Plant Archives Vol. 18 No. 2, 2018 pp. 1659-1662 e-ISSN:2581-6063 (online), ISSN:0972-5210

ESTIMATION OF GENERAL AND SPECIFIC COMBINING ABILITY FOR CERTAIN QUALITY TRAITS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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Abstract

Nine parental lines were crossed in line x tester fashion comprising 6 lines and 3 testers at research form, College of Agriculture, Vellayani, Kerala Agricultural University, to estimate combining ability in tomato for certain quality traits. Combining ability analysis revealed that both additive and non additive gene actions were important for all the quality traits studied. Among the parents EC 461070, EC 461035 and MTM local were found to be good general combiner and posses additive genes for most of the quality characters studied.

Key words : Tomato (*Lycopersicon esculentum*), quality traits, vegetable crop, protective foods.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) 2n=2x=24 is one of the most important vegetable crop grown widely all over the world. It is a member of Solanaceae family and is native to central and south America (Vavilov, 1951). It contains vitamins A, C, potassium, minerals and fibres, so it is categorized as protective foods. The ripe fruits are taken as raw or made into salads, soups, pickles, ketchup, paste and many other products (Chadha, 2001).

Combining ability analysis is one of the powerful tools available to estimate the combining ability effects and aids in selecting the desirable parents and crosses for the exploitation of heterosis (Rashid *et al*., 2007). General combining ability (GCA) is attributed to additive gene effects and additive x additive epistasis and is fixable. On the other hand, specific combining ability attributable to no-additive gene action may be due to dominance and epistasis and is non-fixable. Line × Tester analysis is a useful tool for preliminary evaluation of genetic stock for use in hydrodiziation programme with a view to identify good combiners. Considering this, an investigation was undertaken to identify the best parental combinations for high vitamin A and C content, shelf life and other quality traits.

Materials and Methods

Eighteen F_1 hybrids were obtained by crossing six lines and three testers. Six lines were selected based on high yield and quality using selection index method were EC 461070, EC 461018, EC 461078, Arka Alok, Pkm^{-1} and Mukthi. Three testers were selected based on fruit borer (*Helicoverpa armigera*) resistance (MTM Local, EC 461035 and EC 461057). The exotic genotypes were introduced from AVRDC (Asian Vegetable Research and development Center), Taiwan. All the 18 hybrids and nine parents were raised in randomaized block design with three replications. Ten plants each were planted in plot size of 1.8 × 3m a spacing of 60cm and 60cm. All cultural practices were followed as per package of practices recommendations (KAU, 1996) were followed. The observations recorded for eight traits *i.e*., number of seeds per fruit, pericarp thickness, vitamin C, carotene, pH of juice, TSS, sugar content and shelf life. The combining ability estimates were calculated according to the method given by Griffing (1956).

Results and Discussion

The analysis of variance for line x tester (table 1) revealed high significant variances due to lines and testers for all the characters under the study, which indicated the existence of substantial genetic diversity in parents. The variances due to line × tester interactions, representing specific combining ability were also highly significant for all the traits which suggested manifestation of parental genetic variability in their crosses.

Nature and magnitude of combining ability effects provide guide line in identifying the better parents and their utilization. The summary of the GCA effects of the parents (table 2) revealed that none of the parent found to be good general combiner for all the characters. Negative *gca* and *sca* effects are desirable for the trait number of seeds per fruit. An over all appraisal of *gca* effects revealed that, among parents EC 461070 emerged as good general combiner for carotene content (386.67) and shelf life (1.03). Whereas line EC 461018 traced out good general combiner for total soluble solids (TSS) (0.55) and sugar content of fruits (0.378) and Arka Alok for shelf life (1.08). Among the parents PKM 1 was found to be good general combiner for number of seeds per fruit (-8.31), pericarp thickness 0.21 and TSS% (0.20). Among the male parents, MTM Local emerged as a good general combiner for number of seeds per fruit, pericarp thickness, carotene and shelf life, while EC 461035 for pericarp thickness, vitamin C as well as EC 461057 for number of seeds per fruit, vitamin C, TSS and sugar content. Comprehensive assessment of parents by considering GCA effects for all the characters studied has resulted into identification of parents EC 461070, EC 461035 and MTM local as good general combiners for over all characters. This results were in conformity with Sujeet Kumar and Ramanjini Gowda (2016).

