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Population Dynamics of Whitefly and Disease Incidence of Yellow Vein Mosaic Virus Disease in Okra

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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.) belong to the Malvaceae family and an important vegetable crop widely cultivated in the Indian subcontinent. However, several factors influence okra crop as biotic and abiotic. Among the diseases affecting its cultivation, okra yellow vein mosaic disease (OYVM)

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belong to the family *Geminiviridae* and genus *Begomovirus* and transmitted by whitefly (*Bemisia tabaci*, Order: *Hemiptera*, Family: *Aleyrodidae*, is the one of the most destructive disease. Randomly selected five plants of each plot were observed for the population of whitefly at weekly interval starting with 20 days after sowing. First appearance of whitefly was recorded at 30th standard weekand rapid progress of whitefly population was recorded from 31th standard week to 37th and 38th standard week during both the years. The whitefly population with the minimum temperature and relative humidity showed non-significant positive correlation, whereas, maximum temperature and rainfall was non-significantly negative correlated during both the years. The whitefly population was non-significantly positive correlated with percent disease incidence of YVMV.

Keywords: Okra; whitefly; population dynamics; YVMV; yellow vein mosaic; weather parameter; correlation.

1. INTRODUCTION

"Okra (*Abelmoschus esculentus* L.) commonly known as ladyfinger is an important vegetable crop. Several species of genus *Abelmoschus* are grown in many parts of the world. However, in India*Abelmoschus esculentus* is most common and has great commercial demand due to its nutritional value. It is good source of vitamin A, B, C and also rich in protein, carbohydrates, fats, minerals, iron and iodine" [1,2]. Okra is cultivated for its immature pods to be consumed as fresh and canned food as well as for seed purpose. Its pods contain mucilaginous substances that thicken soups and stews.

"A number of viruses, fungi, bacteria, phytoplasma, nematodes and insect pests attack this crop" [3]. "Okra Yellow Vein Mosaic Virus (OYVMV) transmitted by white fly (*Bemisia tabaci* Gen.) is the most serious disease of okra" [4,5]. "The disease is characterized by a homogenous interwoven network of yellow vein enclosing islands of green tissues within its leaf. In extreme cases, infected leaves become yellowish or creamy color. If plants are infected within 20 days after germination, their growth is retarded; few leaves and fruits are formed and loss may be about 94%. The extent of damage declines with delay in infection of the plants. Plants infected 50 and 65 days after germination suffer a loss of 84 and 49%, respectively" [4].

"The vector of okra yellow vein mosaic virus (OYVMV) is whitefly (*Bemisia tabaci* Genn.) (Aleyrodidae: Homoptera). They breed throughout the year and the female lays stalked yellow spindle shaped eggs singly on the lower surface of the leaf. Nymphs and adults suck the sap usually from the under surface of the leaves and excrete honeydew. Leaves appear sickly and get coated with sooty mold.Several attempts have been made to manage whitefly" [6]. The objective of the present investigation is to bring together a comprehensive update of the research on studies on the population dynamics of whitefly and disease incidence of yellow vein mosaic virus disease in okra.

2. MATERIALS AND METHODS

The population was taken in terms of number of whitefly per plant by using rectangular cage 45 cm long, 30 cm wide and 90 cm high, according to the stage of crop. The rectangular cage was formed by ply wood and fibre glass. The ply wood plate was cut according to required size and made it in rectangular form by folding them. Its inner side was painted black to induce darkness in side. Front side of the cage was covered with a transparent fibre glass screen, while bottom remained open. To record the whitefly population, cage was placed on plant. The flies congregated on inner surface of fibre glass screen due to its phototactic behaviour, which enable to count them very easily.

