Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 1470-1475

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 1470-1475**
Journal homepage: http://www.ijcmas.com

Original Research Article

Assessment of Okra Genotypes for Yellow Vein Mosaic Virus Tolerance

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Keywords

YVMV, Okra, Genotypes, Infestation, Tolerance

A B S T R A C T

Okra (*Abelmoschus esculentus* L. Moench) has wide popularity in terms of cultivation and acceptability all over the world. In spite of its high nutritive value, well acceptability among end users and wide range of available genetic variability, the country is still lagging behind the leading productive countries like Ghana and Egypt in the world. One of the main okra production constraints is high incidence of most destructive yellow vein mosaic virus (YVMV) disease which infects crop at all phenological stages and can cause yield loss ranges between 50 and 94% depending on the stage of crop growth at which infection occurs. This disease is caused by a complex consisting of the monopartite begomovirus BYVMV encapsulated within a typical geminated particle and a small satellite DNA β component. However, several wild species of okra showed high degree of YVMV disease resistance. The reaction of YVMV on 20 okra genotypes including 4 checks Kashi Kranti, Kashi Satdhari, Kashi Lalima and Arka Anamika was determined using whole-plant scoring at 30, 45 and 60 days intervals. These genotypes were screened and evaluated in open field conditions in rainy season of 2015-16. Out of 20 genotypes five were showed resistant reaction to YVMV, whereas eight were moderately resistant to this disease. Remaining genotypes during whole period of experiment showed susceptible and moderately susceptible reaction. Response of these genotypes towards YVMV disease shows variability on the basis of their comparison to each other. Among the five resistant genotypes, highest resistant reaction was observed in Kashi Kranti (18.35%) followed by Kashi Satdhari (19.39%), Kashi Lalima (20.34%), Kashi Mohini (20.81%) and Punjab-8 (21.45%), respectively at 45 days after sowing. The genotypes 307-10-1 (25.45%), Pusa Makhmali (32.35%), VROB-159 (33.45%), VROB-178 (38.27%), Arka Anamika (41.93%), IBS-02 (42.36%), Pusa Sawani (43.75%) and BO-13 (44.35%) showed moderately resistant to YVMV in their increasing order of disease infection. The incidence of YVMV is higher during the months of April and May because of high temperature coupled with high rainfall. Screening of genotypes provides an idea in identification of stable source of resistance for YVMV in okra which can be utilized for development of disease resistant cultivars.

Introduction

Among different vegetable crops okra is considered as one of the most valuable crop which mainly grown for its mature green fruits (rich in fibres, vitamins and minerals) throughout the country (Kumari *et al.*, 2017). It is typically a warm season crops which requires long growing season with moderate temperature for its normal growth and development. India is the leading producer of okra in world having total area of 532.7 thousand hectares and production of 6346.4 thousand tonnes with average productivity of 11.9 tonnes/ ha (Anonymous, 2015). In north Indian plains, there are two main seasons for this crop *viz*., rainy and summer season. High incidence of yellow vein mosaic virus (YVMV) during the rainy season is the main limiting factor for its cultivation (Rana *et al*., 2006). White fly (*Bemisia tabaci* Gen.) is the main carrier of this virus. A complex of monopartite begomovirus, yellow vein mosaic virus (family: Geminiviridae) and a small satellite DNA β component are the major factors responsible for disease development in okra (Jose and Usha, 2003). Major losses in okra fruits yield and quality is caused by this disease and its insect vector. In severe cases crop may infected up to 100 % with the total yield loss of 50 to 94 % which influence by growth stage and environmental conditions (Sastry and Singh, 1974). During initial disease attack symptoms appears as diffused patched and mottling of younger leaves which is followed by irregular interveinal chlorosis on older leaves. After 15 to 20 days of infection, leaf margin shows small vein clearing at many points. An interveinal network of yellow vein surrounded by green patches exhibited by newly developed young leaves. Other than leaves symptoms also appear on fruits as irregular yellow area with longitudinal alignment. In severe incidence, malformed fruits with smaller size developed. Also, fruits show the symptom of yellowing, hard texture with more fibrous content (Brunt *et al*., 1996). Plants with retarded growth along with less number of leaf and fruits appear, if disease attacks initial crop establishment (Sastry and Singh, 1974). Sastry and Singh (1974) reported that total yield loss of 84 per cent occurs when disease attacked after 50 of germination. While, Khan *et al.* (2005) observed total yield loss of 49 per cent due to disease attack after 65 days of germination. These findings suggested that delay in infection leads to reduce yield loss. Considering the above constraints in view, present investigation was conduct to screen the okra genotype for YVMV resistance/ tolerance based on per cent disease incidence which helps in identification of stable source of resistance for this disease.

