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Genetic analysis of biparental mating and selfing in segregating populations of okra

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ABSTRACT

Three populations of the okra, *viz.*, biparental F_2, and single cross F_2, and double cross F_2 populations were developed in 2008 and these populations were evaluated in 2009 to study the extent of genetic variability, heritability, genetic advance of twelve characters in okra. Considerable variation was observed in BIP (biparental population) compared to SC (single cross) F_2 and DC (double cross) F_2 populations for most of the characters, which was confirmed by high mean and wider range of variation as evidenced by high PCV and GCV values for number of branches per plant, number of fruits per plant, average fruit weight (g), and fruit yield per plant (g). It is revealed that inter mating in early segregating generations of different individuals lead to release of additional variability, since biparental mating among the segregates in the F_2 of a cross may provide more opportunity for the recombination to occur, break the linkage blocks and mop up desirable genes and as a result release concealed variability.

Key words: Biparental mating, GCV, PCV, okra.

INTRODUCTION

Okra [*Abelmoschus esculentus*(L.) Moench.] or okra also known as 'lady's finger' is an important vegetable crop cultivated in tropical and sub-tropical parts of the world. Okra tender fruits are used as vegetable, eaten boiled or in culinary preparation as sliced and fried pieces. It is also used for thickening soups and gravies, because of its high mucilage content. Okra fruits are also sliced and sun dried or canned and pickled for off-season use. It has good nutritional value, particularly vitamin-C (30 mg 100 g^{-1}), calcium (90 mg 100 g^{-1}), iron (1.5 mg 100 g^{-1}) and rich in iodine (97 mg 100 g^{-1}).

Creation of variability is the pre-requisite either for development of varieties or inbred lines. Generally amount of variability generated is more in the early segregating generations as compared to later generations. If we attempt intermating in early segregating generations of different individuals additional variability will be released, since biparental mating among the segregates in the F_2 of a cross may provide more opportunity for the recombination to occur, mop up desirable genes and as a result release concealed variability (Paramesharappa *et al.*, 7). In view of the above facts, an attempt has been made in the present study to compare the performance of biparental progenies with the F_2 generation of single cross and double cross populations of okra.

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MATERIALS AND METHODS

The present investigation was carried out at Horticulture Research Station, Devihosur, Haveri, Karnataka during 2008 & 2009. The experimental material was derived from three commercial okra hybrids, namely BH-1, BH-2 and BH-3. In 2008, SC (BH-1 × BH-2) and DC [(BH-1 × BH-2) × (BH-2 × BH-3)] populations were derived by and BIP F_2 is developed by random mating some selected plants in F_2 population of all four hybrids (Kearsay, 5). The experimental material comprised of two BIP (75 progeny), three single cross F_2s (100 progeny) and two double cross (200 progeny) F_2s population. In 2009, all these F_2 populations were grown in simple RBD with two replications and observations were recorded on five randomly selected plants in each F_2 population for twelve characters. All the package of practices were followed for growing a successful crop by giving necessary fertilizer and treatments with a spacing of 60 cm × 30 cm. The phenotypic and genotypic coefficient of variation was computed (Burton *et al.*, 2). The heritability (Hanson *et al.*, 4) and genetic advance as per cent of mean (Robinson *et al.*, 9) was also worked out.

RESULTS AND DISCUSSION

Analysis of variance for the characters studied, in the present investigation indicated highly significant for all the three types of populations suggested the existence of sufficient amount of genetic variability in the parents selected for study (Table 1). Wide variation was observed for most of the characters. Greater mean

Table 1. Analysis of variance for twelve quantitative traits in BIP F_2 population of okra.

Trait	Population	Treatment mean sum of squares	Error mean sum of squares	Calculated 'F' value
Days to 50% flowering	BIP F_2	12.58	4.65	2.75**
	SC F_2	14.47	4.51	3.21**
	DC F_2	12.82	4.29	2.99**
Plant height (cm)	BIP F_2	2118.2	45.02	47.05**
	SC F_2	2506.9	49.07	51.09**
	DC F_2	2606.82	49.92	52.22**
No. of nodes per plant	BIP F_2	25.87	1.86	13.91*
	SC F_2	27.83	1.97	14.13*
	DC F_2	30.23	1.89	15.92**
Internodal length (cm)	BIP F_2	4.08	2.81	1.45**
	SC F_2	6.12	2.93	2.09**
	DC F_2	5.42	2.57	2.11**
Stem diameter (cm)	BIP F_2	2.00	1.08	1.85*
	SC F_2	1.98	1.11	1.79**
	DC F_2	1.66	1.02	1.63*
No. of branches per plant	BIP F_2	3.63	1.06	3.43**
	SC F_2	2.93	1.01	2.91**
	DC F_2	2.58	0.99	2.61**
No. of fruits per plant	BIP F_2	11.98	1.25	7.99**
	SC F_2	7.81	1.19	6.57**
	DC F_2	7.40	1.09	6.79**
Fruit length (cm)	BIP F_2	11.53	1.03	11.2**
	SC F_2	9.91	0.99	10.02**
	DC F_2	9.80	0.97	10.11**
Fruit diameter (cm)	BIP F_2	1.33	0.19	7.05**
	SC F_2	2.06	0.25	8.26**
	DC F_2	1.75	0.22	7.98**
Av. fruit weight (g)	BIP F_2	9.77	2.44	3.99**
	SC F_2	8.57	2.31	3.71**
	DC F_2	7.18	2.21	3.25**
100-seed weight (g)	BIP F_2	1.15	1.25	0.92**
	SC F_2	1.00	1.14	0.88**
	DC F_2	0.92	1.04	0.89**
Fruit yield per plant (g)	BIP F_2	2759.70	53.01	52.06**
	SC F_2	2317.43	48.29	47.99**
	DC F_2	2408.83	49.17	48.99**