Table 1 : Analysis of variance for combining ability in tomato (*Lycopersicon esculentum* Mill.).

Source	Df	Mean square							
		Number of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, µg	pH of juice	TSS, %	Sugar content	Shelf life, days
Replication	2	122.16	0.16	3.18	426096.00**	0.004	0.11	0.03	1.50
Treatments	26	1401.52**	1.21**	20.45**	254270.80**	0.06**	0.61**	0.24**	25.36**
Parents	8	1130.84**	2.51*	35.72**	199600.00**	0.04**	0.91**	0.29**	50.20**
Crosses	17	1331.93**	0.56**	11.28**	272178.80**	0.06**	0.50**	0.22**	15.13**
Parent Vs cross	1	4749.88**	1.80**	54.35**	387200.00*	0.17**	0.008	0.10*	0.39
Lines(female parents)	5	302.99	0.61	3.41	445699.20	0.06	0.88*	0.39*	8.00*
Testers (male Parents)	2	7007.69**	1.90*	45.02*	478688.00	0.10	0.71	0.36	99.82**
Line × Testers	10	711.25**	0.28**	8.46**	144116.80*	0.06**	0.26**	0.10**	1.77*
Error	52	100.78	0.06	2.28	59027.08	0.01	0.04	0.02	0.85

*Significant at 1 per cent level, ** Significant at 5 per cent level.

Table 2 : GCA effects of lines and testers.

	No. of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, µg	pH of juice	TSS, %	Sugar content, %	Shelf life, days
Lines								
EC 46107 (L_1)	8.70*	0.07	0.32	386.67**	-0.03	-0.18*	-0.10	1.03**
EC 461018 (L_2)	-0.83	-0.29**	0.14	-121.11	0.003	0.55**	0.378**	-0.08
EC 461078 (L_3)	-2.62	-0.33**	-0.88	22.22	0.08	-0.17*	-0.11*	-0.73*
Arka Alok (L_4)	-0.87	0.04	-0.54	93.33	0.06	-0.22**	-0.18**	1.08**
PKM-1 (L_5)	-8.31*	0.21*	0.14	-162.22	-0.14**	0.20**	0.10	-1.29**
Mukthi (L_6)	3.93	0.30**	0.83	-218.89**	0.03	-0.19**	0.09	-0.01
SE	3.35	0.08	0.50	80.98	0.04	0.07	0.05	0.31
Testers								
MTM Local (T_1)	-8.88**	0.13*	-1.82**	182.22**	0.03	-0.21**	-0.15**	2.52**
EC 461035 (T_2)	22.61**	0.24**	0.83*	-132.22*	0.05	0.02	0.01	-0.37
EC 461057 (T_3)	-13.73**	-0.37**	1.00**	-50.00	-0.08*	0.19**	0.14**	-2.15**
SE	2.37	0.06	0.36	57.27	0.03	0.05	0.04	0.22

Table 3 : Specific combining ability (*SCA*) effects of line x tester hybrids for eight quality characters.

