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# Efficacy of Certain Insecticides and Neem Products against Shoot and Fruit Borer [*Earias vittella* (Fabricius)] of okra [*Abelmoschus esculentus* (L.) Moench]

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

A field trial was conducted at the research plot at Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, during the *Rabi* Season of 2022-2023 where eight treatments were replicated thrice in Randomized Block Design (RBD) Eight treatments *i.e*., Lambda cyhalothrin 2.5% EC @ 0.3ml/lit, Emamectin benzoate 5% SG @0.5ml/lit ,Spinosad 45%SC@1.3 ml/lit, Chlorantraniliprole 18.5%SC @0.5 ml/lit, Imidacloprid 17.80%SL @0.5ml/lit, Azadirachtin 1% EC @ 10ml/lit, NSKE 5% @ 50 ml/lit and untreated Control. The data on the percent infestation of the shoot and fruit borer on okra third, seven and fourth day

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after spray reveal that all the insecticides and neem products were significantly superior over control. Among all the different treatments lowest shoot and fruit infestation of okra was recorded in Chlorantraniliprole (10.21% ,9.98%) followed by Emamectin benzoate 5%SG (11.45%, 12.29%), Spinosad 45%SC (13.86%, 14.11%), Imidacloprid 17.80% SL (16.94,15.87%), Lambda cyhalothrin 2.5%EC (17.83, 16.03%), Azadirachtin 1% EC (19.25%, 17.04%) and NSKE 5% (20.35%, 18.75%), control (24.84%, 25.98%). The yields among the treatment were significant. The yield and benefit cost ratio was recorded in Chlorantraniliprole 18.5SC (195.5 q/ha) (1:9.3) followed by Emamectin benzoate 5% SG (149.2q/ha), (1:8.2), Spinosad 45 % SC (140.2q/ha), (1:8.11), Imidacloprid 17.80SL (136.3q/ha), (1:7.9), Lambda cychalothrin 2.5 EC (133.2q/ha), (1:7.6), Azadirachtin 1% (96.3q/ha) (1:5.5) and NSKE 5% (92.4q/ha) (1:5.2) as compared to, control (72.2q/ha), (1:4.2).

*Keywords: Benefit cost ratio; Earias vittella; insecticides; neem products; okra.*

## 1. INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an annual vegetable belonging to Malvaceae family; it is also known by different names *viz*., ladies finger, bhendi, bamia, okra or gumbo in different parts of the world. Okra is known as Queen of vegetables. The soft green fruits of okra are highly prized. It can be prepared in a multitude of ways and is a component of many different recipes. Some regions of the world use young, fragile leaves as a leafy vegetable. The cane juice, which is used to make gur or brown sugar, is removed using the roots and stem. Additionally, reports of its medical value include the treatment of ulcers and haemorrhoids. One particularly helpful plant is okra. Although it is mostly grown for its edible fruits, other parts of the plant, such as the leaves, petals, stems, and roots, are also utilised in many regions of the world for food, biofuel, and medicinal purposes [1].

Okra is a rich source of proteins, carbohydrates, and vitamin C. Water (%)90, Energy (kcal)38, Protein (g)2.0, Fat (g)0.1, Carbohydrate (g)7.6, Fibre (g)0.9, Calcium (mg)81, P (mg)63, Fe (mg)0.8, Na (mg)8, K (mg)303, Vitamin A (iU) m660, Thiamine (mg)0.20, Riboflavin (mg)0.06, Niacin (mg)1.00, Ascorbic acid (mg)21.1 and Vitamin B6 (mg) 0.22 [2].

Andhra Pradesh (20%), West Bengal (15%), Bihar (14%), Orissa (11%), Gujarat (10%), Jharkhand (7%), Maharashtra (4%), Assam (3%) and Haryana (3%) are the main states in India that grow okra [3].

Okra's vulnerability to several insect pests at different stages of its growth is one of the main obstacles to its cultivation. Nonetheless, fruit borer and okra shoot seemed to be the most dangerous, causing 45–57.1% damage to fruit. One of the main pests that seriously harm okra is the okra shoot and fruit borer (*Earias vitella* F.). Infestations of fruit borer and okra shoots usually resulted in a 48.97% reduction in the production of okra pods. Damage is caused to okra during its vegetative and reproductive phases by fruit borer larvae and okra shoots. During the reproductive stage, larvae can bore into the fruit and flower buds, feeding on interior tissues. Therefore, the infested flower bud's drop-off and infested fruits become deformed in shape, which lowers their market value. Okra shoot and fruit borer alone causes a damage of between 52.33% and 70.75% [4].

