



## Research Note

### Screening of tomato hybrids for bacterial wilt (*Ralstonia solanacearum*) resistance under field condition

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#### Abstract

Bacterial wilt is caused by *Ralstonia solanacearum* is a most destructive and prevalent disease in worldwide causing enormous yield losses in tomato. In the present study, eight parental lines along with their twenty-eight F<sub>1</sub> hybrids were evaluated against bacterial wilt. Among the parents, two parents CHFT-71 and CHFT-50, showed moderately resistant against wilt. However, none of the parents recorded a highly resistant and immune to the bacterial wilt. Only single cross, CHFT-71×CHFT-50 showed a wilt resistant and four hybrids namely, CHFT-77×CHFT-71, CHFT-79×CHFT-50, CHFT-60×CHFT-50 and H-86×CHFT-50 were found to be moderately resistant against wilt. These five hybrids can be recommended for further evaluation. The promising parental lines can be utilised for the improvement of varieties and development of wilt resistant F<sub>1</sub>'s through hybrid breeding programmes.

#### Keywords

Tomato, hybrids, Bacterial wilt, resistance

Tomato (*Solanum lycopersicum* L.) attracts the farmers for cultivation throughout the year due to low input cost, short duration and wider adaptability (Naika *et al.*, 2005; Tiwari *et al.*, 2012). It is one of the most important fruit vegetable crop of solanaceae family, grown throughout the world (Singh *et al.*, 2005). It contains vitamin C and lycopene, an antioxidant and anticancerous properties. India produced 19.67 million tonnes in 0.81 million hectares with an average productivity of 22.2 tonnes per hectare (Anonymous, 2017). But the production may be significantly reduced by attack of several insect, pest and diseases (Kayani *et al.*, 2017) including post-harvest losses (Regassa *et al.*, 2012).

Bacterial wilt caused by bacterium *Ralstonia solanacearum* is one of the most vital and devastating disease that badly influence the establishment and production of tomato, brinjal, chilli and other solanaceous crops in worldwide (Poussier *et al.*, 1999). In India, a study

showed 10 to 100% incidence of bacterial wilt during the summer (AVRDC, 2005). In the tomato, yield losses by the bacterial wilt may vary according to the host, strain, cultivar, and environment from 0 - 91% (Elphinstone, 2005). There are many problems linked with controlling *Ralstonia solanacearum*, because of its capabilities to survive in soil (even in deeper layers), move along water and association with weeds (Wang and Lin, 2005).

Development of genetically controlled resistance in tomato is the only feasible means of controlling the bacterial wilt. The heterosis breeding is one of the most effective and eco-friendly method that can be managing the disease by transferring the resistant genes through hybridisation. Therefore, it is necessary to screen and identify the resistant/tolerant parents and their hybrids of tomato against bacterial wilt disease so that these can further be utilized in breeding programmes as a source of resistance to this fungal disease.

The research work was carried out during Rabi (October-March), 2015 at the Vegetable Experimental Farm, Department of Vegetable Science, CHF, CAU, Arunachal Pradesh, India, which is geographically situated between 28°04'N latitude and 95°22'E longitude at an elevation of 153 meters above the mean sea level. The climate of this area is tropical humid during summer and mild dry during winter. A dry local seasonal wind blows throughout the winter. The soil of experimental site is sandy loam and infected with *Ralstonia*. The experiment was comprised of eight diverse and homozygous tomato parental lines viz., DVRT-1, DVRT-2, H-86, CHFT-50, CHFT-60, CHFT-71, CHFT-77 and CHFT-79. They were sown in crossing block, during rabi and 28 F<sub>1</sub> hybrids developed by crossing them in diallel technique excluding reciprocals. The experimental resources were procured from IIVR, Varanasi, U.P. (India) and CHF, CAU, A.P. (India) followed by selfing for maintenance.

The experiment was laid out in a Randomized Complete Block Design with three replications to assess the performance of 28 F<sub>1</sub> hybrids and their 8 parental lines against bacterial wilt. The seedlings were transplanted in *Ralstonia* infected soil, rows spaced at 60 cm with plant-to-plant spacing of 45 cm apart. Twenty plants were maintained in each entry of 28 F<sub>1</sub> hybrids and their 8 parental lines. After transplanting, the percentage of wilted plants were recorded daily. To identify the bacterial wilt, a simple diagnostic method (ooze test) was followed in the field i.e., dipping the lower cut ends of wilted plant in a clear glass of water for few minutes, if a stream of milky white bacterial ooze observes in a glass, then it confirms the bacterial wilt (Ramesh, 2008). The number of wilted plants was calculated and mortality per cent was recorded by using the formula and further classified into 0-5 scale (Table 1.) as per the scale given by Mew and Ho (1976).

