Spatio-temporal Pattern of Okra Yellow Vein Mosaic Virus and its Vector in Relation to Epidemiological Factors

Asad Chaudhary*, Khan MA and Kashif Riaz

Department of Plant Pathology, University of Agriculture, Faisalabad-38040, Pakistan

Abstract

Spatio-temporal pattern of Okra (Abelmoschus esculentus L. Moench) belongs to genus Abelmoschus and its family is Malvaceae. It is also known as lady finger. It is an important growing crop of Indo-Pak sub-continent. Okra is a very good source of vitamins A, B, C and is also rich in minerals, protein and isotope [1]. Okra fruit contains 80% water. The approximate nutrient value for 100 g of fresh edible fruit is 20 cal energy; 2 g protein; 0.1 g fat; 2.7 g carbohydrates; 660 g vitamin A; 0.2 mg thiamin; 0.06 mg riboflavin; 1 mg niacin; 44 mg vitamin C; 81 mg Ca; 0.8 mg Fe; 20 mg K and 10 mg Na. Average production of Okra in worldwide is 12,035 million tons. (FAO, 2011). Okra crop is attacked by various pathogens, which cause various diseases. These pathogens include Viruses, bacteria, fungi, mycoplasmas, nematode and insects. Some important diseases are Damping off, Fusarium wilt, Powdery mildew, Cercospora leaf spot, Damping off, Fusarium wilt, Powdery mildew, Cercospora leaf spot, Cucumber mosaic virus and Bhendi Yellow Vein Mosaic virus. The total loss of okra is estimated around 80-90% [3].

Keywords: Okra; Spatial pattern; Temporal pattern; Correlation; Whitefly population; Plant extracts

Introduction

Okra (Abelmoschus esculentus L. Moench) belongs to genus Abelmoschus and its family is Malvaceae. It is also known as lady finger. It is an important growing crop of Indo-Pak sub-continent. Okra is a very good source of vitamins A, B, C and is also rich in minerals, protein and isotope [1]. Okra fruit contains 80% water. The approximate nutrient value for 100 g of fresh edible fruit is 20 cal energy; 2 g protein; 0.1 g fat; 2.7 g carbohydrates; 660 g vitamin A; 0.2 mg thiamin; 0.06 mg riboflavin; 1 mg niacin; 44 mg vitamin C; 81 mg Ca; 0.8 mg Fe; 20 mg K and 10 mg Na. Average production of Okra in worldwide is 12,035 million tons. (FAO, 2011). Okra crop is attacked by various pathogens, which cause various diseases. These pathogens include Viruses, bacteria, fungi, mycoplasmas, nematode and insects. Some important diseases are Damping off, Fusarium wilt, Powdery mildew, Cercospora leaf spot, Leaf curl virus and Bhendi Yellow Vein Mosaic virus. The total loss of vegetable on this regard is about to 20-30%, which may increase up to 80-90% [3].

This viral disease infects during all the stages of growth. It is transmitted by white fly. The most susceptible stage of this disease is from 35 to 50 days. The initial symptoms on young leaf are a diffused, mottled appearance. Clearing of small veins starts near the leaf margin at various points, about 15 to 20 days after infection. Afterward vein clearing develops into a vein chlorosis. In infected leaves interveinal chlorosis occurs due to fibrous deficiency and all leaves turn yellow. The infected fruits are covered with yellow or creamy color, fibrous, small and tough [4]. Spatial and temporal pattern of B. tabaci is needed to study to find out the relative abundance of B. tabaci in the crop, their landing rate as well as the ability of their virus transmission. Spatial and temporal study of this viral disease are used to describes the dynamics of virus spread along with the respect of primary inoculum and all the mechanism involved in spread of vector. Keeping in view the importance of environmental conditions on disease spread the present study was planned to correlate environmental conditions for okra yellow vein mosaic virus and its vector.

The objectives of this study is to study the spatial and temporal pattern of B. tabaci and Okra yellow vein mosaic virus disease incidence in relation to epidemiological factors.

Materials and Methods

The experiment was conducted in the research area of department of Plant Pathology, University of Agriculture Faisalabad. Four different okra varieties viz; Sabz pari, Pahuja, Pusa sawani and Lush green were sown in 10th July 2015. Seed of four okra varieties were taken from Vegetable section of Ayub Agriculture Research Institute, Faisalabad for raising disease screening nursery. Each replication consists of four entries with row to row distance 60 cm and plant to plant distance 20 cm. All the agronomic practices were followed to maintain the okra nursery in good condition. Thus Okra germplasm was subjected to natural viral inoculum, invasion and buildup of white fly (B. tabaci) Population density. The disease on each entry was assessed by following the diseases rating scale (Table 1).

