

# EFFICACY OF INTERCROPPING, BOTANICALS AND INSECTICIDES AGAINST OKRA SHOOT AND FRUIT BORER (*EARIASVITTELLA*) ON OKRA IN UTTAR PRADESH

**Comment [Rr1]:** To avoid repeated use of the word OKRA in the title, I suggest you delete these words – the title will still read well.

## ABSTRACT

This study assesses the effectiveness of ~~using natural and synthetic insecticides~~ intercrops, insecticides and botanicals against the okra shoot and fruit borer *Eariasvittella* ~~as well as maize, marigold, sunflower, and coriander as an intercrop with okra (at a 1:1 ratio of main and intercrop)~~. The okra + marigold (1:1) and okra + coriander (1:1) intercropping had the least shoot damage (4.35 percent, respectively), according to the data (4.70 per cent). Okra + maize (1:1) saw the most shoot damage (5.51%) when compared to monoculture (6.68 per cent). Spinosad 45 SC 75 g a.i./ha (2.49%) had the lowest rate of shoot damage among the insecticides, followed by Abamectin 1.8 EC 25 g a.i./ha (3.12%) and botanical NSKE 5 per cent, which found that the per cent shoot damage (3.25) compared to sole crop (okra) was higher (6.68 per cent). The data showed that the least fruit damage (9.25 percent, respectively) occurred in the intercropping of okra + marigold (1:1) and okra + coriander (1:1) (11.59 per cent) weight basis. The fruit damage in okra + maize (1:1) was highest (15.37%) compared to monoculture (18.08 per cent). Among the insecticides, Spinosad 45 SC 75 g a.i./ha (1.73%) had the lowest rate of shoot damage, followed by Abamectin 1.8 EC 25 g a.i./ha (2.02%) and botanical NSKE 5%, which discovered that the percentage of shoot damage (2.76) compared to lone crop (okra) was higher (18.08 per cent). The highest yield was observed when intercropping coriander and okra (1:1), whereas the lowest yield was recorded when intercropping maize and okra (23.28 q/ha) (1:1).

**Key words:** Okra, *Earias vittella*, intercrop, incidence, shoot and fruit damage, marigold, coriander, maize, sunflower, mono cropping, yield, botanical.

**Comment [Rr2]:** Too many Key words. I suggest you delete the following words: intercrop, incidence, mono cropping, yield, botanical

## INTRODUCTION

In India, okra (*Abelmoschus esculentus* L. Moench), often known as lady's finger, is a widely grown vegetable. It is a perennial member of the Malvaceae family. In addition to India, it is grown in many other tropical and subtropical regions of the world (Citation). Okra

production in the globe is dominated by India, which accounts for 72% of the total (Citation). Okra is grown on a total of 0.51 million hectares in India, where 6.00 million tonnes of green fruits were produced in 2016–17 at a productivity of 11.0 metric tonnes per hectare (Citation). India's top three okra producers are West Bengal, Gujarat, and Bihar (Anonymous, 2017). In almost every country where okra is grown, the okra shoot and fruit borer (OSFB) is a major insect pest of the crop that reduces its economic yield (Citation).

**Comment [Rr3]:** This has not been listed in the Reference section.

The technique of simultaneously farming two or more crops on the same piece of land is referred to as intercropping or mixed cropping. Vegetables grown in fields with other crops reduce insect pest populations, reducing the need for non-environmentally friendly chemical treatments and supporting environmentally friendly production practises. Diverse environments would provide predators and parasitoids with a wider variety of habitats and prey over time, as well as alternative food sources like pollen and nectar, and maintain more stable populations of natural enemies than monocultures (Van Emden, 1965). Physical factors like wind protection, shading, sheltering, preventing dispersal, colour change, etc., or biological factors like the existence of natural enemies, the production of hazardous chemical stimuli, etc. Systems of intercropping may have an impact on the expansion of insect populations (Andow, 1991; Theunissen, 1994). To aid in the development of okra, ecologically friendly insecticides are sprayed on the plants. Spinosad is one of the chemicals used to lower the occurrence and load of important insect pests (Citation). Vegetables are grown with the use of synthetic insecticides.

