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Screening of Brinjal and Tomato Cultivars for Resistance against Fusarium Wilt (*Fusarium oxysporum* f.sp. lycopersici) before and after Grafting

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ABSTRACT

A poly bag experiment was conducted to screen brinjal and tomato cultivars against Fusarium wilt to identify resistant rootstocks before grafting of tomato cultivars to increase production. The experiment was conducted with four Brinjal cultivars (*Solanum torvum*, Manjusree, Utkarsha and kirti) and ten tomato cultivars (US-440, Abhiman, Sahoo, Sweakar, Ayaan, Arka abhed, Arka samrat, Ansar, JK Ratan, Aryaman). Among the brinjal cultivars, Solanum *torvum* (score 0.00) was found to be highly resistant, Utkarsha (score 6.67) was found to be resistant and among tomato cultivars, US- 440, Abhiman, Sahoo, Sweakar, Ayaan, Arka abhed were identified as susceptible (per cent disease incidence 33.3 to 46.67) to fusarium wilt. Screened susceptible tomato cultivars were used as scions for grafting on resistant Solanum *torvum* and Utkarsha rootstocks. Results revealed that susceptible tomato cultivars grafted on *Solanum torvum* and Utkarsha rootstocks showed defence mechanism against Fusarium wilt because the rootstock produces chemicals and enzymes that break down fungal cells and has more lignified cells in its roots resulting in improved tolerance.

Key words: *Screening, Fusarium, Grafting, Root stock, Scion, Solanum torvum, Tomato, Utkarsha.*

Introduction

Tomato (*Solanum lycopersicum* L.) is a significant vegetable crop and is well known for its utilization as fresh vegetable and in processed foods such as tomato paste, tomato juice, ketchup, canned tomatoes that provide high nutritional value for its consumers worldwide. Fresh tomato fruit is in high demand throughout the country all-round the year. The main limitations on tomato production are biotic stressors, mainly pests and pathogens including viruses, fungi resulting in yield losses and abiotic stressors (Bai and Lindhout, 2007; Vitale *et al*., 2014). Hence, there is a need to strengthen the crop improvement programs in tomatoes to incorporate abiotic and biotic stress resistance. Among the biotic stresses, fusarium wilt is the major cause for yield losses. However, crop improvement programs need a significant amount of time to develop resistant varieties. Finding suitable host-resistant strategy (Grafting) is an alternative method that uses resistant rootstocks for susceptible scions (Guan *et al*., 2012) for promoting plant survival rate, decreasing soil-borne pathogen infection by increasing toler-

ance against fusarium wilt. Therefore, the study aims to assess the scions of inter - specific grafted tomatoes for *Fusarium oxysporum* m f.sp. lycopersici resistance by grafting resistant Brinjal rootstocks with susceptible tomato scions.

Materials and Methods

The polybag experiment was conducted by using completely randomized design (CRD) in three replications with four Brinjal cultivars (*Solanum torvum*, Manjusree, Utkarsha and kirti) and ten tomato cultivars (US-440, Abhiman, Sahoo, Sweakar, Ayaan, Arka abhed, Arka samrat, Ansar, JK Ratan, Aryaman) in open field at Loyola farm, Secunderabad. In this experiment, Brinjal and tomato seeds were sown in plug trays. After 20 days these seedlings were then used for further pathogenicity testing against *Fusarium oxysporum* f. sp. *lycopersici* to evaluate the resistance or susceptibility of the Brinjal and Tomato cultivars to the pathogen. The selected seedlings served as the experimental material for the study. Mass multiplication of Fusarium was carried out by following the standard procedure in which two kilograms of sorghum grains were soaked in water overnight in flasks. After maximum water absorption, the excess water was drained off. The flasks containing soaked grains were plugged and autoclaved at 15 psi pressure for 30 minutes to sterilize them. Under aseptic conditions, each flask was inoculated with a 5 mm mycelial disc of *Fusarium oxysporum* f. sp. *lycopersici*. The inoculated flasks were incubated at 25±1°C in a BOD incubator to allow the pathogen to grow and multiply on the sorghum grains. The mass-multiplied *Fusarium oxysporum* f. sp. *lycopersici* on sterilized sorghum grains was added to the poly bags at a rate of 5g/kg of soil. One plant per polybag was maintained for the study. Data was recorded at 30 days after inoculation (DAI), and the percentage of disease incidence was calculated for each cultivar. The reaction of each cultivar to Fusarium wilt was categorized based on the percentage of disease incidence. The disease reaction was assessed using the scale suggested by Morid *et al*. (2012). This scale was used to classify the cultivars based on their resistance or susceptibility to Fusarium wilt. Thus, two resistant brinjal rootstocks and six susceptible tomato scions were screened and grafted. Data on percentage of fusarium wilt incidence for fourteen treatments before grafting and twelve treatments after grafting were recorded and presented as per the disease scale given by Morid *et al*., 2012.