S. no.	Hybrids	Number of seeds per fruit	Pericarp thickness, mm	Vitamin C, mg	Carotene, µg	pH of juice	TSS, %	Sugar content, %	Shelf life, days
1	$L_1 x T_1$	22.709**	0.348*	-0.053	83.33	-0.094	-0.012	0.036	0.483
2	$L_2 x T_1$	-6.557	0.033	-1.424	-115.555	0.079	-0.278*	-0.194*	0.561
3	$L_3 x T_1$	-9.511	-0.491**	1.651	-215.555	0.103	0.097	0.083	-0.628
4	$L_4 x T_1$	-6.237	0.221	0.286	286.667*	0.021	0.078	0.076	0.894
5	$L_5 x T_1$	3.442	0.089	-1.429	-77.778	-0.226**	0.383**	0.127	-1.161*
6	$L_6 x T_1$	-3.847	-0.200	0.968	38.889	0.117	-0.268*	-0.128	-0.150
7	$L_1 x T_2$	-1.624	0.064	0.366	-268.889	0.060	-0.031	-0.055	-0.633
8	$L_2 x T_2$	15.533**	-0.196	2.592**	155.556	-0.131*	0.003	-0.002	-0.189
9	$L_3 x T_2$	-1.448	0.162	-4.482**	-37.778	-0.070	-0.038	-0.018	0.389
10	$L_4 x T_2$	1.637	-0.072	0.199	-152.222	0.008	0.044	0.072	-0.089
11	$L_5 x T_2$	-20.308**	0.040	-0.482	186.667	0.075	-0.448**	-0.267**	0.122
12	$L_6 x T_2$	6.210	0.003	-2.192*	116.667	0.058	0.471**	0.271**	0.400
13	$L_1 x T_3$	-21.084**	-0.412**	-0.314	185.556	0.034	0.043	0.019	0.150
14	$L_2 x T_3$	-8.977	0.164	-1.168	-40.000	0.052	0.276*	0.196*	-0.372
15	$L_3 x T_3$	10.959	0.329*	-1.169	253.334	-0.033	-0.058	-0.064	0.239
16	$L_4 x T_3$	4.600	-0.149	-0.485	-134.444	0.029	-0.123	-0.148	-0.806
17	$L_5 x T_3$	16.866**	-0.130	1.910*	-108.889	0.151*	0.065	0.140	1.039
18	$L_6 x T_3$	-2.363	0.197	1.224	-155.555	-0.175**	-0.203	-0.142	-0.250
	SE	5.80	0.14	0.87	140.27	0.06	0.118	0.09	0.53

The specific combining ability (SCA) reveals the best cross combinations among the genotypes which can be useful for developing hybrids with high vigour for the traits. Results revealed that there was no significant positive *sca* effects for shelf life. Two crosses $L_5 \times T_2$ and $L_1 \times T_3$ were recorded negative significant *sca* effects of number of seeds per fruit. Cross $L_1 \times T_1$ for pericarp thickness, cross $L_2 \times T_2$, $L_5 \times T_3$ for vitamin C content, cross $L_4 \times T_1$ for carotene content of fruit, cross $L_5 \times T_3$ for pH of juice, cross $L_5 \times T_1$ and $L_2 \times T_3$ for TSS%, cross $L_6 \times T_2$ and $L_2 \times T_3$ for sugar content of fruits observed significant *sca* effect. This results are conformity with Hannan *et al*. (2007) and Sujeet Kumar and Ramanjini Gowda (2016). The *sca* variances greater than *gca* variances for number of seeds per fruit, pericarp thickness, vitamin C content of fruits, carotene, TSS and sugar content indicated predominance of non-additive gene action. The *gca* variances were greater than *sca* variances for pH of juice and shelf life indicated predominance of additive type of gene action. Almost identical findings have been reported by Savale and Patel (2017) and Pawan Kumar and Ajaya paliwal (2016).

In the present study the combining ability analysis revealed significant *gca* variance for most of the characters studied. The parents *viz*., the parents EC 461070, EC 461035 and MTM local were good general combiners and possess additive genes for vitamin content and other quality contributing traits.

Acknowledgement

I express my sincere thanks to Dr. D. Chandramony, Former Professor and Head, Department of Plant Breeding and Genetics, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram for her expert guidance, valuable suggestions and constructive criticisms. I am grateful to Dr. L.M. Engle, Geneticist and Head, GRSU, Asian Vegetable Research and Development Centre (AVRDC), Taiwan and Dr.R.V. Singh, Head Germplasm Exchange Division, I.C.A.R., New Delhi for providing seeds of tomato genotypes for conducting this study.

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