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## **MATERIALS AND METHODS**

The experiment was conducted during *Zaid 2022* in the student instructional farm, ANDUAT kumarganj, Ayodhya (U.P.). It was laid out in randomized block design (RBD). ~~okra~~ Okra was raised and with intercrops viz. marigold, coriander, sunflower and maize, at the ratio of 1:1 (main and intercrop) each. After germination, the seedling were thinned out to have a spacing of 60 cm × 30 cm, the marigold transplanting was also done. The plot size was 4 m × 3 m, and the variety was ~~super~~ Super anamika-Anamika of okra while Shweta, Bharat-709 and Caribe-1 were the varieties of maize, sunflower and coriander, respectively. All the cultural practices, recommended for the main crop were uniformly adopted with the seed rate being according to recommendation for particular crop. Starting from 30 days after sowing, data on the incidence of *Eariasvittella* was ~~observed~~ were recorded. Shoot damage was counted randomly on 10 selected tagged plants in each replication at

**Comment [Rr7]:** The treatments are not clearly outlined in this section. Was the data subjected to the analysis of variance (ANOVA)? What method was used to separate means?

weekly interval and ~~%-per cent~~ shoot damage was computed. Mature fruit along with damage fruits was picked at an interval of two to three days and ~~%-per cent~~ damage was computed after each picking. Healthy and infested fruits were sorted out and weighed separately to work out the damage on weight basis.

## RESULTS AND DISCUSSION:

### Shoot borer and fruit borer:

The data on the shoot and fruit damage in okra under different intercrops presented in (Table 1) ~~reveal-showed~~ that the shoot damage in all the crop combination started from 30 days after sowing DAS and ~~combined-continued~~ till 60 DAS, while it attained its peak at 45 DAS. Among all the ~~intercropping-intercrops~~ okra + marigold (1:1) intercropping ~~was observed-with~~ showed the least ~~values-damage~~ of 2.86, 7.99 and 2.19% as against 4.57, 12.28 and 3.18 % in sole crop at 30, 45 and 60 DAS. On the contrary, intercropping of okra with maize (1:1) led to ~~maximum-the highest~~ damage of 3.95, 10.01 and 2.58 % at 30, 45 and 60 DAS, respectively.

Similarly, on ~~cumulative mean basis~~ also, the least damage (4.35%) was in okra + marigold (1:1) intercropping followed by okra + coriander (1:1) (4.70%).

The fruit damage varied remarkably among different crop combinations, the incidence started at 45 DAS and then increased continuously to its a peak at 75 DAS, and then declined. The fruit infestation at 45, 60, 75 and 90 DAS ranged from 3.95 to 4.52, 9.66 to 16.64, 14.04 to 16.13 and 9.34 to 16.13%, respectively. However, on cumulative mean basis the least fruit damage (9.25%) was in okra + marigold (1:1) which was statistically ~~on-at~~ par with okra + coriander (1:1) of 11.59%, okra + sunflower (1:1) of 13.47%, okra + maize (1:1) of 15.37%.

The maximum fruit damage (15.37%) was recorded in okra + maize (1:1). Thus, okra intercropped with marigold (1:1) was the best combination, which was statistically ~~on-at~~ par with okra + coriander (1:1), okra + sunflower (1:1) and okra + maize (1:1). ~~These results agree with those of~~ *Abro et al. (2004)* ~~on Eariasspp. in cotton that okra can used as a trap crop. Mohansundaram et al. (2012) observed that intercropping of okra and cluster bean with Neembean and spinosad spray lead to the least fruit damage due to E. vitella. Sujayanand et al. (2016) observed that marigold intercropped with okra is the best followed by okra and~~

**Comment [Rr8]:** This is not necessary since there is no other sub-heading under RESULTS AND DISCUSSION

**Comment [Rr9]:** What does this mean?

**Comment [Rr10]:** Avoid single-sentence paragraphs.

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coriander. In contrast, Mansour (2017) and Zakkaet al. (2018) concluded that okra, intercropped with maize harboured maximum infestation of various pests.

