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**AR Khanzode**  
PG Student, College of  
Agriculture, GHRU  
Saikheda, Madhya Pradesh,  
India

**Dr. Kevin Gawli**  
Dean, College of Agriculture,  
GHRU Saikheda, Madhya  
Pradesh, India

**A Nagmote**  
HOD, Agricultural Botany  
Section, College of Agriculture,  
GHRU, Saikheda, Madhya  
Pradesh, India

**SA Yelore**  
Assistant Professor, College of  
Agriculture, Konghara, Madhya  
Pradesh, India

**Corresponding Author:**  
**AR Khanzode**  
PG Student, College of  
Agriculture, GHRU  
Saikheda, Madhya Pradesh,  
India

## Combining ability for fruit yield and its components in brinjal (*Solanum melongena* L.)

**AR Khanzode, Dr. Kevin Gawli, A Nagmote and SA Yelore**

### Abstract

The means squares due to general combining ability and specific combining ability were significant for all the characters and means squares due to reciprocal combining ability significant for all the characters except days to 50% flowering and fruit girth. Kirti, Daftri and Simran are the parents were identified as good general combiner for yield and other yield contributing characters. These genotypes were may be recommended for their use in the crossing programme or for developing gene pool. High mean performance, significant useful heterosis, in desirable direction and positive significance SCA/RCA effect were considered as the criteria for selection of potential crosses. Based on above criteria the crosses Harsh X Daftri, Daftri X Kirti, Daftri X Harsh and Harsh X Kelwangi were identified to exhibit high mean, significant positive heterosis over both the checks and significant positive combining ability for grain yield plant-1 and other yield contributing characters.

**Keywords:** Brinjal, combining ability, yield, GCA, SCA

### Introduction

Brinjal, *Solanum melongena* L. (2n=24), also known as aubergine or eggplant, is an important solanaceous vegetable crop in many countries. According to De Candolle (1883) [2], eggplant was known in India in ancient times and probably a native of India (Vavilov, 1928) [7]. It is believed that eggplant may have originated in Indo Burma and China may be the secondary centre of origin. The first record of eggplant in Europe was in the fifteenth century, the name was probably derived from the white egg like fruits. Brinjal is one of the major vegetable crops grown everywhere in India except the higher areas. Though it is a self-pollinated crop, yet cross pollination to the extent of 30 to 40 % has also been reported in Bulgaria (Daskalov and Murtazo, 1957) [1]. This shows a tremendous potential for heterosis breeding. Brinjal is the most widely grown vegetable crop in Asian countries, especially in India, China, Philippines and Japan. The development of an effective heterosis breeding programme in brinjal needs to elucidate the genetic nature and magnitude of quantitatively inherited traits and judge the potentiality of parents in hybrid combinations. Selection of parents for hybridization has to be based on the complete genetic information and prepotency of the potential parents. Identification and selection of flexible parental lines are required to be used in any hybridisation programme to produce genetically modified and potentially rewarding germplasm by assembling fixable gene effects more or less in a homozygous line (Pedapati *et al.*, 2013, Kumar *et al.*, 2013, Singh *et al.*, 2013 and Potla *et al.*, 2013) [4, 6, 5]. With these points in view, heterosis and combining ability studies are prerequisite in any plant breeding programme, which provides the desired information regarding the varietal improvement or exploiting heterosis for commercial purposes (Singh *et al.*, 2013) [6]. The knowledge of gene action and combining ability helps in proper understanding of inheritance of characters in selection of suitable parents for hybridization programme and for obtaining desirable sergeants. Brinjal being in the preliminary stage of breeding, information on good combiner is lacking, therefore, the present investigation was undertaken to identify the potential combinations in order to have superior hybrids of excellent qualities coupled with high yields and nature of gene action for various characters in brinjal.

## Materials and Methods

The research work “Combining ability for yield and its component traits in brinjal” was conducted during *rabi* 2022 at Experiment will be conducted at department of genetics and plant breeding School of agricultural Science, Saikheda. During *rabi* 2022, 30 crosses were obtained by crossing 6 parental inbred line in full diallel mating design. Crossed seeds of these 30 crosses along with 6 parents and check were planted in randomized block design with 3 replications in *kharif* 2023 for evaluation. The recommended cultural practices were followed to raise the healthy crop.

## Results and Discussion

### Combining ability

Combining ability effects (GCA, SCA and RCA effect) were estimated and results obtained are presented in table 1.

### 1. Days to 50% flowering

The parents Harsh (2.29) and Radhika (1.29) had significant positive GCA effect for days to 50% flowering and found to be good combiner for developing early maturing hybrid.

