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Heterosis studies for some fruit characteristics in okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract

The performance of 18 hybrids of okra obtained by crossing six iines with three testers was studied and the magnitude of heterosis was estimated for six characters. The cross, IC-90269 x P-8 exhibited the maximum heterosis (98.20%) over the standard check variety, Parbhani Kranti followed by the cross IC-90269 x Parbhani Kranti (87.30%) for fruit yield per plant. These crosses also displayed the maximum standard heterosis for fruit weight and significant positive heterosis for fruits per plant.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is an important warm season fruit vegetable cultivated in tropical and sub-tropical parts of the world for its tender, non-fibrous edible pods. The immature unripe fruits are used in a variety of ways as cooked vegetable, boiled, fried, soups, stews in meat, frozen, canned and dehydrated forms. Okra fruits are very useful against genitro-urinary disorders like spermatorrhoea and chronic dysentery (Nandkarni, 1972). In Himachal Pradesh, it is mainly cultivated as a market crop in low and mid hill areas, covering about 815 hectares, with a production of about 8715 metric tones (Anonymous, 2003). Okra has tremendous export potential as fresh vegetable and has captured a prominent position among export oriented vegetable crops. The genetic improvement in okra has been carried out primarily through conventional breeding methodologies. Of the different improvement methods, recombinant breeding is the most important technique to combine the desirable traits in a single genetic background. The feasibility of the exploitation of hybrid vigour in okra is acknowledged by the relative ease in emasculation and pollination, very high percentage of fruit setting, more number of seeds per fruit and less seed rate required for planting.

Material and Methods

Six diverse lines of okra *viz.*, VRO-4, EC-169464, EC-169468, IC-90269, IC-31850 and IC-32398, three testers *viz.*, P-8, Parbhani Kranti and Arka Anamika and their 18 F_1 crosses were evaluated in randomized block design during *Kharif*, 2005 at the Experimental Farm of the Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, H.P. Each experimental plot consisted of two rows of 1.5 m length. The plants were spaced at 60 cm row to row and 15 cm plant to plant. The Experimental Farm is located at an elevation of 1290.8m above mean sea level, 32.^{0}6' N latitude and 76^{0}3' E longitude, representing mid hill zone of Himachal Pradesh. The soil of the zone is podzolic type with pH ranging from 5-5.6. The data were taken on 10 competitive plants on some fruit characteristic viz., duration of the availability of marketable fruits, fruit length, fruit diameter, fruits per plant, fruit weight and fruit yield per plant. Parbhani Kranti (tester) is one of the widely adapted variety of the region and is used as a standard check for computation of standard/economic heterosis.

Results and Discussion

The analysis of variance for the different traits studied revealed significant differences among the treatments (Table 1). This indicated that the parents and crosses used in the present study were genetically diverse. Duration of availability of marketable fruits has great significance because extended duration of availability of marketable fruits will make available marketable fruits for a longer time and ultimately increase the marketable yield and bring more remuneration to the farmers. Sufficient variability among the parents and crosses existed for this trait which was evidenced from the significant mean squares. For this trait, heterosis ranged from -13.03 (EC-169468 x Arka

Table 1. Analysis of variance for design of experiment

Source of variation Trait	df	Mean squares due to		
		Replication	Treatment	Error
		2	26	52
Duration of availability of marketable fruits		2.161	39.649*	11.054
Fruit length		3.139*	2.709*	0.724
Fruit diameter		0.061*	0.045*	0.013
Fruits per plant		3.071*	5.185*	0.833
Fruit weight		11.711*	8.691*	1.153
Yield per plant		502.011	2077.636*	204.856