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.

Per cent disease incidence was calculated by using the formula

$$\text{Per cent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants planted}} \times 100$$

Results and Discussion

Results revealed that under poly bag culture, all the four brinjal cultivars and ten tomato cultivars exhibited different scores and percent disease incidence against fusarium wilt.

However, among the fourteen cultivars one wild brinjal *Solanum torvum* exhibited no symptoms and was found to be highly resistant. The score and percent disease incidence of two tomato cultivars was recorded as Arka Samrat (0.67, 6.67), Ansar (0.33,6.67) and one brinjal hybrid Utkarsha (0.33, 6.67) were found to be resistant. Among the tomato cultivars JK Ratan (1.33, 20.00) was found to be

Table 1. Disease reaction of Brinjal and Tomato cultivars for fusarium wilt incidence before grafting

S.No	Reaction	Score	Number of Cultivars	Cultivars
1.	Highly resistant (HR)	0	1	*Solanum torvum* (Brinjal)
2.	Resistant (R)	1 (0-1)	3	Arka Samrat and Ansar (Tomato), Utkarsha (Brinjal)
3.	Moderatelyresistant (MR)	2(1-2)	1	JK -Ratan (Tomato)
4.	Moderately susceptible (MS)	3(2-3)	1	Aryaman (Tomato)
5.	Susceptible (S) and Highly Susceptible (HS)	4 (3-4)	8	Manjusree, Kirti, (Brinjal) US -440, Abhiman, Sahoo, Sweakar, Ayaan, Arka abhed (Tomato)

moderately resistant, Aryaman (2.33, 26.67) moderately susceptible and two brinjal hybrids Manjusree (4.00, 86.67) and Kirti (4.33, 93.33) to be highly susceptible. The score and per cent disease incidence of six tomato cultivars ranged from 3.33 to 3.67 and 33.33 to 46.67 respectively and were found susceptible (Table 3). Twelve grafted tomato plants were also tested against fusarium wilt. The results revealed that Abhiman and US 440 grafted on *Solanum torvum* showed no symptoms and were highly resistant, whereas Sweakar (0.66, 13.33) was shown to be moderately resistant. Among the tomato cultivars grafted on Utkarsha, Sahoo and Ayaan (1.00, 20.00) were found to be moderately susceptible, whereas US-440 and Abhiman (0.33, 6.66) were found to be resistant (Table 4). This study clearly indicates that the use of resistant Brinjal rootstocks in grafting is an effective strategy to control soil-borne pathogen *Fusarium oxysporum* f. sp. lycopersici. The study is supported in accordance with Guan *et al.*, 2012. Specific combinations of heterografts applied as rootstock/stem are beneficial not only to build a rootstock-induced systemic defence against several soil pathogens but also for increased vegetative growth, yield and fruit quality (Rivard and Louws, 2008). Similar results were also reported by Tepper and Anderson (1984) who stated that higher content of total phenol observed during the process of reaction between host cells and pathogen might be responsible for exhibiting resistance mechanism against disease after inoculation with pathogen. The increased production of phenolics above the critical level is cytotoxic and might have contributed to increased cell death in susceptible genotypes and thereby to its hypersensitive reaction to the diseases.

