



Genotypic Correlation of Biometric Traits and Leaf Curl Virus in Tomato

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The present investigation was carried out at three locations, viz., Rayakottai (E_1), Oddanchatram (E_2) and Attur (E_3) of TamilNadu during the summer season, 2007. The experimental material consisted of two tomato F_1 hybrids, their parents and ToLCV resistant and susceptible check varieties/hybrids. The experiment was laid out in a randomized block design with three replications. The results of pooled mean revealed that the two synthesized hybrids viz., CLN 2123A X HN2 and HN2 X CLN 2123A registered higher plant height, number of branches, total phenol content and yield per plant than their parents. Plant height, number of branches per plant, and number of fruits per plant revealed significantly positive association with fruit yield per plant in all the three locations. Pooled mean value of ToLCV incidence recorded at 60 DAP and 75 DAP exhibited negative and significant correlations with plant height, number of fruits per plant, total phenol content and fruit yield per plant in all the three locations. The quality parameters viz., TSS, titrable acidity and ascorbic acid content exhibited positive but non significant correlation with yield per plant.

Key words: Tomato, *Solanum lycopersicum*, genotypic correlation, ToLCV, Yield per plant.

Tomato (*Solanum lycopersicum* L.) is one of the most widely grown vegetable crops in India. Owing to ease in cultivation, high yield, suitability for protected cultivation and its preference as fresh and processed produce, it is considered as an important cash crop. Tomato crop is affected by several diseases at all stages of crop growth (Butani, 1977) and become a major limiting factor in its successful cultivation. Tomato leaf curl virus is a white fly transmitted Gemini virus disease resulted in yield loss up to 100 per cent (Pico *et al.*, 1998). Knowledge in respect of the nature and magnitude of association of yield with various component characters is a prerequisite to bring improvement in the desired direction. Studies on genetic correlation of plant characters in any selection programme is appreciable when highly heritable characters are associated with the important characters like yield (Verma *et al.*, 1997). Hence knowledge on association of tomato leaf curl virus with plant biometric traits and yield is important in breeding programme for developing resistant or tolerant varieties or hybrids

to leaf curl virus in tomato. Keeping this in view, the present investigation on genotypic correlation of plant biometric traits and disease incidence with yield in tomato was undertaken and the results are discussed.

Materials and Methods

The present investigation was carried out during summer season, 2007 at three different locations of TamilNadu. The experimental material consisted of two synthesized tomato F_1 hybrids viz., CLN 2123A X HN2 and HN2 X CLN 2123A which were known to be tolerant to tomato leaf curl virus (ToLCV), along with their parents viz., CLN 2123A and HN2, resistant checks Lakshmi and COTH2 and susceptible checks Hisar Lalit, LCR2 and CO3. The crop was raised in three different geographical locations viz., Rayakottai (E_1), Oddanchatram (E_2) and Attur (E_3) of TamilNadu state. The experiment was laid out in a randomized block design with three replications. All the recommended cultural practices were followed except plant protection measures against the ToLCV vector, thrips. Data were recorded on

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biometrical characters *viz.*, plant height, number of branches per plant, number of fruits per plant, fruit TSS, titrable acidity, ascorbic acid content, total phenol content and percent of disease infections at 60 DAP and 75 DAP, co - efficient of infection at 60 DAP and 75 DAP and fruit yield per plant from ten randomly selected plants of each entry in each replication. Genotypic correlation co - efficient was calculated as suggested by Al Jibouri *et al.* (1958).

Results and Discussion

Results of pooled mean value of three seasons revealed that the two synthesized tomato hybrids *viz.*, CLN 2123A X HN2 (93.70 cm and 11.80) and HN2 X CLN 2123A (96.09 cm and 11.87) registered higher values for plant height and branches per plant respectively than their parents. The highest plant height of 97.13 cm was observed by ToLCV resistant check hybrid Lakshmi and these two synthesized hybrids were on par for plant height. The lowest plant height (57.80 cm) and branches per plant (5.14) were noticed by the susceptible check variety CO3.

Pooled mean data of percent of disease infection of ToLCV at 60 DAP and 75 DAP, the two synthesized hybrids, CLN 2123A X HN2 (8.62 percent and 15.93 percent) and HN2 X CLN 2123A (10.73 and 17.44 percent) recorded less values than their check hybrids and varieties. However, the parent CLN 2123A included in the synthesis of hybrids registered the lowest percent of disease infection values of 9.73 and 14.83 percent at 60 DAP and 75 DAP respectively. Similar trend was also noticed with co-efficient of infection of ToLCV at 60 DAP and 75 DAP (Table 1.). The highest values of 39.33 and 53.20 as percent of disease infection at 60 DAP and 75 DAP and 40.50 and 90.35 as co-efficient of infection values at 60 DAP and 75 DAP were registered by the susceptible check variety CO3. Low ToLCV incidence exhibited by the two synthesized tomato hybrids might be due to the involvement of the resistant parent CLN 2123A and parent CLN 2123A is a multiple cross hybrid derivative with the blood of *Solanum hirsutum* f.