Randomly selected five plants (variety: Pusa Sawani) of each plot were observed for the population of whitefly at weekly interval starting with 20 days after sowing. The observations were recorded between 5-7 AM on the defined day. Meteorological data on temperature, relative humidity and rainfall were obtained weekly from the meteorological observatory of this University. The incidence of yellow vein mosaic of okra was also recorded by using the following formula:

$$\text{Disease incidence } (\%) = \frac{\text{Number of infected plants per plots}}{\text{Number of plants (diseased + healthy) per plots}} \text{ x } 100$$

3. RESULTS AND DISCUSSION

The data recorded on the population of whitefly (*B. tabaci* Genn.) during both the years are presented in Tables 1 & 2. It is evident from the data that the whitefly activity started with 23 and 25 DAS and continued till final harvesting during first and second year, respectively. The whitefly population was recorded for the first time at 30th standard week at a minimum temperature of 26.2^0 and 26.4^0 C, maximum temperature 30.5^0 and 33.5^0 C, relative humidity 71.30 and 75.10 per cent and rainfall 2.0 and 5.0 mm in first and second year, respectively. The Population at above period of observation was 3.26 and 2.38 per plant during 2012 and 2013, respectively. Its population increased upto 37th and 38th standard week with minimum temperature 25.9^0 and 25.9^0 C, maximum temperature 32.5^0 and 32.1^0 C, relative humidity 80.30 and 73.70 percent and rainfall 48.0 and 8.4 mm, the whitefly population more than about seven time as compared to 30th standard week (21.95 and 21.37/plant) in first and second year, respectively. The population of whitefly showed increasing trend in 31th standard week and the increasing trend was continued till 37th and 38th standard week.

Thereafter, decline trend in number of population was recorded from 38th and 39th standard week (15.66 and 5.95 per plant) with minimum temperature 25.5^0 and 24.3^0 C, maximum temperature 30.7^0 and 33.1^0 C, relative humidity 72.40 and 74.30 per cent and rainfall 25.0 and 74.0 mm till to 40th standard week. Thereafter, the crop was ready to harvest.

3.1 Correlation Studies

To know the effect of various abiotic factors on the population of whitefly and per cent disease incidence of yellow vein mosaic of okra, simple correlation has been worked out between meteorological parameter, population of whitefly and PDI of YVMV (Tables 3 and 4).

The whitefly population with the minimum temperature and relative humidity showed non-significant positive correlation, whereas, maximum temperature and rainfall was non-significantly negative correlated during both the years.

The PDI of YVMV with the minimum temperature, rainfall and relative humidity showed non-significant negative correlation during both the years, whereas, maximum temperature and whitefly population was non-significantly positive correlated during first year, but in second year, the maximum temperature was non-significant negative correlated with PDI of YVMV.

3.2 Discussion

Similar results were also found by the various worker in India and also world. Singh [7] noted that “hot weather with little or no rainfall was conducive OYVM for disease development and also for multiplication of *Bemisia tabaci*. Cooler weather with high relative humidity and rainfall were detrimental to whitefly population and spread”.

Pankaj et al. [8] observed that “the minimum temperature, morning and evening relative humidity and rainfall showed positive correlation with *B. tabaci* population in okra while with maximum temperature showed negative correlation”. While, Siddique et al. [9] and Supriya et al. [10] were found that “the positive correlation of *B. tabaci* population on okra with maximum and minimum temperature and a negative correlation with relative humidity, rainfall and wind velocity”.

Pun et al. [11] revealed “a significant, positive correlation between whitefly population and maximum temperature, minimum temperature and sunshine hours, whereas morning relative humidity, wind velocity and total rainfall had negative influence on whitefly population. Disease incidence also had a significant and positive correlation with whitefly population, minimum temperature and sunshine hours while morning relative humidity, evening relative humidity and wind velocity had a high negative association”.

Nath et al. [12] revealed that “the incidence of disease caused by okra yellow vein mosaic virus was lowest in crops sown during 10 Feb. to 10 Mar., when population of the vector, *Bemisia tabaci,* were low. Significant positive associations were recorded between disease incidence and whitefly population, temperature, RH and rainfall. Fruit yield of okra was negatively correlated with disease incidence”.

