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Field Efficacy and Economics of Selected Biopesticides and Chemicals against Shoot and Fruit Borer, *Earias vittella* (Fabricius) on Okra

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Authors' contributions

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

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ABSTRACT

The field trial was conducted at Central Research Field, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during kharif season 2023.The experiment was laid out in in Randomised Block Design (RBD) with eight treatments each replicated thrice using variety Kashi Chaman. The treatments viz., T_1 *Beauveria bassiana* 1.5% T_2 Spinosad 45%SC T_3 Neem seed kernel extract 10%WP T_4 Emamectin Benzoate 5SG T_5 Fipronil 5SC T_6 Chlorantraniliprole 18.5SC T_7 Azadirachtin 0.03%WSP 300PPM (5ml/lit) and along with untreated control T_0 against *Earias vittella* in okra. The data on percentage of shoot and fruit infestation of okra shoot and fruit borer first and second spray mean revealed that all treatments are significantly superior over control. Among all the treatments lowest per cent shoot and fruit, infestation was recorded in T_6 Chlorantraniliprole 18.5SC (8.46)

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(9.44),, T_2 Spinosad 45% SC (9.95) (10.44),, T_4 Emamectin benzoate 5%SG (11.83) (11.85),, T_5 Fipronil 5%SC (12.96) (12.91),, T_3 Neem seed kernel extract 10% WP (14.82) (13.27), T_1 *Beauveria bassiana* 1.5% (15.94) (14.62) and T_7 Azadirachtin 0.03%WSP 300PPM (5ml/lit) (16.97) (14.79) and is significantly superior over the control (23.78) (23.26). While The highest yield was recorded in T_6 Chlorantraniliprole 18.5SC (210.2q/ha),as well as B:C ratio (1:6.54), T_2 Spinosad 45%SC (195.7q/ha) (1:6.02),, T_4 Emamectin benzoate 5SG (163.4q/ha) (1:5.17), T_5 Fipronil 5SC(149.2q/ha) (1:4.69), T_3 Neem seed kernel extract10%WP (138.4q/ha) (1:4.42),, T_1 *Beauveria bassiana* 1.5% (131.7q/ha) (1:4.00), T_7 Azadirachtin 0.03%WSP 300PPM (5ml/lit) (120.2q/ha) (1:3.71), as compared to T_0 control (90.2q/ha) (1:2.96).

Keywords: Cost benifit ratio; chemicals Earias vittella; okra shoot and fruit borer.

1. INTRODUCTION

"Okra (Lady finger or bhendi), *Abelmoschus esculentus* (L.) Moench is cultivated in India mainly for its immature fruits. Okra fruits have nutritious as well as dietary value. Though, it is mainly used as a fresh vegetable, it is also consumed as canned, dehydrated or frozenforms**.** Among vegetables, it occupies an important position and is grown extensively throughout. Okra fruits are an important source of vitamins, calcium, potassium and other minerals. In addition, mucilaginous extract of green stem of okra is used for clarifying sugarcane juice in a jaggery preparation" [1].

"The crop, however, is vulnerable to attack of important insect pests, among which fruit borer *Earias vittella* (Fabricius) is the most important pest causing direct damage to marketable fruits. It alone is reported to cause 57.1 per cent fruit infestation and 54.04 per cent net yield loss in okra" Chaudhary et al*.* [2] "*Earias vittella* damage to okra crop is done by two ways. First, the terminal portion of growing shoots is bored by caterpillars, which move down by making tunnels inside. As a result, the shoot drop downward or dry up" [3-5]. "Second, the larvae enter the fruit by making holes, rendering them unfit for human consumption. According to an estimate this pest can cause 36-90% loss in fruit yield of okra" [6].

"The crop is grown throughout India, Andhra Pradesh is the leading okra producing state which has production of around 884.2 thousand tons from an area of 78.90 thousand ha, with a productivity of 15 tons / ha. It is followed by west Bengal (862.1 thousand tonnes from 74.00 thousand with 11.70 tons / ha productivity. In Uttar Pradesh area, production and productivity of okra is 48.6 thousand ha, 176.26 thousand tones, 8 tons/ha respectively" [7].

"The productivity of okra is low due to many factors in which the attack of shoot and fruit borer, *E. vittella* and *Earias insulana* (Boisduval), Aphid (*A. gossypii*) and Jassid, *A. biguttula* are most serious pests of okra and cause 45.00-57.10% damage to fruits. The sucking pest complex of okra consisting of aphids, leaf hoppers, whiteflies, thrips and mites causes 17.46% yield loss and failure to control them in initial stages was reported to cause 54.04% yield loss" [2,8].

1.1 Objectives

1. To Evaluate Field efficacy of selected biopesticides and chemicals against shoot and fruit borer, *Earias vittella* (Fabricius) on okra.
2. To Calculate Cost Benefit ratio [C:B ratio].