Materials and Methods

A total of 20 okra genotypes (BO-13, Pusa Makhmali, VRO-6, Kashi Mohini, Pusa Sawani, Punjab -8, Kashi Lalima, VROB-19, SB-2, 307-10-1, Kashi Kranti, Kashi Satdhari, CO-3, IC-14909, VROB-178, Arka Anamika, IBS-02, VRO-109, Azad Bhindi-1, VRO-106) including four checks were screened in rainy season for YVMV at Vegetable Research Farm, Bihar Agricultural University, Sabour, Bhagalpur (Bihar) during the year 2015-16. The cultural operations and cultivation aspects were followed according the recommendation of package of practice for okra. For the data analysis, the parameters were recorded as days to first flowering, days to 50 % flowering, first flowering node, plant canopy width (cm), number of primary branches/ plant, plant height (cm), fruit length (cm), fruit diameter (cm), number of fruits/ plant, average fruit weight (g), number of seeds/ pod, fruit yield/ plant (g), fruit yield (q/ha) and percent disease infestation of YVMV. The crop was grown

in fertile soil having neutral pH and sandy loamy texture. The total rainfall received during the crop period was 282.57 mm. The maximum temperature ranged from 23.9˚C – 35˚C during the plant growth and development phase (Fig. 1).

Disease scoring was done by using the standard scale of 0 to 4 (Table 1) at 15 days interval (30, 45 and 60 days after sowing). To calculate the PDI and CI value standard procedure suggested by Banerjee and Kalloo (1987) was practiced.

$$\text{PDI (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

$$\text{CI (\%)} = \text{PDI} \times \text{RV}$$

Where, CI= Coefficient of Infection, PDI = percent disease infection, RV = response value

Results and Discussion

A large number of variations were observed for disease resistance in each genotype. Out of 20 genotypes five were showed resistant reaction to YVMV, whereas eight were moderately resistant to this disease (Table 2). Remaining genotypes during whole period of experiment showed susceptible and moderately susceptible reaction. The more susceptibility of okra to YVMV during rainy season as compare to summer season was also reported by Solankey *et al*. (2014) and suggested that it is mainly due to hot climate with high humidity followed by heavy rainfall which provides a congenial condition for multiplication of vector *i.e.* white fly. In the same way Das *et al.* (2013) reported that rainy season okra having more intensity of YVMV due to favourable environment conditions. These results were also similar to the findings of Sangar *et al*. (1997), Bhagat *et at.* (2001), Chattopadhyay *et al.*(2011) and Das *et al.* (2013) who conducted the experiment during the rainy season. Among the five resistant genotypes, highest resistant reaction was observed in Kashi Kranti (18.35%) followed by Kashi Satdhari (19.39%), Kashi Lalima (20.34%), Kashi Mohini (20.81%) and Punjab-8 (21.45%), respectively after 45 days of sowing (Table 2).

The genotypes 307-10-1 (25.45%), Pusa Makhmali (32.35%), VROB-159 (33.45%), VROB-178 (38.27%), Arka Anamika (41.93%), IBS-02 (42.36%), Pusa Sawani (43.75%) and BO-13 (44.35%) showed moderately resistant to YVMV in their increasing order of disease infection. Joshi (2004) and Yadav *et al.* (2010) reported the disease incidence in the range of 0 to 42.9% and 0 to 35%, respectively for this disease in okra variety Punjab-8. The genotype SB-2 found most susceptible to this disease with highest disease reaction of 76.26 per cent which was followed by VRO-6 (70.34 %), Azad Bhindi-1 (67.34%) and IC-14909 (65.20%), respectively.

The incidence of YVMV is higher during the months of April and May because of high temperature coupled with high rainfall (Fig. 2). The highest percent increase in incidence was observed in the Month of April when the temperature was medium but the rainfall was highest that create the favourable temperature for YVMV as well as for the vector i.e. white flies. Similar results were reposted by Solankey *et al*. (2014). Moreover, at early stage the chances of infection is much higher because of tender leaves can easily be penetrated and trouble-free sucking and transmission of saps by the vectors.