Conformation of the disease

Virus infected plants were collected from the field area. A slanting cut was made on both sides of the stem of infected plant. Wedge-grafting was performed as described by the Pulaiah et al., [5]. The grafted portion were wrapped tightly with Para film and covered with polythene bags. The plants were irrigated and the polythene sheet removed after the grafting was set properly. Non-inoculated served as controls.

| Rating scale | Severity range |
|--------------|----------------|
| 0            | Immune         |
| 1            | Highly resistant |
| 2            | Moderately resistant |
| 3            | Tolerant       |
| 4            | Moderately susceptible |
| 5            | Susceptible    |

Table 1: Showing the diseases rating scale.

*Corresponding author: Asad Chaudhary, Department of Plant Pathology, University of Agriculture, Faisalabad-38040, Pakistan, Tel: +9241920016170; E-mail: sherani639@gmail.com

Received June 16, 2016; Accepted June 28, 2016; Published June 30, 2016

Citation: Chaudhary A, Khan MA, Riaz K (2016) Spatio-temporal Pattern of Okra Yellow Vein Mosaic Virus and Its Vector in Relation to Epidemiological Factors. J Plant Pathol Microbiol 7: 360. doi:10.4172/2157-7471.1000360

Copyright: © 2016 Chaudhary A, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
control. The grafted inoculated plants showing the symptoms of OYVMV which indicates the presence of Okra yellow vein mosaic virus.

Spatial and temporal data

Environmental data consisting of maximum and minimum temperature, rainfall, relative humidity and wind speed were recorded on weekly basis from second week of August 2015 to the end of July 2015 and the weekly average was collected from meteorological station run by University of Agriculture, Faisalabad. The environmental factors (Maximum and minimum temperature, rainfall, relative humidity and wind speed) were correlated with disease incidence (OYVMV) and whitely population data. To study the temporal pattern, data were taken on weekly basis. In case of spatial study, distances of infected plants were measured with the help of measuring tape from the hot spot.

Statistical analysis

The data on the whitely population and percent plant infection were subjected to statistical analysis using RCBD factorial design. To determine the relation of environment with white fly population and percent plant infection data were subjected to the correlation and regression analysis [6].

Results and Discussion

Among all four varieties no any variety shows immunity against OYVMV disease incidence and whitely population. Response of these varieties towards OYVMV disease shows variability on the basis of their comparison to each other. Sabaz Pari shows moderately resistance response to the disease with 27.38% plant infection. Pahuja variety showed tolerant response with 27.38% plant infection. Lush green variety was fall in moderately susceptible category with 52.47% plant infection. Susceptibility was observed in Pusa Sawani cultivar with maximum plant infection about 64.22%. Dhankar et al., [7] performed an experiment in which he screened 51 hybrids of okra and their 20 parents for resistance against okra yellow vein mosaic virus under field condition. Observation was made at 35, 50 and 65 days after sowing. Only one parent and 11 hybrids were fall in resistance category against yellow vein mosaic virus. P-7 was moderately susceptible while the rest fall in the category of susceptible and highly susceptible. Raghpati et al., screened 12 okra varieties against yellow vein mosaic virus. The results show that 2 varieties Bo-1 and HRB-55 were proved highly resistant. Ahmad and Patil [8] screened nineteen okra germplasm, susceptible control Pusa Sawani also included. These germplasm were screened for their resistance towards OYVMV during summer season. The variety Arka Anamika recorded the lowest disease incidence (0.80%) and highest yield (23 t/ha) while Pusa Sawani the susceptible control recorded highest disease incidence (74.99%) and lowest yield (7.90 t/ha). None of them show significant correlation to each other. Sabaz Pari, Pahuja, Lush green and Pusa sawani were susceptible or highly susceptible. Bhagat et al. [12] found the rate of dissemination of okra yellow vein mosaic virus in okra cultivars. Pusa Sawani (highly susceptible) Vaibali, Vadhu (susceptible) and Parabhani Kranti (resistance) during rainy season.

