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Growth Analysis for Biological Yield, Harvest Index and Fruit Yield in Tomato (*Lycopersicon esculentum* Mill.) *

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A growth analysis study in tomato was carried out with three female parents, three male parents and their nine hybrids. The observations recorded were, biological yield, economic yield, harvest index and fruit yield. All the hybrids involving IM 39 as the male parent recorded higher biological yields. Increased economic yield, harvest index and fruit yield were observed in the hybrids. LE 719 × LE 573 was the most outstanding hybrid with higher harvest index, economic yield and fruit yield. LE 719, LE 573 and IM 39 were identified as Potential parents for heterosis breeding in tomato based on harvest index and economic yield.

Breeding for higher yield necessitates the identification of its physiological components causing varietal differences in economic yield. The term biological yield was proposed by Nichiporovich (1960) to represent the total dry matter accumulation of a plant system. Similarly, economic yield has been used to refer to the volume or weight of those plant organs that comprise the product of economic value. The proportion of biological yield represented by economic yield has been called the coefficient of effectiveness (Nichiporovich, 1960) or the migration coefficient (Tsunoda, 1959) or the harvest index (Donald, 1962). The low grain yield potential of legumes was traced by Jain (1975) to a poor harvest index, a characteristic now attributed widely to genetic control in several crop plants. Nijhawan and Chandra (1977) made it clear that harvest index appeared to be an independent variable in mungbean parents and also appears to be independenty governed genetically. The importance of harvest index in determining the yielding capacity and its efficiency in selection for yield have been proved by several researchers (Sims, 1963; Cannell, 1968; Chandler, 1969; Syme, 1970; Rosielle and Frey, 1975). Information on these lines are not available in tomato and as such, the present paper reports the results of an investigation conducted to findout the relationship of economic yield, biological yield and harvest index with fruit yield.

MATERIAL AND METHODS

The present study on tomato (*Lycopersicon esculentum* Mill.) was

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carried out at the Department of Olericulture, Faculty of Horticulture, Tamil Nadu Agricultural University, Coimbatore during 1977—1979. The experimental material comprised of three genotypes viz., LE 719, LE 720 and LE 729 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 a randomised block design with two replications. The total dry matter produced by each plant was multiplied by 14.14 (i. e. number of pots per M^2 of ground area) to get the biological yield and it was expressed in g/M^2 of ground area as suggested by Nichiporovich (1960). All the ripe fruits harvested from each plant were cut into pieces, partially sun dried and then Oven dried at 80°C for 48 hours. The dry fruit weight was then multiplied by 14.14 to get economic yield (Donald, 1962) and it was expressed in g/M^2 of land area. Harvest index is the ratio between economic yield and biological yield expressed in percentage (Donald 1962). Heterosis was calcuted as per cent increase of F_1 over the mid, higher and best parents.

RESULTS AND DISCUSSION

The mean squares were significant for biological yield, economic yield, harvest index and fruit yield (Table I).

The mean performance of the parents and hybrids and the heterosis estimates are furnished in Tables II and III respectively.

Biological yield

The range of biological yield among the parents was from 1185.10 (LE 729) to 1643.40 (Co 2) g/m^2. Out of the nine hybrids, the three hybrids involving IM 39 as male parent recorded higher biological yields. This is apparent from the higher heterosis estimates of 16.39, 13.92 and 6.23 per cent over the best parent as recorded by LE 720 × IM 39, LE 719 × IM 39 and LE 729 × IM 39 respectively. The other hybrids to exhibit heterosis over the best parent were LE 720 × LE 573 (9.48 per cent) and LE 729 × LE 573 (3.07 per cent).

Economic yield

The economic yield showed a range from 375.89 to 646.96 g/M^2 amogn the parents and 447, 49 to 756.62g/M^2 among the hybrids. Nine hybrids over the mid parent, 5 hybrids over the higher parent and 2 hybrids over the best parent showed heterosis. The hybrids LE 719 × LE 573 and LE 719 × IM 39 exhibited heterosis over the best parent.

Harvest index

The highest harvest index of 45.15 per cent was recorded by the female parent, LE 719 and the male parent Co 2 showed the lowest harvest index of 26.60 per cent. The harvest index

varied from 28.84 to 50.84 per cent among the nine hybrids. The heterosis estimates ranged from -5.75 to 27.66 per cent over the mid parent, -15.14 to 23.18 per cent over the higher parent and -36.14 to 12.59 per cent over the best parent. The hybrids to exhibit heterosis over the best parent for this trait were LE 719 × LE 573 and LE 729 × Co 2.

Fruit yield

The male parent IM 39 registered the highest fruit yield of 843.27 g per plant, while the fruit yield of the other parents ranged from 645.42 to 820.50 g per plant. The fruit yield varied from 763.30 to 1147.51 g per plant among the nine hybrids. The outstanding hybirds to record higher fruit yields were, LE 719 × IM 39 (1147.51 g per plant), LE 719 × LE 573 (1129.86 g per plant) and LE 720 × IM 39 (1036.87 g per plant). The most heterotic hybrids were LE 719 × IM 39 and LE 719 × LE 573 with 36.08 and 33.99 per cent heterosis over the best parent.