For days to 50% flowering positive significant SCA effects is desirable. Out of fifteen crosses, none of the cross exhibited positive significant SCA effect for days to 50% flowering.

The cross Daftri X Harsh (2.00) showed positive significant RCA effect for days to 50% flowering among all reciprocal cross.

### 2. Days to 1st flowering

Out of six parents, two parents showed positive significant GCA effects for days to 1st flowering and the parents *viz.*, Harsh (2.18) and Radhika (1.06) were observed as good combiner among the all parents.

Among fifteen direct crosses, none of the cross exhibited significant positive SCA effect for days to 1st flowering, whereas five crosses showed negative significant SCA effect.

Three crosses were recorded significant positive RCA effects for days to 1<sup>st</sup> flowering and the cross Daftri X Harsh (1.50) exhibited highest positive significant RCA effect followed by Simran X Harsh (1.25) and Radhika X Harsh (1.00).

### 3. Plant height (cm)

Among the six parents, only one parent Kirti (7.64) showed significant positive GCA effects indicated as good general combiner for plant height (cm) and Singh *et al.* (2009)<sup>[6]</sup> also got similar results in GCA effects for plant height (cm). Two crosses Daftri X Radhika (19.19) and Harsh X Kelwangi (12.16) showed positive significant SCA effects for plant height (cm) among 15 direct crosses.

For the plant height (cm), five reciprocal crosses *viz.*, Kirti X Harsh (15.8), Daftri X Kirti (10.6), Radhika X Kirti (10.00), Radhika X Daftri (9.47) and Kelwangi X Daftri (13.4) showed positive significant RCA effects. Highest value of RCA effect recorded by the cross Kirti X Harsh (15.8) followed by Kelwangi X Daftri (13.4)

### 4. Numbers of primary branches per plant

Three parents Harsh (1.63), Daftri (1.54) and Simran (1.21) showed positive significant general combining ability effects for days to maturity indicating that they may be good source of gene for earliness Two crosses *viz.*, Kelwangi X Harsh (5.50) and Simran X Radhika (6.25) showed positive significant RCA effects for days to maturity.

### 5. Numbers of flowers per inflorescence

The parents Harsh (2.35) and Radhika (1.35) had significant positive GCA effect for numbers of flowers per inflorescence and found to be good combiner for developing early maturing hybrid.

For numbers of flowers per inflorescence positive significant SCA effects is desirable. Out of fifteen crosses, none of the cross exhibited positive significant SCA effect for numbers of flowers per inflorescence. The cross Daftri X Harsh (2.15) showed positive significant RCA effect for numbers of flowers per inflorescence among all reciprocal cross.

### 6. Numbers of fruit per clusters

Out of six parents, two parents showed positive significant GCA effects no. of fruits per clusters and the parents *viz.*, Harsh (2.27) and Radhika (1.09) were observed as good combiner among the all parents.

Among fifteen direct crosses, none of the cross exhibited significant positive SCA effect for no. of fruits per clusters, whereas five crosses showed negative significant SCA effect. Three crosses were recorded significant positive RCA effects for no. of fruits per clusters and the cross Radhika X Harsh (1.58) exhibited highest positive significant RCA effect followed by Daftri x Harsh (1.57) and Kelwangi X Harsh (1.53).

### 7. Fruit length (cm)

For Fruit length (cm), parents Harsh (0.33) and Daftri (0.31) recorded significant and positive GCA effects indicated as good combiner. Two parents Radhika (-0.41) and Simran (-0.36) were found poor combiner for fruit length (cm).

Six crosses *viz.*, Harsh X Daftri (2.74), Harsh X Kelwangi (1.60), Kirti X Kelwangi (1.22), Daftri X Radhika (1.88), Simran X Kelwangi (1.31) and Daftri X Simran (0.86) exhibited positive significant SCA effect and identified as promising crosses for fruit length (cm) among the direct crosses.

Two crosses Kelwangi X Daftri (0.90) and Radhika X Kirti (0.68) exhibited positive significant RCA effect for fruit length (cm).

### 8. Fruit diameter

The parental line Kirti (28.98), Daftri (11.95) and Simran (8.49) seems to be best general combiner for fruit diameter as they exhibited positive significant GCA effect.

The most desirable and significant SCA effects were obtained for number of fruit diameter in the crosses *viz.*, Harsh X Daftri (108.44), Harsh X Radhika (37.38), Kirti X Daftri (37.86), Kirti X Kelwangi (29.50), Daftri X Simran (58.00), Daftri X Kelwangi (55.28), Radhika X Kelwangi (35.30). The cross Harsh X Daftri (108.44) found best specific combiner for fruit diameter.

