

Variability in selfed progenies of okra (*Abelmoschus esculentus* (L.) moench) through North Carolina Designs

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ABSTRACT

The selfed progenies developed through North Carolina Designs (NCD I, II and III) in F_2 populations of okra viz., HRB-55 x Kamini (cross-1) and BO-13 x Parbhani Kranti (cross-2) were used to study the variability. The results of yield was observed higher in NCD III for both the crosses. The value of CV percent was higher in NCD II for yield in two cross. The results of plant height and intermodal length was higher in NCD III and CV percent higher in NCD I in cross 1. Intermodal length was higher in NCD III and CV percent higher in NCD I in cross 2. The test of significance between the means of selfed progenies developed through North Carolina designs I, II and III for yield per plant, plant height and number of nodes per plant was observed significant in both cross except plant height in cross 2 for NCD III. The mean value of middle inter-nodal length of plant was non significant in NCD I and II for the cross 1.

Key word : Variability, NCD I, NCDII, NCD III and okra

Okra (*Abelmoschus esculentus* L. Moench) is one of the chief and abundant vegetable grown extensively throughout the world in summer and rainy seasons. The genetic improvement of any crop relies mainly on the presence of substantial magnitude of variability in the population. Plant breeders are always engaged with various breeding procedures for crop improvement, out of which, till now, is to hybridize diverse genotypes possessing complementary desirable characters, followed by selection in F_2 and subsequent generations, combining these characteristics from both the parents. The mating design refers to a system of mating employed to develop progenies of certain kinds. Therefore, the present study on variability in okra through NC designs was planned to select proper design.

MATERIALS AND METHODS

The seeds of F_1 generation of two crosses of okra viz., HRB-55 x Kamini (Cross 1) and BO-13 x Parbhani Kranti (Cross 2) were obtained from the Vegetable Research Station, Junagadh Agricultural University,

Juanagdh and F_2 generation was obtained by selfing the F_1 generation at the same place during the kharif 2006. The plants of F_2 population of the crosses were utilized for generating the experimental materials for NCD I, II and III during the summer 2007.

North Carolina Design I, II and III

Crosses for NCD I (Comstock and Robinson, 1952) were made in F_2 populations of HRB-55 x Kamini (Cross 1) and BO-13 x Parbhani Kranti (Cross 2) using randomly selected plants each for male and female. The selected plants as male (five plants) and female (twenty five plants) were selfed by bagging the flower with white butter paper and the seeds were collected at the time of maturity. Thus, the experimental materials for each cross in this design consisted of 30 selfed progenies (F_3) for NCD I. From each F_2 base population (Cross 1 and Cross 2) five plants selected as males and females were selfed for each cross. Thus, the experimental material for each cross in this design consisted 10 selfed progenies (F_3) for NCD II. The experimental material for North Carolina Design III was generated using the parents of each base population i.e. HRB-55 and Kamini for Cross 1 and BO-13 and Parbhani Kranti for Cross 2 as females and five randomly selected plants as male from their respective F_2 . The selected

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male and female plants were selfed. Thus, the experimental material obtained from each cross in this design 7 selfed progenies for NCD-III.

Experimental designs

The experimental selfed progenies developed in NCD I, II and III were evaluated in a compact family block design with two replications for designs I & II and three replications to maintain error degrees of freedom for design III. Each entry was sown in a single row having 20 plants, with a spacing of 60 x 30 cm. Thus, the plot size was 6.0 x 0.6 m. All the recommended agronomic practices were followed to raise the good crop. The observations were recorded for yield per plant (g), plant height (cm), number of nodes per plant and internodal length (cm) from 10 randomly selected plants from each progeny.

RESULTS AND DISCUSSION

Mean, range and coefficient of variation

The overall mean, range and coefficient of variation for four character of okra under study for North Carolina Designs I, II, III are given in Table 1.

Selfed progenies (F_3) of parents plants of NCD

The results of selfed progenies presented in Table 1 indicated that the highest overall yield of 133.62 gm/plant was observed in NCD III followed by 117.14 gm/plant in NCD II and 116.55 gm/plant in NCD I for the cross 1 (HRB-55 x Kamini). It was the highest (139.44 gm/plant) in NCD III followed by NCD I (129.32 gm/plant) and NCD II (121.77 gm/plant) for the Cross 2 (BO-13 x Parbhani Kranti). The value of CV (16.41%) was higher for the cross 1 and it was 15.12% for the cross 2 in NCD II, when it was compared with NCD I and NCD III. Mean plant height was the highest (93.05 cm) in NCD III followed by 92.73 cm in NCD II and 92.64 cm in NCD I for the cross 1. In cross 2, it was the highest (100.32 cm) in NCD I followed by 97.83 cm in NCD II and 95.50 cm in NCD III. The higher variability was observed in NCD I for both the crosses. The average number of nodes per plant were observed higher in NCD II for both the crosses. The value of CV was higher in NCD I for the cross 1 and NCD II for the cross 2. The mean value of middle inter-nodal length of plant was the highest in NCD III followed by NCD II and NCD I for both the crosses and the variability was the highest in NCD I followed by NCD II and NCD III for both the crosses. Comparison of NCD with their selfed progenies (F_3 s)

