INT. J. BIOL. BIOTECH., 10 (2): 217-220, 2013.

ANALYSIS OF COMBINING ABILITY STATUS AMONG PARENTS AND HYBRIDS IN TOMATO

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ABSTRACT

A set of 12 F_1s developed by line × tester mating design were studied during 2008-2009 to investigate the nature and relative contribution of general combining ability, specific combing ability and simple correlation of selected tomato cultivars for yield and yield related traits in tomato. Data recorded for different traits (plant height, fruit length, fruit width, fruit weight, number of fruits per cluster, number of flowers per cluster, days to first picking, number of branches per plant, fruit setting percentage) showed that variability among crosses was mainly due to contribution of lines and line × tester interaction. Correlation studies showed that fruit yield per plant has strong positive correlation and significant values ($p \leq 0.01$) for branches per plant and fruit setting percentage while plant height has negative significant correlation for number of flowers per cluster. For specific combing ability, crosses CLN-2001 × BL-1175, BL-1173 × BL-1175, CLN-2001A × BL-1176 and cross BL-1173 × BL-1176 has shown good positive specific combining ability effects for fruit yield per plant while lines CLN-2001A and BL-1174 are good general combiners in term of fruit yield per plant while in males, BL-1176 and 17895 has shown good general combining ability for fruit yield per plant. So these lines may be used in a breeding program for local varieties development.

Key words: *Lycopersicon esculentum* L., GCA, SCA, Line × tester, Correlation

INTRODUCTION

Vegetables if grown managed and marketed properly, on one hand play a role in the national economy by earning a lot of foreign exchange by their export but also establish the farmer's economy. Tomato is one of the important vegetable crops due to its wide consumption as fresh and in processed form through out the world. It belongs to Solanaceae family which is also known as nightshade family.

Tomato is a perennial crop but it can be grown in different environments without any significant yield losses. Phenotypically stable genotypes are of great importance because the environmental conditions vary from season to season and year to year. An effective breeding program for developing high yielding and improved quality traits require preliminary information on the nature and magnitude of variation in available material and association of the characters with yield and among themselves. The extent to which desirable characters are heritable is also essential to enhance the efficiency of selection.

The interrelation ship between yield components is more advantageous to bring a rational improvement in the desired direction. Therefore, in the present investigation, an attempt was made to study these aspects in tomato by using line ×tester mating design.

MATERIALS AND METHODS

The plant material used for current study was generated by crossing seven tomato pure lines. A line × tester mating design was employed to generate 12 crosses by using three lines as male namely BL-1175, BL-1176, 017895 and four as female CLN-2001A, CLN-1621, BL-1173, BL-1174. Seeds of F_1 along with their parents were sown in a small nursery bed measuring 1 × 1m in rows. Seedlings were spaced at distance of 4 cm from plant to plant and 6cm from row to row. The F_1 seed along with their parents were planted in a randomized complete block design with three replications in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Agronomic and plant protection practices were employed as per requirement to each replication. The observations were recorded of ten competitive plants in each treatment and replication.

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RESULTS AND DISCUSSION

The analysis of variance showed significant ($p \leq 0.01$) differences among tomato genotypes for all the characters studied, viz. plant height, number of branches per plant, number of flowers per cluster, number of fruits per cluster, fruit setting percentage, fruit length, fruit width, fruit weight, and fruit yield per plant which indicates the presence of variability among parents for these characters. Further portioning the mean squares of crosses into lines, testers and line ×tester interaction revealed that mean sum of squares due to lines were significant for all the traits (Chadha, *et al.*, 2001,). However, variances due to line × tester interaction were significant for all the traits except days to maturity indicating presence of wide genetic diversity among lines and testers used in the present study.

Table 1. Estimates of general combining ability values for some yield related traits in tomato.

