randomized complete block design (RBD) included eight treatments, seven involving various insecticides, such as azadirachtin 300 ppm, quinalphos 25 EC, novaluron 10 EC, lambda-cyhalothrin 5 EC, and fipronil 5 SC, with recommended dose (RD) @ 2 mL/L, double dose (DD) @ 4 mL/L and half dose (HD) @ 1-mL/L, and a control with no insecticide. Infestation levels of *E. vitella* were recorded before and after treatment applications. Results indicated that all treatments effectively reduced infestation compared to the untreated control. The lowest fruit infestation and highest yields were achieved with (fipronil @ 4 mL/L), yielding 125.04 q/ha in *Summer* season and 147.04 q/ha in *Kharif* season, with significant yield increases over the control. The highest ICBR, 1:23.33 in *Summer* and 1:20.49 in *Kharif* was observed with (fipronil @ 1 mL/L). Therefore, the novel molecule fipronil can be effectively used to control okra shoots and fruit borer to achieve the higher production of okra.

Keywords: Okra, *Earias vitella*, Insect pest management, Yield, ICBR

ICAR-Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh, Uttar Pradesh, India.

***Corresponding author;** Email: arvindnathsingh@gmail.com

Citation: Afreen, N., Singh, A.N., Divekar, P.A., Majumder, S., Jaiswal, S., and Rai, N. (2025). Assessing the bio-efficacy of novel insecticides against shoot and fruit borer *Earias vitella* (Fabricus) in okra. Vegetable Science 52 (1): 50-57.

Source of support: Nil

Conflict of interest: None.

Received: 20/11/2024 **Revised:** 09/01/2025 **Accepted:** 22/02/2025

Introduction

Okra, a member of the Malvaceae family (*Abelmoschus esculentus* L.), is commonly referred to as lady's finger. Okra is grown throughout in tropical and subtropical regions of India. It is a food with significant nutritional value because of its high concentration of potassium, calcium, iron, and other minerals like magnesium, sodium, and phosphorus, as well as vitamins A, B, and C, fats, and carbohydrates—all of which are vital components of a balanced diet (Aykroyd et al. 1963). Okra seeds are recognized to have a unique protein composition when compared to grains and pulses, with proteins that are balanced in essential amino acids like tryptophan and lysine (Gemede et al. 2016). The okra fruit's medicinal qualities are influenced by significant bioactive compounds present in its mucilage, seeds, and fruits. Overall, India produces 6,416.31 tons of okra, with the top five states producing the most being Gujarat (15.89%), West Bengal (13.93%), Bihar (12.38%), Madhya Pradesh (11.75%), and Orissa (10.33%) (NHB 2021-22). It has been discovered that a range of insect pests target different plant sections, including the leaves, stems, buds, flowers, calyx, roots, and fruits, causing an estimated yield loss of almost 69% (Adja et al. 2019). It has a wide host range. These insects directly harm the delicate shoots and fruits of okra, causing the afflicted plants to produce smaller, malformed fruits (Rahman et al. 2013). Okra is attacked by shoot and fruit borers at every stage of growth, which seriously impairs the crop's quantity and quality (Shah et al. 2001). Fruit loss from *Earias spp.* infestations range from 21.00% to 91.58% in different okra varieties (Kataria and Singh 2021). Conventional pest control relies on chemical insecticides, but selecting the most effective and economically viable option remains a challenge. The present investigation is aimed to evaluate the efficacy of different insecticides against *Earias vitella* under field conditions.

Materials and Methods

The experiments were conducted during Summer 2024 and *Kharif* 2024 at ICAR – Indian Institute of Vegetable Research, Varanasi (India). The experiment was laid out in randomized complete block design (RBD) with four replications. The unit plot size was 4.0 × 3.6 m with maintaining spacing of 60 cm between row to row and 45 cm plant to plant. The land was ploughed 2–3 times, incorporating FYM before sowing. The recommended cultivation practices for growing okra were followed except for plant protection measures. Fertilizers were applied at the recommended rates as a basal application: 100 kg of Nitrogen (N), 40 kg of phosphate (P_2O_5), and 40 kg of potash (K_2O) per hectare. Irrigation was provided as needed, especially at the flowering and fruit formation stages. Weed control was done through hand weeding. The first harvest began 40 to 50 days after sowing, with tender pods of 7 to 10 cm picked regularly.

Materials

The okra seed (var. Kashi Pragati) was obtained from the seed production unit of ICAR-Indian Institute of Vegetable Research, Varanasi. The chemical insecticides azadirachtin 300 ppm, quinalphos 25 EC, novaluron 10 EC, lambda-cyhalothrin 5 EC and fipronil 5 SC were procured from a local market (Table 1).

