The Bioscan 10(4): 1889-1893, 2015 (Supplement on Plant Pathology)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

ASSESSMENT OF RESISTANCE IN TOMATO GENOTYPES AGAINST BACTERIAL WILT DISEASE (*RALSTONIA SOLANACEARUM*) IN ASSAM CONDITION

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KEYWORDS
Tomato
Bacterial wilt
Ralstonia solanacearum
Genotype screening
Resistance

Received on :
17.09.2015

Accepted on :
20.11.2015

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ABSTRACT
An investigation was carried out at experimental garden for Horticultural crops, Department of Horticulture, Assam Agricultural University, Jorhat with forty-seven genotypes of tomato to assess bacterial wilt (*Ralstonia solanacearum*) resistance. The experiment was conducted consecutively for two years during *Rabi* seasons of 2012-13 and 2013-14 following randomized block design with 3 replications. Wilt incidence was calculated till the harvesting stage for each genotype. The check genotypes used in the experiment were Pusa Ruby (susceptible check) and *Konbilahi* (*Lycopersicon pimpinellifolium*) [resistant check]. The genotypes were graded as Resistant(R), Moderately Resistant (MR), Moderately Susceptible (MS) and Susceptible(S) following the standard scale. Highly resistance reaction (HR) was recorded in *Konbilahi* (*L. pimpinellifolium*) followed by resistance reaction (R) in Sel-35, sel-19 and Sel-9. Highest yield was recorded in 2012/TOLCVRES-3 (278.16 q/ha) followed by H-24 (276.85 q/ha) and 2012/TOLCVRES-4 (272.04 q/ha). The genotypes with resistance reaction could be considered as a promising breeding material for development of high yielding bacterial wilt resistant tomato variety.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill), a very popular and leading vegetable crop worldwide known for its very high nutritive values, delicious taste with production of 163.029 lakh MT in an area of 4.815 lakh ha with productivity of 33.900 MT/ha, (Annon., 2014). Bacterial wilt of tomato, caused by *Ralstonia solanacearum* has been a serious problem for tomato production in many tropical, subtropical, and warm temperate regions of the world (Hayward, 1991 and Ghosh and Dutta, 2014). The success of any crop improvement programme through breeding strategy depends on genetically variable materials with better yield potential and resistant to pest and diseases (Meena and Vahadur, 2013). It is very important to evaluate and characterize the germplasms available so that the materials of interest can be identified for resistance and used as a genetic material for resistance breeding programmes from the available local and exotic varieties. Singh (1987) reported Pusa Ruby and Punjab Chhuhara as susceptible genotypes of tomato. Mohanta *et al*. (1998) studied field performance of 23 tomato cultivars in relation to bacterial wilt disease over two seasons in Orissa and found BT-12, BT-14 and Pusa Sheetal were free from wilt, whereas BT-3, Arka Alok, Arka Abha were found susceptible. Dutta and Rahman (2012) worked on varietal screening of tomato against bacterial wilt disease under subtropical humid climate of Tripura with 11 cultivars and found cultivar All Rounder as resistant. In the present study, 47 numbers of tomato genotypes were evaluated in the North Eastern part of India to screen out the potential tomato genotypes resistant to bacterial wilt under field conditions along with their yield potentials.

MATERIALS AND METHODS

The experiment was conducted at the Experimental garden for Horticultural crops, Department of Horticulture, Assam Agricultural University, Jorhat during Rabi seasons of 2012-13 to 2013-14 with forty-seven genotypes (Table 1) of tomato including Pusa Ruby as susceptible check and *Konbilahi* (*L. pimpinellifolium*) as resistant check. The site of the experiment was a bacterial wilt sick plot where tomato and brinjal crops were grown continuously for three years before testing the genotypes. The trial was laid out in randomized block design (RBD) with three replications. All recommended package of practices were followed to raise the crop. One month old tomato plants were artificially inoculated with suspension of *R. solanacearum* @ 1 X 10^8 cfu/ml following root inoculation technique. The data of disease development was recorded and percent disease (wilt) incidence (DI %) was calculated till the harvesting stage for each genotype by the following formula-

$$\text{Disease Incidence (\%)} = \frac{\text{No. of wilted plant}}{\text{Total no. of plants}} \quad 100$$

The resistance for wilt resistant to each genotype was

evaluated by following modified disease rating scale of Mew and Ho (1976).