glabratum a wild species resistant to tomato leaf curl virus. Further, biochemically higher phenol content recorded by these two F₁ hybrids (Table 1.) also confirmed the resistance. Higher phenol content of CLN 2123A (0.22 µg per gram of leaf tissues) might have resulted in increased phenol content of these hybrids and offered resistance to hybrids. The susceptible check variety CO3 registered the lowest phenol content of 0.19 µg per gram of leaf tissues. Fruit yield per plant showed that the two hybrids CLN 2123A X HN2 (2019.35g) and HN2 X CLN 2123A (2255.24g) excelled over their parents CLN 2123A (1326.76g) and HN2 (980.39g). This might be due to the tolerance nature of hybrids to ToLCV. These results have indicated that the presence of over dominant genes in hybrids which would have excelled the better parent CLN 2123A and these findings are in line with the findings of Thangam (2004), Makesh (2004) and Sriharsha (2004). It was also interesting to note that these two hybrids were on par with the ToLCV resistant hybrid Lakshmi, which might be due to the tolerance nature of the two synthesized hybrids to ToLCV. The lowest fruit yield of 773.78g per plant registered by susceptible check CO3 might be due to high incidence of ToLCV during the growing period.

The estimates of genotypic correlation co - efficient for different characters of the study were presented in the Table 2. The analysis of genotypic correlation co - efficient revealed that percent of disease infection at 60 DAP and 75 DAP and co – efficient of infection at 60 DAP and 75 DAP had negative and highly significant correlations with yield per plant at all the three locations *viz.*, Rayakottai (-0.836 and - 0.819 and - 0.692 and -0.820), Oddanchatram (-0.799, - 0.793, - 0.766 and -0.817) and Attur (-0.858, - 0.769, -0.768 and - 0.822). Plant height, number of fruits per plant and total phenol content with percent of disease infection at 60 DAP and 75 DAP and co-efficient of infection at 60 DAP and 75 DAP showed negative significant correlations (Table 2). Plant height, number of fruits per plant and total phenol content showed positive and significant correlations in all the three locations

Table 1. Pooled mean values of hybrids, parents resistant and susceptible check for different characters

Genotypes	Plant height (cm)	Branches per plant	PDI 60		PDI 75		CI 60		CI 75		Total phenol content in leaves ($\mu\text{g per g}$)	Yield per plant (g)
			DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP		
CLN 2123A	84.49	6.52	9.73	14.83	4.86	10.56	0.22				1326.76	
HN2	67.65	5.62	35.91	43.83	50.41	70.18	0.18				980.39	
CLN 2123A X HN2	93.70	11.80	8.62	15.93	7.31	13.31	0.25				2019.35	
HN2 X CLN 2123A	96.09	11.87	10.73	17.44	10.31	15.46	0.29				2255.24	
LCR2	60.18	5.15	37.15	69.37	51.83	83.42	0.19				890.30	
COTH2	91.05	9.80	18.50	25.46	18.13	28.23	0.23				1673.00	
HisarLalit	83.76	9.73	35.69	48.89	61.49	62.82	0.20				1433.49	
Lakshmi	97.13	9.80	10.30	16.19	5.61	11.58	0.26				2081.98	
CO3	57.80	5.14	39.33	53.20	40.50	90.35	0.19				773.78	

of study. Negative significant correlation exhibited by the ToLCV incidence (in terms of percent of disease infection and coefficient of infection) with plant height and number of fruits per plant might be due to severe infection of tomato leaf curl virus which resulted in chlorophyll degeneration followed by yellowing, stunted growth and altered physiology of crop growth. These results are in corroboration with the results of Thangam (2004) and Makesh (2004). The ToLCV incidence also showed negative association with total phenol content in all the three locations of study which inferred that the higher phenol content in synthesized hybrids might have involved in the defense mechanism of tomato genotypes against ToLCV incidence. These results are in line with the findings of Singh and Abidhi (1988).

The studies on ToLCV incidence in three locations of present study revealed that the vegetative traits like plant height (0.951, 0.979 and 0.880, in E_1 , E_2 and E_3 respectively) and number of branches plant (0.986, 0.970 and 0.842 in E_1 , E_2 and E_3 respectively) exhibited positive and highly significant correlations with yield per plant in all the three locations of study. The resistant tomato hybrids and parents would have tolerated the ToLCV infection, there by maintaining optimal biometric traits like plant height and branches per plant which would have resulted in normal fruit yield. But the susceptible parent and check varieties remained stunted thereby low yields were noticed in these lines. These results are in association with the data that plant height and number of branches per plant recorded significant negative associations with ToLCV incidence in all the three locations of testing. Dhankhar and Dhankhar (2006) have observed similar positive associations of plant height and number of branches per plant with yield. Similarly, number of fruits per plant showed highly significant positive correlation with fruit yield in all the three locations of testing (0.959, 0.949 and 0.911 in E_1 , E_2 and E_3

Table 2. Genotypic correlation between biometric traits, ToLC and yield

Traits	Plant height			Branches per plant			No. of fruits per plant			TSS		
	E1	E2	E3	E1	E2	E3	E1	E2	E3	E1	E2	E3
Plant height	1.000	1.000	1.000	0.866**	0.961**	0.894**	0.932**	1.016**	0.934**	0.595	0.283	0.302
Branches per plant				1.000	1.000	1.000	0.904**	0.910**	0.863**	0.750*	0.462	0.489
No. of fruits per plant							1.000	1.000	1.000	0.600	0.155	0.233
TSS										1.000	1.000	1.000

Table 2. Contn.

