Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 247-251
Received: 10-11-2020
Accepted: 12-12-2020

Patel BM
Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Vachhani JH
Vegetable Research Station, Junagadh Agricultural University, Junagadh, Gujarat, India

Godhani PP
Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Sapovadiya MH
Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
Patel BM
Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Combining ability for fruit yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]

Patel BM, Vachhani JH, Godhani PP and Sapovadiya MH

Abstract
The experiment was undertaken to study the combining ability for yield and its attributing traits in okra. Information on the magnitude of combining ability was obtained for fruit yield per plant and its related components following line x tester mating design involving 12 diverse varieties/strains (8 lines and 4 testers). The 12 parents and their 32 resultant F_1s were sown in a Randomized Block Design with three replications. Combining ability analysis revealed that the mean squares due to lines x testers were found highly significant for all the traits under study as well as the magnitudes of SCA variances were higher than the corresponding GCA variances for all the traits. These findings indicated more importance of non-additive gene action as compared to additive gene action in the expression of fruit yield and its component traits. Among the parents, only HRB-108-2 was found as good general combiner for fruit yield per plant and related traits. Thus, the parent was good general combiner for fruit yield per plant also showed good general combining ability for one or more component traits. The hybrid Arka Anamika x GJO-3 showed high sca effects for fruit yield per plant along with significant desirable sca effects for a number of branches per plant, also.

Keywords: Combining ability, gene action, fruit yield, okra

Introduction
Vegetables are prime importance in human diet, as they provide cheaper source of nutrients like carbohydrates, minerals, vitamins, proteins and dietary fibers. Okra [*Abelmoschus esculentus* (L.) Moench] is one of the most important vegetable crops grown extensively throughout the country during both summer and rainy seasons for its green tender fruits. It is a good source of vitamin A, B, and C, protein and mineral elements. The oil content of the seed is quite high (18-20%) and the oil yield from okra crop is 794 kg/ha (Mays *et al*., 1990) [7]. The average nutritive value (ANV) of okra is 3.21%, which is higher than tomato, brinjal and cucurbitaceous vegetables (Sharma and Arora, 1993) [12]. Its fast growth, short duration and photo insensitive nature, genetical study can be completed in short span of time. Moreover, its large flower and monadelphous nature of the stamens make emasculation and pollination process easier. With the ease in fruit set and good number of seeds per pod, okra can be well exploited for hybrid vigour.
The combining ability is the important genetic tool, which provides a guideline for an assessment of the relative breeding potential of the parents or identifying the best combiners, which may be hybridized either to exploit heterosis or to accumulate fixable genes. In order to identify potential crosses for further exploitation, it is important to have prior information about heterosis and nicking ability of the parents involved, since it helps in the identification of superior parents with good general combining ability and crosses with high and desirable specific combining ability effects (Singh *et al*., 1991) [13]. Thus, the present study was conducted to study the combining ability for fruit yield and its components in okra.

Materials and Methods
The present investigation on combining ability in okra [*Abelmoschus esculentus* (L.) Moench] was undertaken with a view to study the nature of gene action and combining ability for different characters of okra parents and hybrids. The experimental materials comprised of 12 parents (8 lines and 4 testers) and their 32 resultant hybrids derived from line x tester mating and one check variety (GJOH-4). These 45 genotypes were sown in a Randomized Block Design with three replications at the Vegetable Research Station, Junagadh Agricultural University, Junagadh during *kharif* 2019. All the recommended agronomical package of practices and plant protection measures were followed timely to raise a healthy crop. The observations on five randomly selected plants were recorded for ten characters *viz*., days to

50% flowering, days to first picking, plant height (cm), number of branches per plant, number of nodes per plant, internodal length (cm), number of fruits per plant, fruit length (cm), fruit girth (cm) and fruit yield per plant (g) (observations on days to 50% flowering and days to first picking were recorded on plot basis). The analysis of variance was performed to test the significance of differences among the genotypes for all the characters as suggested by Panse and Sukhatme (1985) [8]. The analysis of variance for combining ability for all the ten characters was carried-out as suggested by Kempthorne (1957) [6].

