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Short Communication

Heterosis for fruit yield and its component traits in double cross derived inbred lines of okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract

One hundred and twenty hybrids of okra [*Abelmoschus esculentus* (L.) Moench] developed from forty double cross derived lines (female) and three testers (male) were studied for heterosis of fruit yield and its component traits. Analysis of variance showed significant differences among the parents and hybrids. Significant heterosis ranging from –63.68 to 78.58 per cent over better parent was recorded for fruit yield. The gain over superior check US Agro ranged between –58.63 to 21.28 per cent. Three hybrids namely, DBh383 (21.28%), DBh31 (19.23%) and DBh133 (10.93%) showed high heterosis for fruit yield over superior check US Agro and thus were most promising for commercial cultivation.

Key words: Line x tester, heterosis, genetic diversity, variance, okra

Okra [*Abelmoschus esculentus* (L.) Moench] is an important fruit vegetable grown for its tender fruits in India. Manifestation of heterosis is of direct relevance for developing hybrids in both self and cross pollinated vegetable crops. However, in pursuit of taking the progamme of hybrid okra to logical ends, choice of suitable parents through careful and critical evaluation is of paramount importance. This is because *per se* performance of parents is not always a true indicator of its potential in hybrid combinations. Hybrids are making a mark by fast replacing the traditional open pollinated varieties because of their greater uniformity, production stability with higher yields ensuring higher seed set as compared to traditional open pollinated varieties [1]. Keeping these facts, in view then experiment was conducted to identify heterotic okra hybrids.

One hundred and twenty F_1 hybrids were developed by crossing forty double cross derived lines with three testers, namely, Arka Anamika, Pusa Sawani and Parbhani Kranti in a line x tester fashion during *rabi* 2008. These hybrids were evaluated for fruit yield and its components along with with six checks *viz*., Syngenta, Sinnova, Mahyco 10, Ankur, US Agro and Mahyco 417 in Simple Lattice Design with two replications during *kharif* 2009 at Main Agricultural Research Station, Dharwad. Each entry was sown in three rows of 3 meter length with plant to plant distance of 45cm at 60cm apart. The recommended cultural practices were followed. Data on nine quantitative characters *viz*., days to 50% flowering, plant height, number of branches per plant, fruit length, fruit diameter, test weight, fruit weight, number of fruits per plant and fruit yield per plant were recorded. Statistical analysis and variance due to different sources was worked out as per the method outlined by Kempthorne [2].

Analysis of variance with respect to nine characters in parents and hybrids revealed that the mean sum of squares due to parents and hybrids were highly significant for all the characters studied. This indicated the existence of high genetic variation among parents and hybrids. Males exhibited significant

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differences for all the characters except, days to 50 per cent flowering, fruit length, number of fruits per plant and fruit yield per plant. The mean squares due to parents vs crosses, which is a measure of the importance of average heterosis, were significantly different for majority of the traits except for days to 50 per cent flowering and test weight. But variance due to line x tester interaction was significant for plant height, number of branches per plant, fruit length, fruit weight, number of fruits per plant and fruit yield per plant. This differential variance indicated the chance of expression of heterosis for these characters.

Manifestation of heterosis (Table 1) for all the characters in one cross may not be possible but the exploitation of hybrid vigour for yield attributing traits will significantly improve the crop performance over existing hybrids or varieties. Weerasekara *et al.* [3] and Jindal *et al.* [4] evaluated 66 F_1 hybrids and reported such variation in heterosis for different traits. They further reported significant heterobeltiosis and economic heterosis for all the traits and the magnitude of heterosis was higher than heterobeltiosis. The number of days required to 50% of the plants in a genotype to flower is a definite indication of the duration of the genotype. For days to 50% flowering, the hybrid DBh41 was earliest in flowering (46

Table 2. Heterosis (%) over better-parent (BP) and superior standard check US agro for different characters in okra