Females	Number of flower per cluster	Number of fruits per cluster	Fruit setting % age	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Fruit yield per plant	Plant height (cm)	Days to first picking	Number of branches per plant
CLN-2001A	-0.308	-1.21	-18.616	-2.374	-4.023	-12.259	0.157	-0.688	-9.87	-0.405
CLN-1621	0.951	0.90	4.473	0.225	4.069	14.75	-0.192	-0.173	7.428	0.482
BL-1173	-0.95	-0.43	6.245	3.015	1.795	2.296	-0.217	-0.14	-4.832	0.168
BL-1174	0.307	0.74	7.897	-0.867	-1.841	-4.786	0.251	1.002	7.274	-0.245
Males										
BL-1175	0.578	0.25	-0.408	-4.334	2.113	0.086	-0.121	-0.807	0.513	-0.248
BL-1176	0.579	0.46	-2.884	-0.262	-3.848	-2.236	0.106	0.646	1.863	0.017
17895	-1.158	-0.71	3.292	4.597	1.734	2.15	0.015	0.161	-2.377	0.231

Table 2. Estimates of specific combining ability for some yield related traits in tomato.

CROSSES	Number of flower per cluster	Number of fruits per cluster	Fruit setting (%)	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Fruit yield per plant	Plant height (cm)	Days to first picking	Number of branches per plant
CLN-2001A × BL-1175	0.413	0.167	-0.803	1.651	-2.475	-3.471	0.231	-0.433	-1.786	0.193
CLN-1621 × BL-1175	-1.076	-1.0612	-3.155	-2.379	2.621	-2.747	-0.342	-1.146	-4.931	-1.084
BL-1173 × BL-1175	0.663	0.8942	3.958	0.727	-0.146	6.218	0.111	1.578	6.717	0.891
BL-1174 × BL-1175	-0.724	-0.8563	-0.037	-3.443	4.637	8.251	-0.239	-0.599	0.147	0.437
CLN-2001A × BL-1176	1.006	0.8496	-0.59	4.096	-6.53	12.61	0.131	1.825	4.177	-1.134
CLN-1621 × BL-1176	-0.282	0.0067	0.628	-0.653	1.893	-20.861	0.107	-1.226	-4.324	0.697
BL-1173 × BL-1176	-0.228	-0.213	-1.673	1.198	1.946	-0.59	0.042	1.42	-1.44	1.127
BL-1174 × BL-1176	0.755	0.8496	5.542	1.059	-0.194	-7.346	0.206	-1.009	3.824	0.387
CLN-2001A × 017895	-0.527	-0.6366	-3.869	-2.256	-1.752	7.936	-0.248	-0.411	-2.385	-1.513
CLN-1621 × 017895	0.538	0.9023	2.513	0.594	-4.108	-4.19	-0.035	-0.389	3.079	-1.757
BL-1173 × 017895	-0.684	-0.638	-1.797	-2.776	4.103	-2.516	0.005	0.329	-3.071	1.831
BL-1174 × 017895	0.145	-0.2643	-0.717	2.182	0.005	6.706	0.03	0.06	-0.008	-0.074

Table 3. Simple correlation coefficients for some yield related traits in tomato.

	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Plant height (cm)	Frit yield per plant (kg)	Number of flower per cluster	Number of fruits per cluster	Days to first picking	Number of branches per plant
Fruit length (mm)	1.00								
Fruit width (mm)	0.204**	1.00							
Fruit weight (g)	0.351**	0.091	1.00						
Frit yield per plant (kg)	-0.153*	-0.136*	-0.244**	1.00					
Number of flower per cluster	-0.216**	-0.018	-0.009	-0.046	1.00				
Number of fruits per cluster	-0.069	-0.032	0.157*	0.143	0.074*	1.00			
Days to first picking	-0.021	-0.037	0.404**	0.204	0.094	0.405**	1.00		
Number of branches per plant	-0.001	-0.012	-0.065	0.313**	0.647**	-0.396**	0.103	1.00	
Fruit set %age	0.113	-0.027	0.192**	0.184**	0.275**	-0.217**	0.759**	0.433**	1.00