Donald (1962) and Wallace and Munger (1966) in beans showed that the genetic improvement of economic yield was the result of a higher percentage of biological yield being partitioned into the plant organs constituting economic yield. In tomato, the economic product is the fruit and in the present investigation, higher economic yields were recorded in the parents, LE 719 and LE 573 and in the hybrids, LE 719 × IM 39 and LE 719 × LE 573. These two hybrids were highly heterotic with heterosis percentages of 16.95 and 12.02 over the best parent. While the hybrid LE 719 × IM 39 represented a high × medium combination, it was a high × high combination which has resulted in the hybrid LE 719 × 573. The harvest index links the fruit yield to the biological yield, since, the determination of biological yield is a necessary step in the derivation of harvest index. Of the nine hybrids, higher harvest index of 50.84 per cent was exhibited by the hybrid LE 719 × LE 573. This hybrid is an outcome of a high × high combination. The superiority of this hybrid was further evidenced by the highest heterosis of 12.59 per cent over the best parent. However, the biological yield of this hybrid is of low magnitude. This clearly brings out a possible information that a high yielding hybrid is related to a higher harvest index and economic yield but not necessarily to biological yield. A similar report of Syme (1970) also revealed no relationship between harvest index and biological yield in winter wheat and this lends support to the findings of the current investigation. A strong relationship for fruit yield with harvest index and econmic yield indicated that high yielding genotypes were more efficient in utilizing the dry matter for fruit production. Consequently, selection for one attribute, for example harvest index may involve counter selection for another

such as economic yield. The harvest index and economic yield. Thus offer promise in predicting the yielding ability of the tomato hybrids.

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TABLE I Analysis of variance in tomato

Mean sum of squares due to	Biological yield	Economic yield	Harvest index	Fruit yield
Males	18795.0400**	20070.1195**	104.7845**	8932.3679**
Females	23412.1400**	39340.8415**	155.5110**	13791.3295**
Hybrids	92641.2100**	15852.5677**	96.2956**	37399.9250**
Male Vs Female Vs Hybrid	330291.4800**	59293.1680**	21.9240**	114596.6981**

** Significant at 1 per cent level

TABLE II Mean performance of Parents and hybrids in tomato

Parents/ Hybrids	Biological yield g/m²	Economic yield g/m²	Harvest index (per cent)	Fruit yield per plant (g)
LE 719	1390.76	627.78	45.15	820.50
LE 720	1346.24	375.89	27.91	654.42
LE 729	1185.10	394.94	33.33	737.72
LE 719 × LE 573	1425 76	724.70	50.84	1129.86
LE 720 × LE 573	1842.92	639.91	34.73	888.45
LE 729 × LE 573	1735.03	606.99	35.00	866.89
LE 719 × Co 2	1342.74	615.03	45.81	959.52
LE 720 × Co 2	1649.07	567.18	34.38	848.21
LE 729 × Co 2	1551.89	447.49	28.84	815.61
LE 719 × IM 39	1917.78	756.62	39.46	1147.51
LE 720 × IM 39	1959.28	641.70	32.75	1036.87
LE 729 × IM 39	1788.22	604.58	33.81	763.30
LE 573	1581.43	646.96	40.92	815.60
Co 2	1643.40	447.52	26.60	716.19
IM 39	1489.61	530.76	35.63	843.27
CD at 5 per cent for parents	54.28	21.23	0.91	38.27
CD at 5 per cent for hybrids	44.32	17.33	0.74	31.10

TABLE III Per cent of heterosis in tomato

Hybrids	Biological yield			Economic yield			Harvest index			Fruit yield		
	di	dii	diii	di	dii	diii	di	dii	diii	di	dii	diii
LE 719 × LE 573	- 4.06	- 9.84	—15.31	13.70	12.02	12.02	18.11	12.59	12.59	38.12	37.70	33.99
LE 720 × LE 573	25.90	16.53	9.48	25.12	—1.09	—1.09	0.89	- 15.14	—23.09	20.88	8.93	5.36
LE 729 × LE 573	25.43	9.71	3.07	16.52	—6.18	—6.19	—5.75	- 14.48	—22.49	11.62	6.29	2.80
LE 719 × Co 2	—12.64	—20.24	—20.24	14.39	—2.03	—4.94	27.66	1.45	1.45	24.88	16.94	13.79
LE 720 × Co 2	—8.91	—2.02	—2.02	37.76	26.74	- 12.33	26.19	23.18	—23.85	23.77	18.43	0.59
LE 729 × Co 2	8.20	—7.81	—7.81	0.02	0.00	- 30.83	—3.79	—13.49	- 36.14	12.20	10.56	—3.28
LE 719 × IM 39	33.16	28.74	13.92	30.62	20.52	16.95	--2.31	—12.61	- 12.61	37.94	36.08	36.08
LE 720 × IM 39	38.18	31.53	16.39	41.54	20.90	—0.81	3.08	—0.08	- 27.46	38.46	22.96	22.96
LE 729 × IM 39	33.71	20.05	6.23	30.62	13.91	—6.55	- 1.94	5.11	—25.12	- 3.44	—9.48	- 9.48

di, dii and diii – represent heterosis over the mid, higher and best parents.