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Combining Ability for Quantitative Characters in Tomato (*Lycopersicon esculentum* Mill.)*

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Combing ability analysis was carried out in tomato (*Lycopersicon esculentum* Mill.) in a 9X9 diallel crosses including nine parents and 36 F_1 hybrids, excluding the reciprocals. The mean squares of general combining ability (g.c.a.) were higher than that of specific combining ability (s.c.a.) for all the characters studied except for number of primary branches. The parent Pusa Ruby had the maximum positive g.c.a. effect for early yield and highest negative g.c.a. effect for days to fruit ripening. The parent Sl. 120 had maximum negative g.c.a. effect for days to flowering. The parents Marglobe, Roma and Pusa Early Dwarf showed maximum positive g.c.a. effects for total yield, number of fruits per plant and average weight of fruit, respectively. The cross Momor X Pusa, Early Dwarf, gave the highest positive s.c.a. effect for total yield. In general, it was observed that good general combiners for trait also had good *perse* performance and the crosses showing high s.c.a. effects had atleast one of the parents having high g.c.a.

In tomotoes (*Lycopersicon esculentum* Mill.) variability with regard to yield and its components is yet to be adequately studied although some information is available on certain aspects of yield and its components from the work of Larson (1941), Burdik (1954), Theodore and Lana (1957), Corbeil and Buttler (1965), Betlach and Novak (1970) and Khalf-Allah (1970). Since information on some of the components is useful in adopting suitable breeding methodology, a study was undertaken to analyse the combining ability of nine genetically diverse inbred lines of tomato (from India and France) using diallel cross technique and to characterise the genetic architecture of the population so as to formulate efficient breeding procedures for effecting yield improvement.

MATERIALS AND METHODS

The experimental material consisted of nine inbred lines of tomatoes viz., Peru, Mobaci, Momor, B_{2241}, Pusa Early Dwarf, Sl. 120, Roma, Marglobe and Pusa Ruby and their 9x9 non reciprocal diallel set of crosses. The nine parental lines and their 36 F_1 hybrids were grown during Summer 1972, at the Horticultural Research Centre, Pantnagar, in a Randomised Block Design with three replications. The spacing adopted was 100 cm x 50 cm. Five plants were selected at random in each

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replication for recording the observations. Observations were recorded on days taken from transplanting to first flowering and first fruit ripening, number of primary branches per plant, early and total fruit yield per plant, total number of fruits per plant and average weight of fruit. Six pickings were taken for calculating total yield and total number of fruits per plant. The first three pickings were considered for early yield. Combining ability analysis was carried out according to Model-1, Method-2 of Griffing (1956).

RESULTS AND DISCUSSION

The analysis of variance showed significant differences between all the progenies and the results of analysis of variance for general and specific combining ability are given in Table I. All the characters studied had highly significant variances both for general and specific combining ability suggesting the importance of both additive and nonadditive type of gene action. Similar results have been reported by Tayel *et al.* (1959) for earliness, Gilbert(1961) for total yield, Corbeil and Buttler (1965) for maturity, Peat and Whittington (1965) for flowering and total yield. Kolhe (1970) reported that in tomato fruit number is controlled by additive type of gene action. The mean squares of g c. a. were invariably higher than that of s.c.a. (Table I) in all the characters studied except in number of primary branches per plant. Thus, in general the additive type of gene action appeared to play a greater role for all the characters studied except for the number of primary branches per plant.

The parent Pusa Ruby had the maximum g.c a. effects for early fruit yield per plant while Roma showed the highest g.c.a. for number of fruits per plant. The parent Pusa Early Dwarf had the highest g c.a. effect for average weight of fruit. None of the parents had the significant negative g.c.a. effect for days taken to flowering and fruit ripening and number of primary branches per plant. However, parent Sl.120

TABLE I. Analysis of variance table for combining ability

Source of variation	D.F.	Mean Squares						
		Days to first flowering	Days to first fruit ripening	No. of primary branches/plant	Early fruit yield/plant	Total fruit yield/plant	No. of fruits/plant	Average weight of fruit
Replications	2	9.43*	4.27	93.40**	8102.00	0.001	113.41	756.00**
Treatments	44	8.97**	12.40**	12.22**	165946.00**	0.3613**	897.30**	279.00**
Error	88	2.17	2.50	3.25	53388.00	0.0885	193.30	58.00
G.C.A.	8	3.37**	5.97**	3.40**	165983.00**	0.177**	735.44**	280.80**
S.C.A.	36	2.90**	3.66**	3.89**	31268.00**	0.107*	201.52**	51.80**
Error	88	0.72	0.83	1.08	17796.00	0.029	64.10	19.30

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

had the highest non significant negative g.c.a. effect for flowering, Pusa Ruby for fruit ripening and Sl. 120 for number of primary branches per plant. None of the parents showed significant positive g c.a. effect for total fruit per plant. The parent Marglobe had the highest g.c.a. for total fruit yield per plant. The parent Pusa Ruby was the second best general combiner for total fruit yield per plant.

