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Correlation and Path Coefficient Studies in Okra [*Abelmoschus esculentus* (L.) Moench]

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A B S T R A C T

The present study was undertaken on one eighty genotypes of okra to determine the nature of association among different yield attributes and their direct and indirect contribution towards yield. The fruit yield has significantly positive correlation with number of fruits per plant, plant height, average fruit weight, number of seeds per fruit, fruit length, first flower producing node, first fruit producing node, 50 percent flowering and stem diameter respectively, indicating mutual association of these traits. Path coefficient analysis revealed that fruit width (1.431) had maximum direct contribution towards fruit yield followed by number of fruits per plant (0.834), first fruit producing node (0.221) and average fruit weight (0.145). However, 100 seed weight exhibited highest negative direct effect (-1.732) followed by first flower producing node (-0.222), 50 per cent flowering (-0.097) and intermodal length (-0.062) plant height at 45 days after sowing (-0.065) and days to first flowering (-0.040). These important traits may be viewed in selection programme for the further improvement of okra.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] also known as lady's finger and bhendi is an important spring - summer and rainy season vegetable crop cultivated in tropical and sub-tropical parts of the world. Tender fruits of okra are used as vegetable or in culinary preparation as sliced and fried pieces. The leaves are sometimes used as cattle feed. It is also used for thickening soups and gravies, because of its high mucilage content. Okra fruits are also sliced for sun drying or canning or pickling for off season use. It has high nutritive value, 86.1 % water, 2.2 % protein, 0.2 % fat, 9.7 % carbohydrate, 1.0 % fibre and 0.8 % ash (Saifullah and Rabbani, 2009) and also rich in vitamin C (30 mg / 100 g), calcium (90 mg / 100 g) and iron (1.5 mg / 100 g) content (Pal *et al.*, 1952). In addition to its usefulness as a vegetable crop, it is also used medicinally in curing ulcer, suppressing the pains and haemorrhoid effects. The high iodine content of fruits is useful in curing goiter disease and also possesses export potential. The leaves and fruits produce mucilaginous substance. The mucilage has been used as a plasma replacement or blood

volume expander (Siemonsma and Kouame, 2004).

The study of correlation will help in identifying the traits which have strong association with yield. Path coefficient analysis helps for sorting out the total correlation into direct and indirect effects and is useful for choosing the most useful traits to be used for yield improvement through selection. Such information reveals the possibility of simultaneous improvement of various attributes and also helps in increasing the efficiency of selection of complex inherited traits. Keeping this in view, the present investigation was aimed at assessing the association of various characters and direct and indirect path effects of 14 independent components on fruit yield in 180 genotypes.

Materials and Methods

The current study on correlation and path coefficient analysis in okra were undertaken during the year 2014 in *kharif* season at experimental site Vegetable Research Centre, Pantnagar. The One hundred eighty genotypes were evaluated in augmented block design with five checks and six blocks. Planting was done on ridges and furrows with a spacing of 60 x 30 cm. Two to three seeds per hill were dibbled. For recording observations, five plants in each experimental plot were chosen at randomly as per NBPGR minimal descriptors the parameters *viz.,* first flower producing node, first fruit producing node, internodal length (cm), fruit length (cm), fruit width (cm), no. of ridges per fruit, no. of seeds/ fruit, 100 seed weight (g), 50 % flowering, plant height(cm), no. of primary branches, stem diameter (mm), no. fruits/ plant, fruit weight (g) and marketable yield per plant (g).

The correlation co-efficient among all possible character combinations were estimated employing formula given by Al-Jibouri *et al.,* 1958. Path co-efficient analysis suggested by Wright (1921) and Dewey and Lu (1959) was carried out to know the direct and indirect effect of the morphological traits on plant yield.

The mean values of the data collected were used for calculating correlation co-efficient and also direct and indirect effects of path co-efficient and are presented in tables 1 and 2.

Results and Discussion

The yield, in most of all the crops, is referred to as super character which results from multiplicative interaction of several other characters that are termed as yield components. Thus, genetic architect of yield in okra as well as other crops is based on the balance or overall net effect produced by various yield components directly or indirectly by interacting with one to other. Therefore, identification of important yield components and information about their association with yield and also with each other is very useful for developing efficient breeding strategy for evolving high yielding varieties. In this respect, the correlation coefficient which provides symmetrical measurement of degree of association between two variables or characters helps us in understanding the nature and magnitude of association among yield and yield components.