Highly Resistant (HR)	0 per cent plant wilted
Resistant(R)	1 to 10 per cent plant wilted
Moderately Resistant (MR)	>10 to 20 per cent plant wilted
Moderately Susceptible (MS)	>20 to 30 per cent plant wilted
Susceptible(S)	>30 to 70 per cent plant wilted
Highly Susceptible (HS)	>70 per cent plant wilted

The yield against each treatment were converted into q/ha and tabulated for statistical analysis.

RESULTS AND DISCUSSION

Records of the bacterial wilt incidence percentage (DI%) showed HR reaction in genotype *Konbilahi* (*Lycopersicon pimpinellifolium*), R reaction in three genotypes *viz*., Sel-35, Sel-19 and Sel-9, MR reaction in seven genotypes; MS reaction in eighteen genotypes and S reaction in eighteen genotypes (Table 2 and Table 3) under wilt sick field condition with artificial root inoculation. The yield performance in q/ha was highest in genotype 2012/TOLCVRES-3 (278.16 q/ha) followed by H-24 (276.85 q/ha), 2012/TOLCVRES-4 (272.04 q/ha) presented in Table 4.

Mew and Ho (1976) reported that resistant varieties could either delay the initial infection against bacterial wilt of tomato or slow down the rate of wilting if the initial infection is established. Singh (1961) interpreted the type of resistance to bacterial wilt in tomato derived from the North Carolina material as polygenic. The sources of resistance to bacterial wilt disease as either monogenic or polygenic and the genetics of resistance to this disease is very complex (Acosta *et al.*, 1964). The resistant genes identified in *L. pimpinellifolium* (PI 1278054) were partially dominant until 7 weeks after transplanting, but recessive in more mature plants and a small numbers is associated with the resistance. Ferrer (1974) reported that the F_1 population was intermediate between susceptible and resistant parents and the resistance was polygenic in PI 126408. Multiple recessive gene acting additively, determined the resistance to *R. solanacearum* in tomato. Jaworski *et al.* (1987) reported high tolerance levels against *R. solanacearum* in their selection of *L. esculentum* (GA 1565-2-4 BWT, GA 219-1-2 BWT and GA 10095-1-4 BWT) and *L. esculentum* x *L. pimpinellifolium* (Jusl.) Mill (GA

Table 1: Tomato genotypes used for field screening against bacterial wilt resistance

