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Screening of Tomato Genotypes for Resistance to Early Blight (*Alternaria Solani*)

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Abstract: ***Early blight disease caused by Alternaria solani has been a serious problem in tomato growing areas particularly at humid tropical, subtropical and temperate regions of the world. An investigation was carried out at Horticulture Experimental farm, AAU Jorhat with forty-five genotypes of tomato. The experiment was conducted consecutively for two years during Rabi seasons of 2012-13 and 2013-14 in replicated trails. The site of the experiment was a sick plot where tomato was grown continuously for three years before testing the genotypes. Recommended package of practices were followed to raise the crop. Blight incidence was evaluated from the disease symptoms using Percent Disease Index (PDI) after the genotypes were artificially inoculated with isolates of A. Solani. The genotypes Sel-35 (TLBRH-6 X Konbilahi) and Sel-19 (TLBRH-6 X Konbilahi) were highly resistant, 7 were resistant, 14 were moderately resistant, 16 were susceptible and 6 were highly susceptible. The result was found to be similar for both the years. The loss in yield due to the disease ranged from 2.15% in highly resistant genotype to 42.75% for highly susceptible genotype. Disease resistant genotypes along with high productivity could be evolved by incorporating resistant trait present in highly resistant genotypes to high yielding genotypes.***

Keywords: Tomato genotypes, screening, *Alternaria solani*, resistance.

1. Introduction

Tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae and is nutritionally a good crop and a source of vitamin A, vitamin C and minerals. Tomato is affected by various diseases caused by fungi, bacteria, viruses, nematodes and also abiotic factors (Balachand, 1992). Early blight caused by the pathogen *Alternaria solani* is an economically important disease of tomato worldwide including India. The causal organism responsible for early blight is air borne and soil inhabiting (Datar and Mayee, 1981). Warm temperature and extended periods of leaf wetness from dew, rain fall and crowded plantation is favourable for development of this disease. Disease symptoms appeared on all above ground parts of plants particularly leaves, stem, petiole, flowers and fruits (Pandey *et al*., 2002). The yield loss due to early blight has been increasing with the incidence of this disease becoming more prominent with the change in environmental conditions. Early blight can cause loss to the extent of 78% in fruit yield (Singh, 1985; Datar and Mayee, 1981). Under severe epiphytotics loss of fruit may be as high as 95% (Sridhara and Naik, 1983). Disease severity of 90 per cent was recorded in Indo-Gangetic region of the country (Pandey *et al*., 2002). The use of chemicals and fungicides could effectively control the disease but repeated used of this chemicals pollutes the environment and caused health hazards to human beings. Thus, screening of genotypes resistant against early blight would be an effective measure to reduce the dependency on fungicides and chemicals. Thus, identification and utilization of genetic resources resistant to *A. solani* in tomato is the only way to develop early blight-resistant tomato cultivars following appropriate breeding methods. Field evaluation after inoculation of the pathogen isolates is most utilized method for screening of tomato genotypes for early blight resistance. In the present study, the objective was to identify and screen sources of resistance against early blight in tomato genotypes.

2. Materials And Methods

The experiment was conducted at Horticultural Experimental Farm, AAU, Jorhat-13 to screen out the genotypes for resistance to early blight during *Rabi* season 2012-13 and 2014-15 consecutively for two years in a Randomized Block Design. Forty five genotypes of tomato were used in this experiment which was sown in three rows with 2 replications and maintaining planting distance of 60cm between rows and 50cm between plants. Pathogen causing the disease early blight of tomato, *Alternaria solani* was isolated from diseased tomato leaves and was grown on Potato Dextrose Agar (PDA) medium. inoculums suspension pathogen was grown on PDA plates. The plates were incubated on 25°±1°C under a cool white fluorescent diurnal light with 12hr photoperiod for 10-15 days. Ten days old mycelia culture with thickening of conidiogenous hyphae and chlamydospore like structure were used for inoculation. The plants were inoculated 45 days after transplanting with a concentration of 157 cfu/ml during the screening process with a manual backpack sprayer. The disease severity was assessed on all leaves and scored on 0-5 points scale as suggested by Pandey *et al*. 2003 and percent disease incidence (PDI) was calculated following Mckinney (1923) formula. Later, the disease reaction based on PDI was recorded according to the scale given by Peteira e*t al*. 2002. After 7 days of incubation, plants were individually evaluated for disease scoring in each genotypes using 0-5 disease scale as given by Pandey, 2003 which is described as 0=Free from infection, 1=One or two necrotic spots on a few lower leaves of plants, 2=A few isolated spots on leaves, covering nearly 5-10% of the surface area of the plant, 3=Many spots coalesced on the leaves, covering 25% of the surface area of the plant, 4=Irregular, blighted leaves and

