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Combining Ability for Yield and Quality Related Traits in Tomato (*Solanum lycopersicum* L.)

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A B S T R A C T

Thirty six hybrids generated from crossing twelve lines with three testers were studied along with parents for combining ability in tomato. The specific combining ability (SCA) was significant for all the characters, indicating the importance of both additive and non-additive genetic components. But it is found that there was predominance of non-additive genetic components for expression of different traits in the present set of materials. The most promising specific combiner for fruits per plant and pericarp thickness was H-86 x Kashi Amrit. Other cross combiner FLA7171 x Kashi Amrit best in locules per plant and Vitamin C .Hence, the present study was carried out to obtain information on combining ability involved in expressing the different characters in tomato.

Introduction

Tomato [*Solanum lycopersicon* L. isone of the most important commercial crops grown extensively in the tropical and sub-tropical region of the world. It ranks second only after potato (Bose *et al.*, 2). Tomato (*Solanum lycopersicum* L.) belongs to Solanaceae family having chromosome number 2n=2x=24. It has originated from wild form in the Peru- Equador Bolivia region of South America (Rick, 7). It has commercial value in the extraction of tomatine, a steroidal hormone, which is used as a substitute of diosgenin (Amid *et al.*, 1). The unripe green fruits are used for making pickles, preserves and are consumed after cooking as vegetable (Kaur *et al*., 5).

Tomato is a rich source of antioxidants (mainly lycopene and β-carotene), Vitamin A, Vitamin C and minerals like Ca, P and Fe**.** In tomato total antioxidant capacity ranges from 80 to 200 μ mol**.** Ascorbic acid contents of tomatoes have been found to vary according to color and it ranged from 23.21- 40.44 and 24.38 - 33.87 mg/100g in red and yellow cultivars, respectively (Singh *et al*., 8).

Materials and Methods

Twelve genetically diverse germplasm lines of tomato viz., IIVR-Sel.-1, G-3, S. Naveen, DVRT-2, H-24, H-86, H-88, Pusa Sheetal, FLA 7171, Hisar Arun, Sel.-32 and Flora Dode were used as a lines and three (Pusa Sadabahar, Kashi Vishesh and Kashi Amrit were crossed with three testers (Pusa Sadabahar, Kashi Vishesh and Kashi Amrit). The resulting 36 F_1s along with 12 lines and three testers were evaluated in randomized block design (RBD) with three replications at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Vidya- Vihar, Rea Bareli Road, Lucknow during the year 2014-15.

Sixteen plants of each genotypes were transplanted at a spacing of 60 cm x 45 cm. Observations were recorded like plant height (cm), number of branches/plant, days to 50 percent flowering, number of clusters/plant, number of flowers/cluster, number of fruits/cluster, number of fruits/plant, average fruit weight, number of locules/fruit, pericarp thickness, fruit length, fruit width, number of ridges on fruit, fruit yield/plant, TSS (^{0}brix) and vitamin c (mg/100g) were recorded.The standard procedures developed (Kempthorne, 6) were followed to estimate the mean sum of squares (MSS) along with variances of SCA and GCA. Standard statistical tools (Singh and Choudhury, 9) were used to analyze thecombining ability effects.

Results and Discussion

The specific combining ability is represented the dominance and epistatic component of variation that are non-additive gene action. It can be utilized in generation like developing F_1 hybrids. In the present investigation, the thirty six cross manifested consistently high specific combining ability effects for most of the characters (Dahiya *et al.*, 4).

In the present study findings (Table 1 and 2) revealed that the significant and desirable cross in order of merit were H-86 x Pusa Sadabahar and S. Naveen x Kashi Vishesh for plant height FLA 7171 x Pusa Sadabahar for Number of branches per plant, H-24 x Kashi Amrit for days to 50% flowering, S. Naveenx Kashi Vishesh for clusters per plant, FLA 7171 x Pusa Sadabahar for flowers per cluster, FLA 7171 x Pusa Sadabahar for fruits per cluster, H-86 x Kashi Amrit for fruits per plant, H-88 x Kashi Vishesh for average fruit weight, H-24 x Pusa Sadabahar for locules per fruit, IIVR-Sel.-1 x Kashi Amrit for pericarp thickness, S. Naveen x Kashi Amrit for fruit length, H-86 x Pusa Sadabahar for fruit width,G-3 x Kashi Amrit for ridges On fruit, S. Naveenx Kashi Vishesh for fruit yield per plant, G-3 x Kashi Vishesh for TSS and H-88 x Kashi Amrit for vitamin C were showed significant and desirable specific combiner.

