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COMBINING ABILITY OF QUANTITATIVE CHARACTERS IN BRINJAL (*SOLANUM MELONGENA* L.)

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Summary

Combining ability effects were estimated for different characters in a diallel crossing programme comprising 36 crosses developed using 10 parental lines in all possible combinations excluding reciprocals. Parents and crosses differed significantly for *gca* and *sca* effects. On the basis of *gca* and *sca* variances, most of the characters under study indicated the predominance of additive gene action. The parents, CH-190, and CH-586 were good general combiner for fruit breadth and number of branches per plant. Swarna Shree, CH-586, CH-757 and CH-190 were found best general combiner for most of the yield contributing characters. Crosses namely, CH-757 x CH-792, CH-190 x CH-792 and CH-792 x BL-22 have been found superior on the basis of *sca* value and *per se* performance, which may be evaluated for further promotion.

सारांश

१० पिट्रो को समाहित कर ३६ डायललल संकर बनाकर उनकी संयोजन क्षमता का विभिन्न गुणों के लिए अध्ययन किया गया। पिट्रो एवं संकरों में सामान्य संयोजन क्षमता एवं विशिष्ट संयोजन क्षमता के लिए सार्थक विभिन्नता पायी गई। ज्यादातर गुणों के लिए योज्य जीन प्रभावी पाये गये। पिट्र सी. एच. १९० एवं सी. एच. ५८६ फल की मोटाई तथा प्रति पौध शाखाओं की संख्या की दृष्टि से अच्छे सामान्य संयोजक थे। स्वर्णश्री, सी. एच. ५८६, सी. एच. ७५७ और सी. एच. १९० ज्यादातर गुणों के लिए अच्छे सामान्य संयोजक पाये गये। संकर सी. एच. ७५७ x सी. एच. ७९२, सी. एच. १९० x सी. एच. ७९२ और सी. एच. ७९२ x बी. एल. २२ ज्यादातर गुणों के लिए विशिष्ट संयोजक साबित हुए।

Introduction

Brinjal (*Solanum melongena* L.) is one of the most important and widely consumed vegetable crops of India, which can be grown through out the year. This crop exhibits rich genetic diversity for various horticultural traits and has a great scope for its improvement. In brinjal, yield is complex quantitative character and influenced by its contributing traits, i.e., average fruit weight, length, breadth and plant vigour. The selection of parents on the basis of *per se* performance does not necessarily lead to desirable results. The knowledge of combining ability is prerequisite in any plant breeding programme for varietal improvement and for evolving a hybrid. Hence, attempts have been made to study the general combining ability and specific combining ability effects for quantitative traits in brinjal.

Materials and Methods

The present investigation was conducted during kharif season, 2001-2002 at experimental farm of Horticulture and Agro-Forestry Research Programme, Ranchi. Nine diverse genotypes of brinjal, namely, Swarna

Shree (P₁), CH-190 (P₂), CH-586 (P₃), CH-757 (P₄), CH-792 (P₅), BL-3 (P₆), BL-5 (P₇), BL-9 (P₈) and BL-22 (P₉) were crossed in all possible combinations excluding reciprocals. The seeds of 36 F₁s along with their 9 parents were sown in the nursery on July 10, 2001. The seedlings were transplanted on August 8, 2001 in randomized block design at a spacing of 60 x 45 cm with three replications. Standard cultural practices were followed to raise the normal crop. Data were recorded on 10 randomly selected plants in each treatment over replications for 8 characters viz., yield (q/ha), average fruit weight (g), fruit length (cm), fruit breadth (cm), fruit firmness (kg/cm²), days to first flowering, number of branches per plant and plant height (cm). Data were averaged and subjected to statistical analysis. The combining ability estimates were calculated according to method 2 and Model I of Griffing (1956).

Results and Discussion

The analysis of variance for *gca*, *sca* and their ratios are presented in table-I. The mean square due to general and specific combining ability were highly significant for all the characters indicating the impor-

Table 1. Analysis of variance (mean square) for combining ability

Source	df	Yield	Fruit weight	Fruit length	Fruit breadth	Fruit firmness	Days to first flowering	Number of branches	Plant height
<i>gca</i>	8	85911.06**	2600.65**	3.53**	1.64**	1.83**	16.57**	1.04**	274.17**
<i>sca</i>	36	50462.34**	1934.42**	3.45**	1.71**	1.21**	28.36**	0.64**	150.67**
Error	88	7038.06	405.21	0.32	0.13	0.26	3.27	0.14	39.64

** Significant at 1% probability level

tance of additive genetic components in the inheritance of all the characters. The higher magnitude of *gca* variance compared to *sca* variance indicating the predominance of additive type of gene action in the expression of all the characters except fruit breadth and days to first flowering. Similar results were also reported by Singh *et al.* (2002) Ingale and Patil (1997) and Kumar and Ram (1987).