Correlation of environmental factors with yellow vein mosaic virus disease

Correlation of weekly maximum and minimum temperature, relative humidity, rain fall and wind speed with OYVMV disease incidence was determined at variety level. A significant correlation was found between maximum temperature and disease incidence on three varities/lines i.e. Sabaz pari, Pahuja, and Pusa sawani while non-significant correlation with one variety named Lush green. Minimum temperature had highly significant correlation with disease incidence on variety named Pusa sawani and had significant correlation with variety Lush green. It had non-significant correlation with two varities/lines Sabaz pari and Pahuja. Relative humidity showed highly significant relationship with disease incidence on two varities/lines Pahuja and Lush green while sows significant correlation with other two varities/ lines Sabaz pari, Pusa sawani. Rainfall and wind speed showed non-significant relationship with disease incidence on four okra varieties/ lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani (Table 2).

Correlation of environmental conditions with whitely population

A significant correlation was found between maximum temperature and whitely population on all four varities/lines. Similarly minimum air temperature had non-significant correlation with whitely population on all the varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Relative humidity had significant relationship with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Relative humidity had significant relationship with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Rainfall had non-significant correlation with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Wind speed had significant correlation with whitely population on one variety i.e Sabaz pari and shows non-significant correlation with other three varities/lines i.e. Pahuja, Lush green and Pusa sawani as shown in Table 3.

| Variety     | Max Temp. | Min Temp. | RH    | RF    | WS    |
|-------------|-----------|-----------|-------|-------|-------|
| Sabaz pari  | 0.937**   | 0.612     | -0.869* | -0.446 | 0.775 |
| Pahuja      | 0.006     | 0.197     | 0.025  | 0.375 | 0.070 |
| Lush green  | 0.797*    | 0.774     | -0.941** | -0.579 | 0.589 |
| Pusa sawani | 0.050     | 0.071     | 0.005  | 0.229 | 0.219 |

Correlation of weekly maximum and minimum temperature, relative humidity, rain fall and wind speed with OYVMV disease incidence were subjected to statistical analysis using RCBD factorial design. To study the temporal pattern, data were taken on weekly basis. In case of spatial study, distances of infected plants were measured with the help of measuring tape from the hot spot.

Statistical analysis

The data on the whitely population and percent plant infection were subjected to statistical analysis using RCBD factorial design. To determine the relation of environment with white fly population and percent plant infection data were subjected to the correlation and regression analysis [6].

Results and Discussion

Among all four varieties no any variety shows immunity against OYVMV disease incidence and whitely population. Response of these varieties towards OYVMV disease shows variability on the basis of their comparison to each other. Sabaz Pari shows moderately resistance response to the disease with 27.38% plant infection. Pahuja variety showed tolerant response with 27.38% plant infection. Lush green variety was fall in moderately susceptible category with 52.47% plant infection. Susceptibility was observed in Pusa Sawani cultivar with maximum plant infection about 64.22%. Dhankar et al., [7] performed an experiment in which he screened 51 hybrids of okra and their 20 parents for resistance against okra yellow vein mosaic virus under field condition. Observation was made at 35, 50 and 65 days after sowing. Only one parent and 11 hybrids were fall in resistance category against yellow vein mosaic virus. P-7 was moderately susceptible while the rest fall in the category of susceptible and highly susceptible. Raghpati et al., screened 12 okra varieties against yellow vein mosaic virus. The results show that 2 varieties Bo-1 and HRB-55 were proved highly resistant. Ahmad and Patil [8] screened nineteen okra germplasm, susceptible control Pusa Sawani also included. These germplasm were screened for their resistance towards OYVMV during summer season. The variety Arka Anamika recorded the lowest disease incidence (0.80%) and highest yield (23 t/ha) while Pusa Sawani the susceptible control recorded highest disease incidence (74.99%) and lowest yield (7.90 t/ha). None of them show significant correlation to each other. Sabaz Pari, Pahuja, Lush green and Pusa sawani were susceptible or highly susceptible. Bhagat et al. [12] found the rate of dissemination of okra yellow vein mosaic virus in okra cultivars. Pusa Sawani (highly susceptible) Vaibali, Vadhu (susceptible) and Parabhani Kranti (resistance) during rainy season.

Correlation of environmental factors with yellow vein mosaic virus disease

Correlation of weekly maximum and minimum temperature, relative humidity, rain fall and wind speed with OYVMV disease incidence was determined at variety level. A significant correlation was found between maximum temperature and disease incidence on three varities/lines i.e. Sabaz pari, Pahuja, and Pusa sawani while non-significant correlation with one variety named Lush green. Minimum temperature had highly significant correlation with disease incidence on variety named Pusa sawani and had significant correlation with variety Lush green. It had non-significant correlation with two varities/lines Sabaz pari and Pahuja. Relative humidity showed highly significant relationship with disease incidence on two varities/lines Pahuja and Lush green while sows significant correlation with other two varities/ lines Sabaz pari, Pusa sawani. Rainfall and wind speed showed non-significant relationship with disease incidence on four okra varieties/ lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani (Table 2).

