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Screening of Okra [*Abelmoschus esculentum* (L.) Moench] Genotypes for Yellow Vein Mosaic Virus (YVMV) Resistance Under Natural Diseases Pressure Condition

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Sixty genotypes of okra along with pusa sawani as susceptible check were screened for YVMV resistance under field conditions. Per cent disease incidence and coefficient of infection were calculated for all the genotypes. Per cent disease incidence ranged from 10.0 to 100.0, where as coefficient of infection varies from 5.0 to 100.0. Out of 60 genotypes screened, seven genotypes were resistant (MHO -10, MHO -24, MHO -30, KRCO -3, KRCO -10, KRCO -15 and KRCO-28). Fifteen genotypes were moderately resistant(MHO-1, MHO-4 , MHO-6, MHO -13, MHO -14, MHO-16, MHO -21, MHO -27, KRCO-13, KRCO -16, KRCO -18, KRCO -19, KRCO-21, KRCO-23, KRCO-30) and sixteen genotypes were moderately susceptible(MHO -12, MHO -18, MHO -20, MHO -22, MHO -26, MHO -29, KRCO-1, KRCO -4, KRCO -5, KRCO -7, KRCO -8, KRCO -9, KRCO -20, KRCO-22, KRCO-27, KRCO-29).Thirteen genotypes were found to be susceptible (MHO-2, MHO-3 , MHO -6 , MHO -7, MHO -8, MHO -9, MHO -11, MHO -15 , MHO -22 ,MHO -25 ,KRCO -12 , KRCO -14 , KRCO-24 , KRCO-26) and nine were highly susceptible (MHO -5, MHO -17, MHO -19, MHO -28, KRCO -2, KRCO -6 , KRCO -11, KRCO -17, KRCO-25) .Resistant genotypes identified in the present study can be utilized further YVMV resistance breeding programme.

Keywords: Okra, YVMV, Per cent disease incidence, Coefficient of infection.

Okra [*Abelmoschus esculentus* L. (Moench)] is an economically important vegetable grown in tropical and sub-tropical regions of the world. Okra is cultivated for both its immature pods to be consumed as fresh and canned food and seed purpose. But this crop is affected by many viral diseases worldwide and India is not exception. At least, 19 plant viruses are reported to be responsible for causing different diseases to this crop. Among them, yellow vein mosaic virus disease (YVMV) is the most important and destructive disease. The disease is caused by whitefly (*Bemisia tabaci* Genn) transmitted virus complex consisting of a monopartite begomovirus, Bhendi yellow vein mosaic virus (BYVMV) and a beta satellite molecule . The causal virus and its associated beta satellite molecule infect the crop at all the stages of crop growth. The disease is characterized by symptoms of homogenous interwoven network of yellow veins enclosing islands of green tissues. Initially infected leaves exhibit only yellowing of the veins and vein lets , but in the later stages, the entire leaf turns completely yellow. In extreme cases, the infected leaf becomes totally light yellow or cream color. Plants infected at the early stages remain stunted. The fruits of the infected plants exhibit pale yellow

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color, become deformed, small and tough in texture. Thus, the disease affects both the quality of fruits and yield of okra adversely. The total loss of vegetable on this account has been estimated up to 20-30% but if the pathogens are allowed to develop, this loss may increase up to 80-90%. 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 at 50 and 65 days after germination suffer a loss of 84 and 49%, respectively . The disease can't be controlled properly by chemical means. Uprooting of infected plants is not practical and economical because of heavy infection rate in the field. So only practical solution for this problem is to develop tolerant varieties. An extensive search for YVMV tolerance in okra was started by screening germplasm of wild species. Many studies were also undertaken to transfer genes for tolerance to BYVMV from related wild species to susceptible cultivated varieties . The source of resistance to BYVMV has been explored in cultivated species and few varieties like Pusa sawani , Kashi vibhuti and Kashi pragati have been developed through pedigree method. Parbhani kranti, Arka anamika and Arka abhay were developed using interspecific hybridization followed by back cross breeding and variety Punjab padmini by interspecific hybridization, but without back crossing. *Abelmoschus manihot*, *A. manihot* ssp. *manihot*, and *A. teretaphyllus* were used for inter specific hybridization followed by back crossing with cultivated species *A. esculents*. But their resistance has broken down in few years due to intensive and continuous cultivation. Therefore, the present study is taken up to identifying the new source of resistance in okra for YVMV disease and which would be very much useful in developing new resistant varieties.

