J. Hortl. Sci.
Vol. 10(1):74-78, 2015

Evaluation of brinjal genotypes against bacterial wilt caused by *Ralstonia solanacearum*

H.M. Santhosha, K.M. Indiresh, C. Gopalakrishnan[1] and T.H.Singh[1]
University of Horticultural Sciences, Bagalkot, India
[1]ICAR-Indian Institute of Horticultural Research
Hesaraghatta Lake Post, Bengaluru – 560089, India
E-mail: san3070@gmail.com

ABSTRACT

Forty brinjal genotypes were screened by artificial inoculation using *Ralstonia solanacearum* inoculum at a concentration of 1.0 X 10^8 cfu/ml ($O.D_{600}$ = 0.3). Genotypes Arka Nidhi, Haritha, Swetha, Surya, IIHR-3, IIHR-555, WCGR, R-2588, WL-2230, L-3261, L-3270, L-3272 and Arka Anand were found to be resistant to bacterial wilt, whereas, IIHR-7, L-3263, L-3268 and L-3269 were moderately resistant. Genotypes R-2584, R-2586, R- 2592, L-3260, L-3262, L-3264, L-3266 and L-3267 were moderately susceptible, and genotypes R-2580, R-2582, R-2587, R-2591, R- 2593 and R- 2595 were found to be susceptible. Lastly, genotypes R-2581, R- 2594, R-2589, R-2590, WL-2232, Pusa hybrid-6, Arka Shirish, R-2585 and R-2583 were found to be highly susceptible to bacterial wilt. Resistant and moderately resistant genotypes showed longer incubation period.

Key words: Brinjal, bacterial wilt, *Ralstonia solanacearum,* genotypes

INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the important vegetable crops of our own country and belongs to the family Solanaceae. It features on the menu of virtually every household in India, irrespective of food preference, income level or social status. Successful cultivation of the brinjal crop has been hindered by several insect pests and devastating diseases. Among the diseases, bacterial wilt caused by *Ralstonia solanacearum* (Yabucchi *et al*, 1995) is a major limiting factor. This has been the most ubiquitous and serious bacterial disease throughout tropical, sub-tropical and temperate regions of the world (Hayward, 1991).

In India, this disease is of a major concern and is serious in parts of Karnataka, Kerala, Orissa, Maharashtra, Madhya Pradesh and West Bengal (Rao *et al*, 1976). Yield losses ranging from 65 to 70% have been reported in brinjal (Das and Chattopadhyay, 1953). The disease is characterized by sudden wilting of the plant at flowering stage, by yellowing of foliage and stunted plant growth (Kelman, 1953; Rai *et al*, 1975) and an initial, brownish discoloration of vascular tissues occassionally accompanied by browning and rotting of tissues inside vascular bundles (Smith, 1920).

For management of bacterial wilt in the field, various control measures like crop rotation (cultural practice), use of antagonistic organisms (biological method) and application of chemicals (chemical control) are suggested. As the pathogen can survive or persist in the soil for several years, it is very difficult to control bacterial wilt by chemical applications, using antagonistic organisms or by cultural practices. Therefore, mitigation of the disease using appropriate farming practices needs further development and adaptation (Grimault and Prior, 1990). Therefore, search for resistant sources and incorporating those genes in commercial cultivars is a sound approach to the problem.

MATERIAL AND METHODS

The experimental material consisting of 40 genotypes was maintained in a homozygous state at the vegetable block, Post-Graduation Centre, UHS Campus, Bengaluru. Seeds of these genotypes were sown in protrays in the 1st week of August 2011. The experiment was laid out in Randomized Complete Block Design (RCBD), with three replications. A row consisting of 15 plants constituted a replication under each treatment. The 40 genotypes, including resistant (Arka Anand) and susceptible check (Pusa Hybrid-6) were subjected to artificial inoculation which made on seedlings in portrays, a day prior to transplantation into the main field. A slight injury was made to the root with a sterile knife before inoculating while withholding irrigation for a day. Three ml volume of the inoculum at a concentration of 1.0 X 10^8 cfu/ml (O.D600 = 0.3) was poured into the root zone. Thereafter, the seedlings were transplanted into the main field. Ten days after inoculation, symptoms of wilting were seen. Observations were made as per the scale suggested by Zakir Hussain *et al* (2005). Observations on (i) days to 50% bacterial wilt, (ii) bacterial wilt at different stages of plant growth, and (iii) cumulative bacterial wilt incidence at 50 days after inoculation were recorded. Observations were recorded at intervals of 10 days, with the last observation made at 50 days after inoculation.

