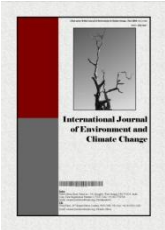

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# Seasonal Incidence of Sucking Pests and Their Natural Enemies in Okra *Abelmoschus esculentus* (L.) Moench

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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

Okra, *Abelmoschus esculentus* (L.) Moench is a major vegetable crop grown in India. The crop is susceptible to various sucking insects and mite pests throughout the cropping period. The present field experiment was carried out to observe the incidence and correlation between weather parameters and sucking pests along with their natural enemies in okra (variety Arka Anamika) at Central Research Station, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha during summer 2021.The maximum population of two major sucking pests i.e., leafhopper and whitefly was observed at 22$^{nd}$ and 19$^{th}$ standard meteorological week (SMW), respectively where as the peak activity of aphid and two spotted spider mites were recorded at 21$^{st}$ SMW. Among the natural enemies, coccinellid and spiders were recorded and the highest activity was observed at 22$^{nd}$ SMW. The correlation studies revealed a significant positive correlation between minimum temperature (r= 0.577) and afternoon relative humidity (r= 0.618) with leafhopper population. Further, there was significant negative correlation between spider population and maximum

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temperature (r= -0.788) where as both morning and afternoon relative humidity (r= 0.677 and r= 746) had positive effect. In addition, there was significant positive correlation between the predators (coccinellid and spider) and prey (aphid and leafhopper) population. Therefore, from ecological point of view understanding the relationship between pest and natural enemies and their incidence is necessary to take timely pest management measures.

*Keywords: Okra; sucking pests; natural enemies; weather factors.*

## 1. INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench (Family: Malvaceae) is an economically important vegetable crop grown in tropical and sub- tropical parts of the world. Due to tenderness and succulence nature of this crop it harbours many insect pests and diseases which require special attention to combat with at proper time and manner. Sucking pests viz., leafhopper, *Amrasca biguttula biguttula* (Ishida); whitefly, *Bemisia tabaci* (Genn.); Aphid, *Aphis gossypii* Glov. and mite, *Tetranychus cinnabarinus* (Boisd.) play a major role in causing significant yield loss in okra through sap sucking from the leaves and tender growing tips resulting in removal of sufficient amount of chlorophyll reducing vital function of plants (photosynthesis) [1]. Whitefly apart from causing direct damage through sap sucking, also acts as a vector of a viral disease, Bhendi Yellow Vein Mosaic (BYMV), as a result the plant completely debilitates with losses to the extent of 90 per cent in fruit yield. In the light of above facts this experiment was carried out to determine the impact of weather parameters on the magnitude of infestation by the sucking pests of okra and their associated natural enemies.

## 2. MATERIALS AND METHOD

The field experiment was carried out to observe the seasonal incidence and correlation of weather parameters with sucking pests of okra (variety Arka Anamika) at Central Research Station, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha during summer 2021. Observations on population of pests and natural enemies were recorded at weekly interval from randomly selected 5 plants leaving aside the border rows 15 days after sowing (DAS) till final harvesting. Lower side of selected leaves were carefully examined for the presence of nymphs and adults of leafhopper, whitefly and aphid. The sampling technique for sucking pests described by Singh and Kaushik [2] was followed where the samples were taken from three leaves, one each from the top, middle and bottom canopy, of five randomly selected plants infesting the crops. Similarly, the population of the two spotted spider mite, *Tetranychus urticae* Koch was recorded on three leaves each from the top, middle and bottom canopy of each plant by using 1 $cm^2$ windows made on the card board and at three places on each leaf and was expressed as number of mites per $cm^2$ [3].

## 3. RESULTS AND DISCUSSION

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

The studies on incidence of leafhopper, *Amrasca biguttula biguttula* affirmed that it is one of the major sucking pest of okra and prevailing throughout the cropping season (Table 1). Mohanasundaram and Sharma [4] and Anitha and Nandihalli [5] also observed the infestation of okra leafhopper throughout the cropping season in their localities.