*Significant at 5% level of significance

Anamika) to 32.05% (IC-32398 x Arka Anamika) and -8.43 (VRO-4 x Arka Anamika) to 21.92% (IC-32398 x P-8) over better parent and the standard check (Parbhani Kranti), respectively (Table 2). Five cross combinations displayed heterobeltiosis, whereas four hybrid combinations namely, IC-32398 x P-8, IC-32398 x Arka Anamika, 31850 x Parbhani Kranti and IC-90269 x Parbhani Kranti exhibited standard heterosis for this trait. Positive heterosis for duration of availability of marketable fruits has also been reported by Nichal *et al.* (2001) and Indurani *et al.* (2003). The magnitude of heterosis for fruit length over better parent and standard check varied from -13.92 (EC-169464 x Parbhani Kranti) to 7.65% (VRO-4 x Parbhani Kranti) and -6.34 (IC-90269 x Arka Anamika) to 19.18 (EC-169468 x Parbhani Kranti), respectively (Table 2).Standard heterosis to the extent of 19.18 and 18.02 per cent was recorded in the hybrid combinations, EC-169468 x Parbhani Kranti and EC-169468 X Arka Anamika, respectively. For fruit diameter, the maximum standard heterosis to the extent of 18.95 per cent was recorded in the cross IC-90269 x Arka Anamika followed by IC-90269 x P-8 (16.99%). None of the cross combination could exhibit significant positive heterosis over better parent for fruit length and fruit diameter.

Increased number of fruits per plant is a direct component leading to higher yield. The yield being a complex character (Grafius, 1959), its improvement is easier if progress is made through its component trait like fruits per plant. Sufficient genetic diversity existed among the parents and the hybrids for this trait. Out of 18 crosses studied, six over better parent and 13 over standard check displayed significant desirable heterosis for fruits per plant. The range of heterosis for this trait varied from -16.18 (EC-169468 x Arka Anamika) to 34.84% (EC-169468 x Parbhani Kranti) and 7.62 (EC-169468 x Arka Anamika) to 73.13% (EC-169468 x Parbhani Kranti) over better parent and standard check (Parbhani Kranti), respectively (Table 3). Maximum standard heterosis to the extent of 73.13 per cent was recorded in the cross, EC-169468 x Parbhani Kranti. This cross also displayed maximum heterobeltiosis and it involved one parent as a land variety, it will be of great practical utility in breeding genotypes having more number of fruits per plant. Positive heterosis for fruits per plant has also been reported by many workers (Elangovan *et al.*, 1981; Nichal *et al.*, 2001 and Rewale *et al.*, 2003).

The fruit weight is a direct component which ultimately leads to higher fruit yield in okra. The magnitude of heterosis over better parent and standard check varied from -11.31 (EC-169464 x Parbhani Kranti) to 16.51% (IC-90269 x P-8) and -11.91 (EC-169464 x P-8) to 35.13% (IC-90269 x P-8), respectively (Table 3). Three hybrid combinations namely, IC-90269 x P-8, IC-31850 x P-8 and IC-90269 x Parbhani Kranti had positive desirable heterosis. Three hybrid combinations namely, IC-90269 XP-8, IC-31850xP-8 and IC-90269X Parbhani Kranti had positive heterosis over the better parent and four cross combinations viz., IC-90269 x P-8, IC-90269 x Parbhani Kranti, IC-90269 x Arka Anamika and IC-32398 x Arka Anamika showed standard heterosis. The results corroborate the findings of Sharma and Mahajan (1978), Ahmed *et al.* (1999) and Pathak *et al.* (2001) who have also observed positive heterosis for fruit weight in Okra.