RESULTS AND DISCUSSION

Any breeding programme, including any that involves host-plant resistance to a pathogen, must begin with an extensive screening of germplasm. Success in finding resistance to bacterial wilt is directly related to availability of resistant genotypes in the germplasm. Development of varieties/ hybrids with suitable horticultural traits is a slow process, despite availability of sources of resistance. This is due to the unstable nature of resistance under different environmental conditions, which has necessitated the breeder to explore better sources of resistance in the cultivated brinjal for breeding bacterial wilt resistance.

The 40 genotypes were screened against Race-I, Biovar 3. Genotypes Arka Nidhi, Haritha, Shwetha, Surya, IIHR-3, IIHR-7, IIHR-555, WCGR, R-2588, R- 2592, WL-2230, L-3260, L-3261, L-3262, L-3263, L-3268, L-3269, L-3270, L-3272 and Arka Anand (Resistant check) showed no 50% wilt even at 50 DAI. However, most genotypes like Pusa Hybrid-6, L-3267, R-2581, R-2589, R- 2593 and R-2583 took the least number of days to show 50% wilt incidence. Genotypes R-2586, L-3266 and R-2584 took the maximum number of days to express 50% wilt. Least number of days taken to express 50% wilt in a genotype shows occurrence of a shorter incubation period, and, such genotypes were highly susceptible to *Ralstonia solanacearum* under field conditions; while, in some genotypes, no 50% wilt even at 50 DAI shows occurrence of a longer incubation period. Therefore, these genotypes are able to withstand attack from *Ralstonia solanacearum* under field conditions, without any great loss in economic yield. Results of the present study are in agreement with those of Zakir Hussain *et al* (2005) (Table 1).

Genotypes Pusa Hybrid-6 (at 0-10 and 11-20 DAI), followed by R- 2595 (at 0-10 DAI), R- 2593 (at 11-20 DAI) and R-2591 (at 11-20 DAI) recorded comparatively higher wilt incidence, indicating that it was the stage that was critical for genotypes becoming susceptible to bacterial wilt. Compare this to the genotypes Shwetha, Surya, IIHR-3, IIHR-7, IIHR-555, WL-2230, L-3261, L-3270 and WCGR, where none, or very low, wilt-incidence was recorded.

At 21-30, 31-40 and 41-50 DAI, most genotypes showed medium to low level of wilt. Most of the susceptible genotypes showed a susceptible reaction in their early stages of growth (0-10 and 11-20 DAI). Similarly, Hoque *et al* (1981) recorded higher incidence of wilt in tomato in the early stage of crop growth, i.e., the first symptom of wilt was observed by them on the 15^{th} day from inoculation. Data on wilting collected by them at 43 days after inoculation varied from 13.3% to 100%.

Significant difference was observed for cumulative bacterial wilt incidence at 50 DAI among the eggplant genotypes studied. Highest incidence was recorded in WL-2232, followed by R-2590, Arka Shirish and Pusa Hybrid-6. Lowest incidence was recorded in the genotypes Surya, IIHR-3 and L-3270. In the present study, during screening of the genotypes, air temperature and relative humidity recorded were 19-28°C and 51-94%, respectively. These factors, together with impact from soil moisture and soil temperature, may have influenced resistance reaction of the genotypes.