During the season incidence of leafhopper commenced from first week of April, which rapidly increased and attained its peak at $22^{nd}$ SMW (fourth week of May) with a mean population density of 14.30 leafhoppers per leaf which could be due to higher afternoon relative humidity (63.00%). However, this pest remained highly active from $20^{th}$ SMW (11.42/ leaf) to $24^{th}$ SMW with a population of 10.62 per leaf. Patel et al. [6] also observed the activity of *A. biguttula biguttula* from March to May with a peak in the fourth week of April with a population of 19 leafhoppers per three leaves. Similarly Jat and Singh [7] reported the infestation of leafhopper from second week of March that attained a peak population in the first week of May. The slight differences in the incidence might be attributed due to the difference in sowing date of the crop and climatic factors of the region.

**Table 1. Incidence of sucking pests and natural enemies in okra along with the abiotic factors during summer, 2021**

| Month | SMW | Temperature (°C) | | RH (%) | | Rainfall | BSH (hours) | Wind velocity | leafhopper/ leaf | whitefly/ leaf | aphid/ leaf | Two spotted spider mite/cm$^2$ leaf | coccinellid/ plant | spider/ plant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | Min | Morning | Afternoon | | | | | | | | | |
| March | 12 | 38.50 | 23.50 | 92.00 | 30.00 | 0.00 | 3.70 | 3.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 13 | 39.70 | 24.60 | 93.00 | 55.00 | 75.00 | 6.30 | 5.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| April | 14 | 37.60 | 25.50 | 92.00 | 46.00 | 3.50 | 6.80 | 6.90 | 0.41 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 15 | 37.00 | 24.80 | 89.00 | 50.00 | 3.70 | 4.60 | 6.60 | 0.83 | 0.69 | 0.73 | 0.00 | 0.08 | 0.00 |
| | 16 | 38.80 | 26.00 | 90.00 | 42.00 | 0.00 | 8.00 | 8.20 | 3.52 | 3.94 | 4.13 | 0.00 | 0.16 | 0.00 |
| | 17 | 39.90 | 26.60 | 89.00 | 37.00 | 0.00 | 7.30 | 7.10 | 5.90 | 4.94 | 5.85 | 0.00 | 0.28 | 0.32 |
| | 18 | 37.30 | 25.00 | 87.00 | 47.00 | 5.60 | 7.60 | 7.50 | 8.14 | 5.65 | 8.61 | 3.52 | 0.48 | 0.24 |
| May | 19 | 37.40 | 25.50 | 85.00 | 60.00 | 58.20 | 8.10 | 6.70 | 8.81 | 8.46 | 11.14 | 5.05 | 0.80 | 0.36 |
| | 20 | 37.10 | 27.30 | 91.00 | 51.00 | 31.20 | 8.90 | 7.90 | 11.42 | 7.85 | 14.05 | 11.57 | 0.84 | 0.40 |
| | 21 | 34.90 | 25.60 | 89.00 | 67.00 | 105.30 | 4.40 | 9.40 | 11.32 | 5.55 | 14.60 | 16.28 | 1.04 | 0.56 |
| | 22 | 33.50 | 27.60 | 92.00 | 63.00 | 28.50 | 5.60 | 6.20 | 14.30 | 6.33 | 10.66 | 13.81 | 1.08 | 0.60 |
| June | 23 | 36.60 | 26.70 | 92.00 | 60.00 | 21.80 | 7.70 | 5.40 | 11.48 | 4.28 | 10.09 | 12.59 | 0.96 | 0.48 |
| | 24 | 32.20 | 25.40 | 94.00 | 72.00 | 113.80 | 0.50 | 3.60 | 10.62 | 3.28 | 5.52 | 12.49 | 0.60 | 0.60 |
| | 25 | 32.20 | 26.20 | 94.00 | 78.00 | 165.80 | 1.80 | 3.20 | 9.76 | 2.28 | 5.65 | 12.26 | 0.52 | 0.48 |

**Table 2. Correlation analysis between weather parameters and sucking pest population in okra during summer, 2021**

| | Summer, 2021 | | | | | | |
|---|---|---|---|---|---|---|---|
| **Insect** | **T (max)** | **T (min)** | **RH (M)** | **RH (E)** | **RF** | **BSH** | **Wind speed** |
| Leafhopper | -0.568 | 0.577* | 0.201 | 0.618* | 0.473 | -0.151 | -0.194 |
| Whitefly | 0.107 | 0.435 | -0.478 | 0.026 | -0.008 | 0.460 | 0.345 |
| Aphid | -0.083 | 0.434 | -0.159 | 0.220 | 0.143 | 0.342 | 0.396 |
| Two spotted spider mite | -0.580 | 0.485 | 0.679 | 0.571 | 0.412 | -0.456 | -0.058 |