### Conclusion :

The shoot and fruit damage all treatments were non-significant before application of insecticides. During Zaid 2022 per cent shoot damage of 2.86, 7.99 and 2.19 per cent was recorded in okra + marigold (1:1) which significantly superior to other treatments followed by okra + coriander (1:1) 3.07, 8.70 and 2.34. The shoot and fruit damage all treatments were non-significant before application of insecticides. During Zaid 2022 per cent shoot damage of 3.61 and 0.80 per cent was recorded in spinosad 45 SC 75 g a.i/ha per ha treated plot at 1st and 14th days after 1st spray which significantly superior to other treatments followed by Abamection 1.8 EC 25 g a.i/ha (4.07 and 1.07).

During Zaid 2022 the per cent fruit damage was recorded in intercropping, per cent shoot damage of 3.95, 9.66, 14.04 and 9.36 per cent was recorded in okra + marigold (1:1) which is significantly superior to other treatments followed by okra + coriander (1:1) 4.01, 12.16, 18.16 and 13.33. The shoot and fruit damage all treatments were non-significant before application of insecticides. During Zaid 2022 per cent fruit damage of 3.01 and 0.73 per cent was recorded in spinosad 45 SC 75 g a.i/ha per ha treated plot at 1st and 14th days after 1st spray which significantly superior to other treatments followed by Abamectin 1.8 EC 25 g a.i/ha (3.21, 1.08, 3.02 and 0.76) > NSKE 5% (4.01, 1.80, 3.80 and 1.42). Spinosad 45 SC 75 g a.i/ha gave maximum fruit yield (77.03 q/ha) followed by Abamectin 1.8 EC 25 g a.i/ha with (58.36 q/ha).

### References :

- Ali, M. I. and M. A. Karim. 1990. Host preference of spotted bollworm (Sbw), *Eariasvittella* (F.) its potential use in Integrated Pest Management of the Sbw in cotton. *Univ. J. Zool. Rajshahi. Univ.* 9: 81-83.
- Ambekar, J. S., A. S. Pawar and M. V. Sakhare. 2000. Bio- efficacy of neem certain products against okra fruit borer. *J Maharashtra Agril. Univ. Pune, India.* 25(1): 42-43.
- Bajad, V. V.; Singh, H.P. and Patil, S. C. 2014. Efficacy of chemical insecticides against shoot and fruit borer, *Earias vittella* (Fab.) on okra (2014). *Biosciences*, 1644.
- Badiyala, A and Raj, D. 2013. Seasonal incidence, varietal screening and management of shoot and fruit borer infesting okra in Kangra valley of Himachal Pradesh. *Indian J. Hort.* 70(2): 304-308.

Comment [Rr13]: This has not been listed in the Reference section.

Comment [Rr14]: This has not been listed in the Reference section.

Comment [Rr15]: This discussion is inadequate.

Comment [Rr16]: This section is inadequate.

Gautam, H. K.; Singh, N. N. and Rai. A. B. 2015. Effect of intercropping on infestation of shoot and fruit borer (*Earias vittella*. Fab) on okra. *Vegetable Science* 42(2), 68-70.

Gosalwad, S. S. and Wadnerkar, D.W. 2009. Economics of pest management in okra (*Abelmoschus esculentus*). *Journal of plant protection and environment*, 6(1): 43- 46.

Mohanasundaram, A.; Sharma, R. K. and Sharma, K. 2012. Ecofriendly management of major insect pests of okra with intercropping and newer molecules. *Indian Journal of Plant Protection* 40(1), 32-37.

Ojha P K and Singh P. 2003. Effect of intercropping on the incidence of insect pests of cauliflower and its economics under agroclimatic zone-1 Bihar. *Pestology* 27 : 22-25.

