HETEROSIS STUDIES FOR QUANTITATIVE TRAITS IN OKRA *[Abelmoschus esculentus* (L.) MOENCH]

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ABSTRACT

A study was conducted in okra [Abelmoschus esculentus (L.) Moench] at Department of Genetics and Plant Breeding, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) to assess the extent of heterosis for eleven quantitative traits including fruit yield per plant. Eight genotypes were crossed in diallel fashion (excluding reciprocals) to develop 28 F_1 hybrids and were evaluated during summer-2012. The analysis of variance for experimental design revealed highly significant differences among the genotypes, parents and hybrids for all the characters except for fruit length for parents, indicating the presence of sufficient amount of genetic variability in the material studied. The interaction between parents and hybrids recorded significant differences for all the characters except for plant height, number of branches per plant, number of nodes per plant and internodal length, indicated that with exception of few traits heterosis could be exploited for most of the traits. Heterosis was worked-out over better parent and standard check variety, GJOH-3. The standard heterosis for fruit yield per plant ranged from -37.05 to 24.66 per cent. The crosses, Arka Anamika x JOL-09-7, JOL-09-7 x JOL-04-8 and GO-2 x JOL-09-7, were the best heterotic combinations for fruit yield per plant, which recorded 24.66 per cent, 23.31 per cent and 20.32 per cent standard heterosis, respectively and could be utilized for commercial exploitation of heterosis after large scale testing. The heterosis for fruit yield per plant was associated with the heterosis expressed by its component characters.

KEY WORDS: Heterobeltiosis, okra, standard heterosis

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an important vegetable crop grown for its green tender fruits in tropical and sub-tropical regions. It is more remunerative than the leafy vegetables. Its green tender fruits are used as vegetable and generally marketed in fresh form. It is also available in dehydrated and canned forms. Exploitation of hybrid vigour to increase the yield has become an important technique in vegetable breeding. Okra is one of the most suitable crop for exploitation of heterosis due to easy emasculation and pollination as well as large number of seeds per cross. Today hybrids are gaining popularity due to their high productivity, better quality, uniform product and adaptation in to varying environmental condition. Combining ability analysis helps to choose suitable parents for hybridization and provides

valuable information regarding F_1 crosses to be exploited commercially. Information on the combining abilities of the genotypes will be helpful in the analysis and interpretation of the genetic basis of important traits. In okra, several researchers have already reported the presence of significantly high heterosis for fruit yield and its components. Heterosis of small amount for individual yield contributing traits may have an additive or synergistic effect on the end product. Hence, the present study was undertaken with a view to find out heterotic combinations for fruit yield and its components in okra.

MATERIAL AND METHODS

A set of 28 hybrids developed using 8 parents (GO-2, GJO-3, GJO-5, Arka Anamika, VRO-6, JOL-09-7, JOL-04-08 and HRB-108-2) of okra through diallel mating design (excluding reciprocals). The 28 hybrids and their eight parents were raised in randomized block design with three replications at Instructional Farm, Junagadh Agricultural University, Junagadh during summer 2012. Each entry was sown in 3.0 m long single row plot at 60 x 30 cm spacing. Observations on five randomly selected plants were recorded for days to 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), 10-fruit weight (g) and fruit yield per plant (g). The mean values were used for estimation of heterosis over better parent and standard check as per the standard procedure. The recommended plant protections and other cultural practices were followed to maintain uniform experimental conditions.

RESULTS AND DISCUSSION

Analysis of variance (Table 1) showed highly significant differences among the genotypes for all the characters indicating the presence of sufficient variability in the experimental material for the traits studied. Differences amongst the hybrids and parents were also found highly significant for all characters except for fruit length among the parents. The interaction between parents and hybrids recorded significant differences for all the characters except for plant height, number of branches per plant, number of nodes per plant and internodal length. This indicated that with exception of few traits heterosis could be exploited for most of the traits.

The details on range of heterobeltiosis and standard heterosis as well as number of hybrids having significant heterosis are presented in Table 2. The extent of heterosis for days to flowering varied from -19.11 to 1.91 per cent, where sixteen crosses exceeded the standard parent in desirable direction. Ten crosses surpassed the standard parent for days to first picking in which heterosis ranged from -17.61 to 2.19 per cent. These findings are in consonance with Pawar *et al.* (1999), Mamta *et al.* (2002) and Rewale *et al.* (2003). The crosses JOL-09-7 x JOL-04-8 and GO-2 x JOL-04-8 could be used in future crop improvement programme for development of varieties with earliness in okra.

The characters contributing towards vegetative growth such as plant height, number of branches per plant and number of nodes per plant exhibited heterosis up to 4.79, 7.63 and 3.25 per cent, respectively. The results are in concurrence with the findings of Rewale *et al.* (2003), Yadav *et al.* (2007) and Vachhani *et al.* (2011). Out

of 28 crosses, 5, 2 and 3 crosses showed significant positive standard heterosis for the characters fruit length, fruit girth and number of fruits per plant, in which heterosis ranged from -3.69 to 16.28, -15.60 to 19.91 and -19.90 to 17.40 per cent, respectively. Similar results have also been reported by Desai (1990) and Patel (1991). A total of two hybrids for 10-fruit weight and 16 hybrids for internodal length showed significant positive standard heterosis. Similar results have also been reported for this characters by Korla (1987) and Vachhani *et al.* (2011).