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sunken lesions with prominent concentric rings on the stem, petiole, and fruit, covering 40-50% of the surface area, 5=Whole plant blighted, leaves and fruits starting to fall; foliar part free of disease. The Percent Disease Index (PDI) was calculated by the formula given by McKinney, 1923; Pandey *et al*., 2003.

$$PDI = \frac{\text{Sum of all ratings X 100}}{\text{Total no. of observations X maximum rating grade}}$$

Disease reaction classes for early blight infection based on percent disease severity in tomato as given by Peteira *et al*. 2002.

Disease reaction	PDI range
Highly resistant	0-12.5
Resistant	12.6–25.0
Moderately resistant	25.1–37.5
Susceptible	37.6–50.0
Highly susceptible	50.1 and above

The yield per plant was recorded from disease free condition and disease infested condition differently. The value was converted to yield per ha. Later, the loss in yield due to disease incidence was calculated and converted into percentage.

3. Results and Discussion

The 45 genotypes were screened for resistance to early blight by inoculating the plant isolates with *A. solani* and the PDI values were recorded for both the years taken at the last reading as given in table-1. The reaction of the genotypes against early blight is shown in table-2 after their score obtained from the PDI values as in table-1.

The PDI ranged from 12.00% to 79.43% during 2012-13 and the value ranged from 11.68% to 77.53% during 2013-14. The PDI of highly resistant genotypes were 12.50% for Sel-35 and 12.00% for Sel-19 during 2012-13. Similar PDI values were obtained during 2013-14 with 12.30% for genotype Sel-35 (TLBRH-6 X Konbilahi) and 11.68% for Sel-19 (TLBRH-6 X Konbilahi). Resistant reaction was recorded in 2012/SPT/TOINDVAR-4, Sel-16, Sel-46, 2012/SPT/TODVAR-5, 2012/SPT/TODVAR-6, 2012/TOLCVRES-3 and Sel-9 from the readings of both the years. The genotypes showing highly susceptible reaction were 2012/TOLCVRES-5 (79.43% and 77.53%), 2012/TOLCVRES-8 (75.32% and 54.45%), 2012/TOLCVRES-1 (73.56% and 72.25%), 2012/SPT/TOINDVAR-3 (72.56% and 53.78%), 2012/SPT/TODVAR-10 (64.34% and 60.45%) and 2012/SPT/TOINDVAR-9 (54.56% and 45.44%) during both the years of observation. Out of the total materials screened, 14 were moderately resistant and 16 were susceptible under field condition after inoculation during both years.

The high resistance reaction in genotypes Sel-35 and Sel-19 could be due to the resistant gene derived from Konbilahi (*Solanum pimpinellifolium*) which is a wild species of tomato as reported by Kim *et al*. (2006). The available sources of resistance were mostly confined to the weedy relatives which have less in use and demand, like *L. pimpinellifolium* (Kalloo and Banerjee, 1993) and *L. esculentum* var. *cerasiforme* (Fageria, 1997). The response of the plant against *A. solani* was measured by observing the symptoms developed after inoculation. This result was similar to the findings of Poysa and Tu (1997) that attained resistance by incorporating resistance from other tomato species. Some experimental findings similar to the present study were also reported by Kamble *et al*. (2007) where they found five lines moderately resistant; Upadhay et al. (2009); Singh *et al*. (2011) revealed that accessions of wild relatives of tomato were highly resistant when screening was done under *in vitro* and Mahantesha *et al*. (2012) also reported resistant tomato genotypes against *Alternaria solani* under field conditions.

