

Growth Analysis of Leaf Characters in Certain Inbreds and Hybrids of Tomato (*Lycopersicon esculentum*) Mill.*

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In tomato (*Lycopersicon esculentum* Mill.), six parents and nine hybrids were evaluated through growth analysis. The number of leaves, leaf area index (LAI) and specific leaf weight showed a steady increase over the stages. On the other hand, a reduction was noticed from stage I to stage IV for specific leaf area and leaf area ratio. Most of the heterotic hybrids, tended to have lower LAI, LAR, SLA and SLW than their respective parents.

Relatively, little effort has been directed towards selection on physiological basis in most of the important vegetable crops. Variations in productivity may be related to leaf number, leaf area index, leaf area ratio etc. This study was undertaken to evaluate the relation of these factors to fruit yield of certain inbreds and their hybrids in tomato (*Lycopersicon esculentum* Mill.)

MATERIAL AND METHODS

The experiment was carried out at the Department of Olericulture, Faculty of Horticulture, Tamil Nadu Agril. University, Coimbatore during 1977-79. The experimental material comprised of three genotypes viz., LE 719, LE 720 and LE 720 as female parents, three genotypes viz., LE 573, Co 2 and IM 39 as male parents and their resultant nine hybrids. The layout of the experiment was randomised

block design with two replications. In each replication, five plants were randomly sampled after 12 (stage I), 25 (stage II), 50 (stage III) and 100 (stage IV) days of sowing. Number of leaves in each plant was counted and the leaf area was measured by using leaf area meter (model LI 3000, Lambda Instruments Corporation Lincoln, Nebraska). Each plant was then divided into roots, stems, leaves and fruits and dried in an oven at 80°C for 48 hours. The formulae suggested by Watson (1952) were followed in the calculation of leaf area index (LAI), leaf area ratio (LAR), specific leaf area (SLA) and specific leaf weight (SLW).

$$\text{LAI} = \text{Leaf area} \times 14.14$$

$$\text{LAR (cm}^2\text{/g)} = \text{L/W}$$

$$\text{SLA (cm}^2\text{/g)} = \frac{\text{L}}{\text{LW}}$$

$$\text{SLW (mg/cm}^2\text{)} = \frac{\text{LW}}{\text{L}}$$

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Where,

14.14 = Number of plants per square metre,

L = Leaf area per plant,

W = Total dry weight of the plant and

LW = dry weight of the leaf

The fruit yield was recorded as g/plant.

The statistical analysis of the data was carried out as per the procedures of Panse and Sukhatme (1967). Heterosis was worked out for the last stage as the per cent deviation of F_1 over the best parent.

RESULTS AND DISCUSSION

The mean sum of squares for leaf area index were significant at all the four stages for males, females, hybrids and male Vs female Vs hybrid interaction (Table I). The variances for leaf area ratio, specific leaf area and specific leaf weight were also significant except for males and females at stages I and III. The mean performance of the parents and the hybrids and the heterosis estimates are furnished in Tables II and III.

Leaf area index showed an increase from stage I to stage IV. Hybrid-involving IM 39 as male parent recorded higher leaf area indices at stage III. The heterosis estimate ranged from -28.05 to 13.25 per cent over the best parent. Four hybrids showed heterosis over the best parent and among them, the hybrids LE 729 X Co 2 and Le 720 X Le 573 recorded heterosis estimates (13.25 and 12.20

per cent) of larger magnitude. There was an increase in leaf number upto stage III and thereafter decreased at the final stage. However, hybrids involving Co 2 as male parent recorded increased leaf numbers at the final stage also. The hybrid LE 720 X LE 573 was the most heterotic one for leaf number with heterosis of 17.36 per cent over the best parent.

Leaf area ratio values showed a decrease from stage I to Stage IV. Of the 9 hybrids, the hybrids involving IM 39 as male parent recorded comparatively low LAR values. None of the hybrids exceeded the best parent for this character.

Specific leaf area decreased from stage I to stage IV, while specific leaf weight showed an increase over the stages. The heterosis estimates of SLW indicated that all the diii values were negative. With regard to SLA, the hybrid LE 729 X IM 39 exhibited heterosis estimates of 23.31, 11.73 and 3.28 per cent over the best parent. The fruit yield was higher in most of the hybrids as compared to the respective parents. The hybrids Le 719 X IM 39, LE 719 X LE 573 and LE 720 X IM 39 were the most heterotic among them with heterosis percentages of 36.08, 33.99 and 22.96 over the best parent.