**Significant at 5% level*

**Table 3. Correlation analysis between weather parameters, natural enemies and their prey population in okra during summer, 2021**

| | Summer, 2021 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Natural enemy** | **T (max)** | **T (min)** | **RH (M)** | **RH (E)** | **RF** | **BSH** | **Wind speed** | **Aphid** | **Leafhopper** |
| Coccinellid | -0.422 | 0.493 | 0.135 | 0.528 | 0.303 | 0.045 | 0.039 | 0.876** | 0.922** |
| Spider | -0.788* | 0.268 | 0.677* | 0.746* | 0.535 | -0.654 | -0.328 | 0.092 | 0.767* |

**Significant at 5% level*
***Significant at 1% level*

**N:B** T (max): Maximum temperature (° C) , T (min): Minimum temperature (° C)
RH (M): Morning Relative humidity (%), RH (E): Evening Relative humidity (%)
RF: Rainfall (mm), BSH: Bright sunshine hours

The correlation studies showed that population of *A. biguttula biguttula* was not affected by maximum temperature (Table 2). The maximum temperature showed a non significant negative effect on *A. biguttula biguttula* population build up where as the minimum temperature (r= 0.577) exhibited positive significant effect. These findings are in agreement with the observations of Preetha and Nadarajan [8] and Singh et al. [9] who recorded a non significant negative effect of maximum temperature and mean temperature on *A. biguttula biguttula* population. Patel et al. [6] observed a significant positive correlation between leafhopper population and minimum temperature in summer season in okra crop. The leafhopper population was significantly and positively correlated with afternoon relative humidity (r= 0.618). This observation is in partial akin with Burade et al. [10] who reported the correlation between leafhopper population and afternoon relative humidity is positive but not significant. Rainfall had positive but non-significant effect on leafhopper population. The present findings differ with that of Mohanasundaram and Sharma [4] and Selvaraj et al. [11] who reported that maximum temperature had positive impact where as rainfall and relative humidity had negative effect on leafhopper population. The observed differences may be attributed to different ecological conditions of the study area. The *A. biguttula biguttula* population was negatively and non significantly correlated with bright sunshine hours.

## 3.2 Whitefly

The incidence of whitefly commenced from first week of April (14$^{th}$ SMW) after 15 DAS which rapidly increased and attained the highest population in 19$^{th}$ SMW (first week of May) with a mean population density of 8.46 whitefly per leaf (Table 1). However the population of whitefly remained fully active on the month of May, thereafter it declined. This data is in accordance with the findings of Patel et al. [6], who reported that the whitefly population in okra started from 11$^{th}$ SMW and it gradually increased attending a peak population of 17 whiteflies per three leaves on 17$^{th}$ SMW. However the present finding differ from the reports of Sapkal et al. [12] who reported that whitefly population reached the highest population very quickly i.e., only three weeks after the first incidence this might be due to favourable weather conditions prevailing in that particular locality at the early stages of crop growth.

The present findings revealed that the maximum temperature had positive effect on *B tabaci* population (Table 2). Minimum temperature had positive but non-significant effect on population build up of whitefly. Our result is in partial confirmation with the findings of Burade et al. [10] who cited that whitefly had significant positive correlation with both maximum and minimum temperature. Morning relative humidity had negative correlation with *B tabaci*. Afternoon relative humidity had positive correlation with *B tabaci* population. Rainfall had negative non significant effect on whitefly population. The present findings differ with those of Singh et al. [9], who reported negative correlation with maximum and minimum temperature, morning and afternoon relative humidity while the correlation was positive with rainfall. The bright sunshine hours and wind speed exhibited positive effect on whitefly. However, all the weather parameters had non-significant effect on *B. tabaci* population in the present findings.

