



Assessment of genetic diversity and identification of early segregating lines in okra (*Abelmoschus esculentus*)

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ABSTRACT

Field experiments were conducted during 2005–06 to 2006–07 to study the genetic diversity among popular single cross hybrids and selection of productive segregants in the segregating generation of single and double cross F₂ populations in okra (*Abelmoschus esculentus* (L.) Moench) at the Agricultural Research Station, Hanumanamatti. Thirteen hybrids with check were grouped into five divergent clusters. Maximum numbers of hybrid were congregated in cluster I and II. The highest intercluster distance was observed between III and V. Based on genetic divergence and *per se* performance, two hybrids from cluster III ('BH 2' and 'BH 13') and one hybrid each from IV ('BH 12') and V ('BH 10') were selected to produce three double cross hybrids 'BH 2'×'BH 10', 'BH 2'×'BH 12' and 'BH 2'×'BH 13'. These double cross hybrids along parental single cross were selfed to produce F₂ populations. Higher frequency transgressive segregates were observed in double cross F₂ that indicated the advantage of multiple cross. Selected superior segregation could be developed into pure lines by selfing and selections.

Key words: *Abelmoschus esculentus*, Cluster, Diversity, Double cross, Segregants

Okra (*Abelmoschus esculentus* (L.) Moench) or *bhendi* is an important vegetable crop cultivated throughout the world and is a native of tropical Africa. It is grown in tropical and subtropical parts of the world. India is the largest producer of okra covering an area of 3.91 lakh ha with an annual production of 39.7 lakh tonnes (CIME 2009). Okra is a commonly used vegetable and is widely employed in culinary preparations. It has good nutritional value, particularly vitamin C (30 mg/100 g), vitamin B₆, calcium (90 mg/100 g) and iron (1.5 mg/100 g) and is a rich source of dietary fibre and folic acid.

Okra belongs to family Malvaceae with $2n = 8x = 72$ or 144 and amphidiploid in nature. It is a self-pollinated crop, however, occurrence of outcrossing by 4 to 19% by insect pollinators has been reported which renders considerable genetic diversity.

Okra is one vegetable crop where heterosis has been exploited successfully. A raise in yield plateau is seen in heterotic hybrids. So, there is a need to develop truly potential inbred line which can produce really novel hybrids with desirable maximum heterosis (Krushna *et al.* 2007). Among the various approaches for developing inbred lines, selection of potential segregating populations is an important one, for

which selection of segregating populations developed from double cross combinations involving parents with desired diversity may prove to be better than segregating populations derived from single cross combinations. It is known that double cross combinations generated employing two single cross combinations which are diverse may produce the desired double cross combinations. Such segregating populations help in identifying pure line varieties. Keeping these things in view, a study was conducted to assess genetic diversity among popular hybrids and to isolate the best segregants from segregating population.

MATERIALS AND METHODS

The experimental material for present investigation consisted of 13 potential F₁ hybrids, viz 'BH 1', 'BH 2' 'BH 13' along with a popular check, namely 'Arka Anamika' was evaluated in randomized block design (RBD) with three replications during winter (*kharif*) season 2005. The plot size was four rows each of 5 m length with a spacing of 60 cm×30 cm. All recommended cultivation practices were followed to raise a good healthy crop. Observations were recorded on five competitive plants for 17 quantitative characters, viz days to first flowering, days to 50% flowering, plant height (cm), number of branches/plant, internodal length (cm), stem diameter (cm), number of nodes at first flowering, pedicel length (cm), fruit length

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(cm), fruit diameter (cm), fruit weight (g), number of ridges on fruit, number of seeds/fruit, 100-seed weight (g), number of fruits/plant, fruit yield/plant (g) and fruit yield/plot (kg). The data was subjected to Mahalanobis (1936) D^2 statistics to assess the genetic diversity between hybrids. The hybrids were grouped into different clusters following the Touchers method.

