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Seasonal incidence of insect pests in okra, *Abelmoschus esculentus* vis-à-vis weather parameters

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Abstract
Investigation on the incidence of different insect pests of okra and its relationship with weather parameters was carried out during February- April 2021 at Crop cafeteria, Department of Agricultural Sciences, Sharda University, Greater Noida. Observations for four insect pests infesting okra i.e., Mealybugs, Leaf miners, Jassids and whiteflies were recorded at weekly intervals. The results showed that the mealybug population started building up from the first week of April and peaked in the fourth week of April, while the leaf miner population was observed in the second week of March. The whitefly pest incidence commenced in the second week of March and peaked in the third week of April.

Keywords: Okra, pest complex, weather parameters, temperature

Introduction

Among the various vegetables grown, Okra *Abelmoschus esculentus* L. (Moench) belongs to the family Malvaceae. It is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. Okra crop is cultivated for its young tender fruits, used to make curry and soups. Fruits are also dried or frozen for use during the off-season. The root and stem are used to clear cane juice in preparation for jaggery/gur. Seeds are a source of oil, protein and are also used as a coffee substitute, while ground up okra seeds have been used as a substitute for aluminium salts in water purification. This crop is suitable for cultivation as a kitchen garden crop as well as on large high-tech commercial farms. It is grown commercially in India. There are several constraints in the cultivation of okra. However, the major constraint is the attack by insect pests. As high as 72 species of insects have been recorded on okra (Srinivas Rao and Rajendran, 2003), of which, the sucking pests comprising of leafhopper, *Amrasca biguttula* (Jassid), whitefly, leafhopper, a polyphagous, the pest has been a serious pest on okra causing heavy loss during these years. The high leafhopper population significantly sucks cell sap, usually from the ventral surface of the leaves and injects toxic saliva into plant tissues, turning the leaves to brown and curl. The sucking pest complex consisting of aphids, leaf hoppers, whiteflies, thrips and mites are major pests and cause 17.46 percent yield loss in okra (Sarkar *et al*., 1996) [5] Jassid (*A. biguttula*) is an important sucking pest of okra that feeds mostly on the lower surface of okra leaves, leading to hopper burn (Bindra and Mahal, 1979) causing considerable yield losses upto 40 to 56 percent (Rawat and Sahu, 1973) [3]. Whitefly, *B. tabaci* has become a serious pest on vegetables, field crops and ornamental plants and fruits worldwide and attacks 176 plant species (Ren *et al*., 2001) [2] with considerable damage (Oliviera *et al*., 2001) [4]. The pest is also known to transmit a serious disease, namely yellow vein mosaic, affecting the quality of the produce. To avoid yield losses caused by the sucking pest complex and encourage the cultivation of okra crop in large area, and to increase the production and productivity of okra in Gujarat as well as in India, all efforts are needed to tackle these major sucking pests by knowing their peak period of infestation through studies on seasonal abundance as well as according to the mode of action of insecticides, bio-pesticides and botanicals. Seasonal abundance of the insect pest provides not only the information on initiation of the pest but also provides the peak activity of the particular pest. Biotic and abiotic parameters play a vital role in population build-up of insect pest. Correlation study helps in to provide either positive or negative association of pest population with biotic or abiotic factors.

It gives direct influence of particular parameter on pest population build-up as well as its indirect effect through other parameters. In the present study the efforts have been made to study the seasonal incidence, its correlation with biotic and abiotic parameters on population build-up of major insect pest of okra. To minimize the losses caused by insect pests in okra crop, the weather conditions prevailing in a region play an important role in occurrence and subsequent build-up of pest population. The role of biotic and abiotic factors for reducing the pest population is one of the methods of Integrated Pest Management.

Materials and Methods

The field experiment was conducted during the February to April, 2021 at Crop cafeteria of Sharda University Greater Noida, Uttar Pradesh. Okra was grown in the field in the Month of February. During the study and crop growth period, all the agronomic practices were carried to raise the crop, except plant protection measures which enabled the buildup of pests and diseases and their natural enemies in a pesticide free environment. Plants were randomly selected from the experimental field, tagged and observations were recorded weekly. All sort of intercultural operations like weeding, harvesting and thinning were done manually. Fruits from the crops were harvested early in the morning by hand plucking at regular intervals.

Results and Discussion

Cotton mealybug, *P. solenopsis*

During the study from February to April, the pest incidence started in first week of April with a bug population of 8.33 bugs/plant as shown in table 1. The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 34℃, 18 ℃ and 20% respectively and it reached to its peak in fourth week of April with a bug population of 9.86 bugs/plant. The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 42 ℃, 23 ℃ and 24% respectively. Beyond that the population exhibited a declining trend.

The pest population showed a positive correlation with maximum temperature for the cropping season (r = 0.668) and is evident from the above table. Minimum temperature also showed significant positive correlation (r = 0.820) whereas relative humidity showed a significant negative correlation (r = -0.712).

Leaf Miner, *Chromatomyia horticola*

During the weekly observation from February to April, the leaf miner was observed in the second week of March at 35 ℃ max temp, 17 ℃ min temp and relative humidity of 42%. The population of leaf miner was 0.85 miners per leaf. After weekly observation, the population was gradually increased and reached peak with a population of 2.02 miners per leaf during last week of March at 30 ℃ max temp, 18 ℃ min temp and relative humidity of 38%. After that the population of leaf miner started gradually decreasing during the successive weeks and found lowest population on 4^{th} week of April at 0.46 miner per leaf and at 42 ℃ max temp, 23 ℃ min temp and relative humidity of 24%. Later on, leaf miner population kept on decreasing and lastly vanished with causing less damage to plants.