## 3.3 Aphid

The population of aphid commenced from second week of April (15$^{th}$ SMW) and reached maximum populations of 14.05 and 14.60 aphids per leaf during 20$^{th}$ and 21$^{st}$ SMW (Table 1). Our observations are in partial akin with the findings of Patel et al. [6] who reported that the incidence of aphids started from first week of March i.e., at 10$^{th}$ SMW and continued up to the crop termination in the last week of May reaching the peak activity in third week of April i.e., 17$^{th}$ SMW with a population of 16.20 per three leaves. The slight difference might be due to change in sowing date and the ecological conditions of the locality.

The maximum temperature had negative but non-significant correlation with aphid population (Table 2). The present findings suggested that there was no significant relation between aphid population and relative humidity.

## 3.4 Two Spotted Spider Mite

The mite population in the okra crop observed from 18$^{th}$ SMW (fifth week of April) with population density of 3.52 per cm$^2$ leaf (Table 1). Thereafter the mite population increased at an accelerated pace in the succeeding weeks to reach peak of 16.28 per cm$^2$ leaf at 21$^{st}$ SMW. This result is in confirmation with the findings of Sugeetha [13], who reported that mite appeared on summer okra crop much earlier i.e., in mid

April on 50 days old crop and reached the peak during end of April to end of May. Similar trend in population fluctuation of mite was reported by Gulati [14], who stated that the incidence of mite started from April and reached the peak in the month of May.

Maximum and minimum temperature exerted a negative and positive effect, respectively on the population of two spotted spider mite (Table 2). Our observation is in conflict with the results of Gulati [14] and Mohanasundaram and Sharma [4] who reported negative effect of minimum temperature on population build up of two spotted spider mite. This is due to change in weather conditions of the locality. Morning relative humidity had positive effect on the population of *T. urticae*. Similar effect of afternoon relative humidity was observed by Gulati [14]. However all the weather parameters had non-significant effect on the mite population throughout the experimental period.

### 3.5 Coccinellids

In the recent studies four species of coccinellids namely *Coccinella transversalis, Cheilomenes sexmaculata, Micraspis discolor* and *Brumoides suturalis* were found associated with sucking pests of okra. Similar result with respect to coccinellid fauna on okra crop were reported by Singh et al. [9] from Madhya Pradesh and Potai and Chandrakar [15] from Raipur, Chhattisgarh. The highest activity of coccinellids (1.08/ plant) synchronized with the peak activity of leafhopper at 22$^{nd}$ SMW (fourth week of May) (Table 1).

The correlation studies indicated that coccinellids were adversely affected by maximum temperature (Table 3). The present findings are in conformity with findings of Meena and Kanwat [16] as they also observed non significant positive correlation of maximum temperature with coccinellids. Both morning and afternoon relative humidity had positive effect in summer season. These predators have significant positive correlation with the population build up of their prey i.e., aphid and leafhopper. These findings are in line with the results of Khating et al. [17] and Lal et al. [18], who stated positive significant correlation between sucking pests and predatory ladybird beetle. This is due to the prey- predator relationship.

### 3.6 Spiders

Spiders are important group of arthropod natural enemies associated with insect pests in okra ecosystem [9]. The highest activity of spider noticed on fourth week of May (22$^{nd}$ SMW) which coincided with the highest activity of leafhopper (Table 1).

The maximum temperature had significant negative influence on the population build up of predatory spiders (r= -0.788) (Table 3). However, both morning (r= 0.677) and afternoon (r= 0.746) relative humidity had significant positive effect as it was already reported by Sahito et al. [19]. Rest of the weather parameters had no significant effect on the population of these predators. The spiders have significant positive correlation (r= 0.767) with leafhopper population.