Details of treatments

For estimating the comparative losses caused by the pests, seven treatments were compared with the control plots. Treatments detail is given in Table 1. The knapsack sprayer fitted with a hollow cone nozzle was used for spray operation after preparing the required concentration of insecticides with water.

Taking three different dosages—half dose, recommended dose, and double dose allows for a comprehensive comparison of insecticide effectiveness and economic feasibility. Evaluating these variations helps determine the minimum effective dose that provides sufficient pest control while minimizing costs and environmental risks. The recommended dose serves as a benchmark for efficacy under field conditions, ensuring reliable pest management. Testing a double dose assesses potential improvements in control but also highlights risks such as increased residues and higher input costs. By comparing these doses, the study identifies the most cost-effective and sustainable pest management strategy.

Observations

Percentage of fruit infestation and yield

Five plants were randomly selected from each treatment and the number of infested fruits per plant was recorded 24 hours before the first spray and after 1, 3, 5,7 and 14 days of each spray. Observation recorded on the 14th day of the first spray and the 14th day of the second spray was considered as pre-treatment for the second and third spray, respectively.

$$\text{Fruit infestation (\%)} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100$$

For recording fruit yield, each plot was harvested separately and the weight of okra was recorded in kg per plot. Okra yield (kg/plot) was converted into q/ha by adjustment based on the area of the plot.

Percent reduction over control

$$\frac{C - T}{C} \times 100$$

Whereas:

C = Percent fruit infestation in untreated or control plot.

Table 1: Detail of treatments

S. no.	*Treatments*	*Formulation*	*Application Rate (mL/ liter of water)*	*Trade name*	*Company*
T_1	Azadirachtin	300 ppm	5	Econeem	Margo Biocontrols Pvt. Ltd.
T_2	Quinalphos	25 EC	1.5	Ekalux	Syngenta Pvt. Ltd.
T_3	Novaluron	10 EC	1.5	Rimon	Indofil Industries Ltd.
T_4	Lambda cyhalothrin	5 EC	1.0	Karate	Syngenta Pvt. Ltd.
T_5	Fipronil (RD)	5 SC	2.0	Regent	Bayer Pvt. Ltd.
T_6	Fipronil (DD)	5 SC	4.0	Regent	Bayer Pvt. Ltd.
T_7	Fipronil (HD)	5 SC	1.0	Regent	Bayer Pvt. Ltd.
T_8	Control	-	-	-	-

T= Percent fruit infestation in treated plots by different chemicals.

Percent increase in yield

Percent increase in yield was computed by using the formula mentioned by Pradhan (1969).

$$\text{Percent increase in yield} = \frac{\text{Yield in treated plots (q/ha)} - \text{Yield in untreated plots (q/ha)}}{\text{Yield in untreated plots (q/ha)}} \times 100$$

A total of three sprays were applied. The first spray was administered at the ETL of the insect pest stage (5% fruit damage and 10% shoot damage), with a follow-up application conducted 15 days later.

Incremental Cost-Benefit Ratio (ICBR)

The economic evaluation of different treatments was carried out by considering the costs associated with insecticides, biopesticides, botanicals, their application, equipment charges, and other related expenses incurred during the study. The okra fruit yield per hectare, along with the prevailing market price, was used to calculate the benefit derived from each treatment per hectare. The Incremental Cost Benefit Ratio (ICBR) was then determined based on the incremental yield benefit over the control and the costs involved to rank the treatments economically. The following parameters were used to calculate the ICBR:

(A) Gross Monetary Benefits

This was determined by multiplying the additional yield over the control with the prevailing minimum local market price of the commodity.

(B) Treatment Costs

This was calculated by summing up all the expenses related to each treatment, including labor and charges for any hired equipment.

(C) Net Monetary Return

This was calculated by subtracting the total cost of the treatment (B) from the gross monetary benefits (A), i.e., A - B.

(D) ICBR

This was determined by dividing the net monetary return (C) by the total treatment cost (B), C/B.