It was also evident from the study conducted that the reduction in yield due to early blight for highly resistant genotypes varies from 2.15% (Sel-19) to 3.05% (Sel-35). The percentage loss ranged from 5.79% to 9.86% for resistant, 10.61% to 14.50% for moderately resistant, 16.76% to 19.86% for susceptible and 30.15% to 42.75% for highly susceptible genotypes. 78% loss in fruit yield was also reported by Datar and Mayee, 1981; 95% fruit loss under severe epiphytotic condition as reported by Sridhara and Naik, 1983. The yield loss was worked out for the year 2012-13 and is given in table-3.

Table 1: Percent disease incidence of early blight in the tomato genotypes

Genotypes	*Percent Disease Index (PDI)*						*Score 37 Days After Inoculation*	
	7 Days After Inoculation		*22Days After Inoculation*		*37 Days After Inoculation*			
	2012-13	*2013-14*	*2012-13*	*2013-14*	*2012-13*	*2013-14*	*2012-13*	*2013-14*
2012/TOLCVRES-1	39.25	42.34	51.08	54.45	73.56	72.25	5	5
2012/TOLCVRES-2	27.04	27.45	36.20	37.35	48.32	49.33	4	4
2012/TOLCVRES-3	11.98	10.24	12.66	14.35	14.34	20.34	2	2
2012/TOLCVRES-4	21.53	20.12	29.28	27.45	35.55	32.12	3	3
2012/TOLCVRES-5	41.23	39.09	55.33	53.69	79.43	77.53	5	5
2012/TOLCVRES-6	22.35	23.00	31.24	29.76	36.44	36.99	3	3
2012/TOLCVRES-7	23.02	21.99	33.22	35.24	42.54	41.21	4	4
2012/TOLCVRES-8	40.01	33.45	53.65	42.32	75.32	54.45	5	5
2012/TOLCVRES-9	20.16	19.31	25.03	24.31	30.43	31.21	3	3
2012/SPT/TOINDVAR-1	19.35	18.33	28.25	27.35	36.64	34.11	3	3
2012/SPT/TOINDVAR-2	20.25	18.73	29.14	27.35	35.35	36.47	4	4
2012/SPT/TOINDVAR-3	35.36	24.31	49.71	36.35	72.56	58.78	5	5
2012/SPT/TOINDVAR-4	12.47	13.45	17.25	16.34	24.34	20.24	2	2
2012/SPT/TOINDVAR-5	28.35	25.33	39.60	35.24	50.00	42.33	5	5

