



## Reaction of tomato (*Solanum lycopersicum*) genotypes for resistance to late blight (*Phytophthora infestans*) disease

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### ABSTRACT

The cultivated tomato (*Solanum lycopersicum* L.) is affected by several of diseases of which late blight, caused by *Phytophthora infestans* (*Mont.* de Bary), being the most severe under epidemic condition. Wild tomato species have proven as continuing source of resistance to this disease. The reaction of 152 tomato genotypes including 4 wild relatives, i.e. *Solanum chilense*, *S. pimpinellifolium*, *S. cheesmaniae*, *S. peruvianum*, against late blight was determined using whole-plant scoring. These genotypes were screened and evaluated in two different conditions (open field and side open poly house) at the Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur (Bihar) in autumn-winter season of 2013-14. Of the 152 genotypes, none of the test genotypes showed immune reaction. Moreover, the genotypes Arka Rakshak, Arka Alok, BRDT-1, Kashi Anupam, Arka Ananya, Azad T-5, C 6 T and Kashi Vishesh high yield potential and lower incidence for late blight. Moreover, wild species *S. chilense*, *S. pimpinellifolium*, *S. cheesmaniae* and *S. peruvianum* showed resistance reaction for late blight. The genotype EC 538380 showed highly resistant disease reaction against late blight besides bearing more fruits. Moreover, significant effect of temperature and relative humidity was established on occurrence late of blight. In general cool, wet, cloudy weather with rainfall and ambient relative humidity favour late blight development and natural epidemics of *P. infestans* in the field which can be useful in screening large populations. The highest disease infestation and severity occurred during the month of January – February when the maximum temperature ranged from 10.4–10.8°C and maximum relative humidity ranged from 90 – 95%.

**Key words:** Late blight, *Phytophthora infestans*, Quality, Tomato, Weather, Yield

Of the 200 pathogens affecting tomato (*Solanum lycopersicum* L.) production worldwide, *P. infestans* (*Mont.* de Bary), the oomycete causing late blight, is the primary cause of tomato crop loss worldwide including India (Nowicki *et al.* 2013). Losses are frequent and severe in areas where tomato is grown near potato fields (Nowicki *et al.* 2012). The causal pathogen from tomato was first described by Payen in France in 1847 and has been found responsible for numerous epidemics since it was first described (Stevenson 1997). *P. infestans* has a wider host range which includes *Solanum lycopersicum*, *S. tuberosum*, *S. sarrachoides*, *S. triflorum*, *S. dulcamara*, *S. sisymbriifolium*, *Nicotiana benthamiana* and plants of the genus *Calibrachoa* (Akhtar *et al.* 2012). *P. infestans* can attack leaves, petioles, stems, fruits and seeds of tomato (Irzhansky and Cohen 2006). Late blight disease may be initiated in nursery and adult plants by air-borne sporangia or

by oospores harbouring the soil and seed (Rubin and Cohen 2004, Govers 2005). Disease symptoms may start as water soaked, pale green irregular leaf lesions, which enlarge, turn brown, shrivel and dry out. Under conditions of moist weather, the underside of the lesions may be covered with a fine white moldy growth composed of sporangiospores and sporangia. On petioles and stems lesions appear at any point as oily, brown areas later turning into black and the whole plant may die. On fruits, the disease appears as dark green to brown, greasy, irregular blotches, and fruit become shriveled at later stages. Cool, rainy weather, high relative humidity and heavy dew formation favour the infection, disease progress and sporangia production (Mohan *et al.* 1996, Stevenson 1997) which can destroy the unprotected crop within 10 to 14 days (Rubin and Cohen 2004, Govers 2005).

Late blight continues to threaten global tomato production, and only few resistant cultivars have been introduced locally (Nowakowska *et al.* 2014). In India, late blight disease-management strategies mainly depend on fungicide applications, which are uneconomical and less effective due to increasing resistance of the pathogen against fungicides (Griffith *et al.* 1992). Identification and utilization of genetic resources resistant to *P. infestans*

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in tomato is the only way to develop late blight resistant tomato cultivars following appropriate breeding methods. Although vast genetic diversity exists in well adapted cultivars/germplasm in tomato in India, so far no systematic study on resistance or susceptibility level of existing tomato genetic resources has been conducted. The main objective of the present investigation was to determine the level of resistance in cultivated and wild *Solanaceous* species to identify potential germplasm resistant to late blight disease. Such information would help breeders to develop late blight resistant cultivars.