## 4. CONCLUSION

Leafhopper, whitefly, aphid and two spotted spider mites are some of the major pests associated with okra throughout the cropping season. However, their population fluctuated with respect to the prevailing weather conditions. The maximum population of leafhopper and whitefly was recorded at 22$^{nd}$ and 19$^{th}$ SMW, respectively where as the peak activity of aphid and two spotted spider mites were recorded at 21$^{st}$ SMW. Four species of coccinellids i.e., *Coccinella transversalis, Cheilomenes sexmaculata, Micraspis discolor* and *Brumoides suturalis* and spiders were found associated with aphids and leafhoppers of okra and their highest activity was observed at 22$^{nd}$ SMW. The correlation studies revealed a significant positive correlation between minimum temperature and afternoon relative humidity with leafhopper population. Furthermore, there was significant negative correlation between spider population and maximum temperature where as both morning and afternoon relative humidity had positive effect. Aphids showed significant positive association with coccinellid population where as leafhopper had similar association with both coccinellid and spider population. Hence it can be concluded that the population of sucking pests is greatly influenced by weather parameters and also a strong positive association was observed between the pests and their natural enemies.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Meena NK, Kanwat PM. Broad reconnaissance of insect pests of okra in semi-arid region of Rajasthan. National Conference on applied Entomology, Sept. 26-28: held at Rajasthan College of Agriculture, Udaipur. 2005;261-262.
2. Singh G, Kaushik S. Comparative efficiency of sampling techniques for jassid population estimation on okra, Indian. J. Ecol. 1990;17:58-60.
3. Nain J, Singh R, Rathee M, Gulati R. Population dynamics of two spotted spider mite, *Tetranychus urticae* Koch (Acarina: Tetranychidae) on okra. Indian J. Entomol. 2017;79(1):21-26.
4. Mohanasundaram A, Sharma RK. Abundance of pest complex of Okra in relation to abiotic and biotic factors. Ann. Pl. Protec. Sci. 2011;19 (2):286-290.
5. Anitha KR, Nandihalli BS. Seasonal incidence of sucking pests in Okra ecosystem. Karnataka J. Agric. Sci. 2008; 21(1):137-138.
6. Patel A, Sing H, Singh G, Singh DV, Singh R. Seasonal incidence of sucking insect pest and correlation with weather parameters in the condition of western UP. J. Pharm. Innov. 2022;11(6):2320-2324.
7. Jat SL, Singh S. Seasonal abundance of major sucking insect pests of okra and their natural enemies in relation to abiotic factors. Int. J. Chem. Stud. 2019;7(3): 2173-2178.
8. Preetha G, Nadarajan L. Validation of IPM modules against sucking pests of okra in Karaikal. Indian J. Entomol. 2007;69:2010-214.
9. Singh Y, Jha A, Verma S, Mishra VK, Singh SS. Population dynamics of sucking insect pest and its natural enemies on okra agro ecosystem in Chitrakoot region. Afr. J. Agric. Res. 2013;8(28):3814-3819.
10. Burade DD, Khobragade AM, Shinde PB. Influence of weather parameters on pest of okra in Parbhani kranti variety. Int. J. Curr. Microbiol. 2019;8(1):806-812.
11. Selvaraj S, Adiroubane D, Ramesh V. Population dynamics of important insect pests of bhindi in relation to weather parameters. Pestology. 2010;34:35-39.
12. Sapkal SD, Mehendale SK, Shinde BD, Sanap PB, Chavan SS. Seasonal incidence of major sucking pests on okra. J. Pharm. Innov. 2022;11(3):68-72.
13. Sugeetha. Studies on spider mite *T lanei* and Pritchard (Acari: Tetranychidae) infesting okra (*Abelmoschus esculentus*). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore (India); 1998.
14. Gulati R. Incidence of *Tetranychus cinnabarinus* (Boisd.) infestation in different varities of *Abelmoschus esculentus* L. Ann. Plant Prot. Sci. 2004; 12(1):45-47.
15. Potai A, Chandrakar G. Studies on seasonal incidence of major insect pests and its natural enemies on okra and their correlation with weather parameters. Int. J. Curr. Microbiol. 2018;6:204-210.
16. Meena NK, Kanwat PM. Studies on the seasonal incidence and relative safety of pesticides against coccinellid beetles in okra ecosystem. J. Biol Cont. 2010;24:58-60.
17. Khating SS, Kabre GB, Dhainje AA. Seasonal incidence of sucking pests of okra along with natural enemies in Khandesh region of Maharashtra. Asian J. Biol. Sci. 2016;11(2):269-272.
18. Lal B, Singh UC, Bhaduaria NS, Tomar SPS, Singh P. Seasonal incidence of major insect pests of okra, *Abelmoschus esculentus* (L.) and their natural enemies. J. Entomol. Zool. Stud. 2020;8(3):736-740.
19. Sahito HA, Talpur MA, Soomro MA, Mastoi AH, Dhiloo KH. Feeding efficacy of spiders on sucking pest complex of okra, *Abelmoschus esculentus* L. Int J Agric Sustain. 2013;2(2):114-116.




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