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Study on the seasonal incidence of shoot and fruit borer (*Earias vittella* Fabricius) of okra [*Abelmoschus esculentus* (L.) Monech] and its correlation with weather factors

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Abstract

The present investigation entitled "To study the seasonal incidence of okra shoot and fruit borer *Earias vittella* (Fab) and its correlation with weather parameters." was conducted during *Kharif* 2024 at the experimental farm, Department of Entomology, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. Observations on pest incidence revealed that shoot damage due to *E. vittella* commenced from the 30th Standard Meteorological Week (SMW) with 2.01% infestation and peaked during the 38th SMW with 25.99% shoot damage. Similarly, fruit infestation on a number basis started in the 33rd SMW (5.93%) and reached a peak of 46.95% in the 40th SMW. On a weight basis, fruit infestation followed the same pattern, beginning with 6.99% in the 33rd SMW and increased to 47.90% on the 40th SMW. Correlation analysis revealed a significant negative correlation between shoot and fruit infestation and both minimum temperature ($r = -0.567^{*}$ for shoot, -0.685^{**} for fruit infestation on number basis and $r = -0.664^{**}$ fruit infestation on weight basis) and evening relative humidity ($r = -0.498^{*}$ for shoot; -0.499^{*} for fruit infestation on number as well as weight basis). Conversely, maximum temperature showed positively non-significant whereas morning relative humidity and rainfall showed negatively non-significant correlations with pest incidence.

Keywords: Okra, shoot and fruit borer, abiotic factor, correlation, infestation

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable crop cultivated widely in tropical and subtropical regions of the world. It is valued for its nutritional richness, being a good source of calcium, potassium, vitamins and minerals, and for its industrial utility, particularly the use of stem mucilage in clarifying sugarcane juice during jaggery preparation (Chauvan, 1972) [5]. India is the largest producer of okra, with major cultivation concentrated in states *viz*., Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu, Punjab and Haryana. The crop is grown mainly during the kharif and summer seasons and occupies about 5.44 lakh ha with an average productivity of 11.93 t/ha (Anonymous, 2023) [1]. Despite its economic importance, okra production is severely constrained by insect pests throughout its growth period. Among these, the okra shoot and fruit borer (*Earias vittella* Fabricius) is recognized as the most destructive pest, causing damage from seedling to fruiting stages. The larvae bore into tender shoots and fruits, resulting in wilting, malformed produce and substantial yield losses. Several studies have reported fruit damage ranging from 22.5 to 76%, with losses in marketable yield reaching up to 69% under severe infestation (Rawat and Sahu, 1973) [8]. The pest is particularly severe in regions with moderate climatic conditions such as Maharashtra, Karnataka, Gujarat and Madhya Pradesh (Brar *et al*., 2000) [3].

The incidence of *E. vittella* exhibits significant fluctuations in response to variations in climatic conditions. Understanding the influence of abiotic factors on the population dynamics of *E. vittella* is essential for effective pest management. Investigating seasonal incidence provides valuable insights into the relationship between weather parameters and pest population levels.

Such studies contribute to a better understanding of pest dynamics in okra, facilitate the development of effective management strategies and help minimize crop losses. Moreover, identifying peak infestation periods enables the implementation of timely and targeted control measures, thereby supporting sustainable agricultural practices. Considering the economic importance of okra and the recurring incidence of this pest, the present study was undertaken to assess its seasonal incidence.

2. Materials and Methods

2.1 Layout of Experiment

For studying the effect of abiotic factors on the incidence of okra shoot and fruit borer (*Earias vittella*), the variety Mahyco hybrid-10 was sown in the month of July 2024 in three plots of 3.6 X 3.6 m^2 sizes keeping row to row and plant to plant distance of 30 cm and 15 cm, respectively. All the recommended cultural practices were followed except application of insecticides.