Amongst the crosses, ten crosses had significant s.c.a. effects for early flowering. The cross Mobaci X Sl. 120 had maximum negative effect while Momor X Roma had minimum. For days to fruit ripening, seven crosses had significant negative s.c.a. effects. The highest estimate was shown by Peru$_2$ X Pusa Ruby. Seven hybrids showed significant positive s.c a. effects for number of primary branches, the maximum and minimum being observed in crosses Sl. 120 X Roma and Momor X Marglobe, respectively. Five hybrids showed significant negative s.c.a. effcts (less number) for number of primary branches per plant. The maximum and minimum were observed in crosses Pusa Early Dwarf X Sl. 120 and Peru$_2$ X Momor, respectively. The negative s.c a. effect observed for the above character would perhaps be useful since it is in the direction needed by the breeder (i.e. suitable for high level of plant population). Three hybrids expressed significant positive s c.a. effects for early fruit yield. The maximum and minimum were observed in crosses Peru$_2$ X Roma and Momor X Pusa Early Dwarf, respectively. In six out of 36 crosses, significant positive s c a. effects were observed for total fruit yield. The s.c.a. effects were highest in the crosses Momor X Pusa Early Dwarf and Momor X Marglobe and lowest in the cross Sl. 120 X Roma. The differences between them were, however, not significant. The s.c a. effects were significant in five F_1 hybrids for number of fruits per plant, the maximum being in Momor X Marglope and minimum being in Peru$_2$ X Pusa Early Dwarf. Five crosses showed significant s c. a. effects for more average weight of fruit, the maximum and minimum being observed in crosses Mobaci X Pusa Ruby and Pusa Early Dwarf X Pusa Ruby, respectively.

In the presence of considerable additive genetic variance, the parents possessing a built in genetic potential for superior performance in hybrids may be selected on the basis of g.c.a. effect. It is interesting to note that the superior crosses for different characters generally involved one of the superior parents for that particular character (Table II). However, the parents associated with good g.c a. effects for a particular character may not necessarily express high specific combining ability for that particular character. It may be concluded that the best parents generally do not make best crosses. Thus, the general combining ability of the parents cannot be predictive Larson (1941) also obtained almost similar results while studying the yield characters of tomato where he found that none of the parents of the highest yielding cross were high in productivity. Heterosis breeding may be taken up for the character, number of primary branches, in which non-additive gene action plays an important role. For the remain-

TABLE II. Best parent, best F_1 and best general combining parent and the best specific cross combination for different characters

Charact	Best parent	Best F_1	Best general combiner	Best specific cross combination
Days to first flowering	Sl. 120, Pusa Ruby	Sl. 120 X Pusa Ruby, Mobaci X Sl. 120	Sl. 120	Mobaci X Sl. 120
Days to first fruit ripening	Pusa Ruby B_{2217}	B_{2217} X Pusa Ruby	Pusa Ruby	$Peru_2$ X Pusa Ruby
No. of primary branches per plant	Marglobe	Pusa Early Dwarf X Sl. 120	Sl. 120	Pusa Early Dwarf X Sl. 120
Early fruit yield/plant	Pusa Ruby	Momor X Pusa Early Dwarf	Pusa Ruby	$Peru_2$ X Roma
Total fruit yield/plant	Pusa Ruby	Momor X Pusa Early Dwarf	Marglobe, Pusa Ruby	Momor X Marglobe, Momor X Pusa Early Dwarf
No. of fruits/plant	B_{2217}	Momor X Roma	Roma	Momor X Marglobe
Average weight of fruit	Pusa Early Dwarf	Pusa Early Dwarf X Pusa Ruby	Pusa Early Dwarf	Mobaci X Pusa Ruby

ing characters, barring certain specific combinations, possibility of development of superior hybrids from the present set of materials is not very high. Selection could, however, be practised with satisfactory response to selection within parents or in segregating generation to exploit additive genetic variance.

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