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2012/SPT/TOINDVAR-6	27.16	21.35	38.71	33.25	49.54	40.33	4	4
2012/SPT/TOINDVAR-7	30.22	29.45	41.66	37.55	49.50	47.64	5	5
2012/SPT/TOINDVAR-8	13.10	12.20	15.24	17.34	23.44	24.10	3	3
2012/SPT/TOINDVAR-9	34.25	25.25	42.34	36.66	54.56	45.44	4	4
2012/SPT/TOINDVAR-10	18.90	21.01	29.00	27.45	36.46	35.44	3	3
2012/SPT/TODVAR-1	17.34	18.33	26.75	23.13	33.67	32.22	3	3
2012/SPT/TODVAR-2	22.44	20.73	32.14	31.35	37.50	37.00	4	4
2012/SPT/TODVAR-3	21.45	21.75	35.08	32.66	44.66	42.24	4	4
2012/SPT/TODVAR-4	23.46	22.44	30.14	32.33	38.64	40.44	4	4
2012/SPT/TODVAR-5	13.45	15.21	14.35	16.25	18.65	20.14	2	2
2012/SPT/TODVAR-6	17.35	15.45	19.25	19.85	23.34	24.00	2	2
2012/SPT/TODVAR-7	21.34	20.01	26.54	24.31	30.21	30.99	3	3
2012/SPT/TODVAR-8	19.08	19.09	27.33	24.13	32.35	30.12	3	3
2012/SPT/TODVAR-9	28.21	33.13	37.10	42.43	46.23	50.00	4	4
2012/SPT/TODVAR10	38.25	39.12	49.21	47.27	64.34	60.45	5	5
10/TOLCVRES-1	17.67	16.24	28.00	26.45	32.91	30.44	3	3
10/TOLCVRES-2	25.80	24.31	33.41	35.13	41.58	43.00	4	4
10/TOLCVRES-3	24.35	23.12	34.12	30.24	45.66	43.56	4	4
10/TOLCVRES-5	21.00	19.13	28.00	27.54	37.68	37.68	3	3
10/TOLCVRES-6	22.54	21.15	28.71	27.75	36.66	37.00	3	3
Sel-35	10.23	7.75	12.25	11.46	12.50	12.30	2	2
Sel-19	10.50	7.56	11.20	10.00	12.00	11.68	2	2
Sel-46	9.78	12.45	15.23	21.70	20.19	24.34	2	2
Sel-16	15.20	14.32	17.34	19.74	25.34	24.45	2	2
Sel-9	10.28	10.25	12.13	11.45	13.00	13.00	2	2
Arka vikas	29.73	28.42	30.08	32.95	38.12	40.99	4	4
Hisar Arun	21.44	14.05	25.77	22.02	33.00	35.24	3	3
H-86	28.29	17.72	34.48	22.45	43.24	38.54	4	4
Punjab Chhuhara(C)	25.34	24.34	29.12	28.75	37.00	37.45	3	3
H-24(C)	16.89	24.75	29.45	32.45	40.35	39.46	3	3
NDT-3 (C)	28.37	23.37	36.00	36.54	45.45	42.34	4	4
C.D. (5%)	3.26	5.37	2.79	3.20	4.40	3.84		
S.E. (m)	1.14	1.8	0.98	1.12	1.54	1.34		

Table 2: Reaction of tomato genotypes against early blight on the basis Percent Disease Index (PDI)

Score	*Reaction*	*PDI value range (%)*	*Genotypes*
1	Highly resistant	0-12.5	Sel-35 and Sel-19
2	Resistant	12.6–25.0	2012/SPT/TOINDVAR-4, 2012/SPT/TODVAR-5, 2012/SPT/TODVAR-6, 2012/TOLCVRES-3, Sel-46, Sel-16 and Sel-9
3	Moderately resistant	25.1–37.5	2012/TOLCVRES-4, 2012/TOLCVRES-6, 2012/TOLCVRES-9, 2012/SPT/TOINDVAR-1, 2012/SPT/TOINDVAR-8, 2012/SPT/TOINDVAR-10, 2012/SPT/TODVAR-1, 2012/SPT/TODVAR-2, 2012/SPT/TODVAR-7, 2012/SPT/TODVAR-8, 10/TOLCVRES-1, 10/TOLCVRES-6, Punjab Chhuhara and Hisar Arun
4	Susceptible	37.6–50.0	2012/TOLCVRES-2, 10/TOLCVRES-3, 2012/TOLCVRES-7, 2012/SPT/TOINDVAR-2, 2012/SPT/TOINDVAR-5, 2012/SPT/TOINDVAR-6, 2012/SPT/TOINDVAR-7, 2012/SPT/TODVAR-3, 2012/SPT/TODVAR-4, 2012/SPT/TODVAR-9, 10/TOLCVRES-2, 10/TOLCVRES-5, H-24, Arka Vikas, NDT-3 and H-86
5	Highly susceptible	50.1 and above	2012/TOLCVRES-1, 2012/TOLCVRES-5, 2012/TOLCVRES-8, 2012/SPT/TOINDVAR-3, 2012/SPT/TOINDVAR-9 and 2012/SPT/TODVAR-10

