



STUDIES ON COMBINING ABILITY FOR YIELD AND YIELD CONTRIBUTING TRAITS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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Abstract

Six high yielding diverse lines of tomato were crossed with three testers to study the combining ability effects for yield and yield contributing traits. The analysis of variance revealed the predominance of nonadditive gene action for most of the traits. Among the parents EC461070, EC461018 and MTM Local were the best general combiners for fruit yield and other characters under the study. Among the crosses EC 461070 x MTM Local is the best valuable combiner for yield and other characters.

Key words : Combining ability, pesticides and fungicides, disease resistant, tomato (*Lycopersicon esculentum* Mill.).

Introduction

Tomato (*Lycopersicon esculentum* Miller) is an important vegetable crop for the growers, consumer and processing industries. It is a rich source of vitamins A and C. The productivity of tomato in India is generally with 30-40 t/ha as compared to the higher productivity of 200-250 t/ha in the western countries. There is a demand for high yielding or hybrid varieties of tomato in the country. With ever increasing demand of tomato, it has become imperative to bring high yielding and pest and disease resistant varieties under cultivation to boost up production and minimizing the use of pesticides and fungicides. Combining ability analysis is an important technique to understand the genetic potential of parents and their hybrids. It also provides the information on gene effects to help us in formulating an effective breeding strategy. Considering this, an investigation was undertaken to identify the best parental combination for high yield.

Materials and Methods

Eighteen F₁ 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 EC461070, EC461018, EC461078, Arka Alok, PKM1 and Mukthi. Three testers were selected based on fruit borer (*Helicoverpa armigera*) resistance (MTM Local, EC-461035 and EC461057). The exotic genotypes were

introduced from AVRDC (Asian Vegetable Research and Development Centre), Taiwan. The hybrids along with parents were raised in randomized block design (RBD) with three replications. The study was carried out at Research Farm, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram. Well developed good quality seeds of nine parents and eighteen hybrids were sown in nursery. Twenty five days after sowing the seedlings were transplanted in the main field. The plot size was 1.8m × 3m. The seedlings were planted at a spacing of 60 cm × 60cm. The cultural and management practices were done as per "Package of practices recommendations" of Kerala Agricultural University (KAU, 1996). The observations recorded for seven traits *i.e.* plant height, number of branches, spread of the plant, number of days to first flowering, number of days to first fruit harvest, number of fruits per plant, weight of fruits per plant and weight of individual fruit. The combining ability estimates were calculated according to the method given by Griffing (1956).

Results and Discussion

The analysis of variance for line × tester (table 1) revealed highly significant variances due to lines and testers for all the characters under the study, which indicated the existence of substantial genetic diversity in the parents. The variances due to line × tester interactions,

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

Source	df	Mean square							
		Plant height (cm)	No. of branches	Spread of the plant (cm)	No. of days to first flowering	No. of days to first fruit harvest	No. of fruits per plant	Wt. of fruits per plant (g)	Weight of individual fruit (g)
Replication	2	37.13	22.21**	3.28	3.87	1.41	22.35	100632**	28.39
Treatments	26	543.95**	35.03**	309.70**	23.65**	139.69**	179.31**	162217**	710.6**
Parents	8	795.20**	46.94**	445.11**	24.05**	203.77**	264.42**	1574102**	776.99**
Crosses	17	450.45**	29.84**	250.34**	24.51**	102.77**	149.34**	179474**	710.11*
Parent Vs cross	1	123.33*	27.97**	235.64**	5.70	263.27**	7.94	353760*	178.95**
Lines (Female parents)	5	802.86*	72.62**	741.23**	23.73	47.98	173.00	1510304	340.46
Testers (Male parents)	10	1091.53*	24.98	64.63	20.59	341.58*	182.69	5579444*	4235.28**
Lines x Testers	10	146.03**	9.42**	42.03**	25.69**	81.55**	130.84**	1052.005**	189.9**
Error	52	22.89	1.80	15.31	4.10	2.94	20.17	81000.93	12.78

**Singnificant at 1% level , *significant at 5 % level.

Table 2 : GCA effects of lines and testers.