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

sum of squares in BIP, compared to SC F_2 and DC F_2 progenies for fruit yield per plant and yield components were observed, The mean values of the biparental progenies were higher than the SC F_2 and DC F_2 populations for all the characters studied (Table 2). The superior means and wider ranges in the biparental progenies may be due to release of hidden genetic variability than in SC and DC F_2 progenies. An increase in the mean performance of biparental progenies over selfed progenies also observed (Prasad, 8). The

Table 2. Mean and range value for twelve quantitative traits in different F_2 populations.

Trait / Population	BIP-I		BIP-II		SC-I		SC-II		SC-III		DC-I		DC-II	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Days to 50% flowering	43.24	38.00-51.00	43.02	36.00-53.00	46.55	41.00-55.00	45.6	40.00-56.00	44.6	45.00-55.00	46.03	41.00-55.00	45.9	42.00-56.00
Plant height (cm)	89	51.00-103.00	81	48.00-110.00	102.14	57.00-137.00	96.2	73.00-125.00	86.4	60.00-125.00	91.32	55.00-115.00	88.92	66.00-110.00
No. of nodes per plant	11.58	6.80-17.80	11.56	7.20-16.60	12.53	8.00-16.50	12.62	8.50-16.80	13.1	8.00-17.50	12.12	8.20-16.40	12.78	8.10-16.34
Internodal length (cm)	3.93	2.90-5.14	3.89	3.03-4.87	5.55	3.20-8.6	6.7	3.60-8.4	6.3	5.00-9.1	6.1	4.50-8.7	6.17	4.10-8.5
Stem diameter (cm)	1.85	1.00-2.26	1.92	1.10-2.64	1.2	0.43-2.4	1.13	0.70-2.1	1.06	0.60-2.4	1.13	0.67-2.3	1.08	0.64-1.62
No. of branches per plant	3.59	1.20-5.4	3.37	1.05-5.0	2.69	1.50-3.5	2.8	1.80-3.7	2.4	1.30-3.2	2.6	1.23-3.9	2.39	1.00-4.0
No. of fruits per plant	23.08	8.70-44.60	24.69	8.00-45.60	19.42	10.00-40.00	23.2	12.00-43.00	22.84	11.00-44.00	23	12.00-35.00	21.38	10.00-39.00
Fruit length (cm)	15.9	9.16-20.88	15.56	10.00-21.00	13.46	9.70-18.30	13.96	9.88-18.75	14.15	10.75-19.68	13.83	10.50-18.90	12.96	10.50-16.50
Fruit diameter (cm)	1.36	0.90-2.3	1.36	0.96-2.39	1.69	1.12-2.68	1.73	1.20-2.62	1.64	1.10-2.46	1.54	1.00-2.4	1.43	1.21-2.22
Av. fruit weight (g)	18.16	10.30-26.35	17.79	8.30-30.24	16.74	10.30-26.00	15.4	14.00-22.00	17.01	13.00-21.00	16.28	12.00-22.00	15.89	13.00-23.00
100-seed weight (g)	6.78	3.44-8.20	6.08	3.54-8.14	6.1	4.10-7.30	5.8	4.00-7.80	6.2	6.00-7.50	6.45	4.80-7.20	4.9	4.00-6.10
Fruit yield per plant (g)	418.4	112.16-740.00	383.5	142.88-747.00	344.6	136.20-674.3	355.57	161.84-700.00	330.85	160.00-638.00	356.33	144.0-680.0	355.12	189.0-672.0

present finding is in agreement with the findings of (Paramesharappa *et al.*, 7) in safflower. PCV was more than their GCV for all the traits indicating influence of environment on expression of these traits.

Wide range was observed for almost all the characters in BIP's (Table 2). It is noteworthy that especially upper limit of range was high in BIP's for most of the characters. At the same time the lower limit was smaller compared to that of other F_2 populations suggesting that intermating has helped in releasing more variability than in selfing generations. General shift in the value of ranges for characters by following biparental approaches was also reported (Nematullah *et al.*, 6) in wheat. BIP has highest range value with

Table 3. Genetic variability parameters for different quantitative traits in F_2 populations of okra.