Pachole, S. H.; Thakur, S. and Simon, S. 2017. Comparative bioefficacy of selected chemical insecticides and biorationals against shoot and fruit borer, (*Earias vittella* ). *Journal of Pharmacognosy and phytochemistry* 6(5), 1493-1495.

Pachole, S. C.; Thakur, S. and Simon, S. 2017. Comparative bioefficacy of selected chemical insecticides and biorationals against shoot and fruit borer, (*Earias vittella*) on okra (*Abelmoschus esculentus*). *Journal of Phrmacognosy and Phytochemistry* 6(5), 1493-1495.

Rajput, G. S. and Tayde A. 2017. Population dynamics and comparative efficacy of certain novel insecticides, botanicals and bioagents, against shoot and fruit borer (*Eariasvittella*Fabricius) of okra crop (*Abelmoschus esculentus*). *Journal of Entomology and Zoology Studies* ; 5(4): 1667-1670.

Shelton A M and Badenes-Perez F R. 2006. Concepts and applications of trap cropping in pest management. *Annual Review of Entomology* 51 : 285-308.

Singh, B. K.; Singh, A.K. and Singh, H. M. 2005. Efficacy of certain synthetic insecticide and two botanicals against the okra shoot and fruit borer *Earias vittella* (Fab.). *Indian Society of Pest Management and Economics Zoology*, 13(1): 99-103.

Sinha, S. R. and Sharma, R. K. 2007. Utilization of some novel insecticides schedules in insect pest management of okra (*Abelmoschus esculentus*). *Pesticides Research Journal*, 20(2): 234-236.

Sinha, S. R.; Singh, R. and Sharma R. K. 2007. Management of insect pests of okra through insecticides and intercropping. *Annals of plant protection sciences* 15(2), 321- 324.

Singh, H. B.; Bajad, V. V. and Chamroy, T. 2015. Seasonal incidence and field efficacy of insecticides against shoot and fruit borer, *Earias vittella* (Fab.) on okra. *Plant Archives* 15(1), 389-392.

Srinivasan, P. M. and R. B. Gowder. 1959. A preliminary note on the control of the bhendi shoot and fruit borer, *Earias vittella* F and *E. insulana*, *J. Agric. Sci.* 30(1):55- 57.

Comment [Rr17]: These listed references have not been cited in the text.

Sujayanand, G. K.; Sharma, R. K. and Shankarganesh K. 2016. Impact of intercrops and border crops on pest incidence in okra. *Indian J. Horti.* 73(2): 219-223.

**Comment [Rr18]:** These listed references have not been cited in the text.

Theunissen J. 1994. Intercropping in field vegetable crops: Pest management by agrosystem. Diversification overview. *Pesticide Science*42 : 65-68.

Atwal. A. S. 1976. Agricultural Pest of India and South – East Asia. Kalyani Publishers. New Delhi, Ludhiana: Pp. 283-285.

**Comment [Rr19]:** This listed reference has not been cited in the text.

Atwal. A. S. 1976. Agricultural Pest of India and South – East Asia. Kalyani Publishers. New Delhi, Ludhiana: Pp. 283-285.

**Comment [Rr20]:** This is a repetition of the previous reference. It should be deleted.

UNDER PEER REVIEW

Table 1.: Effect of Intercropping and Insecticides and Botanicals on shoot and fruit damage by *Earias vittella* in okra during Zaid season 2022