Results and Discussion

The character-wise results in respect of analysis of variance for combining ability for ten characters is presented in Table 1. Analysis of variance for combining ability in respect of ten characters showed that the mean squares due to lines and testers were significant for all the traits except lines were non-significant for days to first picking, inter nodal length and fruit girth. While testers were non-significant for fruit girth and fruit yield per plant. The lines x testers interaction was highly significant for all traits, which indicated the existence of genetic variability among the parents. Since the mean squares due to lines, testers and line x tester interactions do not provide clear cut picture regarding relative magnitudes of additive and non-additive genetic components, the unbiased variances due to both of general ($\hat{\sigma}^2_{GCA}$) and specific ($\hat{\sigma}^2_{SCA}$) combine ability were estimated along with $\hat{\sigma}^2_{GCA}/\hat{\sigma}^2_{SCA}$ ratio.

Estimates of genetic components of variance revealed that the variance due to testers ($\hat{\sigma}^2_t$) were higher than the variance due to lines ($\hat{\sigma}^2_l$) for all the characters except number of fruits per plant fruit length and fruit girth indicating equal role of testers and lines towards total additive genetic variance. Estimates of $\hat{\sigma}^2_{GCA}$ and $\hat{\sigma}^2_{SCA}$ revealed that the magnitudes of SCA variances were higher than the due to GCA variance for all the characters suggesting involvement of non-additive gene actions in the inheritance of these characters. In the present study, the ratio of $\hat{\sigma}^2_{GCA}/\hat{\sigma}^2_{SCA}$ was lower than unity for all the characters indicating predominance of non-additive gene action in governing these traits. The importance of non-additive genetic variances for fruit yield per plant has been reported by several workers such as Verma and Sood (2015) [15], Verma *et al.* (2016) [16], Ayesha *et al.* (2017) [3], Jupiter *et al.* (2017) [4], Rameshkumar *et al.* (2017) [10], Satish *et al.* (2017) [11], Kayande *et al.* (2018) [5] and Ayam *et al.* (2019) [2].

The character-wise estimates of general combining ability effects for each parent are presented in Table 2 and indicated that the merit of the parents differs significantly for different characters. In the present study, both GCA and SCA variances were significant for days to 50% flowering, days to first picking, plant height, number of fruits per plant and fruit length. This suggested that both additive and non-additive variances were important in the expression of these traits.

The magnitude of GCA variance due to testers for days to 50% flowering, days to first picking, plant height, number of branches per plant, number of nodes per plant, inter nodal length, fruit length and fruit girth were comparatively higher than those due to lines, which indicated greater diversity among the testers for these components. On the other hand, large variations in number of fruits per plant and fruit yield per plant were observed among the lines. In the present study, a contribution of male parent for variability was found to be higher than the female parents in majority of the characters under study.

An overall appraisal of gca effects for the material used in the present study indicated that none of the parents was good general combiner for all the characters studied. The best general combiner for various characters were; HRB-108-2, GJO-3 and VRO-6 were found good general combiners for days to 50% flowering. The parents, Arka Abhay, Arka Anamika, HRB-108-2, GJO-3 and VRO-6 were noted as good general combiners for days to first picking. From the results, it was observed that the parents EC-169513, GJO-3 and GAO-5 were found good general combiners for plant height. For number of branches per plant, parents HRB-108-2, IC-90107, GO-6 and VRO-6 were found good general combiners. For the trait number of nodes per plant, the female parents Arka Abhay, HRB-55 and HRB-108-2 and male parents GO-6 and VRO-6 were recorded as good general combiners. The female parents Arka Abhay and HRB-108-2 as well as male parent GO-6 had good potential for number of fruits per plant as they had significant and positive gca effects. The female parents Arka Abhay and HRB-55 and male parent GO-6 registered as good combiners in desirable direction for fruit length. None of the parents was found good general combiner for inter nodal length and fruit girth. Whereas, only one female parent, HRB-108-2 was found the good general combiner for the fruit yield per plant.

