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LINE X TESTER ANALYSIS FOR YIELD AND PROCESSING CHARACTERISTICS IN TOMATO

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Abstract: Combining ability analysis of 15 hybrids (3 lines x 5 testers) and 8 parents in tomato indicated the role(s) of additive gene action for the characters studied, demanding biparental approach and recurrent selection for improvement. Hybrids LE 206 x Ohio 8129 and Sakthi x TH 318 for total solids, Sakthi x HW 208 F and LE 206 x Ohio 8129 for insoluble solids and LE 206 x Ohio 8129 and LE 206 x St 64 for lycopene are promising for improvement of quality traits.

Key **words;** Combining ability, hybridization, line x tester analysis, tomato

INTRODUCTION

Information on gene action and combining ability facilitates choice of suitable parents for hybridization. In the present study attempt is made to work out combining ability effects of accessions and hybrids and gene action governing yield and processing characteristics of tomato.

MATERIALS AND METHODS

The tomato accessions (Sakthi, LE 206, LE 214) were crossed with selected processing varieties (HW 208 F, St 64, Ohio 8129, TH 318, Fresh Market 9) in a line x tester fashion (3 x 5). The fifteen hybrids along with the eight parents were raised in pots. Twelve pots were maintained in each entry. Observations were recorded from five randomly selected plants. Analyses of fruits for chemical composition were done as per AOAC methods (AOAC, 1980) except for lycopene content (Adsule and Dan, 1976) and consistency (Takada and Nelson, 1983). Combining ability analysis was done as per Kempthorne (1957).

RESULTS AND DISCUSSION

The analyses of variance revealed highly significant difference among the 23 genotypes for all characters studied. The mean squares due to parents differed significantly except for reducing sugar content. Highly significant differences were observed for the variance component, 'parents vs hybrids' for all characters except reducing sugar, ascorbic acid, storage life and locules/fruit. Significant mean squares among lines and testers revealed wide range of variability among them. Mean squares due to line x tester interaction were significant for plant height, days to harvest, fruits/plant, fruit yield/plant, fruit weight, locules, TSS, total solids, insoluble solids, lycopene and ascorbic acid contents.

High correlations were observed (Table 1) between *per se* performance of parents and estimates of gca effects for fruit weight, yield/plant, total solids, insoluble solids, ascorbic acid and lycopene. The good general combiners were TH 318 and LE 214 (higher plant height), Ohio 8129, St 64 and Sakthi (dwarfness), Sakthi, LE 206, Ohio 8129 and St 64 (earliness), TH 318, Ohio 8129 and Sakthi (fruits/plant), Sakthi, TH 318, Fresh Market 9 and HW 208 F (yield/plant), Fresh Market 9, Sakthi and HW 208 F (fruit weight), TH 318 (fruit shape index), St 64 and LE 206 (pericarp thickness), Ohio 8129, LE 206 and St 64 (storage life), HW 208 F and Fresh Market 9 (juice yield), St 64 and LE 206 (TSS), HW 208 F, St 64, Sakthi and LE 206 (total solids), HW 208 F, Ohio 8129 and St 64 (insoluble solids and reducing sugar), TH 318 and Sakthi (acidity), HW 208 F (pH), HW 208 F and Ohio 8129 (consistency), St 64, Ohio 8129 and LE 206 (lycopene) and HW 208 F and LE 214 (ascorbic acid). The good general combiners may be useful as outstanding parents with favourable alleles for yield and quality traits.

Table 1. Estimate of general combining ability effects of lines and testers

Lines/testers	Plant height (cm)	Days to harvest	Fruits/ plant	Fruit/ yield/ plant (g)	Fruit weight (g)	Fruit shape index	Locules/ fruit	Pericarp thickness (mm)	Storage life (days)	Juice yield (%)
Lines										
Sakthi	-4.11**	-1.16*	1.84**	209.66**	8.00**	0.003	0.01	-0.13	0.09	0.44
LE 206	0.31	-1.80**	0.08	-95.11**	-5.28**	-0.0004	0.03	0.26**	1.65**	-0.40
LE 214	4.41**	2.96**	-1.92**	-114.56**	-2.72**	-0.002	0.05	-0.12	-1.75**	-0.04
SE (gi)	0.55	0.47	0.52	14.51	0.82	0.006	0.03	0.07	0.36	0.36
SE (gi-gj)	0.77	0.67	0.74	20.52	1.16	0.009	0.04	0.12	0.50	0.51
Testers										
St 64	5.49**	-6.31**	1.08	-87.47**	-6.67**	-0.009	-0.20	0.89**	1.36**	0.80
Ohio 8129	-7.29**	-1.84**	-1.88**	-158.11**	-10.66**	0.005	-0.07	-0.55**	2.03**	-2.20**
HW 208 F	0.31	3.03**	-2.65**	49.84**	7.01**	-0.009	0.19	-0.40**	0.09	1.40**
TH 318	11.71**	-0.17	2.88**	106.83**	-1.56	0.019*	-0.05	0.09	-3.57**	-1.00*
Fresh Market 9	0.77	5.29**	-3.19**	88.90**	11.88**	-0.006	0.12	-0.03	0.09	1.00*
SE (gi)	0.71	0.61	0.68	18.73	1.06	0.008	0.04	0.09	0.46	0.47
SE (gi-gj)	1.00	0.86	0.96	26.49	1.50	0.001	0.06	0.13	0.65	0.66