MATERIALS AND METHODS

The present investigation was carried out using 152 diverse okra genotypes including 4 wild species (*S. chilense*, *S. cheesmaniae*, *S. peruvianum*, *S. pimpinellifolium*) collected from National Bureau of Plant Genetic Resources, New Delhi, India; Indian Institute of Vegetable Research, Varanasi, India and Indian Institute of Horticultural Research, Bengaluru, India. These genotypes were screened and evaluated in two different conditions, i.e. open field and side open poly house of the Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur (Bihar) in autumn-winter season of 2013-14. The climate of this place is tropical to subtropical; characterized by dry summers, moderate rainfall and very cold winters. December and January are usually the coldest months when the mean temperature normally falls as low as 10.1°C (Fig 1). The high level of relative humidity (above 90%) occurred during January–February that favours the infection of *P. infestans* (Fig 2). The soil of the both experimental plots (open field and side open poly house) was sandy loam in texture having good fertility, properly leveled and well drained. The recommended agronomic practices for raising experimental crop were adopted. Observations were recorded on 20 economically important traits, viz. days to first flowering (DFF), days to 50% flowering (D50%F), days to first fruit harvesting (DFFH), plant height (PH), number of primary branches/plant (NPBPP), number of

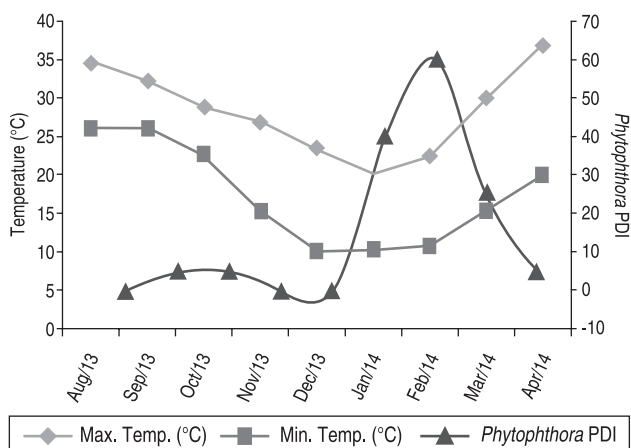


Fig 1 Effect of temperature on *Phytophthora infestans* disease severity

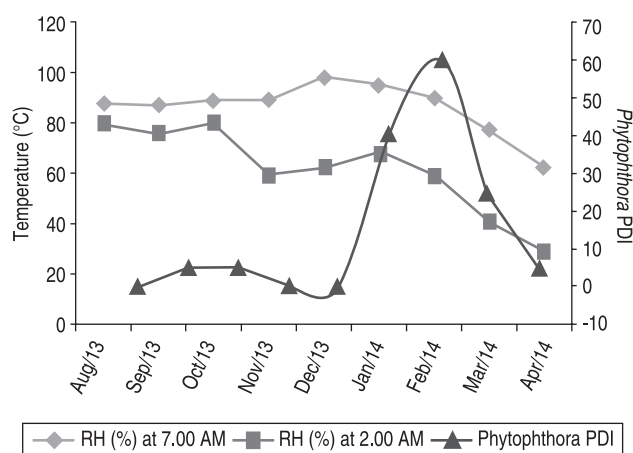


Fig 2 Effect of relative humidity on *Phytophthora infestans* disease severity

fruits/plant (NFPP), fruit yield/plant (FYPP), 10 fruits weight (10 FW), fruit length (FL), fruit girth (FG), number of locules/fruit (NLPF), pericarp thickness (PT), total soluble solids (TSS), plant growth type (PGT), stem pubescence (SP), leaf orientation (LO), leaf serration (LS), fruit shape (FSh), fruit colour (FCo) and per cent disease infestation of *P. infestans*. TSS reading was observed with help of digital Refractometer in °Brix. The reading was taken from firm and freshly harvested fruits.

