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SCREENING OF SOME TOMATO ENTRIES AGAINST LEAF CURL DISEASE IN THE SYLHET REGION

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ABSTRACT

Tayab B, Muqit A, Haque AHMM, Uddin MZ, Yesmin S (2016) Screening of some tomato entries against leaf curl disease in the Sylhet region. Int. J. Sustain. Crop Prod. 11(3), 1-7.

An experiment was conducted to screen some tomato entries against leaf curl disease caused by *Tomato yellow leaf curl virus* (TYLCV) & *Tomato leaf curl virus* (ToLCV) in the field of Sylhet region under natural infection. The experiment was conducted during November 2014 to April 2015 at Regional Agricultural Research Station of Bangladesh Agricultural Research Institute (BARI) at Akbarpur, Moulvibazar. Twenty nine tomato lines namely GPT-009, GPT-011, GPT-015, GPT-017, SL-011, SL-012, China cherry, GWT-043, GWT-052, GBT-037, GBT-053, GBT-056, SL-001, SL-003, SL-008, SL-009, SL-010, W₁₁ Hybrid-1, W₁₁ Hybrid-33, W₁₁ Hybrid-35, W₁₁ Hybrid-37, AVTOV-1007, AVTOV-1008 and AVTOV-1010 were observed for disease reaction where BARI Tomato-3, BARI Tomato-5, BARI Tomato-11, BARI Tomato-14 & BARI Tomato-15 were used as control. None of the varieties were found to show complete resistance against leaf curl disease. However, W₁₁ Hybrid-37 and AVTOV-1010 showed very low level of disease incidence.

Key words: tomato lines, screening, TYLCV, ToLCV, Sylhet region

INTRODUCTION

Tomato (Solanum lycopersicum) is one of the most consumed, nutritious and widely grown popular vegetable crops in Bangladesh as well as in the tropical, sub-tropical and temperate regions of the world. Its importance as a crop is indicated by increasing trend of area under cultivation and production. Among the vegetables, tomato ranks third in the world in terms of area and production next to potato and sweet potato, placing itself first as processing crop (Salam et al. 2010). Bangladesh produces 1,90,213 metric ton of tomato per annum from 58854 acres of land (BBS 2013). However the yield of tomato is quite low (8.00 t/ha) compared to the other leading tomato producing countries of the world such as United States, China, Egypt, Turkey and India with the yield of 87.96, 49.87, 39.85, 37.83 and 20.11 t/ha, respectively (FAO 2012). The low production of tomato can be attributed to diseases and insect pests, unfavorable weather conditions and cultivation method. Several fungal, bacterial, nemic and viral pathogens are reported to infect tomato in Bangladesh. Among the yield limiting factors of tomato, viral diseases play an important role of which Tomato leaf curl disease caused by Tomato yellow leaf curl virus (TYLCV) and Tomato leaf curl virus (ToLCV) is a destructive and economically important disease occurring throughout tomato growing areas in the world. Symptoms of the diseases include leaf curl, stunting, reduction in leaf size, flower drop etc. It is a Gemini virus transmitted by whitefly (Bemisia tabaci). Around 7 million hectares of crop plants in 40 countries are subjected to begomovirus attack by TYLCV or by mixed infections in 15 of those countries (Akram et al. 2014) Leaf curl disease can infect tomato plants in all stages. The losses due to tomato leaf curl virus can reach up to 93.3% if infected at very early stages of the crop growth.

In Bangladesh, TYLCV was first reported by Akanda (1991). Since then efforts have been made to characterize the virus systemically and manage the disease through manipulation of sowing dates to avoid high vector population, growing seedling in net house, application of insecticide (Paul 2002; Rahman 2003; Gupta 2000; Azam 2001; Akhter 2003 and Sultana 2001), reflective mulches, mixed cropping with plants more attractive to the vector, elimination of weeds and other crops acting as virus reservoir. Although the efforts described above generated quite a good pieces of information regarding TYLCV and its management including yield loss pattern in Bangladesh yet none of these efforts could provide sufficient, comprehensive and conclusive information about TYLCV (Muqit 2006).