	Plant height (cm)	No. of branches	Spread of the plant (cm)	No. of days to first flowering	No. of days to first fruit harvest	No. of fruits per plant	Wt. of fruits per plant (g)	Weight of individual fruit (g)
Lines								
EC-461070	16.58**	4.97**	12.00**	-0.068	2.7**	5.38**	555.45**	3.97**
EC-461018	1.19	-2.65**	-2.5	-3.12**	-1.25*	4.82**	466.95**	10.65**
EC-461078	-10.34**	-2.40**	-15.66**	1.59*	-2.22**	-3.43*	-265.922**	-2.71*
Arka Alok	-0.41	1.25**	4.02**	0.36	2.65**	-4.18**	-322.59**	-2.06
Pkm-1	-7.87**	-5.93**	1.72	0.54	1.82**	1.08	-69.33	-5.07**
Mukthi	0.84	-1.12*	0.33	0.17	1.59	-3.67*	-364.56**	-4.84**
SE	1.59	0.45	1.30	0.67	0.57	1.50	94.87	1.16
Testers MTM Local	6.82**	1.22**	1.24	-0.64	4.79**	3.52**	580.31**	11.80**
EC-461035	1.67	-0.10	0.94	-0.60	-1.08**	-2.68*	-50.55	5.546**
EC-461057	-8.49**	-1.13**	-2.18*	1.23	-3.72**	-0.84	-529.77**	-17.34**
SE	1.13	0.32	0.92	0.48	0.40	1.06	67.08	0.82

**Singnificant at 1% level, *significant at 5 % level.

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 summery 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 traits number of days to first flowering and number of days to first fruit harvest. An over all appraisal of *gca* effects revealed that, among parents EC 461070 emerged out as good general combiner for plant height, number of branches, spread of the plant, number of branches, spread

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

Hybrids	Plant height (cm)	Number of branches	Spread of the plant (cm)	No. of days to first flowering	No. of days to first fruit harvest	Number of fruits per plant	Weight of fruits per plant (g)	Weight of individual fruit (g)
1 EC461070 x MTM Local	12.607**	2.809**	6.755**	-1.013	1.161	13.077**	1127.195**	7.760**
2 EC461018 x MTM Local	-3.849	0.098	0.019	-1.398	5.217**	-3.889	-64.069	1.446
3 EC461078 x MTM Local	-0.392	-0.913	0.695	1.390	0.383	0.525	-179.866	-4856*
4 Arka Alok x MTM Local	-5.743*	0.998	-1.411	-1.162	1.517	-3.823	-400.814*	-4.360*
5 PKM -1 x MTM Local	-3.581	-1.391	-2.903	-1.283	-5.717**	0.111	25.256	3.247
6 Mukthi x MTM Local	-5.776*	-1.602*	-3.156	3.467**	-2.561*	-6.001*	-507.702**	-3.237
7 EC-461070x EC-461035	-3.581	-0.635	-4.084	2.493*	2.467*	-3.821	-457.84**	-4.374*
8 EC-461018x EC-461035	2.091	1.520	3.923	-3.448**	-2.911**	4.079	430.875*	5.915**
9 EC-461078x EC-461035	-3.643	-0.491	-0.771	0.637	-2.478*	2.117	180.828	2.016
10 Arka Alok x EC-461035	6.666*	-0.446	0.623	-0.549	-1.478	0.779	168.394	5.527**
11 PKM 1 x EC-461035	-0.247	0.098	0.494	0.680	-2.844**	-4.288	-539.803**	-14.074**
12 Mukthi x EC-461035	-1.286	-0.046	-0.185	0.187	7.244**	1.134	217.519	4.989*
13 EC-461070x EC-461057	-9.026**	-2.174**	-2.671	-1.480	-3.628**	-9.256**	-669.381**	-3.387
14 EC-461018x EC-461057	1.758	-1.619*	-3.943	4.846**	-2.306*	-0.189	-366.806**	-7.361**
15 EC-461078x EC-461057	4.035	1.404	0.076	-2.027	2.094*	-2.642	-0.962	2.840
16 Arka Alok x EC-461057	-0.923	-0.552	0.787	1.711	-0.039	3.044	232.420	-1.167
17 PKM -1 x EC-461057	-2.906	1.293	2.408	0.603	8.561**	4.177	514.547**	10.827**
18 Mukthi x EC-461057	7.062*	1.648*	3.342	-3.653**	-4.683**	4.866	290.182	-1.751
SE	2.76	0.77	2.26	1.17	0.99	2.57	164.32	2.01

