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EVALUATION OF TWELVE BARI TOMATO VARIETIES AGAINST DIFFERENT WILTS UNDER FIELD CONDITION

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ABSTRACT

Twelve tomato varieties namely BARI Tomato-1 (Manik), BARI Tomato-2 (Ratan), BARI Tomato-3, BARI Tomato-4, BARI Tomato-5, BARI Tomato-6 (Choiti), BARI Tomato-7, BARI Tomato-8 (Shila), BARI Tomato-9 (Lalima), BARI Tomato-11, BARI Tomato-12 (Shidur) and BARI Tomato-14 were grown in the Horticultural farm of Sher-e-Bangla Agricultural University (SAU), Dhaka, October 2007 to March 2008 to determine the status of the varieties against different wilts of tomato. The tomato varieties were evaluated on the basis of wilt incidence and impact of disease on the growth and yield. At 55 days after transplanting (DAT), the variety BARI Tomato-9 (Lalima) exhibited the highest Bacterial wilt incidence (44.47%) and the lowest Bacterial wilt incidence (15.53%) was recorded in the variety BARI Tomato-1 (Manik). At 95 DAT, the highest Fusarium and Namic wilt incidence was recorded in the variety BARI Tomato-7 (40.00%) and the lowest Fusarium and Namic wilt incidence (17.77%) was recorded in the variety BARI Tomato-1 (Manik) and BARI Tomato-2 (Ratan). The highest yield (41.11 t ha^{-1}) was recorded in the variety BARI Tomato-8 (Shila) and the lowest yield (21.11 t ha^{-1}) was recorded in the variety BARI Tomato-4 and BARI Tomato-1 (Manik). Among the varieties BARI tomato-1 (Manik) and BARI Tomato-2 (Ratan) showed resistant reaction and the varieties BARI Tomato-6 and BARI Tomato-8 showed moderately resistant reactions. Rest of the varieties showed moderately susceptible reactions against bacterial wilt. In case of Fusarium and Nemic wilts BARI Tomato-1 (Manik) and BARI Tomato-2 (Ratan) showed resistant reactions, while BARI Tomato-3, 9, 11 showed moderately resistant reactions and rest of the varieties showed moderately susceptible reactions.

Key word: Evaluation, wilt, BARI, tomato, varieties

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is the most important and widely consumed vegetables in Bangladesh as well as in the world. Generally it can be grown as winter vegetables in our country. But now a days some varieties are released by Bangladesh Agricultural Research Institute (BARI), which are grown in summer season. Tomato is famous for canned vegetables for its diversified use like salad, juice, sauce and preserved. It has excellent source of vitamin A, B, C and mineral as compared to eggplant (Hobson and Davis, 1971 and Rashid, 1976). Sometimes it is commonly referred to as a poor man orange.

The global average yield of tomato was recorded 27.8 t/ha in 1997 (Anonymous, 1997), while it was 7.3 t ha^{-1} in Bangladesh (Anonymous, 1999). In Bangladesh the total land under tomato cultivation in 1997-98 was 12,955.47 hectares and total production was approximately 94,000 metric tons. About 15014.17 ha of land were under tomato cultivation, producing 100485 ton fresh fruits in the year 2001 (BBS, 2004). Although the total cultivated area and production of tomato in our country have increased gradually over the last few years but the productivity is still very low (6.46t ha^{-1}) compared to the average of the world yield (26.29 t ha^{-1}) (FAO, 2003). It seems that the area of tomato cultivation increased to an appreciable extent in Bangladesh, whereas the production (yield per hectare) remains almost unchanged. There is an ample scope of tomato cultivation in Bangladesh

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which may provide nutrition to the population of the country suffering chronically from malnutrition. Moreover, researchers in Bangladesh have been working to develop tomato varieties for year round cultivation (Chowdhury, 1993).

