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Heterosis studies in okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract
A set of 42 genotypes including 6 females, 5 males, their 30 resultant hybrids and one commercial check variety (GJOH-4) were sown during summer-2018 at Vegetable Research Station, Junagadh Agricultural University, Junagadh to study the magnitudes of heterosis using line x tester analysis for ten characters. Significant differences were observed among parents and hybrids indicating considerable genetic variation among these genotypes. Significant standard heterosis and high *per se* performance with regards to fruit yield per plant were recorded by the crosses *viz*., JOL-2K-19 x AOL-13-73, JOL-2K-19 x EC-169513 and GO-2 x EC-169513.

Keywords: Heterosis, heterobeltiosis, standard heterosis, fruit yield, **o**kra

Introduction
Vegetables are prime importance in human diet, as they provide cheaper source of nutrients like carbohydrates, minerals, vitamins, proteins and dietary fibers. The fruits of okra are rich source of vitamin A, C and minerals *viz.;* Ca, Mg, I and Fe. The seeds of okra are good source of protein (20%) and vegetable oil (14%). The average nutritive value (ANV) of okra is 3.21%, which is higher than tomato, brinjal and cucurbitaceous vegetables (Sharma and Arora, 1993) [12]. It is an important annual vegetable crop grown for its immature, green and non-fibrous edible fruits in the tropical and subtropical regions of the world. In addition to fruits, leaves are also consumed in some African countries. 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]).
It is a member of the *Malvaceae* family, which includes fiber crops such as cotton (*Gossypium spp*.) and Kenaf (*Hibiscus cannabinus*). Presently accepted binomial of okra is *Abelmoschus esculentus* (L.) Moench, formerly referred as *Hibiscus esculentus* L.
The ease in emasculation followed by hand pollination along with larger flower size, very high percentage of fruit setting and a good number of seeds (50 to 70) per fruit offer greater scope for commercial exploitation of heterosis in okra. Therefore, a study was undertaken to develop F_1 hybrids, which will ultimately help in increasing area under F_1 hybrids in okra. Therefore, the present investigation was carried out to estimate the magnitudes of heterosis for fruit yield and its contributing characters in okra. Several reports on heterosis for fruit yield and its attributes have enhanced the scope for commercial utilization of heterosis in okra. The present investigation was undertaken to work out for further exploitation of heterosis for fruit yield in okra.

Materials and Methods
The present investigation on "heterosis and combining ability in okra [*Abelmoschus esculentus* (L.) Moench]" was undertaken with a view to study the heterosis, nature of gene action and combining ability for different characters of okra parents and hybrids. The experimental materials comprised of 11 parents (6 lines and 5 testers) and their 30 resultant hybrids derived from line x tester mating and one check variety (GJOH-4). These 42 genotypes were sown in a Randomized Block Design with three replications at the Vegetable Research Station, Junagadh Agricultural University, Junagadh during summer 2018. The observations on five randomly selected plants were recorded for ten characters (except days to 50% flowering and days to first picking) *viz*., plant height (cm), number of branches per plant, number of nodes per plant, fruit girth (cm), fruit length (cm), internodal length (cm), number of fruits per plant and fruit yield per plant (g).

Results and Discussion

Exploitation of heterosis in okra has been recognized as a practical tool in providing the breeders a means of improving yield and other important traits. The success of hybridization programme mostly depends on the choice of right type parents for hybridization. The analysis of variance revealed significant differences among the genotypes, parents and hybrids for all the character. This indicated that considerable amount of genetic variability was present in the material studied and the materials were suitable for the study of manifestation of heterosis, combining ability and genetic parameters involved in the inheritance of different traits. Mean squares due to parents *vs.* hybrids were also significant for all the characters except days to 50% flowering and fruit girth, which indicated F_1's had heterotic effects for these characters (Table 1).