Methods of Observation: For recording the observations, the crop was left for natural infestation. The observations of shoot infestation by *Earias vittella* were recorded at weekly interval and fruit infestation at each picking and converted into weekly basis. The observations on shoot and fruit borer, *Earias vittella* were recorded on five randomly selected and tagged plants throughout the crop period by visual count of the plant in which the top portion was infested, started 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 infested shoots. In case of fruit borer, the observations were recorded on infestation of fruits both on number and weight basis at each picking starting from initiation of fruit infestation till last picking of fruits. The per cent infestation of fruits on number basis was calculated by counting the infested and healthy fruits separately from selected tagged plants. The weight of both healthy and infested fruits was taken separately and level of infestation was worked out in per cent. Formulas used for above calculation as follows:

$$\text{Percent shoot infestation (\%)} = \frac{\text{number of infested shoots}}{\text{Total number of shoots}} \times 100$$

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

$$\text{Percent fruit infestation (\%) by weight} = \frac{\text{Weight of infested fruits}}{\text{Total weight of fruits}} \times 100$$

The data recorded on infestation of shoot and fruit borer and meteorological parameters was used for statistical analysis. To infer the results of seasonal incidence, simple correlation was worked out between per cent shoot and fruit infestation by okra and abiotic parameters, *viz*; maximum and minimum temperatures, relative humidity and rainfall

Interpretation of data

To interpret the results of seasonal incidence of okra shoot and fruit borer, the simple correlation was computed between per cent shoot and fruit infestation by okra and abiotic factors (maximum and minimum temperature, relative humidity and rainfall). The following formula was used for calculating correlation coefficient.

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{N\sum x2 - (\sum x)2.N \sum y2 - (\sum y)2}$$

Where,
r = Simple correlation coefficient
x = Independent variables *i.e.* abiotic components
y = Dependent variables *i.e.* pests
N = Number of observations

Results and Discussion

The present investigation was conducted to study the seasonal incidence of shoot and fruit borer, *Earias vittella* (Fab.), on okra and its correlation with prevailing weather parameters during *Kharif* 2024. The observations on shoot and fruit infestation (number and weight basis) revealed distinct seasonal trends influenced by abiotic factors.

The infestation of *Earias vittella* on okra shoots was first observed during the vegetative stage of the crop. The pest incidence commenced in the 30th Standard Meteorological Week (SMW), corresponding to the fourth week of July, with 2.01% shoot damage. The infestation increased progressively in subsequent weeks and reached its peak (25.99%) during the 38th SMW (Third week of September). The peak infestation coincided with maximum temperature of 31.7 °C, minimum temperature of 21.0 °C, morning and evening relative humidity of 81 and 52%, respectively and 3.00 mm rainfall. Thereafter, a gradual decline in shoot infestation was observed, and the incidence diminished towards the later crop stages.

Correlation analysis indicated that shoot infestation exhibited a significant negative correlation with minimum temperature (r = −0.567*) and evening relative humidity (r = −0.498*), suggesting that lower night temperatures and reduced evening humidity favoured pest buildup. Maximum temperature showed a positive but non-significant correlation (r = 0.102^{NS}), whereas morning relative humidity (r = −0.295^{NS}) and rainfall (r = −0.061^{NS}) also had non-significant negative Correlation with shoot infestation. These findings emphasize the prominent role of minimum temperature and evening humidity in influencing pest dynamics. The present findings are in agreement with Chaudhary *et al.,* (2024) [4], who reported initiation of infestation during late August (2.10%) with a peak in September (13.32%). Similarly, Varnekar *et al.,* (2024) [11] observed non-significant associations between shoot infestation and major abiotic factors, while Sonawane *et al.,* (2021) [10] reported a significant negative correlation between minimum temperature and *E. vittella* incidence, supporting the present observations.

Fruit infestation (number basis) commenced during the 33rd SMW (second week of August) with 5.93% damage. The infestation gradually increased and attained its maximum level (46.95%) during the 40th SMW (first week of October). The peak infestation occurred under climatic conditions comprising maximum temperature of 32.59 °C, minimum temperature of 22.9 °C, morning and evening relative humidity of 82.7 and 50.3%, respectively and absence of rainfall. These conditions appeared conducive for pest multiplication and fruit damage. The correlation analysis for fruit infestation (number basis) revealed a significant negative correlation with minimum temperature (r = −0.685**) and evening relative humidity (r = −0.499*). However, maximum temperature ($r = 0.352^{NS}$), morning relative humidity ($r = -0.161^{NS}$) and rainfall ($r = -0.206^{NS}$) exhibited non-significant relationships. These results indicate that comparatively lower minimum temperatures and reduced evening humidity levels favoured increased fruit infestation. The findings corroborate those of Sharma *et al.*, (2025) [9], who reported a significant negative correlation between fruit infestation and minimum temperature (r = −0.90**) and non-significant association with rainfall. Muhammad *et al.*, (2011) [7] also documented peak infestation during September–October under warm and relatively dry conditions. Earlier, Kumar and Devraj (1988) [6] observed that fruit infestation typically began around the sixth week after germination and peaked between the 10th and 11th weeks of crop growth, corresponding to early October, thus supporting the present results.