Tomato is susceptible to more than 200 diseases and the average yield loss due to disease is as high as 70-75%. Among the constrains responsible for low yield of tomato world wide, the wilt complex and virus diseases are considered to be the most important of them. The crop is frequently suffered by various soil borne diseases. Wilt complex of tomato (*Fusarium* sp., *Ralstonia solanacearum*, *Meloidogyne* sp.) are the major constraints for growing of the crop in farmer's field and kitchen garden. In Bangladesh Fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici)* and Bacterial wilt (*Ralstonia solanacearum*) is common in non-flooded high land, where solanaceous vegetables are grown continuously without crop rotation. Sudden wilting of tomato is very acute and occurs commonly in these non-flooded areas. Cultivation of tomato is sometime difficult due to high incidence of the wilt pathogens (Ali *et.al.*, 1994). Root-knot caused by *Meloidogyne incognita* is another important and widely distributed disease in the country (Mian, 1986). Particularly, the Bacterial wilt caused by *Ralstonia solanacearum* is a destructive soil-borne disease of tomato in Bangladesh. Chemical control of the disease is not effective so far, therefore, growing of resistant variety is only the way to cope with the disease. Management of wilts by resistant variety is the most sustainable way. The genetically resistant of tomato varieties are developed and released by different research organizations. Bangladesh Agricultural Research Institute (BARI) developed and released some genetically potential tomato varieties. Those varieties need to be evaluated against the wilts to detect the resistant status. Moreover, it is immensely important for wilt management in Bangladesh. Considering the above facts, the present study was undertaken to find out the resistance status of twelve tomato varieties against wilts in the natural field condition.

MATERIALS AND METHODS

Twelve BARI Tomato varieties viz. BARI Tomato-1 (Manik), BARI Tomato-2 (Ratan), BARI Tomato-3, BARI Tomato-4, BARI Tomato-5, BARI Tomato-6 (Choiti), BARI Tomato-7, BARI Tomato-8 (Shila), BARI Tomato-9 (Lalima), BARI Tomato-11, BARI Tomato-12 (Shidur) and BARI Tomato-14 were assessed in the present study. The experiment was conducted in the Horticultural farm of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207. The experiment was carried out during the period from October 2007 to March 2008. Seeds were collected from vegetable seed centre of BARI. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were 15 plants per plot. Wilted plants were counted periodically and converted to percent wilt. Data on incidence of bacterial wilt were recorded at 25, 35, 45 and 55 days after transplanting (DAT,) and Fusarium and Nemic wilts were recorded at 50, 65, 80 and 95 DAT. The disease incidence was calculated by the following formula.

$$\% \text{ Disease incidence} = \frac{\text{Number of infected plant}}{\text{Number of total plants inspected}} \times 100$$

Growth and yield contributing characters were also considered for data collection. The data obtained for different parameters were analyzed. The analysis of variance was performed by using MSTAT program. The significance of variance of the treatment means was estimated by DMRT (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Bacterial wilt incidence

Bacterial wilt incidence in the natural field condition at 25, 35, 45 and 55 DAT of twelve BARI Tomato varieties are presented in the Table 1. Tomato cultivars showed statistically significant variation in respect of Bacterial wilt incidence in the present study at 25 DAT. All the cultivars performed comparatively lower wilt incidence at 25 DAT and the average wilt incidence varied from 6.70% to 11.10%. Statistically significant variation was recorded among the tomato varieties in terms of Bacterial wilt incidence at 35 DAT. All the cultivars performed comparatively medium wilt incidence at 35 DAT and it varied from 8.90% to 20.00%. The highest Bacterial wilt incidence (20.00%) was recorded in BARI Tomato-12 (Shidur) and the lowest in BARI Tomato-1 (Manik), which was statistically identical with BARI tomato-6 (Choiti). In the present experiment BARI tomato varieties showed statistically significant variation in respect of Bacterial wilt incidence at 45 DAT. All the varieties performed comparatively higher wilt incidence and the average wilt incidence varied from 11.10% to 28.90%. The highest Bacterial wilt incidence (28.90%) was recorded in BARI Tomato-12 (Shidur), which was statistically similar with BARI tomato-8, 9, 11, 7, 14, 4, 5 and BARI tomato-3. The lowest wilt incidence (11.10%) was recorded in BARI Tomato-1 (Manik), which was closely followed by BARI Tomato-2 (Ratan) and BARI Tomato-6 (Choiti).

