Screening of tomato genotypes against curly top virus under field conditions of District Lasbela, Balochistan

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Abstract

Tomato (*Lycopersicon esculentum* Mill) is an important fruit crop in Balochistan but its production is decreasing due to severe attack of *Curly top virus* (CTV). In this study, eight commercial tomato genotypes were evaluated against CTV and four varieties Dormin, Lema, Yaaqi, and Xico expressed 8–10.5% infection. The Dollar showed 11% infection whereas a high level of infection of 20–25% was recorded in local and Roma, respectively. Severa was highly resistant, Dormin, Lema, Yaqi, and Xico were resistant, Dollar was susceptible and Roma and Local were highly susceptible against CTV. The maximum biological yield was recorded in Severa followed by Dormin and Lema while lower biological yield was recorded in Local. Severa was found resistant with maximum yield and further suggested for the cultivation in Balochistan.
Keyword: Tomato, Baluchistan, Biological yield, *Curly top virus,* Screening.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the important crops of the world. It is an important vegetable and cash crop for many low-income farmers in various countries of the tropics such as Iran, Pakistan, China and India (Adjata, 2008). Pakistan is the most important producer of tomato and area comparison during the years 2015 to 2018 showed an annual increase in the cultivation of tomato up to 50% (GOP, 2019). The *solanaceous* crops include tomato, potato, and chilies and the production of all these crops is lower in the country due to several biotic and abiotic factors. Among biotic factors, several fungi (Abbas *et al*., 2014), nematode (Parveen *et al*., 2013), and viruses (Abbas *et al*., 2012; Biswas *et al*., 2014; Urooj *et al*., 2016; Qamar *et al.,* 2016) were reported in the country. Among all these, CTV is highly destructive in tomato and it has caused 95% yield losses in tomato crops of sub-tropical zones (Abbas*et al*., 2016: Gorovits *et al.,* 2013). The availability of resistant germplasm against CTV is still unknown in the country and molecular tools can play a vital role in virus confirmation (Khan *et al*., 2017). The suitable variety of tomato should have suitable characters and identification of a reliable cultivar is on the critical decision and dynamic process as it may remain favourable for a few to many years (Wege, 2007). The objectives of the current study were to screen the resistant varieties of tomato among different popular lines available in Lasbela District and spatial variation among different tomato varieties grown in three different localities in Uthal.

Materials and Methods

During the year 2017-18, 10 tomato fields were selected randomly to examine the impact of CTV on the yield and their economic losses. The data was collected on disease intensity and different morphological parameters such as plant height, the number of flowers per plant, and the number of fruits per plant was recorded. Eight major tomato cultivars (Dollar, Dormin, Lema, Local, Roma, Servera, Xico, and Yaqi) were sown at Awadan (area 1), Haworoo (area 2), Uthal (area 3), and PirGouth (area 4) and Research farm at Department of Plant Pathology, Faculty of Agriculture LUAWMS was used as a control. These varieties were further studied for the screening of the resistance against the tomato CTV and its biological yield. The crop was observed at different stages and disease severity was assessed (Wheeler, 1969). Randomized Completely Block Design (RCBD) with two replications was used for data collection and other trials

Result and Discussion

The infecting plants were exhibiting the dwarfed leaves and leaves were cupped upward and rolled inward (Fig. 1). Similar symptoms of CTV in the tomato crop were recorded in California (Chen *et al*., 2010) but only symptomology is not a reliable confirmation of CTV because curling and rolling were also recorded in *Potato lear roll virus* (PLRV) (Abbas *et al*., 2012). According to the survey, the results in the intensity of disease were lower up to 5% in LUAWMS followed by 5.1% in Awadan and Haworoo. Dormin, Xico, Yaqi, and Lema were exhibiting the disease intensity in the range of 8.2–8.5%, 8.4–8.6%, 9.1–9.3%, and 10.1–10.3%, respectively. Furthermore, tomato varieties Local and Roma showed high susceptibility against CTV. The intensity was 20.1–20.2% in Roma and 25.0–25.2% in Local. Dollar of tomato was susceptible in response as it exhibited 11.0–11.4% disease intensity