Table 3: Comparison of yield and its loss percentage between disease free condition and disease infested condition for the year 2012-13

Sl. No.	*Genotypes*	*Resistant reaction from PDI reading*	*Yield per ha (q) (disease free condition)*	*Yield per ha (q) (disease infested condition)*	*Loss in yield per ha (q)(due to disease incidence)*	*% loss in yield (due to disease incidence)*
1	2012/TOLCVRES-1	HS	**246.53**	**172.21**	74.32	30.15
2	2012/TOLCVRES-2	S	192.4	154.21	38.19	19.85
3	2012/TOLCVRES-3	S	240.00	220.21	45.59	17.15
4	2012/TOLCVRES-4	MR	237.9	203.43	34.47	14.49
5	2012/TOLCVRES-5	HS	**221.83**	**151.34**	70.49	31.78
6	2012/TOLCVRES-6	MR	222.47	190.21	32.26	14.50
7	2012/TOLCVRES-7	S	181.6	146.42	35.18	19.37
8	2012/TOLCVRES-8	HS	**230.2**	**160.24**	69.96	30.39
9	2012/TOLCVRES-9	MR	250.87	220.12	30.75	12.26
10	2012/SPT/TOINDVAR-1	MR	205.48	176.48	29.00	14.11

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11	2012/SPT/TOINDVAR-2	S	173.43	136.42	37.01	21.34
12	2012/SPT/TOINDVAR-3	HS	**196.96**	**131.00**	65.96	33.49
13	2012/SPT/TOINDVAR-4	R	126.1	118.80	7.30	5.79
14	2012/SPT/TOINDVAR-5	S	116.55	94.42	22.13	18.99
15	2012/SPT/TOINDVAR-6	S	159.55	132.21	27.34	17.14
16	2012/SPT/TOINDVAR-7	S	145.93	116.98	28.95	19.84
17	2012/SPT/TOINDVAR-8	MR	190.69	166.59	24.10	12.64
18	2012/SPT/TOINDVAR-9	HS	**192.78**	**110.37**	82.41	42.75
19	2012/SPT/TOINDVAR-10	MR	211.9	186.21	25.69	12.12
20	2012/SPT/TODVAR-1	MR	224.22	198.42	25.80	11.51
21	2012/SPT/TODVAR-2	MR	240.13	214.24	25.89	10.78
22	2012/SPT/TODVAR-3	S	264.67	212.11	52.56	19.86
23	2012/SPT/TODVAR-4	S	168.15	135.00	33.15	19.71
24	2012/SPT/TODVAR-5	R	188.52	170.21	18.31	9.71
25	2012/SPT/TODVAR-6	R	244.2	230.12	14.08	5.77
26	2012/SPT/TODVAR-7	MR	211.2	184.21	26.99	12.78
27	2012/SPT/TODVAR-8	MR	195.68	172.42	23.26	11.89
28	2012/SPT/TODVAR-9	S	235.62	189.00	46.62	19.79
29	2012/SPT/TODVAR10	HS	**194.7**	**121.72**	72.98	37.48
30	10/TOLCVRES-1	MR	201.29	178.34	22.95	11.40
31	10/TOLCVRES-2	S	208.67	168.21	40.46	19.39
32	10/TOLCVRES-3	R	268.82	250.12	18.70	6.96
33	10/TOLCVRES-5	S	196.78	158.21	38.57	19.60
34	10/TOLCVRES-6	MR	142.74	123.35	19.39	13.58
35	Sel-35	HR	**80**	**77.56**	2.44	3.05
36	Sel-19	HR	**77.67**	**76.00**	1.67	2.15
37	Sel-46	R	95.67	86.24	9.43	9.86
38	Sel-16	R	90.67	83.46	7.21	7.95
39	Sel-9	R	81.33	74.56	6.77	8.32
40	Arka vikas	S	194.48	156.22	38.26	19.67
41	Hisar Arun	MR	205.56	182.24	23.32	11.34
42	H-86	S	146.27	118.21	28.06	19.18
43	Punjab Chhuhara (C)	MR	221.76	198.24	23.52	10.61
44	H-24 (C)	S	303	252.21	50.79	16.76
45	NDT-3 (C)	S	258.19	212.12	46.07	17.84

