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Research Note

Genetic divergence in okra (*Abelmoschus Esculentus* L. Moench.)

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Abstract
Genetic divergence was studied among 25 okra germplasm lines using Mahalanobis D2 analysis. Analysis of variances for dispersion indicated significant differences among the genotypes and they were grouped into four clusters. The cluster I consisted of 22 genotypes, whereas cluster II, III and IV were solitary clusters. Highest inter cluster distance observed between clusters I and cluster IV, while cluster I shown maximum intra cluster distance. Characters days to 50 per cent flowering and plant height (cm) contributed maximum of 18.0% towards genetic divergence followed by number of seeds per fruit (16.0%). Cluster I and IV shown high cluster means for yield and yield components, therefore genotypes viz., IIVR- 11, HRB- 55, 134, 148 and Parbhani kranti (Cluster I) and 315 (Cluser IV) of these diverse clusters may be used for further hybridization.

Key words
Okra, Genetic divergence, yield components

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop grown in World as well as India. Hybrid vigor was already successfully exploited in okra with commercial hybrid development; therefore genetic divergence among the parents is important factor while selecting the parents for hybridization. Rao (1960) and Ramanujam *et al.,* (1974) also observed that a cross involving genetically diverse parents is more likely to produce high heterotic effects as compared with lines which are more closely related with each other. Moll *et al.* (1974) indicated that the level of heterosis exhibited by a hybrid is a function of the genetic divergence between the parents. Cress (1966) demonstrated that 'genetic diversity is necessary for significant heterosis but not sufficient to guarantee it'. The importance of genetic diversity for selecting parents in recombination breeding of different autogamous crops to obtain transgressive segregants has been very well emphasized by Khanna and Mishra (1977), Singh and Ramanujan (1981), Cox and Murphy (1990). Also, while performing selection more importance should be given to the characters which contribute more towards diversity. Hence the present study was undertaken to understand the genetic diversity among the 25 germplasm lines and to identify the lines for further hybridization.

Twenty five genotypes of okra collected from the Indian Institute of Vegetable Science (IIVR), Varanasi were grown in randomized block design with three replication and spacing of 60 x 30 cm at the Department of Botany, Pratishthan Mahavidylaya, Paithan, Aurangabad, Maharashtra in kharif 2009. The observations were recorded on 5 randomly selected plants from each genotype for eight quantitative characters viz., days to first flowering, days to 50 per cent flowering, plant height (cm), number of branches per plant, number of nodes per plant, inter nodal length (cm), tender fruit length (cm), number of seeds/ fruit, number of fruits per plant and weight of fruits/plant (g). Genetic divergence was analyzed using the Mahalanobis D^2 statistics (1936) and genotypes were grouped into clusters by following the Tocher's method described by Rao (1952).

Analysis of variances revealed significant differences among the 25 genotypes for all the eight characters studied. Wilk's criteria used to test the aggregate effects of all the eight traits. It indicated the significant differences among the genotypes. Similar results were found by Moll *et al.* (1974) and Pradip *et al.* (2010). Twenty five genotypes were grouped into four clusters (Table 1), Maximum of 22 genotypes were grouped in to cluster I and cluster II, III and IV were solitary clusters with single genotype. Pradip *et al.* (2010) also reported similar type of distribution of genotypes. The distribution of the genotypes into different clusters was based on D2 values, which ranged from 2.35 to 5.09 (Table 2). Highest inter cluster D2 values observed between cluster I and IV (5.09) followed by III and IV (3.86) and I and III (3.10), whereas lowest observed in between II and III (2.35). Highest intra cluster distance was shown by cluster I (2.05), while rests of the clusters were having zero intra cluster distance. Genotypes for the hybridization should be selected from the more distant clusters as chances are more to obtain heterotic combinations as compared to combinations involving genotypes from same clusters.

Cluster means indicate the variation for the quantitative trait among the cluster (Table 3). Considering major yield contributing characters along with earliness to flowering and maturity cluster I and IV shown high cluster means for yield and yield components, therefore genotypes from

these diverse clusters should be used for further hybridization and isolating transgressive segregants in later generations.

Analysis of contribution of the characters to genetic diversity (Table 3) reveled that characters days to 50 percent flowering and plant height (cm) contributed highest up to 18.00%, followed by number of seeds per fruit (16.00%) and days to first flowering (12.33%), however character weight of fruits per plant (g) contributed lowest (3.67%). De et al. (1988) proposed that traits contributing maximum towards the D^2 values need to be given more emphasis for deciding the clusters to be taken for further selection and choice of parents for hybridization. Moll *et al.* (1974), John *et al.* (1992), Abdul *et al.* (1994) and Pradip *et al.* (2010) also observed similar level of contribution of plant height (cm), inter nodal length (cm), tender fruit length (cm) and weight of fruits per plant (g).

On the basis of inter cluster distance, clusters I and IV were identified as more divergent clusters, and genotypes viz., IIVR- 11, HRB- 55, 134, 148 and Parbhani kranti (Cluster I) and 315 (Cluser IV) of these diverse clusters should be used for further improvement in heterosis in yield targeted traits with creation of wider variability.

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Table 1. Grouping of twenty five genotypes into different clusters

Cluster	Number of genotypes	Genotypes
I	22	Bo-2, VRO-4, VRO-6, IIVR-11, 35, HRB-55, DOV-91-4, 134, 148, 156, 162, EC-171, 173, 320, 337, 364, 391, 403, 410, EC-316053, Vaibhav and Parbhani kranti
II	1	198
III	1	447
IV	1	315

Table 2. Average intra (diagonal) and inter cluster distance (D^2) in okra.

Cluster	I	II	III	IV
I	**2.05**	3.91	3.10	5.09
II		**0.00**	2.35	3.08
III			**0.00**	3.86
IV				**0.00**

Table 3. Cluster means and per cent contribution of different characters in okra

Clusters	Days to first flowering	Days to 50 percent flowering	Tender fruit length (cm)	Internodal length (cm)	Plant height (cm)	Number of seeds/ fruit	Number of fruits/plant	Weight of fruits/plant (g)
I	43.12	48.91	10.89	2.74	43.11	46.38	11.35	136.41
II	45.33	56.00	10.27	2.77	44.00	34.33	5.87	108.60
III	42.00	52.67	11.17	2.90	41.50	49.00	9.00	97.00
IV	48.00	55.67	10.40	2.20	21.60	52.67	9.67	137.13
Contribution of individual characters towards total genetic divergence (%)	12.33	18.00	10.33	10.00	18.00	16.00	11.67	3.67