Table 1. Incidence of Bacterial wilt among twelve BARI Tomato varieties at different growing periods of the crop

Treatments	Bacterial wilt incidence			
	25 DAT (%)	35 DAT(%)	45 DAT (%)	55 DAT (%)
BARI Tomato-1 (Manik)	6.70b	8.90c	11.10c	15.53c
BARI Tomato-2 (Ratan)	6.70b	11.10bc	13.30c	17.77c
BARI Tomato-3	8.90a	15.53a-c	22.23b	33.33b
BARI Tomato-4	11.10a	15.53a-c	24.47a	37.77ab
BARI Tomato-5	8.90a	13.30a-c	22.23b	33.33b
BARI Tomato-6 (Choiti)	6.70b	8.90c	15.53c	28.90b
BARI Tomato-7	8.87a	15.53a-c	24.47a	37.77ab
BARI Tomato-8 (Shila)	8.90a	17.76ab	26.67a	28.90b
BARI Tomato-9 (Lalima)	6.70b	11.10bc	26.67a	44.47a
BARI Tomato-11	6.70b	15.53a-c	26.67a	37.77ab
BARI Tomato-12 (Shidur)	6.70b	20.00a	28.90a	44.43a
BARI Tomato-14	8.90a	17.77ab	24.47a	37.77ab
CV (%)	31.13	26.90	16.50	14.83
LSD	4.21	6.49	6.21	8.33

*Means in Column followed by the same letter (s) did not differ significantly at level by DMRT

A statistically significant variation was recorded among the tomato varieties in terms of Bacterial wilt incidence at 55 DAT. All the cultivars executed comparatively higher level of wilt incidence and it varied from 15.53% to 44.47%. In BARI tomato-9 (Lalima), the highest bacterial wilt incidence (44.47%) was recorded, which was statistically identical with BARI Tomato-12 (Shidur). The lowest wilt incidence (15.53%) was recorded in the cultivar BARI Tomato-1 (Manik), which was statistically identical with the variety BARI Tomato-2 (Ratan). Anonymous *et.al.*, (1999) screened tomato varieties against Bacterial wilt disease and found that the wilt incidence ranged from 5 to 40%.

Result showed that immune source or highly resistant to *Ralstonia solanacearum* among the tested varieties of tomato were not found but two cultivars namely BARI Tomato-1 (Manik) and BARI Tomato-2 (Ratan) showed resistant reactions and two cultivars namely BARI Tomato-6 (Choiti) and BARI Tomato-8 (Shila) showed moderately resistant reactions (Table 2). Rest of the varieties showed moderately susceptible reactions.

Table 2. Reaction of BARI tomato varieties to bacterial wilt caused by *R. solanacearum*

Treatments	Bacterial wilt Incidence (%) at 55 DAT	Reaction
BARI Tomato-1 (Manik)	15.53c	R
BARI Tomato-2 (Ratan)	17.77c	R
BARI Tomato-3	33.33b	MS
BARI Tomato-4	37.77ab	MS
BARI Tomato-5	33.33b	MS
BARI Tomato-6 (Choiti)	28.90b	MR
BARI Tomato-7	37.77ab	MS
BARI Tomato-8 (Shila)	28.90b	MR
BARI Tomato-9 (Lalima)	44.47a	MS
BARI Tomato-11	37.77ab	MS
BARI Tomato-12 (Shidur)	44.43a	MS
BARI Tomato-14	37.77ab	MS

*Means in Column followed by the same letter (s) did not differ significantly by DMRT

HR= Highly resistant (0-5% wilted plant), R=Resistant (<5-20% wilted plant), MR= Moderately resistant (<20- 30% wilted plant), MS= Moderately susceptible (<30-50% wilted plant), S=Susceptible (<50-70% wilted plant), HS= Highly susceptible (<70% and above wilted plant) (Rahman and Hoque, 1986).