2. MATERIALS AND METHODS

The experiment will be conducted during kharif season 2023 at Central Research Field (CRF), SHUATS, Prayagraj, Uttar Pradesh, India, in a randomized block design with eight treatments replicated three times using variety Kashi Chaman in a plot size of (2m×1m) at a spacing of (45×30cm) with a recommended package of practices excluding plant protection. The soil of the experimental site is well drained and medium high.

In this experiment eight treatments are used consisting application T_1 *Beauveria bassiana 1.0% WP* (10gm/lit) T_2 Spinosad 45%SC (0.35ml/lit) T_3 Neem seed kernel extract 10%WP (50gm/lit) T_4 Emamectin Benzoate 5SG (0.3gm/lit) T_5 Fipronil 5SC (2ml/lit) T_6 Chlorantraniliprole 18.5SC (0.25ml/lit) T_7 Azadirachtin 0.03%WSP 300PPM (5ml/lit) and treatment of untreated control were tested against okra shoot and fruit borer.

As the ETL 5%shoot infestation and 10% fruit infestation crossed per plant crossed and application of the two sprays of insecticidal treatments were applied at 15 days interval.

The shoot and fruit infestation was recoreded from randomly selected plants in every plot and infestation per 5 plants was noted. After that mean of three replications was calculated for each treatment and the same was done with the untreated plot. The shoot infestation of *Earias vittella* was recorded before 1 day before of first spraying and on 7th day and 14th day after insecticidal application. The fruit infestation of *Earias vittella* was recorded before 1 day before of second spraying and on 7th day and 14th day after insecticidal application. Healthy okra fruits are picked and their weight from each treatment was expressed as marketable yield in quintal per hectare. Ultimately, the cost benefit ratio was calculated on the basis of prevailing market price of yield, insecticides and spraying cost.

2.1 Data Analysis

Percent Shoot Infestation:

$$\% \text{ Shoot Infestation} = \frac{\text{Number of infested shoots}}{\text{Number of total shoots}} \times 100$$

Percent Fruit Infestation:

$$\% \text{ Fruit Infestation} = \frac{\text{Number of infested fruits}}{\text{Number of total fruits}} \times 100$$

(Kalva Rani et al*.* [9])

2.2 Economics

Cost benefit ratio:

$$\text{C: B Ratio} = \frac{Gross\ returns}{Total\ cost\ incurred}$$

(Choudhury. A.R et al. [10])

3. RESULTS AND DISCUSSION

The data on the percent infestation of shoot and fruit borer on okra 7th and 14th day after first spray and second spray revealed that all the chemicals and biopesticides treatments were significantly superior over control. “Among the selected treatments, Chlorantraniliprole 18.5SC was found effective in controlling the shoot and fruit borer population which can be recommended for management of shoot and fruit borer on okra” [11]. The values obtained in the first and second spray are 8.46% and 9.44% respectively. The results were similar to the findings reported by Patra et al*.* [12] who reported that Chlorantraniliprole 18.5SC was most effective treatment. The next effective treatment was in Spinosad 45% SC which the values obtained in first and second spray are 9.95% and 10.44 respectively. These findings were support by Yadav et al*.* [13], Mane et al*.* [14] and Naidu et al*.* [15].

The efficacy of Emamectin benzoate 5%SG in first and second spray are 11.83% and 11.85% respectively. These results are similar to the findings of Bangar et al*.* [16] and Dash et al*.* [17]. Fipronil 5SC was found to be next effective treatment and the values obtained in the first and second spary are 12.96% and 12.91% respectively. These findings were similar and supported by Rakshith et al*.* [18] and Singh et al. [19]. This was followed by the next best treatment which is Neem seed kernel extract 10% WP in which the efficacy values obtained 14.82% and 13.27% respectively which was supported by HB Mulani et al*.* [20] This was followed by next effective treatment *Beauveria bassiana* 1.5% 15.94%and 14.62% respectively which was supported by Sarkar et al*.* [21] and Azadirachtin 0.03%WSP 300PPM 16.97% and 14.79%. These findings are supported by Nayak et al. [22] and Ramesh et al*.* [23] These are found to be least effective than all the treatments and is significantly superior over the control (23.78) (23.26).

The yield among the treatments was significant. The highest yield was recorded in T_6 Chlorantraniliprole 18.5SC (210.2q/ha), T_2 Spinosad 45%SC (195.7q/ha), T_4 Emamectin benzoate 5SG (163.4q/ha), T_5 Fipronil 5SC(149.2q/ha), T_3 Neem seed kernel extract10%WP (138.4q/ha), T_1 *Beauveria bassiana* 1.5% (131.7q/ha), T_7 Azadirachtin 0.15%EC (120.2q/ha), as compared to T_0 control (90.2q/ha). which was supported by Bansode et al*.* [24] Naidu et al*.* [15], Nayak et al. [22]. Bansode et al*.* [24]. and Dash et al. [17].