Increase in the yield is an ultimate objective of any breeding programme and the genetic improvement of this complex attribute is possible and relatively easier if progress is made through its component traits like number of fruits per plant and fruit weight. The mean performance of the parents and crosses for this trait ranged from 90.33 g (P-8) to 130.84 g (IC-90269) and 100.57 g (EC-169464 x P-8) to

Table 2. Estimation of heterosis for duration of availability of marketable fruits, fruit length and fruit diameter over better parent (BP) and the standard check, Parbhani Kranti (SC)

Trait	Duration of availability of marketable fruits		Fruit length		Fruit diameter	
	% increase over		% increase over		% increase over	
Cross	BP	SC	BP	SC	BP	SC
VRO-4 x P-8	-5.79	-7.40	4.62	6.34	-6.54	-7.84
VRO-4 x Arka Anamika	-2.55	-8.43	-6.47	2.39	-16.05*	-11.11
VRO-4 x Parbhani Kranti	6.19	6.19	7.65	7.65	0.65	0.65
EC-169464 x P-8	-3.29	-1.55	-8.43	0.16	-3.82	-1.31
EC-169464 x Arka Anamika	-7.27	-5.60	-7.22	1.48	-13.58*	-8.50
EC-169464 x Parbhani Kranti	-0.17	1.62	-13.92*	-5.84	-11.46*	-9.15
EC-169468 x P-8	-7.48	-1.13	-2.26	5.93	-4.58	-4.58
EC-169468 x Arka Anamika	-13.03	-7.07	4.44	18.02*	1.23	7.19
EC-169464 x Parbhani Kranti	0.41	7.30	5.46	19.18*	4.58	5.23
IC-32398 x P-8	24.03*	21.92*	5.02	6.75	-2.61	-2.61
IC-32398 x Arka Anamika	32.05*	20.71*	2.37	9.79	0.00	5.88
IC-32398 x Parbhani Kranti	5.31	5.31	2.47	2.47	1.96	1.96
IC-90269 x P-8	5.22	3.43	0.16	1.81	3.47	16.99*
IC-90269 x Arka Anamika	11.50	5.75	-9.20	-6.34	5.20	18.95*
IC-90269 x Parbhani Kranti	18.21*	18.21*	-1.65	-1.65	-2.31	10.46
IC-31850 x P-8	0.57	-1.13	4.61	6.34	0.65	0.65
IC-31850 x Arka Anamika	18.17*	8.51	-9.98	-3.46	-12.35*	-7.19
IC-31850 x Parbhani Kranti	18.64*	18.65*	-4.03	-4.03	-0.65	-0.65
SE ±	2.71	2.71	0.69	0.69	0.09	0.09

Table 3. Estimation of heterosis for fruits per plant, fruit weight and fruit yield per plant over better parent (BP) and the standard check, Parbhani Kranti (SC)

Trait	Duration of availability of marketable fruits		Fruit length		Fruit diameter	
	% increase over		% increase over		% increase over	
Cross	BP	SC	BP	SC	BP	SC
VRO-4 x P-8	15.13	32.83*	-4.86	-10.13	14.83	19.61
VRO-4 x Arka Anamika	-0.96	14.27	-9.60	-6.66	-16.76	6.04
VRO-4 x Parbhani Kranti	2.64	18.42	-8.14	-8.14	-4.14	9.75
EC-169464 x P-8	-9.09	20.50	-8.17	-11.91	-19.11*	3.05
EC-169464 x Arka Anamika	11.80	48.20*	-0.86	2.37	19.48*	52.22*
EC-169464 x Parbhani Kranti	21.83*	61.50*	-11.31	-11.32	12.40	43.19*
EC-169468 x P-8	-0.32	27.98*	0.94	-4.66	6.55	22.00
EC-169468 x Arka Anamika	-16.18*	7.62	-1.79	1.41	-5.51	7.98
EC-169464 x Parbhani Kranti	34.84*	73.13*	-2.22	-2.22	47.82*	69.25*
IC-32398 x P-8	28.21*	49.17*	-7.44	0.30	19.10*	49.71*
IC-32398 x Arka Anamika	15.23	34.07*	6.76	15.68*	23.52*	55.26*
IC-32398 x Parbhani Kranti	11.19	29.36*	-5.60	2.29	3.75	30.41*
IC-90269 x P-8	25.47*	46.68*	16.51*	35.13*	47.85*	98.20*
IC-90269 x Arka Anamika	2.01	19.25	5.16	21.97*	8.36	45.26*
IC-90269 x Parbhani Kranti	23.34*	44.18*	11.61*	29.44*	39.75*	87.34*
IC-31850 x P-8	24.63*	38.78*	14.02*	7.69	54.37*	48.39*
IC-31850 x Arka Anamika	15.30	28.39*	-1.86	1.33	35.95*	29.34*
IC-31850 x Parbhani Kranti	12.06	24.79*	4.22	4.22	29.62*	29.62*
SE ±	0.75	0.75	0.88	0.88	11.69	11.69