Among the various genotypes used in this trial, only Arka Nidhi, Haritha, Shwetha, Surya, IIHR-3, IIHR-555, WCGR, R-2588, WL-2230,L-3261, L-3270, L-3272 and Arka Anand were resistant to bacterial wilt; IIHR-7, L-3263, L-3268 and L-3269 were found to be moderately resistant.

Vasse *et al* (2005) reported that resistance exhibited by various genotypes may be due to the secondary metabolism of polyphenols, and the higher concentration of steroidal glycoalkaloids present in resistant plants, thereby preventing bacterial movement into the vicinity of the plant system (by their action as a repellent). Further, Prior *et al* (1994) reported that inhibitor extracts, tyloses and gums in resistant plants act like filters, thereby preventing bacterial movement within a plant system.

Among the genotypes used in our experiment, Arka Nidhi, Haritha, Shwetha, Surya, IIHR-3, IIHR-555, WCGR, R-2588, WL-2230, L-3261, L-3270, L-3272 and Arka Anand graded as resistant to bacterial wilt, whereas, IIHR-7, L-

Table 1. Reaction of eggplant genotypes at different stages of plant growth to bacterial wilt pathogen (%) under field conditions

Sl. No.	Genotype	Days to 50% bacterial wilt	Bacterial wilt incidence (%) 0-10 DAI	11-20 DAI	21-30 DAI	31-40 DAI	41-50 DAI	Cumulative bacterial wilt incidence at 50 DAI (%)	Disease reaction
1	Arka Nidhi	-	5 (12.63)	2.5 (9.09)	5 (12.92)	2.5 (9.09)	0	15.00 (22.73)	Resistant
2	Haritha	-	2.5 (9.09)	0	0	12.5 (20.63)	1.66 (4.31)	16.67 (23.93)	Resistant
3	Shwetha	-	0	0	0	5 (12.92)	0	5.00 (12.92)	Resistant
4	Surya	-	0	0	0	0.83 (3.03)	1.66 (4.31)	2.50 (7.34)	Resistant
5	IIHR-3	-	0	0	0	0	2.5 (9.09)	2.50 (9.09)	Resistant
6	IIHR-7	-	0	0	0	15 (22.59)	10 (18.04)	25.00 (29.91)	Moderately resistant
7	Arka Shirish	18	36.04 (36.86)	25 (29.97)	13.63 (21.60)	0.83 (3.03)	12.5 (20.63)	88.00 (70.17)	Highly susceptible
8	IIHR-555	-	0	0	0	0	20 (26.44)	20.00 (26.44)	Resistant
9	WCGR	-	2.5 (9.09)	0	2.5 (9.09)	0	0	5.00 (12.92)	Resistant
10	R-2580	26	5 (10.45)	25 (29.91)	25 (29.91)	15 (22.59)	2.5 (7.34)	72.50 (58.89)	Susceptible
11	R-2581	12	35 (36.22)	37.5 (37.74)	7.5 (15.89)	0	2.5 (9.09)	82.50 (65.59)	Highly susceptible
12	R-2582	24	20 (26.53)	27.5 (31.60)	15 (22.73)	1.66 (4.31)	0	64.17 (53.23)	Susceptible
13	R-2585	18	27.5 (31.60)	35 (36.26)	20 (26.44)	2.5 (9.09)	0.83 (3.03)	85.83 (68.63)	Highly susceptible
14	R-2583	15	22.62 (28.36)	33.28 (35.20)	13.79 (21.73)	12.04 (19.19)	0	81.74 (63.94)	Highly susceptible
15	R-2584	36	0.93 (3.20)	27.59 (31.66)	19.48 (26.15)	5.52 (13.34)	0	53.52 (47.01)	Moderately susceptible
16	R-2586	50	2.5 (9.09)	15 (22.73)	10 (18.43)	17.33 (24.43)	5 (12.92)	49.83 (44.89)	Moderately susceptible
17	R-2587	19	7.38 (15.61)	42.62 (40.73)	14.06 (21.97)	0	0	64.06 (53.15)	Susceptible
18	R-2588	-	7.5 (15.23)	5 (12.63)	0	0.83 (3.03)	0	13.33 (20.75)	Resistant
19	R- 2592	-	3.57 (6.36)	7.04 (15.29)	21.47 (27.57)	10.23 (18.56)	0	42.33 (40.54)	Moderately susceptible
20	R-2589	14	35 (36.26)	27.5 (31.60)	15 (22.78)	2.5 (9.09)	1.66 (4.31)	81.67 (64.63)	Highly susceptible
21	R-2590	16	26.49 (30.93)	23.18 (28.76)	26.49 (30.95)	6.29 (14.40)	5.62 (13.36)	88.07 (69.88)	Highly susceptible
22	R-2591	19	5.29 (13.00)	47.02 (43.27)	8.77 (17.09)	0	14.73 (22.50)	75.82 (60.65)	Susceptible
23	R- 2593	14	12.5 (20.70)	50.34 (45.17)	9.46 (17.81)	6.08 (14.14)	0	78.38 (62.29)	Susceptible
24	R- 2594	30	12.5 (20.63)	25.34 (30.20)	15 (22.78)	15 (22.73)	13.5 (20.63)	81.33 (63.68)	Highly susceptible
25	L-3261	-	0	5 (12.63)	0	0	0	5.00 (12.63)	Resistant
26	R- 2595	20	38.25 (38.19)	15.75 (23.37)	11.08 (19.23)	1.5 (4.08)	1.85 (4.54)	68.44 (55.84)	Susceptible
27	WL-2230	-	0 7.5	(15.74)	5 (12.63)	5 (10.45)	0	17.50 (24.07)	Resistant
28	WL-2232	18	28.12 (32.05)	35.09 (36.28)	11.25 (19.54)	17.54 (24.72)	0	92.09 (73.78)	Highly susceptible
29	L-3260	-	2.9 (9.80)	17.53 (24.71)	0	14.9 (22.65)	11.25 (19.39)	46.59 (43.02)	Moderately susceptible
30	L-3262	-	5 (12.92)	17.5 (24.68)	10 (18.04)	10 (18.04)	5 (12.63)	47.50 (43.54)	Moderately susceptible
31	L-3269	-	2.54 (7.40)	15.4 (23.04)	7.63 (15.88)	0.86 (3.09)	5.03 (12.69)	31.46 (34.10)	Moderately resistant
32	L-3263	-	5 (12.63)	20 (26.55)	0.83 (3.03)	0	0.83 (3.03)	26.67 (31.07)	Moderately resistant
33	L-3264	26	22.5 (28.28)	25 (29.97)	5 (12.92)	1.66 (4.31)	0.83 (3.03)	55.00 (47.85)	Moderately susceptible