Three double crosses ('BH 2' × 'BH 10', 'BH 2' × 'BH 12' and 'BH 2' × 'BH 13') were developed which represent maximum single cross hybrid diversity. These double cross hybrids were selfed to obtain F_2 populations during summer 2006. Simultaneously, the single cross hybrids involved in the generation of double cross hybrids were also selfed to derive F_2 populations. Then F_2 populations of three double crosses and four single crosses, F_1 parental hybrids of three double crosses and four single crosses along with the check were evaluated in RBD with three replications during *kharif* 2006. The plot consisted of two rows each for single and double cross hybrids, 16 rows each for single and double cross F_2 population and two rows each of commercial and local checks. As per the plot size the row length was 6 m with a spacing of 60 cm × 30 cm. Observations were recorded on five competitive plants in each population for above mentioned characters. The data was subjected for analysis of superior segregants in single and double cross F_2 populations.

RESULTS AND DISCUSSION

Based on D^2 values fourteen hybrids were grouped into five different clusters. Of the five clusters, cluster I and II comprised five hybrids each ('BH 3', 'Arka Anamika', 'BH 4', 'BH 9' and 'BH 8' and 'BH 7', 'BH 1', 'BH 11', 'BH 6' and 'BH 5', respectively), followed by III cluster comprising two hybrids ('BH 2' and 'BH 13'). Cluster IV and V were solitary comprising 'BH 12' and 'BH 10', respectively.

The intra-cluster distance (Table 1) was highest in cluster II (18.21), followed by cluster I (14.81) and cluster III (12.13). The inter cluster D^2 values were maximum between III and V (284.76). The minimum distance observed between cluster III and IV (23.43) indicated close relationship among the hybrids. Cluster V was the most diverse as it showed maximum inter-cluster distance.

The mean data obtained for 17 characters indicated the considerable differences between the different clusters. The cluster II required minimum (41.13) days to first flowering,

Table 1 Intra- and inter-cluster distance in five clusters

Cluster	I	II	III	IV	V
I	14.809	36.843	105.549	84.86	82.889
II		18.215	73.098	52.534	214.36
III			12.125	23.439	284.269
IV				0.0	262.753
V					0.0

whereas cluster V required maximum (42.52) days to first flowering. The cluster II required minimum (43.87) and cluster V required maximum (44.81) days to 50% flowering. Maximum and minimum plant height of 102.52 and 94.45 cm were observed in cluster II and cluster I, respectively.

Minimum number of branches/plant (1.42) was observed in cluster IV and maximum number of branches/plant (2.15) was observed in cluster I. Highest internodal length (8.70 cm) and lowest internodal length (8.17 cm) observed in cluster III and cluster V, respectively. The maximum stem diameter (1.13 cm) was observed in cluster V and minimum stem diameter (1.08 cm) was observed in cluster II.

In case of node to first flowering, cluster III showed earliness (2.33) and it was late in cluster V (2.93). The maximum pedicel length (3.48 cm) was observed in cluster III and minimum pedicel length (3.32 cm) was in cluster IV.

The longest fruits (14.67 cm) and the smallest fruits (14.23 cm) were produced in cluster I and cluster IV, respectively. Cluster V had lowest average fruit diameter (1.66 cm), whereas cluster II had highest fruit diameter (1.72 cm). The cluster V had less number of fruits/ridges (5.25), whereas cluster III had maximum number of fruit ridges (5.58). The minimum (50.40) and maximum (57.5) number of seeds/fruit were observed in cluster III and cluster V, respectively. Highest 100-seed weight (7.24 g) and lowest 100-seed weight (6.95 g) were recorded in cluster V and cluster IV, respectively.

Cluster II had highest average fruit weight (17.08 g), while cluster I had lowest average fruit weight (16.09 g). Cluster V gave the highest number of fruits/plant (20.22) and cluster II the lowest (18.12). The highest fruit yield/plant (344.02 g) and fruit yield/plot (22.89 kg) was observed in cluster V, whereas lowest fruit yield/plant (301.34 g) and fruit yield/plot (19.29 kg) was observed in cluster II.