| Treatments                              | Mean percent damage caused by okra fruit borer** |                  |                 |                 |                               |                  |                  |                  |                  |
|---|--|------------------|-----------------|-----------------|-------------------------------|------------------|------------------|------------------|------------------|
|   | Shoot damage (%)                                 |                  |                 |                 | Fruit damage (%) weight basis |                  |                  |                  |                  |
|   | 30 DAS   | 45 DAS           | 60 DAS          | Cumulative mean | 45 DAS                        | 60 DAS           | 75 DAS           | 90 DAS           | Cumulative mean  |
| T <sub>1</sub> – Okra + Marigold (1:1)  | 2.86<br>(9.74)                                   | 7.99<br>(16.42)  | 2.19<br>(8.50)  | 4.35<br>(12.03) | 3.95<br>(11.46)               | 9.66<br>(18.11)  | 14.04<br>(22.01) | 9.36<br>(17.81)  | 9.25<br>(17.71)  |
| T <sub>2</sub> – Okra + Sunflower (1:1) | 3.46<br>(10.71)                                  | 9.27<br>(17.72)  | 2.45<br>(9.01)  | 5.06<br>(13.00) | 4.13<br>(11.73)               | 14.00<br>(22.01) | 21.67<br>(27.74) | 14.02<br>(21.99) | 13.46<br>(21.52) |
| T <sub>3</sub> – Okra + Coriander (1:1) | 3.07<br>(10.09)                                  | 8.70<br>(17.15)  | 2.34<br>(8.81)  | 4.70<br>(12.53) | 4.01<br>(11.57)               | 12.16<br>(20.41) | 18.16<br>(25.22) | 13.33<br>(21.45) | 11.59<br>(19.90) |
| T <sub>4</sub> – Okra + Maize (1:1)     | 3.95<br>(11.46)                                  | 10.01<br>(18.45) | 2.58<br>(9.24)  | 5.51<br>(13.58) | 4.35<br>(12.04)               | 16.64<br>(24.08) | 24.20<br>(29.47) | 16.13<br>(23.68) | 15.37<br>(23.08) |
| T <sub>5</sub> – Abamectin 15 g a.i/ha  | 4.07<br>(11.63)                                  | 1.07<br>(5.93)   | 4.22<br>(11.85) | 3.12<br>(10.17) | 3.21<br>(10.32)               | 1.08<br>(5.89)   | 3.02<br>(10.01)  | 0.76<br>(4.96)   | 2.02<br>(8.16)   |
| T <sub>6</sub> – NSKE 5%                | 3.82<br>(11.27)                                  | 2.52<br>(9.14)   | 3.41<br>(10.64) | 3.25<br>(10.39) | 4.01<br>(11.55)               | 1.80<br>(7.71)   | 3.80<br>(11.24)  | 1.42<br>(6.84)   | 2.76<br>(9.56)   |
| T <sub>7</sub> – Spinosad 75 g a.i/ha   | 3.61<br>(10.95)                                  | 0.80<br>(5.14)   | 3.06<br>(10.07) | 2.49<br>(9.08)  | 3.01<br>(12.04)               | 0.73<br>(4.90)   | 2.81<br>(9.65)   | 0.36<br>(3.44)   | 1.73<br>(7.55)   |
| T <sub>8</sub> – Okra (Sole crop)       | 4.57<br>(12.34)                                  | 12.28<br>(20.52) | 6.00<br>(14.18) | 6.68<br>(14.98) | 5.67<br>(13.77)               | 20.00<br>(26.57) | 28.54<br>(32.29) | 18.11<br>(25.19) | 18.08<br>(25.16) |
| <b>SEm±</b>                             | <b>(0.24)</b>                                    | <b>(0.14)</b>    | <b>(0.14)</b>   | <b>(2.19)</b>   | <b>(0.17)</b>                 | <b>(0.29)</b>    | <b>(0.11)</b>    | <b>(0.28)</b>    | <b>(2.05)</b>    |
| <b>CD@ 5%</b>                           | <b>(0.72)</b>                                    | <b>(0.41)</b>    | <b>(0.42)</b>   | <b>(6.64)</b>   | <b>(0.51)</b>                 | <b>(0.87)</b>    | <b>(0.33)</b>    | <b>(0.83)</b>    | <b>(6.04)</b>    |

**Comment [Rr21]:** These asterisks call for a footnote, which should explain the data shown on this table. What do the data in brackets mean?