Sl. No.	Genotypes /treatments	Source	Plant Type	Fruit size	Fruit shape
1	2012/TOLCVRES-1	AICRP (VC)	Determinate	Medium	Oval
2	2012/TOLCVRES-2	AICRP (VC)	Determinate	Medium	Flat
3	2012/TOLCVRES-3	AICRP (VC)	Determinate	Large	Oblong
4	2012/TOLCVRES-4	AICRP (VC)	Determinate	Medium	Round
5	2012/TOLCVRES-5	AICRP (VC)	Determinate	Medium	Round
6	2012/TOLCVRES-6	AICRP (VC)	Determinate	Medium	Round
7	2012/TOLCVRES-7	AICRP (VC)	Determinate	Large	Round
8	2012/TOLCVRES-8	AICRP (VC)	Determinate	Large	Round
9	2012/TOLCVRES-9	AICRP (VC)	Determinate	Medium	Round
10	2012/SPT/TOINDVAR-1	AICRP (VC)	Indeterminate	Medium	Round
11	2012/SPT/TOINDVAR-2	AICRP (VC)	Indeterminate	Large	Oblong
12	2012/SPT/TOINDVAR-3	AICRP (VC)	Indeterminate	Medium	Oval
13	2012/SPT/TOINDVAR-4	AICRP (VC)	Indeterminate	Medium	Round
14	2012/SPT/TOINDVAR-5	AICRP (VC)	Indeterminate	Medium	Round
15	2012/SPT/TOINDVAR-6	AICRP (VC)	Indeterminate	Medium	Round
16	2012/SPT/TOINDVAR-7	AICRP (VC)	Indeterminate	Medium	Flat round
17	2012/SPT/TOINDVAR-8	AICRP (VC)	Indeterminate	Large	Flat round
18	2012/SPT/TOINDVAR-9	AICRP (VC)	Indeterminate	Medium	Round
19	2012/SPT/TOINDVAR-10	AICRP (VC)	Indeterminate	Medium	Round
20	2012/SPT/TODVAR-1	AICRP (VC)	Determinate	Medium	Round
21	2012/SPT/TODVAR-2	AICRP (VC)	Determinate	Large	Flat round
22	2012/SPT/TODVAR-3	AICRP (VC)	Determinate	Medium	Round
23	2012/SPT/TODVAR-4	AICRP (VC)	Determinate	Medium	Round
24	2012/SPT/TODVAR-5	AICRP (VC)	Determinate	Medium	Oval
25	2012/SPT/TODVAR-6	AICRP (VC)	Determinate	Medium	Round
26	2012/SPT/TODVAR-7	AICRP (VC)	Determinate	Medium	Pear
27	2012/SPT/TODVAR-8	AICRP (VC)	Determinate	Medium	Round
28	2012/SPT/TODVAR-9	AICRP (VC)	Determinate	Medium	Round
29	2012/SPT/TODVAR-10	AICRP (VC)	Determinate	Medium	Round
30	10/TOLCVRES-1	AICRP (VC)	Determinate	Medium	Flat round
31	10/TOLCVRES-2	AICRP (VC)	Determinate	Large	Pear
32	10/TOLCVRES-3	AICRP (VC)	Determinate	Medium	Oval
33	10/TOLCVRES-5	AICRP (VC)	Determinate	Medium	Round
34	10/TOLCVRES-6	AICRP (VC)	Determinate	Medium	Round
35	Sel-35	AAU, Jorhat	Indeterminate	Small	Round
36	Sel-19	AAU, Jorhat	Indeterminate	Small	Round
37	Sel-9	AAU, Jorhat	Semi- indeterminate	Small	Round

Table 1: Continue..

Sl. No.	Genotypes /treatments	Source	Plant Type	Fruit size	Fruit shape
38	Sel-46	AAU, Jorhat	Semi- indeterminate	Small	Round
39	Sel-16	AAU, Jorhat	Indeterminate	Small	Round
40	Punjab Chhuhara	PAU, Ludhiana	Determinate	Medium	Oblong
41	H-24	IIVR, Varanasi	Determinate	Medium	Round
42	Arka vikas	IIHR, Bangalore	Semi- determinate	Medium	Oval
43	NDT-3	NDUAT, Faizabad	Semi- indeterminate	Medium	Oval
44	Hisar Arun	HAU, Hisar	Determinate	Medium	Round
45	H-86	IIVR, Varanasi	Determinate	Medium	Flat round
46	*Konbilahi* (C)	Local	Indeterminate	Small	Round
47	Pusa Ruby (C)	IARI, New Delhi	Indeterminate	Medium	Round

Table 2: Screening of tomato genotypes for their tolerance against bacterial wilt under field condition