The pooled mean data of both conditions (open field and side open poly house) were used for statistical analysis and correlations between different variables were tested for significance using the statistical procedure coined by Gomez and Gomez (1984).

Natural epidemics of *P. infestans* in the field can be used advantageously for screening large populations of genotypes for resistance to this disease (Gopal and Singh 2003, Forbes *et al.* 2014). Late blight (*P. infestans*) incidence data regarding the proportion of leaf and plant blighted were visually estimated by whole-plant scoring under natural epidemic using 0-5 scale (Table 1) to calculate per cent disease incidence (PDI) value was calculated by the procedure of Akhtar *et al.* (2012).

$$PDI (\%) = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

RESULTS AND DISCUSSION

Growth, yield and quality contributing traits

Based on the results from the initial field experiments (Table 2), the tallest plant was with genotype EC 638156 (231.7 cm) followed by Azad T-5 (144.3 cm) and EC 538380 (143.5 cm). The highest number of primary branches/plant were observed in EC 538380 and Arka Rakshak (9.0) followed by Arka Ananya and EC 638156 (6.0).

The days to first flowering from days to transplanting (Table 2) was lowest in the genotypes EC 521068 (47 days) followed by EC 676730 (48 days) and Azad T-5 (49 days),

Table 1 Disease scale for rating of tomato late blight

Disease rating	Symptoms severity for whole-plant assay	Per cent disease incidence (PDI)	Disease response
0	No visible symptoms apparent	0	Immune
1	A few minute lesions to about 10% of the total leaf area is blighted and usually confined to the 2 bottom leaves	0.01-10	Highly resistant
2	Leaves on about 25% of the total plant area are infected	10.01-25	Resistant
3	Leaves on about 50% of the total plant area are infected	25.01-40	Tolerant
4	Leaves on about 75% of the total plant area are infected	40.01-60	Susceptible
5	Leaves on whole plant are blighted and plant is dead	> 60.01	Highly susceptible

while earliest 50 percent flowering from transplanting was observed in the genotypes EC 538380 (56 days) followed by EC 521068 (57 days) and Azad T-5 (58 days), i.e. these were the early genotypes. However, for days to first fruit harvesting from days to transplanting was observed in Arka Vikas (97 days) followed by Arka Ananya and EC 676730 (98 days).

The highest number of fruits/plant (Table 2) was obtained in the genotype EC 538380 (381 fruits) followed by EC 521068 (132 fruits) and Arka Rakshak (86 fruits). However, the highest average fruit weight of ten fruits was observed in the genotype Kashi Anupam (698 g) followed by Arka Rakshak (688 g) and BRDT-1 (685 g). The highest fruit yield per plant was obtained in the genotype Arka Rakshak (5933 g) followed by Arka Alok (4379 g) and BRDT -1 (2964 g). These results were in consonance with the findings of Ahirwar *et al.* (2013), Kumar *et al.* (2012) and Saleem *et al.* (2013).

The highest fruit length (cm) was observed (Table 2) in the genotype Pusa Rohini (4.9 cm) followed by EC 501577 (4.8 cm) and Kashi Anupam (4.7 cm). However, the highest fruit girth (cm) was observed in EC 676730 (18.8 cm) followed by Arka Vikas and EC 501577 (16.2 cm). The

Table 2 Mean performance of promising tomato genotypes for growth and yield contributing traits