In case of standard heterosis, many crosses manifested significant shift in the desired direction *viz.*, days to 50% flowering 3 cross, days to first picking 4 crosses, plant height 29 crosses, number of branches per plant 14 crosses, number of nodes per plant and fruit girth 2 crosses, internodal length 3 crosses, number of fruits per plant 5 crosses, internodal length 7 crosses, fruit length and fruit yield per plant 3 crosses. In present investigation, the nature and magnitude of heterosis for fruit yield and yield attributes over the better parent and standard check (GJOH-4) were studied for 10 characters in all the 30 crosses (Table 2).

In case of days to 50% flowering, cross JOL-2K-19 x AOL-13-133 was the earliest to better parent and HRB-55 x IC-90107 to standard parent for days to 50% flowering. Heterosis for earliness in okra was reported by Kumar and Sreeparvathy (2010) [4], Paul (2013) [9], Tiwari *et al*. (2015) [13], Gavint *et al.* (2017) [2] and Prakash *et al.* (2019) [10] (Table 2).

In case of days to first picking, cross HRB-108-2 x AOL-13-133 was the earliest to better parent for days to first picking. While, cross HRB-55 x IC-90107 was the earliest to standard parent. Heterosis for earliness was earlier reported by Gajera and Vaddoria (2014) [1] and Tiwari *et al*. (2015) [13] (Table 2).

Plant height at fully matured stage is one of the important ideotypes in okra for higher yield. Heterobeltiosis and standard heterosis ranges for plant height varied -18.63% (HRB-108-2 x AOL-03-01) to 65.37% (JOL-2K-19 x EC-169513) and 8.45% (HRB-108-2 x AOL-13-133) to 97.72% (GO-2 x EC-169513), respectively. Heterosis for plant height in okra in desired direction was reported by Kumar and Sreeparvathy (2010) [4], Paul (2013) [9], Tiwari *et al.* (2015) [13] and Gavint *et al*. (2017) [2] (Table 2).

The number of branches per plant is major yield attributing component contributing to higher productivity. Heterobeltiosis and standard heterosis ranges for this trait varied from -56.10% (HRB-108-2 x AOL-13-73) to 120.00% (VRO-6 x EC-169513) and from -54.55% (VRO-6 x IC-90107) to 54.55% (GO-2 x AOL-13-133), respectively. Heterosis for numbers of branches per plant in okra in desired direction was reported by Kumar and Sreeparvathy (2010) [4], Paul (2013) [9], Tiwari *et al*. (2015) [13], Hadiya *et al.* (2018) [3] and Prakash *et al.* (2019) [10] (Table 2).

With respect to number of nodes per plant, heterobeltosis and standard heterosis ranges varied from -29.76% (VRO-6 x AOL-13-133) to 46.61% (JOL-2K-19 x AOL-13-73) and -24.03% (JOL-2K-19 x AOL-13-133) to 12.34% (JOL-2K-19 x AOL-13-73), respectively. Positive heterosis for this trait in okra was reported by Kumar and Pathania (2011) [5], Gajera and Vaddoria (2014) [1] and Makdoomi *et al.* (2018) [6] (Table 2).

For internodal length, the cross AOL-08-5 x AOL-13-73 exhibited the highest significant and negative (desirable) heterobeltiosis. While, significant and negative (desirable) heterosis was noticed in cross HRB-108-2 x IC-90107 over standard check. Heterosis in significant and positive direction for internodal length was reported by, Kumar and Pathania (2011) [5], Vachhani *et al.* (2011) [14], Paul (2013) [9], Satish *et al.* (2017) [11], Makdoomi *et al.* (2018) [6] and Prakash *et al.* (2019) [10] (Table 3).

Number of fruits per plant is a major fruit yield contributing character. The cross combination JOL-2K-19 x EC-169513 showed the highest magnitude of heterobeltiosis, whereas the cross combination JOL-2K-19 x AOL-13-73 and JOL-2K-19 x EC-169513 expressed the highest degree of standard heterosis for the number of fruits per plant. Numerous workers including Kumar and Sreeparvathy (2010) [5], Vachhani *et al.* (2011) [14], Paul (2013) [95], Patel and Patel (2016) [8], Satish *et al.* (2017) [11] and Makdoomi *et al.* (2018) [6] observed positive heterosis for number of fruits per plant in okra (Table 3).