Various strategies have been tried to control the disease. In Bangladesh, farmers usually spray chemicals to control the vector (Whitefly) of TYLCV. But indiscriminate use of insecticides to kill whitefly has made this insect resistant and also causes environmental pollution. Use of resistant genotypes is the most suited option. Several tomato varieties were screened in Bangladesh (Muqit *et al.* 2006). Because of evolution of new viral strains that overcome the existing resistant germplasm, which is the prime importance to continue searching for new resistant varieties. The potential benefit of viral resistant germplasm are great, because it is the most economical and environmentally safe strategy. Evaluation of various physical, chemical or cultural methods and their integration also appears to be a better option as a management strategy under present circumstances to manage leaf curl in Bangladesh. Many varieties have been released by different research organizations without testing their reaction against TYLCV and ToLCV. In such situation it is very much necessary to assess their reaction against leaf curl disease. Besides these, it is also essential to know the nature of the host pathogen interaction in order to develop an effective disease management strategy. In consideration of the situation stated

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above, the present research program was undertaken to screen 29 entries of tomato to meet the following objectives- i. to screen the available germplasm against leaf curl disease and ii. to find out a virus resistant or tolerant tomato variety.

MATERIALS AND METHODS

The experiment was conducted during the 2nd week of October 2014 to 1stweek of April 2015. Seedlings were transplanted between 2nd & 3rd week of November 2014 in the experimental field of BARI, RARS, Akbarpur, Moulvibazar. Geographically the experimental field is located at 24.48° North latitude and 91.78° East longitude at an elevation of 13 meters above the sea level belonging to Non-calcareous Grey Floodplain Soil under the Agro-Ecological Zone - 20 (AEZ - 20) named Eastern Surma-Kushiyara Floodplain under Sylhet Division.

Planting Materials

A total number of 29 varieties of tomato were used in the experiment. The varieties were GPT-009, GPT-011, GPT-015, GPT-017, SL-011, SL-012, China cherry, GWT-043, GWT-052, GBT-037, GBT-053, GBT-056, SL-001, SL-003, SL-008, SL-009, SL-010, W₁₁ Hybrid-1, W₁₁ Hybrid-33, W₁₁ Hybrid-35, W₁₁ Hybrid-37, AVTOV-1007, AVTOV-1008, AVTOV-1010, BARI Tomato-3, BARI Tomato-5, BARI Tomato-11, BARI Tomato-14, BARI Tomato-15 (latter 5 variety were control).

Identification of leaf curl disease

Identification of the virus disease was done through visual observation of typical symptoms of TYLCV and ToLCV infection like upward curling, cupping, with or without marginal chlorosis, smaller leaflets and stunting of the plant. The experiment was laid out in one factorial randomized complete block design with 3 and 4 replications. The size of each unit plot was $4.8 \text{ m} \times 1 \text{ m}$ with 60 cm \times 40 cm row to row and plant to plant distance. Total number of plot was 101. The individual plot and the block were separated for irrigation and drainage by 50 cm channels.

Each unit plot consisted of total 24 plants. Among them total infected plants were counted from each unit plot.

Disease incidence

Disease incidence was calculated by the standard formula:

Disease incidence (%) = $\frac{No.of infected plants}{No.of total plants inthe plot} \times 100$

Disease severity

Disease severity was determined by the following disease severity scale (1-4) where

Scale 1: Only upper 2-3 leaves infected

Scale 2: Infection in upper 25% of the leaves but no visible reduction is seen

Scale 3: More than 25% leaves and twigs infected and visible reduction in plant height and branches is clearly seen and

Scale 4: More than 50% tissue is infected and severe stunting is visible.

Reduction of growth parameters

Reduction (%) of growth parameters were calculated by the following formula:

Reduction (%) =
$$\frac{\text{Height of Healthy plant} - \text{Height of Diseased plant}}{\text{Height of Healthy plant}} \times 100$$

Similar equation was also followed in case of number of branches, canopy etc.

Statistical analysis

The collected data were transformed by the Square Root Transformation method then the data were statistically analyzed using "Analysis of Variance Technique" and the significance of mean difference were adjudged by "Duncan's Multiple Range Test" (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Processing tomato lines

Reaction of processing tomato lines are presented in Table 1. Significant difference in disease reaction was observed in processing tomato lines. BARI Tomato-3 had the lowest disease incidence (4.17%) and severity (0.25) too. Among the entries GPT-011 had the lowest disease incidence (4.45) which was similar to BARI Tomato-3 and the highest disease incidence (15.06%) was observed in GPT-015. The highest severity was found in GPT-017. These results were consistent with those results of Akram *et al.* (2014).