When the benefit cost ratio was worked out, interesting results was achieved [25]. Among the treatment studied the best and most economical treatment was T_6 Chlorantraniliprole 18.5SC (1:6.54), followed by T_2 Spinosad 45%SC (1:6.02), T_4 Emamectin benzoate 5SG (1:5.17), T_5 Fipronil 5SC(1:4.69), T_3 Neem seed kernel extract10%WP (1:4.42), T_1 *Beauveria bassiana* 1.5% (1:4.00), T_7 Azadirachtin 0.03%WSP

300PPM (1:3.71), as compared to T_0 control (1:2.96). These findings were similar and supported by Srivastava et al. [25], Chandravanshi et al. [26], Surendra Kumar et al. [13] Rakshith et al. [18] and Singh et al. [19].

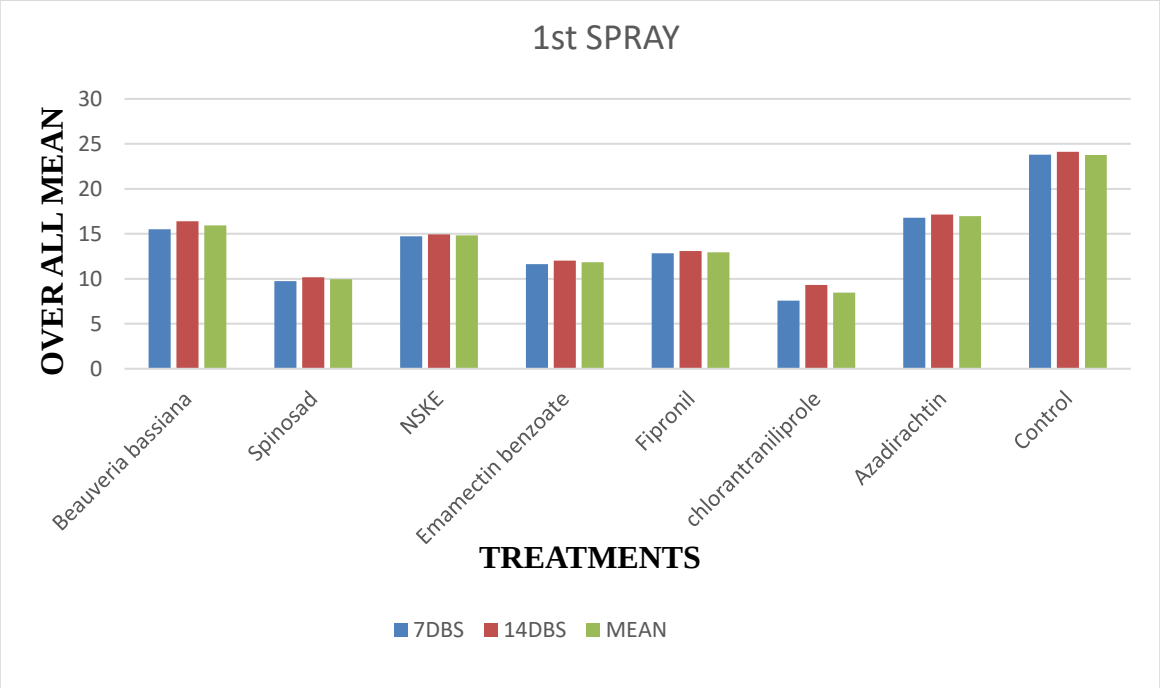

Fig. 1. Assessment of biopesticides and chemicals against okra shoot and fruit borer *Earias vittella* in okra first spray