Cross	Days to 50% flowering		Plant height		No. of branches/plant		Fruit length		Fruit diameter		Test weight		Fruit weight		No. of fruits per plant		Fruit yield per plant (g)	
	BP	US agro	BP	US agro	BP	US agro	BP	US agro	BP	US agro	BP	US agro	BP	US agro	BP	US agro	BP	US agro
DBh383	5.94*	9.18**	20.94**	66.25**	32.35**	55.17**	–21.45**	0.81	10.62**	10.62**	12.5	38.46**	–9.64*	–21.68**	70**	51.79**	78.58**	21.28**
DBh31	–1.01	0	–20.93**	26.01**	–43.4**	3.45	27.11**	40.49**	7.63*	12.39**	–20**	7.69	66.97**	18.07**	–28.4**	3.57	25.21**	19.23**
DBh133	0	2.04	3.27*	41.96**	–40.54**	51.72**	6.94	37.25**	9.62*	0.88	20**	38.46**	–9.59*	–21.63**	–9.09	60.71**	4.03	10.93*
DBh122	–3.92	0	26.46**	50.89**	57.14**	89.66**	4.29	27.94**	–9.73**	–9.73*	–11.76	15.38	20.99**	–11.56**	–19.05*	21.43*	31.86**	10.53*
DBh131	–2	0	14.63**	51.42**	–36.49**	62.07**	–0.37	8.5	–9.73**	–9.73*	–20**	7.69	18.62**	–16.12**	–24.24	33.93**	3.63	10.5*
DBh132	–3.92	0	27.4**	68.3**	–32.43**	72.41**	–1.65	20.65*	–7.96*	–7.96*	20**	38.46**	3.04	–24.68**	–12.12	55.36**	2.78	9.59
DBh51	2.02	3.06	–6.5**	42.69**	93.55**	106.9**	12.27	22.27*	0	0	–2.86	30.77**	–32.87**	–36.3**	66.1**	75**	8.09	7.32
DBh123	5.15*	4.08	21.67**	67.24**	37.93**	37.93**	–12.3	12.55	6.73	–1.77	–29.41**	–7.69	–19.51**	–30.24**	1.19	51.79**	26.5**	6.03
DBh253	–5.83*	–1.02	–31.39**	-5.69**	30.43**	106.9**	–18.93*	4.05	2.88	–5.31	–13.33	0	–16.97**	–28.04**	8.97	51.79**	4.92	1.92
DBh261	–7.77**	–3.06	–14.51**	2.18	–26.47**	–13.79*	–25.33**	–9.31	–12.5**	–7.08	–25.71**	0	48.6**	5.09	–11.48	–3.57	31.87**	1.55
DBh42	–8.82**	–5.1*	13.26**	63.93**	–34.43**	37.93**	–5.28	16.19	0	0	21.43**	30.77**	–15.25**	–38.05**	–10.58	66.07**	–16.27**	1.35
DBh112	–7.84**	–4.08	2.99*	32.43**	–11.43	6.9	2.31	25.51*	–3.28	4.42	14.29	23.08**	–2.8	–28.94**	52.73**	50**	44.41**	1.16
S.Em±	3.22	2.22	1.41	1	0.12	0.06	1.18	0.91	0.2	0.16	0.54	0.36	0.84	0.5	3.26	2.1	20.79	12.85
CD @ 5%	4.24	2.92	3.88	2.78	0.32	0.17	3.26	2.52	0.56	0.42	1.5	1	2.33	1.39	9.01	5.81	57.46	35.63
CD @ 1	3.22	2.22	2.5	3.66	0.43	0.23	3.88	3.31	3.26	0.57	2.97	1.32	3.06	1.83	11.86	7.65	75.64	46.9