Fusarium and Nemic wilt incidence

Fusarium and Nemic wilt incidence in the natural field condition at 50, 65, 80 and 95 DAT of twelve BARI Tomato varieties are presented in the Table 3. Tomato cultivars showed statistically significant variations in respect of Fusarium and Nemic wilt incidence at 50 DAT. All the cultivars performed comparatively lower wilt incidence at 50 DAT and the average wilt incidence varied from 6.7 to 11.10%. Statistically significant variation was recorded among the tomato varieties in terms of Fusarium and Nemic wilt incidence at 65 DAT. All the cultivars performed comparatively medium wilt incidence at 65 DAT and it varied from 8.90 to 17.77%. The highest Fusarium and Nemic wilt incidence (17.77%) was recorded in the variety BARI Tomato-11, which was statistically identical with BARI Tomato-7 and the lowest in BARI Tomato-8 (Shila). In the present experiment, BARI Tomato varieties showed statistically significant variation in respect of Fusarium and Nemic wilt incidence at 80 DAT. All the varieties performed comparatively higher wilt incidence and the average wilt incidence varied from 13.30 to 24.47%. The highest Fusarium and Nemic wilt incidence (24.47%) was recorded in the variety BARI tomato-7. The lowest wilt incidence (13.30%) was recorded in the variety BARI Tomato-1 (Manik), which was closely followed by the variety BARI Tomato-2 (Ratan), BARI Tomato-8 (Shila) and BARI Tomato-12 (Shidur). A statistically significant variation was recorded among tomato varieties in terms of Fusarium and Nemic wilt incidence at 95 DAT. All the cultivars showed comparatively higher level of wilt incidence and it varied from 17.77 to 40.00%. In the variety BARI Tomato-7, the highest Fusarium and Nemic wilt incidence (40.00%) was recorded, which was closely followed by the variety BARI Tomato-5.

Table 3. Incidence of fusarium and nemic wilt among twelve BARI tomato varieties at different growing periods of the crops

Treatments	Fusarium and Nemic wilt incidence			
	50 DAT (%)	65 DAT (%)	80 DAT (%)	95 DAT (%)
BARI Tomato-1 (Manik)	6.70b	11.10ab	13.30c	17.77c
BARI Tomato-2 (Ratan)	6.67b	11.10ab	15.53bc	17.77c
BARI Tomato-3	11.10a	15.53ab	20.00a-c	26.67bc
BARI Tomato-4	6.70b	11.10ab	17.77a-c	31.10ab
BARI Tomato-5	11.10a	13.33ab	22.23ab	33.33ab
BARI Tomato-6 (Choiti)	6.70b	15.53ab	20.00a-c	31.10ab
BARI Tomato-7	11.10a	17.77a	24.47a	40.00a
BARI Tomato-8 (Shila)	6.70b	8.90b	15.53bc	31.10ab
BARI Tomato-9 (Lalima)	8.90a	15.53ab	20.00a-c	26.67bc
BARI Tomato-11	11.10a	17.77a	22.23ab	26.67bc
BARI Tomato-12 (Shidur)	6.70b	11.10ab	15.53bc	33.33ab
BARI Tomato-14	11.10a	15.53ab	22.23ab	33.33ab
CV (%)	31.40	29.18	20.21	17.77
LSD	4.63	6.76	6.52	8.75

*Means in Column followed by the same letter (s) did not differ significantly by DMRT

BARI Tomato-12 (Shidur) and BARI Tomato-14 (33.33%). The lowest wilt incidence (17.77%) was recorded in the variety BARI Tomato-1 (Manik), which was statistically identical with the variety BARI Tomato-2 (Ratan) (Table 4).

