ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Combining ability analysis of growth, yield and quality traits in cherry tomato (Solanum lycopersicum var. cersiforme)

***Renuka D. M., T. H. Singh, Geeta S. V. and Sheela Malaghan**
UHS, Bagalkot

Manuscript Info

Manuscript History:

Received: 15 May 2015
Final Accepted: 25 June 2015
Published Online: July 2015

Key words:

cherry tomato, combining ability, diallel analysis

****Corresponding Author***

Renuka D. M

Abstract

A study was carried out to know the Combining ability effects for growth, yield and quality traits in a 7x7 diallel analysis excluding reciprocals by using 7 parents namely IIHR-2754(P_1), IIHR-2758(P_2), IIHR-2860(P_3), IIHR-2863(P_4), IIHR-2864(P_5), IIHR-2865(P_6) and IIHR-2866(P_7) in randomized block design with three replications. Parents IIHR-2754(P_1) and IIHR-2864(P_5) exhibited high general combining ability effect for most of the characters. Genotypes IIHR-2754(P_1) and IIHR-2864(P_5) were good general combiner for yield appear to be worthy of exploitation in future breeding. It is suggested that involving these lines may be developed through multiple crossing to isolating high yielding varieties. The crosses IIHR-2754 X IIHR-2864 and IIHR-2754 X IIHR-2866 showed high specific combining ability and per se performance for yield per plant suggesting that these hybrids may be further tested for commercial utilization.

INTRODUCTION

Cherry tomato (*Solanum lycopersicum* var. *cerasiforme)* is a botanical variety of the cultivated tomato or a smaller garden variety of tomato,[1] Cherry tomato is grown for its edible fruits, which can be consumed either fresh as a salad or after cooking as snacks. Cherry tomato has good nutritional information being, total carbohydrate, sugars, protein, calcium, and iron. They are a great source of vitamin-C (13mg/100g), dietary fibre (2.0 g), vitamin A (25%) and vitamin K and also a good source of vitamin E (Alpha Tocopherol), thiamine, niacin, vitamin B_6, foliate, phosphorus, copper, potassium and manganese. They are low in sodium and very low in total fat (0.3 g), saturated fat (0.1 g) and Cholesterol, [2].

Although cherry tomatoes have more nutritional values as compare to normal tomatoes there is a less work has been done with respect to quality improvement in cherry tomatoes. There was no breeding programme targeted towards nutritive values in India. Therefore, there is a need for improvement of varieties or hybrids specifically for fresh market and processing qualities with high nutritive value and higher yield Therefore, the present study was undertaken to generate information for identification of good general and specific combiners for the improvement of yield and its component traits.

Combining ability studies are more reliable as they provide useful information for the selection of parents in terms of performance of the hybrids and elucidate the nature and magnitude of various types of gene actions involved in the expression of quantitative traits. Diallel cross analysis provides the estimates of genetic parameters regarding combining ability as well as a rapid overall picture of the dominance relationship of the parents studied using the first filial generations (F_1) with or without reciprocals, Diallel analysis involving parents give the additional information as presence or absence of average degree of dominance, distribution of dominant and recessive genes in the parents. Application of diallel technique in a self-pollinated crop like tomato for this purpose may be appropriate,[3]. Hence the study was undertaken to estimate the combining ability in terms of specific and general combing ability and also the heterosis in the present work.

MATERIAL AND METHODS:

The material for the present investigation comprised of seven cherry tomato lines (*Solanum lycopersicum* var. *cersiforme*) namely IIHR-2754(P_1), IIHR-2858(P_2), IIHR-2860(P_3), IIHR-2863(P_4), IIHR-2864(P_5), IIHR-2865(P_6) and IIHR-2866(P_7). Half diallel analysis attempted by using seven parents of cherry tomato during *kharif* 2011. All 21 F_1 along with their (seven) parents were evaluated in randomized block design with three replications at Division of Vegetable Crops, Indian Institute of Horticultural Research Bangalore during *Rabi* season 2012. The crop was raised with row to row and plant to plant spacing 1 x 0.60m respectively. The observations were recorded on randomly selected five plants from parents and F_1s. The observations were recorded on plant height, number of primary branches, total inflorescence, average fruit weight, fruits per cluster, fruits per kg, fruits per plant, yield per plant, yield per plot, yield for hectare, number of locules per fruit, fruit firmness and pericarp thickness. The combining ability analysis was worked out as per method suggested by griffing method-1 and method-2.

