

Growth Analysis for Seed Germination, Seedling Weight and Yield of Fruits in Tomato (*Lycopersicon esculentum* Mill.) Inbreds and Hybrids*

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Investigations on the growth analysis of tomato (*Lycopersicon esculentum* Mill.) involved nine hybrids and their six parents. Heterosis over the best parent was recorded for all the characters observed. The hybrids involving IM 39 as male parent had higher hundred seed weight, fresh weight, and dry weight of the seedlings and a relationship was evident between these characters and fruit yield. Germination percentage, germination energy and germination index were of larger magnitude in hybrids when compared to their parents. The hybrid LE 719 x Co 2 had the highest germination percentage (28.542) and germination index (397). The parameters, namely, germination, germination energy and germination index did not, however, have any association with the yield.

Tomato (*Lycopersicon esculentum* Mill.) has a favourably high dry matter yield on per day per unit area basis and research is necessary to identify and investigate the processes that affect plant growth and the effect plant growth and the effect of these processes on the growth reaction of the plant that determine the ultimate yield. The present investigation is concerned with a detailed analysis of growth of tomato hybrids and parents in germination and early growth traits.

MATERIAL AND METHODS

The experiment was carried out at the Department of Olericulture, Tamil Nadu Agricultural University, Coimbatore during January-May, 1978. Nine hybrids involving three female parents (LE 719, LE 720 and LE 729) and three male parents (LE 573, Co-2 and IM39) were used in this study. The germination study of the

hybrids and their parents was conducted as per the ISTA rules (1966) by keeping the seeds in petri dishes at a temperature of 27°C. The experimental design was a randomised block one with two replications. One hundred seeds in each of the hybrid and parent were sown per replication in the germination study. The crop was grown under pot culture and 25 plants were maintained under each hybrid and parent to record the yield of fruits.

The observations recorded were, hundred seed weight (mg), germination (percent), germination energy (Baskin, 1969), germination index, fresh weight of seedlings (mg), dry weight of seedlings (mg) and yield of fruits per plant (g). Fifty numbers of ten days old seedlings were sampled at random to record fresh weight and then dry weight.

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Heterosis for these characters was calculated as the percent increase of F_1 performance above the performance of mid parent (di), higher parent (dii) and best parent (diii).

RESULTS AND DISCUSSION

Mean sum of squares (Table 1) due to males females, hybrids and male Vs female Vs hybrid were significant for all the characters except dry weight of seedlings for males and hundred seed weight, germination, germination energy and germination index for females, thus indicating that the genetic stock selected for the present study had wide variability for the characters observed. Furthermore, significance for male Vs female Vs hybrids for all the characters indicated the presence of a substantial amount of hybrid vigour in the hybrids.

Mean performance of the parents and hybrids and the estimates of heterosis are given in Tables 2 and 3. Six out of nine hybrids exhibited positive heterosis over the best parent in respect of hundred seed weight and the most heterotic hybrid was LE 720 \times IM 39 with 7.57 percent of diii estimates. Positive heterosis over the best parent was recorded in four hybrids with regard to germination and dry weight of seedlings and the hybrids to exhibit the highest diii estimates were, LE 719 \times Co 2 and LE 720 \times IM 39 respectively.

Of the nine hybrids, five showed high diii estimates for germination index and fresh weight of seedlings. The highly heterotic hybrids were LE 719 \times Co 2 for germination index and LE 729 \times IM 39 for fresh weight of seedlings.

The hybrids, LE 719 \times Co 2 (13.52 per cent) and LE 720 \times LE 573 (0.55 per cent) showed heterosis over the best parent in respect of germination energy. Positive heterosis for yield of fruits per plant was recorded in eight hybrids over the mid and higher parents and in seven hybrids over the best parent. LE 719 \times IM 39 and LE 719 \times LE 573 were the most outstanding hybrids for fruit yield with 36.08 and 33.99 percent heterosis over the best parent.

The phenomenon heterosis has been viewed as a consequence of physiological stimulus due to heterozygosity (Ashby, 1932, 1937). Ashby has postulated the initial capital theory and he has established a relationship between seed size and the resultant vigour in tomato seedlings. The heterotic hybrids, namely LE 719 \times IM 39 and LE 719 \times LE 573 exhibited heterosis for hundred seed weight and this initial capital is a likely contributor for the early germination of the hybrids. The rapid development of the hybrids is possibly due to an effective mobilization of the substrates to the embryo during germination, resulting in an early emergence of leaves, which in turn has provided an advantageous start in photosynthetic potential. According to Donaldson and Blackman (1974), the larger embryo of the hybrid is primarily determined by a greater rate of growth and this is evidenced in the present study as a positive heterosis for fresh weight and dry weight of the seedlings in the heterotic hybrids. For such an appreciable heterosis, an early initiation of active photosynthesis in the hybrids could be ascribed as suggested by Donaldson and Blackman (1974).