The ranges of heterobeltiosis and standard heterosis was -32.66% (HRB-55 x EC-169513) to 19.92% (AOL-08-5 x Kashi Kranti) and from -26.62% (JOL-2K-19 x Kashi Kranti) to 18.80% (AOL-08-5 x Kashi Kranti), respectively for fruit length. Above pronounced results regarding fruit trait have been noticed by few researchers like; Patel and Patel (2016) [8], Gavint *et al.* (2017) [2] and Prakash *et al.* (2019) [10] reported significant and negative heterosis for fruit length in okra (Table 3).

Conspicuous heterosis was recorded for fruit girth in the present investigation. The standard heterosis ranged from -8.46% (AOL-08-5 x AOL-13-73) to 5.64% (JOL-2K-19 x EC-169513). The present finding is in agreement with the findings of Kumar and Sreeparvathy (2010) [4], Paul (2013) [9], Makdoomi *et al.* (2018) [6] and Hadiya *et al.* (2018) [3] (Table 3).

Yield is the character of economic importance for which considerable magnitude of heterosis was registered in number of crosses in the present investigation. The cross combination; JOL-2K-19 x AOL-13-73 exhibited the highest significant and positive heterobeltiosis. While, the cross combination; JOL-2K-19 x AOL-13-73 exhibited highest significant and positive heterosis over standard check followed by JOL-2K-19 x EC-169513 and GO-2 x EC-169513. Positive heterosis for fruit yield per plant was observed by Vachhani *et al.* (2011) [14], Gajera and Vaddoria (2014) [1], Tiwari *et al.* (2015) [13], Patel and Patel (2016) [8], Gavint *et al.* (2017) [2], Hadiya *et al*. (2018) [3] and Prakash *et al.* (2019) [10] (Table 3).

Conclusion

It is concluded from the present study that out of 30 hybrids, three hybrids exhibited significant and positive standard heterosis over check GJOH-4 for fruit yield per plant. The best three crosses *viz*., JOL-2K-19 x AOL-13-73, JOL-2K-19 x EC-169513 and GO-2 x EC-169513 manifested significant and desirable heterobeltiosis and standard heterosis for fruit yield per plant and other yield contributing characters. High heterotic response for fruit yield per plant was mainly obtain due to high heterotic response observed for other related characters like plant height, number of internodes per plant, fruit weight, fruit girth, fruit length, fruit dry weight and number of fruits per plant.

Table 1: Analysis of variance for experimental design in respect to ten characters in okra

Source of variation	d.f.	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 (cm)	Fruit yield per plant (g)
Replications	2	10.756 *	10.593	23.555	0.030	0.609	0.008	1.308	0.421	0.133 *	118.751
Genotypes	40	24.917 **	14.427 **	223.417 **	0.403 **	10.606 **	3.433 **	15.459 **	2.857 **	0.120 **	1349.967 **
Parents	10	38.751 **	14.721 **	217.220 **	0.525 **	17.459 **	2.516 **	15.325 **	4.657 **	0.237 **	1859.748 **
Hybrids	29	21.004 **	13.429 **	157.640 **	0.373 **	6.178 **	3.355 **	13.763 **	2.222 **	0.084 **	1190.244 **
Parents *vs.* Hybrids	1	0.045	40.428 **	2192.899 **	0.076 *	70.481 **	14.866 **	65.948 **	3.301 **	0.007	884.120 *
Error	80	2.856	4.877	12.247	0.011	1.589	0.115	0.586	0.253	0.042	170.428

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

Table 2: Estimation of heterobeltiosis (H_1) and standard heterosis (H_2) percentage for ten characters in okra