Tomato Lines	Disease Incidence (%)	Disease Severity
CRT 000	8.34 ab	1.25 ab
GP1-009	(2.780)	(1.102)
CDT 011	4.45 bc	0.75 ab
GP1-011	(1.845)	(0.9575)
CDT 015	15.06 a	1.25 ab
GP1-013	(3.825)	(1.102)
CDT 017	8.25 ab	1.50 a
GP1-017	(2.807)	(1.205)
DADI Temeta 2	4.17 c	0.25 b
BARI Tomato-5	(1.043)	(0.7825)
CV (%)	38.68	22.80
LSD	1.408	0.3471

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Table L.	Disease	reaction o	r some	processing	tomato	lines	against	I omato	lear	curi	disease
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Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of *Ty gene* inserted tomato lines (Cherry type)

Ty gene inserted (cherry type) tomato lines did not show better tolerance against leaf curl disease as compared to BARI Tomato-11 (Table 2). China cherry tomato showed similar disease reaction to BARI Tomato-11 (2.78%). Muqit *et al.* (2006) also reported that BARI Tomato-11 (cherry type) possessed field resistance against TYLCV. Other lines had significantly higher disease incidence and severity. The results are not fully consistent with the previous findings.

 Table 2. Reaction of some Ty gene inserted tomato lines (Cherry type) for yield and disease resistance against

 Tomato leaf curl disease

Tomato Lines	Disease Incidence (%)	Disease Severity	
SI 011	13.89 a	1.67 ab	
SL-011	(3.66)	(1.273)	
SI 012	19.44 a	2.00 a	
SL-012	(4.363)	(1.41)	
China Charry	2.78 b	0.67 b	
China Chefry	(1.437)	(0.9433)	
BADI Tomato 11	2.78 b	0.67 b	
BARI Tolliato-11	(1.437)	(0.9433)	
CV (%)	22.87	20.06	
LSD	1.119	0.4137	

Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of Semi indeterminate tomato lines

Semi indeterminate tomato lines showed relatively lower amount of disease (Table 3). Tomato line GWT-052 had significantly lower incidence of leaf curl disease as compared to BARI Tomato-14 or GWR-043. It had only 5.50% disease incidence with a severity level of 0.50 only. Reaction of BARI Tomato-14 & GWT-043 were similar.

Table 3. Reaction of some semi indeterminate tomato lines against Tomato leaf curl disease

Tomato Lines	Disease Incidence (%)	Disease Severity
CWT 042	17.98 a	1.00 ab
G w 1-043	(4.122)	(1.00)
GWT 052	5.50 b	0.50 b
0 W 1-032	(2.005)	(0.855)
BARI Tomato 1/	23.33 a	1.75 a
BARI Tolliato-14	(4.122) 5.50 b (2.005) 23.33 a (4.758) 19.77	(1.285)
CV (%)	19.77	20.49
LSD	1.145	0.3338

Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation; LSD = Least Significant Difference

Disease reaction of selected β-Carotene rich tomato lines

Significant difference in disease reaction was found in β -Carotene rich tomato lines (Table 4). The test lines had much lower disease incidence and severity than control. Leaf curl incidence varied from 5.72 to 8.94% in test lines whereas in control (BARI Tomato-14) it was 24.23%. The lowest (5.72%) disease incidence was observed in GBT-056. Although other two varieties had higher amount of disease. There was no significant difference between them. Similar result was observed in disease severity.

Tomato Lines	Disease Incidence (%)	Disease Severity	
GBT 037	7.94 b	0.67 b	
081-037	(2.527)	(0.9033)	
CRT 053	8.94 b	1 b	
081-033	(2.920)	(1.00)	
GBT 056	5.72 b	1 b	
GB1-050	(2.363)	(1.00)	
BARI Tomato 14	24.23 a	2.33 a	
DARI Tolliato-14	(4.910)	(1.487)	
CV (%)	27.11	21.81	
LSD	1.549	0.4291	

Table 4. Reaction of some selected β -Carotene rich tomato lines against leaf curl disease

Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of Ty gene inserted tomato lines(non-cherry type)

Wide variation was found among *Ty gene* inserted on-cherry tomato lines (Table 5). All the entries showed lower amount of disease as compared to BARI Tomato-15 except SL-003. The lowest disease incidence was observed in SL-010 (6.30%) which was followed by SL-009 (7.47%), SL-008 (12.20%) and SL-001 (14.49%). There was no significant difference between BARI Tomato-15 and SL-003. Although there was significant difference between bars incidence but no difference was observed in disease severity. Similar finding was also reported by Al Abdallat *et al.* (2010).