The association analysis (Table 1) showed highly significant and positive correlation of fruit yield per plant with number of fruits per plant (0.753), plant height (0.341), average fruit weight (0.241), number of seeds per fruit (0.208), fruit length (0.197), 50 percent flowering (0.188), first fruit producing node (0.184), stem diameter (0.178) and first flower producing node (0.168) respectively, indicating the possibility of simultaneous selection for these traits.

Table.1 Correlation coefficient for 15 parameters in okra genotypes

Characters	first flower producing node	Ist fruit producing node	internodal length	Fruit length (cm)	fruit width (cm)	No. of ridges per fruit	no. of seeds/ fruit	100 seed weight (g)	50 % flowering	plant height(cm)	no. of primary branches	stem diameter (mm)	no. fruits/ plant	fruit weight (g)
Ist flower produc. Node	**1.000**													
Ist fruit producing node	**0.965****	**1.000**												
internodal length	**-0.021**	**-0.030**	**1.000**											
Fruit length (cm)	**0.178***	**0.176***	**0.014**	**1.000**										
fruit width (cm)	**-0.120**	**-0.080**	**0.057**	**-0.035**	**1.000**									
No. of ridges per fruit	**0.074**	**0.056**	**0.274****	**-0.015**	**-0.040**	**1.000**								
no. of seeds/ fruit	**0.179***	**0.194****	**0.155***	**0.261****	**-0.113**	**0.120**	**1.000**							
100 seed weight (g)	**-0.194****	**0.141**	**-0.012**	**-0.173***	**0.952****	**-0.019**	**-0.232****	**1.000**						
50 % flowering	**0.251****	**0.226****	**0.070**	**0.242****	**-0.317****	**0.124**	**0.222****	**-0.460****	**1.000**					
plant height(cm)	**0.118**	**0.167***	**0.195****	**0.226****	**0.186***	**-0.129**	**0.325****	**0.058**	**0.153***	**1.000**				
no. of primary branches	**-0.109**	**-0.053**	**-0.168***	**-0.223****	**0.262****	**0.058**	**-0.103**	**0.399****	**-0.341****	**0.066**	**1.000**			
stem diameter (mm)	**0.118**	**0.139**	**0.165***	**0.163***	**0.029**	**-0.046**	**0.136**	**-0.051**	**0.142**	**0.343****	**0.058**	**1.000**		
no. fruits/ plant	**-0.005**	**0.026**	**-0.094**	**-0.098**	**0.137**	**-0.223****	**-0.096**	**0.180***	**-0.110**	**0.106**	**0.276****	**-0.016**	**1.000**	
fruit weight (g)	**0.115**	**0.107**	**0.001**	**0.065**	**-0.026**	**0.052**	**-0.021**	**-0.060**	**0.139**	**0.004**	**0.007**	**0.054**	**0.050**	**1.000**
marketable yield / plant (g)	**0.168***	**0.184***	**-0.020**	**0.197****	**-0.057**	**-0.224****	**0.208****	**-0.172***	**0.188***	**0.341****	**-0.004**	**0.178***	**0.753****	**0.241****