Similarly, a critical examination of *per se* performance of best crosses for sixteen characters also reviled that there is no direct relationship between the *per se* of the crosses and their parents similar findings have been also reported (Brar *et al.,* 3).

Table.1 Estimation of specific combining ability (SCA) effect for the 8 characters of tomato

S. No.	Crosses	Plant height (cm)	Branches per plant	Days to 50% flowering	Clusters per plant	Flowers per cluster	Fruits per cluster	Fruits per plant	Average fruit weight (g)
1	IIVR-Sel.-1 x Pusa Sadabahar	-0.43	0.50	-0.25	-0.14	0.07	-0.40*	0.26	-2.30
2	IIVR-Sel. 1 x Kashi Vishesh	0.88	-0.23	-0.69	0.32	0.58	0.47*	-3.20**	-3.87
3	IIVR-Sel.-1 x Kashi Amrit	-0.45 *	-0.27	0.94	-0.19	-0.65	-0.07	2.94**	6.17*
4	G-3 x Pusa Sadabahar	-0.64	-0.29	-0.63	0.10	-0.31	-0.21	5.01**	-3.46
5	G-3 x Kashi Vishesh	0.51	-0.01	-0.12	-0.21	0.15	0.07	-1.71	1.09
6	G-3 x Kashi Amrit	0.13*	0.29	0.76	0.11	0.15	0.14	-3.30**	2.37
7	S. Naveen x Pusa Sadabahar	-1.46	-0.09*	-1.33*	-0.07	0.07	0.57**	-1.81*	3.98
8	S. Naveenx Kashi Vishesh	1.99*	0.29	1.33*	0.48*	0.10	-0.01	4.19**	-0.06
9	S. Naveen x Kashi Amrit	-0.52	-0.20	0.01	-0.41	-0.18	-0.56**	-2.38**	-3.92
10	DVRT-2 x Pusa Sadabahar	1.56	-0.15	-0.07	0.40	0.14	0.16	5.71**	3.79
11	DVRT-2 x Kashi Vishesh	-1.69	0.30	-0.55	-0.41	0.18	-0.29	-3.85**	0.08
12	DVRT-2 x Kashi Amrit	0.13	-0.15	0.63	0.01	-0.32	0.12	-1.86*	-3.87
13	H-24 x Pusa Sadabahar	-1.62	-0.11	1.18*	-0.23	-0.10	0.30	-3.27**	5.59*
14	H-24 x Kashi Vishesh	0.93	0.21	0.68	0.17*	-0.71**	-0.50*	2.21*	-1.65
15	H-24 x Kashi Amrit	0.69	-0.10	-1.87**	0.06	0.81**	0.20	1.07	-3.95