Table 4. Reaction of twelve BARI tomato varieties to fusarium and nemic wilt caused by *Fusarium oxysporum* f.sp *lycopersici and Meloidogyne incognita*

Treatments	Fusarium and Nemic wilt incidence (%) at 95 DAT	Reaction
BARI Tomato-1 (Manik)	17.77c	R
BARI Tomato-2 (Ratan)	17.77c	R
BARI Tomato-3	26.67bc	MR
BARI Tomato-4	31.10ab	MS
BARI Tomato-5	33.33ab	MS
BARI Tomato-6 (Choiti)	31.10ab	MS
BARI Tomato-7	40.00a	MS
BARI Tomato-8 (Shila)	31.10ab	MS
BARI Tomato-9 (Lalima)	26.67bc	MR
BARI Tomato-11	26.67bc	MR
BARI Tomato-12 (Shidur)	33.33ab	MS
BARI Tomato-14	33.33ab	MS

*Means in Column followed by the same letter (s) did not differ significantly by DMRT

HR= Highly resistant (0-5% wilted plant), R=Resistant (<5-20% wilted plant), MR= Moderately resistant (<20- 30% wilted plant), MS= Moderately susceptible (<30-50% wilted plant), S=Susceptible (<50-70% wilted plant), HS= Highly susceptible (<70% and above wilted plant)

Among the varieties used in the present trial, the variety BARI Tomato-1 (Manik) and BARI Tomato-2 (Ratan) were marked as resistant to Fusarium and Nemic wilt. BARI Tomato-3, BARI Tomato-9 (Lalima) and BARI Tomato-11 were regarded as moderately resistant. Rest of the varieties showed moderately susceptible reactions.

Growth and yield contributing characters

Tomato cultivars showed statistically significant variation in respect of shoot length, shoot weight, root length and root weight (Table 5). Different varieties performed different shoot length and it varied from 24.67 to 40.67 cm. The highest shoot length was recorded in BARI Tomato-7 which was statistically identical with the variety BARI Tomato-12 (Shidur). The lowest shoot length was recorded in the variety BARI tomato-2 (Ratan), which was closely followed by the variety BARI tomato-8 (Shila) and BARI tomato-9 (Lalima) (26.00 cm and 26.33 cm, respectively). The varieties performed different shoot weight and it varied from 82.33 to 255.35gm. The highest shoot weight was recorded in the variety BARI Tomato-12 (Shidur), which was closely followed by the variety BARI Tomato-7 and BARI Tomato-5 (201.00 gm and 201.33 gm, respectively). The lowest shoot weight was recorded in the variety BARI Tomato-2 (Ratan), which was closely followed by the variety BARI Tomato-9 (Lalima), BARI Tomato-4 and BARI Tomato-14 (101.00gm, 115.00gm and 130.67gm, respectively).

Table 5. Growth and yield contributing characters of wilt infected different BARI tomato varieties

Treatments	Shoot length plant^{-1} (cm)	Shoot weight plant^{-1} (g)	Root length plant^{-1} (cm)	Root weight plant^{-1} (g)
BARI Tomato-1 (Manik)	38.00b	174.67c	31.00ab	30.33b
BARI Tomato-2 (Ratan)	24.67f	82.33j	25.67cd	18.00d
BARI Tomato-3	39.67a	132.00f	30.67b	16.00e
BARI Tomato-4	35.67c	115.00h	22.33de	16.00e
BARI Tomato-5	35.00c	201.33b	31.33ab	32.00a
BARI Tomato-6 (Choiti)	39.67a	124.00g	21.33e	12.00f
BARI Tomato-7	40.67a	201.00b	20.00e	13.00f
BARI Tomato-8 (Shila)	26.00e	162.33e	21.33e	21.33c
BARI Tomato-9 (Lalima)	26.33e	101.00i	21.67e	16.00e
BARI Tomato-11	32.50d	166.00d	26.67c	21.00c
BARI Tomato-12 (Shidur)	40.33a	255.35a	34.67a	32.00a
BARI Tomato-14	37.50b	130.67f	27.00c	16.00e
CV (%)	2.27	1.63	8.02	4.59
LSD	1.34	1.76	3.55	1.58