Table.2 Path coefficient analysis for 15 characters in okra genotypes

Characters	first flower producing node	Ist fruit producing node	internodal length	Fruit length (cm)	fruit width (cm)	No. of ridges per fruit	no. of seeds/ fruit	100 seed weight (g)	50 % flowering	plant height (cm)	no. of primary branches	stem diameter (mm)	no. fruits/ plant	fruit weight (g)	Correlation with marketable yield / plant (g)
Ist flower produc. Node	**-0.221**	0.214	0.001	0.003	-0.172	0.001	0.008	0.335	-0.024	0.008	-0.003	0.005	-0.004	0.017	0.168*
Ist fruit producing node	-0.218	**0.222**	0.002	0.003	-0.114	0.001	0.009	0.244	-0.022	0.012	0.001	0.005	0.022	0.016	0.184*
internodal length	0.005	-0.007	**-0.062**	0.000	0.082	0.004	0.007	0.020	-0.007	0.014	-0.004	0.006	-0.079	0.000	0.02
Fruit length (cm)	-0.039	0.039	-0.001	**0.018**	-0.050	-0.000	0.012	0.299	-0.024	0.016	-0.006	0.006	-0.082	0.009	0.197**
fruit width (cm)	0.027	-0.018	-0.004	-0.001	**1.431**	-0.001	-0.005	-1.649	0.031	0.013	0.007	0.001	0.114	0.004	0.057
No. of ridges per fruit	-0.016	0.012	-0.017	-0.000	-0.057	**0.016**	0.006	0.033	-0.012	-0.009	0.002	-0.002	-0.186	0.007	0.224**
no. of seeds/ fruit	-0.039	0.043	-0.010	0.005	-0.161	0.002	**0.046**	0.403	0.022	0.023	-0.003	0.005	-0.080	0.003	0.208**
100 seed weight (g)	0.043	-0.031	0.001	-0.003	1.362	-0.000	-0.011	**-1.732**	0.045	0.004	0.011	-0.002	0.150	0.009	0.172*
50 % flowering	-0.055	0.050	-0.004	0.004	-0.453	0.002	0.010	0.796	**-0.097**	0.011	-0.009	0.005	-0.092	0.020	0.188*
plant height(cm)	-0.026	0.037	-0.012	0.004	0.266	-0.002	0.015	-0.101	-0.015	**0.070**	0.002	0.013	0.089	0.001	0.341**
no. of primary branches	0.024	-0.012	0.010	-0.004	0.375	0.001	-0.005	-0.692	0.033	0.005	**0.026**	0.002	0.231	0.001	0.004
stem diameter (mm)	-0.026	0.031	-0.010	0.003	0.042	-0.001	0.006	0.088	-0.014	0.024	0.002	**0.039**	-0.014	0.008	0.178*
no. fruits/ plant	0.001	0.006	0.006	-0.002	0.196	-0.003	-0.004	-0.312	0.011	0.007	0.007	-0.001	**0.834**	0.007	0.753**
fruit weight (g)	-0.025	0.024	-0.000	0.001	-0.037	0.001	0.001	0.104	-0.014	0.000	0.000	0.002	0.041	**0.145**	0.241**

It could be suggested from correlation estimates that yield could be improved through selection based on these characters. These findings are in agreement with those of Reddy *et al.,* (1985), Korla and Rastogi (1978), Shukla (1990), Akinyele and Osekita (2006) and Kumar and Yadav (2009). Significant negative correlation were observed for fruit yield per plant with number of ridges per fruit (-0.224) and 100 seed weight (-0.172) respectively, indicating that yield was quite high if number of ridges less and 100 seed weight is more. Similar results were also reported by Korla and Rastogi (1978) and Majumdar *et al.,* (1974). Whereas, number of fruits per plant with number of primary branches per plant and 100 seed weight, plant height with number of seeds per fruit, fruit length and intermodal length, first fruit producing node with first flower production node and 100 seed weight with fruit width were exhibited significant positive association. This indicates the interdependency of the various characters on each other. In general, the genotypic correlation coefficients was observed to be higher than the corresponding phenotypic correlations for all the character combinations under study, indicating that there was an inherent association among various characters and the phenotypic expression of correlation might have lessened under the influence of environment.

In the path coefficient analysis (Table 2), fruit width (1.431) had maximum direct contribution towards fruit yield followed by number of fruits per plant (0.834), first fruit producing node (0.221), average fruit weight (0.145) and plant height (0.0706). However, 100 seed weight exhibited highest negative direct effect (-1.732) followed by first flower producing node (-0.222), 50 per cent flowering (-0.097) and intermodal length (-0.062) plant height at 45 days after sowing (-0.065) and days to first flowering (-0.040). These important traits may be viewed in selection programme for the further improvement of okra. Ariyo *et al.,* (1987), Mishra and Singh (1985) and Reddy *et al.,* (1985) obtained similar results earlier. All characters mentioned earlier, which contributed directly and positively to fruit yield per plant possess significant correlations suggesting that the association between these traits is perfect. Regarding the indirect effects, high positive indirect effect was found in case of 100 seed weight (1.362), number of primary branches (0.375) and plant height (0.266) via fruit width. These results were also similar to the findings of Ariyo *et al.,* (1987), Mishra and Singh (1985) and Reddy *et al.,* (1985). Therefore, one can rely upon fruit width, number of fruits per plant, first producing node, average fruit weight and plant height while selecting the okra genotypes with high fruit yielding.

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