The hybrid vigour for fruit yield per plant varied from -37.05 to 24.66 per cent. A total of three hybrids registered significant standard heterosis for fruit yield per plant. The highest value of heterosis was displayed by the cross Arka Anamika x JOL-09-7(24.66 %) followed by JOL-09-7 x JOL-04-8 (23.31 %) and GO-2 x. JOL-09-7(20.32 %). Heterosis for fruit yield has been reported earlier by Bhalekar *et al.* (2004), Wammanda *et al.* (2010) and Vachhani *et al.* (2011).

The crosses which showed high heterosis for fruit yield per plant also had high heterosis for number of fruits per plant, number of branches per plant, plant height, number of nodes per plant, fruit length and fruit girth. The results thus, revealed that the heterosis for fruit yield per plant was associated with the heterosis expressed by its component characters (Table 3). Such a situation of combinational heterosis has been reported in okra by Saha and Kabir (2001), Bhalekar *et al.* (2004), Wammanda *et al.* (2010) and Vachhani *et al.* (2011). The crosses Arka Anamika x JOL-09-7 and JOL-09-7 x JOL-04-8 showed desirable heterosis for fruit yield per plant along with other traits viz., days to flowering, days to first picking and number of fruits per plant. Therefore, these cross combinations may be tested in large scale trials to confirm the superiority for heterosis.

CONCLUSION

From the results, it can be concluded that the crosses, Arka Anamika x JOL-09-7, JOL-09-7 x JOL-04-8 and GO-2 x JOL-09-7, were the best heterotic combinations for fruit yield per plant, which recorded 24.66 per cent, 23.31 per cent and 20.32 per cent standard heterosis, respectively and could be utilized for commercial exploitation of heterosis after large scale testing.

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Table 1: Analysis of variance for experiment design for different characters in okra

Source of Variation	df	Days to 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)	10-Fruit Weight (g)	Fruit Yield Per Plant (g)
Replications	2	0.11	0.15	9.87	0.23	3.49	0.01	0.76	0.44	0.007	326.26*	1219.44
Genotypes	35	35.83**	37.62**	636.92**	0.98**	15.11**	1.03**	11.0**	2.40**	0.64**	861.50**	5264.12**
Parents	7	50.28**	54.48**	788.83**	0.84**	21.06**	1.14**	6.51**	0.35	0.53**	232.47**	1275.74*
Hybrids	27	31.20**	32.38**	620.00**	1.05**	14.10**	1.04**	9.33**	1.44**	0.49**	615.30**	3750.90**
Parents Vs	1	59.52**	61.12**	30.19	0.14	0.64	0.03	88.32**	42.51**	5.39**	11912.11**	74039.71**
Error	70	2.63	7.22	29.71	0.19	2.35	0.09	2.10	0.43	0.08	77.04	526.91

***,** Significant at 5 per cent and 1 per cent levels of significance, respectively*

Table 2: Range of heterobeltiosis (H_1) and standard heterosis (H_2) as well as number of crosses with specific heterotic effects for various traits in okra

Sr. No.	Characters	Range of Heterosis (%)		Number of Crosses With Significant Heterosis			
		Heterobeltiosis (%)	Standard Heterosis (%)	Heterobeltiosis (%)		Standard Heterosis (%)	
				+Ve	-Ve	+Ve	-Ve
1.	**Days to Flowering**	-3.97 to 21.21	-19.11 to 1.91	19	0	0	16
2.	**Days to First Picking**	-4.19 to 19.15	-17.61 to 2.19	15	0	0	10
3.	**Plant Height (cm)**	-45.80 to 68.91	-45.03 to 4.79	5	13	0	18
4.	**Number of Branches Per Plant**	-44.17 to 24.44	-48.85 to 7.63	1	8	0	16
5.	**Number of Nodes Per Plant**	-35.21 to 32.25	-33.66 to 3.25	3	11	0	16
6.	**Internodal Length (cm)**	-26.06 to 42.17	-24.76 to 12.12	16	3	3	16
7.	**Number of Fruits Per Plant**	-16.22 to 39.42	-19.90 to 17.40	10	1	3	2
8.	**Fruit Length (cm)**	-0.06 to 23.15	-3.69 to 16.28	15	0	5	0
9.	**Fruit Girth (cm)**	-8.73 to 21.42	-15.60 to 19.91	13	0	2	4
10.	**10-Fruit Weight (g)**	-16.28 to 49.39	-30.85 to 15.46	18	2	2	5
11.	**Fruit Yield Per Plant (g)**	-17.67 to 96.34	-37.05 to 24.66	18	0	3	5

+ve = Positive, -ve = Negative

Table 3: Comparative study of three most standard heterotic crosses for fruit yield per plant along with *per se* performance and their heterotic effects for component characters in okra

Sr. No.	Crosses	Mean Fruit Yield Per Plant (g)	Fruit Yield Per Plant (g)	Days to Flowering	Days to First Picking	Plant Height (cm)	Fruit Length (cm)	Fruit Girth (cm)	10-Fruit Weight (g)	Number of Branches Per Plant	Number of Nodes Per Plant	Internodal Length (cm)	Number of Fruits Per Plant
1.	**Arka Anamika x JOL-09-7**	254.19	24.66**	-17.22**	-13.07**	-29.89**	-3.12	4.25	6.09	-8.40	-17.29**	-11.21*	17.40*
2.	**JOL-09-7 x JOL-04-8**	251.44	23.31*	-19.11**	-17.61**	1.91	3.15	4.93	15.46**	-34.35**	0.79	10.56*	17.03*
3.	**GO-2 x JOL-09-7**	245.34	20.32*	-3.82	-5.68	4.74	-3.69	-7.03	5.48	-12.21	1.57	6.93	3.68

***,** Significant at 5 per cent and 1 per cent levels of significance, respectively*

[MS received: May 17, 2014] *[MS accepted: June 18, 2014]*