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Research Note

Yellow vein mosaic virus resistant hybrids in okra (*Abelmoschus esculentus* L.) Moench)

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Abstract
Seven parents and 42 hybrids of okra were screened for resistance/susceptibility to yellow vein mosaic virus. The parents P_1 (AE 64 (White)), P_2 (AE 64 (Pink)) and P_4 (AE 65 (Pink) were found complete resistance to disease. The parents P_3 (AE 65 (White)), P_6 (AE 70 (White)) and P_7 (AE 71 (White) were found tolerant to disease. The parent P_5 (AE 66 (Pink) found susceptible to disease. 42 hybrids are obtained by crossing seven parents in diallel design. Twelve out of 42 hybrids did not show any symptom of YVMV and were $P_1 \times P_2$, $P_1 \times P_3$, $P_1 \times P_4$, $P_1 \times P_5$, $P_1 \times P_7$, $P_2 \times P_1$, $P_2 \times P_4$, $P_4 \times P_1$, $P_4 \times P_2$, $P_4 \times P_3$, $P_4 \times P_5$ and $P_4 \times P_7$. Eight hybrids *viz.*, $P_2 \times P_3$, $P_3 \times P_1$, $P_3 \times P_2$, $P_3 \times P_4$, $P_4 \times P_6$, $P_5 \times P_1$, $P_6 \times P_4$ and $P_7 \times P_4$ were highly resistant to the YVMV disease with the incidence of 7.14, 3.57, 7.14, 7.14, 7.14, 3.57, 3.57 and 3.57 per cent respectively at 105 DAS.

Key words
Okra, YVMV, resistance, parents, hybrids.

Okra (*Abelmoschus esculentus* L.) Moench) is one of the most popular vegetable crops cultivated throughout India. Because of high consumer's demand and thereby better price, farmers grow okra widely during summer season. Okra yellow vein mosaic virus is the most destructive disease, which causes colossal losses up to 92-94% in the crop by affecting the quality and yield of fruits. Sharma and Arora, 1989, Singh (1985), Batra and Singh (2000), Vinod *et al.* (2000), Rattan and Aravind Bindal (2000), Rashid *et al.* (2002), Debnath and Nath (2003), Indurani *et al.* (2003), Aneesha (2010), Amaranatha (2011), Benchasri (2011), Tiwari *et al.* (2012) and Reddy *et al.* (2013) also reported different degree of resistance, hence the present studies were undertaken for the screening of okra varieties for the incidence of yellow vein mosaic.

The present investigation was carried out in the Department of Vegetable Crops, TNAU, Coimbatore with seven parents and their 42 hybrids with spreader row of highly susceptible hybrid Arka Anamika under field conditions during February - May 2013. The parents P_1 (AE 64 (White)), P_2 (AE 64 (Pink)) and P_4 (AE 65 (Pink) were found complete resistance to disease. The parents P_3 (AE 65 (White)), P_6 (AE 70 (White)) and P_7 (AE 71 (White) were found tolerant to disease. The parent P_5 (AE 66 (Pink) found susceptible to disease. The disease incidence was recorded at fifteen days interval up to 105 days after sowing based on scale 0 = immune, 1-10 = highly resistant, 11-25 = moderately resistant, 26- 50 = tolerant, 51-60 = moderately susceptible, 61-70 = susceptible and 71-100 = highly susceptible (Ali *et al.* 2005).

The experiment was laid out in a randomized block design with three replications having a plot size of 4 m^2 with a spacing of 60 x 30 cm. The Per Cent Disease Index(PDI) was recorded and the results are presented in Table 1.