Results and Discussion

Bio-efficacy of different insecticides against okra shoot and fruit borer, *Earias vitella*

The effect of different treatments against shoot and fruit borer (*Earias vitella*) was assessed based on the percent fruit infestation in all respective treatments. Percent fruit damage by *E. vitella* in each treatment before spraying was recorded as approximately uniform in each plot and varied non-significantly ranges from 29.68 to 31.13 and 35.94 to 38.94% fruit damage per plant, respectively, Summer 2024 and *Kharif* 2024. All the treatments were found to be significantly superior to control in reducing percent fruit infestation. The minimum fruits infestation was recorded seven days after the third spray in T_6 (fipronil @ 4 mL/l) at 2.94% followed by T_5 (fipronil @ 2 mL/l) at 4.78%, T_7 (fipronil @ 1-mL/l) 8.52%, T_3 (novaluron @ 1.5 mL/l) 9.03%, T_4 (lambda cyhalothrin @1-mL/l) 9.24%, T_2 (quinalphos @ 1.5 mL/l) 9.99%, T_1 (azadirachtin @ 5 mL/l) 10.56% and maximum fruits infestation was recorded in T_8 (control) 52.30%. However, T_7 (fipronil 1-mL/l) was statistically at par with T_3 (novaluron @ 1.5 mL/l) and T_4 (lambda-cyhalothrin @ 1-mL/l). T_2 (quinalphos @ 1.5 mL/l) and T_1 (azadirachtin @ 5 mL/l) were statistically at par with each other. This also reveals that T_6 (fipronil @ 4 mL/l) showed the highest reduction of fruit infestation over control, with 94.37% during the Summer of 2024 (Table 2). During the autumn season of 2023, Saini and Rajnikant (2024) recorded the lowest shoot and fruit infestation in fipronil 5% SC (12.46 and 13.09%), azadirachtin 1% EC (12.77 and 14.16%), and NSKE 5% (13.42 and 14.63%).

Hasan (2010) recorded the highest suppression of fruit borer infestation in okra was with lambda-cyhalothrin 14.60 and 27.07% during two consecutive years which supports the present findings. Yadav et al. (2017) recorded that the percentage reduction by spinosad compared to the control was 57.84%. Fipronil and imidacloprid followed in effectiveness, achieving reductions of 53.51 and 44.32%, respectively and the azadirachtin-treated plot exhibited the highest average fruit infestation (10.55 and 6.80%) and the lowest population reduction (21.62 and 18.92%) among the treatments. These findings support the present findings.

As similar as, previous season the minimum fruits infestation (3.31%) was recorded 7th day after third spray in T_6 (fipronil @ 4 mL/L) followed by T_5 (fipronil @ 2 mL/l) 5.19%, T_7 (fipronil @ 1 mL/l) 7.49%, T_3 (novaluron @ 1.5 mL/l) 9.44%, T_4 (lambda cyhalothrin @ 1 mL/l) 10.44%, T_2 (quinalphos @ 1.5 mL/l) 10.65%, T_1 (azadiractin @ 5 mL/l) 12.75% and maximum fruits infestation (56.52) percent was recorded in T_8 (Control). However, T_5 (fipronil @ 2 mL/l) was statistically at par with T_7 (fipronil @ 1 mL/l). T_3 (novaluron @1.5 mL/l) was statistically at par to T_4 (lambda cyhalothrin @ 1 mL/l) and T_2 (quinalphos @ 1.5 mL/l). The result also reveals that T_6 (fipronil @ 4 mL/l) 94.14% showed the highest reduction of fruit infestation over control during *kharif* 2024 (Table 3). Yadav et al. (2017) reported similar results, showing that insecticides tested against *Earias* spp. on okra were effective, the lowest percentage of shoot and fruit borer infestation was observed with indoxacarb treatment (1.36%), followed by spinosad (1.75%), emamectin benzoate (2.57%), and fipronil (2.98%), supporting the present findings. Chauhan et al. (2021) similarly reported that fipronil, applied at 50 g a.i./ha every two weeks, was the most effective treatment for managing the shoot and fruit borer in okra. The study further showed that all tested insecticides significantly reduced pest infestation compared to the untreated plot.

Table 2: Efficacy of different insecticides to control shoot and fruit borer (Earias vitella) in okra during Summer 2024

