Impact of Agro-Ecological Factors on the Dynamics of Sucking Insect Pests Population on Okra, *Abelmoschus esculentus* (L.) Moench

ABSTRACT

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| --- |
| **Aims:** To correlate population of major sucking insect pests on okra with the predator and abiotic factors, *i.e.,* the minimum & maximum temperature, relative humidity and rainfall.  **Study design:** Five separate plots of 2.25 x 1.5 m2 size keeping row to row and plant to plant distance of 45 cm and 30 cm, respectively were maintained.  **Place and Duration of Study:** The investigations were carried out in *Kharif,* 2022 at Horticulture farm, S.K.N. College of Agriculture, Jobner.  **Methodology:** The Pusa Bhindi-5 variety of okra was sown on 14th July, 2022 and recommended package of practices were adopted for raising the crop excluding plant protection measures. The observations on insect pest populations (leafhopper and whitefly) were recorded on five randomly selected and tagged plants in each plot at weekly interval and simple correlation was computed between mean observations of pest populations, natural enemies and meteorological parameters.  **Results:** The infestation of leafhopper and whitefly on the okra crop began on 15th August (33rd SMW). Peak populations of leafhoppers (30.28 per three leaves) were observed in the third week of September (38th SMW), with minimum and maximum temperatures of 21.1°C and 33.1°C, respectively, and relative humidity at 50%. Whitefly populations (17.84 per three leaves) peaked in the second week of September (37th SMW) when the minimum and maximum temperatures were 21.5°C and 34.7°C, respectively, and relative humidity was 45%. The correlation analysis revealed a non-significant relationship between leafhopper populations and the following abiotic factors: minimum temperature (r = 0.42), relative humidity (r = -0.34), and rainfall (r = -0.51). However, a significant positive correlation was found between leafhopper populations and maximum temperature (r = 0.63), as well as with the ladybird beetle *Menochilus sexmaculatus* (r = 0.80) at a 5% significance level. For whitefly populations, non-significant correlation was observed with the set of abiotic factors: maximum temperature (r = 0.61), minimum temperature (r = 0.54), relative humidity (r = -0.30), and rainfall (r = -0.50). A significant positive correlation was noted between whitefly populations and the ladybird beetle *M. sexmaculatus* (r = 0.79) at the 5% significance level.  **Conclusion:** The study reveals that leafhopper and whitefly populations on okra are positively correlated with maximum temperature and the presence of the ladybird beetle *Menochilus sexmaculatus*. However, abiotic factors like minimum temperature, relative humidity and rainfall have minimal influence on pest populations, emphasizing the role of natural predators in pest management. |

*Keywords: Leafhopper, Whitefly, Okra, Abiotic factors, Ladybird beetle*

1. INTRODUCTION

Okra (*Abelmoschus esculentus*), also known as lady's finger or bhindi, is a vital summer vegetable in India, belonging to the Malvaceae family (Tindall, 1983). It is rich in vitamins, minerals, amino acids, and proteins, with its seeds providing edible oil (Berry *et al*., 1988). The mucilage of okra has diverse practical uses (Qayyum, 1990; Mithal, 2006). Grown widely in tropical and subtropical regions like India, Nigeria, Pakistan, and Ghana, it thrives in various environmental conditions and is a significant *kharif* crop (Ghosh & Jana, 2022). India is the leading producer, cultivating 548.95 thousand hectares, yielding 7,157.64 thousand metric tons (MT) with an average productivity of 13.04 MT per hectare (Anon., 2023).

Okra is highly susceptible to insect pests, which significantly reduce yields (Kumar *et al*., 2002). In India, 72 species of pests, including aphids, whiteflies, leafhoppers, thrips, and mites, affect the crop (Pal *et al*., 2013). Among these, aphids, whiteflies, and leafhoppers are the most prevalent (Pal *et al*., 2013; Das *et al*., 2021). Leafhoppers cause leaf necrosis and curling, while whiteflies transmit viral diseases, especially under high temperatures (Noopur *et al*., 2022). The incidence of these pests is influenced by weather parameters such as temperature, humidity, and solar radiation (Burade *et al*., 2019). Understanding these parameters and pest activity patterns is essential for developing effective pest management strategies.