Moreover, the female parent HRB-108-2 noticed as good general combiner for fruit yield per plant also found good general combiner for days to 50% flowering, days to first picking, number of branches per plant, number of nodes per plant and number of fruits per plant. Thus, the parent was good general combiner for fruit yield per plant also showed good general combining ability for one or more component traits. These findings are in concurrence with earlier results of Wakode *et al.* (2016) [17], Jupiter *et al.* (2017) [4], Paul *et al.* (2017) [9], Satish *et al.* (2017) [11], Sugani Devi *et al.* (2017) [14], Annapurna and Singh (2018) [1] and Kayande *et al.* (2018) [5].

The character wise estimates of specific combining ability (sca) effects of 32 hybrids are presented in Table 3. The estimates of sca effect revealed that none of the crosses was consistently superior for all the traits. Out of 32 crosses studied, a number of crosses showed significant sca effects in desired direction for fruit yield per plant (3), days to 50% flowering (2), days to first picking (6), plant height (2), number of branches per plant (4), number of nodes per plant (7), inter nodal length (1), number of fruits per plant (2), fruit length (5), fruit girth (3) and fruit yield per plant (3). The highest sca effect for fruit yield per plant was manifested by Arka Anamika x GJO-3, which also exhibited significant sca effects in desired direction for number of branches per plant. This cross was involved average x average general combining parents for fruit yield per plant, also recorded first rank *per se* performance and having significant and positive heterobeltiosis and standard heterosis for fruit yield per plant.

Estimates of sca effects for days to 50% flowering revealed that out of 32 hybrids, only two hybrids HRB-55 x GO-6 (-2.20) and EC-169513 x GAO-5 (-2.82) registered significant negative sca effects. Only hybrid EC-169513 x GJO-3 (2.30) exhibited significant positive sca effect for this trait. The range of sca effects was from -2.82 (EC-169513 x GAO-5) to 2.30 (EC-169513 x GJO-3).

The estimates of sca effects, 11 cross combinations showed significant effects for days to first picking. Out of these significant crosses, 6 and 5 showed negative and positive sca effects, respectively. The range of estimate sca effect for days to first picking was -2.36 (EC-169513 x GAO-5 and IC-90107 x VRO-6) to 2.18 (IC-90107 x GO-6). The cross combinations, Arka Abhay × GJO-3 (-2.11), Arka Anamika x GO-6 (-1.41), KS-404 x GJO-3 (-1.62), HRB-55 x GO-6 (-1.74), EC-169513 x GAO-5 (-2.36) and IC-90107 x VRO-6 (-2.36), showed significant and negative sca effects for days to first picking.

The results on sca effects of plant height indicated that out of 32 crosses, only 3 crosses showed significant sca effects. Only one hybrid HRB-108-2 x GO-6 (18.35) showed significant positive sca effects for this trait.

Out of 32 crosses, 10 crosses exhibited significant sca effects for number of branches per plant. Out of these, 4 crosses were significant with positive values. The range of sca effects was observed from -0.29 (Arka Anamika x VRO-6) to 0.46 (HRB-108-2 x GAO-5) for number of branches per plant. Whereas, 6 hybrids showed significant and negative sca effects for this trait.

While, estimates of sca effects for numbers of nodes per plant revealed that 7 crosses expressed significant and positive sca effects. The range of sca effects was observed from -2.18 (IC-90107 x GO-6) to 3.78 (HRB-108-2 x GO-6) for number of nodes per plant.

A perusal of sca effects revealed that 4 cross combinations expressed significant sca effects for intermodal length, of which, only one cross Arka Abhay x GO-6 (-0.54) had significant and negative sca effect. The range of sca effects was observed from -0.55 (Arka Abhay x GO-6) to 1.03 (Arka Abhay x GJO-3) for internodal length.

Estimates of sca effects for number of fruits per plant showed that only 3 crosses noticed significant sca effects of which, 2 crosses had significant and positive sca effects. The corresponding range was observed -2.06 (Arka Abhay x GAO-5) to 3.18 (HRB-108-2 x GO-6) for this trait.

For fruit length, out of 32 crosses, 6 crosses showed significant and positive sca effects. The highest significant and positive sca effect was recorded by the hybrid HRB-55 x GJO-3 (1.67). Five crosses exhibited significant and negative sca effects for this character. The corresponding range was -1.87 (EC-169513 x GO-6) to 1.67 (HRB-55 x GJO-3).