The mean values of various characters obtained in different North Carolina designs were compared with

their respective selfed progenies of parent plants selected from F_2 (F_3 s) grown adjacent to the plots of respective designs. The difference in mean values was tested by Student 't' test (Table 2). The results indicated that the fruit yield was significantly higher in all the NCD I, II and III, when it was compared with their F_3 s in both the crosses). Comparison of biparental mating and selfing was made in a chickpea crosses by Singh (2004) and he reported that the mean values for all the traits except primary branches were higher in BIPs than F_3 progenies. The number of nodes per plant was found higher and significant in NCD I, II and III for both the crosses, when they were compared with selfed progenies. The mean plant height was significantly higher in all NCD I, II and III for the cross 1 and NCD I and II for the cross 2. It was non significant in NCD III for the cross 2. The mean value of middle inter-nodal length of plant was non significant in NCD I and II for the cross 1. However, it was significantly higher in NCD III (Cross 1) and in NCD I, II and III (cross 2), when it was compared with selfed progenies. Genetic variability created through biparental mating in chickpea was estimated by Kampli *et al.* (2002) in the F_2 of the cross ICCV-10 x BG 256 of chickpea. The biparental population (BIP) had better mean performance than the F_3 selfs for all the characters under study. The lower limit of the range was, in general, smaller for almost all the characters in the BIPs. The upper limit was also increased in the desired direction for all the characters. Sufficiently high genetic variation was maintained in the BIP population for most of the characters except for secondary branches. The BIPs also exhibited improved estimates of heritability and genetic advance. Ortiz and Golmirzaie (2002) studied hierarchical and factorial mating designs (also known as North Carolina mating designs I and II, respectively) to determine these variance components. The results of design I gave a negative digenic variance (σ^2_D), this design provided almost the same estimate of narrow-sense heritability (h^2) for tuber yield as that obtained in design II. Results suggest that two females per male may not be enough for design I in tetrasomic potato. Four females per male are preferable to determine σ^2_A in design I for this tetrasomic crop. Deor (2004) studied on biparental progenies in sprouting broccoli (*Brassica oleracea* var. *italica* Plenck). Biparental progenies were developed in F_2 generation of a heterotic cross viz., PS x PK-1 by using North Carolina design 1. Besides the development of BIP's, F_2 population was bud pollinated to produce F_3 progenies which were evaluated in randomized block

Table 1 Mean, range and coefficient of variation for different characters of selfed progenies developed through North Carolina Designs I, II and III.

Sr. No.	Character		Cross 1 (HRB-55 x Kamini)			Cross 2 (BO-13 x Parbhani Kranti)		
			North Carolina Designs			North Carolina Designs		
			I	II	III	I	II	III
1	Yield / plant (gm)	Mean	116.55	117.14	133.62	129.32	121.77	139.44
		Range	79.46-159.38	75.64-160.20	100.00-160.00	77.02-184.34	78.14-153.00	100.00-163.50
		CV %	12.78	16.41	9.26	12.07	15.12	9.47
2	Plant height (cm)	Mean	92.64	92.73	93.05	100.32	97.83	95.50
		Range	58.00-120.00	70.00-125.00	73.00-115.50	62.00-128.00	68.28-123.71	75.50-118.00
		CV %	13.28	9.72	10.08	13.33	11.23	9.46
3	No. of Nodes / plant	Mean	13.07	13.78	13.75	14.24	14.53	13.82
		Range	8-20	9-19	10-18	11-19	10-22	11-17
		CV %	14.68	12.33	9.32	10.86	12.12	8.30
4	Internodal length (cm)	Mean	5.38	5.54	6.12	5.84	5.85	6.61
		Range	2.36-11.55	3.45-8.60	4.08-9.64	2.67-9.80	3.59-8.96	4.97-8.89
		CV %	25.75	17.36	14.39	21.20	15.80	12.21

Table 2 Test of significance between the means of progenies developed through different North Carolina Designs and their selfed progenies (F_3) of parents.

Sr. No.	Character		Cross 1 (HRB-55 x Kamini)			Cross 2 (BO-13 x Parbhani Kranti)		
			North Carolina Designs			North Carolina Designs		
			I	II	III	I	II	III
1	Yield / plant (gm)		*	*	*	*	*	*
2	Plant height (cm)		*	*	*	*	*	NS
3	No. of Nodes / plant		*	*	*	*	*	*
4	Internodal length (cm)		NS	NS	*	*	*	*

* Significant at $P = < 0.05$ NS :Non Significant

design. The analysis of variance of BIP's and F_3 progenies revealed significant differences for all the traits. T-test also indicated significant differences in the mean performance of the biparental and F_3 progenies for all the traits except for plant frame. Ved and Varma (2006) made comparison of biparental progenies with selfed F_3 population in barley cross of RD 2035 x RD 2535 to assess the impact on generating variability for grain filling period, peduncle length, spikelets per spike, harvest index and grain yield per plant. They reported that BIPs had better mean performance than their F_3 progenies for all the characters. The lower limit of the range was, in general, smaller for almost all the characters in the BIPs while upper limit also increased in the desired direction for all the characters. BIPs were able to provide greater variability for selection of desirable plants for higher grain yield. Increased mean performance of BIPs population exhibited higher estimates of heritability and genetic advance for all the characters. Patel (2010) compared mean of different characters of NCD III with F_3 progenies, they were higher for yield, plant height, leaf length and leaf breadth in two cross of tobacco in NCD III than F_3 progenies.

CONCLUSION

The selfed progenies developed through North Carolina Designs (NCD I, II and III) in F_2 populations of okra were used to study the variability. The results of mean yield of okra higher in NCD III and CV percent in NCD II were observed in both the crosses. The value of CV percent was higher in NCD II for yield in two cross. The test of significance between the means of selfed progenies developed through North Carolina designs I, II and III for yield per plant, plant height and number of nodes per plant was observed significant in both cross except plant height in cross 2 for NCD III. The mean value of middle inter-nodal length of plant was non significant in NCD I and II for the cross 1.

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