Genotype	<i>Phytophthora</i> PDI	DFP	D50%F	DFFH	NFPP	FYPP (g)	10FW (g)	PH (cm)	NPBPP	FL (cm)	FG (cm)
Arka Rakshak	13.33	56	67	106	86.3	5933.13	687.5	83.7	9.5	4.1	12.2
Arka Alok	16.67	60	71	114	68.8	4379.12	636.5	70.5	4.3	1.4	12.7
BRDT-1	25.67	69	76	117	43.3	2963.89	684.5	92.3	3.7	3.6	10.2
Kashi Anupam	29.33	67	74	117	38.2	2666.36	698.0	67.7	5.3	4.7	14.8
Arka Ananya	33.67	54	62	98	47.6	2533.75	532.3	95.3	6.5	4.1	13.5
Azad T-5	29.33	49	58	99	44.6	2424.01	543.5	144.3	5.7	2.7	7.8
C 6T	28.44	51	59	110	44.5	2391.88	537.5	82.7	4.5	3.8	14.2
Kashi Vishesh	43.67	67	76	112	36.6	2285.67	624.5	72.5	4.3	3.6	8.2
C 26-1	19.67	55	67	104	45.3	2269.53	501.0	80.8	4.7	3.9	13.8
Pusa Rohini	26.67	72	79	118	38.8	2122.36	547.0	63.3	5.8	4.9	14.5
Arka Vikas	51.44	52	59	97	39.5	1986.85	503.0	74.6	9.2	4.2	16.2
EC 676750	47.57	57	71	112	44.5	1922.40	432.0	83.7	4.1	3.8	10.2
EC 538380	8.67	50	56	104	380.7	1808.33	47.5	143.7	5.8	1.7	3.2
EC 620421	28.44	60	73	115	34.8	1746.96	502.0	101.7	5.3	4.0	15.2
EC 521068	54.67	47	57	100	132.0	1696.20	128.5	93.7	5.5	3.7	8.2
EC 676730	68.33	48	58	98	49.1	1436.18	292.5	87.3	5.3	4.0	18.8
EC 638156	27.88	52	63	105	53.0	1412.45	266.5	231.7	6.3	3.4	9.5
EC 501577	31.44	58	65	109	52.5	1341.38	255.5	134.7	5.3	4.8	16.2
EC 676816	58.33	60	69	111	28.7	1290.07	449.5	72.7	4.3	3.8	13.2
EC 538405	59.33	54	62	102	32.3	1191.22	368.8	54.3	4.5	2.6	13.5
CD (P=0.05)	8.12	11.41	12.11	14.10	6.12	208.12	71.21	36.12	1.87	1.30	3.56

Percent disease infestation of *Phytophthora infestans* (*Phytophthora* PDI), days to first flowering (DFP), days to 50% flowering (D50%F), days to first fruit harvesting (DFFH), number of fruits per plant (NFPP), fruit yield per plant (FYPP), ten fruit weight (10FW), plant height (PH), number of primary branches per plant (NPBPP), fruit length (FL) and fruit girth (FG).

genotypes, viz. Arka Rakshak (13.33 %), Arka Alok (16.67 %), BRDT-1 (25.67%) had lower level of PDI value with high fruit yield as well as the genotype EC 538380 (8.67 %) had highly resistant reaction against *P. infestans* with high number of fruits (Table 2).

The highest number of locules/fruit (Table 3) was observed in the genotype C 6T (5.7) followed by Arka Vikas and BRDT-1 (5.0) while the lowest number of locules was observed in the genotype EC 538380 (2.0). The highest pericarp thickness of fruit was observed in the genotype Arka Vikas (6.4 mm) followed by Arka Rakshak (6.2 mm) and Kashi Anupam (5.6 mm). The highest total soluble solids (TSS) was observed in the genotype EC 538380 (6.4 °Brix) followed by EC 638156 (6.3 °Brix) and Kashi Anupam (5.3 °Brix). Similar finding for quality traits was reported by Ahirwar *et al.* (2013), Al-Aysh *et al.* (2012) and Yadav *et al.* (2013).