In respect of fruit girth, out of 32 crosses, there was 7 crosses showed significant sca effect for fruit girth. Out of them, 3 crosses showed significant and positive whereas, 4 crosses showed significant and negative sca effects for fruit girth. The corresponding range was -1.62 (Arka Anamika x VRO-6) to 1.71 (EC-169513 x VRO-6). With regard to sca effects for fruit yield per plant, only 3 hybrids showed significant and positive sca effects. There was no any negative cross for this trait. The sca effects ranged from -14.19 (Arka Anamika x VRO-6) to 28.44 (Arka Anamika x GJO-3). The hybrids; Arka Anamika x GJO-3 (28.44), Arka Abhay x VRO-6 (22.61) and HRB-55 x GAO-5 (22.00) showed significant positive effects. These all superior crosses were found to be the best combination for fruit yield per plant involved average x average combiners. It could be due to better complementation between favourable alleles of parents involved.

Table 1: Analysis of variance for combining ability for ten characters in okra

Source of variation	d. f.	Days to 50% flowering	Days to first picking	Plant height (cm)	Number of branches per plant	Number of nodes per plant	Internodal length (cm)	Number of fruits per plant	Fruit length (cm)	Fruit girth (mm)	Fruit yield per plant (g)
		1	2	3	4	5	6	7	8	9	10
Replications	2	3.219	0.698	47.135	0.002	0.789	0.020	19.965**	1.878*	0.209	115.728
Crosses	31	11.927**	11.276**	216.224**	0.191**	9.393**	0.448**	6.489**	4.030**	2.261**	617.558**
Lines	7	14.094**	14.689	216.732**	0.144**	5.747**	0.216	11.071**	3.697**	1.274	1021.259**
Testers	3	31.371**+	31.149**+	642.347**+	0.333**	16.016**	0.370*	6.204*	6.484**	1.627	230.305
Lines × Testers	21	8.427**	7.300**	155.180**	0.186**	9.662**	0.536**	5.003**	3.791**	2.681**	538.313**
Error	62	3.358	1.117	48.157	0.028	0.466	0.12989	1.871	0.594	0.780	239.404
Estimates of genetic component of variance											
$\hat{\sigma}^2_l$	-	0.895	1.131	14.047	0.009	0.440	0.007	0.767	0.258	0.041	65.154
$\hat{\sigma}^2_t$	-	1.167 *	1.251*	24.758 *	0.012	0.648	0.010	0.180	0.245	0.035	@
$\hat{\sigma}^2_{GCA}$	-	1.076 **	1.211 **	21.188 **	0.011	0.578	0.009	0.376**	0.249*	0.037	21.465
$\hat{\sigma}^2_{SCA}$	-	1.689 **	2.060**	35.674 **	0.053 **	3.065**	0.135**	1.044**	1.065**	0.633**	99.636**
$\hat{\sigma}^2_{GCA} / \hat{\sigma}^2_{SCA}$	-	0.637	0.588	0.594	0.207	0.188	0.067	0.360	0.234	0.058	0.215

*, ** Significant @ 5% and 1% levels, respectively against error mean square

+, ++ Significant @ 5% and 1% levels, respectively against line x tester interactions mean square

@ Estimates are negative

Table 2: Estimation of general combining ability (GCA) effects for ten characters in okra