Trea-tment	First Spray Pre-trea-tment	1 DAS	3 DAS	5 DAS	7 DAS	Mean (First Spray)	Second Spray Pre-trea-tment	1 DAS	3 DAS	5 DAS	7 DAS	Mean (Second Spray)	Third Spray Pre-trea-tment	1 DAS	3 DAS	5 DAS	7 DAS	Mean (Third Spray)	Reduction over control
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean		
T_1	29.68 (32.99)*	27.43 (31.62)	25.14 (30.08)	23.89 (29.25)	21.15 (27.36)	24.41	24.83 (29.87)	23.83 (29.2)	21.58 (27.66)	19.08 (25.88)	15.06 (22.81)	20.88	17.31 (24.52)	16.31 (23.78)	14.56 (22.42)	11.56 (19.84)	10.56 (18.96)	14.07	79.79
T_2	30.04 (33.22)	27.97 (31.91)	24.97 (29.96)	23.72 (29.13)	20.88 (27.18)	24.39	22.38 (28.22)	21.63 (27.69)	20.63 (27.00)	18.13 (25.19)	13.38 (21.45)	19.24	15.88 (23.46)	15.88 (23.46)	12.88 (21.00)	10.44 (18.85)	9.99 (18.41)	13.02	80.89
T_3	30.12 (33.27)	27.82 (31.81)	24.07 (29.36)	22.07 (28.00)	17.11 (24.42)	22.77	19.09 (25.89)	18.09 (25.16)	16.34 (23.82)	14.84 (22.64)	12.72 (20.88)	16.22	14.47 (22.33)	13.75 (21.74)	11.86 (20.13)	9.56 (18.00)	9.03 (17.48)	11.74	82.73
T_4	29.78 (33.05)	29.30 (32.76)	24.80 (29.89)	23.55 (29.02)	20.48 (26.89)	24.54	21.48 (27.59)	20.98 (27.24)	19.48 (26.16)	16.34 (23.82)	13.95 (21.90)	18.45	15.20 (22.92)	14.45 (22.33)	12.12 (20.33)	10.12 (18.53)	9.24 (17.68)	12.23	82.32
T_5	31.13 (33.90)	27.98 (31.92)	22.48 (28.29)	18.23 (25.26)	10.84 (19.21)	19.89	14.32 (22.20)	13.32 (21.38)	10.82 (19.19)	9.82 (18.23)	8.6 (17.04)	11.38	9.6 (18.03)	9.1 (17.54)	8.6 (17.02)	7.03 (15.36)	4.78 (12.53)	7.83	90.84
T_6	30.91 (33.76)	29.49 (32.88)	19.11 (25.91)	15.59 (23.25)	8.84 (17.28)	18.26	11.01 (19.36)	10.26 (18.66)	9.51 (17.95)	8.01 (16.39)	5.97 (14.13)	8.96	8.09 (16.49)	7.84 (16.23)	6.67 (14.96)	5.69 (13.77)	2.94 (9.82)	6.25	94.37
T_7	30.08 (33.24)	30.93 (33.77)	23.55 (29.02)	21.05 (27.29)	14.98 (22.75)	22.63	16.60 (24.03)	15.10 (22.85)	14.10 (22.04)	12.60 (20.77)	11.35 (19.65)	13.96	12.85 (21.00)	12.10 (20.34)	10.45 (18.85)	9.54 (17.59)	8.52 (16.95)	10.70	83.70
T_8	30.15 (33.28)	33.94 (35.62)	35.79 (36.73)	36.54 (37.17)	37.29 (37.61)	35.90	40.82 (39.69)	41.82 (40.27)	42.63 (40.74)	43.63 (41.32)	45.13 (42.19)	42.81	47.13 (43.34)	48.13 (43.91)	49.35 (44.61)	50.80 (45.44)	52.30 (46.30)	49.55	0.00
C.D.	N/A	1.019	0.933	0.912	1.209		1.203	1.209	1.044	1.335	1.32		1.684	1.325	1.378	1.142	1.39		
SE(m)	0.33	0.344	0.315	0.308	0.408		0.406	0.408	0.353	0.451	0.446		0.569	0.448	0.465	0.386	0.469		
SE(d)	0.466	0.487	0.446	0.435	0.577		0.574	0.578	0.499	0.638	0.631		0.804	0.633	0.658	0.545	0.664		
C.V.	1.977	2.099	2.108	2.157	3.223		2.996	3.075	2.758	3.714	3.962		4.736	3.781	4.15	3.677	4.748		

*Figure in parenthesis is square root transformed value
Pre-treatment – 1 day before spray
Pre- treatment for second spray is 14th day after first spray and pre-treatment for third spray is 14th day after second spray.

Table 3: Efficacy of different insecticides to control shoot and fruit borer (*Earias vitella*) in okra during *kharif* 2024

