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Tomato and Brinjal Germplasm Screening and Rootstock Identification for Fusarium Wilt Resistance

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Fusarium oxysporum is a destructive disease of tomato (*Solanum lycopersicum* L.) that causes large yield losses in fields and commercial greenhouses, implying the need for disease resistance research. The current study was conducted in *Rabi* - 2021 at the Postgraduate Research Block, Department of Vegetable Science, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. In the present study, 25 genotypes of tomato and brinjal were studied for Fusarium wilt resistance at morphological level. Scoring of Fusarium wilt infection severity based on morphological symptoms revealed five groups *viz.,* asymptomatic/no chlorosis in one cultivar (*Solanum torvum*) slight chlorosis of leaves in two genotypes (Arka Keshav and Surya), Moderate chlorosis with wilting or stunting of the plant in ten genotypes (EC-620509, EC-615055, EC-620378, EC-620389, EC-620394, EC-620422, EC-631369, AVTO-9803, EC-620428 and EC-631379), severe chlorosis with wilting and stunting of the plant in four genotypes (EC-620503, LA-1589, Marutham and PKM-1) and plant death was observed in eight genotypes (EC-620441, EC-620452, LA -0490, Money maker, Pusa rohini, Pusa sheethal, including susceptible checks (Pusa Ruby and Arka Vikas). Genotypes exhibiting Fusarium wilt resistance will be grafted on to commercial variety of tomato and evaluated under open field conditions for yield, quality parameters and disease resistance under Telangana conditions.

Keywords: Tomato; brinjal; fusarium Wilt; genotypes.

1. INTRODUCTION

Fusarium oxysporum is major soil borne fungal pathogens of both greenhouse and field grown tomatoes in the warm vegetable growing areas of the world Rosewich et al. [1]. *Fusarium oxysporum* penetrates the roots mainly through wounds and proceeds into and throughout the vascular system, leading to functional collapse, systemic wilting and often the death of the infected plant. *Fusarium oxysporum f.* sp. *lycopersici* (FOL) causes disease only in plants of the genus *Lycopersicon* by Rowe [2] and inhabits most tomato growing regions worldwide, causing tomato production yield losses Staniazsek et al. [3].

This fungus responsible for vascular wilt disease in tomato and infects the vascular system of roots, inhibiting water transport, which in turn results in rapid plant death Malhotra et al. [4]; McGrath et al. [5]. The first symptom of fusarium wilt in gardens and fields is usually the golden yellowing of a single leaflet or shoot, or a slight wilting and drooping of the lower leaves on a single stem. Yellowed and wilted leaflets drop early. Affected plants turn to bright yellow, wilt, dry up, and usually die before maturity. Three physiologic races of FOL, named 1, 2 and 3 in order of their discovery by Booth [6]; Grattidge and Obrien [7] are traditionally distinguished by each having a specific pathogenicity to tomato cultivars.

2. MATERIALS AND METHODS

The experimental material comprised of 15 germplasm lines, 9 released varieties and 1 wild species (Table 1) which were obtained from NBPGR, Regional Station, Hyderabad; IARI, New Delhi; IIHR, Bengaluru; TNAU, Periyakulam; UC DAVIS, California, USA; TNAU, Coimbatore; KAU, Thrissur, and COE, Jeedimetla. All the cultivars were evaluated systematically during the research period. The experiment was laid out with Twenty-five genotypes of tomato and brinjal in Randomized Block Design (RBD) with three replications during *Rabi*, 2021 at PG Students Research Block of the College of Horticulture, Rajendranagar, Hyderabad (Plate 1).

Fusarium oxysporum f. sp. *lycopersici* infected tomato plants showing characteristics symptoms were collected from Noble seeds private limited, Bengaluru. The diseased samples were carefully placed in polythene bags, properly tagged and brought to the laboratory and subjected to microscopic examination and tissue isolation. The infected samples were washed with running tap water to remove soil particles and then cut into small bits with the help of a sterilized scalpel, about 5mm size involving healthy as well as diseased portion from root portions showing characteristic diseased symptoms like browning of vascular tissue.

Plate 1. Screening the tomato and brinjal germplasm for fusarium wilt

The tissue bits were surface sterilized with 1 per cent sodium hypochlorite solution for 40-60 seconds followed by rinsing twice in sterilized distilled water to remove traces of sodium hypochlorite. These surface sterilized pieces were transferred on to sterilized tissue paper and allowed to air dry for two minutes. Later, four tissue bits were transferred on Potato Dextrose Agar (PDA) in Petri plates under aseptic conditions. Plates were incubated at 26±2 °C in BOD incubator for 3 to 4 days.