**Table 1. The mortality per cent and scored as per the scale given by Mew and Ho (1976)**

Scale	Mortality (%)	Reaction
0	0	Highly Resistant (HR)
1	1 to 10	Resistant (R)
2	>10 to 20	Moderately Resistant (MR)
3	>20 to 30	Moderately Susceptible (MS)
4	>30 to 70	Susceptible(S)
5	>70 per cent	Highly Susceptible (HS)

CHFT-60×CHFT-79, DVRT-1×DVRT-2, DVRT-2×CHFT-60 and DVRT-2×CHFT-50. The screening of twenty-eight F<sub>1</sub> hybrids of tomato against bacterial wilt disease revealed that, none of the genotype was found highly resistant (Table 4).

Only one cross (CHFT-71×CHFT-50) showed resistant response against the wilt disease. Four tomato hybrids i.e., CHFT-77×CHFT-71, CHFT-79×CHFT-50, CHFT-60 × CHFT-50 and H-86×CHFT-50 were found to be moderately resistant against wilt. Resistance to bacterial wilt in tomato is partially recessive (Monma *et al.*, 1997). However, nine

$$\text{Mortality percent (\%)} = \frac{\text{Number of plants infest}}{\text{Total number of plant}} \times 100$$

Response of parental lines against wilt: In susceptible genotypes, wilting of the tomato seedlings were started in a week after transplanting, while resistant ones took two weeks to show the symptoms. Leaves drooping is the primary symptom followed by the entire plant sagging within a few days. In severe infection, brown discoloration in vascular system was also observed in transverse cut part of susceptible plants (AVRDC, 2005). The range of susceptibility against wilt in parental lines varied from 2.67 (CHFT-50) to 11.33 plants (CHFT-60). The lowest mortality rate was recorded in parent CHFT-50 (13.33 %) along with CHFT-71 (20.00 %) reflects the moderate resistance (Table 2.). Dutta and Rahman (2012) also recorded the minimum mortality rate 8.98 % in All Rounder cultivar. Parents DVRT-2, CHFT-77 and CHFT-60 were found to be susceptible, whereas DVRT-1, CHFT-79 and H-86 were found to be moderate susceptible to wilt (Table 3). None of the tomato genotype was found to be highly resistance against the bacterial wilt. Among the 8 parents, two genotypes (CHFT-71 and CHFT-50) were found to be moderately resistant against the wilt.

Response of F<sub>1</sub> crosses against wilt: The hybrids of tomato confirmed different reactions in expression of *Ralstonia solanacearum* resistance. The results showed that the number of wilted plants and mortality rate in hybrid evaluation were ranged from 1.33 to 10.00 plants and 6.67 % to 50.00 %, respectively (Table-2). Minimum mortality rate was observed in CHFT-71×CHFT-50 followed by CHFT-77×CHFT-71, CHFT-79×CHFT-50, CHFT-60×CHFT-50 and H86×CHFT-50. However, maximum mortality recorded in DVRT-2×CHFT-71 followed by

crosses were recorded as moderately wilt susceptible namely, DVRT-1×CHFT-79, DVRT-1 ×CHFT-50, DVRT-2×CHFT-77, DVRT-2×H-86, CHFT-77×CHFT-60, CHFT-77×CHFT-79, CHFT-60×H-86, CHFT-60×CHFT-71 and CHFT-79×CHFT-71. For the development of sturdy *Ralstonia solanacearum* resistant hybrids, it is necessary that both the parents should have resistance genes at different loci for improved resistance in suitable genetic background. Although, the chances of linkage drag with wilt resistance cannot be ignored entirely (Jyothi *et al.*, 2012). Among twenty eight crosses of tomato, fourteen hybrids especially DVRT-1×DVRT-2, DVRT-1 ×CHFT-77,

**Table 2. Number of wilted plants, mortality per cent and reaction of each tomato parents and their hybrids against bacterial wilt**