Table 1 continued

Lines/testers	Tss, %	Total solids,%	Insoluble solids,%	Reducing sugar, %	Acidity, %	pH	Consist-ency, ppt	Lycopene mg 100g^{-1}	Vit.C mg 100g^{-1}
Lines									
Sakthi	-0.09	0.43**	0.022	-0.11	0.018*	-0.009	0.009	-0.36**	-1.26**
LE 206	0.32**	0.22*	0.005	-0.19*	-0.006	-0.011	0.007	1.56**	-1.66**
LE 214	-0.23	-0.66**	-0.027*	-0.08	-0.011	0.021	-0.016*	1.20**	2.93**
SE (gi)	0.06	0.09	0.012	0.08	0.007	0.020	0.004	0.13	0.59
SE (gi-gj)	0.08	0.13	0.017	0.12	0.009	0.028	0.005	0.18	0.83
Testers									
St 64	0.48**	0.48**	0.033**	0.23*	-0.001	-0.033	-0.002	2.24**	1.15
Ohio 8129	-0.19**	0.11	0.047**	0.41**	-0.015	0.034	0.014**	2.41**	-4.90**
HW 208 F	-0.18**	0.71**	0.068**	0.01	0.001	0.057*	0.026**	-1.02**	4.13**
TH 318	0.06	-0.26*	-0.080**	-0.03	0.035**	-0.059*	-0.016**	-1.75**	-2.85**
Fresh Market 9	-0.17*	-1.03**	-0.071	-0.62**	-0.020*	0.001	-0.023**	1.88**	2.47
SE (gi)	0.07	0.11	0.015	0.11	0.009	0.025	0.005	0.16	0.76
SE (gi-gj)	0.10	0.16	0.021	0.15	0.012	0.036	0.006	0.23	1.07

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

Table 2. Cross combinations showing significantly high sca effects

Characters	Crosses
Plant height	
Tall	LE 206 x St 64, LE 214 x HW 208 F
Short	LE 206 x HW 208 F, LE 214 x St 64
Days to harvest	
"Early	LE 214 x Ohio 8129, Sakthi x TH 318
Fruits/plant	Sakthi x TH 318, LE 206 x Fresh Market 9
Yield/plant	Sakthi x TH 318, Sakthi x Fresh Market 9
Fruit weight	Sakthi x Fresh Market 9, LE 206 x Ohio 8129
Juice yield	LE 214 x TH 318, LE 206 x Ohio 8129
TSS	Sakthi x TH 318, LE 206 x St 64
Total solids	LE 206 x Ohio 8129, Sakthi x TH 318
Insoluble solids	Sakthi x HW 208 F, LE 206 x Ohio 8129
Lycopene	LE 206 x Ohio 8129, LE 206 x St 64

Table 3. Components of additive and non-additive variances and heritability for yield and quality traits in tomato

Characters	Cov HS	02 A	Cov FS	σ^2 D	Heritability
Plant height (cm)	6.07	24.26	86.64	5.98	0.64
Days to harvest	2.05	8.21	32.16	5.04	0.44
Fruit/plant	0.28	1.11	17.03	13.51	0.05
Fruit yield/plant (kg)	0.003	0.01	0.07	0.02	0.33
Average fruit weight (g)	9.11	36.41	186.35	54.44	0.34
Fruit shade index	0.01*	0.03*	0.01*	0.05*	0.03
Locules/fruit	0.001	0.003	0.033	0.028	0.06
Pericarp thickness (mm)	0.031	0.123	0.386	0.013	0.46
Storage life (days)	0.64	2.54	8.95	-0.41	0.46
Juice yield (%)	0.21	0.85	2.11	-0.32	0.21
TSS (%)	0.004	0.015	0.282	0.210	0.05
Total solids (%)	0.06	0.24	1.05	0.14	0.48
Insoluble solids (%)	0.0003	0.001	0.006	0.004	0.14
Reducing sugar (%)	0.02	0.06	0.17	-0.02	0.37
Acidity (%)	0.05*	0.18*	0.75*	0.10*	0.19
pH	0.20*	0.70*	1.40*	-0.50*	0.07
Consistency (ppt)	0.05*	0.19*	0.69*	0.02*	0.48
Lycopene (mg / 100 g)	0.51	2.03	8.32	1.31	0.57
Ascorbic acid (mg / 100 g)	1.60	6.40	24.49	2.17	0.47

*Original figures were multiplied by 10^{-1}

Combinations showing significantly high sca effects (Table *2)* were LE *206* x St 64 and LE 214 x HW 208 F (tallness), LE 206 x HW 208 F and LE 214 x St 64 (dwarfness), LE 214 x Ohio 8129 and Sakthi x TH 318 (earliness), Sakthi x TH 318 and LE 206 x Fresh Market 9 (fruits/plant), Saktlii x TH 318 and Sakthi x Fresh Market 9 (yield/plant), Sakthi x Fresh Market 9 and LE 206 x Ohio 8129 (fruit wight), LE 214 x TH 318 and LE 206 x Ohio 8129 (juice yield), LE 206 x St 64 and Sakthi x TH 318 (TSS), LE 206 x Ohio 8129 and Sakthi x TH 318 (total solids), Sakthi x HW 208 F and LE 206 x Ohio 8129 (insoluble solids) and LE 206 x Ohio 8129 and LE 206 x St 64 (lycopene). The F_1 hybrids showing high sca effect for solids and lycopene can be considered for improving processing characteristics.

Additive gene action predominated for plant height, days to harvest, storage life, pericarp thickness, total solids, lycopene, ascorbic acid, juice yield, reducing sugar, consistency, fruit shape index, acidity and pH. Significant advancement could be made by selection in the improvement of these characters. Non-additive gene action was observed for fruits/plant, yield/plant, average fruit weight, locules/fruit, TSS and insoluble solids (Table 3). Since additive and non-additive genetic variances were observed for the characters studied, biparental approach and recurrent selection can be utilized to exploit both gene actions simultaneously.

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