Seasonal incidence of shoot and fruit borer (*Earias vittella*) in okra

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1. Abstract

The present investigation carried out during the *Kharif* season 2023 at Deeksha Bhawan Entomology Field, Institute of Agriculture and Natural Sciences, Deen Dayal Upadhyaya Gorakhpur University, (Uttar Pradesh). During the investigation it has been revealed that the infestation of the shoot and fruit borer,*Earias vitella* on shoots of okra commenced in the 4th week of August which gradually increased and peaked in the last week of September. The infestation of pests on fruits started in the last week of August which gradually increased and peaked in the 43rdexpand in the abstract (SMW). The correlation studies showed that the maximum temperature, minimum temperatures, relative humidity morning, and relative humidity evening had a non-significant positive correlation while rainfall showed a negative non-significant effect on shoot infestation. However, the infestation of *E.~~arias~~ vitella* on fruits of okra showed a negative non-significant correlation with maximum temperature, relative humidity morning and rainfall while minimum temperature and relative humidity evening had a negative significant correlation.

Keywords- *population, okra, shoot and fruit borer~~Abelmoschus esculentus~~,correlation, weather parameters damage,*

2. Introduction

Okra, *Abelmoschus esculentus* (L.) or Ladies finger, which is also known as 'Bhindi ', is one of the important vegetables of India. It is one of the most widely known and utilized species of the family Malvaceae (Naveed *et al*., 2009) and an economically important vegetable crop grown in tropical and sub-tropical parts of the world (Oyelade *et al*., 2003; Andras *et al*., 2005; Saifullah & Rabbani, 2009). This crop is one of the most widely known and utilized species of the family Malvaceae (Naveed et al., 2009). Okra plant was previously included in the genus Hibiscus. Later, it was designated to Abelmoschus, which is distinguished from the genus Hibiscus (Aladele *et al*. 2008).Okra originated in Ethiopia (Sathish & Eswar, 2013) and was then propagated in North Africa, in the Mediterranean, in Arabia and India by the 12th century BC (Nzikou et al., 2006). Considering the little contact between Ethiopia and the rest of the world within historic times, it is not surprising that little is known about the early history and distribution of okra. The routes by which okra was taken from Ethiopia to North Africa, the eastern Mediterranean, Arabia, and India, and when, are by no means certain (Tindall, 1983).Okra is suitable for cultivation as a garden crop as well as on large commercial farms (Rubatzky & Yamaguchi, 1997). Okra plants are grown commercially in many countries such as India, Japan, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar, Malaysia, Thailand, India, Brazil, Ethiopia, Cyprus and in the Southern United States (Qhureshi, 2007). Among vegetable crops, this crop occupies an important position and is grown extensively throughout India mainly for its immature fruits and an area of 5.31 lakh hectares with a production of 63.50 lakh tones a productivity of 11.93 tonnes per hectare. Uttar Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, Haryana and Punjab are the most prominent okra-growing states in India, where it is grown as a kharif and summer season crop. (Anon., 2021). Okra plays an important role in the human diet and is a good source of protein, carbohydrates, vitamins, calcium, potassium, enzymes, and total minerals which are often lacking in the diet of developing countries(Saifullah and Rabbani, 2009: Gopalan *et al.,* 2007).The composition of okra pods per 100 g edible portion is water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fiber 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 µg, riboflavin 0.08mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. The fruits of okra have reawakened beneficial interest in bringing this crop into commercial production.Its medicinal value has also been reported in curing ulcers and relief from ~~hemorrhoids~~haemorrhoids. It~~Okra~~ has also been found to be medically beneficial as a plasma replacement or blood volume expander and also useful in genitourinary disorders, spermatorrhea and chronic dysentery.