Trea-tment	First spray: Pre-trea-tment	First spray: 1 DAS	First spray: 3 DAS	First spray: 5 DAS	First spray: 7 DAS	Mean (First spray)	Second spray: Pre-trea-tment	Second spray: 1 DAS	Second spray: 3 DAS	Second spray: 5 DAS	Second spray: 7 DAS	Mean (Second spray)	Third spray: Pre-trea-tment	Third spray: 1 DAS	Third spray: 3 DAS	Third spray: 5 DAS	Third spray: 7 DAS	Mean (Third spray)	Reduction over control
	Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean		Mean	Mean	Mean	Mean	Mean		
T_1	35.94 (36.81)*	34.60 (36.00)	27.45 (31.56)	24.24 (29.47)	23.96 (29.27)	27.56	26.21 (30.75)	25.26 (30.13)	22.01 (27.95)	19.76 (26..37)	18.73 (25.63)	22.85	22.5 (28.29)	21.12 (27.31)	17.21 (24.49)	14.75 (22.57)	12.75 (20.87)	17.67	77.41
T_2	37.59 (37.79)	34.81 (36.13)	29.04 (32.59)	25.04 (30.01)	20.12 (26.63)	27.26	23.88 (29.22)	22.71 (28.43)	20.46 (26.86)	17.51 (24.72)	16.69 (24.08)	20.84	18.19 (25.21)	17.17 (24.43)	13.43 (21.47)	11.97 (20.22)	10.65 (19.04)	14.29	81.1
T_3	38.89 (38.56)	38.15 (38.12)	27.68 (31.73)	24.13 (29.37)	17.07 (24.39)	26.76	19.32 (26.06)	17.82 (24.96)	15.26 (22.97)	13.16 (21.26)	12.32 (20.52)	16.00	14.07 (22.00)	13.32 (21.39)	11.70 (19.98)	10.20 (18.54)	9.44 (17.85)	11.75	83.2
T_4	38.94 (38.59)	36.32 (37.02)	27.49 (31.58)	21.80 (27.82)	18.43 (25.38)	26.01	21.38 (27.52)	20.76 (27.09)	16.92 (24.27)	14.61 (22.44)	13.17 (21.24)	17.83	16.17 (23.70)	14.94 (22.72)	12.19 (20.39)	10.94 (19.30)	10.44 (18.84)	12.94	81.5
T_5	38.94 (38.58)	37.40 (37.68)	21.42 (27.55)	17.29 (24.54)	12.98 (21.1)	22.28	15.15 (22.89)	14.03 (21.98)	10.85 (19.19)	9.86 (18.25)	8.75 (17.14)	11.93	9.27 (17.66)	8.66 (17.05)	6.89 (15.19)	6.23 (14.44)	5.19 (13.12)	7.25	90.81
T_6	38.71 (38.46)	35.51 (36.56)	19.68 (26.29)	15.62 (23.25)	10.14 (18.55)	20.24	12.72 (20.88)	12.06 (20.28)	8.62 (17.02)	7.85 (16.24)	5.78 (13.87)	9.56	7.38 (15.72)	6.78 (15.07)	5.55 (13.62)	4.65 (12.43)	3.31 (10.46)	5.54	94.14
T_7	37.10 (37.50)	33.89 (35.58)	25.59 (30.36)	21.43 (27.56)	15.93 (23.51)	24.21	17.68 (24.85)	16.26 (23.76)	12.13 (20.34)	11.13 (19.48)	10.17 (18.58)	13.68	11.41 (19.71)	10.46 (18.84)	8.99 (17.43)	7.99 (16.38)	7.49 (15.85)	9.27	86.74
T_8	38.7 (38.45)	40.13 (39.29)	42.22 (40.91)	43.04 (40.98)	42.79 (40.83)	42.05	44.07 (41.57)	44.90 (42.05)	46.65 (43.06)	47.54 (43.57)	49.14 (44.49)	46.29	53.49 (46.98)	53.77 (47.14)	54.74 (47.70)	55.52 (48.15)	56.52 (48.73)	54.81	0
C.D.	N/A	2.009	1.918	1.799	1.656		1.383	1.556	1.861	1.487	1.681		1.812	2.071	1.809	1.866	1.836		
SE(m)	0.665	0.679	0.648	0.608	0.559		0.467	0.526	0.629	0.502	0.568		0.612	0.699	0.611	0.63	0.62		
SE(d)	0.941	0.96	0.916	0.859	0.791		0.661	0.743	0.889	0.71	0.803		0.865	0.989	0.864	0.891	0.877		
C.V.	3.492	3.663	4.109	4.172	4.268		3.34	3.845	4.987	4.176	4.895		4.913	5.769	5.421	5.859	6.022		

*Figure in parenthesis is square root transformed value

Pre-treatment – 1 day before spray

Pre- treatment for second spray is 14th day after first spray and pre-treatment for third spray is 14th day after second spray.

A comparable observation was documented by Naidu and Kumar (2019), who reported 10.76% shoot infestation and 17.98% fruit infestation following the application of fipronil. Similarly, Umrao et al. (2013) noted that fipronil resulted in 21.11% fruit damage and a 62.56% reduction in damage compared to the control.