Tomato Lines	Disease Incidence (%)	Disease Severity
SL 001	14.49 ab	1.00 a
SL-001	(3.020)	(1.040)
SI 002	27.92 a	1.67 a
SL-005	(5.153)	(1.273)
ST 008	12.20 ab	1.33 a
SL-008	(3.317)	(1.137)
SL-009	7.47 ab	1.33 a
	(2.703)	(1.137)
SL-010	6.30 b	1.00 a
	(2.460)	(1.00)
PADI Tomoto 15	25.18 a	1.67 a
BARI Tolliato-15	(4.077)	(1.283)
CV (%)	43.60	25.14
LSD	2.595	0.4963

Table 5. Reaction of some Ty gene inserted tomato lines(non-cherry type) against leaf curl disease

Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of F₁S of some winter tomato lines

Among four hybrid winter tomato lines W_{11} Hybrid-37 line showed significantly lower amount of disease (Table 6). They had only 0.5% disease incidence where other hybrids (W_{11} Hybrid-35 and W_{11} Hybrid-1) had significantly higher amount of disease. Reaction of BARI Tomato-5 was similar with W_{11} Hybrid-37. Tomato line W_{11} Hybrid-37 had the lowest disease severity (0.5) whereas W_{11} Hybrid-35 showed the highest disease severity (2.0).

Tomato Lines	Disease Incidence (%)	Disease Severity
W Herbrid 1	19.44 ab	1.00 ab
w_{11} Hybrid-1	(3.827)	(1.040)
W Hybrid 22	3.17 bc	0.67 ab
w ₁₁ Hybrid-55	(1.503)	(0.9433)
W Hubrid 25	27.30 a	2.00 a
w ₁₁ Hybrid-55	(5.197)	(1.380)
W Hybrid 27	0.50 c	0.50 bc
w ₁₁ Hyond-57	(0.710)	(0.710)
RAPI Tomato 5	5.45 bc	0.67 ab
BARI Tolliato-5	(2.090)	(0.9033)
CV (%)	51.74	32.69
LSD	2.415	0.5702

Table 6.	Reaction of	f F ₁ S	of some	winter	tomato	lines	against	leaf curl	disease
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Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of advanced lines of winter tomato

Reaction of three advanced tomato lines against leaf curl disease is presented in Table 7. Results showed that there was no significant different among the test lines. Significant difference was observed in disease severity. BARI Tomato-14 had significantly higher disease severity as compared to test entries. The lowest disease incidence was observed in AVTOV-1010.

Table 7. Reaction of some advance	d lines of	winter tomato	against lea	uf curl	disease
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Tomato Lines	Disease Incidence (%)	Disease Severity
AVTOV 1007	11.11 a	0.33 b
AV10V-1007	(2.397)	(0.807)
AVTOV 1008	16.67 a	0.33 b
AV10V-1008	(2.83)	(0.807)
AVTOV 1010	0.5 a	0.5 b
AV10V-1010	(0.71)	(0.710)
BADI Tomato 14	20.45 a	1.67 a
BARI Tolliato-14	(4.383)	(1.243)
CV (%)	25.85	26.27
LSD	4.444	0.4215

Figures in the parenthesis are transformed values. Means followed by the same letter are not significantly different at 5% level by DMRT

CV = Co-efficient of Variation

LSD = Least Significant Difference

Disease reaction of different groups of tomato lines

Reaction of seven different categories of tomato lines are shown in Table 8. Results suggested that there is no significant difference between different groups of tomato in terms of disease reaction. However, β -carotene rich tomato lines had comparatively lower disease incidence (7.53%) followed by processing tomatoes, advanced winter tomato lines, semi indeterminate tomato lines, *Ty gene* inserted lines (cherry type) and hybrids. *Ty gene* inserted tomato lines had the highest amount of disease (13.68%). Disease severity ranged from 0.37 to 1.45. The lowest disease severity was observed in Advance winter tomato lines (0.39) and the highest in *Ty gene* inserted tomato lines (1.45). Semi indeterminate tomato lines had also low level of disease severity.

Table 8. Reaction of different tomato groups against leaf curl disease

Tomato Lines	Disease Incidence (%)	Disease Severity
Processing tomato	9.25	1.19
Ty gene inserted (cherry type)	12.04	1.45
Semi-indeterminate	11.74	0.75
β-carotene rich	7.53	1.25
Ty gene inserted	13.68	1.27
F_1S of winter tomato	12.06	1.04
Advanced winter tomato	9.43	0.39

Effect of leaf curl on growth parameters

Effect of leaf curl disease on growth parameters of tomato plants were recorded randomly from 27 tomato lines. Plant height, number of branches and canopy of tomato plant were greatly influenced by leaf curl disease. The losses due to leaf curl infection on plant height ranged from 1.8 to 46.8% (Table 9). The highest reduction in plant height was observed in AVTOV-1007 (46.8%) whereas the lowest reduction was recorded from GWT-043 (1.8%).