Four crosses *viz.*, Kirti X Harsh (87.5), Radhika X Kirti (50.2), Daftri X Kirti (25.5) and Kelwangi X Radhika showed positive significant RCA effect. The cross Kirti X Harsh (87.5) exhibited highest positive RCA effect followed by Radhika X Kirti (50.2) for fruit diameter.

### 9. Fruit girth (cm)

Parent Kirti (0.50) recorded highly positive significant GCA effect among six parents which identified as good general combiner for fruit girth (cm).

Among the fifteen direct crosses, cross Harsh X Daftri (1.19) showed significant positive SCA effect and identified as best cross combination. None of the cross exhibited significant RCA effect among all 15 crosses

**Table 1a:** GCA effect of presents, SCA effect of crosses and RCA effect of reciprocals

Sr. No	Parents Crosses	Days to 50% flowering	Days to 1 <sup>st</sup> flowering	Plant height (cm)	No. of primary branches per plant	No. of flower per inflorescence	No. of fruit per cluster
	Parents						
1	Harsh	2.29**	2.18**	0.61	1.63**	2.35**	2.27**
2	Kirti	-2.33**	-1.74**	7.64**	-3.04**	-2.43**	-1.71**
3	Daftri	-0.58	-0.69**	-1.16	1.54*	-0.88	-0.65**
4	Radhika	1.29**	1.06**	-1.51	-0.13	1.35**	1.09**
5	Simran	-0.33	-0.53**	-2.71	1.21*	-0.32	-0.48**
6	Kelwangi	-0.33	-0.28	-2.87	-1.21*	-0.32	-0.27
	S.E. (gi)	0.29	0.18	1.60	0.59	0.31	0.18
<b>Direct Crosses</b>							
7	Harsh x Kirti	-2.12**	-2.51**	0.39	2.25	-2.22**	-2.47**
8	Harsh x Daftri	-1.37	-1.56*	0.75	-2.08	-1.39	-1.51*
9	Harsh x Radhika	-0.25	-0.31	8.33	-1.17	-0.35	-0.41
10	Harsh x Simran	0.38	0.03	-15.25**	-3.00	0.48	0.23
11	Harsh x Kelwangi	-1.87	-2.22**	12.16*	0.17	-1.89	-2.12**
12	Kirti x Daftri	1.75	0.11	5.92	1.83	1.85	0.10
13	Kirti x Radhika	-1.62	-1.89**	6.77	-1.00	-1.64	-1.88**
14	Kirti x Simran	0.00	-0.56	7.82	0.42	0.00	-0.66
15	Kirti x Kelwangi	-1.00	-1.56*	9.23	-2.67	-1.05	-1.59*
16	Daftri x Radhika	-0.87	-0.68	19.19**	-2.08	-0.67	-0.67
17	Daftri x Simran	-2.50*	-1.85**	6.91	-3.17	-2.59*	-1.75**
18	Daftri x Kelwangi	-1.00	-0.35	4.87	-1.50	-1.09	-0.31
19	Radhika x Simran	-0.87	-0.85	6.22	2.25	-0.81	-0.87
20	Radhika x Kelwangi	-0.12	-0.10	-9.87	2.67	-0.19	-0.19
21	Simran x Kelwangi	1.00	0.74	0.83	-2.17	1.75	0.75
	S.E.(sij)	0.94	0.57	5.08	1.87	0.74	0.47
<b>Reciprocal Crosses</b>							
22	Kirti x Harsh	0.50	0.00	15.8**	2.25	0.56	0.09
23	Daftri x Harsh	2.00*	1.50**	-9.55*	3.00	2.15*	1.57**
24	Radhika x Harsh	0.50	1.00*	-2.97	-0.75	0.54	1.02*
25	Simran x Harsh	1.00	1.25*	-7.40	-0.25	1.90	1.29*
26	Kelwangi x Harsh	0.25	-0.25	3.15	5.50**	0.29	-0.21
27	Daftri x Harsh	-1.00	-1.25*	10.6*	1.25	-1.09	-1.23*
28	Radhika x Harsh	-0.50	-1.50**	10.0*	2.75	-0.51	-1.58**
29	Simran x Harsh	-0.50	-0.25	-4.70	2.00	-0.58	-0.27
30	Kelwangi x Harsh	-1.00	-1.50**	0.25	3.00	-1.71	-1.53**
31	Radhika x Daftri	0.00	0.25	9.47*	2.25	0.22	0.27
32	Simran x Daftri	-0.25	-0.50	2.50	-0.50	-0.45	-0.54
33	Kelwangi x Daftri	0.75	0.75	13.4**	-0.25	0.78	0.71
34	Simran x Radhika	0.75	0.25	-7.55	6.25**	0.70	0.24
35	Kelwangi x Radhika	0.50	0.75	-0.60	-1.25	0.55	0.73
36	Kelwangi x Simran	-0.50	0.00	-7.10	1.25	-0.55	0.14
	S.E. (rij)	0.80	0.49	4.31	1.58	0.73	0.58