Sr. No.	Parents	Days to 50% flowering	Days to first picking	Plant height (cm)	No. of branches per plant	No. of nodes per plant	Inter nodal length (cm)	No. of fruits per plant	Fruit length (cm)	Fruit girth (mm)	Fruit yield per plant (g)
		1	2	3	4	5	6	7	8	9	10
LINES											
1	Arka Abhay	-0.30	-0.72*	4.02 *	0.07	1.04 **	-0.02	1.89 **	0.47 *	0.359	6.93
2	Arka Anamika	-0.80	-0.89 **	-2.31	-0.08	-0.76 **	-0.12	-0.23	-0.02	0.281	5.52
3	KS-404	0.03	0.45	-2.15	-0.07	-0.47 *	-0.09	-0.39	0.23	0.363	3.14
4	HRB-55	2.12 **	2.12**	-1.23	-0.08	0.52 *	0.18	-0.21	0.97 **	-0.391	5.17
5	HRB-108-2	-1.39 *	-1.39 **	2.85	0.18 **	0.84 **	0.10	0.98 *	-0.62 **	-0.341	10.62 *
6	EC-169513	0.95	0.78*	-8.15 **	-0.13 **	-0.39	-0.18	-0.91 *	-0.25	-0.063	-6.64
7	IC-90107	-0.39	-0.14	3.27	0.10*	-0.52 *	0.16	-0.87 *	-0.07	0.131	-15.35 **

8	IC-97716	-0.22	-0.22	3.69	0.01	-0.27	-0.04	-0.27	-0.71**	-0.337	-9.39 *
S. E. (g_i) ±		0.53	0.31	2.00	0.05	0.19	0.10	0.39	0.22	0.25	4.47
S. E. ($g_i - g_j$) ±		0.75	0.43	2.83	0.07	0.28	0.15	0.56	0.31	0.36	6.32
Testers											
1	GJO-3	-0.80 *	-0.80 **	-5.73**	-0.11 **	-0.14	0.01	-0.22	-0.54 **	-0.343 *	0.978
2	GAO-5	1.66 **	1.62 **	-2.77 *	-0.09 **	-1.10 **	-0.07	-0.42	0.18	0.017	-3.16
3	GO-6	-0.14	-0.01	2.90*	0.13 **	0.54**	-0.11	0.73 **	0.64 **	0.035	3.87
4	VRO-6	-0.72 *	-0.80 **	5.60 **	0.07*	0.70**	0.17 **	-0.09	-0.28 *	0.290	-1.69
S. E. (g_j) ±		0.37	0.22	1.41	0.03	0.14	0.07	0.28	0.16	0.18	3.16
S. E. ($g_i - g_j$) ±		0.53	0.31	2.00	0.05	0.19	0.10	0.39	0.22	0.25	4.47

*, ** Significant @ 5% and 1% levels, respectively

Table 3: Estimation of specific combining ability (SCA) effects for ten characters in okra