Economics of different treatments

The yield among the treatments was significant. The highest yield was recorded in T_6 (fipronil @ 4 mL/l) 125.04 q/ha followed by T_5 (fipronil @ 2 mL/l) 120.19 q/ha, T_7 (fipronil @ 1 mL/l) 111.07 q/ha, T_3 (novaluron @ 1.5 mL/l) 102.00 q/ha, T_4 (lambda-cyhalothrin @ 1 mL/l) 96.56 q/ha, T_2 (quinalphos @ 1.5 mL /l) 89.24 q/ha, T_1 (azadirachtin @ 5 mL/l) 85.61 q/ha and T_8 control 64.36 q/ha as well as highest increase yield 94.28% over control recorded in T_6 (fipronil @ 4 mL/l). However, the Highest ICBR (1: 23.33) was recorded in T_7 (fipronil @ 1 mL/l) during *summer* 2024 (Tables 4 and 5).

The highest yield was recorded in T_6 fipronil (4 mL/l) 147.04 q/ha, followed by T_5 (fipronil @ 2 mL/l) 141.69 q/ha,

Table 4: ICBR of different insecticides to control shoot and fruit borer (*Earias vitella*) in okra during *summer* 2024 and *kharif* 2024.

	Summer 2024			*Kharif* 2024		
Treatments	*Yield q/ha*	*Yield increase over control (%)*	*ICBR*	*Yield q/ha*	*Yield increase over control (%)*	*ICBR*
T_1	85.61	33.02	4.49	111.63	22.26	4.25
T_2	89.24	33.66	10.60	112.98	23.75	9.10
T_3	102.00	58.49	5.45	121.33	32.89	4.14
T_4	96.56	50.03	20.90	117.21	28.38	16.62
T_5	120.19	86.75	18.79	141.43	54.90	16.7
T_6	125.04	94.28	12.13	147.04	61.04	11.06
T_7	111.07	72.58	23.33	132.57	45.20	20.49
T_8	64.36			91.30	0	0
C.D.	3.206	-		3.88	-	-
SE(m)	1.083	-	-	1.83	-	-

Table 5: Pooled data of efficacy of different insecticides to control shoot and fruit borer (*Earias vitella*) in okra during *Summer* 2024 and *kharif* 2024

	First Spray					*Second Spray*				*Third spray*				*Percentage reduction over control*
Treatment	*Pretreatment*	*1 DAS*	*3 DAS*	*5 DAS*	*7 DAS*	*1 DAS*	*3 DAS*	*5 DAS*	*7 DAS*	*1 DAS*	*3 DAS*	*5 DAS*	*7 DAS*	
	Mean	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	
T_1	32.74	31.06	26.29	24.06	22.55	24.54	21.79	19.42	16.9	18.72	15.89	13.15	11.66	78.57
T_2	33.41	31.39	27.01	24.38	20.50	22.17	20.55	17.82	15.04	16.53	13.16	11.21	10.32	81.03
T_3	34.10	32.98	25.88	23.10	17.09	17.95	15.80	14.04	12.52	13.53	11.78	9.88	9.23	83.03
T_4	35.20	32.81	26.15	22.68	19.45	20.87	18.20	15.48	13.56	14.69	12.15	10.53	9.84	81.91
T_5	34.19	32.69	21.95	17.76	11.91	13.68	10.83	9.84	8.67	8.88	7.74	6.63	4.99	90.82
T_6	34.67	32.50	19.4	15.61	9.49	11.16	9.072	7.93	5.87	7.31	6.11	5.17	3.12	94.26
T_7	34.12	32.41	24.57	21.24	15.45	15.68	13.12	11.87	10.76	11.28	9.72	8.76	8.00	85.29
T_8	34.31	37.03	39.01	39.79	40.04	43.36	44.64	45.58	47.13	50.95	52.05	53.16	54.41	0
C.D.	N/A	1.86	1.49	1.44	1.307	1.374	1.484	1.127	1.198	1.699	1.537	1.093	1.361	
SE(m)	0.617	0.62	0.506	0.486	0.441	0.464	0.501	0.381	0.405	0.574	0.519	0.369	0.46	
SE(d)	0.872	0.89	0.716	0.688	0.624	0.656	0.709	0.538	0.572	0.812	0.734	0.522	0.65	
C.V.	3.619	3.83	3.852	4.125	4.511	4.383	5.206	4.289	4.962	6.469	6.455	4.981	6.589	

Pre-treatment – 1 day before spray
Pre- treatment for second spray is 14th day after first spray and pre-treatment for third spray is 14 days after second spray.
DAS – Day after spray