RESULT AND DISCUSSION:

The analysis of variance for combining ability (general and specific combining ability) was found highly significant for all the characters (Table 1) indicating that both additive and non additive gene actions played significant role for the expression of these characters. GCA variances were higher in magnitude than the SCA variances for most of the characters indicating the pre dominance of the additive gene effects for the characters. [4] also reported that additive gene effects appeared more important than non-additive gene effects for average fruit weight, early yield, total yield and TSS in %.

General Combining ability effects:

The GCA component is primarily function of the additive genetic variance. GCA and SCA variances with each parent play significant role in the choice of parents. A parent with higher positive significant GCA effects is considered as a good general combiner. The results of GCA to effects for fortheen characters are present in the Table 2. The estimates of GCA effects for plant height are given in Table-2. Parent IIHR-2865 (P_6) showed highest positive GCA effect (8.63**) followed by parent IIHR-2754 (P_1) with the GCA effect (5.67**) on the other hand parent IIHR-2858 (P_2) showed highest negative significant effect (-12.30). So, the parent IIHR-2865 (P_6) was the best general combiner for plant height.

Parent IIHR-2754 (P_1) showed the highest GCA effect (0.24**) for number of primary branches per plant and three parents showed the negative significant effects. Parent IIHR-2863 (P_4) showed highest negative significant effect (-0.13). For the character number of secondary branches per plant Parent IIHR-2754 (P_1) showed the highest positive significant effect (0.94**) so Parent IIHR-2754 (P_1) was the best general combiner for the number of secondary branches per plant.

Parent IIHR-2754(P_1) performed as the best general combiner for total number of inflorescence with the GCA value (3.10**) followed by Parent IIHR-2858 (P_2) with GCA value (1.21**) since these parents had the higher and significant positive GCA effects. The other parent showed either insignificant or negative significant GCA values for this trail, [5] also reported such findings.

The estimates of GCA effects for average fruit weight showed that parent IIHR-2864 (P_5) had the highest positive significant GCA value (4.59**) followed by parent IIHR-2860(P_3)(0.65). The other parents had either insignificant or significant GCA values for this trait thus IIHR-2864(P_5) was the best general combiner to use in crosses for improvement of individual fruit weight as indicated by significant and higher GCA effects the findings were similar to[6] For fruits per kg among seven parents five parents showed positive significant effects and two parents showed negative significant effects, the parent IIHR-2754 (P_1) had highest positive significant value (8.61**) and IIHR-2864(P_5) had highest negative significant value (-12.16) so IIHR-2754 (P_1) was the best general combiner for the character numbers of fruits per kg. IIHR-2858(P_2) had the highest positive significant GCA effect (0.56**) followed by parent and parent IIHR-2754(P_1) (0.52**) and parent IIHR-2864(P_5) showed the negative GCA effect (-1.15) for fruits per cluster. And for fruits per plant parent IIHR-2754 (P_1) had the highest positive significant effect (49.90**) fallowed by IIHR-2858(P_2) (34.34**) and three parents showed negative significant effects. General combining ability effect for yield per plant showed that parent IIHR-2754 (P_1) had the highest positive significant value (0.11**) and two parents showed negative significant GCA values. For yield per plot the parent IIHR-2866(P_7) had highest positive significant effect (5.43**) fallowed by parent IIHR-2865(P_6) with GCA effect (0.77) and parent IIHR-2863(P_4) had highest negative significant effect (-3.53) fallowed by IIHR-2858(P_2), IIHR-2860(P_3) with same GCA value (-2.38). General combining ability effect for yield per hectare among seven parents three parents showed positive significant effects and four parents showed negative significant effects, in positive direction the parent IIHR-2866(P_7) had the highest significant value (3.40) fallowed by IIHR-2864P_5) (1.94) as suggested by [5],[6],[7]. In this respect they opined that both additive and non-additive genetic variances were important in the inheritances of total yield but additive genetic variance was more important than non-additive genetic variance.