In Mohanpur, Nadia, West Bengal, researchers researched the biology of the shoot and fruit borer on okra. The head and thorax of the medium-sized (13–15 mm) moths are pale brownish white. Silvery creamy white hind wings. In contrast, *E. vittella's* forewings are creamy white with a wide, wedge-shaped horizontal green stripe in the centre. The caterpillar has several brown and milky white patterns on its brownish-white body. The single, round, pale blue-green eggs have longitudinal ridges. On buds, flowers, and fruits, the female lays her eggs. The apical bud is where the most eggs are laid. The duration of the incubation phase is 4-5 days, while the larval and pupal phases last 5-21 and 7-8 days, respectively. Pupate in silken cocoons fashioned like inverted boats. The life cycle takes thirty to forty days to complete. Damage manifests itself in the fruiting stage, when larvae burrow into fruits and feed, polluting them with excrement. Damage signs include afflicted shoots fading, a dead growth point, and maybe erased side shoots. Damaged fruits get warped, and fallen blooms and buds fall. Fruits that have been impacted should not be eaten. The entrance hole is clogged with excreta in the affected fruits. Fruits that are boring lose market value [5].

Numerous insect pests harm okra crops, including jassids (*Amrasca biguttula bigutulla*, Ishida); aphids (*Aphis gossypii* Glover); fruit borers (*Earias insulana* Boisduval and *Earias vittella* Fab.); *Helicoverpa armigera* Hub.; whiteflies (*Bemisia tabaci* Genn.); and the periodically occurring red spider mite (*Tetranychus cinnabarinus*). *Earias vittella* (Fabricius), the shoot and fruit borer, is the most harmful pest to okra because its immature larvae eat delicate shoots during the early stages of the plant's vegetative growth [6].

*Earias vittella*, the Okra shoot and fruit borer (OSFB), is the most dangerous insect that directly damages delicate shoots and fruits. Marketable production is said to have decreased by roughly 69% as a result of this insect pest's onslaught. Fruit borer damage amounts to approximately 22.5% in Uttar Pradesh, 25.93% to 40.91% in Madhya Pradesh, and 45% in Karnataka. This results in compromised nutritional content and unfitness for human consumption [4].

## 2. MATERIALS AND METHODS

The study was carried out in a Randomized Block Design (RBD) with eight treatments that were reproduced three times using the Arka Anamika variety at Central Research Farm, SHUATS, Naini, Prayagraj, Uttar Pradesh, India, during the *Rabi* season 2022-2023. It has a plot size of 2m×1m at a spacing of 45cm × 30cm with a recommended package of practices excluding plant protection. The treatments taken for research along with untreated plot were Lambda cyhalothrin 2.5%EC @ 1 gm/lit, Emamectin benzoate 5%SG @0.5ml/lit, Spinosad 45%SC @ 1.3 ml/lit, Chlorantraniliprole 18.5%SC @0.5 ml/lit, Imidacloprid 17.80%SL @0.5 ml/lit, Azadirachtin 1%EC @1ml/ lit, NSKE 5% @50ml/ lit. The population of okra shoot and Fruit borer was recorded before 1 day spraying and on 3rd day,7th day and 14th day after insecticidal application. The populations of okra shoot and fruit borer was recorded on 5 randomly selected and tagged plants from each plot and then it was converted into per cent of infestation by following formula. An economic threshold level (ETL) of 5% shoot damage and 10 % fruit damage was considered for making spray decisions [7,8].