Early growing fungal mycelia was transferred to another PDA plats and allowed to grow for next seven days at 26±2 °C. The culture was further purified by growing hyphal tips produced on such plates and maintained on PDA slants for further use. The pathogen was identified as *F. oxysporum* f. sp. *lycopersici* based on morphological characteristics. Pathogenicity was demonstrated for the isolated pathogen. The pathogen was sub-cultured at monthly intervals and maintained at 4 °C in a refrigerator.

One week (7 days) old *F. oxysporum f. sp. lycopersici* cultures, grown on PDA plates, were flooded with about 10ml of sterile distilled water and the conidia were dislodged with a cell spreader, filtered through cheese cloth, and counted with a haemocytometer. The concentration was adjusted to 10^6 conidia per ml. For obtaining large amounts of the spore suspension, the fungus was grown on maize (solid substrate), 50g of maize was added to 250ml conical flasks to which 60% of distilled water was added, autoclaved, inoculated with 1ml spore suspension of *F. oxysporum* and incubated for 7 days. Sterile distilled water was added to these cultures and the spore suspension was adjusted to 10^6 conidia per ml. The spore suspension was used for further pathogenicity assay.

Solid substrate served as a better medium for obtaining large amount of spore suspension Nirmala devi and Srinivas [8]. 25 genotypes of tomato and brinjal were sown in pro trays filled with cocopeat and watered regularly. Twenty days old healthy seedlings were selected and used for further pathogenicity test. Twenty days old seedlings were inoculated by standard root dip method. Conidia of all the isolates were recovered from one week old cultures.

Seedlings were removed from the portrays, shaken to remove the adhering particles and washed carefully under tap water. The roots were trimmed with a sterile scissor and were

Table 1. List of tomato and brinjal genotypes used for disease screening along with their sources

S. No	Name of the variety/accession	Source
1	EC-620509	NBPGR, Hyderabad
2	EC-615055	NBPGR, Hyderabad
3	EC-620428	NBPGR, Hyderabad
4	EC-620378	NBPGR, Hyderabad
5	EC-620389	NBPGR, Hyderabad
6	EC-620394	NBPGR, Hyderabad
7	EC-620422	NBPGR, Hyderabad
8	EC-631369	NBPGR, Hyderabad
9	EC-620503	NBPGR, Hyderabad
10	AVTO-9803	NBPGR, Hyderabad
11	EC-631379	NBPGR, Hyderabad
12	EC-620441	NBPGR, Hyderabad
13	EC-620452	NBPGR, Hyderabad
14	LA-1589	UC, DAVIS, California, USA
15	LA -0490	UC, DAVIS, California, USA
16	Money maker	UC, DAVIS, California, USA
17	Marutham	TNAU, Coimbatore
18	Pusa rohini	IARI, New Delhi
19	Pusa sheethal	IARI, New Delhi
20	Pusa ruby	IARI, New Delhi
21	PKM-1	TNAU, Periyakulam,
22	Arka Vikas	IIHR, Bengaluru
23	Arka Keshav	IIHR, Bengaluru
24	Surya	KAU, Thrissur
25	*Solanum torvum*	COE, Jeedimetla

submerged in the conidial suspension for 30 minutes. The inoculated seedlings were transplanted to mini polybags, 15cm diameter, surface sterilized with 0.1% mercuric chloride Dubey and Singh [9] containing soil and sand 1:1 ratio.

2.1 Procedure for Screening Fusarium Wilt

Two kgs of sorghum grains were soaked in water overnight in flasks. The excess water which is left after maximum absorption by different grain substrate was drained off and the flasks containing soaked grains were plugged and autoclaved at 15 psi pressure for 30 minutes. The substrate in flasks was inoculated with actively growing 5 mm mycelial disc of the pathogen under aseptic conditions and inoculated flasks were incubated at 25±1^{0}C in BOD incubator.

Fusarium oxysporum f. sp. lycopersici mass multiplied on sterilize sorghum grains, each @ 5g/kg of soil were added to the pots/poly bags. One plant per pot/polybag was maintained. The data was recorded at 30 days after inoculation (DAI) and per cent disease incidence was calculated. The reaction of each genotype was categorized based on per cent disease incidence. The disease reaction was calculated as per the scale suggested by Morid et al. [10].

2.1.1 Data on percentage of fusarium wilt incidence for twenty-five genotypes were recorded and presented as per the disease scale given by Morid et al. [10].

0- No symptoms
1- Slight chlorosis, wilting or stunting of the plant.
2- Moderate chlorosis, wilting or stunting of the plant.
3- Severe chlorosis, wilting or stunting of the plant.
4- Death of the plant.