2. material and methods

The study aimed to investigate the succession and incidence of major sucking insect pests, specifically leafhopper and whitefly, on okra (variety Pusa Bhindi-5). A total of five plots, each measuring 2.25 x 1.5 m², were maintained with a row-to-row and plant-to-plant spacing of 45 cm and 30 cm, respectively. The crop was sown on 14th July 2022 and grown using recommended package of practices, excluding plant protection measures, allowing for natural pest infestation. Observations were made weekly on five randomly selected tagged plants per plot, starting from the appearance of the pests until harvest. Insect populations (both nymphs and adults of leafhopper and whitefly) were counted in the early morning when the pests were less active. In total, three leaves (top, middle, and bottom) from each tagged plant were inspected, both the upper and lower surfaces being carefully examined (absolute counting) (Thakkar and Rote, 2001; Sharma and Sinha, 2009).

Data on pest populations and environmental variables, including temperature, humidity, and rainfall, were statistically analyzed. Simple correlation analyses were performed to assess the relationship between pest populations, predator numbers, and abiotic factors.

The following formula was used for calculating correlation coefficient (Gupta, 1996):

N ∑xy – (∑x) (∑y)

r =

√ N∑x2 - (∑x)2. N∑y2 - (∑y)2

Where,

r = Simple correlation coefficient

x = Independent variables, *i.e.,* abiotic components

y = Dependent variables, *i.e.,* pests

N = Number of observations

3. results and discussion

The data on succession and incidence of a pest species provide useful information on the population buildup of pest in relation to the meteorological parameters. Such information can effectively be utilized in predicting the buildup of pest population and thus, helpful in integrated pest management programme. During the investigation, leafhopper, *Amrasca biguttula biguttula*, whitefly, *Bemisia tabaci* (Genn.) were noticed as major sucking insect pests of okra.

**3.1 Leafhopper, *Amrasca biguttula biguttula* (Ishida)**

The infestation of *A. biguttula biguttula* on okra commenced during the third week of August (33rd SMW) and persisted until the third week of October, marking the end of the crop season. Initial leafhopper population was recorded at 2.44 per three leaves during the *kharif* season of 2022, gradually increasing to a peak of 30.28 per three leaves in the third week of September (38th SMW). Subsequently, the population declined, reaching low levels by October (Table.1 and Table 2). This seasonal trend aligns with findings from Meena *et al*. (2010a) and Pachori *et al*. (2016), though slight variations in the timing of incidence peak can be attributed to differences in local agro-climatic conditions.

The appearance of leaf hopper populations was associated with specific climatic conditions, with an onset at 30.3°C maximum temperature, 21.1°C minimum temperature, 62% mean relative humidity, and 93 mm rainfall. The peak population coincided with 33.1°C maximum temperature, 21.1°C minimum temperature, and 50.0% relative humidity. A significant positive correlation (r = 0.63) was observed between maximum temperature and leaf hopper population, consistent with the studies of Bhute *et al*. (2012) and Kalkal *et al*. (2015),. The negative correlation with relative humidity and rainfall was supported by Singh *et al*. (2013), while non-significant correlations with minimum temperature were in agreement with Meena *et al*. (2010a) and Nagar et al. (2017).

**3.2 Whitefly, *Bemisia tabaci* (Genn.)**

The infestation of *Bemisia tabaci* (whitefly) commenced in the third week of August (33rd SMW) and persisted throughout the crop season. Initially, the whitefly population was low, but it steadily increased, peaking in the 37th SMW with a recorded population of 17.84 whiteflies per three leaves (Table 1 and Table 2). These findings are consistent with those of Rawat *et al*. (2020a), who observed the maximum whitefly population in early September. Pachori *et al*. (2016) and Nagar *et al*. (2017) also partially corroborate these results, with minor differences likely attributed to variations in crop sowing dates and regional climatic conditions.

The correlation matrix revealed a non-significant positive relationship between whitefly population and both maximum (r = 0.61) and minimum (r = 0.54) temperatures, aligning with findings by Meena *et al*. (2010a) and Prasad *et al*. (2012). Additionally, relative humidity and rainfall showed a non-significant negative correlation with whitefly population, similar to the results of Chaitanya *et al*. (2018) and Patel *et al*. (2018).

**3.3 Ladybird beetle, *Menochilus sexmaculatus* (Fab.)**

The population of the ladybird beetle, *Menochilus sexmaculatus*, was recorded in the experimental field of okra within the range of 0.2 to 4.2 individuals per five plants. The peak population of 4.2 individuals per five plants was observed on 19th September (38th SMW), coinciding with a minimum temperature of 21.1°C, maximum temperature of 33.1°C, and 50% relative humidity. This observation aligns with the findings of Nagar *et al*. (2017), who also reported peak populations of the ladybird beetle in September, with a correlation showing a non-significant relationship with temperature.