Hybrids	Days to 50% flowering		Days to first picking		Plant height (cm)		Numbers of branches per plant		Numbers of nodes per plant	
	1		2		3		4		5	
	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2
GO-2 x AOL-13-133	6.21 **	9.22 **	1.81	3.68	25.83 **	55.36 **	21.43 **	54.55 **	20.51 **	-8.44 *
GO-2 x AOL-13-73	-0.68	2.13	-4.81 *	-3.07	44.14 **	77.98 **	2.44	27.27 **	8.70	-18.83 **
GO-2 x Kashi Kranti	9.37 **	-0.71	2.60	-3.07	4.14	52.67 **	10.53 **	27.27 **	4.00	-15.58 **
GO-2 x EC-169513	-4.86 **	-2.84	-4.81 *	-3.07	60.14 **	97.72 **	0.00	-45.45 **	22.32 **	-11.04 **
GO-2 x IC-90107	-4.82 **	-2.13	-3.03	-1.84	20.14 **	64.81 **	13.89	-37.88 **	15.52 **	-12.99 **
VRO-6 x AOL-13-133	3.60 *	2.13	9.26 **	8.59 **	-13.28 **	40.43 **	-35.71 **	-18.18 **	-29.76 **	-23.38 **
VRO-6 x AOL-13-73	2.89	1.42	-3.09	-3.68	-7.50 **	49.80 **	-12.20 **	9.09 *	-21.43 **	-14.29 **
VRO-6 x Kashi Kranti	21.87 **	10.64 **	8.45 **	2.45	-15.97 **	36.08 **	-44.74 **	-36.36 **	-21.43 **	-14.29 **
VRO-6 x EC-169513	-0.71	-2.13	-4.94 *	-5.52 **	6.07 *	71.76 **	120.00 **	33.33 **	-22.02 **	-14.94 **
VRO-6 x IC-90107	1.45	0.00	6.79 **	6.13 **	3.32	67.32 **	-25.00 **	-54.55 **	-11.90 **	-3.90
JOL-2K-19 x AOL-13-133	-12.77 **	-12.77 **	-0.61	-0.61	22.87 **	38.95 **	4.65	36.36 **	-0.85	-24.03 **
JOL-2K-19 x AOL-13-73	10.64 **	10.64 **	1.85	1.84	38.41 **	57.68 **	4.65	36.36 **	46.61 **	12.34 **
JOL-2K-19 x Kashi Kranti	7.02 **	-2.84	1.95	-3.68	-12.01 *	28.11 **	-44.19 **	-27.27 **	0.00	-18.83 **
JOL-2K-19 x EC-169513	0.00	0.00	-2.45	-2.45	65.37 **	80.57 **	-44.19 **	-27.27 **	38.14 **	5.84
JOL-2K-19 x IC-90107	2.13	2.13	-0.61	-0.61	10.20	51.19 **	-34.88 **	-15.15 **	12.71 *	-13.64 **
HRB-55 x AOL-13-133	22.22 **	1.42	-0.63	-3.07	29.35 **	67.50 **	-2.38	24.24 **	28.21 **	-2.60

(Contd…)

Table 2: (Contd…)

Hybrids	1	2	3	4	5	6	7	8	9	10
HRB-55 x AOL-13-73	23.93 **	2.84	-1.89.	-4.29 *	14.39 *	48.13 **	-43.90 **	-30.30 **	12.82 *	-14.29 **
HRB-55 x Kashi Kranti	20.51 **	0.00	3.25	-2.45	13.65 **	65.46 **	-44.74 **	-36.36 **	9.60 *	-11.04 **
HRB-55 x EC-169513	23.08 **	2.13	1.26	-1.23	13.46 **	46.92 **	-48.44 **	-50.00 **	11.97 *	-14.94 **
HRB-55 x IC-90107	1.71	-15.60 **	-5.03 *	-7.36 **	2.97	41.27 **	6.25	3.03	31.62 **	0.00
HRB-108-2 x AOL-13-133	-1.37	1.42	-5.42 **	-3.68	-4.10	8.45	-42.86 **	-27.27 **	6.84	-18.83 **