2.1.2 Per cent disease incidence

Per cent disease incidence was calculated by using following formula,

Per cent disease incidence = Number of plants infected / Total number of plants planted x 100

3. RESULTS AND DISCUSSION

The percent disease incidence in genotypes was ranged from 0% to 100% (Table 2). Lowest per cent of disease incidence (0.00%) was observed in *Solanum torvum*. Highest per cent of disease incidence was found in genotypes *viz.,* Pusa sheethal (100%), EC-620452(100%), LA-0490 (91.66%), EC-620441 (91.66%), Money maker (83.33%), Pusa rohini (83.33%) including susceptible checks (Pusa Ruby 100% and Arka Vikas83.33%). Arka Keshav and Surya recorded 8.33%, 16.66% disease incidence respectively. Genotypes *viz.,* EC-620509, EC-615055, EC-620378, EC-620389, EC-620394, EC-620422, EC-631369, AVTO-9803, EC-620428 and EC-631379 recorded 50.00%, 33.33%, 33.33%, 41.66%, 50.00%, 41.66%, 33.33%, 50.00%, 50.00% and 41.66% disease incidence respectively. EC-620503, LA-1589, Marutham and PKM-1 recorded 58.33% disease incidence respectively (Fig. 1).

Out of 25 genotypes, fusarium wilt incidence was reported ranging from 0 to 4 scores according to Morid *et. al* (2012). Among these *Solanum torvum* is highly resistant (HR) to fusarium wilt with “0” score. Arka Keshav and Surya were resistant (R) to fusarium wilt with 0.33 and 0.67 score respectively (Table 3).

Genotypes *viz.,* EC-620509, EC-615055, EC-620378, EC-620389, EC-620394, EC-620422, EC-631369, AVTO-9803, EC-620428 and EC-631379 were moderately resistant (MR) to fusarium wilt with scores *i.e.* 2.00, 1.33, 1.33,1.67, 2.00, 1.67, 1.33, 2.00, 2.00 and 1.67 respectively. EC-620503, LA-1589, Marutham and PKM-1 recorded 2.33 score were moderately susceptible (MS) to fusarium wilt. Pusa sheethal, EC-620452, LA -0490, EC-620441, Money maker, Pusa rohini including susceptible checks Pusa Ruby and Arka Vikas were susceptible (S) and highly susceptible (HS) to fusarium wilt recorded score *viz.,* 4.00, 4.00, 3.67, 3.67, 3.33, 3.33, 4.00 and 3.33 respectively.

These results were in uniformity with the findings of Chaudhary and Sharma [11], Gousset et al*.* [12], Mahmoud et al*.* [13, Ahmadvand et al*.* [14], Bahattin et al. [15], Akansha Pandey and Sanjeev Dubey [16], Antonio et al*.* [17], Biswas and Ghosh [18], Latifah et al*.* [19] and Sushma et al. [20].