Estimates of general combining ability effects are given in table-2. Among the nine parental lines, the parent Swarna Shree exhibited highly significant *gca* estimates for fruit breadth and fruit length. The parent CH-190 showed highest *gca* effects and was a good general combiner for fruit breadth and number of branches. CH-586 exhibited highest *gca* effects for yield, fruit length, average fruit weight, fruit breadth, number of branches and plant height whereas negative *gca* effects for days to first flowering. CH-757 has significant higher *gca* effects for yield, average fruit weight, fruit length, fruit breadth and fruit firmness. The parent CH-792 has significant *gca* effects for fruit firmness. Parent BL-3 was best general combiner for fruit length, while BL-5 was best for fruit firmness. The parent BL-22 was the best general combiner for number of branches. Further, for most of the characters, there was a close agreement between the ranking on the basis of the *gca* and the *per se* performance of the parents, but such agreement did not exist for plant height and number of branches. There-

fore, both *gca* effects and *per se* performance should be taken together for assessing true breeding potential. Similar results were also reported by Ingale and Patil (1997) and Rashit *et al.* (1988).

The estimates of *sca* effects are given in Table-3. The numbers of crosses having desirable significant estimates were 11 for yield, 5 for average fruit weight, 9 for fruit length, 11 for fruit breadth, 4 for fruit firmness, 6 for days to first flowering, 2 for number of branches and 5 for plant height. The three best performing crosses showing highest *sca* effects in order of merit were CH-757 x CH-792, CH-190 x CH-792 and CH-792 x BL-22 for yield, CH-190 x CH-792, SS x CH-757 and CH-190 x CH-757 for average fruit weight, SS x BL-5, SS x BL-9 and CH-586 x BL-22 for fruit length, CH-792 x BL-22, CH-190 x CH-792 and SS x CH-752 for fruit breadth, BL-3 x BL-9, SS x CH-792 and CH-586 x BL-5 for fruit firmness, CH-757 x CH-792, BL-3 x BL-22 and CH-90 x CH-792 for number of branches and SS x BL-9, BL-5 x BL-22 and CH-752 x BL-5 for plant height, whereas highest negative *sca* effects for days to first flowering were in CH-190 x CH-792, SS x CH-792, SS x BL-9. It is clear from the result obtained that in majority of the crosses which showed the best *sca* effects, having atleast one of the 3 most outstanding parental lines namely, Swarna Shree, CH-190 and CH-757, which have high *gca* effects for one or more for the yield contributing characters. Such observation has also

Table 2. Estimates of general combining ability effects for different characters

Character / Parent	Yield	Fruit weight	Fruit length	Fruit breadth	Fruit firmness	Days to first flowering	Number of branches	Plant height
Swarna Shree	-177.20**	5.08	0.50*	0.44**	0.22	-1.10	0.05	-5.03*
CH-190	-46.12	-0.05	0.01	0.28*	-0.42*	1.03	0.27*	2.28
CH-586	70.04*	27.00**	0.46*	0.43**	-0.29	-1.27*	0.33*	5.58*
CH-757	136.69**	20.38**	0.86**	0.37**	0.40*	1.67*	-0.10	-0.72
CH-792	37.55	-21.68**	-0.49*	-0.60**	1.63**	1.61*	-0.42**	-5.15*
BL-3	-27.74	-8.07	0.55**	-0.30*	-0.24	0.90	-0.05	-4.79*
BL-5	-38.32	-8.09	0.25	-0.14	0.60*	0.69	-0.48**	-5.49*
BL-9	21.46	-10.01	-0.79**	-0.15	-0.37*	0.75	0.01	-4.07*
BL-22	20.63	-4.55	0.36	-0.34**	-0.12	-0.96	0.39**	6.41
SE (gi)	23.84	5.72	0.16	0.10	0.14	0.51	0.10	1.79

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

Table 3. Estimates of specific combining ability effects for different characters