The role of growth indices to serve as physiological components of yield was investigated by Buttery and Buzzelli (1972) and Donaldson and

Blackman (1973). In the present study, the heterotic hybrids tended to have a lower LAI than their respective parents indicating that excessive leaf area during the later stages of growth may be detrimental to increased yield. Such a result was reported in mung bean (AVRDC, 1975), wherein, a negative relationship was exhibited between LAI and yield. The hybrids manifesting heterosis for yield invariably exhibited a low leaf area ratio (LAR). This may be due to a greater utilization of the photosynthates for faster growth of the tissues leading to increased reproductive activities as postulated by Humphries and Thorne (1964). Voldeng and Blackman (1973) have also reported that in *Zea mays*, LAR of the hybrids was generally less than those of the inbreds and this is in conformity with the present findings. This view was further amplified by Buttery and Buzzell (1972), who have reported that in plants with a LAR, the leaves have a larger sink for their photosynthetic products than do leaves in plants with a high LAR.

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TABLE I. Analysis of variance

Step	Variances due to	Leaf number	Leaf area index	Leaf area ratio	Specific leaf area	Specific leaf weight	Yield
I	Male	0.4467**	0.0000007**	877.6729**	649.7873**	0.0338 NS	
	Female	0.1550**	0.0000004**	737.9616**	4126.9803**	0.0853 NS	
	Hybrid	0.3713**	0.0000010**	1306.7478**	3235.6720**	0.5002**	
	Male Vs Female Vs Hybrid	10.244**	0.0000038**	353.0314*	5122.5682**	0.3133*	
II	Male	1.250**	0.000063**	376.1660**	3028.6143**	0.5266**	
	Female	1.0017**	0.000536**	276.9992**	576.6461**	0.0838**	
	Hybrid	0.2697**	0.000311**	1444.8404**	3358.3062**	0.3999**	
	Male Vs Female Vs Hybrid	0.4818**	0.001363**	833.2055**	967.5095**	0.0932**	
III	Male	3.2717**	0.5306**	92.3276 NS	1092.2044**	1.2106**	
	Female	35.6110**	0.1641**	826.9180**	11.9804 NS	0.0072 NS	
	Hybrid	120.0310**	0.7597**	2927.1953**	1221.8404**	0.9146**	
	Male Vs Female Vs Hybrid	49.9122**	0.1684**	2043.9715**	853.8133**	0.7354**	
IV	Male	30.1817**	0.2358**	2.2643**	663.0696**	7.2627**	8932.3879**
	Female	15.4017**	0.4426**	29.9498**	50.3031**	0.2608**	13791.3295**
	Hybrid	29.8188**	1.2343**	53.9388**	292.1833**	2.1944**	37399.9250**
	Male Vs Female Vs Hybrid	3.2679**	0.5249**	116.2727**	185.1706**	6.3960**	114598.6981**

** Significant at 1 per cent level
 * Significant at 5 per cent level
 NS Non significant.

TABLE II Mean performance of the parents and hybrids in tomato

Parents/Hybrids	Leaf number				Leaf area index				Leaf area ratio (cm ² /g)			
	Stages I	II	III	IV	I	II	III	IV	I	II	III	IV
LE 719	2.30	6.80	36.43	20.90	0.0032	0.0871	2.4440	3.6915	313.93	199.66	183.36	26.64
LE 720	1.95	6.85	29.75	26.50	0.0024	0.0901	2.0920	4.5645	333.37	199.70	172.44	33.91
LE 728	1.75	8.05	34.81	23.70	0.0025	0.1169	2.6590	3.8255	294.96	220.07	211.87	32.28
LE 719 X LE 573	2.10	7.05	18.35	18.90	0.0036	0.1132	1.7645	3.4500	290.42	215.41	171.59	24.27
LE 720 X LE 573	2.08	7.35	33.99	31.10	0.0047	0.1499	2.6505	5.1290	358.79	256.15	167.88	27.79
LE 728 X LE 573	3.00	7.05	21.70	25.30	0.0042	0.1414	2.2485	4.4975	287.16	237.25	182.26	25.76
LE 719 X Co 2	3.25	7.25	22.70	23.40	0.0047	0.1043	2.5825	3.5925	312.89	230.02	211.72	26.75
LE 720 X Co 2	2.20	7.15	21.05	24.20	0.0034	0.1174	2.4949	3.3135	305.49	199.63	228.82	20.08
LE 728 X Co 2	2.35	6.95	18.85	18.30	0.0033	0.0980	2.1785	5.1700	314.13	192.20	218.83	33.31
LE 719 X IM 39	2.90	7.95	31.75	25.10	0.0040	0.1212	3.0465	4.7060	265.92	185.69	226.01	24.63
LE 720 X IM 39	2.35	7.15	36.95	25.50	0.0034	0.1144	3.8400	3.2845	294.94	215.86	210.33	16.73
LE 720 X IM 39	2.05	7.90	23.35	21.70	0.0025	0.1168	3.1725	4.7280	296.91	194.32	287.84	18.04
LE 575	1.65	6.85	29.05	22.90	0.0021	0.1054	2.0665	3.5375	295.58	170.86	216.25	22.37
Co 2	1.85	7.10	31.00	26.30	0.0027	0.1066	2.4555	4.1230	280.01	206.51	229.55	24.49
IM 39	2.55	6.60	26.70	18.50	0.0033	0.0963	3.0875	3.5175	321.82	207.72	230.60	23.62
C D at 5 % for parents	0.14	0.15	0.85	1.01	0.0001	0.0039	0.0908	0.1995	10.09	3.39	5.52	0.64
C D at 5 % for hybrids	0.12	0.12	0.53	0.83	0.001	0.0032	0.0742	0.1630	8.24	3.18	5.33	0.44