Sl. No.	Genotypes	Mortality (%)		Average Mortality (%), Polled	Resistant Reaction
		2012-13	2013-14		
1	2012/TOLCVRES-1	37.04 (37.48)*	37.78 (37.90)*	37.41(37.70)*	S
2	2012/TOLCVRES-2	32.22 (34.58)	33.58 (35.34)	32.90(34.99)	S
3	2012/TOLCVRES-3	17.61 (24.72)	23.33 (28.85)	20.47(26.86)	MS
4	2012/TOLCVRES-4	17.27 (24.44)	20.61 (26.95)	18.94(25.73)	MR
5	2012/TOLCVRES-5	24.02 (29.35)	23.33 (28.85)	23.68(29.10)	MS
6	2012/TOLCVRES-6	20.58 (26.97)	28.32 (32.10)	24.45(29.62)	MS
7	2012/TOLCVRES-7	31.95 (34.18)	27.86 (31.85)	29.91(33.07)	MS
8	2012/TOLCVRES-8	29.17 (32.68)	29.73 (32.81)	29.45(32.78)	MS
9	2012/TOLCVRES-9	25.76 (30.37)	26.20 (30.76)	25.98(30.61)	MS
10	2012/SPT/TOINDVAR-1	26.10 (30.64)	27.89 (31.75)	27.00(31.20)	MS
11	2012/SPT/TOINDVAR-2	54.17 (47.41)	50.00 (45.00)	52.09(46.20)	S
12	2012/SPT/TOINDVAR-3	37.59 (37.69)	39.78 (39.03)	38.68(38.43)	S
13	2012/SPT/TOINDVAR-4	21.53 (27.63)	26.67 (31.06)	24.10(29.39)	MS
14	2012/SPT/TOINDVAR-5	29.25 (32.73)	26.69 (30.99)	27.97(31.88)	MS
15	2012/SPT/TOINDVAR-6	43.75 (41.17)	44.00 (41.50)	43.88(41.36)	S
16	2012/SPT/TOINDVAR-7	16.67 (24.03)	28.11 (31.88)	22.39(28.15)	MS
17	2012/SPT/TOINDVAR-8	19.45 (26.17)	20.50 (26.71)	19.97(26.50)	MR
18	2012/SPT/TOINDVAR-9	43.75 (41.31)	42.42 (40.59)	43.08(41.02)	S
19	2012/SPT/TOINDVAR-10	16.67 (24.03)	20.44 (26.69)	18.56(25.51)	MR
20	2012/SPT/TODVAR-1	19.32 (26.06)	23.22 (28.65)	21.27(27.43)	MS
21	2012/SPT/TODVAR-2	29.25 (32.73)	30.03 (33.02)	29.64(32.95)	MS
22	2012/SPT/TODVAR-3	41.75 (40.09)	43.89 (41.44)	42.82(40.78)	S
23	2012/SPT/TODVAR-4	27.08 (31.32)	28.50 (32.23)	27.79(31.82)	MS
24	2012/SPT/TODVAR-5	19.32 (26.06)	22.94 (28.32)	21.13(27.31)	MS
25	2012/SPT/TODVAR-6	20.58 (26.97)	25.78 (30.08)	23.18(28.67)	MS
26	2012/SPT/TODVAR-7	25.94 (30.56)	25.91 (30.37)	25.93(30.50)	MS
27	2012/SPT/TODVAR-8	46.06 (42.72)	56.98 (49.05)	51.52(45.87)	S
28	2012/SPT/TODVAR-9	22.39 (28.12)	21.56 (27.19)	21.97(27.73)	MS
29	2012/SPT/TODVAR-10	37.50 (37.74)	35.61 (36.53)	36.56(37.15)	S
30	10/TOLCVRES-1	22.33 (28.03)	25.78 (30.350	24.05(29.33)	MS
31	10/TOLCVRES-2	42.78 (40.84)	47.17 (43.33)	44.97(42.10)	S
32	10/TOLCVRES-3	15.86 (23.41)	19.57 (26.04)	17.71(24.76)	MR
33	10/TOLCVRES-5	18.88 (25.73)	19.11 (25.62)	19.00(25.73)	MR
34	10/TOLCVRES-6	37.50 (37.75)	34.72 (36.02)	36.11(36.92)	S
35	Sel-35	8.34 (16.73)	5.70 (13.64)	7.02(15.36)	R
36	Sel-19	4.53 (12.17)	4.97 (12.76)	4.75(12.59)	R
37	Sel-9	9.38 (17.72)	5.30 (13.10)	7.34(15.64)	R
38	Sel-46	16.67 (24.03)	15.61 (22.73)	16.14(23.46)	MR
39	Sel-16	15.44 (23.08)	12.88 (20.66)	14.16(21.97)	MR
40	Punjab Chhuhara	40.03 (39.23)	43.56 (41.21)	41.80(40.27)	S
41	H-24	34.83 (36.11)	27.67 (31.90)	31.25(33.97)	S
42	Arka vikas	40.83 (39.68)	44.22 (41.67)	42.53(40.70)	S
43	NDT-3	31.37 (33.94)	33.41 (35.27)	32.39(34.69)	S
44	Hisar Arun	34.89 (36.00)	36.50 (37.00)	35.70(36.68)	S
45	H-86	34.66 (35.88)	34.89 (36.05)	34.77(36.08)	S
46	*Konbilahi* (*L. pimpinellifolium*), C	0.00 (0.00)	0.00 (0.00)	0.00(0.00)	HR
47	Pusa Ruby(C)	55.34 (48.07)	54.52 (47.63)	54.93(47.83)	S
	S.Ed. (±) CD (0.05)	3.276.50	3.987.91	2.555.06	