Percent shoot infestation = (Infected shoots / Total number of shoots) × 100

Percent fruit infestation = (Infected fruits / Total number of fruits) × 100

Costs for crop cultivation and treatment were included to determine the overall cost. Using the formula below, the cost-benefit ratio was determined [8]:

BCR = [Gross returns (₹/ha) / Total cost of treatment (₹/ha)] × 100

## 3. RESULTS AND DISCUSSION

The results (Table: 1) after 1st and 2nd spray revealed that all the treatments were significantly superior over to the control in managing the pest infestation of *Earias vittella* in okra. The data on the mean percent shoot infestation of 3rd, 7th and 14th day after first spray revealed that all the treatments outperformed the untreated plot. Among all the treatments lowest percent infestation was recorded in Chlorantraniliprole 18.5%SC (10.21%) followed by Emamectin benzoate 5%SG (11.45%), Spinosad 45%SC (13.86%), Imidacloprid 17.80%SL (16.94%), Lambda cyhalothrin 2.5EC (17.83%) and Azadirachtin 1% EC (19.25%), NSKE 5% (20.35%). The treatment NSKE 5% was found to be least effective with 20.35% shoot infestation. The untreated plot recorded lowest of (24.84%) shoot infestation.

The data on the mean percent fruit infestation of 3rd, 7th and 14th day after second spray indicated that Chlorantraniliprole 18.5%SC was most effective against *Earias vittella* with (9.98%) fruit infestation. The next best treatment was Emamectin benzoate 5%SG (12.29%) followed by Spinosad 45%SC (14.11%) in management of fruit borer. Imidacloprid 17.80%SL (15.87%) Lambda cyhalothrin 2.5EC (16.03%) and Azadirachtin 1%EC (17.04%) fruit infestation, respectively. The treatment NSKE 5% with (18.75%) fruit infestation was found to be least effective than all the treatments. The maximum fruit infestation was observed in untreated plot (25.98%).

**Table 1. Efficacy of insecticides and neem product against okra shoot and fruit borer [*Earias vittella* (Fabricius)] on okra**

| S. No | Treatments | Doses | Percent shoot and fruit infestation of *Earias vittella* | | | | | | | | | Yield (q/ha) | C:B ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | First spray (Shoot infestation) | | | | | Second spray (fruit infestation) | | | | | |
| | | | 1DBS | 3 DAS | 7 DAS | 14 DAS | Mean | 3 DAS | 7 DAS | 14 DAS | Mean | | |
| $T_0$ | Untreated | - | 20.54 | 23.00$^{a}$ | 25.38$^{b}$ | 26.15$^{a}$ | 20.84$^{a}$ | 24.76$^{a}$ | 25.53$^{a}$ | 27.66$^{a}$ | 23.98$^{a}$ | 72.2 | 1:4.2 |
| $T_1$ | Lambda cyhalothrin 2.5% EC | 0.3ml/lit | 20.56 | 18.13$^{bc}$ | 17.6$^{cde}$ | 17.76$^{cde}$ | 17.83$^{de}$ | 17.27$^{cd}$ | 14.95$^{c}$ | 15.89$^{cd}$ | 16.03$^{d}$ | 133.2 | 1:7.6 |
| $T_2$ | Emamactin benzoate 5% SG | 0.5ml/lit | 16.31 | 12.16$^{c}$ | 10.47$^{e}$ | 11.73$^{de}$ | 11.45$^{ef}$ | 12.93$^{d}$ | 11.44$^{de}$ | 12.50$^{ef}$ | 12.29$^{ef}$ | 149.2 | 1:8.2 |
| $T_3$ | Spinosad 45% SC | 1.3ml/lit | 17.19 | 15.39$^{bc}$ | 12.92$^{bc}$ | 13.27$^{bc}$ | 13.86$^{bc}$ | 14.83$^{b}$ | 13.49$^{b}$ | 14.10$^{b}$ | 14.11$^{bc}$ | 140.2 | 1:8.1 |
| $T_4$ | Chlorantraniliprole18.% SC | 0.5ml/lit | 16.02 | 11.00$^{c}$ | 09.32$^{e}$ | 10.31$^{e}$ | 10.21$^{f}$ | 10.93$^{d}$ | 09.01$^{e}$ | 10.00$^{f}$ | 09.98$^{f}$ | 195.5 | 1:9.3 |
| $T_5$ | Imidacloprid 17.80%SL | 0.4ml/lit | 19.48 | 17.5o$^{bc}$ | 16.44$^{bcd}$ | 16.68$^{bcd}$ | 16.94$^{cd}$ | 16.67$^{bc}$ | 14.26$^{c}$ | 16.70$^{c}$ | 15.87$^{cd}$ | 136.3 | 1:7.9 |
| $T_6$ | Azadirachtin 1% EC (10000 ppm) | 1ml/lit | 20.24 | 19.74$^{bc}$ | 18.63$^{de}$ | 19.40$^{de}$ | 19.25$^{ef}$ | 18.42$^{cd}$ | 16.47$^{cd}$ | 16.23$^{de}$ | 17.04$^{de}$ | 96.3 | 1:5.5 |
| $T_7$ | NSKE 5% | 50ml/lit | 18.21 | 21.21$^{b}$ | 19.32$^{b}$ | 20.54$^{b}$ | 20.35$^{b}$ | 19.43$^{b}$ | 17.97$^{b}$ | 18.87$^{b}$ | 18.75$^{b}$ | 92.4 | 1:5.3 |
| | F- test | - | NS | S | S | S | S | S | S | S | S | | |
| | CD.@ 0.05% | - | - | 01.36 | 02.79 | 01.92 | 01.53 | 01.82 | 02.78 | 01.26 | 01.41 | | |
| | S. Ed. (±) | - | 02.82 | 01.15 | 00.82 | 02.02 | 50 | 00.90 | 00.27 | 04.85 | 01.09 | | |