Okra is a better source of livelihood to the farmers but the infestation of different insect pests at various stages of its growth limits its successful cultivation and yield. According to Dhamdhere *et al.* (1984), the crop is attacked by several species of insect pests causing considerable damage. All the plant stages are susceptible to insect pests and more than seventy-two species of insect pests have been recorded on okra crop (Naik *et al.,* 2012). The major pests reported are jassid, *Amrasca biguttula biguttula* (Ishida), aphid, *Aphis gossypii* (Glover), whitefly, *Bemisia tabaci* (Genn.), shoot and fruit borer, *Earias insulana* (Boisd) and *E. vittella* (Fab.), fruit borer, *Helicoverpa armigera* (Hb.), while minor pests include leaf roller, *Sylepta derogata* (Fab), mite, *Tetranychus cinabarinus* (Boisd.), green plant bug, *Nezara viridula* (Linn.) and green semilooper, *Anomis flava* (Fab.) (Meena and Kanwat, 2005; Mandal *et al.*, 2007 and Yadav, 2015).

Among all pests, shoot and fruit borer (*Earias insulana* and *E. vittella*) the most destructive pests of okra, as young larva bores into tender shoots in early vegetative growth of plants and grown-up larvaedamage fruits resulting in serious loss in yield.*E. vittella* is an oligophagous pest and its main hosts are okra and cotton. It is also found feeding on a large number of cultivated and wild malvaceous plants species. The pest is active almost the year round and prefers high humidity and high temperature for its growth and development. The affected fruits are rendered unfit for human consumption, as well as for procurement of seed. The borer has been reported to cause 24.6 to 26.0 per cent damage to okra shoots (Pareek *et al.,* 1986 and Zala *et al.,* 1999) and 40 to 100 per cent loss to fruits (Pareek and Bhargava, 2003, Shinde *et al.,* 2007 and Rai *et al.,* 2014). The pest is active almost year-round and prefers high humidity and high temperatures for its growth and development. In India, an estimated loss of 69.00 per cent in marketable yield was due to the attack of this insect on okra alone (Ray *et al.*, 2019).

The incidence of *E. vittella* shows violent fluctuations due to changes in climatic conditions. Information on the impact of abiotic factors on the incidence of *E. vittella* is very useful for the management of this pest in eastern Uttar Pradesh. The seasonal incidence study will help to determine the relation between the weather factors and the population of this pest. Keeping in view the importance of okra and incidence of shoot and fruit the present work was carried out to know the seasonal incidence of pest and results obtained were documented here under.

Comment [SK1]: Also write about the need to carry out such timely studies with regard to climate change and its effect on the major insect pest.

3. Materials and method

The field experiment was carried out during the *Kharif* season 2023 at Deeksha Bhawan Entomology Field, Institute of Agriculture and Natural Sciences, Deen Dayal Upadhyaya Gorakhpur University, (Uttar Pradesh). Geographically Gorakhpur is situated within latitude 26*46'N and Longitude 82'2E with an altitude of 75 meters above the mean sea level. To study the seasonal incidence of shoot and fruit borer infesting okra in relation to key abiotic factors, *Basanti*cultivar a commonly grown and recommended variety in thisarea was sown on the first week of August 2023 inplots of 3.0 X 3.0 m^2 size keeping row to row and plant toplant distance of 45 and 30 cm, respectively. For recording the observations, the crop was left for the natural infestation. The data on the shoot and fruit borer, *Earias* spp. were recorded on five randomly selected and tagged plants throughout the crop period by a visual count of the plant in which the top portion was damaged, starting after two weeks of sowing to last picking of the fruits. The per cent shoot infestation was calculated by counting the total number of shoots and the number of damaged shoots. The per cent infestation of fruits on a number basis was calculated by counting the infested and healthy fruits separately from selected tagged plants at each picking till the last picking of fruits. The data recorded on shoot and fruit damage and meteorological parameters were used for statistical analysis (Panse *et al.*, 1967). The simple correlation was computed between shoot and fruit damage and abiotic factors, *viz.;* maximum and minimum temperature, relative humidity and rainfall. The following formulae w~~as~~ere used for calculating the correlation coefficient is given below (Gupta,1996).

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The formula used in

$$\text{Percent shoot damage} = \frac{\text{Total number of damage shoots}}{\text{Total number of shoots}} \times 100$$

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

$$\text{Correlation coefficient} = \frac{\text{Cov (XY)}}{\sqrt{var\,(x) var(y)}}$$

Where,
r = correlation coefficient,
Cov(XY) = Covariance of the characters X and Y,
Var (x) and Var (y) = Variance of the characters of X and Y, respectively.