The pest population showed a positive correlation with maximum temperature for the cropping season (r = 0.429) and is evident from the above table. Minimum temperature also showed significant positive correlation (r = 0.671) whereas relative humidity showed a significant negative correlation (r = -0.767).

Jassid, *Amrasca biguttula biguttula* (Ishida)

During the study from February to April, the pest incidence started in last week of March with a pest population of 2.22 pest/plant as shown in table. The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 30 ℃, 18 ℃ and 38% respectively and it reached to its peak in third week of April with a bug population of 5.6 pest/plant. After that the population of jassid started gradually decreasing during the successive weeks and found lowest population on 4^{th} week of April at 2.22 bugs per plant.The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 41 ℃, 22 ℃ and 24% respectively. Beyond that the population exhibited a declining trend.

The pest population showed a positive correlation with maximum temperature for the cropping season (r = 0.569) and is evident from the above table. Minimum temperature also showed significant positive correlation (r = 0.812) whereas relative humidity showed a significant negative correlation (r = -0.641)

Whitefly, *Bemisia tabaci* (Gennadius)

During the study from February to April, the pest incidence started in second week of March with a fly population of 0.1 fly/plant as shown in table. The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 35 ℃, 17 ℃ and 42% respectively and it reached to its peak in third week of April with a fly population of 3.3 fly/plant. The corresponding means of maximum temperature, minimum temperature and humidity at the population of the pest were 35 ℃, 19 ℃ and 19% respectively. Beyond that the population exhibited a declining trend.

The pest population showed a positive correlation with maximum temperature for the cropping season (r = 0.632) and is evident from the above table. Minimum temperature also showed significant positive correlation (r = 0.875) whereas relative humidity showed a significant negative correlation (r = - 0.720).

From the above study, it is safely concluded that studies related to population dynamics of different pests such as Jassids, mealy bug, leaf miner and white fly etc. at different temperature and humidity shows different levels of pest buildup in Okra. Studies pertaining to the pest succession in okra gave the best chance of spotting a new pest soon after its arrival, to count the pest number and their status in the crop and to choose when to take control measures. The study clearly revealed that changes in weather not only affects the status of the insect pests but also affects their population distribution, dynamics and abundance. From the present study, we can conclude that the maximum population of sucking insect-pests in the study was recorded. In the end of March, maximum pest infestation on Okra was observed.

Table 1: Population of cotton mealybug, *P. solenopsis* in okra during cropping season of 2021 under different weather factors

Date	Max. temp (℃)	Min. temp (℃)	Humidity (%)	Number of bugs/plant
4-Feb	23	12	69	0.00
11-Feb	26	10	52	0.00
18-Feb	28	10	52	0.00
25-Feb	33	13	50	0.00
4-March	34	12	38	0.00
11-March	35	17	42	0.00
18-March	35	16	32	0.00
25-March	30	18	38	0.00
1-April	34	18	20	8.00
8-April	35	19	19	8.33
15-April	41	22	24	8.83
22-April	34	21	42	8.18
29-April	42	23	24	9.86

Table 2: Population of Leaf Miner, *Chromatomyia horticola* in okra during cropping season of 2021 under different weather factors.

Date	Max. temp (℃)	Min. temp (℃)	Humidity (%)	Number of miners/plant
4-Feb	23	12	69	0.00
11-Feb	26	10	52	0.00
18-Feb	28	10	52	0.00
25-Feb	33	13	50	0.00
4-March	34	12	38	0.00
11-March	35	17	42	0.85
18-March	35	16	32	1.2
25-March	30	18	38	1.58
1-April	34	18	20	2.02
8-April	35	19	19	1.85
15-April	41	22	24	1.5
22-April	34	21	42	0.89
29-April	42	23	24	0.46

Table 3: Population of Jassids *Amrasca biguttula biguttula* in okra during cropping season of 2021 under different weather factors

Date	Max. temp (℃)	Min. temp (℃)	Humidity (%)	Number of bugs/plant
4-Feb	23	12	69	0.00
11-Feb	26	10	52	0.00
18-Feb	28	10	52	0.00
25-Feb	33	13	50	0.00
4-March	34	12	38	0.00
11-March	35	17	42	0.00
18-March	35	16	32	0.00
25-March	30	18	38	2.22
1-April	34	18	20	2.44
8-April	35	19	19	3.6
15-April	41	22	24	5.6
22-April	34	21	42	3.8
29-April	42	23	24	2.22

Table 4: Population of cotton mealybug, *Bemisia tabaci* in okra during cropping season of 2021 under different weather factors

Date	Max. temp (℃)	Min. temp (℃)	Humidity (%)	Number of bugs/plant
4-Feb	23	12	69	0.00
11-Feb	26	10	52	0.00
18-Feb	28	10	52	0.00
25-Feb	33	13	50	0.00
4-March	34	12	38	0.00
11-March	35	17	42	0.1
18-March	35	16	32	0.3
25-March	30	18	38	1.9
1-April	34	18	20	1.5
8-April	35	19	19	2.7
15-April	41	22	24	3.3
22-April	34	21	42	2.1
29-April	42	23	24	2.3

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