* Data in the parentheses are angular transformed values

Table 3: Reaction of tomato genotypes against bacterial wilt (*Ralstonia solanacearum*) under field condition

Scale	Mortality %	Reaction	No. of genotypes	Name of the genotypes
0	0	Highly resistant	1	*Konbilahi* (*Lycopersicon pimpinellifolium*)
1	1-10	Resistant	3	Sel-35 , Sel-19 , Sel-9
2	>10-20	Moderately resistant	7	2012/TOLCVRES-4, 2012/SPT/TOINDVAR-8, 2012/SPT/TOI NDVAR-10, 10/TOLCVRES-3, 10/TOLCVRES-5, Sel-46, Sel-16
3	>20-30	Moderately susceptible	18	/TOLCVRES-3, 2012/TOLCVRES-5, 2012/TOLCVRES-6, 2012/TOLCVRES-7, 2012/TOLCVRES-8, 2012/TOLCVRES-9, 2012/SPT/TOINDVAR-1, 2012/SPT/TOINDVAR-4, 2012/SPT/ TOINDVAR-5, 2012/SPT/TOINDVAR-7, 2012/SPT/ TODVAR-1, 2012/SPT/TODVAR-2, 2012/SPT/TODVAR-4, 2012/SPT/TODVAR-5, 2012/SPT/TODVAR-6, 2012/SPT/ TODVAR-7, 2012/SPT/TODVAR-9, 10/TOLCVRES-1
4	>30-70	Susceptible	18	2012/TOLCVRES-1, 2012/TOLCVRES-2, 2012/SPT/TOIN DVAR-2, 2012/SPT/TOINDVAR-3, 2012/SPT/TOINDVAR-6, 2012/SPT/TOINDVAR-9, 2012/SPT/TODVAR-3, 2012/SPT/ TODVAR-8, 2012/SPT/TODVAR-10, 10/TOLCVRES-2, 1 0/TOLCVRES-6, Punjab Chhuhara, H-24, Arka vikas, NDT-3, Hisar Arun, H-86, Pusa Ruby(C)
5	>70-100	Highly susceptible	0	-