16	H-86 x Pusa Sadabahar	2.53`*	0.17	0.24	-0.03	-0.36	-0.18	-6.67**	4.23
17	H-86 x Kashi Vishesh	-2.32*	0.14	0.27	-0.23	0.02	0.35	0.53	2.41
18	H-86 x Kashi Amrit	-0.20	-0.31	-0.51	0.26	0.34	-0.17	6.14**	-6.63**
19	H-88 x Pusa Sadabahar	1.61	0.05	0.86	-0.12	-0.05	0.14	2.54**	-1.81
20	H-88 x Kashi Vishesh	-1.12	-0.45	-0.68	-0.06	0.09	-0.21	-1.29	6.84**
21	H-88 x Kashi Amrit	-0.48	0.40*	-0.18	0.18	-0.04	0.07	-1.25	-5.03
22	Pusa Sheetal x Pusa Sadabahar	-0.81	-0.01	0.51	-0.44	-0.11	-0.11	2.01	-3.04
23	Pusa Sheetal x Kashi Vishesh	0.05	-0.20	-0.28	-0.06	-0.05	-0.11	1.74	-2.08
24	Pusa Sheetal x Kashi Amrit	0.76	0.21	-0.23	0.50*	0.17	0.22	-3.75	5.12
25	FLA 7171 x Pusa Sadabahar	1.26	0.36*	-1.18*	0.22	1.20**	1.13**	-1.41	3.64
26	FLA 7171 x Kashi Vishesh	-1.54	-0.04	0.04	-0.19	-0.30	-0.45*	-0.05	-3.12
27	FLA 7171 x Kashi Amrit	0.29	-0.32 *	1.14	-0.02	-0.90**	-0.68**	1.46	-0.52
28	Hisar Arun x Pusa Sadabahar	-0.57	-0.22	1.26*	0.35	-0.54*	-0.52	-1.91	-3.04
29	Hisar Arun x Kashi Vishesh	0.38	-0.14	-0.54	-0.06	-0.09	0.34	2.07	0.42
30	Hisar Arun x Kashi Amrit	0.19	0.36	-0.72	-0.29	0.63**	0.18	-0.16	2.62
31	Sel.-32 x Pusa Sadabahar	-0.28	-0.31	0.99	-0.09	0.35	-0.17	-0.72	-1.21
32	Sel.-32 x Kashi Vishesh	0.96	0.29*	-0.98	0.43	-0.23	0.02	-1.60	-2.65
33	Sel.-32 x Kashi Amrit	-0.68	0.02*	-0.01	-0.34	-0.12	0.15	2.32	3.87
34	Flora Dode x Pusa Sadabahar	-1.14	0.09	-1.56**	0.06	-0.36	-0.72	0.26	-6.36
35	Flora Dode x Kashi Vishesh	0.99	-0.15	1.53*	-0.19*	0.27	0.32	0.97	2.59
36	Flora Dode x Kashi Amrit	0.15	0.06	0.04	0.13	0.10	0.40	-1.23	3.77
S.E ±M		0.762	0.248	0.550	0.229	0.266	0.192	1.109	2.354
CD (5%)		1.519	0.495	1.097	0.456	0.530	0.383	2.212	4.696