Table 1. Contd...

Sl. No.	Genotype	Days to 50% bacterial wilt	Bacterial wilt incidence (%) 0-10 DAI	11-20 DAI	21-30 DAI	31-40 DAI	41-50 DAI	Cumulative bacterial wilt incidence at 50 DAI (%)	Disease reaction
34	L-3266	42	13.38(21.42)	26.25 (30.80)	6.52 (14.72)	4.45 (11.84)	2.39 (8.89)	52.99 (46.70)	Moderately susceptible
35	L-3267	12	27.5 (31.60)	31 (33.81)	0	1.13 (3.54)	0	59.63 (50.55)	Moderately susceptible
36	L-3268	-	1.94 (4.64)	14.56 (22.38)	11.58 (19.82)	0	0	28.09 (31.89)	Moderately resistant
37	L-3270	-	0	2.5 (9.09)	0	0	0	2.50 (9.09)	Resistant
38	L-3272	-	2.5 (9.09)	5 (12.92)	0.83 (3.03)	0	2.5 (9.09)	10.83 (19.18)	Resistant
39	Arka Anand (Resistant Check)	-	5 (12.63)	2.5 (9.09)	0	0	0	7.50 (15.74)	Resistant
40	Pusa hybrid-6 (Susceptible check)	11	47 (43.26)	38.25 (38.18)	2.56 (7.46)	0	0	87.81 (69.69)	Highly susceptible
	Level of Significance		**	**	**	**	**	**	
	SEm±		1.14	0.93	1.22	0.93	0.56	2.03	
	CD @ 5%		3.21	2.64	3.45	2.64	1.58	5.72	
	CV (%)		12.21	7.35	16.59	18.65	15.66	8.47	