It was observed that parameters such as hybrid productivity, maximum yield/plant, higher number of fruits, shorter internodal length and lesser number of ridges fall in cluster V while hybrids having lower values for number of nodes at first flowering and seed/fruit in cluster III. The inter-cluster distance was found to be highest between cluster III and cluster V. Hence, it is expected that the cross combination involving hybrids from each of these clusters would produce maximum heterosis. Also the chances of isolating superior or transgressive segregants in advanced generations are higher.

Analysis of productive segregants in F_2 for important component characters (Table 2) revealed that there was a higher frequency of superior segregants for fruit yield/plant namely 'BH 10' (42.50%) and 'BH 2' (35%) in single cross, 'BH 2' × 'BH 10' (45%) and 'BH 2' × 'BH 12' (37.5%) in double cross F_2 population. The double cross 'BH 2' × 'BH 10' had higher frequency of productive segregants for fruit yield/plant (31.66%) and number of fruits/plant (35.83%). The cross 'BH 2' × 'BH 12' had higher frequency for fruit weight (61.66%).

Table 2 Per cent transgressive and superior segregants from single and double cross F₂ populations for three yield related characters

	Transgressive segregants			Superior segregants
	Fruits/ plant (%)	Fruit weight (%)	Yield/ plant (%)	Yield/ plant (%)
<i>Single cross</i>				
'BH 2'				35.00
'BH 10'				42.50
'BH 12'				33.75
'BH 13'				25.00
Mean of the population				34.06
<i>Double cross</i>				
'BH 2'×'BH 10'	35.83	38.33	31.66	45.00
'BH 2'×'BH 12'	24.16	61.66	21.66	37.50
'BH 2'×'BH 13'	18.33	30.00	17.50	28.33
Mean of the population	26.33	43.33	23.60	36.94

Superior plants from each cross have been listed in Table 3. These selected segregants were superior to the checks for fruit yield and for other important characters. The frequency of superior segregants was higher in double cross than single cross. This indicates that segregating individuals are obtained by involvement of higher number of different parents. The isolation of this kind of useful segregants for further utility has been reported by Naidu (1993) and Patil (1997) in tomato (*Solanum lycopersicon* L. Moench).

Among seven F₂ populations the double cross 'BH 2'×'BH 10' showed higher number of superior segregants (54), followed by single cross 'BH 10' (50). More number of segregants were obtained in the range of 350–450 g class interval and only one superior segregants in the range of 750–850 g class interval. This differential ability of the double cross hybrids to ensure higher frequencies of superior segregants is attributed to the parents possessing greater genetic diversity and different set of genes for yield, complementing to each other.

Among the F₂ populations of single cross, 'BH 10' (1–21) was the most high-yielding with an average of 700 g fruit yield/plant, it was found to be medium tall with 2–3 branches, having shorter internodal length. Similarly, in 'BH

Table 3 Frequency distribution of superior segregants for fruit yield (g) in single and double cross F₂ populations of *bhendi*

Population	350–450	450–550	550–650	650–750	750–850
'BH 2'	25	12	2	3	
'BH 10'	28	11	7	4	
'BH 12'	26	8			
'BH 13'	19	9	3		
'BH 2'×'BH 10'	35	7	4	7	1
'BH 2'×'BH 12'	28	10	2	5	
'BH 2'×'BH 13'	20	13		1	

2' (4–67) was erect medium plant with short internodal length and recorded 674.3 g fruit yield/plant. In double cross F₂ populations in ('BH 2'×'BH 10') the plant 6–104 was found to be tall with more branches, long inter-nodal length and had yielding capacity of 840 g fruit yield/plant with an average fruit weight of 23 g. Similarly, in 'BH 2'×'BH 12' the plant 69–110 fruit yield/plant, which was medium tall with branches having shorter internodal length, long green fruits had a fruit yield around 750 g. Isolation of this kind of useful segregants for further utility has been reported by Naidu (1993) and Patil (1997) in tomato.

Transgressive/superior segregants represents one of the rapid method of enhancing the yield level or any other desirable characters. All these superior segregants could be developed into pure lines by selfing.

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