Highest significant and positive GCA effect for number of locules per fruit was found in Parent IIHR-2865(P_6)(0.43), (Table 2). The parents IIHR-2860(P_3) and IIHR-2863(P_4) showed same negative insignificant value (-0.12) so parent IIHR-2865(P_6) was the best general combiner for number of locules per fruit.

In case of fruit firmness parent IIHR-2864(P_5) showed highest and positive significant GCA effect (0.89**) and two parents showed the same negative significant value (-0.12). For pericarp thickness parent IIHR-2864(P_5) had the highest positive significant value (0.91**) fallowed by parent IIHR-2860(P_3) (0.08) the other parents had significant or insignificant negative GCA values for the trait, hence parent IIHR-2864(P_5) was the best general combiner for pericarp thickness.

Specific Combining ability

The SCA effects signify the role of non-additive gene action in the expression of the characters. It indicates the highly specific combining ability leading to highest performance of some specific cross combinations. That is why it is related to a particular cross. High SCA effects may arise not only in crosses involving high combiners but also in those involving low combiners. The SCA effects of 21 F_1 crosses for the fortheen different characters studied are presented in Table-3.

Among 21 hybrids, 16 hybrids displayed significant SCA effects for plant height among that 11 showed the positive SCA effect and remaining 5 showed the negative effect. In case of number primary of branches per plant, 11 hybrids expressed significant SCA effects in both direction in which IIHR-2754 X IIHR-2860(0.18**) had significant highest positive SCA effect, for number secondary of branches per plant, 11 hybrids expressed significant SCA effects in both direction which ranged between -2.91**(IIHR-2864 X IIHR-2865) to 0.5* (IIHR-2860 X IIHR-2863).

In case of number of inflorescence per plant, out of 21 hybrids 15 hybrids showed the significant SCA effect in both direction, the value ranged between the -6.05(IIHR-2858 X IIHR-2863) to 20.18**(IIHR-2858 X IIHR-2860). In case of number of fruits per kg, the hybrid IIHR-2864 X IIHR-2865(13.69**) registered highest SCA effects followed by IIHR-2754 X IIHR-2858(5.24**) hence (IIHR-2858 X IIHR-2860) was the best general combiner for number of fruits per kg.

For fruit yield per plant, out of 21 hybrids 12 hybrids showed the positive significant SCA effects which ranged between 1.19** (IIHR-2754 X IIHR-2860) to 0.11*(IIHR-2858 X IIHR-2866) therefore the hybrid IIHR-2754 X IIHR-2860 used for further breeding work, which indicated that yield potential can be tapped through heterosis by this specific combiner.

In case of number of locules per fruit, the hybrid IIHR-2865 X IIHR-2866 (0.40) recorded maximum SCA effect. In case of pericarp thickness, the hybrid IIHR-2858 X IIHR-2865(0.84*) recorded maximum SCA effects. These results were in accordance with,[8] and[9], (Table-3).

Table 1: Analysis of variance for combining ability for different traits in cherry tomato

		Mean sum of squares									
Source of variance	df	Plant height (cm)	No. Of primary branches	No. Of secondary branches	Total. Inflorescences	Average fruit weight (g)	Fruits/ kg	Fruits/ cluster	Fruits/ plant	Yield/plat (kg)	Yield/ha (t)
GCA	6	529.283	0.164	3.505	29.301	42.29	369.043	2.855	11624.59	0.121	38.181
SCA	21	292.483	0.059	1.727	41.438	7.52	93.585	0.633	3648.52	0.237	65.163
Error	54	79.414	0.037	0.213	2.967	0.23	2.203	0.106	463.29	0.007	0.296

*-significant at 5 %, **- significant at 1 %

Table 3: Specific combining ability effects for different traits in cherry tomato lines