(Table 1). The maximum 76% infection was recorded in area 2 followed by 71.33% in area 5 and 71% in area 4. Minimum disease severity was exhibited in Severa in area 1 (6%) and area 3 (6.33%) and the Dormin (6.66%) in area 3. The results showed that Severa was very low in disease severity of 6%, whereas Local was very high of 70% in disease severity. Low disease severity were recorded in Severa (6%) followed by Dormin (9%), Lima (12%), Yaqi (22%), Dolla (24% Xico (25%), Roma (31%) and Local (70%). Hajiabadi, 2012 confirmed TLCV and TLMSV in Qazvin province of North Iran and reported 2.4% and 2.37% incidence of the virus in Alborz and Abiyek, respectively. Kanjilal *et al.* (2000) reported that the disease rates in susceptible genotypes of tomato were 39 to 86%. Nahiyan *et al.* (2014) screened 16 tomato genotypes and reported that diseases (viral and bacterial) percentage varied (0% to 66.7%) due to variation of variety (Table 1).

Biological yield comparison among eight tomato cultivars showed that Severa was higher in average biological yield followed by Dormin and Lema. Lower biological yields were recorded in Local followed by Roma, Xico, and Dollar. The highest plant height 39 inches was recorded in the local variety followed by 37 inches in Roma 36 inches in Dormin and 30 inches in Yaqi. The plant height of Severa, Dollar and Xico was recorded as 35 inches, 34 inches, and 32 inches, respectively. This difference is due to varietal genetic character not due to the effect of disease (Olaniyi *et al.,* 2010). Fruit length and diameter varied in different tomato varieties (Hussain *et al.,* 2001). Maximum fruits (218) were recorded in Severa while Local was exhibiting the minimum 7. The high average weight per fruit was 121 g in Lima followed by 115 g in Dormin, 112 g in Yaqi, 110 g in Xico, 109 g in Roma, 98 g in Dollar, 89 g in Local, and 87 g in Severa. The lowest fruit weight of 87 g was recorded in the high resistant variety because of its genetic character, as this variety has low fruit size in higher number of fruits. During this research, the yield was a maximum of 18.94 kg in variety Severa which was followed by 7.36 kg in Dormin, 6.89 kg in Lima, 1.90 kg in Yaqi. The lowest yield was recorded in variety Local hat was 1kg followed by Roma that was 1.19 kg, 1.32 in Xico and 1.47 in Dollar (table 2). The total yield of the tomato crop depends upon the above-mentioned factors and breeders have developed several varieties that produced giant to small fruit and are suitable to grow in every climate (Benton, 2008). Biswas *et al.,* 2014 studied the virus infection of ARI Tomato-4 (V1), BARI Tomato-5 (V2), BARI Tomato-7 (V3), and BARI Tomato-9 (V4) and recorded plant height, maximum leaves and branches on the individual plant, number of flowers, number of fruits, fruit diameter, individual fruit weight and total yield in the virus-infected plants. The serological confirmation and molecular analysis should be conducted to confirm CTV in the particular area. The proper identification and resistance source will enhance the yield of tomato crop and also improve the economic condition of the grower.

Conclusion

Severa was recorded as highly resistant against CTV and it was also exhibiting the maximum yield. It was considered as an ideal genotype for cultivation in Uthal and adjacent areas.

Table 1: Disease severity of CTV and resistance response of tomato varieties.

Varieties	Area 1	Area 2	Area 3	Area 4	Area 5 (Control)	Avg. Infection (%)
Disease severity						
Severa	6	7	6.33	7.33	7	6.73
Dormin	9	8	6.66	9.33	9	8.19
Lema	12	13	13	12.66	12	12.53
Yaqi	20.33	23.33	22.33	22.33	24	22.46
Dollar	24	25.66	24.33	22.66	25	24.33
Xico	24	24.33	23	25.33	26.33	24.6
Roma	31	31.66	31.33	35	35	32.8
Local	66.33	76	70	71	71.33	70.93
LSD	5.16	2.64	2.73	2.91	4.84	