Character / Parent	Yield	Fruit weight	Fruit length	Fruit breadth	Fruit firmness	Days to first flowering	Number of branches	Plant height
Swarna Shree x CH-190	-104.93	-1.02	-0.43	1.15**	-0.12	0.29	0.06	-4.77
Swarna Shree x CH-586	-287.75**	-22.24	-1.46**	-0.44	-0.29	10.72**	-0.83**	5.10
Swarna Shree x CH-757	11.30	71.88**	2.00**	1.57	0.40	4.74**	0.26	-11.18
Swarna Shree x CH-792	10.98	13.43	-3.42**	0.40	1.63**	-6.49**	-0.16	8.66
Swarna Shree x BL-3	37.59	-58.54**	1.85**	-5.56**	-0.24	3.62*	-0.71*	1.45
Swarna Shree x BL-5	39.53	8.53	2.77**	-0.20	0.60	0.16	0.47	-21.56**
Swarna Shree x BL-9	83.03	13.24	2.45**	-0.85**	-0.37	-5.63**	0.41	22.42**
Swarna Shree x BL-22	157.94*	25.88	-1.90**	-0.18	-0.12	-2.78	-0.06	-5.23
CH-190 x CH-586	-136.12	-17.11	0.74	-0.79**	0.08	0.20	0.37	7.20
CH-190 x CH-757	257.69**	69.67**	0.61	1.30**	-0.16	-0.53	-0.29	10.84
CH-190 x CH-792	421.40**	75.32**	1.99**	1.83**	-0.14	-10.15**	0.78*	-1.73
CH-190 x BL-3	70.81	-26.72	-0.90	-0.05	0.32	-1.64	0.74*	8.16
CH-190 x BL-5	-113.80	-68.03**	-0.27	-2.05**	-1.23**	1.84	-0.16	-16.03**
CH-190 x BL-9	120.57	-3.68	-1.34**	0.49	-0.30	-2.82	0.69*	-13.65**
CH-190 x BL-22	89.72	-48.32**	0.62	-1.63**	-0.50	0.23	-0.20	7.79
CH-586 x CH-757	142.61	-7.04	-0.71	-0.42	-0.56	-2.37	-0.91**	6.87
CH-586 x CH-792	-281.52**	-32.98	-2.65**	0.18	-1.28**	5.61**	0.40	6.30
CH-586 x BL-3	181.82**	10.08	-1.54**	0.65*	-0.40	-4.88**	0.35	9.02
CH-586 x BL-5	145.16	21.85	-0.11	0.34	1.18**	0.73	-0.05	14.91**
CH-586 x BL-9	328.93**	-66.15**	2.15**	-2.42**	0.09	-0.26	0.64	4.80
CH-586 x BL-22	239.44**	26.91	2.16**	0.27	0.62	0.19	-0.08	1.99
CH-757 x CH-792	424.03**	-1.44	1.09**	-0.36	0.97*	1.69	0.99**	1.44
CH-757 x BL-3	-213.88**	-26.63	-2.45**	-0.89**	-2.01**	12.06**	-1.89**	-3.09
CH-757 x BL-5	245.89**	34.05	0.94	1.20**	0.81	-1.46	0.38	19.09**
CH-757 x BL-9	-65.39	16.98	0.59	0.85**	-0.06	0.01	0.40	-1.64
CH-757 x BL-22	13.85	-70.65**	1.33**	-2.09**	-0.77	0.60	-0.08	-22.20**
CH-792 x BL-3	-99.94	47.98	-0.08	0.90**	-1.91**	-1.42	0.60	5.67
CH-792 x BL-5	-162.87	-7.89	-1.48**	0.01	-1.86**	6.99**	-1.30**	-10.27
CH-792 x BL-9	-172.87*	-30.97	-2.07**	-0.49	-0.29	8.60**	-1.61**	1.95
CH-792 x BL-22	345.70**	53.07**	-1.13**	2.00**	-0.31	-5.22**	0.01	-15.86**
BL-3 x BL-5	220.71**	-3.29	-0.66	-0.08	-1.33**	0.63	-0.68*	-0.72
BL-3 x BL-9	158.23*	36.12*	-0.96	1.02**	3.28**	-2.30	0.35	-7.49
BL-3 x BL-22	-114.31	17.74	-0.09	0.65*	0.48	-1.98	0.95**	10.03
BL-5 x BL-9	-163.24*	-26.22	-2.22**	1.05**	0.43	7.85**	-1.56**	-12.02*
BL-5 x BL-22	-219.28**	-9.52	-2.29**	0.29	0.82	-2.04	0.05	21.92
BL-9 x BL-22	-206.14**	-33.09	0.33	-0.84**	-0.42	7.24**	-0.09	-2.94
SE (Sij)	76.72	18.41	0.51	0.32	0.46	1.65	0.34	5.76

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

been made by Varshney *et al.* (1999) Ponnuswami and Irulappan (1992) and Singh and Kumar (1988). For assessing the superiority of a hybrid generally its *sca* effects and *per se* performance should be taken into account. In the present study, it was clear that there was a close correspondence between *sca* effects and the *per se* performance for most of the economic characters. It was also evident that best cross combination for most of the characters generally involved one good and one poor general combiner with high *sca* effects may be due to a complementary type of

gene action which can be fixed to a great extent in the segregating generations, whereas crosses with high *sca* effects which involved poor x poor combiners, may be utilized for exploitation of hybrid as the non additive, non fixable genes seems to play a greater role.

Parents like Swarna Shree, CH-792 and CH-190 in general were proved to be good general combiners for most of the yield contributing characters. Among combinations based on the *sca* values and F_1 *per se* performance the hybrid namely, CH-757 x CH-792,

CH-190 x CH-792 and CH-792 x BL-22 has been found superior and these combination can be tested for promotion of F₁ hybrids in brinjal.

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