Rating scale	Type	Disease incidence (%)
0	Immune	0
1	Highly resistant	1-10
2	Moderate resistant	11-25
3	Tolerant	26-50
4	Moderate susceptible	51-60
5	Susceptible	61-70
6	Highly susceptible	71-100

Parents P_1, P_2 and P_4 did not show any symptom of yellow vein mosaic virus disease. They are immune to the disease as they are completely free from incidence. These results confirm the earlier findings of Dhankar *et al.* (1998), Rattan and Aravind Bindal (2000), Batra and Singh (2000), Vinod *et al.* (2000), Debnath and Nath (2002) and Tiwari *et al.* (2012). This was further confirmed by artificial inoculation of virus through whiteflies. Indurani (1999) also confirmed resistance of genotypes by vector transmission.

Parent P_5 showed YVMV incidence of 7.14, 32.14, 71.43 and 82.14 per cent at 60, 75, 90 and 105 DAS respectively. This parent is referred as highly susceptible parent. Same result was reported by Vinod *et al.* (2000), Rashid *et al.* (2002) and Nizar *et al.* (2004). Whereas P_3, P_6 and P_7 are referred as tolerant parents based on PDI. This is line with the findings of Tiwari *et al.* (2012). P_6 showed incidence of 7.14,

17.86, 25 and 46.43 per cent at 60, 75, 90 and 105 DAS respectively. P_3 showed incidence of 7.14, 28.57 and 42.83 per cent at 75, 90 and 105 DAS respectively. P_7 showed incidence of 3.57, 10.71, 21.43 and 39.29 per cent at 60, 75, 90 and 105 DAS respectively. These results confirm the experimental results of Batra and Singh (2000), Rashid *et al*. (2002), Debnath and Nath (2002), Nizar *et al*.(2004), Benchasri (2011), Tiwari *et al*. (2012) and Kamalpreet *et al*. (2013).

Twelve out of 42 hybrids did not show any symptom of YVMV and were $P_1 \times P_2$, $P_1 \times P_3$, $P_1 \times P_4$, $P_1 \times P_5$, $P_1 \times P_7$, $P_2 \times P_1$, $P_2 \times P_4$, $P_4 \times P_1$, $P_4 \times P_2$, $P_4 \times P_3$, $P_4 \times P_5$ and $P_4 \times P_7$. Rattan and Aravind Bindal, (2000) and Batra and Singh, (2000) supported these results. Among them eight hybrids were direct crosses and four were reciprocal cross combinations. Four crosses *viz.*, $P_3 \times P_5$, $P_5 \times P_6$, $P_6 \times P_5$ and $P_6 \times P_7$ were highly susceptible for yellow vein mosaic virus with the incidence of 82.14, 100, 92.85 and 85.71 per cent respectively at 105 DAS. The cross $P_5 \times P_3$ is a susceptible with the incidence of 64.29 per cent at 105 DAS. This is in accordance with the experimental results of Tiwari *et al*. (2012) at 105 DAS in different parents. Eight hybrids *viz.*, P3 x P6, P3 x P7, P5 x P4, P5 x P7, P6 x P3, P7 x P1, P7 x P3, P7 x P5 and P7 x P6 were tolerant to YVMV with the incidence of 46.43, 35.71, 28.57, 46.43, 14.29, 39.29, 46.43 and 42.86 per cent respectively at 105 DAS. This is line with the experimental results of Sankara *et al.* (2012) at 105 DAS in different hybrids.

Eight hybrids *viz.*, $P_1 \times P_6$, $P_2 \times P_5$, $P_2 \times P_6$, $P_2 \times P_7$, $P_5 \times P_2$, $P_6 \times P_1$, $P_6 \times P_2$ and $P_7 \times P_2$ were moderately resistant to the yellow vein mosaic virus disease with the incidence of 17.86, 21.43, 14.29, 10.71, 21.43, 17.86, 14.29 and 10.71 per cent respectively at 105 DAS. This is in line with the experimental results of Sankara *et al*. (2012) and Kamalpreet *et al*. (2013). Eight hybrids *viz.*, $P_2 \times P_3$, $P_3 \times P_1$, $P_3 \times P_2$, $P_3 \times P_4$, $P_4 \times P_6$, $P_5 \times P_1$, $P_6 \times P_4$ and $P_7 \times P_4$ were highly resistant to the YVMV disease with the incidence of 7.14, 3.57, 7.14, 7.14, 7.14, 3.57, 3.57 and 3.57 per cent respectively at 105 DAS. This is line with the experimental results of Sankara *et al.* (2012).