GROWTH ANALYSIS OF LEAF CHARACTERS IN CERTAIN INBREDS AND HYBRIDS OF TOMATO

Parents/Hybrids	Specific leaf area/ cm ² /g of dry leaf				Specific leaf weight mg/cm ²				Yield g/plant
	stages I	II	III	IV	I	II	III	IV	
LE 719	501.75	303.81	197.01	122.47	1.99	3.29	5.08	8.17	920.50
LE 720	513.77	273.78	195.34	114.50	1.95	3.65	5.12	8.74	1044.32
LE 729	429.77	302.52	209.16	113.20	2.33	3.31	5.00	8.84	737.72
LE 719 X LE 573	422.51	311.02	213.23	123.10	3.44	3.32	4.90	8.11	1129.95
LE 720 X LE 573	498.70	316.20	215.31	110.02	2.91	2.66	4.87	9.09	888.45
LE 729 X LE 573	385.55	342.04	219.47	93.55	2.54	2.93	4.53	10.59	866.99
LE 719 X Co 2	450.21	316.84	206.71	102.30	2.22	3.22	4.84	9.78	919.52
LE 720 X Co 2	410.77	259.89	162.52	99.42	2.32	3.85	6.15	10.08	846.41
LE 729 X Co 2	433.25	274.49	198.80	109.10	2.31	3.65	5.03	9.17	815.91
LE 719 X IM 39	382.57	249.09	173.62	111.44	2.66	4.02	5.70	8.98	1147.51
LE 720 X IM 39	415.31	308.4	156.77	91.54	2.41	3.24	6.30	10.93	1036.87
LE 729 X IM 39	431.46	271.57	223.48	126.48	3.37	3.68	4.48	7.91	731.31
LE 719 X IM 3J	463.21	240.52	188.92	116.48	2.16	4.15	5.03	8.59	815.0
LE 573	429.41	313.37	180.78	80.89	2.33	3.14	5.53	12.37	716.19
Co 2	457.6	286.24	152.61	91.95	2.19	3.49	6.58	10.28	843.77
IM 39	487	4.87	6.71	3.21	0.30	0.05	0.11	0.29	38.27
C.D at 5% for Parents	11.33	3.98	5.38	2.62	0.24	0.04	0.11	0.23	31.10
C.D at 5% for hybrids	9.74								

TABLE III Per cent heterosis over the best (iii) parent in tomato

Hybrids	Leaf number	Leaf area index	Leaf area ratio	Specific		Fruit yield
				Leaf area	Leaf weight	
LE 719 X LE 573	-28.68	-24.21	-28.42	-49.74	-34.43	33.99
LE 720 X LE 573	17.36	12.70	-18.04	-10.16	-28.51	5.39
LE 729 X LE 573	-4.72	2.14	-24.04	-23.61	-13.59	2.80
LE 719 X Co 2	-11.70	-21.29	-21.11	-16.40	-20.97	13.79
LE 720 X Co 2	-8.08	-27.42	-40.83	-18.57	-18.06	0.59
LE 729 X Co 2	-31.13	13.25	1.76	-10.91	-25.88	-3.28
LE 719 X IM 39	-5.28	3.09	27.65	-9.00	-27.44	36.02
LE 720 X IM 39	-2.98	-29.05	-50.55	-25.25	-11.69	22.96
LE 729 X IM 39	-18.11	3.57	-46.79	3.28	-36.07	-9.48

TABLE III Percent heterosis over the best (III) parent in tomato

Hybrids	Leaf number	Leaf area index	Leaf area ratio	Specific leaf area	Specific leaf weight	Fruit yield
LE 719 X LE 573	-28.68	-24.21	-28.42	-49.74	-34.43	33.89
LE 729 X LE 573	17.36	12.20	-18.04	-10.16	-26.51	8.36
LE 729 X LE 673	-4.72	-2.14	-24.04	-23.61	-13.59	2.80
LE 719 X LE 573	-11.70	-21.29	-21.11	-16.40	-20.97	13.79
LE 729 X Co 2	-8.63	-27.42	-40.83	-18.57	-18.06	0.59
LE 729 X Co 2	-31.13	13.25	-1.76	-10.91	-25.88	-3.28
LE 719 X IM 39	-6.26	3.09	-27.65	-9.00	-27.44	36.58
LE 729 X IM 39	-3.96	-25.05	-50.65	-25.25	-11.69	22.96
LE 729 X IM 33	-16.11	2.67	-46.79	3.29	-36.07	-9.18