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Research Note

Genetic variability and correlation studies in Okra (*Abelmoschus esculentus* (L.) Monech)

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Abstract
The present investigation on genetic variability and correlation in Okra was conducted with thirty-three genotypes including four national check varieties with the objective of improving yield through selection. The results revealed that wide variability was found for different traits in Okra. Invariably, higher values were observed for phenotypic coefficient of variation with respect to corresponding genotypic coefficient of variation indicating the impact of environmental factors towards trait expression. The presence of moderate to high heritability coupled with moderate genetic advance for fruit weight, days to 50% flowering, fruits per plant as well as fruit yield per plant indicated their possibility of improvement with simple selection procedure in okra. Similarly, highly significant and positive correlation of fruit yield per plant with plant height, nodes per plant and fruits per plant was observed.

Keywords
Okra, genetic variability, correlation

Okra (*Abelmoschus esculentus* (L.) Moench) is one of the important vegetable crops grown for its tender green fruits throughout India, Turkey and other neighboring countries. It has high nutritive value and export potential. To improve yield and other characters, information on genetic variability and inter-relationship among different traits is necessary. The improvement in any crop is proportional to the magnitude of its genetic variability present in the germplasm (Dhankhar and Dhankhar, 2002). The genotypic co-efficient of variation (GCV) indicates the range of genetic variability present in different characters. Yield, is a complex trait influenced by various yield attributing plant characters, hence direct selection for yield is often misleading. Therefore knowledge about inter-relationship between pairs of these characters and with yield is essential to bring a rational improvement in the desirable traits. Information derived from correlation studies will reveal the possibility of simultaneous improvement of various attributes and also helps in increasing the efficiency of selection of complex inherited traits. The demand for okra variety (as well as hybrids) than the existing ones is always desired for the attributes like higher yield, more number of fruits, high fruit weight, good size fruits and earliness to enhance productivity and subsequently improve income generation to the local producers. Keeping this in view, the present investigation was undertaken to assess the genetic variability, association of twelve characters on fruit yield in thirty three lines of okra.

Experimental material consisted of twenty-nine genotypes with four checks (HOK-152, Pusa Sawani, Arka Anamika, BO-2) were evaluated by adopting Randomized Block Design with three replications during *kharif* 2013 at All India Co-ordinated Research Project on Vegetable Crops, Horticulture Research Station of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India. The entries were planted in five rows with ten plants in each row. The inter and intra row spacing was 60 cm and 30 cm, respectively, and all the recommended cultural practices were followed to raise a good crop. Data on twelve quantitative characters viz,, plant height (cm), nodes per plant, fruit length (cm), fruit girth (cm), fruit weight (g), number of fruits per plant, 1st flowering node, duration of fruiting (days), days to first flowering, days to 50% flowering, days to first harvest and yield per plant were recorded. Mean values of ten plants from each row were subjected to analysis of variance. Fruit weight is based on the mean of ten fruits from each plant. Genotypic and phenotypic correlation coefficient was computed by adopting the procedure of Dewey and Lu (1959).

Variations were observed among the 33 genotypes of okra with respect to 12 different vegetative, flowering, fruit yield and yield attributing parameters (Table 1). The results indicated that wide variations for fruit weight (12.23g to 23.40g), first flowering nodes (4.90 to 7.77), and fruit yield per plant (192.26g to 433.34g). Similarly fruit yield per plant had the highest mean of 290.90g followed

by plant height (160.62 cm) whereas lowest mean was observed for first flowering node (6.10). The study also indicated invariably, higher values for all the parameters under study for phenotypic coefficient of variation (PCV) as compared to their respective GCV indicating the impact of the environmental factors towards their expression. Similar results were also reported by Singh *et al*. (1998) and Adiger *et al*. (2011). However, maximum difference between GCV and PCV were observed for characters such as nodes per plant (5.21 and 12.59), plant height (6.17 and 13.01) and days to first flowering (9.51 and 19.12) indicating environmental influence on the expression of these traits was high as compared to other traits. Other traits showed moderate estimates of GCV and PCV. Prevalence of greater genetic variability among the 33 tested genotypes reveals that yield improvement through selection is possible in okra.
The efficiency of selection not only depends on the magnitude of genetic variability but also on the heritability of the characters. The high heritability in broad sense was recorded for fruit weight (74.74%), days to 50% flowering (67.49%) and duration of fruiting (63.38%). The high heritability denotes high proportion of genetic effects in the determination of these traits and can be selected for improving fruit yield in okra (Table 2). The genetic advance as per cent of mean was maximum for fruit weight, yield per plant, duration of fruiting, 1st flowering node, days to 50% flowering and fruit length. In the present investigation, high heritability coupled with high genetic advance was observed for yield per plant, fruit weight, days to 50% flowering and duration of fruiting which might be due to large additive gene effects which revealed that the selection based on these traits will improve fruit yield in okra.