T_7 (fipronil @ 1 mL/l) 132.57 q/ha, T_3 (novaluron @ 1.5 mL/l) 121.33 q/ha, T_4 (lambda-cyhalothrin @ 1 mL/l) 117.21 q/ha, T_2 (quinalphos @ 1.5 mL /l) 112.98 q/ha, T_1 (azadirachtin @ 5 mL/l) 111.63 q/ha and T_8 control (91.30) q/ha during *kharif* 2024 as well as highest increase yield over control recorded in T_6 (fipronil @ 4 mL/l) 61.04%. However, the highest ICBR was recorded T_7 (fipronil @1 mL/l) (1: 20.49) during *Kharif* 2024 (Table 4). Saichand and Kumar (2024) reported 149.2 q/ha by using fipronil 5 % SC. Laichattiwar and Meena (2014) evaluated the efficacy of various insecticides against okra shoot and fruit borer, *Earias vitella* and found maximum cost-benefit ratio was obtained from plots treated with fipronil with (1:11.76) followed by spinosad (1:8.77). Yadav et al. (2017) recorded that the highest yield and marketable okra fruits from the plot treated with spinosad (96.75 qt/ha), followed by fipronil (93.68 qt/ha) and imidacloprid (87.50 qt/ha) in *Zaid* 2014. Similarly, in *Zaid* 2015, spinosad (98.54 qt/ha) achieved the highest yield, followed by fipronil (95.22 qt/ha) and imidacloprid (88.42 qt/ha).

Gosalwad and Kawathekar (2009) also evaluated the efficacy of different insecticides against *E. vitella* and found an effect of different treatments on marketable fruit yield of okra revealed that the yield recorded from fipronil @ 30 g a.i./ha, spinosad @ 30 g a.i./ha was significantly superior over rest of the insecticide treatments which supporting the present findings.

Conclusion

All the tested insecticides significantly reduced fruit infestation by *Earias vitella* compared to the untreated control. Among them, fipronil @ 4 mL/L (T_6) provided the highest reduction over control and the highest yield in both seasons (125.04 q/ha and 147.04 q/ha). Fipronil @ 2 mL/L (T_5), on the other hand, showed promising results with slightly lower yields (120.49 q/ha and 141.69 q/ha), making it a viable alternative to higher doses. Fipronil @ 1-mL/L (T_7) had the highest ICBR, indicating its economic efficiency. Other insecticides, including novaluron, lambda-cyhalothrin, and quinalphos, also reduced fruit damage and improved yields but were less effective than fipronil.

References

Adja, N. A., Nandjui, J., Sadia, G. H., Adingra, T., Akamou, F. and Danho, M. (2019). Are bioinsecticides able to effectively substitute chemicals in the control of insect pests of okra (*Abelmoschus esculentus* L. Moench) in Cote d'Ivoire? Journal of Applied Biosciences, 142: 14435-14447.

Aykroyd, W. R., Gopalan, C., and Balasubramanian, S. C. (1963). The nutritive value of Indian foods and the planning of satisfactory diets. Special Report Series - Indian Council of Medical Research, 42, 1–255.

Chauhan, V., Vashisht, S. D., Sharma, L., and Gandhi, V. (2021). Assessment of leaf hopper, management of *Earias vitella* and population dynamics of sucking pests of okra: A review. The Pharma Innovation Journal SP-10 (8), 95-100.

Gemede, H. F., Haki, G. D., Beyene, F., Woldegiorgis, A. Z., and Rakshit, S. K. (2016). Proximate, mineral, and antinutrient compositions of indigenous Okra (*Abelmoschus esculentus*) fruits accessions: implications for mineral bioavailability. Food science and nutrition, 4(2), 223-233.

Gosalwad, S. S., and B. K. Kawathekar, (2009). Efficacy of insecticides against okra fruit borer (*Earias vittella* Fabricius) Journal of plant protection and Environment 6(2): 59-63.

Hasan, W. (2010). Evaluation of some insecticides against spotted bollworm, *Earias vitella* (Fab.) on different okra cultivars. Trends in Biosciences, *3*(1), 41-44.

Kataria SK, Singh G (2021) Efficacy of Biorational Insecticides against Spotted Bollworm *Earias spp.* in okra. Indian Journal of Entomology 1–3. https://doi.org/10.55446/IJE.2021.84

Kumar KI, and Tayde AR (2018). Screening of okra genotypes against shoot and fruit borer (*Earias vitella* Fab.) under field conditions in Allahabad. Journal of Pharmacognosy and Phytochemistry;7(1):657- 659.

Laichattiwar, M. A., and R. S Meena. (2014). Efficacy of various insecticides against okra shoot and fruit borer, *Earias vitella* (Fab) Journal of Entomological Research, 38(2): 121-124.

