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Research Article

In vivo screening of okra (*Abelmoschus esculentus* L.) germplasm collections against sucking pests

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Abstract
An "*In vivo* screening of okra germplasm/accessions against sucking pests" was undertaken at Dhadhagoundanpatti village (Alanganallur block) a bhendi growing belt of Madurai district. For this study, thirty okra accessions were screened against sucking pests' *viz*., aphids, jassids, and whiteflies. The results showed that accessions IC 15027 showed resistant level, IC 90202, IC 90203, IC 90213, IC 90214 found to be moderately resistant to sucking pests.

Key words
Okra, germplasm, sucking pests

Introduction

Okra (*Abelmoschus esculentus* L.) commonly known as bhendi or lady's finger belongs to the Malvaceae family and is an important vegetable crop grown across different States in India throughout the year. Among the different species of the genus, *Abelmoschus*, *Abelmoschus esculentus* is commercially grown due to its nutritional value. The major production constraint for okra is yellow vein mosaic disease, which is causing yield and quality losses wherever the crop is grown mainly in the summer season. The yellow vein mosaic disease of okra (YVMD) is caused by Bhendi yellow vein mosaic virus (BYVMV) and was first reported in 1924 (Kulkarni, 1924). The virus belongs to the genus Begomo virus, family: Geminiviridae (Fauquet and Stanley 2005). This virus is being transferred by one of the sucking pests white fly, *Bemicia tabaci* (Gennadius). The other sucking pests causing yield loss are of aphids, *Aphis gossypii* (Glover), the leaf hopper, *Amarasca devastans* (Dist). These are the serious pests infesting okra crop (Uthamsamy and Balasubramanian, 1978). This disease and its vector cause heavy loss to okra byn affecting the quality andquantity of the fruits. Infection to 100 per cent in the field is quiet common and the yield loss range from 50 to 94 per cent (Sastry and Singh, 1974). The plant protection measures to overcome the pest problem in general include the application of insecticides. As the marketable fruits are needed to be tender for better price the harvest is regular. Coherently the usage of insecticides increases and becomes a menace for their higher level of residues and toxicity while consuming the fruits.

Considering the residual and toxic nature of pesticides, an eco-friendly method of using the host plant resistance to sustain the pest attack shall be relied as successes have been realized earlier (Nataraja *et al.,* 2013). Keeping this in view, the present study was undertaken to screen some of the germplasm/accessions of okra against sucking pests under natural field condition.

Materials and methods

The experiment was conducted at a bhendi growing belt, Dhadagoundanpatti village of Alanganallur block at Madurai district during February, 2015 to screen the okra accessions under natural infection condition. For this 30 germplasm accessions/varieties were sown for screening. The experimental materials comprised 3 rows of each accession of 3 m length with a row to row distance 60 cm and plant to plant distance of 45 cm. All the recommended cultural practices were followed to raise the crop and no plant protection measures were followed. For the screening of yellow vein mosaic virus disease of okra accessions and to find out, the level of incidence of the yellow vein mosaic virus disease incidence was recorded based on the appearance of yellowing symptom on the and fruits of the plants. The observations were made at weekly intervals to assess the YVMVD incidence and the severity grades were designated using the numerical from 0-4 on the basis of visual observations. To quantify the disease severity, the calculations were made using the per cent disease incidence with respect to the number of diseased plants and total number plants observed per plot as suggested by Bag *et al.,* (2013) of NBPGR. The per cent disease incidence (PDI) was calculated by the given formula:

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

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

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Based on the scaling, the coefficient of infection (CI) was calculated by multiplying the per cent disease incidence (PDI) to the response value (RV) assigned for each severity grade. Thus the coefficient value combined the amount of infection and its severity and PDI was not only the determining factor to differentiate between resistant and susceptible accessions. One accession showed higher PDI but as it had low severity grade, it may not be categorized as highly susceptible or susceptible. This ruled out the possibility of relationship between the PDI and their reaction to YVMD. Hence, co-efficient of infection, which was expressed as a product of the PDI and severity grade (Response Value), was more useful in selecting suitable accession resistant to YVMD.

$$CI = PDI \times RV$$

Accession/varieties used: IC 90202, IC 90203, IC 90213, IC 90214, IC 90218, IC 90219, IC 90223, IC 90285, IC 90269, IC 90270, IC 90284, IC 15438, IC 15537, IC 15027, IC 45827, IC 45828, IC 48281, IC 48948, IC14909, IC 52301, Arka Anamika, VRO 104, Kashi Pragathi, Punjab 8, Pusa Sawani, Kashi Manghali, Kashi Vibhuti, Varsha Uphar, VRO 106, PUSA A4.