Conclusion

In this poly bag experiment, it was concluded that the selected brinjal rootstocks *Solanum torvum* and Utkarsha were best for preventing wilt caused by *Fusarium oxysporum*. The use of heterograft (Brinjal

Table 2. Disease reaction of Brinjal and Tomato cultivars for fusarium wilt incidence after grafting

S.No	Disease reaction	Score	Total	Treatment
1.	Highly resistant(HR)	0	2	R_1S_1, R_1S_2,
2.	Resistant (R)	1(0-1)	10	R_1S_3, R_1S_4, R_1S_5, R_1S_6, R_2S_1, R_2S_2, R_2S_3, R_2S_4, R_2S_5, R_2S_6
3.	Moderately resistant(MR)	2(1-2)	-	-
4.	Moderately susceptible (MS)	3(2-3)	-	-
5	Susceptible (S) and Highly susceptible (HS)	4(3-4)	-	-

Table 3. Scores and per cent disease incidence of fusarium wilt of Brinjal and Tomato cultivars before grafting

S.No.	Name of the cultivar	Score	Disease reaction	Per cent disease incidence (%)
1	*Solanum torvum*	0.00	HR	0.00
2	Utkarsha	0.33	R	6.67
3	Manjusree	4.00	HS	86.67
4	Kirti	4.33	HS	93.33
5	US -440	3.33	S	33.33
6	Abhiman	3.67	S	46.67
7	Sahoo	3.67	S	40.00
8	Sweakar	3.33	S	40.00
9	Ayaan	3.33	S	46.67
10	Arka abhed	3.67	S	33.33
11	Arka samrat	0.67	R	6.67
12	Ansar	0.33	R	6.67
13	JK Ratan	1.33	MR	20.00
14	Aryaman	2.33	MS	26.67
	S.Em ±	0.17		2.38
	CD	0.24		3.36

Note: HR - Highly resistant, R- Resistant, MR -Moderately resistant, MS -Moderately susceptible S- Susceptible, HS - Highly Susceptible.

Table 4. Scores and per cent disease incidence of fusarium wilt of Brinjal and Tomato cultivars after grafting

S. No.	Treatment	Score	Per cent disease incidence (%)
1	R_1S_1	0.00	0.00
2	R_1S_2	0.00	0.00
3	R_1S_3	0.33	6.66
4	R_1S_4	0.66	13.33
5	R_1S_5	0.33	6.66
6	R_1S_6	0.33	6.66
7	R_2S_1	0.33	6.66
8	R_2S_2	0.33	6.66
9	R_2S_3	1.00	20.00
10	R_2S_4	0.66	13.33
11	R_2S_5	1.00	20.00
12	R_2S_6	0.66	13.33
	S.Em±	0.025	0.49
	CD	0.035	0.68

NOTE: R_1S_1- US-440 grafted on *Solanum torvum*, R_1S_2 – Abhiman grafted on *Solanum torvum*, R_1S_3- Sahoo grafted on *Solanum torvum*, R_1S_4 - Sweakar grafted on *Solanum torvum*, R_1S_5 - Ayan grafted on *Solanum torvum*, R_1S_6-Arka abhed grafted on *Solanum torvum*; R_2S_1 - US-440 grafted on Utkarsha, R_2S_2 - Abhiman grafted on Utkarsha, R_2S_3 - Sahoo grafted on Utkarsha, R_2S_4 - Sweakar grafted on Utkarsha, R_2S_5 - Sweakar grafted on Utkarsha, R_2S_6- Sweakar grafted on Utkarsha.

/tomato) combination was more advantageous over homografts due to higher resistance. Among the grafted tomato cultivars Abhiman and US-440 grafted on *Solanum torvum* showed no symptoms and were highly resistant for *Fusarium oxysporum.* This specific combination of heterografts can be utilized for further study.

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Conflict of Interest

No conflict of interest

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