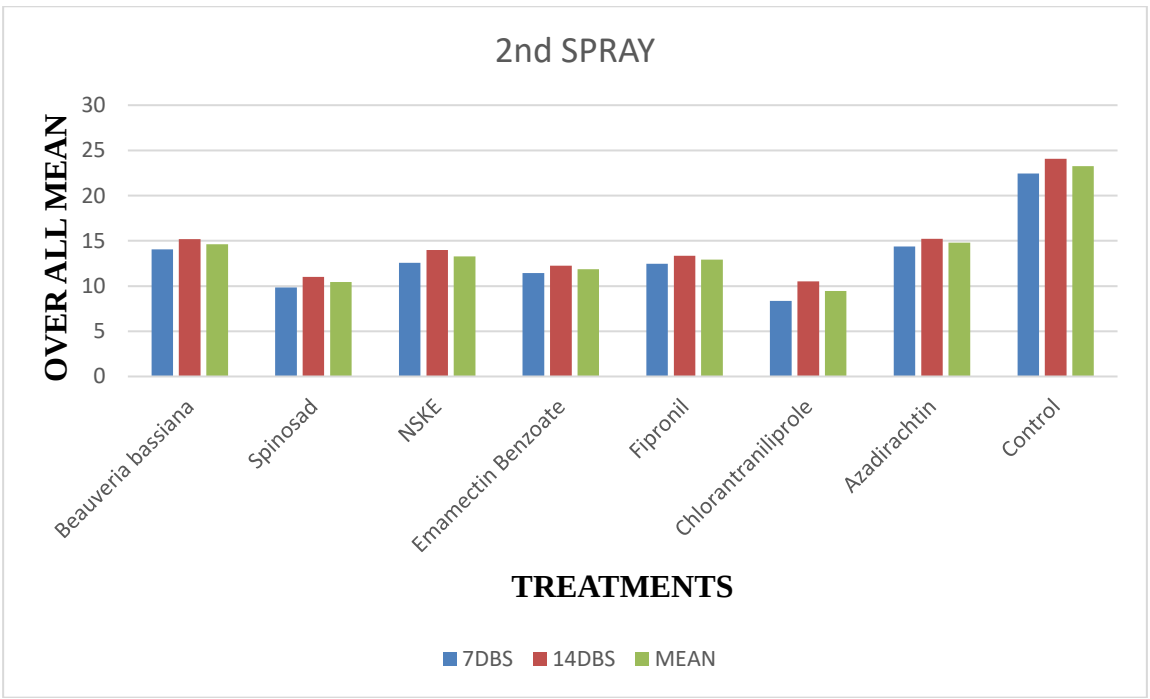

Fig. 2. Assessment of biopesticides and chemicals against okra shoot and fruit borer *Earias vittella* in okra second spray

Table 1. Field Efficacy of selected biopesticides and chemicals against shoot and fruit borer, *Earias vittella* (Fabricius) on okra and Yeild and C:B ratio

T.No	Treatments	Per cent shoot and fruit infestation of *Earias.vittella* /5Plants								Yield (q/ha)	C:B Ratio
		1st Spray				2nd Spray					
		1DBS	7 DAS	14 DAS	Mean	1 DBS	7 DAS	14 DAS	Mean		
T_1	*Beauveria bassiana* 1.0%	18.44	15.51	16.38	15.94	18.49	14.05	15.19	14.62	131.1	1:4.00
T_2	Spinosad 45%SC	16.93	9.73	10.17	9.95	17.74	9.86	11.02	10.44	195.7	1:6.02
T_3	Neem seed kernel extract 10%WP	15.57	14.72	14.93	14.82	18.10	12.56	13.99	13.27	138.4	1:4.42
T_4	Emamectin benzoate 5%SG	17.41	11.63	12.03	11.83	18.95	11.45	12.26	11.85	163.4	1:5.17
T_5	Fipronil 5%SC	17.26	12.84	13.08	12.96	17.09	12.48	13.34	12.91	149.2	1:4.69
T_6	Chlorantraniliprole 18.5SC	16.67	7.59	9.30	8.46	18.92	8.37	10.52	9.44	210.2	1:6.54
T_7	Azadirachtin 0.03% WSP 300PPM	19.09	16.78	17.16	16.97	18.58	14.37	15.22	14.79	120.2	1:3.71
T_8	Control	17.95	23.80	24.11	23.78	19.81	22.46	24.06	23.26	90.2	1:2.96
	F- test	**NS**	**S**	**S**	**S**	**NS**	**S**	**S**	**S**		
	S. Ed. (±)	1.725	0.686	0.715	0.074	2.257	0.436	0.629	0.051		
	C. D. (P = 0.05)	-	2.11	2.16	0.93	-	1.68	2.02	1.16	-	-

4. CONCLUSION

From the above discussion it was found that, spraying of insecticides significantly reduced the shoot and fruit borer percent infestation in okra. The present findings conclude that the new generation insecticides like T_6 Chlorantraniliprole 18.5SC(0.25ml/lit), followed by T_2 Spinosad 45%SC(0.35ml/lit), T_4 Emamectin benzoate 5SG(0.3gm/lit). T_5 Fipronil 5SC(2ml/lit), T_3 Neem seed kernel extract10%WP(50gm/lit) , T_1 *Beauveria bassiana* 1.5%SG(10gm/lit), T_7 Azadirachtin 0.03%WSP 300PPM (5mg/lit) treatment of untreated control plant T0 were found effective against shoot and fruit borer of okra *Earias vittella*.

Further, it was observed that the cost benefit ratio was also high with T_6 Chlorantraniliprole 18.5SC and T_2 Spinosad 45%SC. Hence, it is suggested that the effective insecticides may be alternated in harmony with the existing Intergrated pest management programes in order to avoid the problems associated with insecticidal resistance, pest resurgence etc.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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