Observation of the incidence of sucking pests: Aphids, Jassids, White flies: The observation on sucking pests like aphids, jassids and white fly were recorded with their occurence in field and continued till harvesting with an interval of seven days at vegetative, flowering and fruiting stages on five randomly selected plants. The intensity of the incidence of each was calculated (Anitha and Nandhihalli, 2008)

In each plant, three leaves representing the top, middle and bottom were selected and the total number of adults on each leaf was recorded during early morning hours. Totally ten plants were selected at random, and the mean population was worked out to express the population as mean number per three leaves.

Statistical analysis: The population of the sucking pest complex during the crop period was converted to mean population per plant. These values were subjected to statistical analysis (square rot transformation and grouping based on DMRT). Based on the standard deviation values, the germplasm lines were categorized as Resistant, Moderately resistant, moderately susceptible, and susceptible, and highly susceptible. The scaling procedure of Bag *et al*. (2012) was adopted for grouping.

Results and discussion

Screening against Aphids: Based on the mean aphid population of the study accessions/varieties were categorized as highly resistant, resistant, moderately resistant, moderately susceptible, susceptible, and highly susceptible.

Among the 30 accessions screened for resistance to sucking pests, the total population of aphids ranged from 3.89 to 92.46/3 leaves shown in Table 2. The aphid population was significantly less in IC 15027(3.89) and recorded as resistant category. The other accessions recorded as resistant were IC 14909 (4.34), PUSA A4 (12.74), Varsha Uphar (13.95), VRO 106(16.27), Kashi Pragathi (18.42), VRO 104 (20.16), Punjab-8 (20.70), Kashi Manghali (23.52).The only accession that showed susceptible to aphid was Pusa sawani (92.46).This is study is in conformity with Jalgaonkar, 2002.

Screening against Jassids: The population of leaf hoppers ranged from 3.20 to 88.43/ three leaves shown in Table 2. Among the 30 accessions the leaf hopper population was significantly less in IC 14909 (3.20), IC 15027 (3.74) with a resistant category. This was followed by Varsha Uphar (6.80), PUSA A4 (6.21), VRO 104(7.70), VRO106 (7.93), Kashi Manghali(8.98), Kashi Pragathi(7.03), and Punjab-8(7.90),with a resistant category. The only accession that showed susceptible to leaf hopper was Pusa sawani (88.43).This is study is in conformity with Jalgaonkar, (2002).

Screening against whiteflies: Among the 30 accessions screened for resistance to sucking pests, the total population of whitefly ranged from 7.89 to 71.43/3 leaves shown in Table 2. The whitefly population was significantly less in IC 15027 (7.89) and recorded as resistant category. The other accessions recorded as whitefly resistant were IC 14909 (8.78), PUSA A4 (9.88), Varsha Uphar (10.81), VRO 106(12.61), Kashi Pragathi (11.45),VRO 104 (12.54), Punjab-8(12.87), Kashi Manghali (14.62). The only accession showed susceptible to whitefly was Pusa sawani (71.43). This is study is in close conformity with the study of Patel *et al*. (2009) and Gonde *et* al. (2012).

