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Research Note

Genetic analysis of biparental mating and selfing in segregating populations of Bhendi [*Abelmoschus esculentus* (L.) Moench]

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Abstract:
Three populations of the bhendi *viz,* BIP, SC , and DC population were developed in 2008 and these populations were evaluated in 2009 to study the extent of genetic variability, heritability and genetic advance for twelve characters in bhendi. Considerable variation was observed in BIP compared to SC F_2 and DC 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), fruit yield per plant (g). It is revealed that intermating 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.

Keywords: Biparental mating PCV, GCV, Bhendi,

Bhendi (*Abelmoschus esculentus (*L) Moench.) or Okra in hindi, also known as lady's finger is an important vegetable crop cultivated in tropical and sub-tropical parts of the world. Bhendi 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. Bhendi 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), calcium (90 mg/100 g) and iron (1.5mg/100 g) in the edible fruit. 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 (Parameshwarappa *et al*., 2009). 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 Bhendi.

The present investigation was carried out at Horticulture Research Station (HRS), Devihosur, Haveri, Karnataka during 2008 and 2009. The experimental material was derived from three commercial bhendi hybrids BH-1, BH-2 and BH-3. In 2008, SC (BH-1 X BH-2) and DC F_2 [(BH-1 X BH-2) X (BH-2 X BH-3)] populations were derived by selfing and BIP F_2 was developed by random mating 100 selected plants in F_2 population (Kearsay 1965). The experimental material comprised of BIP (100 progeny), single cross F_2's population (75 progeny), and double cross F_2's population (200 progeny). In 2009, these F_2 populations were grown at 60 X 30 cm spacing 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 recommended package of practice was carried out to grow a successful crop. The phenotypic and genotypic coefficient of variation was computed according to Burton and Devane (1953). The heritability and genetic advance as per cent of mean was worked out as per the method of Hanson *et al.* (1956) and Robinson *et al.* (1949), respectively.

Wide variation was observed for most of the characters. Greater mean 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 1). 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. Prasad (1984) also observed an increase in the mean performance of biparental progenies over selfed progenies. The present finding is in agreement with the findings of Parameshwarappa *et al.* (2009) in safflower for number of branches. 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 by Nematullah and Jha (1993) in wheat. BIP has highest range value with 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 by Dhankar and Dhankar (2002) for number of fruits per plant in bhendi.

Among the characters, in all the populations, fruit yield per plant and number of branches per plant showed high GCV and PCV (Table 2), 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, 100 seed weight. Similar results were obtained by Bindu *et al.* (1997) for days to first flowering in 70 genotypes of bhendi.

High heritability coupled with high genetic advance 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 a moderate heritability coupled with high GAM for the same characters. High heritability estimates in case of BIPs compared to selfed series were also reported by Yunus and Paroda (1983) in wheat and Parameshwarappa *et al.* (2009) in safflower. Hence these fruit related characters could be improved by simple selection as they are due to additive gene action.

The results revealed that there was considerable variation for the twelve characters in all F_2 population studied, but when compared, it was noteworthy that more variability in BIP than SC and DC F_2 population indicating that intermating has helped in releasing more variability than in selfing generations. 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. Thus, the present variability observed in the investigation could be exploited in the crop improvement program to improve the yield of bhendi.

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Table 1. Mean, S.E and Range value for twelve quantitative characters in different F_2 populations