Crosses / Hybrid	Plant height (cm)	No. of primary branches	No. of secondary branches	Total. Inflorescence	Average fruit weight (g)	Fruits/ kg	Fruits/ cluster	Fruits/ plant
IIHR-2754XIIHR-2858	-9.95 **	0.29 **	-0.28	-2.53 **	-1.16 **	5.24 **	0.26	-9.31
IIHR2754XIIHR-2860	9.38 *	0.18 *	0.06	-0.38	3.78 **	-15.65 **	-0.56 **	-31.87 **
IIHR-2754XIIHR-2863	20.71 **	0.32 **	-0.80 **	9.73 **	2.51 **	-12.35 **	-1.19 **	19.76 *
IIHR-2754XIIHR-2864	-3.69	-0.23 **	2.09 **	-5.94 **	-3.42 **	3.91 **	-0.70 **	-77.02 **
IIHR-2754XIIHR-2865	17.45 **	-0.12	-1.24 **	-1.79 *	2.75 **	-12.43 **	-0.15	-24.24 **
IIHR-2754XIIHR-2866	-4.73	-0.34 **	-0.02	2.40 **	0.36	-2.31 **	-0.26	8.43
IIHR-2858XIIHR-2860	-1.66	-0.16 *	0.35	20.18 **	-1.19 **	4.13 **	0.41 **	196.35 **

IIHR-2858XIIHR2863	-26.32 **	-0.01	0.17	-6.05 **	0.17	-0.91	-0.22	-56.02 **
IIHR-2858XIIHR-2864	23.60 **	0.10	-0.28	-1.71 *	-0.52 *	-1.98 **	-1.07 **	-58.80 **
IIHR-2858XIIHR-2865	14.08 **	-0.12	-0.94 **	2.44 **	1.62 **	-5.65 **	-0.19	10.31
IIHR-2858XIIHR-2866	22.90 **	-0.01	-0.39 *	0.29	3.26 **	-11.54 **	-0.30 *	-10.35
IIHR-2860XIIHR-2863	-18.32 **	-0.12	0.50 **	-0.23	1.67 **	-6.13 **	0.30 *	12.76
IIHR-2860XIIHR-2864	7.94 *	0.32 **	-0.94 **	-3.23 **	1.75 **	-4.87 **	-0.89 **	-56.02 **
IIHR-2860XIIHR-2865	4.08	0.44 **	1.06 **	-1.08	1.53 **	-5.20 **	-0.67 **	-35.91 **
IIHR-2860XIIHR-2866	17.90 **	-0.12	-0.39 *	-2.56 **	-0.91 **	3.24 **	-1.11 **	-64.24 **
IIHR-2863XIIHR-2864	24.27 **	-0.19 *	1.87 **	8.55 **	-0.96 **	-0.91	-0.52 **	34.94 **
IIHR-2863XIIHR-2865	12.42 **	-0.08	-1.46 **	3.03 **	1.44 **	-5.24 **	0.04	30.39 **
IIHR-2863XIIHR-2866	11.90 **	0.03	-1.57 **	1.88 **	1.41 **	-5.46 **	0.26	29.39 **
IIHR-2864XIIHR-2865	-18.99 **	-0.31 **	-2.91 **	1.03	-5.15 **	13.69 **	-0.15	3.28
IIHR-2864XIIHR2866	-10.84 **	-0.19 *	-0.69 **	2.88 **	-2.07 **	2.13 **	0.74 **	53.28 **
IIHR-2865XIIHR-2866	-6.69	-0.08	0.65 **	-1.31	0.10	0.80	0.30 *	1.39
SE ±	3.63	0.07	0.18	0.70	0.19	0.60	0.13	8.78
CD @ 5 %	7.11	0.15	0.36	1.37	0.37	1.18	0.25	17.2
CD @ 1 %	9.32	0.2	0.48	1.8	0.48	1.55	0.33	22.47

Continued..