Ali et al. [13] studied “correlation of environmental conditions (maximum and minimum air temperature, relative humidity, rainfall, clouds and wind velocity) with okra yellow vein mosaic virus (OYVMV)

Table 1. Effect of meteorological factors on whitefly population and percent disease incidence (PDI) of yellow vein mosaic disease of okra during first year

S. No.	Standard weeks	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)	Whitefly population (No.)	PDI (%)
			Min.	Max.			
1.	27	121.00	26.3	31.50	89.20	-	0.00
2.	28	82.00	27.3	31.30	82.30	-	0.00
3.	29	82.00	25.7	32.30	79.40	-	0.00
4.	30	2.00	26.2	30.50	71.30	3.26	0.00
5.	31	163.00	25.6	32.80	84.60	4.65	6.20
6.	32	14.00	26.00	31.70	75.70	8.49	8.15
7.	33	42.00	26.4	32.80	71.10	8.35	12.39
8.	34	15.00	26.2	32.00	69.00	11.56	16.20
9.	35	24.00	27.2	31.60	73.50	12.27	26.65
10.	36	12.00	25.50	32.00	77.00	18.33	37.64
11.	37	48.00	25.9	32.50	80.30	21.95	52.37
12.	38	25.00	25.50	30.70	72.40	15.66	61.67
13.	39	0.00	23.80	32.30	70.70	3.13	71.49
14.	40	0.00	21.8	33.00	71.20	1.63	85.47

Table 2. Effect of meteorological factors on whitefly population and percent disease incidence (PDI) of yellow vein mosaic disease of okra during second year

S. No.	Standard weeks	Rainfall (mm)	Temperature (^{0}C)		Relative humidity (%)	Whitefly population (No.)	PDI (%)
			Min.	Max.			
1.	27	25.6	25.7	32.5	78.6	-	0.00
2.	28	32.0	26.5	32.3	80.6	-	0.00
3.	29	38.8	27.0	34.1	75.7	-	0.00
4.	30	5.0	26.4	33.5	75.1	2.38	0.00
5.	31	77.8	24.7	34.2	74.9	3.83	4.20
6.	32	47.6	25.4	32.9	75.2	7.83	8.15
7.	33	41.6	25.9	34.2	73.9	9.81	15.39
8.	34	20.1	26.4	34.0	75.0	15.85	26.20
9.	35	24.0	26.0	31.7	81.0	18.95	34.65
10.	36	0.0	25.7	33.0	69.9	19.17	43.89
11.	37	42.0	24.8	32.8	74.5	20.17	56.84
12.	38	8.4	25.9	32.1	73.7	21.37	68.35
13.	39	74.0	24.3	33.1	74.3	5.95	76.67
14.	40	3.6	23.5	29.8	73.0	4.45	84.49

Table 3. Correlation coefficient between meteorological factors, whitefly population and percent disease incidence (PDI) of yellow vein mosaic disease of okra during first year

	Rainfall (mm)	Minimum temperature (^{0}C)	Maximum temperature (^{0}C)	Relative humidity (%)	Whitefly Population (No.)	PDI (%)
Rainfall (mm)	1					
Minimum temperature (^{0}C)	0.212825	1				
Maximum temperature (^{0}C)	0.369957	-0.41937	1			
Relative humidity (%)	0.792325	0.166712	0.290068	1		
Whitefly population (No.)	-0.01944	0.455302	-0.14059	0.290331	1	
PDI (%)	-0.35424	-0.76566	0.240185	-0.1996	0.064425	1

Table 4. Correlation coefficient between meteorological factors, whitefly population and percent disease incidence (PDI) of yellow vein mosaic disease of okra during second year

	Rainfall (mm)	Minimum temperature (^{0}C)	Maximum temperature (^{0}C)	Relative humidity (%)	Whitefly population (No.)	PDI (%)
Rainfall (mm)	1					
Minimum temperature (^{0}C)	-0.35508	1				
Maximum temperature (^{0}C)	0.457626	0.505852	1			
Relative humidity (%)	0.209126	0.237777	-0.06855	1		
Whitefly population (No.)	-0.34999	0.378301	-0.09316	0.045371	1	
PDI (%)	-0.174	-0.58821	-0.68537	-0.25459	0.288787	1

disease severity and *Bemisia tabaci* population was determined on okra. Minimum temperature and relative humidity had significant correlation with OYVMV disease severity and whitefly population. The disease incidence increased with the rise in minimum temperature and whitefly population decreased with increase in the relative humidity".

