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Research Note

Genetic studies in F_2 generation of bhendi [*Abelmoschus esculentus* (L.) Moench]

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Abstract
Genetic studies involving F_2 segregants of bhendi arising out of two crosses *viz.,* SKY/DR/RS/107 X Tiruchi Local and IC69257 X 770 along with their four parents and a check (Arka Anamika) was performed using twelve biometric traits recorded from randomly selected plants. Both PCV and GCV were of high magnitude for the number of primary branches at final harvest, internodal length, fruit yield per plant and the number of fruits per plant in both the crosses, indicating the importance of these traits in exercising selection. The traits, internodal length, plant height at final harvest, the number of primary branches at final harvest, the number of fruits per plant and fruit yield per plant had registered high magnitude of heritability coupled with high genetic advance as percentage of mean in both the crosses, revealing the preponderance of additive genes in control of these traits.

Key words
Bhendi, PCV, GCV, heritability in broad sense, genetic advance and F_2 segregants

Bhendi is a hardy annual vegetable crop of the Malvaceous family, capable of being grown all through the year. However, many biotic and abiotic stress factors limits its performance especially in a summer crop. The availability of many hybrids, though offers greater scope for year round cultivation of bhendi, the cost of these hybrid seeds and their intensive cultivation requirements limit their use by marginal and small farmers, who forms the major proportion of vegetable growers. Hence, identification of a region specific high yielding variety with tolerance to stresses assumes significance. Considering the above facts, an attempt was made to analyse a segregating population of bhendi with high yield, early maturity, shorter internodes, fruits of uniform size, shape, colour and ridges, coupled with complemental nutritive value.

The variability existing among the genotypes offer an excellent scope for genetic improvement through selection (Mishra *et al*., 2015). Hence, the major aim of any breeder is to evolve a superior variety simply through selection from among the available genotypes. The study of F_2 generation can serve as an ideal population for selecting genotypes with desired traits as maximum segregation and recombination are expected for exercising selection. In addition to assessing the extent of variability in the segregating population for yield and its component traits, the estimation of heritable portion of measured variability and expected genetic advance may be of greater utility for yield improvement in bhendi under a given situation. Hence, an attempt was made in the present investigation to estimate the extent of variability as well as to partition the total variance into heritable and non heritable components, as the phenotypic expression of every character results from the interaction of genotype and environment.

Variability studies on F_2 generation of bhendi was undertaken during *kharif,* 2018 at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal of U.T. of Puducherry in the Cauvery delta zone. The two cross combinations identified for recombinant

breeding in F_1 through combining ability studies formed the study material. The hybrid combinations include SKY/DR/RS/107 X Tiruchi Local designated (Cross 1) and IC 69257 X 770 designated as (Cross 2). Cross 1 had shown shorter internodal length and Cross 2 had higher number of fruits as well as yield per plant. In order to determine the variability parameters, parents were crossed and the resultant hybrids were selfed to generate F_2.

The F_2 population derived by selfing of F_1 resulting out of the two hybrid combinations SKY/DR/RS/107 X Tiruchi Local and IC 69257 X 770 were raised in an unreplicated trial with a spacing of 45 X 30 cm, twelve important biometric traits *viz.,* days to first flowering, node number of first flowering, plant height at flowering, days to first harvest, fruit length, fruit girth, fruit weight, internodal length, plant height at final harvest, the number of primary branches at final harvest, the number of fruits per plant and fruit yield per plant were recorded on 250 randomly selected plants among the 1000 F_2 segregants raised in both crosses. The statistical parameters were analysed as per Panse and Sukhatme (1961). PCV and GCV were calculated as suggested by Empig *et al*. (1970) and were categorized based on the grouping of Sivasubramaniam and Menon (1973). Heritability (h^2) in broad sense and Genetic advance (GA) were also estimated and categorized using the method of Robinson *et al*. (1949) and Johnson *et al.* (1955), respectively.

The GCV which represents the heritable component of total variance was found lower than PCV for all the characters (**Table 1 and 2**), indicating the influence of environment in expression of the traits under study as reported earlier by Ahamed *et al*. (2015) and Archana *et al.* (2015).

High genotypic variability was observed for the number of primary branches at final harvest (28.12 %) as observed earlier by Chandra *et al.* (2014), internodal length (26.53 %) as suggested by Singh *et al.* (2006) and Yonas *et al.* (2014), fruit yield per plant (25.08 %) and the number of fruits per plant (24.43 %) in Cross 1 [SKY/DR/RS/107 X Tiruchi Local] as reported by Awadhesh *et al*. (2016) and Bagwale *et al*. (2016). While the GCV was high for internodal length (25.83 %), the number of primary branches at final harvest (24.18 %), fruit yield per plant (22.97 %), plant height at final harvest (21.78 %), the number of fruits per plant (21.33 %) and plant height at flowering (21.32 %) in Cross 2 [IC69257 X 770], suggesting that these traits could better respond to selection.

The traits *viz.,* plant height at final harvest (19.96 %), fruit weight (18.29 %), node number of first flowering (12.46 %) and plant height at flowering (11.15 %) had shown moderate variability in Cross 1, while in Cross 2 the GCV was of moderate magnitude for fruit weight (17.03 %). The presence of moderate to low genetic variability is an indication of lesser response expected for these traits in crop improvement of bhendi through selection, compared to traits with high genetic variability as reported earlier by Katagi *et al.* (2014).