Screening of okra accessions for Yellow Vein Mosaic Virus (YVMV) Disease resistance: Screening of okra accessions was done against the Yellow Vein Mosaic virus disease resistance and their level of resistance is presented in the following pattern (Table 3). The per cent disease incidence (PDI) ranged from 7.84 to 60.54 per cent. The accession IC 14909 recorded the least percent disease incidence of 7.84 per cent and exhibited the reaction as resistant one. This was followed by the accessions VRO 106 and Kashi manghali which recorded the least PDI (9.76 and 9.87) respectively and response value of different accessions ranged from 0.50 to 0.75. The response value was less in Kashi pragathi (0.25) and Varsha uphar (0.25). The Coefficient of variation varied

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between 5.18 to 45.41.The Coefficient of infection was less in IC 15027 5.18, PUSA A4 5.25 and IC 14909 5.88. The YVMV reaction showed that eight accessions recorded a resistant level, and Pusa Sawani was the only accession showed susceptiblity level to YVMV incidence.

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Table 1. Scale for screening for their reactions against the sucking pests

Symptoms	Severity grade	Response value	Coefficient of infection	Reaction
Symptoms absent	0	0.0	0-4	Highly resistant
Very mild upto 25 % leaves	1	0.25	5-9	Resistant
Appearance of symptom in 26 – 50 % of leaves	2	0.50	10-19	Moderately resistant
Appearance of symptom in 51-75 % of leaves	3	0.75	20-39	Moderately susceptible
Severe disease infection in more than 75 % of leaves	4	1.00	40-69	Susceptible
			70- 100	Highly susceptible

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Table 2. Reaction of different okra accessions/varieties against sucking pests

S.No.	Accessions	Aphids		Leaf hoppers		Whitefly	
		Population/ three leaves	Reaction	Population/ three leaves	Reaction	Population/ three leaves	Reaction
1	IC90202	32.02 (5.66)^{f}	MR	19.23 (4.39)^{h}	MR	17.76 (4.21)^{g}	MR
2	IC90203	37.34 (6.11)^{hi}	MR	22.43 (4.74)^{j}	MR	20.71 (4.55)^{j}	MR
3	IC90213	29.25 (5.41)^{e}	MR	17.56 (4.19)^{f}	MR	16.22 (4.03)^{f}	MR
4	IC90214	32.87 (5.73)^{g}	MR	19.74 (4.44)^{h}	MR	18.23 (4.27)^{h}	MR
5	IC90218	34.89 (5.91)^{h}	MR	17.83 (4.22)^{f}	MR	17.04 (4.13)^{g}	MR
6	IC90219	75.43 (8.69)^{n}	MS	20.23 (4.50)^{i}	MS	42.62 (6.52)^{m}	MS
7	IC90223	72.87 (8.54)^{l}	MS	22.74 (4.77)^{j}	MS	43.89 (6.62)^{n}	MS
8	IC90285	43.99 (6.63)^{gh}	MS	20.79 (4.56)^{i}	MR	17.49 (4.18)^{g}	MR
9	IC90269	39.64 (6.30)^{i}	MR	16.28 (4.03)^{e}	MR	19.87 (4.46)^{i}	MR
10	IC90270	31.05 (5.57)^{f}	MR	18.30 (4.28)^{g}	MR	15.56 (3.94)^{e}	MR
11	IC90284	70.76 (8.41)^{k}	MR	23.27 (4.82)^{k}	MS	48.02 (6.92)^{l}	MS
12	IC15438	82.53 (9.08)^{o}	MS	27.14 (5.21)^{m}	MS	42.69 (6.53)^{m}	MS
13	IC15537	64.64 (8.04)^{j}	MS	21.26 (4.61)^{j}	MS	45.60 (6.75)^{k}	MS
14	IC15027	3.89 (1.97)^{a}	R	3.74 (1.93)^{a}	R	7.89 (2.81)^{a}	R
15	IC45827	72.64 (8.52)^{l}	MS	23.89 (4.89)^{k}	MS	28.77 (5.36)^{l}	MS
16	IC45828	34.19 (5.85)^{h}	MR	16.74 (4.09)^{e}	MR	17.53 (4.19)^{g}	MR
17	IC48281	39.88 (6.32)^{i}	MR	19.52 (4.42)^{j}	MR	20.45 (4.52)^{j}	MR
18	IC48948	73.48 (8.57)^{m}	MS	22.14 (4.71)^{j}	MS	31.78 (5.64)^{m}	MS
19	IC14909	4.34 (2.08)^{b}	R	3.20 (1.79)^{a}	R	8.78 (5.64)^{a}	R
20	IC52301	85.70 (9.26)^{o}	MS	25.83 (5.08)^{l}	MS	37.06 (6.09)^{o}	MS
21	Arka anamika	67.12 (8.19)^{j}	MS	42.15 (6.15)^{j}	MS	49.03 (7.00)^{l}	MS
22	VRO-104	20.16 (4.49)^{d}	R	7.70 (2.77)^{c}	R	12.54 (3.54)^{c}	R
23	Kashi mangali	23.52 (4.85)^{de}	R	8.98 (3.00)^{de}	R	14.62 (3.82)^{d}	R
24	Kashi pragathi	18.42 (4.29)^{d}	R	7.03 (2.65)^{c}	R	11.45 (3.38)^{bc}	R
25	Punjab-8	20.70 (4.55)^{d}	R	7.90 (2.81)^{c}	R	12.87 (3.59)^{c}	R
26	Pusa sawani	92.46 (9.62)^{op}	S	88.43 (9.40)^{n}	S	71.43 (8.45)^{p}	S
27	Kashi vibuthi	31.23 (5.59)^{f}	MR	15.29 (3.91)^{e}	MR	16.02 (4.00)^{f}	MR
28	Varsha uphar	13.95 (3.73)^{b}	R	6.80 (2.61)^{b}	R	10.81 (3.29)^{b}	R
29	VRO 106	16.27 (4.03)^{c}	R	7.93 (2.82)^{c}	R	12.61 (3.55)^{c}	R
30	PUSA A4	12.74 (3.57)^{b}	R	6.21 (2.49)^{b}	R	9.88 (3.14)^{ab}	R
	SE.d	0.12		0.13		0.13	
	CD	0.21		0.23		0.23	