#### Character association of different traits on yield, quality and late blight disease

The understanding of association of various characters related to yield is important in aiming at rational improvement in a complex polygenic character through selection. Correlation studies provide information

that the selection for one character will result in progress for all correlated characters. The correlation coefficient analysis indicated that days to first flowering was positively significantly correlated (Table 4) with days to 50% flowering (0.974), days to first harvesting (0.866). Moreover, days to 50% flowering had significant and positive genotypic association with days to first fruit harvesting (0.914) and fruit length (0.446). Plant height had significant and positive correlation with total soluble solids (0.567) while significant negative correlation with 10 fruit weight (-0.474) and number of locules/fruit (-0.473). Number of fruits/plant had positive and significant correlation with total soluble solids (0.513) while negative and significant association with 10 fruit weight (-0.596), fruit length (-0.505) and fruit girth (-0.639). The 10 fruit weight has positive and significant association with number of locules/fruit (0.468), pericarp thickness (0.495) and fruit yield/plant (0.621). Fruit length had positive and significant correlation with fruit girth (0.578) while fruit girth had negative and significant correlation with total soluble solids (-0.486). The fruit pericarp thickness had positive and significant correlation with fruit yield/plant (0.468). Moreover, fruit yield/plant negatively and significantly associated with *Phytophthora* percent disease incidence (-0.504). Similar pattern of correlation was also

Table 3 Mean performance of promising tomato genotypes for quality traits

Genotype	NLPF	PT (mm)	TSS (°Brix)	PGT	SP	LO	LS	FSh	FCo
Arka Rakshak	3.3	6.2	4.4	Determinate	Present	Semi erect	Absent	Heart shape	Red
Arka Alok	3.5	5.5	4.7	Determinate	Present	Semi erect	Absent	Obovoid	Orange
BRDT-1	5.0	3.1	4.8	Determinate	Present	Horizontal	Absent	Obovoid	Red
Kashi Anupam	3.0	5.6	5.3	Determinate	Present	Semi erect	Absent	Obovoid	Orange
Arka Ananya	4.0	3.8	4.5	Determinate	Present	Semi erect	Absent	Circular	Red
Azad T-5	3.3	3.7	5.1	Determinate	Present	Semi erect	Absent	Circular	red
C 6T	5.7	3.4	5.1	Determinate	Present	Semi erect	Absent	Flat	red
Kashi Vishesh	3.0	5.3	5.1	Determinate	Present	Semi erect	Absent	Circular	Orange
C 26-1	2.3	4.5	3.6	Determinate	Present	Semi erect	Absent	Circular	Red
Pusa Rohini	4.0	4.9	5.1	Determinate	Present	Semi erect	Absent	Circular	Red
Arka Vikas	5.0	6.4	5.2	Determinate	Present	Semi erect	Absent	Flat	Orange
EC 676750	3.3	3.4	4.7	Indeterminate	Present	Semi drooping	Absent	Circular	Red
EC 538380	2.0	1.9	6.4	Determinate	Absent	Semi drooping	Absent	Circular	Red
EC 620421	3.3	4.3	4.1	Determinate	Present	Semi erect	Absent	Circular	Orange
EC 521068	3.3	3.5	4.8	Indeterminate	Present	Semi erect	Absent	Circular	Red
EC 676730	3.3	2.8	4.7	Indeterminate	Present	Semi drooping	Less	Circular	Orange
EC 638156	2.0	3.0	6.3	Indeterminate	Present	Semi erect	Less	Circular	Red
EC 501577	2.3	3.7	4.9	Indeterminate	Present	Semi drooping	Less	Circular	Orange
EC 676816	4.3	5.4	4.3	Determinate	Present	Horizontal	Absent	Circular	Red
EC 538405	3.0	3.6	5.0	Determinate	Absent	Semi drooping	Absent	Obovoid	Red
CD (P=0.05)	0.36	0.84	0.42						

Number of locules/fruit (NLPF), pericarp thickness (PT), total soluble solids (TSS), plant growth type (PGT), stem pubescence (SP), leaf orientation (LO), leaf serration (LS), fruit shape (FSh) and fruit colour (FCo).

accounted by Mahapatra *et al.* (2013), Yadav *et al.* (2013) and Chernet *et al.* (2013).