193.44 g (IC-90269 x P-8), indicating the presence of sufficient genetic variability among the genotypes used in the present study. A considerable amount of heterosis was observed over better parent (-19.11 to 54.37%) and standard check (3.05 to 98.20%). Nine crosses over better parent and 12 over the standard check exhibited significant positive heterosis (Table 3).

The most heterotic crosses were IC-90269 x P-8 (98.20%), IC-90269 x Parbhani Kranti (87.34%) and EC-169468 x Parbhani Kranti (69.25%) producing per plant fruit yield of 193.44g, 182.84 g and 165.19 g in comparison to 97.60 g of Parbhani Kranti, a widely accepted variety of the region. Hybrid vigour for yield per plant has also been reported by Chaudhary *et al.* (1991), Dhankhar and Dhankhar (2001) and Bhalekar *et al.* (2004).

References

Ahmed N, Hakim MA and Gandroo MY 1999. Exploitation of hybrid vigour in okra [*Abelmoschus esculentus* (L.) Moench]. Indian J. Hort. **56** (3): 247-251.

Anonymous 2003. Vegetable Seed Sector of India. Agriculture Today: 30-31.

Bhalekar SG, Desia UT and Nimbalkar CA 2004. Heterosis studies in okra. J. Maharashtra Agric. Univ. **29** (3): 360-362.

Chaudhary DR, Kumar J, Vidyasagar and Sharma SK 1991. Line x tester analysis of combining ability in okra [*Abelmoschus esculentus* (L.) Moench]. South Indian Hort. **39** (6): 337- 340.

Dhankhar BS and Dhankhart SK 2001. Heterosis and combining ability studies for some economic characters in okra [*Abelmoschus esculentus* (L.) Moench]. Haryana J. Hortic. Sci. **30** (3-4): 230-233.

Elangovan M, Muthukrishan CR and Irulappan I 1981. Combining ability in bhindi [*Abelmoschus esculentus* (L.) Moench]. South Indian Hort. **29** (1):15-22.

Grafius JE 1959. Heterosis in barley. Agronomy J. **51**: 551-554.

Indurani C, Veeraragavathatham D and Auxcilia J 2003. Studies on the development of FI hybrids in okra [*Abelmoschus esculentus* (L.) Moench] with high resistance to yellow vein mosaic virus. South Indian Hort. **51** (1/6): 219-226.

Nandkarni KM 1972. Quoted by Bose, T.K. and Som, M.G. 1986. Vegetable Crops in India. Naya Prokash, Calcutta.

Nichal SS, Datke SB, Desmukh TD, Patil MP and Ujjainkar VV 2001. Diallel analysis for combining ability studies in okra [*Abelmoschus esculentus* (L.) Moench]. Annals Plant Physiol. **14** (2): 120-124.

Pathak R, Syamal MM, Singh AK and Pathak R 2001. Line x tester analysis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. Annals Agric. Res. **22** (1): 80-82.

Rewale VS, Bendale VW, Bhave SG, Madhav RR and Jadhav BB 2003. Heterosis for yield and yield components in okra. J. Maharashtra Agric. Univ. **28** (3): 247-249.

Sharma BR and Mahajan YP 1978. Line x tester analysis of combining ability and heterosis for some economic charcters in okra. Scientia Horticulturae **9** (2): 111-118.