Fig. 1. Effect of Intercropping, Insecticides & botanicals against shoot damage by okra shoot and fruit borer during *Zaid* season, 2022

Comment [Rr22]: The axes need to be clearly labeled: Treatment (X-axis) and Mean percent shoot damage (Y-axis)

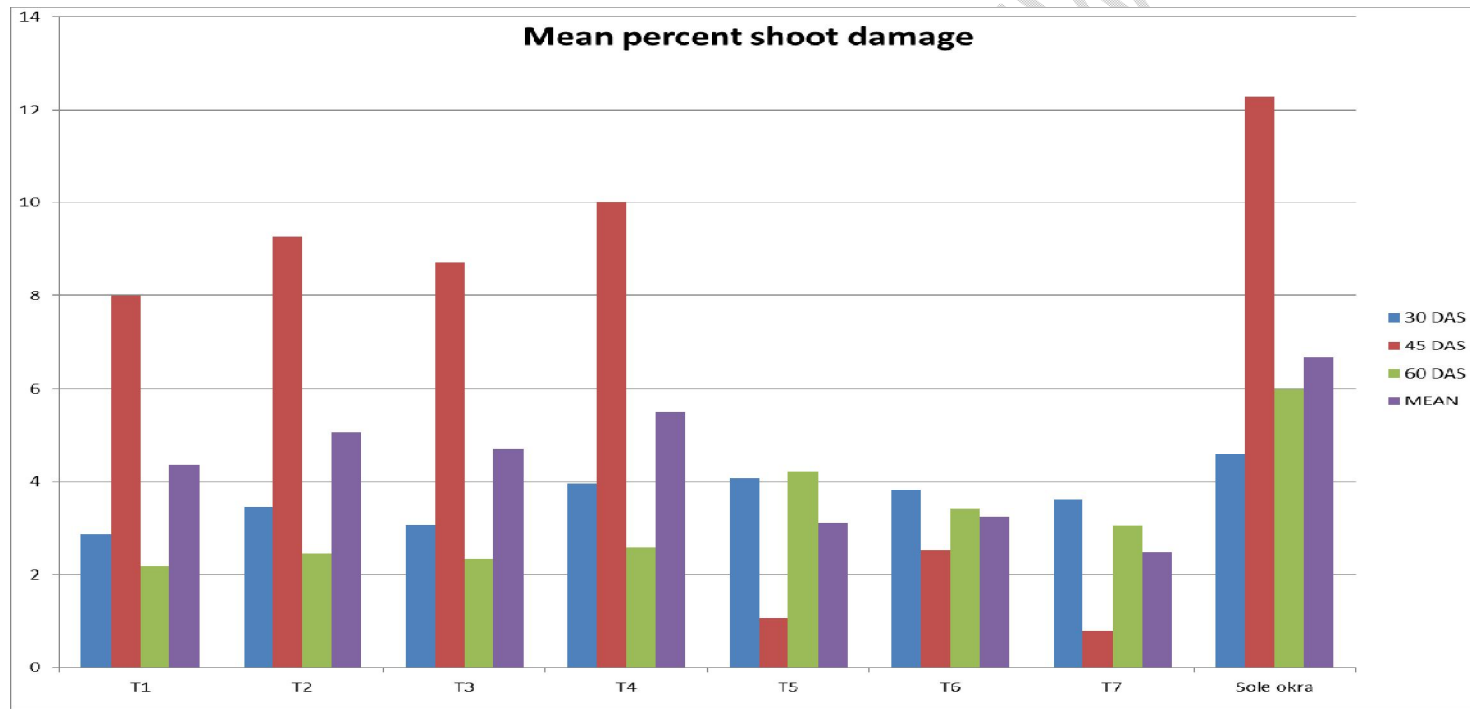


Fig 2. Effect of Intercropping, Insecticides & botanicals against fruit damage by okra shoot and fruit borer during *Zaid* season, 2022

Comment [Rr23]: The axes need to be clearly labeled: Treatment (X-axis) and Mean percent fruit damage (Y-axis)