Table.1 Classification of disease reaction based on standard scale for YVMV in okra

Symptoms	Severity grade	Response value	Coefficient of infection	Reaction
Symptom absent	0	0	0 – 4	HR
Very mild symptom up to 25% leaves	1	0.25	4.1 – 9	R
Appearance of disease between 26 to 50% leaves	2	0.50	9.1 – 19	MR
Symptom between 51 to 75% leaves	3	0.75	19.1 – 39	MS
Severe disease infection at 75% leaves	4	1.00	39.1 – 69	S
Above 75% leaves	>4	>1.00	69.1 – 100	HS

Note: HR = Highly resistant, R = Resistant, S = Susceptible, HS = Highly susceptible, MR = Moderately resistant, MS = Moderately susceptible. Correlation between variables were tested for significance (Gomez and Gomez, 1984).

Table.2 Periodical incidence of YVMV with disease reaction and yield during rainy season in diverse okra genotypes

Genotypes	Percent diseased incidence at			Disease reaction at 45 Days after Sowing (DAS)	Yield (Q/ha)
	30 DAS	45 DAS	60 DAS		
BO-13	27.21	44.35	58.18	MR	151.98
Pusa Makhmali	25.41	32.35	40.85	MR	176.81
VRO-6	50.37	70.34	88.76	MS	161.22
Kashi Mohini	9.83	20.81	23.69	R	200.75
Pusa Sawani	23.91	43.75	49.12	MR	136.93
Punjab-8	8.13	21.45	22.41	R	206.40
VROB-159	11.77	33.45	46.77	MR	209.86
SB-2	26.49	76.26	82.11	S	118.33
307-10-1	9.17	25.45	39.81	MR	152.67
CO-3	22.48	54.24	69.96	MS	174.83
IC-14909	29.84	65.20	82.11	MS	164.38
VROB-178	18.57	38.27	46.28	MR	197.97
IBS-02	25.11	42.36	49.37	MR	167.36
VRO-109	19.89	55.34	73.15	MS	173.01
Azad Bhindi-1	44.75	67.34	79.87	MS	161.96
VRO-106	32.98	59.72	68.94	MS	125.75
Arka Anamika (C)	25.81	41.93	48.31	MR	167.03
Kashi Kranti (C)	9.63	18.35	21.85	R	253.25
Kashi Satdhari (C)	15.78	19.39	24.72	R	237.12
Kashi Lalima (C)	12.31	20.04	23.98	R	191.06

Figure.1 Meteorological data during crop growing period (February – June, 2015)