HRB-108-2 x AOL-13-73	-1.37	1.42	-4.21 *	-2.45	13.91 **	29.77 **	-56.10 **	-45.45 **	20.00 **	-10.39 **
HRB-108-2 x Kashi Kranti	12.49 **	2.13	14.29 **	7.98 **	-18.63 **	18.46 **	2.63	18.18 **	5.60	-14.29 **
HRB-108-2 x EC-169513	-2.08	0.00	-1.80	0.00	37.98 **	44.70 **	56.52 **	9.09 *	45.00 **	-5.84
HRB-108-2 x IC-90107	4.15 *	7.09 **	3.03	4.29 *	-10.81 **	22.36 **	4.35	-27.27 **	13.79 **	-14.29 **
AOL-08-5 x AOL-13-133	0.00	4.26 *	-0.63	-1.84	-8.15 **	43.03 **	4.65	36.36 **	-4.22	3.25
AOL-08-5 x AOL-13-73	-4.08 *	0.00	-0.01	-1.23	-8.81 **	42.01 **	-13.95 **	12.12 **	-21.08 **	-14.94 **
AOL-08-5 x Kashi Kranti	12.49 **	2.13	3.25	-2.45	-1.07	54.06 **	-16.28 **	9.09 *	-3.61	3.90
AOL-08-5 x EC-169513	-1.39	0.71	-1.87	-3.07	10.48 **	72.04 **	-51.16 **	-36.36 **	-12.05 **	-5.19
AOL-08-5 x IC-90107	-12.24 **	-8.51 **	-4.35 *	-5.52 **	13.69 **	77.05 **	-9.30 **	18.18 **	0.60	8.44 *
Range	-12.77% to 23.93%	-15.60% to 10.64%	-5.42% to 14.29%	-7.36% to 8.59%	-18.63% to 65.37%	8.45% to 97.72%	-56.10% to 120.00%	-54.55% to 54.55%	-29.76% to 46.61%	-24.03% to 12.34%
Mean	4.65%	0.54%	0.25%	-1.04%	11.67%	51.72%	-10.60%	-5.35%	6.87%	-9.57%
S.Em.±	0.97	0.97	1.27	1.27	2.02	2.02	0.05	0.05	0.72	0.72

*, ** Significant at P=0.05 and P=0.01, respectively

Table 3: Estimation of heterobeltiosis (H_1) and standard heterosis (H_2) percentage for ten characters in okra

Hybrids	Internodal length (cm)		Numbers of fruits per plant		Fruit length (cm)		Fruit girth (cm)		Fruit yield per plant (g)	
	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2
	1	2	3	4	5	6	7	8	9	10
GO-2 x AOL-13-133	47.54 **	47.54 **	7.83	-30.77 **	0.00	-3.41	-1.75	-5.64 **	0.41	-15.29 **
GO-2 x AOL-13-73	81.16 **	104.92 **	26.89 **	-10.65 **	9.73 **	5.99 *	2.52	-1.81	24.06 **	4.67
GO-2 x Kashi Kranti	37.68 **	55.74 **	-7.14	-30.77 **	-1.86	-5.20 *	-0.14	-5.91 **	-6.73	-17.27 **
GO-2 x EC-169513	-16.15 **	-11.48 *	44.83 **	-0.59	-1.45	-4.81	-5.64 **	0.00	37.19 **	15.74 **
GO-2 x IC-90107	40.58 **	59.02 **	-5.17	-34.91 **	6.20 *	2.58	-4.79 **	-2.62	7.12	-9.62
VRO-6 x AOL-13-133	91.80 **	91.80 **	-31.89 **	-34.91 **	4.19	0.75	4.48 *	0.34	-17.55 **	-8.93
VRO-6 x AOL-13-73	13.08 **	67.21 **	-8.98 **	-13.02 **	-3.38	-6.57 **	-1.12	-5.31 **	-28.91 **	-21.47 **
VRO-6 x Kashi Kranti	16.25 **	52.46 **	-20.12 **	-23.67 **	0.48	-2.83	9.76 **	3.43	-5.22	4.70
VRO-6 x EC-169513	52.17 **	60.66 **	-7.74 *	-11.83 **	2.63	-0.75	-8.11 **	-2.62	24.41 **	-16.50 **
VRO-6 x IC-90107	44.03 **	91.26 **	2.74	-2.37	9.50 **	5.88 *	-0.85	1.41	-27.10 **	-19.48 **
JOL-2K-19 x AOL-13-133	78.69 **	78.69 **	12.44 *	-27.81 **	-0.76	-11.16 **	-7.62 **	-0.74	-15.63 **	-29.61 **
JOL-2K-19 x AOL-13-73	29.31 **	47.54 **	79.83 **	26.63 **	-2.61	-12.81 **	-10.19 **	-3.49	46.52 **	22.25 **
JOL-2K-19 x Kashi Kranti	35.06 **	54.10 **	-11.11 **	-33.73 **	-18.75 **	-26.62 **	-10.00 **	-3.29	-21.24 **	-30.14 **
JOL-2K-19 x EC-169513	86.34 **	96.72 **	84.48 **	26.63 **	11.66 **	-0.04	-1.69	5.64 **	46.35 **	22.11 **
JOL-2K-19 x IC-90107	47.99 **	68.85 **	10.34 *	-24.26 **	-2.78	-12.09 **	-8.37 **	-1.54	5.24	-12.19 *
HRB-55 x AOL-13-133	95.08 **	95.08 **	-5.75	-2.96	-12.44 **	4.09	3.50	-0.60	-17.28 **	-2.02
HRB-55 x AOL-13-73	6.43	57.38 **	-32.47 **	-30.47 **	-14.61 **	1.51	0.63	-3.63	-37.02 **	-25.39 **