Table 4: Average yield of tomato genotypes during 2012-13 and 2013-14

Sl. No.	Genotypes	Yield (q/ha) 2012-13	2013-14	Average Yield (q/ha) (Polled)
1	2012/TOLCVRES-1	168.19	258.59	213.39
2	2012/TOLCVRES-2	143.37	227.41	185.39
3	2012/TOLCVRES-3	210.71	345.6	278.16
4	2012/TOLCVRES-4	209.78	334.29	272.04
5	2012/TOLCVRES-5	181.51	319.18	250.35
6	2012/TOLCVRES-6	189.66	292.36	241.01
7	2012/TOLCVRES-7	136.54	236.12	186.33
8	2012/TOLCVRES-8	176.01	284.85	230.43
9	2012/TOLCVRES-9	199.21	253.75	226.48
10	2012/SPT/TOINDVAR-1	164.8	305.83	235.32
11	2012/SPT/TOINDVAR-2	92.44	198.72	145.58
12	2012/SPT/TOINDVAR-3	135.89	143.23	139.56
13	2012/SPT/TOINDVAR-4	111.91	179.87	145.89
14	2012/SPT/TOINDVAR-5	95.42	239.22	167.32
15	2012/SPT/TOINDVAR-6	102.71	151.13	126.92
16	2012/SPT/TOINDVAR-7	134.57	225.77	180.17
17	2012/SPT/TOINDVAR-8	166.57	330.55	248.56
18	2012/SPT/TOINDVAR-9	121.4	229.22	175.31
19	2012/SPT/TOINDVAR-10	189.54	352.52	271.03
20	2012/SPT/TODVAR-1	193.86	220.14	207
21	2012/SPT/TODVAR-2	182.85	228.4	205.63
22	2012/SPT/TODVAR-3	167.13	182.83	174.98
23	2012/SPT/TODVAR-4	135.57	241.14	188.36
24	2012/SPT/TODVAR-5	165.06	171.4	168.23
25	2012/SPT/TODVAR-6	206.91	90.63	148.77
26	2012/SPT/TODVAR-7	169.38	128.06	148.72
27	2012/SPT/TODVAR-8	118.52	88.83	103.68
28	2012/SPT/TODVAR-9	195.83	223.02	209.43
29	2012/SPT/TODVAR-10	134.65	150.78	142.72
30	10/TOLCVRES-1	169.31	162.61	165.96
31	10/TOLCVRES-2	132.36	102.96	117.66
32	10/TOLCVRES-3	239.16	209.08	224.12
33	10/TOLCVRES-5	172.59	183.64	178.12
34	10/TOLCVRES-6	102.17	118.57	110.37
35	Sel-35	104.71	313.16	208.94
36	Sel-19	103.19	311.72	207.46

1405-1-2 BWT) and were jointly released by ARS/USDA and University of Georgia. Singh (1987) reported Pusa Ruby and Punjab Chuhhara as susceptible genotypes of tomato. Sharma (1996) tested thirty six genotypes of tomato at Danubase, Nepal

Table 4: Cont.....

Sl. No.	Genotypes	Yield (q/ha) 2012-13	2013-14	Average Yield (q/ha) (Polled)
37	Sel-9	100.28	316.06	208.17
38	Sel-46	92.69	287.36	190.03
39	Sel-16	89.63	289.75	189.69
40	Punjab Chhuhara	145.94	248.13	197.04
41	H-24	210.42	343.27	276.85
42	Arka vikas	128.03	247.32	187.68
43	NDT-3	190.16	348.02	269.09
44	Hisar Arun	146.8	218.68	182.74
45	H-86	108.54	157.39	132.97
46	*Konbilahi* (*L. pimpinellifolium*), (C)	94.1	299.61	196.86
47	Pusa Ruby(C)	107	132.56	119.78
	S.Ed. (±)	10.93	20.77	11.26
	C.D. (0.05)	21.71	41.25	22.35

and found 12 genotypes resistant to bacterial wilt. Similarly, Mohanta *et al*. (1998) also studied 23 tomato cultivars in relation to bacterial wilt over two seasons in Orissa and found BT-12, BT-14 and Pusa Sheetal were free from wilt, whereas BT-3, Arka Alok, Arka Abha were found sussceptibe. Dutta and Rahman (2012) also worked on varietal screening of tomato against bacterial wilt disease under subtropical humid climate of Tripura with 11 cultivars and found cultivar 'All Rounder' as resistant.

ACKNOWLEDGEMENT

The authors are thankfully acknowledges the help and cooperation received from the AAU authority and the financial assistance from the ICAR through the AICRP (VC), IIVR, Varanasi and DST, New Delhi through INSPIRE Fellowship.

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