4. CONCLUSION

First appearance of whitefly was recorded at 30th standard week and rapid progress of whitefly population was recorded from 31th standard week to 37th and 38th standard week during the first and second year, respectively. Maximum whitefly population was recorded in 37th and 38th standard week during the first and second year, respectively. The whitefly population with the minimum temperature and relative humidity showed non significant positive correlation, whereas, maximum temperature and rainfall was non significantly negative correlated during both the years. The per cent disease (PDI) incidence of OYVM with the minimum temperature, rainfall and relative humidity showed non significant negative correlation during both the years. The maximum temperature and whitefly population had non significantly positive correlated during first year, whereas, in second year, the maximum temperature was found non significant negative correlated with PDI of YVMV.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Baloch AF, Qayyum SM, Baloch MA. Growth and yield performance of okra (Abelmoschus esculentus L) cultivars. Gomal University Journal of Research. 1990;10:191.
2. Gopalan C, Rama Sastri BV, Balasubramanian S. Nutritive Value of Indian Foods, published by National Institute of Nutrition (NIN), ICMR; 2007.
3. Prakasha TL, Patil MS, Benagi VI. Survey for bhendi yellow vein mosaic disease in parts of Karnataka. Karnataka Journal of Agricultural Sciences. 2010; 23:658-659.
4. Fajinmi AA, Fajinmi OB. Incidence of okra mosaic virus at different growth stages of okra plants (*Abelmoschus esculentus* (L.) Moench) under tropical condition. Journal of General and Molecular Virology. 2010;2:28-31.
5. Sastry KSM, Singh SJ. Effect of yellow vein mosaic virus infection on growth and yield of okra crop. Indian Phytopathology 1974;27:294-297.
6. Pun KB, Sabitha Doraiswamy. Effect of age of okra plants on susceptibility to Okra yellow vein mosaic virus. Indian Journal of Virology. 1999;15:57-58.
7. Singh SJ. Etiology and epidemiology of whitefly-transmitted virus diseases of okra in India. Plant Disease Research. 1990;5(1):64-70.
8. Pankaj K, Singh DV, Sachan SK. Succession of importance insect pests of okra (Abelmoschus esculantous) under western Uttar Pradesh climate conditions. International Journal of Engineering and Management Sciences. 2017;8(1):72-74.
9. Siddique F, Safder Ali, Muhammad E, Muhammad Atiq, Abdul Rashid. Epidemiological Characterization of Okra yellow veinmosaic virus and its vector. Advances in Environmental Biology. 2016; 10(4):194-203.
10. Supriya B, Parimal Panda, Manmatha Hansda, Kausik Mandal. Screening of okra genotypes and preliminary studies on incidence of insect pests on okra (*Abelmoschus esculentus* L.). Journal of Agriculture and Technology. 2016;3:56-58.
11. Pun KB, Sabitha Doraiswamy, Balasubramanian G. Prediction of whitefly population and Okra yellow vein mosaic virus disease incidence in okra. Indian Journal of Virology. 2005;16 (1/2):19-23.
12. Nath PD, Gupta MK, Bora P. Influence of sowing time on the incidence of yellow vein mosaic and whitefly population on okra. Indian Journal of Virology. 1992;8(1):45-48.
13. Ali S, Khan MA, Habib A, Rasheed S, Iftikhar Y. Correlation of environmental conditions with okra yellow vein mosaic virus and Bemisiatabaci population density. International Journal of Agriculture and Biology. 2005;7(1):142-144.

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