#### Disease reaction of different tomato genotypes against *P. infestans*

Variable levels of the PDI were found in all the genotypes under the whole-plant scoring (Table 1). None of the test genotypes was completely disease free, i.e. showed immune response. Field screening under epidemic condition can be treated as a reliable procedure under suitable environmental condition for both host and pathogen. The current results were obtained through whole-plant scoring which showed the highest discrimination between tomato genotypes and were indicated to be efficient and reliable for screening of tomato germplasm for late blight resistance (Akhtar *et al.* 2012). None of the test genotypes showed immune reaction (Table 5). Out of 152 tomato genotypes, only 18 genotypes expressed highly resistant response against *P. infestans*, i.e. EC 677040, EC 538380, EC 620519, EC 620564, EC 623067, EC 676796, EC 677071, C-22-2, EC 109757, EC 109764, EC 538411, EC 671594, EC 676593, EC 677061, IHR 2627 and wild species *S. chilense*, *S. pimpinellifolium*, *S. cheesmaniae*. However, only 27 genotypes expressed resistant response including wild species *S. peruvianum*. Only 36 genotypes expressed tolerant reaction, while 43 genotypes were categorized under susceptible reaction which had highest share of total genotypes. Moreover, 28 genotypes showed highly susceptible disease reaction against *P. infestans*. These results were in agreement with the findings of Gopal and Singh (2003), Govers (2005), Irzhansky and Cohen (2006), Nowicki *et al.* (2012), Nowicki *et al.* (2013), Forbes *et al.* (2014) and Nowakowska *et al.* (2014).

#### Effect of temperature and relative humidity on *P. infestans* disease severity

Cool, wet, cloudy weather with rainfall and ambient relative humidity (RH) above 90% and temperatures of 7 to 21°C favour late blight development (Simon *et al.* 2012, Forbes *et al.* 2014). However, natural epidemics of *P. infestans* in the field can be useful for screening large populations for identification of resistant genotypes (Gopal and Singh 2003, Forbes *et al.* 2014). On the basis of the said experiment it was observed that the highest disease infestation and severity occurred during the month of January – February when the maximum temperature ranges from 10.4 – 10.8°C and maximum relative humidity ranged from 90 – 95% which is the ideal condition for late blight development and favours the easy inoculation of this disease, coupled with cloudy weather that promotes its expression (Fig 1 and 2). Moreover, earlier other reports indicated that the incidence of late blight disease was higher during the cool and wet weather when relative humidity was very high which support our findings (Gopal and Singh 2003, Nowicki *et al.* 2013, Nowakowska *et al.* 2014 and Forbes *et al.* 2014).

From the present study, it can be inferred that there is significant effect of temperature and relative humidity on occurrence of late blight. It was observed that highest disease infestation and severity occurred during the month of January – February when the maximum temperature ranged from 10.4 – 10.8 °C and maximum relative humidity ranged from 90 – 95%. None of the test genotypes showed immune reaction. However, from the large number of genotypes evaluated under this study, the genotypes Arka Rakshak, Arka Alok, BRDT-1, Kashi Anupam, Arka Ananya, Azad T-5, C 6T and Kashi Vishesh had high yield potential and

Table 4 Genotypic character association for different quantitative traits in tomato

Character	DFE	D50%F	DFFH	PH	NPBPP	NFPP	10FW	FL	FG	NLPP	PT	TSS	FYPP	PDI
DFE	1.000	0.974*	0.866*	-0.230	-0.230	-0.356	0.442	0.422	0.250	0.016	0.233	-0.157	0.098	-0.159
D50%F		1.000	0.914*	-0.176	-0.284	-0.357	0.378	0.446*	0.255	-0.066	0.182	-0.209	0.083	-0.168
DFFH			1.000	-0.078	-0.393	-0.179	0.244	0.289	0.164	-0.035	0.032	-0.062	0.051	-0.285
PH				1.000	0.145	0.291	-0.474*	-0.179	-0.403	-0.473*	-0.358	0.567*	-0.223	-0.316
NPBPP					1.000	0.123	0.027	0.236	0.119	0.021	0.433	0.130	0.376	-0.152
NFPP						1.000	-0.596*	-0.505*	-0.639*	-0.368	-0.357	0.513*	0.003	-0.393
10FW							1.000	0.215	0.281	0.468*	0.495*	-0.407	0.621*	-0.182
FL								1.000	0.578*	0.208	0.184	-0.309	-0.132	0.230
FG									1.000	0.305	0.252	-0.486*	-0.060	0.308
NLPP										1.000	0.317	-0.218	0.155	0.242
PT											1.000	-0.441	0.468*	-0.017
TSS												1.000	-0.220	-0.168
FYPP													1.000	-0.504*
PDI														1.000