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TABLE 1 Analysis of variance in tomato

Characters	Mean sum of squares			Male Vs Female Vs Hybrid
	Male	Female	Hybrid	
Hundred seed weight	98.2800*	76.8475	1274.6769**	9245.5610**
Germination percentage	275.1667**	1.6667	61.3472*	368.3778**
Germination energy	30.8912**	0.3297	6.9696**	46.3192**
Germination index	3868.6667*	4.6667	9015.2222**	33772.7111**
Fresh weight of seedlings	9112.5817*	88570.5350**	48157.0418**	205543.4450**
Dry weight of seedlings	12.2450	136.7604**	362.8775**	96.1607**
Yield of fruits per plant	8932.3679**	13791.3295**	37399.9250**	114596.6911**

* Significant at 5 percent level

** Significant at 1 percent level

TABLE 2
Mean performance of the Parents and hybrids in tomato

Parents/hybrids	Hundred seed weight (mg)	Germination (percentage)	Germination energy	Germination index	Fresh weight per 50 seedlings (mg)	Dry weight per 50 seedlings (mg)	Yield of fruits Per plant (g)
LE 719	205.6	78.5	20.344	141	1041	83.70	820.50
LE 720	207.9	77.0	19.640	140	1064	98.33	654.42
LE 729	217.3	77.5	19.642	143	1516	97.70	737.72
LE 719 × LE 573	287.9	82.5	22.959	266	1634	104.30	1129.86
LE 720 × LE 573	245.2	89.5	25.284	319	1487	94.35	888.45
LE 729 × LE 573	282.9	90.0	24.951	294	1375	93.10	866.89
LE 719 × Co 2	281.1	97.5	28.542	397	1550	97.00	959.52
LE 720 × Co 2	259.4	82.0	22.092	241	1665	91.35	848.21
LE 729 × Co 2	222.2	96.5	24.450	216	1301	74.35	815.61
LE 719 × IM 39	288.5	88.0	23.129	198	1658	108.15	1147.51
LE 720 × IM 39	298.5	94.5	24.016	179	1670	121.30	1036.87
LE 729 × IM 39	289.9	88.5	23.700	258	1780	109.80	763.30
LE 573	263.4	87.0	25.139	242	1491	102.50	815.60
Co 2	271.0	92.5	24.344	248	1626	100.65	716.19
IM 39	277.4	70.0	17.969	169	1558	97.60	843.27
C. D. at 5 percent for parents	6.3	5.1	0.920	15	57	2.31	38.27
C. D. at 5 percent for hybrids	5.1	4.2	0.752	12	47	1.89	31.10

TABLE 3
Percent heterosis for different traits in tomato

Hybrids	Hundred seed weight			Germination percentage			Germination energy			Germination index		
	di	dii	diii	di	dii	diii	di	dii	diii	di	dii	diii
LE 719 x LE 573	22.90	9.30	3.79	-0.30	-5.17	-10.81	0.96	-8.67	-8.67	38.90	9.91	7.25
LE 720 x LE 573	4.05	-6.91	-11.61	9.14	2.87	-3.24	12.90	0.55	0.55	64.43	31.81	28.62
LE 729 x LE 573	17.70	7.40	1.98	9.42	3.44	-2.70	11.43	-0.75	-0.75	52.72	21.48	18.54
LE 719 x LE Co 2	18.08	3.73	1.33	14.04	5.41	5.41	27.75	17.25	13.52	104.11	60.08	60.08
LE 720 x LE Co 2	8.33	4.28	-6.49	3.24	-11.35	-11.35	0.43	-9.24	-12.13	24.22	-2.82	-2.82
LE 729 x LE Co 2	-8.99	-18.01	-19.90	13.53	4.32	4.32	11.18	0.45	-2.74	10.48	-12.90	-12.90
LE 719 x IM 39	19.59	4.00	4.00	18.62	12.10	-4.86	21.60	13.71	-7.99	27.74	17.15	-20.16
LE 720 x IM 39	23.02	7.57	7.57	28.57	22.73	2.16	28.65	22.30	-4.45	16.85	5.91	-27.82
LE 729 x IM 39	17.20	4.51	4.51	20.00	14.19	4.32	26.94	20.67	-5.72	65.38	52.66	4.03

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Hybrids	Fresh weight of seedlings			Dry weight of seedlings			Yield of fruits per plant		
	di	dii	diii	di	dii	diii	di	dii	diii
LE 719×LE 573	28.98	9.52	0.43	12.03	1.75	1.75	38.12	37.70	33.99
LE 720×LE 573	16.29	0.26	-8.54	-8.04	-7.95	-7.95	20.88	8.93	5.36
LE 729×LE 573	-8.54	-9.30	15.43	-6.79	-8.97	-8.97	11.62	6.29	2.80
LE 719×LE Co 2	16.23	-4.67	-4.57	5.22	-3.62	-5.36	24.88	16.94	13.79
LE 710×LE Co 2	23.79	2.39	2.99	-8.18	-9.23	-10.87	23.77	18.43	0.59
LE 729×LE Co	-17.25	20.04	-20.04	-25.03	-26.13	-27.46	12.20	10.56	-3.28
LE 719×IM 39	27.58	6.41	1.96	19.30	10.69	5.51	37.94	36.08	36.08
LE 720×IM 39	27.30	7.12	2.64	23.81	23.81	18.34	38.46	22.96	22.96
LE 729×IM 39	15.81	14.24	9.47	12.44	12.38	7.12	-3.44	-9.48	-9.48