Crosses / Hybrid	Yield/plat (kg)	Yield/plot (kg)	Yield/ha (t)	No. of Locule/fruit	Fruit firmness (kg/ mm^2)	Pericarp thickness (mm)
IIHR-2754XIIHR-2858	0.21 **	8.45 **	5.28 **	0.25 *	-0.50 **	-0.60 **
IIHR2754XIIHR-2860	1.19 **	-11.55 **	-7.22 **	0.32 **	-1.92 **	0.02
IIHR-2754XIIHR-2863	-0.21 **	-0.06	-0.04	-0.34 **	2.80 **	0.41 **
IIHR-2754XIIHR-2864	-0.13 **	11.56 **	7.23 **	0.29 *	0.73 **	0.10 *
IIHR-2754XIIHR-2865	0.77 **	7.97 **	4.98 **	-0.23	0.72 **	0.57 **
IIHR-2754XIIHR-2866	0.19 **	25.31 **	15.82 **	-0.12	-1.23 **	-0.10 *
IIHR-2858XIIHR-2860	0.41 **	-0.58	-0.36	-0.34 **	-0.66 **	-0.50 **
IIHR-2858XIIHR2863	-0.19 **	5.90 **	3.69 **	-0.01	-0.60 **	0.69 **
IIHR-2858XIIHR-2864	0.39 **	4.53 **	2.83 **	-0.38 **	0.53 **	1.51 **
IIHR-2858XIIHR-2865	-0.38 **	-3.73 **	-2.33 **	-0.56 **	1.11 **	0.84 **
IIHR-2858XIIHR-2866	0.11 **	11.27 **	7.04 **	-0.12	1.14 **	0.37 **
IIHR-2860XIIHR-2863	-0.21 **	5.90 **	3.69 **	0.06	1.31 **	-0.26 **
IIHR-2860XIIHR-2864	-0.03	10.19 **	6.37 **	0.03	2.71 **	0.43 **
IIHR-2860XIIHR-2865	0.23 **	14.27 **	8.92 **	-0.1	0.16 **	-0.10 *
IIHR-2860XIIHR-2866	-0.08 *	-2.40 **	-1.50 **	-0.05	1.62 **	0.19 **
IIHR-2863XIIHR-2864	0.24 **	2.68 **	1.67 **	-0.31 *	-0.83 **	-0.25 **
IIHR-2863XIIHR-2865	0.30 **	4.42 **	2.76 **	-0.16	-1.18 **	0.25 **
IIHR-2863XIIHR-2866	0.16 **	15.08 **	9.43 **	-0.05	1.64 **	0.38 **
IIHR-2864XIIHR-2865	0.22 **	0.05 ns	0.03	0.14	-0.88 **	-0.06
IIHR-2864XIIHR2866	-0.06	-8.29 **	-5.18 **	0.25 *	-0.99 **	-0.53 **
IIHR-2865XIIHR-2866	-0.23 **	-0.55	-0.34	0.40 **	1.79 **	-0.26 **
SE ±	0.03	0.35	0.22	0.12	0.05	0.04
CD @ 5 %	0.06	0.06	0.43	0.23	0.1	0.09
CD @ 1 %	0.09	0.86	0.568	0.3	0.13	0.12

*-significant at 5 % , **- significant at 1 %

REFERENCES:

1) LENUCCI, M. S. CADINU, D. TAURINO, M. PIRO, G. DALESSANDRO, G., 2006. Antioxidant composition in cherry a high pigment tomato cultivars. *J. Agric. Food Chem*., **54**: 2606-2613.

2) ANONYMOUS, 2009, Cherry tomato nutritional information; USDA National Nutritional Database for Standard Reference

3) GRIFFING. B., 1956, Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.*, **9**: 463-493.

4) HANNAN. M. M, MANOSH. K. B, MOHAMMAD. B. A, MONZUR. H AND RAFIUL. I., 2007b. Combining ability analysis of yield and yield components in tomato (*Lycopersicum esculentum* Mill.). *Turk J. Bot*., **31:** 559-563.

5)PATIL. V. S., 2003, Studies on double crosses involving potential tomato hybrids. *M. Sc. (Agri.) Thesis*, Uni. Agric. Sci. Dharwad (India).

6) POOJA KAPUR VIDYASAGAR AND SANJAY CHADHA (2013), Combining ability and gene action studies over environments in bacterial wilt resistant tomato genotypes. *Veg. Sci*. 40 (2): 164-168

7) H. VIRUPANNAVAR, P.R. DHARMATTI, K.H. YASHAVANT KUMAR AND AJJAPPA SOGALAD (June, 2010), Combining ability studies on bacterial wilt resistance in tomato for processing qualities and yield. *The Asian Journal of Horticulture.* 5(1): 111-113

8) Sharma, D. and Sharma., H.R., 2010, Combining ability analysis for yield and other horticultural traits in tomato. Indian J. Hort. 67(3): 402-405

9) MALLANGOWDA, S., 2005, Studies on double crosses involving potential purple brinjal hybrids. *M. Sc. (Agri.) Thesis*, Uni. Agric. Sci. Dharwad (India).