characters / Populations	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± 0.31	38.00-51.00	43.02± 0.33	36.00-53.00	46.55± 0.33	41.00-55.00	45.6± 0.42	40.00-56.00	44.6± 0.65	45.00-55.00	46.03± 0.59	41.00-55.00	45.9± 0.65	42.00-56.00
Plant height (cm)	89±0.75	51.00-103.00	81± 0.69	48.00-110.00	102.14± 0.71	57.00-137.00	96.2± 0.59	73.00-125.00	86.4± 0.66	60.00-125.00	91.32± 0.63	55.00-115.00	88.92± 0.26	66.00-110.00
No of nodes per plant	11.58± 0.39	6.80-17.80	11.56± 0.33	7.20-16.60	12.53± 0.36	8.00-16.50	12.62± 0.38	8.50-16.80	13.1± 0.45	8.00-17.50	12.12±0.74	8.20-16.40	12.78± 0.68	8.10-16.34
Internodal length (cm)	3.93± 0.49	2.90-5.14	3.89± 0.41	3.03-4.87	5.55± 0.45	3.20-8.6	6.7± 0.59	3.60-8.4	6.3± 0.52	5.00-9.1	6.1±0.65	4.50-8.7	6.17± 0.44	4.10-8.5
Stem diameter (cm)	1.85± 0.40	1.00-2.26	1.92± 0.39	1.10-2.64	1.2± 0.39	0.43-2.4	1.13± 0.45	0.70-2.1	1.06± 0.45	0.60-2.4	1.13±0.25	0.67-2.3	1.08± 0.58	0.64-1.62
Number of branches per plant	3.59± 0.96	1.20-5.4	3.37± 0.93	1.05-5.0	2.69± 0.85	1.50-3.5	2.8± 0.88	1.80-3.7	2.4± 0.88	1.30-3.2	2.6±0.62	1.23-3.9	2.39± 0.11	1.00-4.0
Number of fruits per plant	23.08± 0.32	8.70-44.60	24.69± 0.33	8.00-45.60	19.42± 0.33	10.00-40.00	23.2± 0.31	12.00-43.00	22.84± 0.33	11.00-44.00	23±0.45	12.00-35.00	21.38± 0.22	10.00-39.00
Fruit length (cm)	15.9± 0.19	9.16-20.88	15.56± 0.20	10.00-21.00	13.46± 0.20	9.70-18.30	13.96± 0.19	9.88-18.75	14.15± 0.22	10.75-19.68	13.83±0.45	10.50-18.90	12.96± 0.66	10.50-16.50
Fruit diameter (cm)	1.36± 0.20	0.90-2.3	1.36± 0.21	0.96-2.39	1.69± 0.21	1.12-2.68	1.73± 0.22	1.20-2.62	1.64± 0.55	1.10-2.46	1.54±0.65	1.00-2.4	1.43± 0.27	1.21-2.22
Average fruit weight (g)	18.16± 0.19	10.30-26.35	17.79± 0.20	8.30-30.24	16.74± 0.25	10.30-26.00	15.4± 0.29	14.00-22.00	17.01± 0.48	13.00-21.00	16.28±0.44	12.00-22.00	15.89± 0.89	13.00-23.00
100 seed weight (g)	6.78± 0.18	3.44-8.20	6.08± 0.19	3.54-8.14	6.1± 0.27	4.10-7.30	5.8± 0.23	4.00-7.80	6.2± 0.44	6.00-7.50	6.45±0.33	4.80-7.20	4.9± 0.27	4.00-6.10
Fruit yield per plant (g)	418.4± 0.15	112.16-740.00	383.5± 0.16	142.88-747.00	344.6± 0.21	136.20-674.3	355.57± 0.28	161.84-700.00	330.85± 0.75	160.00-638.00	356.33± 0.63	144.0-680.0	355.12± 0.14	189.0-672.0

Table 2. Genetic variability parameters for different quantitative traits in F_2 populations of Bhendi

Characters	Populations	GCV (%)	PCV (%)	h^2bs	GA	GAM (%)
	BIP F_2	4.89	5.63	55.43	3.92	8.66
Days to 50 % flowering	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
	BIP F_2	10.86	11.75	80.85	15.45	23.84
Plant height (cm)	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
	BIP F_2	15.76	16.27	65.24	25.81	41.26
Number of nodes per plant	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
	BIP F_2	15.62	20.23	67.74	2.37	33.45
Internodal length (cm)	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
	BIP F_2	10.8	12.02	49.29	0.18	19.75
Stem diameter (cm)	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
	BIP F_2	23.52	31.96	86.52	1.11	36.42
Number of branches per plant	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
	BIP F_2	19.96	23.17	81.8	6.33	39.05
Number of fruits per plant	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
	BIP F_2	19.78	21.76	72.6	4.65	37.05
Fruit length (cm)	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
	BIP F_2	14.91	17.93	62.20	0.33	22.34
Fruit diameter (cm)	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
	BIP F_2	17.8	20.45	66.80	5.48	31.93
Average fruit weight (g)	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
	BIP F_2	8.07	9.04	77.70	0.86	14.80
100 seed weight (g)	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
	BIP F_2	36.71	39.82	85.0	185.70	69.70
Fruit yield per plant (g)	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