Figures in Paranthesis are square root transformed values
In Column, means followed by same letter(s) are not significantly different at P=0.05 by DMRT
MPP: Mean population per plant, LR: Level of Resistance, HR: Highly resistant, R: Resistant, MR: Moderately Resistant, MS: Moderately susceptible, S: Susceptible, HS: Highly susceptible.

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Table 3. Field screening of different okra accessions for Yellow Vein Mosaic Virus (YVMV) disease resistance

S.No.	Accessions	PDI	RV	CI	Reaction
1	IC90202	22.78	0.50	11.39	MR
2	IC90203	24.64	0.50	12.32	MR
3	IC90213	26.32	0.50	13.16	MR
4	IC90214	34.54	0.50	17.27	MR
5	IC90218	20.21	0.75	15.16	MR
6	IC90219	37.99	0.75	28.49	MS
7	IC90223	30.98	0.75	23.24	MS
8	IC90285	19.23	0.75	14.42	MR
9	IC90269	28.90	0.50	14.45	MR
10	IC90270	34.87	0.50	17.44	MR
11	IC90284	45.43	0.50	22.72	MS
12	IC15438	52.41	0.50	26.21	MS
13	IC15537	65.42	0.50	32.71	MS
14	IC15027	10.35	0.50	5.18	R
15	IC45827	43.44	0.75	32.58	MS
16	IC45828	25.47	0.50	12.74	MR
17	IC48281	27.65	0.50	13.83	MR
18	IC48948	29.69	0.75	22.27	MS
19	IC14909	7.84	0.50	5.88	R
20	IC52301	38.54	0.74	28.52	MS
21	VRO-104	16.54	0.50	8.27	R
22	Kashi mangali	9.87	0.50	7.40	R
23	Kashi pragathi	26.72	0.25	6.68	R
24	Kashi vibuthi	36.98	0.50	18.49	MR
25	Arka anamika	56.67	0.50	28.34	MS
26	Punjab-8	17.43	0.50	8.72	R
27	Varsha uphar	25.54	0.25	6.39	R
28	VRO 106	9.76	0.50	7.32	R
29	PUSA A4	10.50	0.50	5.25	R
30	Pusa sawani	60.54	0.75	45.41	S
	S.Ed		0.13		
	C.d		0.23		

PDI-Percent Disease incidence; RV-Response value; CI-Coefficient of Infection