4. Result and discussion

The data on seasonal incidence of a pest provide useful information on the population buildup of pestsconcerning the abiotic factors of the environment. Such information can effectively be utilized in predicting the buildup of pest population and is thus helpful in revalidation of integrated pest management programmes.

Weekly observations on shoot damage were recorded as soon as infestation started, while fruit damage was recorded at each picking till the last picking of the crop. Shoot and fruit borer, *E. arias vittella* (Fab.) were recorded infesting okra shoots and fruits during the study. The shoot damage was noticed when the crop was in the vegetative stage. The data presented in Table 1 revealed that the infestation of the shoot and fruit borer on shoots of okra commenced in the 4th week of August (2.10%) *i.e.* four weeks after sowing (WAS) which gradually increased and reached to peak (13.32%) in the last week of September (39 SMW) at 33.35 º C and 25.41 º C maximum and minimum temperatures, 77.28 per cent relative humidity Morning and 71.28 per cent relative humidity evening and 0.68 mm rainfall. The maximum temperature (r= 0.194), minimum temperatures (r = 0.317), relative humidity morning (r = 0.0.372), and relative humidity evening (r = 0.155) had a non-significant positive correlation while rainfall (r = -0.362) showed a negatively non-significant effect on shoot infestation. As soon as the fruiting started, the incidence of this insect pest on the shoots started to decline and disappeared from shoots during 43 SMW. The present findings are in accordance with Meena and Kanwat (2005), Meena *et al*. (2010) and Sharma and Jat (2010) who reported that the pest infestation was present during the full cropping season. Sharma and Jat (2010) also reported that the shoot infestation reached to peak in the last week of September. The minimum temperature and relative humidity had a non-significant correlation with shoot damage is also in full conformity with the findings of Yadav (2015). Chaudhary (2016) reported that minimum temperature, relative humidity and rainfall showed a non-significant correlation with the shoot damage. Rathore *et al.* (2021) reported that the infestation has a non-significant correlation with maximum and minimum temperatures, relative humidity morning, relative humidity in the evening and negative non-significant with the rainfall. Nandaniya and Chawda (2022) reported a non-significant correlation between shoot infestation with minimum temperature and relative humidity evening. Ankur *et al.,* (2022) reported non-significant correlation with the minimum temperature.

The infestation of pests on fruits started in the last week of August *i.e.* 38 SMW (4.75%) which gradually increased and reached to peak (18.75 %) in the 5^{th} week of October *i.e.* 44 SMW at 31.6 º C maximum temperature and 17.42 º C minimum temperature, 74.57 per cent relative humidity morning, 60.28 per cent relative humidity evening and 00.0 mm rainfall. The infestation of *Earias vitella* on fruits of okra showed a negative non-significant correlation with maximum temperature (r = -0.481), relative humidity morning (r = -0.471) and rainfall (r= -0.496) while minimum temperature (-0.883) and relative humidity evening (-0.663) had negative significant correlation. Yadav (2015) reported that minimum

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temperature and relative humidity showed a significant negative correlation while rainfall had a non-significant correlation with fruit damage. Chaudhary (2016) reported that minimum temperature and relative humidity showed a negatively significant correlation with fruit infestation.