(*Contd….*)

Table 3: (Contd…)

Hybrids	1	2	3	4	5	6	7	8	9	10
HRB-55 x Kashi Kranti	46.25 **	91.80 **	-2.30	0.59	-15.91 **	-0.04	4.63 *	-1.41	-17.90 **	-2.74
HRB-55 x EC-169513	42.86 **	50.82 **	-28.16 **	-26.04 **	-32.66 **	-19.95 **	-10.01 **	-4.63 *	-43.84 **	-33.47 **
HRB-55 x IC-90107	26.17 **	67.54 **	6.32	9.47 **	-32.15 **	-19.34 **	-8.27 *	-6.18 **	-15.24 **	0.40
HRB-108-2 x AOL-13-133	16.31 *	-10.38 *	-18.89 *	-47.93 **	4.98	-9.94 **	-1.79	-0.60	-31.63 **	-36.08 **
HRB-108-2 x AOL-13-73	112.77 **	63.93 **	26.05 **	-11.24 **	3.68	-11.05 **	0.86	2.08	-12.74 *	-18.42 **
HRB-108-2 x Kashi Kranti	70.21 **	31.15 **	11.90	-16.57	1.79	-8.07 **	-1.46	-0.27	-32.64 **	-37.02 **
HRB-108-2 x EC-169513	70.21 **	31.15 **	49.14 **	2.37 **	8.24 **	-7.14 **	-2.09	3.76 *	14.16 **	6.73
HRB-108-2 x IC-90107	13.48 *	-12.57 *	2.59	-29.59 *	-7.94 **	-16.76 **	-6.70 **	-4.57 *	-15.24 **	-20.75 **
AOL-08-5 x AOL-13-133	55.74 **	55.74 **	-6.01	-7.40 **	-1.63	-2.55	-3.24	-3.69	2.70	-8.16
AOL-08-5 x	-38.65 **	-9.29	-24.32 **	-25.44 **	-12.68 **	-13.49 **	-8.03 **	-8.46 **	-0.21	-10.76 *