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Table 1. Screening of parents and F_1 hybrids for YVMV incidence (PDI (Per cent)) at 15 days interval in okra

Parents and Hybrids	YVMV incidence					
	Days after sowing					
	45	60	75	90	105	Score
P_1	0	0	0	0	0	I
P_2	0	0	0	0	0	I
P_3	0	0	7.14	28.57	42.83	T
P_4	0	0	0	0	0	I
P_5	0	7.14	32.14	71.43	82.14	HS
P_6	0	7.14	17.86	25	46.43	T
P_7	0	3.57	10.71	21.43	39.29	T
$P_1 \times P_2$	0	0	0	0	0	I
$P_1 \times P_3$	0	0	0	0	0	I
$P_1 \times P_4$	0	0	0	0	0	I
$P_1 \times P_5$	0	0	0	0	0	I
$P_1 \times P_6$	0	0	0	7.14	17.86	MR
$P_1 \times P_7$	0	0	0	0	0	I
$P_2 \times P_1$	0	0	0	0	0	I
$P_2 \times P_3$	0	0	0	0	7.14	HR
$P_2 \times P_4$	0	0	0	0	0	I
$P_2 \times P_5$	0	0	0	10.71	21.43	MR
$P_2 \times P_6$	0	0	0	3.14	14.29	MR
$P_2 \times P_7$	0	0	0	3.14	10.71	MR
$P_3 \times P_1$	0	0	0	0	3.57	HR
$P_3 \times P_2$	0	0	0	0	7.14	HR
$P_3 \times P_4$	0	0	0	0	7.14	HR
$P_3 \times P_5$	0	10.71	42.86	60.71	82.14	HS
$P_3 \times P_6$	0	3.57	10.71	25	46.43	T
$P_3 \times P_7$	0	3.57	7.14	21.43	35.71	T
$P_4 \times P_1$	0	0	0	0	0	I
$P_4 \times P_2$	0	0	0	0	0	I
$P_4 \times P_3$	0	0	0	0	0	I
$P_4 \times P_5$	0	0	0	0	0	I
$P_4 \times P_6$	0	0	0	7.14	7.14	HR
$P_4 \times P_7$	0	0	0	0	0	I
$P_5 \times P_1$	0	0	0	0	3.57	HR
$P_5 \times P_2$	0	0	0	7.14	21.43	MR
$P_5 \times P_3$	0	0	14.29	28.57	64.29	S
$P_5 \times P_4$	0	0	0	10.71	28.57	T
$P_5 \times P_6$	0	3.57	14.29	42.85	100	HS
$P_5 \times P_7$	0	3.57	10.71	28.57	46.43	T
$P_6 \times P_1$	0	0	3.57	7.14	17.86	MR
$P_6 \times P_2$	0	0	0	3.57	14.29	MR
$P_6 \times P_3$	0	3.57	14.29	28.57	46.43	T
$P_6 \times P_4$	0	0	0	0	3.57	HR
$P_6 \times P_5$	0	10.71	35.71	71.43	92.85	HS
$P_6 \times P_7$	0	7.14	32.14	75	85.71	HS
$P_7 \times P_1$	0	0	0	3.57	14.29	T
$P_7 \times P_2$	0	0	0	3.57	10.71	MR
$P_7 \times P_3$	0	3.57	10.71	17.86	39.29	T
$P_7 \times P_4$	0	0	0	0	3.57	HR
$P_7 \times P_5$	0	7.14	14.29	50	46.43	T
$P_7 \times P_6$	0	7.14	7.14	25	42.86	T