Trait	Population	GCV (%)	PCV (%)	h^2bs	GA	GAM (%)
Days to 50% flowering	BIP F_2	4.89	5.63	55.43	3.92	8.66
	SC F_2	3.68	5.99	37.8	2.01	4.65
	DC F_2	2.48	6.09	55.90	0.33	2.74
Plant height (cm)	BIP F_2	10.86	11.75	80.85	15.45	23.84
	SC F_2	15.18	15.29	88.49	28.03	31.03
	DC F_2	14.97	15.68	86.45	22.72	31.72
No. of nodes per plant	BIP F_2	15.76	16.27	65.24	25.81	41.26
	SC F_2	12.5	15.6	64.2	24.68	32.51
	DC F_2	14.41	15.15	57.77	34.85	40.95
Internodal length (cm)	BIP F_2	15.62	20.23	67.74	2.37	33.45
	SC F_2	17.60	18.30	86.64	2.52	35.04
	DC F_2	16.71	18.09	85.32	5.26	31.79
Stem diameter (cm)	BIP F_2	10.8	12.02	49.29	0.18	19.75
	SC F_2	12.36	12.99	30.16	0.17	18.55
	DC F_2	9.92	12.57	31.80	1.55	20.51
No. of branches per plant	BIP F_2	23.52	31.96	86.52	1.11	36.42
	SC F_2	18.35	19.63	87.4	0.63	35.29
	DC F_2	19.29	20.57	87.9	0.74	37.32
No. of fruits per plant	BIP F_2	19.96	23.17	81.8	6.33	39.05
	SC F_2	19.86	20.93	80.0	5.85	38.79
	DC F_2	17.43	22.4	60.44	6.39	27.89
Fruit length (cm)	BIP F_2	19.78	21.76	72.6	4.65	37.05
	SC F_2	10.88	13.80	62.2	2.39	17.69
	DC F_2	8.33	9.92	58.97	1.91	14.21
Fruit diameter (cm)	BIP F_2	14.91	17.93	62.20	0.33	22.34
	SC F_2	11.22	14.29	61.6	0.32	17.98
	DC F_2	11.89	15.22	61.0	0.39	19.02
Av. fruit weight (g)	BIP F_2	17.8	20.45	66.80	5.48	31.93
	SC F_2	9.58	11.93	64.98	2.76	15.57
	DC F_2	12.23	17.74	47.5	3.09	17.37
100-seed weight (g)	BIP F_2	8.07	9.04	77.70	0.86	14.80
	SC F_2	4.02	3.13	70.64	0.34	4.02
	DC F_2	6.70	7.90	72.10	0.20	2.86
Fruit yield per plant (g)	BIP F_2	36.71	39.82	85.0	185.70	69.70
	SC F_2	19.18	19.54	59.00	145.25	19.25
	DC F_2	19.89	21.10	60.00	149.23	20.50

appreciable mean value for traits, *viz*., number of fruits per plant, number of branches per plant, 100-seed weight, and fruit yield per plant. This indicates that there is a great scope for selection in this population and increasing the mean in desired direction. These finding were similar to the reported mean and range values for number of fruits per plant in okra (Dhankar *et al*., 3).

Among the characters, in all the populations, fruit yield per plant and number of branches per plant showed high GCV and PCV (Table 3), moderate GCV and PCV in case of number of fruits per plant, fruit length, number of nodes per plant, internodal length, stem diameter, plant height, average fruit weight, followed by lower GCV and PCV for Days to 50% flowering and 100-seed weight. Similar results were obtained for days to first flowering in 70 genotypes of okra (Bindu *et al*., 1). High heritability coupled with high genetic advances as percentage of mean (GAM) was recorded for the characters plant height, number of branches per plant, average fruit weight, number of fruits per plant, fruit yield per plant in all the F_2 population. However for the character fruit weight, 100-seed weight and number of fruits per plant the population BIP showed high heritability and GAM. Whereas, SC and DC F_2 showed the moderate heritability coupled with high GAM for the same characters. High heritability estimates in case of BIPs compared to selfed series were also reported (Paramesharappa *et al*., 7; Yunus *et al*., 10). Hence, these fruit related characters could be improved by simple selection as they are represented merely due to additive gene action.

To conclude the results revealed that there was considerable variation for the twelve characters in BIP, compared to SC F_2 and DC F_2 population studied. The PCV and GCV were higher for most of the characters, *viz*., plant height, and number of branches per plant, number of fruits per plant, average fruit weight, and fruit yield per plant. High heritability and GAM was observed for plant height, number of branches per plant, number of fruits per plant, fruit yield per plant. The superior means and wider ranges in the biparental progenies may be due to release of hidden genetic variability than in SC and DC F_2 progenies that was possible due to intermating in BIP. An increase in the mean performance of biparental progenies over selfed progenies also evidenced.

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