Correlation analysis showed that the infestation of ladybird beetles exhibited a non-significant positive correlation with maximum and minimum temperature, which is consistent with the findings of Bhatt and Karnatak (2018). However, the correlation with rainfall and relative humidity was negative and non-significant, suggesting that these environmental factors might have a lesser role in influencing the predator population in the okra crop. These results partially support the observations of Raghuwanshi *et al*. (2018), indicating that while temperature may play a role, other climatic factors like humidity and rainfall do not significantly affect the ladybird beetle’s population in okra fields.

**Table.1 Weekly mean meteorological observations recorded during *Kharif*, 2022**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.**  **No.** | **SMW\*** | **Duration** | | **Temperature**  **(°C)** | | **Relative**  **Humidity**  **(%)** | **Total**  **Rainfall**  **(mm)** |
| **From** | **To** | **Max.** | **Min.** |
| 1. | 33 | 13.08.2022 | 19.08.2022 | 30.3 | 21.1 | 52 | 93.0 |
| 2. | 34 | 20.08.2022 | 26.08.2022 | 30.2 | 20.9 | 59 | 32.0 |
| 3. | 35 | 27.08.2022 | 02.09.2022 | 33.2 | 21.1 | 41 | 00.0 |
| 4. | 36 | 03.09.2022 | 09.09.2022 | 35.2 | 20.3 | 47 | 00.0 |
| 5. | 37 | 10.09.2022 | 16.09.2022 | 34.7 | 21.5 | 45 | 05.0 |
| 6. | 38 | 17.09.2022 | 23.09.2022 | 33.1 | 21.1 | 50 | 17.0 |
| 7. | 39 | 24.09.2022 | 30.09.2022 | 32.9 | 18.7 | 45 | 13.0 |
| 8. | 40 | 01.10.2022 | 07.10.2022 | 35 | 16.8 | 42 | 0.0 |
| 9. | 41 | 08.10.2022 | 14.10.2022 | 30.6 | 17.0 | 51 | 46.0 |
| 10. | 42 | 15.10.2022 | 21.10.2022 | 33.4 | 12.3 | 40 | 0.0 |

*\*SMW = Standard Meteorological Week*

**Table 2 Correlation between populations of insect pest, predator and meteorological parameters**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S.N. | SMW\* | Date of observations | Mean population / three leaves | | | |
| Leafhopper | Whitefly |  | |  | | --- | | Population of  *Menochilus*  *sexmeculatus* | | | Five plants | |
| 1 | 33 | 13.08.2022 | 2.44 | 2.96 |  | 0.2 |
| 2 | 34 | 20.08.2022 | 5.88 | 6.16 |  | 1.4 |
| 3 | 35 | 27.08.2022 | 12.36 | 9.84 |  | 2.4 |
| 4 | 36 | 03.09.2022 | 19.68 | 12.96 |  | 2.84 |
| 5 | 37 | 10.09.2022 | 25.44 | 17.84 |  | 3.4 |
| 6 | 38 | 17.09.2022 | 30.28 | 15.16 |  | 4.2 |
| 7 | 39 | 24.09.2022 | 22.56 | 14.2 |  | 1.8 |
| 8 | 40 | 01.10.2022 | 15.68 | 8.64 |  | 1 |
| 9 | 41 | 08.10.2022 | 4.08 | 3.12 |  | 2.2 |
| 10 | 42 | 15.10.2022 | 3.32 | 1.96 |  | 0.4 |
| Correlation with maximum temperature | | | 0.63\*\* | 0.61 |  | 0.36 |
| Correlation with minimum temperature | | | 0.42 | 0.54 |  | 0.52 |
| Correlation with relative humidity | | | -0.34 | -0.30 |  | -0.18 |
| Correlation with rainfall | | | -0.51 | -0.50 |  | -0.38 |
| Correlation with *Menochilus sexmaculatus* | | | 0.80\*\* | 0.79\*\* |  |  |

*\*Standard Meteorological Week*

*\*\*Significant at 5 per cent level of significance*

**Fig. 1. An agro-ecological analysis of the sucking insect pests population on okra (*Abelmoschus esculentus* (L.) Moench)**

4. Conclusion

The study highlights the complex interaction between pest populations and climatic factors in okra cultivation. Both leafhopper and whitefly infestations followed distinct seasonal patterns, with temperature playing a crucial role in their population dynamics. While temperature positively influenced the leafhopper population, humidity and rainfall had a negative impact. The ladybird beetle population showed a non-significant correlation with temperature and environmental factors, suggesting that other ecological factors might influence its dynamics. These findings underscore the importance of integrating meteorological data into pest management strategies to predict pest outbreaks and optimize control measures in integrated pest management programs.

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