Traits	Titrable acidity			Ascorbic acid			Total phenol content			PDI 60 DAP		
	E1	E2	E3	E1	E2	E3	E1	E2	E3	E1	E2	E3
Plant height	0.554	0.300	0.325	0.701*	0.578	0.402	0.899**	0.983**	0.913**	-0.894**	-0.844**	-0.794**
Branches per plant	0.570	0.429	0.456	0.866**	0.594	0.663	0.943**	0.957**	0.856**	-0.712*	-0.639	-0.702*
No. of fruits per plant	0.555	0.244	0.237	0.751**	0.613	0.489	0.932**	1.086**	0.904**	-0.885**	-0.899**	-0.938**
TSS	0.854**	0.845**	0.955**	1.070**	0.489	0.710*	0.743**	0.216	0.030	-0.367	0.046	0.006
Titrable acidity	1.000	1.000	1.000	0.956**	0.747**	0.657	0.750**	0.071	0.021	-0.294	0.066	0.026
Ascorbic acid				1.000	1.000	1.000	0.888**	0.642	0.358	-0.571	-0.470	-0.451
Total phenol content							1.000	1.000	1.000	-0.937**	-0.959**	-0.896**
PDI 60 DAP										1.000	1.000	1.000

* Significant at 5% level; ** significant at 1% level

Table 2. Contn.

Traits	PDI 75 DAP			CI 60 DAP			CI 75 DAP			Fruit yield		
	E1	E2	E3	E1	E2	E3	E1	E2	E3	E1	E2	E3
Plant height	-0.917**	-0.855**	-0.771**	-0.725*	-0.803**	-0.623	-0.916**	-0.853**	-0.800**	0.951	0.979**	0.830**
Branches per plant	-0.715*	-0.635	-0.641	-0.542	-0.590	-0.513	-0.679*	-0.661	-0.658	0.986**	0.970**	0.842**
No. of fruits per plant	-0.877**	-0.904**	-0.884**	-0.727*	-0.862**	-0.790**	-0.857**	-0.915**	-0.914**	0.959**	0.949**	0.911**
TSS	-0.371	0.080	-0.120	-0.096	0.108	0.161	-0.393	0.103	-0.010	0.724*	0.367	0.234
Titrble acidity	-0.447	0.049	-0.108	-0.079	0.100	0.201	-0.442	0.044	0.045	0.650	0.284	0.276
Ascorbic acid	-0.726*	-0.490	-0.550	-0.399	-0.465	-0.389	-0.645	-0.514	-0.381	0.843**	0.564	0.533
Total phenol content	-0.845**	-0.969**	-0.808**	-0.912**	-0.922**	-0.814**	-0.946**	-0.986**	-0.886**	1.016**	1.055**	0.931**
PDI 60 DAP	0.905**	1.001**	0.923**	0.960**	0.997**	0.946**	0.988**	0.992**	0.972**	-0.836**	-0.799**	-0.858**
PDI 75 DAP	1.000	1.000	1.000	0.796**	0.999**	0.906**	0.927**	0.996**	0.926**	-0.819**	-0.793**	-0.796**
CI 60 DAP				1.000	1.000	1.000	0.904**	0.994**	0.944**	-0.692*	-0.766**	-0.768**
CI 75 DAP							1.000	1.000	1.000	-0.820**	-0.817**	-0.822**
Fruit Yield										1.000	1.000	1.000

* Significant at 5% level; ** significant at 1% level

E1 – Rayakottai
E2 – Oddanchatram
E3 - Attur

respectively) which might have been attributed due to the more strength of the source-sink and its implication on the yield under disease incidence also. This trait, number of fruits per plant showed negative significant correlation with ToLCV incidence at different stages of observation also supports the above result. Similar findings were also reported by Das *et al.* (1998) and HarDevinder Singh and Cheema (2006).

In general the quality parameters would not be expressed by the genotypes under biotic and abiotic stress conditions. In contrast, in the present study, total soluble solids (0.724, 0.367 and 0.234 in E₁, E₂ and E₃ respectively), titrable acidity (0.650, 0.284 and 0.276 in E₁, E₂ and E₃ respectively) and ascorbic acid content (0.843, 0.564 and 0.533 in E₁, E₂ E₃ respectively) expressed positive correlations with yield in all the three locations of study. It indicated that the genotypes used in the present investigation have better photosynthetic partitioning and translocation efficiencies, thereby expressing quality traits *viz.*, TSS, acidity and ascorbic acid in the fruits. Positive association of TSS with yield in tomato was also reported by HarDevinder Singh and Cheema (2006).

Thus, the present study emphasised the utilization of resistant or tolerant sources against the disease, ToLCV in tomato which would confer resistance or tolerance in the F₁'s at the maximum value of expression in terms of yield.

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