Naidu, G., and Kumar, A. (2019). Field efficacy of certain insecticides against shoot and fruit borer (*Earias vittella* Fab.) on rainy season okra in Prayagraj (UP). Journal of Entomology and Zoology studies, *7*(6), 1211-1213.

National Horticulture Board (NHB) (2021-22) (1st Adv. Estimate): https://www.nhb.gov.in/

Pradhan, S. (1969). *Insect pests of crops* (Vol. 28). New Delhi: National Book Trust, India Book House.

Rahman M. M., Uddin M. M. and Shahjahan M. (2013) Management of okra shoot and fruit borer, *Earias vittella* (Fabricius) using chemical and botanical insecticides for different okra varieties. International Research Journal of Applied Life Sciences, 2, 1–9.

Saichand, N., and Kumar, A. (2024). Field Efficacy and Economics of Selected Biopesticides and Chemicals against Shoot and Fruit Borer, *Earias vitella* (Fabricius) on okra. International Journal of Plant and Soil Science, 36(7), 618-624.

Saini, P. K., and Rajnikant, A. T. (2024). Field Efficacy of Certain Chemicals and Neem Products against Shoot and Fruit Borer, *Earias vitella* (Fabricius.) on Okra in Prayagraj, UP, India. Journal of Experimental Agriculture International, 46(7), 1106-1111.

Shah BR, Vyas HN, Jhala RC (2001). Life table of shoot and fruit borer, *Earias vitella* (Fab.) for determining key mortality factors in okra, *Abelmoschus esculentus* (L.) Moench. National Conference on Plant Protection. New Horizons in the Millennium (NCPP) Udaipur.4.

Umrao, R. S., Singh, S., Kumar, J., Singh, D., and Singh, D. (2013). Efficacy of novel insecticides against shoot and fruit borer (*Earias vitella* Fabr.) in okra crop. Hortflora Research Spectrum, 2, 251-254.

Yadav, G. P. S., Ramkewal, R., Singh, R. S., and Vikrant, V. (2017). Effect of certain eco-friendly insecticides on *Earias vitella* (major insect) of okra crop in Central Region of Uttar Pradesh, India. Plant Archives, 17 (1) 135-140.

Yadav, S. K., Kumawat, K. C., Deshwal, H. L., Kumar, S., and Manohar, S. V. S. (2017). Bio-efficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra. International Journal of Current Microbiology Applied Sciences 6(7), 1035-1044.

सारांश

भिंडी की फसल को कीटों, विशेष रूप से ***Earias vitella*** से भारी नुकसान होता है, जो फल उत्पादन में 76% तक की कमी का कारण बन सकते हैं। कीट नियंत्रण उपायों का मूल्यांकन करने के लिए, भाकृअनुप- भारतीय सब्जी अनुसंधान संस्थान, वाराणसी में भिंडी की किस्म 'काशी प्रगति' पर पहले और दूसरे मौसम में प्रयोग किए गए। रैंडमाइज़्ड कम्पलीट ब्लॉक डिज़ाइन (RBD) में आठ उपचार थे, जिनमें से सात विभिन्न कीटनाशकों के साथ थे, जैसे कि अज़ादीराच्टिन, क्विनाल्फोस, नोवालुरोन, लैम्ब्डा सायहलोथ्रीन और फिप्रोनिल, जो अनुशंसित खुराक (RD), दोहरी खुराक (DD) और आधी खुराक (HD) में थे, और एक नियंत्रण था जिसमें कोई कीटनाशक नहीं था। ***E. vitella*** के संक्रमण स्तरों को उपचार आवेदन से पहले और बाद में दर्ज किया गया। परिणामों से पता चला कि सभी उपचारों ने नियंत्रण के मुकाबले संक्रमण को प्रभावी रूप से कम किया। सबसे कम फल संक्रमण दर और सबसे उच्चतम उपज फिप्रोनिल (4 मि.ली./लीटर) से प्राप्त हुई, जो पहले मौसम में 125.19 क्विंटल/हेक्टेयर और दूसरे मौसम में 147.04 क्विंटल/हेक्टेयर थी, और नियंत्रण के मुकाबले महत्वपूर्ण उपज वृद्धि हुई। सबसे उच्चतम लाभ-लागत अनुपात फिप्रोनिल (1 मि.ली./लीटर) के साथ देखा गया। ये निष्कर्ष कीटनाशक उपचारों की प्रभावशीलता, विशेष रूप से फिप्रोनिल, को रेखांकित करते हैं जो भिंडी की उपज पर कीटों के प्रभाव को कम करने में सहायक हैं।