On weight basis, fruit infestation initiated during the 33rd SMW with 6.99% damage and reached its peak (47.9%) during the 40th SMW. The peak incidence coincided with similar weather parameters as recorded for number basis infestation, indicating consistency in pest behaviour across assessment methods. Correlation studies on weight basis infestation revealed a significant negative correlation with minimum temperature (r = −0.664**) and evening relative humidity (r = −0.499*), while maximum temperature ($r = 0.300^{NS}$), morning relative humidity ($r = -0.176^{NS}$) and rainfall ($r = -0.198^{NS}$) showed non-significant correlations. These findings suggest that minimum temperature plays a crucial role in regulating fruit infestation intensity. The results are in close conformity with Chaudhary *et al.,* (2024) [4] and Baldev *et al.*, (2023) [2], who also reported significant negative associations between minimum temperature and fruit infestation on weight basis. The consistency of these findings across studies reinforces the importance of weather parameters, particularly minimum temperature and evening relative humidity, in determining seasonal incidence patterns of *Earias vittella*.

Overall, the study demonstrates that *Earias vittella* infestation begins during the early vegetative stage of okra, intensifies under favourable warm and relatively dry conditions and peaks during September–October. Among the weather parameters studied, minimum temperature and evening relative humidity were the most influential factors governing pest incidence. Understanding these relationships is essential for forecasting pest outbreaks and implementing timely, weather-based integrated pest management strategies to minimize yield losses in okra cultivation.

Table 1: Seasonal incidence of okra shoot and fruit borer during *Kharif* -2024 (Shoot infestation)

Standard Meteorological Week (SMW)	Period	Per cent shoot infestation	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
			Max	Min	Morn	Even	
27	July 2-08	0	31.6	24.3	83.1	59.9	6.6
28	9-15	0	30.4	23.5	83.9	63.6	39.2
29	16-22	0	30.3	23.7	87.3	67.9	79.8
30	23-29	2.01	29.2	23.7	84.7	67.1	31.6
31	30-05	6.03	30	23	82.7	62.6	3.6
32	Aug 6-12	8.98	29.7	23.55	84.3	64.3	3
33	13-19	13.76	32.3	23.8	86.7	55.6	1.4
34	20-26	13.89	29.2	21.9	90.3	73	253.4
35	27-02	17.72	29.8	22.8	83.1	62	36.8
36	Sept 3-9	23.25	29.5	22.6	85	60.7	4
37	10-16	25.18	30.2	21.5	78.4	58.6	3.2
38	17-23	25.99	31.7	21	81	52	3
39	24-30	20.04	30	22.7	87.4	64.01	86
40	Oct 1-7	19.66	32.59	22.9	82.7	50.3	0
41	8-14	12.03	30.26	21.8	88	66	16.2
42	15-21	8.08	31.5	20.5	88	64	8
	Mean	12.29	30.52	22.70	84.8	61.98	35.99
	Min	0	29.2	20.5	78.4	50.3	0
	Max	25.99	32.59	24.3	90.3	73	253.4
	r	-	0.102	-0.567	-0.295	-0.498	-0.061

Table 2: Correlation between percent shoot infestation by *Earias vittella* on okra and weather parameters during *Kharif*-2024.