MATERIAL AND METHODS

A total of 60 okra genotypes were collected from different sources (Table -1) and sown in randomized block design in three replications with spacing of 60 x 30 cm in 5 meter rows. Seeds of most susceptible variety Pusa sawani were also sown along the borders of entire plots to provide adequate virus source to the vector. Observations on disease severity and intensity were recorded at 30 days interval on ten randomly selected plants of each genotype and cumulative data was obtained. To assess the resistance of a given genotype, symptom severity grades designated with numerical values of 0 to 4 were given on the basis of visual observations. To quantify the disease severity, calculations were made as shown in Table 1.

The per cent disease incidence (PDI) was calculated by the formula:

$$PDI = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

The coefficient of infection (CI) was calculated by multiplying the per cent disease incidence. The response value assigned for each severity grade. Thus the coefficient value combines the amount of infection and its severity (Table 2).

RESULTS AND DISCUSSION

Data on the reaction of various okra genotypes to yellow vein mosaic disease incidence was presented in Table -3. Results indicated a wide range of response within the tested genotypes ranging from resistance to highly susceptible. Per cent diseases index is not a determining factor to differentiate between resistant and susceptible genotype, because genotype may show higher PDI, due to its low severity grade, but it may not be categorized as highly susceptible or susceptible. This ruled out the possibility of relationship between the PDI and their reaction to yellow vein mosaic disease. Hence, co-efficient of infection, which is expressed as a product of the PDI and severity grade (response value) will be more useful in selecting suitable accession resistant to yellow vein mosaic disease. The Co-efficient of infection (CI) in tested genotypes ranged from 3.6 to 100. Among the 60 genotypes screened, in seven genotypes *viz*, MHO -10, MHO -24, MHO -30, KRCO -3, KRCO -10, KRCO -15 and KRCO-28, the mean disease rating was 30, 10, 20, 10, 10, 10 and 30 respectively. They had no disease symptoms. Based on the percent disease incidence and disease reaction score, these genotypes were resistant to yellow vein mosaic virus. Fifteen lines (MHO-1,

MHO-4 , MHO-6, MHO -13, MHO -14, MHO-16, MHO -21, MHO -27, KRCO-13, KRCO -16, KRCO -18, KRCO -19, KRCO-21, KRCO-23, KRCO-30) were moderately resistant with the mean disease rating of 20, 30, 30, 50, 30, 30, 60, 30 ,20, 30, 20, 50, 10, 40 and 20 respectively. Thirteen genotypes (MHO-2, MHO-3 , MHO -6 , MHO -7, MHO -8, MHO -9, MHO -11, MHO -15 , MHO -22 ,MHO -25 ,KRCO -12 , KRCO -14 , KRCO-24 , KRCO-26) exhibited susceptible reaction, where as nine lines (MHO -5, MHO -17, MHO -19, MHO -28, KRCO -2, KRCO -6 , KRCO -11, KRCO -17, KRCO-25) were highly susceptible to YVMV, 16 lines were moderately susceptible (MHO -12, MHO -18, MHO -20, MHO -22, MHO -26, MHO -29, KRCO-1, KRCO -4, KRCO -5, KRCO -7, KRCO -8, KRCO -9, KRCO -20, KRCO-22, KRCO-27, KRCO-29). Resistance particularly against virus is non-durable, the battle between the disease and search for resistant source is a continuing process. In the same way, resistance to YVMD is not stable in the cultivated species and frequent breakdown of resistance have been observed in developed varieties. Frequent change of resistant variety is required and further

Table 1. Details of okra genotypes used for yellow vein mosaic virus (YVMV) resistance Screening.

Genotype code	Genotype	Genotype code	Genotype	Genotype code	Genotype
L_1	MHO-1	L_{22}	MHO -22	L_{43}	KRCO -13
L_2	MHO-2	L_{23}	MHO -23	L_{44}	KRCO -14
L_3	MHO-3	L_{24}	MHO -24	L_{45}	KRCO -15
L_4	MHO-4	L_{25}	MHO -25	L_{46}	KRCO -16
L_5	MHO -5	L_{26}	MHO -26	L_{47}	KRCO -17
L_6	MHO -6	L_{27}	MHO -27	L_{48}	KRCO -18
L_7	MHO -7	L_{28}	MHO -28	L_{49}	KRCO -19
L_8	MHO -8	L_{29}	MHO -29	L_{50}	KRCO -20
L_9	MHO -9	L_{30}	MHO -30	L_{51}	KRCO-21
L_{10}	MHO -10	L_{31}	KRCO-1	L_{52}	KRCO-22
L_{11}	MHO -11	L_{32}	KRCO -2	L_{53}	KRCO-23
L_{12}	MHO -12	L_{33}	KRCO -3	L_{54}	KRCO-24
L_{13}	MHO -13	L_{34}	KRCO -4	L_{55}	KRCO-25
L_{14}	MHO -14	L_{35}	KRCO -5	L_{56}	KRCO-26
L_{15}	MHO -15	L_{36}	KRCO -6	L_{57}	KRCO-27
L_{16}	MHO -16	L_{37}	KRCO -7	L_{58}	KRCO-28
L_{17}	MHO -17	L_{38}	KRCO -8	L_{59}	KRCO-29
L_{18}	MHO -18	L_{39}	KRCO -9	L_{60}	KRCO-30
L_{19}	MHO -19	L_{40}	KRCO -10		
L_{20}	MHO -20	L_{41}	KRCO -11		
L_{21}	MHO -21	L_{42}	KRCO -12		