**=Highly Significant; *=Significant; $^{ns=}$ Non Significant.

Among the crosses, CLN-2001A × BL-1176 were able to get the highest plant height (72.99 cm) followed by BL-1173 × 017895 (69.16 cm). For number of fruits per cluster, the highest mean value for BL-1175 was observed (3.96) while in case of female parents, the highest fruits were attained by CLN-2001A (5.84) followed by CLN-1621 (4.34). Among crosses, cross combination CLN-2001A × BL-1176 gave the highest number of fruits per cluster (6.48) followed by cross BL-1174 × BL-1176 attaining mean value of (5.15). Significant GCA and SCA values had been observed which indicated the presence of wide variability in germplasm for this character (Sharma *et al.* 2002: Bhatt *et al*. 2004). The highest contribution was from BL-1173 (37.84 cm) followed by CLN-1621 (34.47 cm) for fruit length. In case of cross combinations the highest fruit length was attained by cross BL-1174 × 017895 (36.55 cm) followed by cross CLN-2001A × 017895 (35.99 cm).

Highly significant GCA and SCA effects have been reported by Ali *et al*. 1989, Chandrasikhar and Rao, 1989, Bhatt *et al*., 2001 for different triats in tomato. Among female parents BL-1174 (1.01) had the highest positive general combing ability effects. However, the highest negative effects were shown in line CLN-2001A (-0.68) and CLN-1621 (-0.17). Lines CLN-1621 and BL-1173 possessing (0.48) and (0.17) respective values for general combing ability effects and may be potential parents for determining the number of branches per plant. Present studies are quite close with the results reported by Ghosh, *et al*., 1997, Sharma, *et al.*, 2001 who observed the similar results for number of branches per plant in tomato crosses. As regarding fruit weight male parent 017895 (2.15) and among the female parents CLN-1621 (14.75) and BL-1173 (2.29) are the potential agents. The results also support the findings of Prasad and Mathura (1999), Hazra *et al*. (2001), who observed significant differences between genotypes for this trait.

Fruit yield per plant is an important yield attribute. Line BL-1176 showed positive effects (0.11). Female parents BL-1174 and CLN-2001A possessed (0.25) and (0.16) values respectively for general combining ability effects (table 1) and are potential parents for improving fruit yield per plant. Referring to GCA and SCA variances, significant estimates have been reported by Ali *et al*. 1989, Bhatt *et al*. 2000 and Sharma, *et al.*, 1996.

For fruit length, a range of specific combining ability effects is available starting from (4.09) for cross combination CLN-2001A × BL-1176 to (0.59) for CLN-1621 × 017895. Specific combining ability effects for number of flowers per cluster range from (1.04) for CLN-2001A × BL-1176 to (0.14) for BL-1174 × 017895. The negative effects ranged from (-1.08) for CLN-1621 × BL-1175 to (-0.23) for BL-1173 × BL-1176. These findings confirm the results obtained by Singh (2002). For plant height the percent contribution of lines × tester interaction was higher than the individual contribution of the lines and testers indicating high estimates of variances due to specific combining ability. Fruit yield per plant has strong positive correlation and significant values for branches per plant and fruit setting percentage

Plant height as positive significant values for fruit yield per plant, number of fruits per cluster, days to first picking, number of branches per plant and fruit setting percentage while only one negative non significant value (Table 2) was obtained for number of flowers per cluster in case of plant height (Suresh and Gulshan, 1989).

Conclusion

Lines CLN-2001A and BL-1174 are best general combiners among females in term of fruit yield per plant while BL-1174 is also good general combiner for the plant height. BL-1175, among males has shown positive GCA values for fruit yield per plant and fruit length. In review of above findings, lines CLN-2001A and BL-1174 are good general combiners in term of fruit yield per plant while in males, BL-1176 and 17895 has shown good general combining ability for fruit yield per plant. So these lines may be used for development of local varieties. BL-1174 × BL-1176 is good combination for hybrid development because its SCA value was maximum indicating hybrid vigor in terms of fruit yield per plant.

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(*Accepted for publication February 2013*)