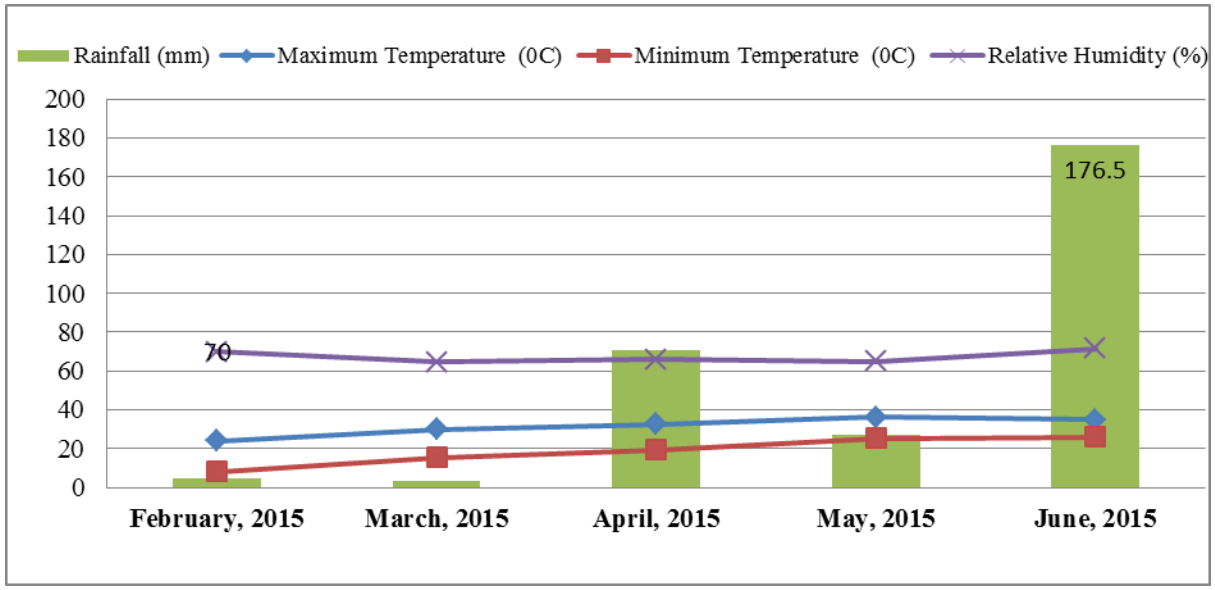
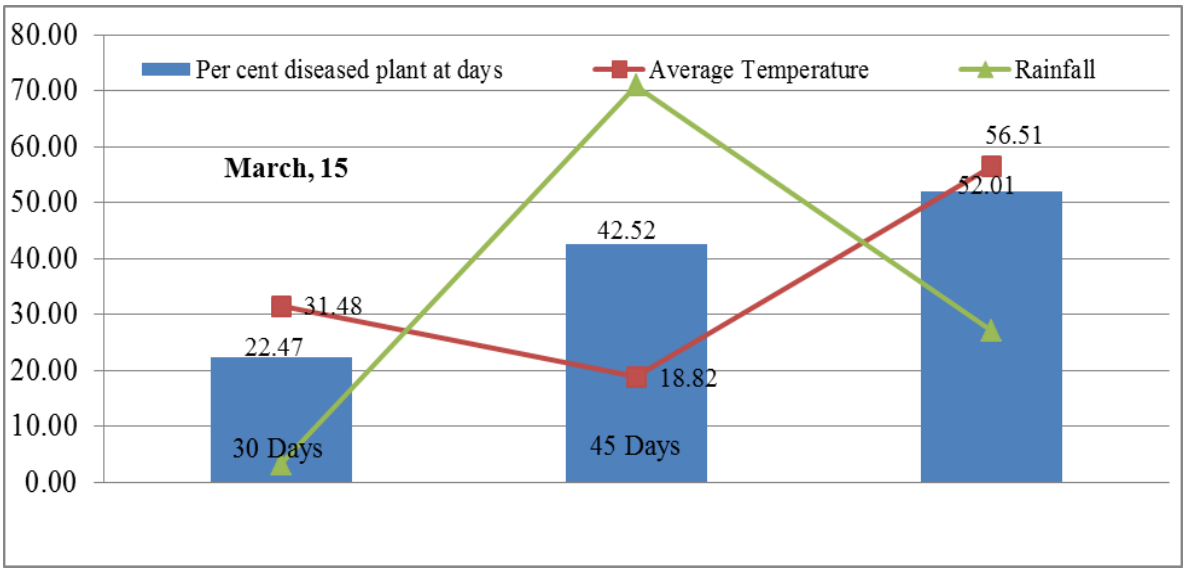


Figure.2 Effect of temperature and rainfall on YVMV incidence of okra



Among all genotypes the highest yield was observed in Kashi Kranti (253.25 q/ha) followed by Kashi Satdhari (237.12 q/ha), VROB-159 (209.86 q/ha), Punjab-8 (206.40 q/ha) and Kashi Mohini (200.75 q/ha), respectively (Table 2). The one of the major reason for higher yield of these genotypes is less incidence of YVMV which occur at the cost of more trichomes on leaf structure and typical leaf texture. The genotype Kashi Lalima is highly resistant to YVMV than showed less yield due to its genetic nature and some of its metabolites may diverted for production of anthocyanin pigments. The lowest yield was observed in genotype SB-2 (188.33q/ha) is due to highest incidence of YVMV.

The above results suggested that disease incidence and its severity depends upon the genotype and also environmental factors. Screening of genotypes provides an idea in identification of stable source of resistance for YVMV in okra which can be utilized for development of disease resistant cultivars. With the findings of above said experiments it may be concluded that the varieties, Kashi Kranti and Kashi Satdhari could be recommended for commercial cultivation in YVMV disease prone area during rainy season. Kashi Lalima can also be a better option for commercial cultivation in disease prone area due to less incidence of disease even though it gave lesser yield compare to other resistant variety but high price of these pods could compensate the yield loss. As well as these genotypes can be used as a donor for development of YVMV resistant/ tolerant okra genotypes with higher yield.

Acknowledgments

The authors acknowledge the Bihar Agricultural University, Sabour, Bhagalpur (Bihar) for providing the research facility and financial support. The authors are also thankful to IIVR, Varanasi, NBPGR, New Delhi and IIHR, Bengaluru for the provision of okra germplasm used in this study.

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