Table 2. Scale used for classifying disease reaction of okra genotypes to yellow vein mosaic virus (YVMV).

Symptoms	Severity grade (SG)	Response value (RV)	Coefficient of infection(CI)	Reaction
symptoms absent	0	0	0-4	Highly resistant
Very mild symptoms up to 25% leaves	1	0.25	5-9	Resistant
Appearance of symptoms up to 26-50 % leaves	2	0.50	10-19	Moderately resistant
Appearance of symptoms upto 51-75% leaves	3	0.75	20-39	Moderatelysusceptible
Severe diseases infection in >75% leaves	4	1.00	40-69	susceptible
			70-100	Highly susceptible

Table 3. Categorization of okra genotypes based on YVMV incidence

Sl. No.	Genotypes	Mean of disease rating (%)PDI	Response value (RV)	Coefficient of infection (CV)	Disease reaction
1	MHO-1	20	0.5	10	MR
2	MHO-2	40	1	40	S
3	MHO-3	60	1	60	S
4	MHO-4	30	0.5	15	MR
5	MHO -5	70	1	70	HS
6	MHO -6	30	0.5	15	MR
7	MHO -7	60	0.75	45	S
8	MHO -8	40	1	40	S
9	MHO -9	80	0.75	60	S
10	MHO -10	30	0.25	7.5	R
11	MHO -11	80	0.75	60	S
12	MHO -12	70	0.5	35	MS
13	MHO -13	50	0.25	12.5	MR
14	MHO -14	30	0.5	15	MR
15	MHO -15	60	1	60	S
16	MHO -16	30	0.5	15	MR
17	MHO -17	80	1	80	HS
18	MHO -18	50	0.5	25	MS
19	MHO -19	90	1	90	HS
20	MHO -20	50	0.5	25	MS
21	MHO -21	60	0.25	15	MR
22	MHO -22	40	0.5	20	MS
23	MHO -23	60	0.75	45	S
24	MHO -24	10	0.5	5	R
25	MHO -25	70	0.75	52.5	S
26	MHO -26	50	0.5	25	MS
27	MHO -27	30	0.5	15	MR
28	MHO -28	90	1	90	HS
29	MHO -29	50	0.5	25	MS
30	MHO -30	20	0.25	5	R
31	KRCO-1	70	0.5	35	MS
32	KRCO -2	100	1	100	HS
33	KRCO -3	10	0.5	5	R
34	KRCO -4	60	0.5	30	MS
35	KRCO -5	30	0.75	22.5	MS
36	KRCO -6	90	1	90	HS
37	KRCO -7	70	0.5	35	MS
38	KRCO -8	60	0.5	30	MS
39	KRCO -9	40	0.5	20	MS
40	KRCO -10	10	0.5	5	R
41	KRCO -11	90	1	90	HS
42	KRCO -12	60	0.75	45	S
43	KRCO -13	20	0.5	10	MR
44	KRCO -14	80	0.75	60	S
45	KRCO -15	10	0.5	5	R
46	KRCO -16	30	0.5	15	MR
47	KRCO -17	100	1	100	HS
48	KRCO -18	20	0.5	10	MR
49	KRCO -19	50	0.25	12.5	MR
50	KRCO -20	60	0.5	30	MS

51	KRCO-21	10	0.75	7.5	MR
52	KRCO-22	50	0.5	25	MS
53	KRCO-23	40	0.25	10	MR
54	KRCO-24	60	0.75	45	S
55	KRCO-25	80	1	80	HS
56	KRCO-26	90	0.75	67.5	S
57	KRCO-27	50	0.5	25	MS
58	KRCO-28	30	0.25	7.5	R
59	KRCO-29	70	0.5	35	MS
60	KRCO-30	20	0.5	10	MR
61	P.Sawani CC	90	0.75	67.5	S

development of new YVMD resistant variety is essential. Therefore, these newly identified resistant accessions can be utilized further in okra breeding programme for development of yellow vein mosaic resistant lines.

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