Sr. No.	Weather parameters	Correlation coefficient
1	Maximum temperature (^{0}C)	0.102^{NS}
2	Minimum temperature (^{0}C)	-0.567*
3	Morning relative Humidity (%)	-0.295^{NS}
4	Evening relative Humidity (%)	-0.498*
5	Rainfall (mm)	-0.061^{NS}

Table 3: Seasonal incidence of okra shoot and fruit borer during *Kharif*-2024 (Fruit infestation on number basis)

Standard Meteorological Week (SMW)	Period	Per cent fruit infestation (Number basis)	Temperature (^{0}C)		Relative Humidity (%)		Rainfall
			Max	Min	Morn	Even	(mm)
27	July 2-08	0	31.6	24.3	83.1	59.9	6.6
28	9-15	0	30.4	23.5	83.9	63.6	39.2
29	16-22	0	30.3	23.7	87.3	67.9	79.8
30	23-29	0	29.2	23.7	84.7	67.1	31.6
31	30-05	0	30	23	82.7	62.6	3.6
32	Aug 6-12	0	29.7	23.55	84.3	64.3	3
33	13-19	5.93	32.3	23.8	86.7	55.6	1.4
34	20-26	6.07	29.2	21.9	90.3	73	253.4
35	27-02	14.92	29.8	22.8	83.1	62	36.8
36	Sept 3-9	25.97	29.5	22.6	85	60.7	4
37	10-16	34.94	30.2	21.5	78.4	58.6	3.2
38	17-23	36.63	31.7	21	81	52	3
39	24-30	36.98	30	22.7	87.4	64.01	86
40	Oct 1-7	46.95	32.59	22.9	82.7	50.3	0
41	8-14	33.44	30.26	21.8	88	66	16.2
42	15-21	32.01	31.5	20.5	88	64	8
	Mean	17.12	30.52	22.70	84.79	61.98	35.99
	Min	0	29.2	20.5	78.4	50.3	0
	Max	46.95	32.59	24.3	90.3	73	253.4
	r	-	0.352	-0.685	-0.161	-0.499	-0.206

Table 4: Correlation between percent fruit infestation (number basis) by *Earias vittella* on okra and weather parameters during *Kharif*-2024

Sr. No	Weather parameters	Correlation coefficient
1	Maximum temperature (^{0}C)	0.352^{NS}
2	Minimum temperature (^{0}C)	-0.685**
3	Morning relative Humidity (%)	-0.161^{NS}
4	Evening relative Humidity (%)	-0.499*
5	Rainfall (mm)	-0.206^{NS}

Table 5: Seasonal incidence of okra shoot and fruit borer during *Kharif* -2024 (Fruit infestation on weight basis)

Standard Meteorological Week (SMW)	Period	Per cent Fruit Infestation (Weight basis)	Temperature (^{0}C)		Relative Humidity (%)		Rainfall
			Max	Min	Morn	Even	(mm)
27	July 2-08	0	31.6	24.3	83.1	59.9	6.6
28	9-15	0	30.4	23.5	83.9	63.6	39.2
29	16-22	0	30.3	23.7	87.3	67.9	79.8
30	23-29	0	29.2	23.7	84.7	67.1	31.6
31	30-05	0	30	23	82.7	62.6	3.6
32	Aug 6-12	0	29.7	23.55	84.3	64.3	3
33	13-19	6.99	32.3	23.8	86.7	55.6	1.4
34	20-26	7.33	29.2	21.9	90.3	73	253.4
35	27-02	22.01	29.8	22.8	83.1	62	36.8
36	Sept 3-9	32.55	29.5	22.6	85	60.7	4
37	10-16	36.54	30.2	21.5	78.4	58.6	3.2
38	17-23	38.5	31.7	21	81	52	3
39	24-30	38.9	30	22.7	87.4	64.01	86
40	Oct 1-7	47.9	32.59	22.9	82.7	50.3	0
41	8-14	35.02	30.26	21.8	88	66	16.2
42	15-21	30.01	31.5	20.5	88	64	8
	Mean	18.48	30.52	22.70	84.79	61.98	35.99
	Min	0	29.2	20.5	78.4	50.3	0
	Max	47.9	32.59	24.3	90.3	73	253.4
	r	-	0.300	-0.664	-0.176	-0.499	-0.198

Table 6: Correlation between percent fruit infestation (weight basis) by *Earias vittella* on okra and weather parameters during *Kharif*-2024

Sr. No	Weather parameters	Correlation coefficient
1	Maximum temperature (^{0}C)	0.300^{NS}
2	Minimum temperature (^{0}C)	-0.664^{**}
3	Morning relative Humidity (%)	-0.176^{NS}
4	Evening relative Humidity (%)	-0.499^{*}
5	Rainfall (mm)	-0.198^{NS}

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