Sr. No.	**Hybrids**	**Days to 50% flowering**	**Days to first picking**	**Plant height (cm)**	**No. of branches per plant**	**No. of nodes per plant**	**Inter nodal length (cm)**	**No. of fruits per plant**	**Fruit length (cm)**	**Fruit girth (mm)**	**Fruit yield per plant (g)**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Arka Abhay × GJO-3	-2.12	-2.12 **	-3.85	-0.17	-1.57 **	1.03 **	-1.27	0.19	-0.11	-8.95
2	Arka Abhay × GAO-5	1.09	1.14	-6.15	-0.20 *	-2.04 **	-0.16	-2.07 *	-0.59	-0.21	-12.29
3	Arka Abhay × GO-6	0.89	0.43	4.85	0.42 **	1.32 **	-0.55 *	0.74	-0.22	-0.65	-1.38
4	Arka Abhay × VRO-6	0.14	0.55	5.15	-0.05	2.30 **	-0.30	2.60 **	0.62	0.96	22.62 *
5	Arka Anamika × GJO-3	-0.95	-0.95	3.48	0.45 **	0.23	-0.13	0.39	-0.04	0.59	28.44 **
6	Arka Anamika × GAO-5	-0.07	0.97	-0.81	-0.27 **	0.36	-0.29	0.12	0.51	0.60	-3.36
7	Arka Anamika × GO-6	-0.95	-1.41 *	-2.15	0.11	-0.01	0.22	-0.30	-0.17	0.43	-10.89
8	Arka Anamika × VRO-6	1.97	1.39 *	-0.52	-0.29 **	-0.57	0.20	-0.21	-0.30	-1.62 **	-14.196
9	KS-404 × GJO-3	-1.78	-1.62*	6.31	-0.03	-1.82 **	0.15	-0.32	-0.77	-0.30	5.06
10	KS-404 × GAO-5	1.43	0.30	1.69	-0.19	0.77	0.05	0.58	0.08	1.51**	-5.64
11	KS-404 × GO-6	-0.12	0.59	-0.65	0.06	-0.66	0.16	-0.48	1.24 **	-0.13	3.44
12	KS-404 × VRO-6	0.47	0.72	-7.35	0.16	1.71 **	-0.36	0.22	-0.54	-1.072*	-2.86
13	HRB-55 × GJO-3	1.14	0.72	5.73	0.04	3.25 **	-0.40	1.16	1.67 **	0.64	-0.50
14	HRB-55 × GAO-5	2.01	1.97 **	2.10	-0.05	-1.32 **	0.11	0.50	-1.46 **	-0.50	22.02 *
15	HRB-55 × GO-6	-2.20 *	-1.74 **	-5.56	-0.10	-0.96*	-0.35	-1.259	0.55	0.15	-13.33
16	HRB-55 × VRO-6	-0.95	-0.95	-2.27	0.10	-0.98*	0.64**	-0.401	-0.76	-0.28	-8.18
17	HRB-108-2 × GJO-3	0.30	0.55	-10.69 **	-0.25*	-1.21 **	-0.35	-0.80	0.82	0.18	-4.53
18	HRB-108-2 × GAO-5	0.18	0.14	-5.31	0.46 **	-0.48	-0.31	-1.23	0.51	0.12	-8.87
19	HRB-108-2 × GO-6	0.30	0.09	18.35 **	-0.22 *	3.79 **	0.03	3.18 **	-1.27 **	0.47	17.66
20	HRB-108-2 × VRO-6	-0.78	-0.78	-2.35	0.01	-2.11 **	0.65 **	-1.16	-0.06	-0.77	-4.26
21	EC-169513 × GJO-3	2.30 *	2.05 **	1.98	-0.03	-0.07	0.03	-0.07	0.97 *	-0.19	1.08
22	EC-169513 × GAO-5	-2.82 **	-2.37 **	4.69	-0.22 *	-0.08	0.21	1.07	1.35 **	-0.37	1.09
23	EC-169513 × GO-6	-1.03	-0.74	0.02	0.06	-0.18	0.19	-0.83	-1.87 **	-1.16 *	-5.39
24	EC-169513 × VRO-6	1.55	1.05	-6.69	0.19	0.33	-0.40	-0.17	-0.45	1.72 **	3.23
25	IC-90107 × GJO-3	1.30	1.30 *	-4.10	0.01	0.42	-0.27	0.30	-1.67 **	-0.68	-7.14
26	IC-90107 × GAO-5	-0.82	-1.12	3.27	0.28 **	1.78 **	0.30	0.67	-0.57	-1.08 *	9.04
27	IC-90107 × GO-6	1.64	2.18 **	-6.73	-0.14	-2.19 **	0.31	-0.59	0.81	0.33	-5.67
28	IC-90107 × VRO-6	-2.12	-2.37 **	7.56	-0.14	-0.01	-0.34	-0.37	1.43 **	1.43 **	3.81
29	IC-97716 × GJO-3	-0.20	0.05	1.15	-0.01	0.77	-0.01	0.62	-1.16 *	-0.13	-13.46
30	IC-97716 × GAO-5	-0.99	-1.03	0.52	0.17	0.10 *	0.10	0.36	0.18	-0.07	-1.93
31	IC-97716 × GO-6	1.47	0.59	-8.15*	-0.18	-1.11 **	0.01	-0.47	0.93 *	0.55	15.56
32	IC-97716 × VRO-6	-0.28	0.39	6.48	0.02	-0.66	-0.11	-0.51	0.06	-0.36	-0.16
S. E. (S_{ij}) ±		1.06	0.61	4.01	0.09	0.39	0.21	0.79	0.44	0.51	8.93
S_{ij} - S_{kl}		1.49	0.86	5.67	0.14	0.56	0.29	1.12	0.63	0.72	12.63
S_{ij} - S_{kl}		2.24	1.29	8.49	0.20	0.84	0.44	1.67	0.94	1.08	18.95

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

Conclusion

It is concluded from the present study that the importance of non-additive gene action for all yield components except plant height in the present study indicated that heterosis breeding is the best possible option for improving these traits in okra. The gca effects of the parent HRB-108-2 indicated that it was good general combiner for fruit yield per plant and other yield attributing traits. While, sca effects of the hybrid revealed that hybrid Arka Anamika x GJO-3 was found to be the best cross combination for fruit yield per plant and other yield attributing trait like number of branches per plant.