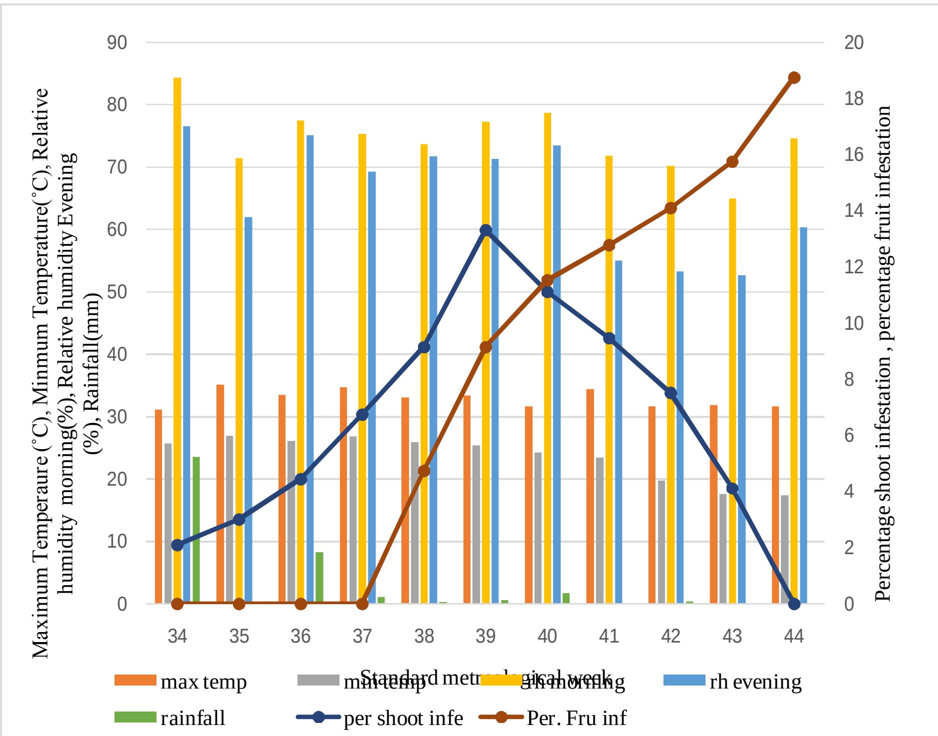
Table 1 Incidence of the shoot and fruit borer in Okra during *Kharif* Season 2023

S.No.	SMW	Temperature		Relative Humidity (RH)		rRainfall (mm)	Per. shoot infestation (%)	Per. Fruit infestation (%)
		Max.temp .	Min. temp.	rh MMmorning	rh eEvening			
1.	34	31.10	25.65	84.28	76.57	23.55	2.10	0
2.	35	35.10	26.94	71.42	62.00	0.31	3.01	0
3.	36	33.42	26.12	77.42	75.14	8.28	4.45	0
4.	37	34.75	26.88	75.28	69.28	1.18	6.75	0
5.	38	33.14	25.91	73.57	71.71	0.32	9.15	4.75
6.	39	33.35	25.41	77.28	71.28	0.68	13.32	9.15
7.	40	31.61	24.37	78.71	73.42	1.72	11.12	11.54
8.	41	34.42	23.44	71.85	55.00	0.00	9.47	12.78
9.	42	31.60	19.74	70.14	53.28	0.45	7.51	14.1
10.	43	31.90	17.65	65.00	52.71	0.00	4.12	15.75
11.	44	31.60	17.42	74.57	60.28	0.00	0	18.75

Table 2 Correlation coefficient (r) of sShoot and fruit borer with weather parameters in okra crop during *Kharif*, 2023

Metrological parameters	Correlation coefficient (r)	
Merge the cell with the one above	Shoot infestation	Fruit infestation
Max.imum temp.erature	0.194	-0.481
Minimum Min.Temperature Temp.	0.317	-0.883
Relative humidityRH morning	0.0372	-0.478
Relative humidityRH evening	0.155	-0.663
Rainfall	-0.362	-0.496

Fig..1 Shoot and fruit infestation by shoot and fruit borer in relation with the weather parameters during the study period, *Kharif*, 2023



There is need for better discussion. Results can be compared with the changes in other insects' correlation with weather also. This would throw some light on climate change impact and also add weight to your study and the results.

5. Conclusion

From the present study it can be concluded that the infestation of the shoot and fruit borer on shoots of okra commenced in the 4th week of August (2.10%) *i.e.* four weeks after sowing which gradually increased and reached to peak (13.32%) in the last week of September. The infestation of pests on fruits started in the last week of August i.e. 38 SMW (4.75%) which gradually increased and reached to peak (18.75 %) in the 5th week of October i.e. 43 SMW. The correlation studies showed that the maximum temperature (r= 0.194), minimum temperatures (r = 0.317), relative humidity morning (r = 0.0.372), and relative humidity evening (r = 0.155) had a non-significant positive correlation while rainfall (r = -0.362) showed a negatively non-significant effect on shoot infestation. However, the infestation of *Earias vitella* on fruits of okra showed a negative non-significant correlation with maximum temperature (r = -0.481), relative humidity morning (r = -0.471) and rainfall (r= -0.496) while minimum temperature (-0.883) and relative humidity evening (-0.663) had negative significant correlation.

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