**10. Average fruit weight (g)**

The parent Kirti (0.63) exhibited significant positive GCA effect for average fruit weight (g) followed by Kelwangi (0.35). The parents Kirti and Kelwangi were observed to be good combiner for developing hybrids in Brinjal.

The crosses Harsh X Daftri (5.03), Harsh X Kelwangi (4.00), Radhika X Kelwangi (2.16), Kirti X Daftri (0.84), Kirti X Kelwangi (1.93), Daftri X Radhika (2.90) and Radhika X Simran (1.44) showed significantly positive SCA effect for average fruit weight (g). The cross Harsh X Daftri (5.03) exhibited highest significant SCA effect followed by Kirti X Daftri (4.00) for average fruit weight (g). Among the reciprocal crosses, four crosses viz., Daftri X Kirti (3.85), Radhika X Harsh (2.17), Simran X Kirti (1.64), and Daftri X Harsh (0.79) showed positive significant RCA effect for average fruit weight (g).

**11. Total yield per plant (kg)**

Among the parents, Kirti (0.26) was good combiner as it recorded GCA effect in the desirable direction followed by Simran (0.08). While Harsh (-0.28), Kelwangi (- 0.05) and Radhika (-0.02) were poor combiner for total yield per plant (kg). Among fifteen direct crosses, five crosses viz., Harsh X Daftri (0.66), followed by Harsh X Kelwangi (0.53), Daftri X

Radhika (0.27), Daftri X Simran (0.35) and Radhika X Kelwangi (0.31) showed positive significant SCA effects, for total yield per plant (kg). Cross Harsh X Simran (-0.59) showed negative significant effect for this trait. Among the reciprocal crosses, nine cross showed significant RCA effect, out of which five crosses showed positive and four crosses showed negative RCA effect. The cross Daftri X Kirti (0.61) exhibited highest positive RCA effect followed by Radhika X Harsh (0.32) and Daftri X Harsh (0.28).

**12. TSS (%)**

Three parents Harsh (1.63), Daftri (1.54) and Simran (1.21) showed positive significant general combining ability effects for total soluble solid indicating that they may be good source of gene for earliness. None of the direct crosses showed significant positive SCA effects out of fifteen crosses for total soluble solid. Two crosses viz., Kelwangi X Harsh (5.50) and Simran X Radhika (6.25) showed positive significant RCA effects for total soluble solid. The parent Kirti was observed as best general combiner in the estimation of GCA effect as it recorded positive significant GCA effect for plant height, fruit girth, Average fruit weight, total yield per plant. Parent Daftri also recorded as good general combiner for numbers of

primary branches per plant, TSS, fruit length and fruit diameter. The parent Simran exhibited positive significant GCA effect for Numbers of primary branches per plant, TSS, fruit diameter, Total yield per plant. Among the direct crosses Harsh X Daftri exhibited significant positive SCA effect for fruit length (cm), fruit girth (cm), fruit diameter (cm), Average fruit weight, and total yield per plant (kg). In the crosses Harsh X Kelwangi and Radhika X Kelwangi recorded

positive significant SCA effect recorded for fruit diameter, Average fruit weight, total yield per plant (kg) and plant height (cm). Out of fifteen reciprocal crosses, Daftri X Harsh, Radhika X Harsh, Daftri X Kirti and Simran X Kirti showed positive significant RCA effect for total yield per plant (kg), Average fruit weight, fruit diameter (cm) and plant height (cm) therefore these hybrids can be further used for commercial exploitation.