*Means in Column followed by the same letter (s) did not differ significantly at level by DMRT

Different varieties performed different root length and it varied from 20.00 to 34.67 cm. The highest root length was recorded in Tomato-12 (Shidur), which was statistically similar with BARI Tomato-1 (Manik) and BARI Tomato-5 (31.00 cm and 31.33 cm). The lowest root length was recorded in the variety BARI Tomato-7, which was statistically identical with the variety BARI Tomato-6 (Choiti), BARI Tomato-8 (Shila) and BARI Tomato-9 (Lalima) (21.33 cm, 21.33 cm and 21.67 cm, respectively). The varieties also performed different root weight and it varied from 12.00 to 32.00 gm. The highest root weight was recorded in the variety BARI Tomato-12 (Shidur), which was statistically identical with the variety BARI Tomato-5. The lowest root weight was recorded in BARI Tomato-6 (Choiti), which was statistically identical with BARI Tomato-7 (13.00 gm).

Yield of different BARI tomato varieties

The varieties showed statistically significant variation in terms of average yield (Table 6). The average yield per plant varied from 0.78 to 3.03 kg. The highest yield per plant was recorded in the variety BARI Tomato-8 (Shila), which was closely followed by the variety BARI Tomato-5 (2.83 kg)

and BARI Tomato-12 (Shidur) (2.55kg). The lowest yield per plant was recorded in the variety BARI Tomato-11, which was closely followed by the variety BARI Tomato-7 (1.40 kg) and BARI Tomato-14 (1.50 kg). The average yield per plot varied from 9.50 to 18.50 kg. The highest yield per plot was recorded in the variety BARI Tomato-8 (Shila), which was statistically identical with the variety BARI Tomato-5 (17.79 kg). The lowest yield per plot was recorded in the variety BARI Tomato-1 (Manik), which was statistically identical with the variety BARI Tomato-4 (9.50 kg) and BARI Tomato-14 (10.0 kg). The average yield per hectare varied from 21.11 to 41.11 ton. The highest yield per hectare was recorded in the variety BARI Tomato-8 (Shila), which was statistically identical with the variety BARI Tomato-5 (39.92 ton). The lowest yield per hectare was recorded in the variety BARI Tomato-1 (Manik), which was statistically identical with the variety BARI Tomato-4 (21.11 ton) and BARI Tomato-14 (22.22 ton).

Table 6. Yield performance of different BARI tomato varieties against wilt diseases

Treatments	Yield (Kg plant^{-1})	Yield (Kg plot^{-1})	Yield (t ha^{-1})
BARI Tomato-1 (Manik)	2.03c	9.50e	21.11e
BARI Tomato-2 (Ratan)	2.17c	15.00b	33.33b
BARI Tomato-3	2.00c	13.00c	28.88c
BARI Tomato-4	2.13c	9.50e	21.11e
BARI Tomato-5	2.83ab	17.97a	39.92a
BARI Tomato-6 (Choiti)	2.20c	12.50c	27.77c
BARI Tomato-7	1.40d	11.00d	24.44d
BARI Tomato-8 (Shila)	3.03a	18.50a	41.11a
BARI Tomato-9 (Lalima)	1.60d	11.00d	24.44d
BARI Tomato-11	0.78e	10.77d	23.92d
BARI Tomato-12 (Shidur)	2.55b	15.67b	34.81b
BARI Tomato-14	1.50d	10.00e	22.22e
CV (%)	8.40	3.45	3.45
LSD	0.28	0.75	1.67

*Means in Column followed by the same letter(s) did not differ significantly at level by DMRT

Considering the overall results it may be concluded that the cultivars BARI Tomato-1 (Manik) and BARI Tomato-2 (Ratan) was graded as a resistant against Bacterial, Fungal and Nemic wilt among diseases twelve BARI Tomato varieties used in the experiment. Resistant and Moderately resistant cultivars having desirable agronomic trials may be recommended for cultivation as a resistant source in Bacteria, Fungi and Nematodes prone areas.

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