DAI – Days after inoculation; Figures in parentheses are angular transformed values

3263, L-3268 and L-3269 graded as moderately resistant to bacterial wilt. However, further research is needed to evaluate level of resistance of the genotypes under different agro-climatic zones of the country, to study the stability of resistance to various races of *Ralstonia solanacearum*.

ACKNOWLEDGEMENT

Santhosha, H.M. is grateful to Department of Science and Technology, Govt. of India, New Delhi, for awarding INSPIRE fellowship (2010–2013) to pursue this work at College of Horticulture (Bengaluru Campus), University of Horticultural Sciences, Bagalkot

REFERENCES

Grimault, V. and Prior, P. 1990. Approach des mecanismes de resistance a fletrissement bactarian (*Pseudomonas solanacearum* E.F. Smith) Chez la tomato. In: *Society Franchaise de phytopahologie, Zenus congress de la SFP*, Montpellier, pp. 28-30

Das, C.R. and Chattopadhyay, S.B. 1953. Bacterial wilt on eggplant. *Indian Phytopathol.*, **8**:130-135

Hayward, A.C. 1991. Biology and epidemology of bacterial wilt caused by *Pseudomonas solanacearum. Annu. Rev. Phytopathol.*, **29**:65-87

Hoque, M.O., HO, M.L. and Chowdhury, B.C. 1981. Screening tomato varieties for resistance to bacterial wilt. *Bangladesh J. Agril. Res.*, **6**:55

Kelman, A. 1953. The bacterial wilt caused by *Pseudomonas solanacearum*: A literature review and bibliography. North Carolina Agril. Expt. Stn. *Technical bulletin*, **99**:194-197

Prior, P., Grimault, V. and Schmit, J. 1994. Resistance to bacterial wilt (*Pseudomonas solanacearum*) in tomato: present status and prospects. In: Hayward, A.C., Hartman, G.L., (eds.). Bacterial wilt: the disease and its causative agent, *Pseudomonas solanacearum.* CAB International, Wallingford, 209 p.

Rai, P.V., Shivappasetty, K.K.A. and Vasanthasetty, K.P. 1975. Bacterial wilt of petunia and its source of inoculum. *Curr. Res.*, **4**:173-174

Rao, M.V.B., Sohi, H.S. and Vijay, O.P. 1976. Reaction of some varieties of brinjal to *Pseudomonas solanacearum*. *Veg. Sci.*, **3**:61-64

Smith, E.F. 1920. Brown rot of *Pseudomonas solanacearum*. An introduction to bacterial diseases of plants. W.B. Saunder Co., Phildelphia, U.S.A., pp. 177-201

Vasse, J., Danoun, S. and Trigalet, A. 2005. Microscopic studies of root infection in resistant tomato cultivar Hawaii 7996. In: Allen, C., Prior, P. and Hayward, A.C. (eds.). Bacterial wilt disease and the *Ralstonia solanacearum* species complex. APS Press, St. Paul, Minnesota, USA, 285 p.

Yabucchi, Y., Ikuya, Y., Hisako, H. and Yukiko, N, 1995. Transfer of two *Burkholderia* and an *Alacaligenes* species to *Ralstonia* genome. *Microbiol – Immunol.*, **39**:897-904

Zakir Hussain, M., Rahman, M.A. and Bashar, M.A. 2005. Screening of brinjal accessions for bacterial wilt caused by *Ralstonia solanacearum. Bangladesh J. Bot*., **34**:53-58

(MS Received 12 April 2014, Revised 18 May 2015, Accepted 26 May 2015)