Response of tomato genotypes			
Genotype	**Awadan**	**Haworoo**	**(Controls)**
Savera	5.1% (HR)	5.1% (HR)	5.0% (HR)
Dormin	8.5% (R)	8.4% (R)	8.2% (R)
Lema	10.2% (R)	10.3% (R)	10.1% (R)
Yaqi	9.1% (R)	9.2% (R)	9.3% (R)
Dollar	11.1% (S)	11.0% (S)	11.4% (S)
Xico	8.5% (R)	8.6% (R)	8.4% (R)
Roma	20.0% (HS)	20.1% (HS)	20.2% (HS)
Local	25.1% (HS)	25.0% (HS)	25.2% (HS)

Comparison of disease severity				
Varieties	**Total plants**	**Diseased plants**	**Disease Incidence (%)**	**Infection (%)**
Severa	100	6	3a	6a
Dormin	100	9	5a	9a
Lema	100	12	5a	12b
Yaqi	100	22	12b	22c
Doller	100	24	23c	24c
Xico	100	25	24c	25c
Roma	100	31	23c	31d
Local	100	70	24c	70e
LSD	--	--	3.06	7.4

HR = Highly Resistant, R = Resistant, S = Susceptible and HS = Highly Susceptible

Table 2: Morphological traits and total yield of eight tomato varities against CTV.

Comparison of total yield						
Varieties	**APH**	**NFP**	**WFP**	**Yield (Kg)**		
Severa	35	218	87	18.96		
Dormin	36	64	115	7.36		
Lema	32	57	121	6.89		
Yaqi	30	17	112	1.90		
Dollar	34	15	98	1.47		
Xico	34	12	110	1.32		
Roma	37	11	109	1.19		
Local	39	7	89	1.00		
LSD	5.27	6.34	8.31	7.43		
Marketable tomato fruit						
Varieties	**DI (%)**	**TNF**	**NMF**	**NUF**	**NUF (B/A*100)**	
Severa	6	218	200	18	8.25	
Dormin	9	64	53	11	17.18	
Lema	12	57	50	7	12.28	
Yaqi	22	17	13	4	23.52	
Dollar	24	15	12	1	6.66	
Xico	25	12	9	3	25	
Roma	31	11	9	2	18.18	
Local	70	7	6	1	14.28	
LSD	7.44	10.82	66.68	38.43	4.34	
Number of tomato fruits						
Severa	214	216.33	220	220.33	217	217.53
Dormin	63.33	64.66	64	62	63.33	63.46
Lema	56.33	58	54.66	59.33	59	57.46
Yaqi	16	16	17.66	17.66	17.33	16.93
Dollar	15	14	14.66	16.66	14.33	14.93
Xico	11	12.33	11	11	12.33	11.53
Roma	9	12.33	11	11	11	10.86
Local	7	8	7	7	6.66	7.13
LSD	61.18	62.49	0.177	63.27	62.62	
Area wise comparison of yield						
	Area 1	**Area 2**	**Area 3**	**Area 4**	**Area 5**	**Total**
Severa	18.96	17.966	18.46	19.666	19.166	94.23
Dormin	7.36	6.36	6.86	8.06	7.56	36.2
Lema	6.89	5.89	6.39	7.59	7.09	33.88
Yaqi	1.90	0.90	1.40	2.60	2.10	8.92
Dollar	1.47	0.47	0.97	2.17	1.67	6.75
Xico	1.32	0.32	0.82	2.02	1.52	6
Roma	1.19	0.19	0.69	1.89	1.39	5.39
Local	0.62	0.37	0.12	1.32	0.82	2.51
LSD	1.31	1.52	1.42	1.24	1.35	

PH = Average Plant height (Inch) NFP = Number of fruits per plant, WFP = Average weight of per fruit (g), NUF = Number of un-marketable fruits, NMF = Number of marketable fruit, APH = Average plant height (inch), TNF = Total number of fruit, DI = Disease Incidence

Fig. 1: Symptoms of tomato plant infected with CTV (A) and low biological yield (B).

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