** Significant at 1% level, * Significant at 5% level.

of the plant, number of fruits per plant, weight of fruits per plant and weight of individual fruit. Whereas, line EC461018 traced out good general combiner for number of days to first flowering, number of days to first fruit harvest, number of fruits per plant, weight of fruits per plant, weight of individual fruit and EC461078 for number of days to first fruit harvest. Among the parents Arka Alok was found to be good general combiner for number of branches per plant and spread of the plant. Male parent MTM Local for plant height, number of branches, number of fruits per plant, weight of individual fruit, while EC461035 for numbers of days to first fruit harvest and weight of individual fruit as well as EC 461057 for number of days to first fruit harvest.

Specific combining ability is the manifestation of nonadditive component of genetic variance and associated with interaction effects, which may be due to dominance and epistatic component of genetic variation that are nonfixable in nature, such nonfixable components are potential parameters for heterosis breeding, which is very much useful in tomato where commercial exploitation of heterosis is feasible. In the case of *sca* effects, none of the hybrids exhibited favourable *sca* effect for all the characters (table 3). Significant *sca* effects in favourable direction as observed in many crosses for plant height (3 crosses), number of branches (2), spread of the plant (1), number of days to first flowering (2), number of days to first fruit harvest (8), number of fruits per plant (1), weight of fruits per plant (3) and weight of individual fruit (5). This result getting support from the findings of Saleem *et al.* (2009), Singh *et al.* (2010) and Ravindra Kumar *et al.* (2013).

The magnitude of *sca* effects having a vital importance in selecting

the cross combinations with higher probability of obtaining desirable transgressive segregants. The range of *sca* effects for total yield per plant varied from 669.88 (EC461070 × EC461057) to 1127.195 (EC461070 × MTM Local). Nine hybrids showed significant *sca* effects, of which three hybrids attributed towards positive direction for total yield per plant. Out of eighteen crosses, the best three specific crosses were EC461070 × MTM Local, PKM × EC-462057 and EC-461018 × EC461035.

The best specific combination for total yield per plant *viz.*, EC461070 × MTM Local recorded the desirable significant *sca* effects for traits of plant height, number of branches, spread of the plant, number of fruits per plant and weight of individual fruit. The second best cross *i.e.*, PKM-1 × EC461057 had desirable significant *sca* effects for weight of individual fruit. Whereas, the third best cross EC461018 × EC461035 had significant *sca* effects for number of days to first flowering, number of days to first fruit harvest and individual fruit weight.

In the present study, the combining ability analysis revealed significant *gca* variance for most of the characters. The lines *viz.*, EC461070, EC461018 and tester MTM Local were good general combiners for fruit yield and possess additive genes for fruit yield and other yield contributing traits.

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References

- Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel system. *Aust. J. Bio. Sci.*, **9** : 463-493.
- KAU (1996). Package of Practices Recommendations. Directorate of Extension, Kerala Agricultural University, Thrissur, p. 267.
- Ravindra Kumar, K. Srivastava, Norang Pal Singh, N. K. Vasistha, R. K. Singh and M. K. Singh (2013). Combining ability analysis for yield and quality traits in tomato (*Solanum lycopersicum* L.). *J. Agri. Sci.*, **5(2)** : 213 - 218.
- Saleem, M. Y., M. Asghar, M. H. Ahsancel, T. Rafique, A. Kamaran, and A. A. Khan (2009). Genetic analysis to identify suitable parents for hybrid seed production in tomato (*Lycopersicon esculentum* Mill.). *Pakistan J. Biol.*, **41(3)** : 1107-1116.
- Singh, S. P., M. C. Thakur and N. K. Pathania (2010). Reciprocal cross differences and combining ability studies for some quantitative traits in tomato (*Lycopersicon esculentum* Mill.) under mid hill conditions of western Himalayas. *Asian J. Hort.*, **5(1)** : 172-176.