AOL-13-73										
AOL-08-5 x Kashi Kranti	34.83 **	76.83 **	17.12 **	15.38	19.92 **	18.80 **	3.98 *	3.49	-6.88	-16.74 **
AOL-08-5 x EC-169513	39.65 **	47.43 **	-2.10	-3.55 **	-3.80	-4.70	-4.18 *	1.54	-2.18	-12.53 *
AOL-08-5 x IC-90107	32.59 **	76.07 **	10.81	9.17 **	-12.57 **	-13.38 **	-5.32 **	-3.16	15.21 **	3.02
Range	-38.65% to 112.77%	-12.57% to 104.92%	-32.47% to 84.48%	-47.93% to 26.63%	-32.66% to 19.92%	-26.62% to 18.80%	-10.19% to 9.76%	-8.46% to 5.64%	-43.84% to 46.52%	-37.02% to 22.25%
Mean	43.65%	55.92%	6.04%	-13.01%	-3.17%	-5.77%	-2.70%	-1.62%	-4.39%	-10.83%
S. Em.±	0.19	0.19	0.44	0.44	0.29	0.29	0.11	0.11	7.53	7.53

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

References

1. Gajera AD, Vaddoriya MA. Heterosis studies for quantitative traits in okra [*Abelmoschus esculentus* (L.) Moench]. AGRES-An Int. e-J. 2014; 3(2):160-165.
2. Gavint KN, Vadodariya KV, Bilwal BB. To study the nature and magnitude of heterosis for fruit yield and yield attributes in okra [*Abelmoschus esculentus* (L.) Moench]. J. Pharmacog. Phytochem, 2017; 7(1):2583-2587.
3. Hadiya HN, Mali SC, Baraiya VK, Patel AI. Studies on assessment of heterosis for fruit yield and attributing characters in okra [*Abelmoschus esculentus* (L.) Moench]. Int. J. Chem. Stud. 2018; 6(5):1919-1923.
4. Kumar PS, Sreeparvathy S. Study of heterosis in okra [*Abelmoschus esculentus* (L.) Moench]. Electron. J. Plant Breed. 2010; 1(6):1431-1433.
5. Kumar S, Pathania NP. Combining ability and gene action studies in okra [*Abelmoschus esculentus* (L.) Meonch]. J. Res. Punjab Agric. Univ. 2011; 48(1&2):43-47.
6. Makdoomi MI, Kouser P, Wani ZA, Dar K, Hussain AN, Faheema M *et al*. Heterosis studies in okra [*Abelmoschus esculentus* (L). Moench]. Int. J. Curr. Microbiol. App. Sci. 2018; 7(02):3297-3304.
7. Mays DA, Buchanan W, Bradford BN, Giordano PM. Fuel production potential of several agricultural crops. Ad. New Crops, 1990, 260-263.
8. Patel BG, Patel AI. Heterosis studies in okra [*Abelmoschus esculentus* (L.) Moench]. Ann. Agr. Environ. Sci. 2016; 1(1):15-20.
9. Paul T. Genetic architecture and fruit yield analysis in okra [*Abelmoschus esculentus* (L.) Moench]. M. Sc. Thesis, NAU., Navsari, 2013.
10. Prakash K, Pitchaimuthu M, Srinivasa V, Venugopalan R. Heterosis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. Int. J. Curr. Microbiol. App. Sci. 2019; 8(1):353-367.
11. Satish K, Kejal B, Suresh K, Prajapati DB, Agalodiya AV. Heterosis study in okra *[Abelmoschus esculentus* (L.) Moench]. J. Sci., Agriculture & Engineering. 2017, 7(24):85-89.
12. Sharma BR, Arora SK. Improvement of okra. Advances in Horticulture. Vegetable Crops part-I. (Eds) Chadha, K. L. and Kalloo, G. J., Malhotra Publishing House, New Delhi. 1993; 5:343-364.
13. Tiwari JN, Kumar S, Ahlawat TR, Kumar A, Patel N. Heterosis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. Asian J. Hort. 2015; 10(2):201-206.
14. Vachhani JH, Shekhat HG, Kachhadia VH, Jivani LL, Padhar PR. Heterosis and inbreeding depression in okra [*Abelmoschus esculentus* (L.) Moench]. Res. on Crops. 2011; 12(2):556-560.