Reduction in number of branches ranged from 9.09 to 57.1%. The lowest reduction in number of branches was observed in China cherry (9.09%) and the highest in AVTOV-1007 (57.1%) lines. Plant canopy was also influenced by the leaf curl disease and it ranged from 1.6 to 59.5%. The highest reduction in canopy was observed in AVTOV-1007 (59.5%) tomato line whereas the lowest canopy reduction was observed in BARI Tomato-5 and BARI Tomato-11 (1.6%). Results indicated that reduction in growth parameters is not similar in all the test lines. Higher reduction in growth parameters indicates higher susceptibility to the disease.

	Plant height (cm)			N	o. of branc	hes	Canopy (cm ²)		
Tomato Entries	Healthy	Diseased	Reduction (%)	Healthy	Diseased	Reduction (%)	Healthy	Diseased	Reduction (%)
GPT-009	87.2	82.4	5.5	8	6	25.0	3282.8	2130.4	35.1
GPT-011	90.2	57.2	36.6	7	6	14.3	2793.2	2173.2	22.1
GPT-015	84.6	64.4	23.9	5	4	20.0	2445.2	1646.2	32.7
GPT-017	88.2	79.12	10.3	10	6	40.0	3324.0	2649.4	20.3
SL-011	147.2	134.4	8.7	16	16	NA	8803.0	7363.0	16.4
SL-012	173.0	165.2	4.5	21	19	9.5	10165.6	9528.4	6.3
China cherry	84.2	82.0	2.61	11	10	9.09	2810.6	2700.0	3.93
GWT-043	119.0	116.8	1.8	7	6	14.3	9741.8	9374.0	3.8
GWT-052	132.8	95.8	27.9	6	4	33.3	8992.0	7489.0	16.7
GBT-037	135.2	110.8	18.05	6	6	NA	7818.0	4257.2	45.5
GBT-053	167.6	171.4	NA	10	7	30.0	7507.4	6214.0	17.2
GBT-056	136.8	100.6	26.5	7	5	28.5	4023.0	2489.4	38.1
SL-001	87.6	76.8	12.3	9	6	33.3	5014.0	3515.6	29.9
SL-003	102.0	96.0	5.9	8	7	12.5	5995.0	5421.2	9.6
SL-008	109.6	102.0	6.9	8	5	37.5	8590.2	7224.0	15.9
SL-009	122.2	90.0	26.4	9	4	55.5	7982.0	4627.8	42.02
SL-010	96.2	70.4	26.8	7	4	42.9	4814.8	2743.6	43.01
W ₁₁ Hybrid-1	88.6	63.0	28.9	6	4	33.3	5450.6	3359.0	38.3
W ₁₁ Hybrid-33	91.0	89.0	2.2	6	6	NA	5249.2	5003.8	4.7
W ₁₁ Hybrid-35	97.0	87.0	10.3	6	6	NA	5543.6	4420.4	20.6
W ₁₁ Hybrid-37	91.0	NA	NA	6	NA	NA	4988.0	NA	NA
AVTOV-1007	103.0	54.8	46.8	7	3	57.1	5819.0	2358.8	59.5
AVTOV-1008	94.2	92.3	2.0	6	7	NA	5815.0	5654.0	2.8
AVTOV-1010	95.0	NA	NA	8	NA	NA	5900.0	NA	NA
BARI-3	86.8	NA	NA	7	NA	NA	4003.6	NA	NA
BARI-5	97.0	95.0	2.1	6	6	NA	5316.8	5234.0	1.6
BARI-11	92.8	91.0	1.9	11	9	18.1	3050.0	3000.0	1.6
BARI-14	122.0	115.5	5.3	7	6	14.3	4366.4	3532.5	19.09
BARI-15	99.0	92.0	7.07	10	7	30.0	4693.2	4738.0	NA

Table 9. Effect of leaf curl disease on growth parameters of different tomato lines

*NA = Not Applicable

CONCLUSION

None of the varieties tested was resistant to leaf curl disease. However, W_{11} Hybrid-37, AVTOV-1010, AVTOV-1008, China cherry, BARI-3, BARI-11 found to be moderately resistant. The varieties W_{11} Hybrid-37 and AVTOV-1010 seemed to have some field resistance which could be utilized for the improvement of popular varieties. However, this is one year data. To know the resistance status of the varieties these need to be tested in different locations of the country and for two more seasons.

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