The results on correlation studies of 12 important traits of okra observed in the present study revealed highly significant and positive correlation of fruit yield per plant with plant height, nodes per plant as well as number of fruits per plant at both genotypic and phenotypic level indicating their mutual association of these traits. Hence, the fruit yield per plant in okra can be achieved through selection of these traits. The present findings are in conformity with those of Khan *et al*. (2005), Adiger *et al*. (2011), Jagan *et al*. (2013) and Reddy *et al*. (2013). Similarly, plant height showed significant positive correlation with nodes per plant, fruit length, number of fruits per plant, yield per plant suggesting that taller plants in okra will have more number of nodes resulting in more number of fruits per plant and more total fruit yield. Similarly, nodes per plant was significantly and positively correlated with fruit length, number of fruits per plant and yield per plant suggesting more number of nodes in okra plant results in production of more number of fruits per plant and having higher fruit length resulting higher total yield. This indicates the interdependency of the various characters on each other. Jayapandi and Balkrishnan (1992) and Chitra (1999) reported similar results in okra.

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Table 1. Genetic variability of 12 different parameters in okra

Sl. No.	Characters	Range	Grand Mean	Phenotypic coefficient of variance (PCV)	Genotypic coefficient of variance (GCV)	Heritability (in broad sense) (%)	Genetic Advance as percent mean
1.	Plant height (cm)	117.58-188.20	160.62	13.01	6.17	22.54	6.04
2.	Nodes per plant	21.40-29.87	25.69	12.59	5.21	17.12	4.44
3.	Fruit length (cm)	11.80-17.63	15.26	11.62	7.55	42.23	10.11
4.	Fruit girth (cm)	5.78-6.78	6.18	5.60	3.36	35.88	4.14
5.	Fruit weight (g)	12.23-23.40	19.63	14.23	12.30	74.74	21.91
6.	Number of fruits per plant	16.27-23.55	19.88	11.63	6.90	35.23	8.44
7.	First flowering node	4.90-7.77	6.10	17.12	9.51	30.87	10.89
8.	Duration of fruiting	35.55-46.26	41.71	8.88	7.07	63.38	11.59
9.	Days to first flowering	30.36-40.10	35.50	7.35	4.67	40.31	6.11
10.	Days to 50% flowering	34.88-47.27	41.20	7.33	6.02	67.49	10.19
11.	Days to first harvest	39.37-47.72	43.42	6.59	4.73	51.46	6.99
12.	Yield per plant (g)	192.26-433.34	290.90	21.30	13.81	41.99	18.43

Table 2. Genotypic and phenotypic correlation between 12 characters in Okra.

Characters		Nodes plant^{-1}	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of fruits Plant^{-1}	First flowering node	Duration of fruiting	Days to first flowering	Days to 50% flowering	Days to first harvest	Yield plant^{-1} (g)
Plant height (cm)	G	0.718**	0.834**	0.100	0.679**	0.557**	-0.338	0.349*	-0.079	-0.344*	0.138	0.550**
	P	0.539**	0.386*	0.091	0.284	0.394*	-0.300*	0.092	-0.158	-0.199	0.102	0.340*
Nodes plant^{-1}	G		0.751**	-0.403**	0.580**	0.974**	0.070	0.844**	0.522**	0.328*	0.767**	1.044**
	P		0.322*	0.021	0.152	0.703**	0.018	0.271	0.011	0.076	0.123	0.504**
Fruit length (cm)	G			-0.290	0.495**	0.287	-0.107	0.635**	0.265	0.137	0.137	0.602**
	P			0.106	0.442**	0.287	-0.052	0.351*	0.075	0.051	0.084	0.277
Fruit girth (cm)	G				0.234	-0.405**	-0.313*	-0.193	-0.244	-0.414**	-0.341	-0.188
	P				0.175	-0.060	-0.014	0.031	-0.093	-0.221	-0.180	0.005
Fruit weight (g)	G					0.265	-0.093	-0.114	-0.031	-0.070	-0.088	0.453**
	P					0.167	-0.063	-0.056	-0.017	-0.084	-0.047	0.242
No. of fruits plant^{-1}	G						-0.118	0.392*	0.218	0.046	0.564**	0.914**
	P						-0.107	0.227	-0.050	-0.068	0.075	0.657**
First flowering node	G							-0.114	0.763**	0.925**	0.389*	0.142
	P							0.045	0.371*	0.516**	0.082	0.015
Duration of fruiting	G								0.113	0.222	0.319*	0.472**
	P								0.123	0.053	0.006	0.240
Days to first flowering	G									0.796**	0.753**	0.345*
	P									0.533**	0.364*	0.056
Days to 50% flowering	G										0.704**	0.180
	P										0.483**	0.047
Days to first harvest	G											0.558**
	P											0.177

* and ** indicates significant at 5 and 1 percent level, respectively