Parents/hybrids	Number of wilted plants	Mortality (%)	Reaction
DVRT-1	6.00	30.00	MS
DVRT-2	6.67	33.33	S
CHFT-77	8.67	43.33	S
CHFT-60	11.33	56.67	S
CHFT-79	4.67	23.33	MS
H-86	6.00	30.00	MS
CHFT-71	4.00	20.00	MR
CHFT-50	2.67	13.33	MR
DVRT-1×DVRT-2	8.67	43.33	S
DVRT-1 ×CHFT-77	7.33	36.67	S
DVRT-1×CHFT-60	8.00	40.00	S
DVRT-1×CHFT-79	6.00	30.00	MS
DVRT-1×H-86	7.33	36.67	S
DVRT-1×CHFT-71	6.67	33.33	S
DVRT-1×CHFT-50	4.67	23.33	MS
DVRT-2×CHFT-77	5.33	26.67	MS
DVRT-2×CHFT-60	8.67	43.33	S
DVRT-2×CHFT-79	7.33	36.67	S
DVRT-2×H-86	4.67	23.33	MS
DVRT-2×CHFT-71	10.00	50.00	S
DVRT-2×CHFT-50	8.67	43.33	S
CHFT-77×CHFT-60	5.33	26.67	MS
CHFT-77×CHFT-79	6.00	30.00	MS
CHFT-77×H-86	6.67	33.33	S
CHFT-77×CHFT-71	4.00	20.00	MR
CHFT-77×CHFT-50	6.67	33.33	S
CHFT-60×CHFT-79	9.33	46.67	S
CHFT-60×H-86	5.33	26.67	MS
CHFT-60×CHFT-71	4.67	23.33	MS
CHFT-60×CHFT-50	3.33	16.67	MR
CHFT-79×H-86	6.67	33.33	S
CHFT-79×CHFT-71	5.33	26.67	MS
CHFT-79×CHFT-50	4.00	20.00	MR
H-86×CHFT-71	6.67	33.33	S
H-86×CHFT-50	3.33	16.67	MR
CHFT-71×CHFT-50	1.33	6.67	R

**Table 3. Screening of tomato parents against bacterial wilt under field condition**

Scale	Mortality (%)	Reaction	Number of parents	Name of parents
0	0	Highly Resistant (HR)	0	-
1	1 to 10	Resistant (R)	0	-
2	>10 to 20	Moderately Resistant (MR)	2	CHFT-71, CHFT-50
3	>20 to 30	Moderately Susceptible (MS)	3	DVRT-1, CHFT-79, H-86
4	>30 to 70	Susceptible(S)	3	DVRT-2, CHFT-77, CHFT-60
5	>70	Highly Susceptible (HS)	0	-

**Table 4. Screening of tomato hybrids against bacterial wilt under field condition**

Scale	Mortality (%)	Reaction	Number of hybrids	Name of Hybrids
0	0	Highly Resistant (HR)	0	-
1	1 to 10	Resistant (R)	1	CHFT-71×CHFT-50
2	>10 to 20	Moderately Resistant (MR)	4	CHFT-77×CHFT-71, CHFT-79×CHFT-50, CHFT-60×CHFT-50, H-86×CHFT-50
3	>20 to 30	Moderately Susceptible (MS)	9	DVRT-1×CHFT-79, DVRT-1×CHFT-50, DVRT-2×CHFT-77, DVRT-2×H-86, CHFT-77×CHFT-60, CHFT-77×CHFT-79, CHFT-60×H-86, CHFT-60×CHFT-71, CHFT-79×CHFT-71 DVRT-1×DVRT-2, DVRT-1×CHFT-77, DVRT-1×CHFT-60, DVRT-1×H-86, DVRT-1×CHFT-71, DVRT-2×CHFT-60, DVRT-2×CHFT-79, DVRT-2×CHFT-71, DVRT-2×CHFT-50, CHFT-77×H-86, CHFT-77×CHFT-50, CHFT-60×CHFT-79, CHFT-79×H-86, H-86×CHFT-71
4	>30 to 70	Susceptible (S)	14	
5	>70	Highly Susceptible (HS)	0	-

DVRT-1×CHFT-60, DVRT-1×H-86, DVRT-1×CHFT-71, DVRT-2×CHFT-60, DVRT-2×CHFT-79, DVRT-2×CHFT-71, DVRT-2×CHFT-50, CHFT-77×H-86, CHFT-77×CHFT-50, CHFT-60×CHFT-79, CHFT-79×H-86 and H-86×CHFT-71 displayed susceptible response toward the bacterial wilt disease. None of crosses observed highly susceptible against the bacterial wilt. Oliveira *et al.* (1999) stated that additive effects of genes responsible for resistance against the disease.

Screening of hybrids and cultivars for *Ralstonia solanacearum* resistance is a significant aspect in the development of tomato hybrids that can be achieved through hybrid breeding. In the present study, no immunity was found in any parent and hybrids of tomato towards bacterial wilt. Only one and four hybrids showed resistant and moderately resistant toward wilt, respectively. These five hybrids *i.e.*, CHFT-71×CHFT-50, CHFT-77×CHFT-71, CHFT-79×CHFT-50, CHFT-60 × CHFT-50 and H-86×CHFT-50, can be recommended for further evaluation and will be utilised under the bacterial wilt problematic areas. The gradual shift toward the resistance may eventually be used to delay the onset of wilt symptoms and could result in genotypes that can be used to produce an economical and marketable yield. However, the best two parents CHFT-71 and CHFT-50, recorded moderately resistant against wilt could be used further for development of varieties/ hybrids through the hybridisation and breeding programmes.

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