Correlation of environmental conditions with whitely population

A significant correlation was found between maximum temperature and whitely population on all four varities/lines. Similarly minimum air temperature had non-significant correlation with whitely population on all the varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Relative humidity had significant relationship with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Relative humidity had significant relationship with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Rainfall had non-significant correlation with whitely population on all four varities/lines i.e. Sabaz pari, Pahuja, Lush green and Pusa sawani. Wind speed had significant correlation with whitely population on one variety i.e Sabaz pari and shows non-significant correlation with other three varities/lines i.e. Pahuja, Lush green and Pusa sawani as shown in Table 3.

Correlation of weekly maximum and minimum temperature, relative humidity, rain fall and wind speed with OYVMV disease incidence recorded on four varieties/lines during 2015.
whitefly population, the disease incidence decreases with increase in distance and time with respect to infected foci. In case of whitefly population, it increases with increase in time while distance shows minor effect (Figure 1).

Conclusion

It was concluded that among all environmental factors, two variables includes wind speed and rainfall shows non-significant correlation with OYVMV disease incidence and whitefly population. There were observed that with increase in minimum temperature the disease incidence and whitefly population increased. Similarly with decrease in relative humidity, the disease incidence and whitefly population increased. Spatial study of OYVMV and whitefly shows that with increase in time and distance, the disease incidence and whitefly population also increased. These findings could be used to make out disease predicting model.

References

1. Baloch AF, Qayyum SM, Baloch MA (1990) Growth and yield performance of okra (Abelmoschus esculentus L) cultivars. Gomal Uni J Res 10: 191.
2. MINFAL (2013) Government of Pakistan, Ministry of Food, Agriculture and Livestock. Economic Wing, Islamabad Pakistan.
3. Hamer C, Thompson T (1957) Vegetable crops McGraw-Hill Co., Inc. New York. pp: 533-534.
4. Brunt AA, Crabtree K, Dalvitiz MJ, Gibbs AJ, Watson L (1996) Viruses of Plants-- Description and lists from the VIDE Database.CAB Int. (Wallingford, UK) pp: 233-234.
5. Pullaiah N, Reddy TB, Mosses GJ, Reddy BM, Reddy DR (1998) Inheritance of resistance to yellow vein mosaic virus. Indian J Genet Plant Breed 58: 349-352
6. Steel R, Torrie JH, Dicky D (1997) Principal and procedure of statistics. A biometric approach, 3rd Ed. McGraw Hill Book Co. Inc. New York.
7. Dhankar SK, Dhankar BS, Sharan BS (1996) Screening of okra genotypes for resistance to yellow vein mosaic disease. Ann Bio Ludhiana 12: 90-92.
8. Ahmad Z, Patil MS (2006) Screening of okra varieties against okra yellow vein mosaic virus. Karnataka J of Agric Sci 76: 123-134.
9. Srivastava PK, Srivastava KJ, Sharma HK, Gupta RP (1995) Evaluation of different varieties of okra against yellow vein mosaic virus (OYVMV). News Lett Nat Hort Res Devl Foun 15: 8-10.
10. Singh JS (1990) Etiology and epidemiology of whitefly transmitted virus disease of okra. Ind Plant Dis Res 5: 64-70.
11. Sanger RBS (1997) Field reaction of bhindi varieties to yellow vein mosaic virus. Ind J Virol 13: 131-134.
12. Bhagat AP, Yadavardi BP, Parasad Y (2001) Rate of dissemination of okra yellow vein mosaic virus disease in three cultivars of okra. Ind Phytopath 54: 468-469.

| Variety      | Max Temp | Min Temp | RH   | RF   | WS   |
|--------------|----------|----------|------|------|------|
| Sabaz pari   | 0.861*   | 0.507    | -0.874* | -0.500 | 0.870* |
| Pahuja       | 0.792*   | 0.666    | -0.848* | -0.717 | 0.711 |
| Lush green   | 0.896*   | 0.775    | -0.882* | -0.565 | 0.660 |
| Pusa sawani  | 0.889*   | 0.745    | -0.852* | -0.557 | 0.644 |

Upper values indicated Pearson’s correlation coefficient; Lower values indicated level of significance at 5% probability.
* = Significant (P<0.05); ** = Highly significant (P<0.01)

Table 3: Correlation of environmental factors with whitefly population recorded on four varities/lines during 2015.

![Figure 1: Relationship of Spatial pattern with OYVMV disease incidence and whitefly population.](image-url)