*DBS- Day Before Spray, DAS- Day After Spray, NS-Non-significant, S- Significant, Cost of yield per quintal- (₹)2500*

The highest yield was recorded in Chlorantraniliprole 18.5%SC (195.5 q/ha) followed by Emamectin benzoate 5%SG (149.2q/ha), Spinosad 45%SC (140.2q/ha), Imidacloprid 17.80%SL (136.3q/ha), Lambda cyhalothrin 2.5EC (133.2 q/ha), Azadirachtin 1%EC (96.3 q/ha) and NSKE 5% (92.4 q/ha), as compared to untreated plot (72.2q/ha).When cost benefit ratio was worked out the best and most economical treatment was Chlorantraniliprole 18.5%SC (1:9.3) followed by Emamectin benzoate 5%SG (1:8.2), Spinosad 45%SC (1:8.11), Imidacloprid 17.80%SL (1:7.9) , Lambda cyhalothrin 2.5EC (1:7.6), Azadirachtin 1%EC (1:5.5), NSKE 5% (1:5.2) and untreated plot (1:4.2).

The best successful treatment for the okra shoot and fruit borer infestation was determined to be chlorantraniliprole 18.5%SC. 10.21% and 9.98%, respectively, are the values attained in the first and second sprays. The outcomes matched those of studies published Pachole et al*.* [2]*,* Rajput and Tayde [9], Sarkar et al. [10]. Emamectin benzoate 5% proved to be a successful treatment after that, with first and second spray values of 11.54% and 12.29%, respectively. The results of Shrivastava et al. [11] corroborated these conclusions. In the first and second sprays, Spinosad 45% SC has an effectiveness of 13.86% and 14.11%, respectively. These outcomes concur with those of Wajid et al. [12] and Uma rao et al. [13] Imidiacloprid is the next successful treatment, with rates of 16.40% and 15.30% in the first and second sprays, respectively. The findings of Bangar and Patel [14], Gadhiya et al. [15], and Dash et al. [6] are comparable to these results. The next most successful treatment was discovered to be lambda cyhalothrin 2.5% EC, with values achieved in the first and second sprays being 17.83% and 16.03%, respectively. Similar results were obtained by Shirale et al. [7] and Rakshith et al. [16]. The Spinosad recorded a high yield, as reported by Kumar et al. [16] and Pachole et al. [2] indicating that chlorantraniliprole was supported by the maximum cost benefit ratio (1:9.3) that was attained. The Emamectin benzoate 5% cost-benefit ratio was 1:8.2, and Shirale et al. [7] provided support for the findings. Cost-benefit ratio Spinosad 45% SC was found in the treatment of (1:8.1); Kumar et al*.* [18] and Javed et al. [19] corroborated this finding. According to Dash et al. [6] and Rakshith et al. [16], the cost-benefit ratios for imidacloprid (1:7.9) and lambda cyhalothrin (1:7.6) treatments were determined [20].

## 4. CONCLUSION

The study's findings demonstrated that the best treatments for okra fruit and shoot infestation were chlorantraniliprole (18.5%SC), emamectin benzoate (5% SG), and spinosad (45% SC). These treatments produced the highest yields and had the highest Cost-Benefit ratios when compared to other treatments. It was discovered that neem treatments such NSKE 5% and Azadirachtin 1%EC were the least successful at controlling *Earias vittella.*

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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