\*Significant @ 5% level of significance. Days to first flowering (DFE), days to 50% flowering (D50%F), days to first fruit harvesting (DFFH), plant height (PH), number of primary branches per plant (NPBPP), number of fruits per plant (NFPP), ten fruit weight (10FW), fruit length (FL), fruit girth (FG), number of locules per fruit (NLPP), pericarp thickness (PT), total soluble solids (TSS), per cent disease infestation of *Phytophthora infestans* (PDI) and fruit yield per plant (FYPP).

Table 5 Reaction of tomato genotypes against late blight

Disease rating	PDI	No. of genotypes	Genotypes	Disease response
0	0	0		Immune
1	0.01-10	18	EC 677040, EC 538380, EC 620519, EC 620564, EC 623067, EC 676796, EC 677071, EC 677072, EC 109757, EC 109764, EC 538411, EC 671594, EC 676593, EC 677061, IIHR 2627, <i>S. chilense</i> , <i>S. pimpinellifolium</i> , <i>S. cheesmaniae</i>	Highly resistant
2	10.01-25	27	<i>S. peruvianum</i> , BRDT-2, Kashi Anupam, EC 528372, EC 538156, EC 538455, H-88-78-1, IIHR 2625, Sun Cherry, Sel-18, Arka Alok, C-26-1, CLN-1621 L, CLNB, EC 538439, EC 676728, EC 676795, EC 677042, EC 677075, Hisar Arun, IIHR 2201, Uday, Vaibhav, Arka Rakshak, EC 109762, EC 671592	Resistant
3	25.01-40	36	Arka Ananya, BRDT-1, BRDT-3, Azad T-6, C 2-2, C 6T, EC 501577, EC 521068, EC 620421, EC 638156, EC 676772, EC 676799, EC 677046, Floradade, Hisar Lalit, IIHR 2275, Swarna Naveen, C 19-1, EC 381263, EC 676765, IIHR 2381, IIHR 2629, Reo Grande, Arka Meghali, Arka Samrat, C 9-2, EC 520046, EC 578422, EC 581017, EC 671598, EC 677049, F 7012, H 88-78-4, H 88-78-5, IIHR 2190, IIHR 2745	Tolerant
4	40.01-60	43	Kashi Vishesh, Arka Saurabh, EC 677034, EC 677039, H-24, Arka Vikas, Azad T-5, BT-10, Cherry Red, EC 109575, EC 362948, EC 621667, EC 676792, EC 677063, EC 677083, IIHR 2617, Indam Naveen 2000, Pant T-5, Pusa Rohini, Pusa Ruby, Roza, Yellow Cherry, Yellow Round, EC 676791, EC 677047, IIHR 2197, IIHR 932, Arka Ahuti, Arka Ashish, Azad T-2, C-13-1, EC 366899, EC 43772, EC 501575, EC 538405, EC 676781, EC 676794, EC 676816, EC 677072, IIHR 2160, Indam 2006, Indam TMH-35, Pink Cherry	Susceptible
5	> 60.01	28	EC 620439, EC 671599, EC 676750, EC 677066, EC 677068, F-7028, Arka Abha, EC 109751, EC 501582, EC 676730, EC 676790, IIHR 2167, B-10-2, EC 501580, EC 625644, H-1-1, B-9-2, EC 620500, EC 671592, IIHR 2325, IIHR 2754, Pant T-7, EC 620442, Gujarat T-2, EC 620404, EC 676754, EC 677069, EC 676798	Highly susceptible

lower incidence for late blight. Moreover, wild species *S. chilense*, *S. pimpinellifolium*, *S. cheesmaniae* and *S. peruvianum* showed resistance reaction against late blight. However, the genotype EC 538380 exhibited highly resistant disease reaction against late blight and also produced number of fruits. Hence, these genotypes could be utilized for further tomato breeding programmes.

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