*, ** Significant at 5% and 1% level, respectively

Table.2 Estimation of specific combining ability (SCA) effect for the 8 characters of tomato

S. No.	Crosses	Locules per fruit	Pericarp thickness (mm)	Fruit length (cm)	Fruit width (cm)	Ridges on fruit	Fruit yield per plant (kg)	TSS (°Brix)	Vit. C (mg/100g)
1	IIVR-Sel.-1 x Pusa Sadabahar	0.17	0.07	-0.18	0.18	0.06	-0.22*	0.06	-0.71
2	IIVR-Sel. 1 x Kashi Vishesh	-0.16	-0.88**	-0.08	-0.34	0.01	-0.26**	-0.16	1.31
3	IIVR-Sel.-1 x Kashi Amrit	-0.02	0.81**	0.26	0.16	-0.07	0.48**	0.10	-0.60
4	G-3 x Pusa Sadabahar	-0.03	-0.44*	0.30	-0.15	-0.42**	-0.03	-0.15	0.24
5	G-3 x Kashi Vishesh	0.23	0.28	-0.26	0.30	0.02	0.33**	0.33*	-0.05
6	G-3 x Kashi Amrit	-0.20	0.16	-0.04	-0.15	0.40**	-0.30**	-0.17	-0.19
7	S. Naveen x Pusa Sadabahar	0.21	0.20	0.37	0.17	-0.05	-0.08	0.18	0.43
8	S. Naveenx Kashi Vishesh	0.03	0.09	0.15	0.31	0.06	0.38**	-0.12	-0.68
9	S. Naveen x Kashi Amrit	-0.23	-0.30	0.52*	-0.49**	-0.01	-0.29*	-0.06	0.25
10	DVRT-2 x Pusa Sadabahar	-0.19	0.25	0.33*	0.08	0.07	0.23*	-0.06	0.10
11	DVRT-2 x Kashi Vishesh	-0.03	-0.35*	-0.30	-0.23	-0.09	-0.07	-0.11	1.22
12	DVRT-2 x Kashi Amrit	0.21	0.09	-0.03	0.15	0.02	-0.16	0.18	-1.31 *
13	H-24 x Pusa Sadabahar	0.80**	0.27	-0.09	0.21	0.07	-0.20*	0.23	-0.46
14	H-24 x Kashi Vishesh	-0.50**	-0.16	-0.09	-0.10	-0.13*	-0.02	-0.25	-0.85
15	H-24 x Kashi Amrit	-0.30	-0.10	0.18	-0.11	0.06	0.22*	0.03	1.32
16	H-86 x Pusa Sadabahar	-0.31	0.17	0.16	0.38*	0.31**	-0.11	0.13	0.98
17	H-86 x Kashi Vishesh	0.60**	0.47**	0.17*	0.19	-0.16*	-0.12	0.00	-0.61
18	H-86 x Kashi Amrit	-0.29	-0.64**	-0.33	0.18	-0.15*	0.22*	-0.13	-0.37
19	H-88 x Pusa Sadabahar	0.02	0.34*	-0.05	-0.15	0.06	0.03	0.02	-1.70
20	H-88 x Kashi Vishesh	-0.21	-0.70**	0.06	-0.10	-0.01	0.09	-0.11	-0.51
21	H-88 x Kashi Amrit	0.20	0.36	-0.01	0.25*	-0.05	-0.12	0.09	2.22*
22	Pusa Sheetal x Pusa Sadabahar	-0.54	-0.23	-0.63	-0.02	0.07	-0.02	-0.13	-0.78
23	Pusa Sheetal x Kashi Vishesh	0.09	0.17	-0.08	-0.19	-0.01	0.03	-0.16	2.17*
24	Pusa Sheetal x Kashi Amrit	0.45	0.06	0.71	0.20	-0.07	-0.01	0.29*	-1.39
25	FLA 7171 x Pusa Sadabahar	-0.48	-0.23	-0.21	-0.45	-0.09	-0.01	-0.28*	-0.28
26	FLA 7171 x Kashi Vishesh	0.06	0.38	-0.01	-0.10	0.16*	-0.05	0.32*	-1.40
27	FLA 7171 x Kashi Amrit	0.42*	-0.15	0.22	0.55*	-0.07	0.06	-0.04	1.68*
28	Hisar Arun x Pusa Sadabahar	-0.13	-0.39	0.01	0.14	0.03	0.21*	-0.20	1.75
29	Hisar Arun x Kashi Vishesh	0.13	0.27	0.06	0.36	-0.01	-0.10	0.16	-0.54
30	Hisar Arun x Kashi Amrit	0.00	0.12	-0.06	-0.50	-0.02	-0.10	0.04	-1.21
31	Sel.-32 x Pusa Sadabahar	0.57	-0.23	0.00	0.45	-0.08	0.08	0.14	-0.15
32	Sel.-32 x Kashi Vishesh	-0.36	0.32	-0.03	0.05	0.10	-0.17	0.07	1.48
33	Sel.-32 x Kashi Amrit	-0.21	-0.09	0.03	-0.50	-0.02	0.10	-0.20	-1.32
34	Flora Dode x Pusa Sadabahar	-0.09	0.22	0.00	-0.09	-0.04	0.13	0.07	0.59
35	Flora Dode x Kashi Vishesh	0.11	0.10	0.41	-0.16	0.07	-0.03	0.03	-1.51
36	Flora Dode x Kashi Amrit	-0.02	-0.32	-0.41*	0.25	-0.03	-0.10	-0.10	0.93
S.E ±M		0.189	0.129	0.148	0.166	0.077	0.060	0.145	0.714
CD (5%)		0.376	0.258	0.296	0.331	0.153	0.120	0.289	1.424

*, ** Significant at 5% and 1% level, respectively

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