High magnitude of heritability and genetic advance as percentage of mean recorded for internodal length (Cross 1 - 89.48 and 51.71 %; Cross 2 - 72.57 and 45.32 %), plant height at final harvest (Cross 1 - 69.26 and 34.21

Table 1. Mean performance, variability, heritability and genetic advance in F_2 generation of the cross SKY/DR/RS/107 X Tiruchi Local

Character	Mean ± S.E	Range		PCV (%)	GCV (%)	h^2 (%)	GA	GA as % of mean
		Minimum	Maximum					
Days to first flowering	41.86 ± 0.17	38.00	54.00	6.36	3.42	29.02	1.59	3.80
Node number of first flowering	3.77 ± 0.04	3.00	8.00	17.84	12.46	48.74	0.68	17.92
Plant height at flowering (cm)	24.07 ± 0.37	13.50	63.20	24.15	11.15	21.29	2.55	10.60
Days to first harvest	48.49 ± 0.17	44.00	60.00	5.45	3.51	41.45	2.25	4.65
Fruit length (cm)	13.28 ± 0.14	10.00	19.50	16.41	9.32	32.24	1.45	10.90
Fruit girth (cm)	6.39 ± 0.04	4.90	8.30	10.17	7.29	51.33	0.69	10.76
Fruit weight (g)	17.68 ± 0.26	9.94	29.32	23.63	18.29	59.93	5.16	29.17
Internodal length (cm)	6.54 ± 0.12	2.30	14.30	28.05	26.53	89.48	3.38	51.71
Plant height at final harvest (cm)	135.48 ± 2.05	46.20	219.60	23.98	19.96	69.26	46.35	34.21
Number of primary branches at final harvest	2.42 ± 0.05	1.00	4.00	31.27	28.12	80.85	1.26	52.08
Number of fruits per plant	34.68 ± 0.59	7.00	62.00	26.70	24.43	83.72	15.96	46.04
Fruit yield per plant	513.34 ± 9.17	125.89	1068.00	28.24	25.08	78.89	235.59	45.89

%; Cross 2 - 62.17 and 35.37 %), the number of primary branches at final harvest (Cross 1 - 80.85 and 52.08 %; Cross 2 - 67.20 and 40.83 %), the number of fruits per plant (Cross 1 - 83.72 and 46.04 %; Cross 2 - 64.82 and 35.38 %) as well as fruit yield plant (Cross 1 - 78.89 and 45.89 %; Cross 2 - 75.60 and 41.15 %) is an indication that these traits are well under the control of additive gene effect as proposed earlier by Archana *et al.* (2015). The traits, fruit girth (51.33 and 57.81%, respectively) and fruit weight (59.93 and 50.42 %, respectively) had shown moderate heritability in cross I and cross II, respectively. Similar estimate of heritability was reponed by Kerure *et al.* (2017) for fruit weight, Katagi *et al.* (2014) for fruit girth. However, fruit weight could be more relied upon for the selection as it has registered a higher magnitude of genetic advance as percentvage of mean in both the crosses, emphasizing its importance in crop improvement of bhendi (**Table 1 and 2**).

Table 2. Mean performance, variability, heritability and genetic advance in F_2 generation of the cross IC69257 X 770

Character	Mean ± S.E	Range		PCV (%)	GCV (%)	h^2 (%)	GA	GA as % of mean
		Minimum	Maximum					
Days to first flowering	42.50 ± 0.16	38.00	56.00	5.97	4.08	46.68	2.44	5.74
Node number of first flowering	3.88 ± 0.04	3.00	6.00	15.09	7.61	25.44	0.31	7.91
Plant height at flowering (cm)	25.91 ± 0.45	13.60	68.70	27.24	21.32	61.23	8.90	4.36
Days to first harvest	48.98 ± 0.15	44.00	63.00	4.83	2.23	21.32	1.04	2.12
Fruit length (cm)	13.04 ± 0.12	10.00	19.60	15.06	7.87	27.35	1.11	8.48
Fruit girth (cm)	6.00 ± 0.04	4.40	7.60	9.73	7.40	57.81	0.70	11.59
Fruit weight (g)	16.52 ± 0.25	9.22	28.94	23.99	17.03	50.42	4.12	24.92
Internodal length (cm)	7.34 ± 0.14	2.70	15.70	30.32	25.83	72.57	3.33	45.32
Plant height at final harvest (cm)	116.24 ± 2.03	44.40	209.50	27.62	21.78	62.17	41.12	35.37
Number of primary branches at final harvest	2.81 ± 0.05	1.00	5.00	29.49	24.18	67.20	1.15	40.83
Number of fruits per plant	32.23 ± 0.54	10.00	71.00	26.49	21.33	64.82	11.40	35.38
Fruit yield per plant (g)	515.78 ± 8.62	202.68	1155.83	26.42	22.97	75.60	212.23	41.15

The characters days to first flowering and plant height at flowering in Cross 1 as well as node number of first flowering, days to first harvest and fruit length in Cross 2 had shown low heritability estimate and the genetic advance as percentage of mean observed for these traits were also found low (**Table 1 and 2**). This indicated limited scope for advancement of these traits through selection and such findings had been documented earlier by Mazid *et al.* (2013) for node number of first flowering, Bagwale *et al.* (2016) for days to first flowering, Sharma and Prasad (2015) for days to first harvest and Balakrishnan and Sreenivasan (2010) for fruit length of bhendi.

The study of variability, heritability and genetic advance as percentage of mean indicated the importance of fruit yield per plant, the number of fruits per plant, internodal length and plant height at final harvest are as more reliable traits for excersing selection from segregating population of bhendi.

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