*Significant at 5% probability level, **Significant at 1% probability level days) followed by DBh42 (46.5 days). Most of the hybrids showed significant negative heterosis for days to 50% flowering ranging from –6.12 % to 12.24 % over superior check. Maximum negative heterosis for early flowering was recorded in cross DBh 82 over better parent and DBh41 over US Agro. The existence of both positive and negative heterotic effects over parents and checks suggest the presence of non-additive gene action for this trait. Significant negative heterosis for this character has been reported earlier [3, 5, 6]. Plant height reported by several workers is an important yield component, which is significantly associated with fruit yield. The hybrid DBh292 (147.65 cm) recorded maximum plant height, whereas hybrid DBh272 (67.75 cm) was dwarfest among all hybrids. Highest heterosis over better parent was recorded in cross DBh102 (57.02 %) followed by DBh372 (52.59 %). Significant negative heterosis is desirable for this trait and the highest significant negative heterosis was observed in the cross DBh63 (–43.62 %) over better parent and DBh332 (–9.53 %) over superior check. Branches are the important growth parameters contributing to productivity. Highest heterosis (106.9%) was recorded in hybrids DBh51 and DBh253 over better parent US Agro. Fruit length for hybrids ranged from 9.1 cm (DBh301) to 17.35 cm (DBh31). The hybrid DBh31 gave 27.11% heterotic advantage over better parent, whereas hybrids, DBh31 and DBh133 gave 40.49 and 37.25% heterosis over superior check respectively. The consumer prefers slender fruits with lower fruit girth. Among the hybrids, less fruit diameter was observed in the cross DBh353 (4.1 cm) followed by DBh313 (4.55 cm). Most of the hybrids showed significant negative heterosis for fruit diameter. Panda and Singh [7] reported significant negative heterosis for fruit diameter. The test weight and fruit weight of the genotypes serve as an indicator of yield as both the characters are important contributing to yield. In the present investigation, most of the hybrids recorded positive heterosis over better parent and standard check. The hybrid DBh42 showed significant positive heterosis (21.43%) over better parent as well as over US Agro (30.77%). Three hybrids, namely, DBh132, DBh133 and DBh383 showed significant positive hetrosis (38.46%) over superior check US Agro. Heterosis of lower magnitude (6-9%) has been earlier reported for this fruit [5, 6]. For fruit weight, high significant positive heterosis over better parent was recorded in cross DBh31 (66.97%) followed by DBh261 (48.60%), however, the same hybrids, DBh31 and DBh261 recorded 18.07 and 5.09% heterosis for fruit weight over superior check respectively. The present findings support the results of Mamta Rani *et al*. [8-10]. For number of fruits per plant the positive heterosis over BP varied from 1.19% (DBh123) to 70% (DBh383). Most of the hybrids showed positive and significant heterosis for number of fruits/plant, the hybrid DHb42 was the best (66.07%). Solankey and Singh [9] also studied a large number of okra hybrids and reported ample scope for improvement in yield through heterosis breeding. The fruit yield per plant varied from 132.71 g (line 39) to 446.86 g (line 4) among the parents. Hybrid DBh383 (447.72 gm) recorded highest yield followed by DBh31 (440.16 gm) and DBh133 (409.50 g). Heterosis for fruit yield per plant over better parent ranged from –63.38% to 78.58% while it ranged from -58.63% to 21.28% over superior check. Most of the hybrids showed positive heterosis for this trait. Maximum significant positive heterosis was observed in the cross DBh383 over better parent (78.58 %) and superior check (21.28 %). Among 120 crosses, 36 hybrids exhibited positive and significant heterosis for fruit yield per plant over better parent and 5 crosses over superior check. The average heterosis for yield was 8.88% which indicated that hybrids had higher fruit yield per plant than the parents. The positive heterosis is due to differences in genetic background of lines used in hybridization and it is confirmed by the significant difference in parental variances for all the characters. It is observed that the crosses with average performance showed higher degree of heterosis for this trait. Positive heterosis for fruit yield per plant has been also reported earlier [11, 12]. The crosses showing high heterosis for yield have also exhibited good specific combining ability effects Pal and Sabesan [13] observed close correspondence between *per se* performance of parents and their gca effects in okra. Evidently manifestation of heterosis for yield and yield components may be due to non additive gene effects in the parents. The moderate to high heterosis exhibited by the crosses for fruit yield and its components may be exploited to improve the yield potential of the existing superior varieties of okra. A hybrid merits consideration only when it yields at least 25% more than the highest yielding pure line. In present study, hybrid DBh383, DBh31 and DBh133 were commercially exploitable. Extensive trials of these hybrids in large scale plots and on farmers fields need to be conducted to ascertain their yield potential. However, present study revealed manifestation and considerable amount of heterosis for yield per plant in okra and indicates large scope for heterosis breeding for further improvement in yield.

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