**Table 1b:** GCA effect of presents, SCA effect of crosses and RCA effect of reciprocals

Sr. No	Parents Crosses	Fruit length (cm)	Fruit diameter (cm)	Fruit girth (cm)	Average fruit weight	Total yield per plant	TSS
	Parents						
1	Harsh	0.33*	-39.60**	-0.49**	-0.32**	-0.24**	1.63**
2	Kirti	0.10	28.98**	0.50**	0.63**	0.26**	-3.04**
3	Daftri	0.31*	11.95**	-0.10	-0.31	-0.03	1.54*
4	Radhika	-0.41**	-6.12	0.11	-0.19	-0.02	-0.13
5	Simran	-0.36**	8.49*	-0.08	-0.16	0.08*	1.21*
6	Kelwangi	0.02	-3.69	0.06	0.35**	-0.05	-1.21*
	S.E.(gi)	0.12	3.67	0.15	0.11	0.03	0.59
<b>Direct Crosses</b>							
7	Harsh x Kirti	-0.55	13.31	-0.38	-0.49**	0.16	2.25
8	Harsh x Daftri	2.74**	108.44**	1.19*	5.03**	0.66**	-2.08
9	Harsh x Radhika	0.41	37.38**	0.05	-1.72**	0.07	-1.17
10	Harsh x Simran	-2.54**	-70.56**	-0.77	-2.21**	-0.59**	-3.00
11	Harsh x Kelwangi	1.60**	37.84**	0.49	4.00**	0.53**	0.17
12	Kirti x Daftri	0.73	-40.84**	-0.53	0.84*	-0.22	1.83
13	Kirti x Radhika	-0.94*	6.63	0.55	0.41	0.13	-1.00
14	Kirti x Simran	0.39	3.52	-0.47	-0.20	-0.18	0.42
15	Kirti x Kelwangi	1.22**	29.50*	0.74	1.93**	0.14	-2.67
16	Daftri x Radhika	1.88**	-2.61	0.31	2.90**	0.27*	-2.08
17	Daftri x Simran	0.86*	58.00**	0.62	0.45	0.35**	-3.17
18	Daftri x Kelwangi	-2.00**	55.28**	0.05	-0.35	0.19	-1.50
19	Radhika x Simran	-0.86	12.62	0.15	1.44**	0.02	2.25
20	Radhika x Kelwangi	0.89	35.30**	0.73	2.16**	0.31**	2.67
21	Simran x Kelwangi	1.31**	8.45	0.21	-0.07	0.10	-2.17
	S.E.(sij)	0.39	11.63	0.48	0.36	0.11	1.87
<b>Reciprocal Crosses</b>							
22	Kirti x Harsh	-1.15	87.5*	0.54	-0.61*	0.038	2.25
23	Daftri x Harsh	-0.005	16.1	0.19	0.79*	0.28**	3.00
24	Radhika x Harsh	0.097	16.9	-0.24	2.17**	0.32**	-0.75
25	Simran x Harsh	-0.64	-6.58	-0.005	-1.34	-0.03	-0.25
26	Kelwangi x Harsh	-0.28	-38.2**	0.46	-2.54	-0.28**	5.50**
27	Daftri x Harsh	-0.55	25.1*	0.53	3.85**	0.61**	1.25
28	Radhika x Harsh	0.68*	50.2**	0.49	-2.74**	0.28**	2.75
29	Simran x Harsh	0.31	5.65	-0.38	1.64**	0.26**	2.00
30	Kelwangi x Harsh	-0.43	4.95	-0.01	-0.75*	0.16	3.00
31	Radhika x Daftri	-0.06	10.3	0.12	-0.28	-0.05	2.25
32	Simran x Daftri	0.36	-8.80	0.35	-0.44	-0.22**	-0.50
33	Kelwangi x Daftri	0.90*	-43.4**	-0.39	-5.60	-0.82**	-0.25
34	Simran x Radhika	-0.86	-12.9	0.15	0.18	-0.02	6.25**
35	Kelwangi x Radhika	0.02	22.1*	0.20	-2.04	-0.29**	-1.25
36	Kelwangi x Simran	0.76	-10.7	-0.09	0.68	0.14	1.25
	S.E. (rij)	0.33	9.87	0.40	0.30	0.09	1.58

**Conclusion**

Among the direct crosses Harsh X Daftri exhibited significant positive SCA effect for fruit length (cm), fruit girth (cm), Fruit diameter, Average fruit weight (g), total yield per plant (kg). In the crosses Harsh X Kelwangi and Radhika X Kelwangi recorded positive significant SCA effect recorded for fruit diameter, average fruit weight (g), Total yield per plant (kg) and plant height (cm). Out of fifteen reciprocal crosses, Daftri X Harsh, Radhika X Harsh, Daftri X Kirti and Simran X Kirti showed positive significant RCA effect for total yield per plant (kg), Average fruit weight (g), Fruit diameter and plant height (cm).

On basis of mean performance and estimate of general combining ability, the parent Kirti, Simran and Daftri exhibited significant superiority and positive significant GCA for total yield per plant and some other yield contributing characters hence these parents observed good general combiner for yield and yield contributing characters.

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