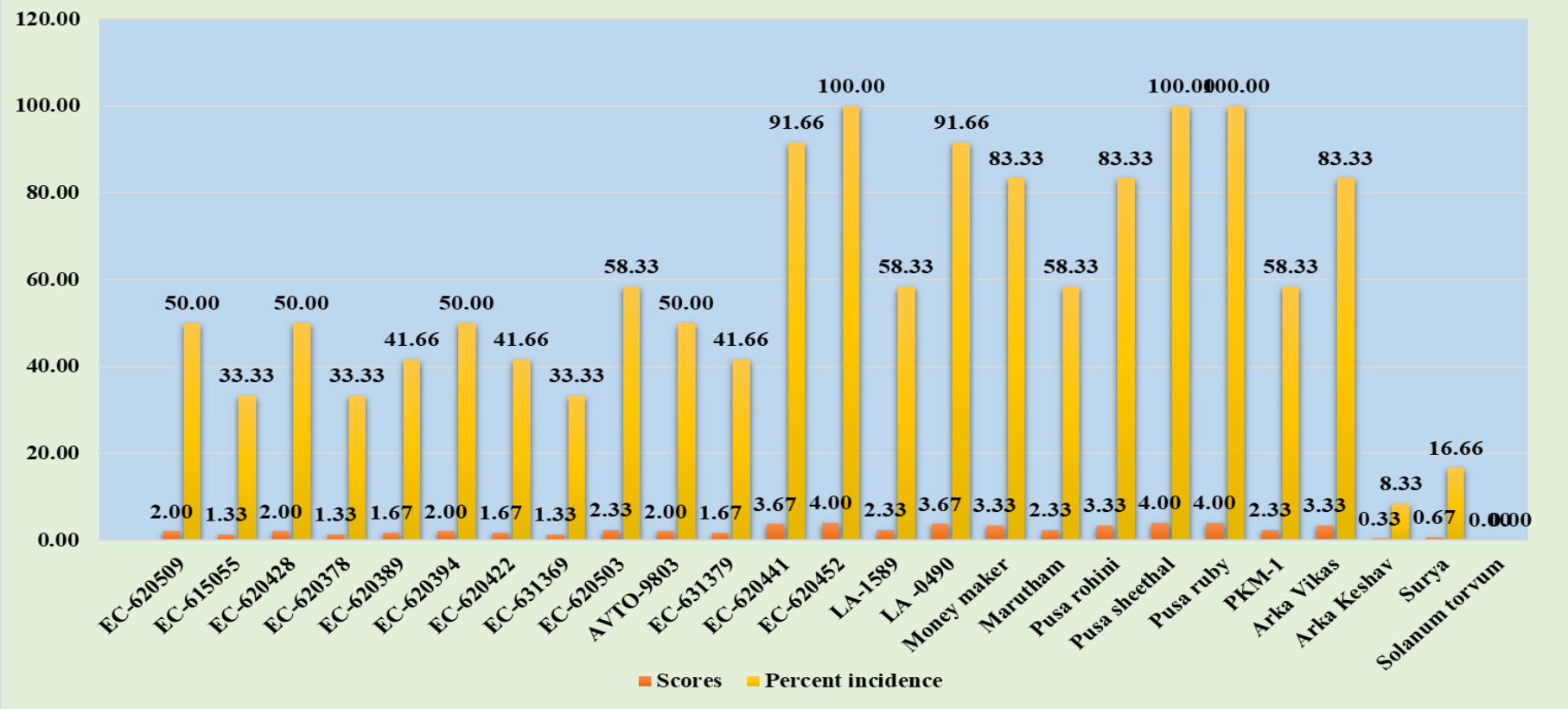

Fig. 1. Scores and percent incidence of fusarium wilt in 25 genotypes of tomato and brinjal

Table 2. Scores and percent incidence of fusarium wilt in 25 genotypes of tomato and brinjal

S. no	Name of the genotypes	Score	Percent incidence (%)
1	EC-620509	2.00	50.00
2	EC-615055	1.33	33.33
3	EC-620428	2.00	50.00
4	EC-620378	1.33	33.33
5	EC-620389	1.67	41.66
6	EC-620394	2.00	50.00
7	EC-620422	1.67	41.66
8	EC-631369	1.33	33.33
9	EC-620503	2.33	58.33
10	AVTO-9803	2.00	50.00
11	EC-631379	1.67	41.66
12	EC-620441	3.67	91.66
13	EC-620452	4.00	100.00
14	LA-1589	2.33	58.33
15	LA -0490	3.67	91.66
16	Money maker	3.33	83.33
17	Marutham	2.33	58.33
18	Pusa rohini	3.33	83.33
19	Pusa sheethal	4.00	100
20	Pusa ruby	4.00	100
21	PKM-1	2.33	58.33
22	Arka Vikas	3.33	83.33
23	Arka Keshav	0.33	8.33
24	Surya	0.67	16.66
25	*Solanum torvum*	0.00	0.00
		S.Em±	5.75
		SD	28.76

Table 3. Disease reaction of tomato and brinjal genotypes for fusarium wilt incidence

S. no	Reaction	Score	Number of genotypes	Genotypes
1.	Highly resistant (HR)	0	1	*Solanum torvum*
2.	Resistant (R)	1 (0-1)	2	Arka Keshav, Surya
3.	Moderately resistant (MR)	2 (1-2)	10	EC-620509, EC-615055, EC-620378, EC-620389, EC-620394, EC-620422, EC-631369, AVTO-9803, EC-620428, EC-631379
4.	Moderately susceptible (MS)	3 (2-3)	4	EC-620503, LA-1589, Marutham, PKM-1
5.	Susceptible (S) and Highly Susceptible (HS)	4 (3-4)	8	EC-620441, EC-620452, LA -0490, Money maker, Pusa rohini, Pusa sheethal, Pusa ruby, Arka Vikas

4. CONCLUSION

Identification of resistant source for any disease is one of the best methods for management. In the current study, an effort was made to screen 25 genotypes of tomato and brinjal against Fusarium wilt. Out of 25 genotypes screened, *Solanum torvum* is highly resistant (HR) with “0” score, Arka Keshav and Surya were resistant (R) to Fusarium wilt with 0.33 and 0.67 score respectively. This screening of genotypes will further help to utilize in the crop improvement programme.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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