It could be suggested from the result that the genotypes Sel-35 and Sel-19 were highly resistant and these genotypes could be utilized in any tomato breeding programmes as a donor parent for developing early blight resistant variety.

References

[1] Balanchard, D. (1992). A colour atlas of tomato diseases. Wolfe Pub. Ltd., Brook House, London, pp. 298.
[2] Datar, V.V. and Mayee, C.D. (1981). Assessment of loss in tomato yield due to early blight. *Ind. Phytopathology* **34**: 191-195.
[3] Frageria, M.S. and Kokli, U.K. (1997). Correlation studies in tomato. *Haryana J. Hort. Sci.* **25**: 158-160.
[4] Kalloo, G. and Banerjee, M.K. (1993). Early blight resistance in *Lycopersicon esculentum* transferred from *L. pimpinellifolium* and *L. hirsutum* f. *glabratum*. *Garten bauuissen schaft* **58**: 238-39.
[5] Kamble, S.B.; Pawar, D.R.; Sankeshwari, S.B.; Parab, M.M. and Arekar, J.S. (2007). Field screening of different tomato varieties and advanced lines against early blight of tomato. *Agric. Sci. Digest.* **27**(4): 267 – 269
[6] Kim, M. And Mutschler, M.A. (2006). Characterization of late blight resistance derived from *Solanum pimpinellifolium* L3708 against multiple isolates of the pathogen *Phytophthora infestans*. *J. Amer. Soc. Horti. Sci.* **131**(5): 637-645.
[7] Mahantesha, S.R.; Rawal, R.D. and Ramaswamy, G.R. (2012). Field evaluation of tomato genotypes for resistance to *Alternaria solani*. *Trends Biosci.* **5**(4): 294.
[8] Mckinney, H.H. (1923). Influence of soil temperature and moisture on infection of wheat seedling by *Helminthosporium sativum*. *J. of Agri. Res.* **26**: 195–217.
[9] Pandey, K.K.; Pandey, P.K. and Satpathy, S. (2002). Integrated management of disease and insect of tomato, hot pepper and cole crops. Technical Bulletin No.9. IIVR Varanasi, pp.22.
[10] Peteira, B.; Diaz, D.F.; Chavez, M.G.; Martinez, B. and Miranda, I. (2002). Search of a RAPD marker associated to *Alternaria solani* resistance in tomato. *Rev Protection Veg.* **17**(1): 6–13.
[11] Poysa, V. and Tu, J. (1997). Response of cultivars and breeding lines of *Lycopersicon spp.* to *Alternaria solani*. *Canadian Plant Disease Survey* **76**(1): 5- 8.
[12] Singh, P.C.; Kumar, P.; Singh, M.; Rai, A.; Singh, M.C. and Rai, M. (2011). Identification of resistant sources against early blight disease of tomato. *Ind. J. Hort.* **68**(4): 516-521.
[13] Singh, R.S. (1985). Disease of vegetable crops. Oxford and IBH Publishing Co. New Delhi, pp. 441.
[14] Sridha, T.S. and Naik L.B. (1983). Relative resistance of tomato cultivars to early blight. *The Madras Agric. J.* **70**: 488-489.
[15] Upadhyay, P.; Singh, P.C.; Sinha, B.; Singh, M.; Kumar, R.; Pandey, K. K. and Rai, M. (2009). Sources of resistance against early blight (*Alternaria solani*) in tomato (*Solanum lycopersicum*). *Ind. J. Agric. Sci.* **79**(9): 752–753.

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