References

1. Annapurna, Singh SP. Analysis of combining ability status and nature of gene action among hybrids for yield and quality traits in okra [*Abelmoschus esculentus* (L.) Moench]. Int. J Pure App. Biosci 2018;6(2):1547-1553.
2. Ayam PD, Bhattacharjee T, Banerjee S, Maurya PK, Chatterjee S, Chattopadhyay A. Heterotic expression of okra hybrids for tolerance to enation leaf curl virus. Int. J Veg. Sci 2019;8(1):624-651.
3. Ayesha Revanappa, Satish D, Hadimani HP, Siddappa R. Nature of gene action in okra [*Abelmoschus esculentus* (L.) Moench] through diallel analysis. Int. J Curr. Microbiol. App. Sci 2017;6(10):256-260.

4. Jupiter S, Waikhom S, Kandasamy R. Study on combining ability in okra [*Abelmoschus esculentus* (L.) Moench]. Asian J Hort 2017;12(1):41-45.
5. Kayande NV, Kumbhalkar HB, Shinde S. Selection of parents based on combining ability studies in okra (*Abelmoschus esculentus* (L). Moench). Int. J Curr. Microbiol. App. Sci 2018;6:1935-1940.
6. Kempthorne O. An Introduction of Genetics Statistics. John Willey & Sons. Inc., New York 1957.
7. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. ICAR, New Delhi 1985.
8. Paul T, Desai RT, Choudhary R. Genetic architecture, combining ability and gene action study in okra [*Abelmoschus esculentus* (L.) Moench]. Int. J Curr. Microbiol. App. Sci 2017;6(4):851-858.
9. Rameshkumar D, Gunasekar R, Sankar R. Gene action studies for quantitative and qualitative traits in okra (*Abelmoschus esculentus* (L.) Moench). Int. J Chem. Stud 2017;5(5):2309-2312.
10. Satish K, Suresh K, Agalodiya AV, Prajapati DB. Combining ability for yield and its attributing traits in okra [*Abelmoschus esculentus* (L.) Moench]. Int. J Curr. Microbiol. App. Sci 2017b;6(9):1944-1954.
11. Sharma BR, Arora SK. Improvement of okra. Advances in horticulture. Vegetable Crops Part-I. (Eds) Chadha KL, Kalloo GJ. Malhotra Publishing House, New Delhi 1993;5:343-364.
12. Singh D, Sharma BR, Singh HC. Genetical analysis to predict the breeding potential in an intervarietal cross in okra [*Abelmoschus esculentus* (L.) Moench] for improvement in fruit and seed yield. In Golden Jubilee Symposium on Genetic Research and Education: Current Trends and Next Fifty Years. Abstr 1991;2:605.
13. Sugani Devi, Choudhary BR, Verma IM. Combining ability analysis yield and yield contributing characters in okra (*Abelmoschus esculentus* (L). Moench). The Bioscan Inter. Quart. J Life Sci 2017;12(3):1593-1596.
14. Verma A, Sood S. Gene action studies on yield and quality traits in okra (*Abelmoschus esculentus* (L.) Moench). Afr. J Agric. Res 2015;10(43):4006-4009.
15. Verma A, Sood S, Singh Y. Combining ability for fruit yield and contributing traits in okra [*Abelmoschus esculentus* (L.) Moench]. J Appl. & Nat. Sci 2016;8(3):1594-1598.
16. Wakode MM, Bhave SG, Navhale VC, Delvi VV, Devmore JP, Mahadik SG. Combining ability studies in okra (*Abelmoschus esculentus* L. Moench). Electron. J Plant Breed 2016;7(4):1007-1013.