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Correlation and path coefficient analysis in okra (*Abelmoschus esculentus*)

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ABSTRACT

The present study was carried out on twenty genotypes of okra [*Abelmoschus esculentus* (L.) Moench] with view to find out the correlation and path co efficient values among the seed yield components. Fruit yield/plant had significant positive association with number of fruits/plant and number of first fruiting node, whereas it exhibited significant negative association with days to flowering. Fruit yield/plant high positive direct effect on seed yield/plant indicating direct selection based on these characters would improve seed yield/plant.

Key words: Correlation coefficient, Fruit yield, Okra, Path analysis

Okra [*Abelmoschus esculentus* (L.) Moench] is an important fruit vegetable crop of significance in the Malvaceae family. It is extensively grown in temperate, subtropical and tropical regions of the world (Kochhar 1986). Its fruits have high nutritive, medicinal and industrial value and export potential. It is a good source of vitamins A, B and C, protein and mineral elements (Jaiprakashnarayan *et al.* 2004) analyzed fruit and reported 6.60 to 10.40% crude fibers 84.60 to 90.50% edible portion 14.40 to 18.60% protein as of total dry weight. For improving this crop through conventional breeding and selection, adequate knowledge of association that exists between yield and yield related quantitative characters are essential for the identification of selection procedure. And these are controlled by polygenes and are much influenced by environment (Adeniji and Peter 2005). The appropriate knowledge of such interrelationships and its contributing components can significantly improve the efficiency of a breeding program by using selection indices. Correlation and path coefficient analyses are the prerequisites for improvement of any crop including okra for selection of superior genotypes and its traits. The correlation studies simply measure the associations between yield and other traits. Correlation analysis provides information about yield components and thus helps in selection of superior genotypes from diverse genetic populations. The information obtained from the correlation coefficients can be enhanced by partitioning into direct and indirect effects for a set of a pair-wise cause-effect interrelationships (Kang *et al.* 1983) and path coefficient analysis permits the same. It is basically a standardized partial regression analysis and deals with a closed system of variables that are linearly related. This information provides a basis for allocation of appropriate weightage to various yield components. Highly significant associations of pod yield were observed in okra with plant height (Bello *et al.* 2006, Mehta *et al.* 2006, Patro and Sankar 2006, Somashekhar *et al.* 2011), number of branches per plant (Singh *et al.* 2006, Rashwan 2011), internodal length (Mohapatra *et al.* 2007, Somashekhar *et al.* 2011), days to 50% flowering (Bello *et al.* 2006), first flowering node, first fruiting node (Jaiprakashnarayan and Mulge 2004), fruit length (Bendale *et al.* 2003, Pal *et al.* 2008), fruit width (Mohapatra *et al.* 2007, Pal *et al.* 2008, Rashwan 2011, Somashekhar *et al.* 2011), fruit weight (Mohapatra *et al.* 2007), and total number of fruits per plant (Rashwan 2011, Somashekhar *et al.* 2011). Pod yield has been reported to be influenced by strong direct effects of plant height (Mehta *et al.* 2006), number of branches per plant, internodal length (Mohapatra *et al.* 2007), fruit length, fruit weight (Mehta *et al.* 2006, Patro and Sankar 2006), and total number of fruits per plant (Jaiprakashnarayan and Mulge 2004, Mohapatra *et al.* 2007). Plant height, number of branches per plant, internodal length, fruit length, fruit weight and number of fruits per plant were identified as potential selection criteria in breeding programs aiming at higher yield. In this study, an attempt was made to study the interrelationship among characters and the direct and indirect effects of important yield components on pod yield in germplasm lines by adopting correlation and path coefficient analysis, with a view to identify the potential parents and promising crosses for their further use in breeding programme (Medagam Thirupathi Reddy *et al.* 2013).

MATERIALS AND METHODS

The present study was carried out at Horticulture

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Research Centre, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The 20 germplasms lines during 2013 were maintained by using conventional good agronomic practices and laid out in Randomized Block Design (RBD) with three replications. Coefficients of correlation between two characters were determined as suggested by AL-Jibouri *et al.* (1958). Path coefficient analysis was carried out as suggested by Wright (1921) and illustrated by Dewey *et al.* (1959).

RESULTS AND DISCUSSION

Complex characteristics such as yield must be related to many individually distinguishable characteristics. It is obvious that fruit yield is a complex character that depends up on many independent yield contributing characters, which are regarded as yield components. All changes in the components need not however, be expressed by changes in yield. This is due to varying degree of positive and negative associations between yield and its components and among components themselves. Therefore, selection should be based on these component characters after assessing their association with fruit yield per plant.

Correlation coefficient analysis

From the perusal of the estimates of phenotypic and genotypic coefficients of variation (Table 1), in general, it was observed that estimates of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic correlation coefficients. The present findings are in consonance with the earlier findings of Akinyele and Osekita (2006), Bello *et al*. (2006), Mehta *et al*. (2006), Rashwan (2011) and Somashekhar *et al*. (2011). More significant genotypic association between the different pairs of characters than the phenotypic correlation means that there is strong association between those characters genetically, but the phenotypic value is lessened by the significant interaction of environment.

Genotypic correlation

The positive and significant correlation was observed for green fruit yield per plant with number of fruit per plant (0.462). Green fruit yield/plant also has significant positive association with number of first fruiting node (0.510). Positive significant association number of fruits per plant with number of branches per plant (0.366), and with number of node per plant (0.708), width of fruit with plant height (0.472), with number of first fruiting node (0.403), with length of first fruiting node (0.574) and with length of internode (0.354), length of fruits with plant height (0.597), with length of first fruiting node (0.294) and with length of internode (0.293), length of internode with plant height (0.524), number of nodes per plant with number of branches per plant (0.416), number of branches per plant with days to flowering (0.304). The positive correlation was observed for green fruit yield per plant with plant height (0.264), length of first fruiting node (0.044), length of internode (0.251), length of fruits (0.028) and with width of fruits (0.003). Positive correlation observed in number of fruits per plant with plant height (0.217), length of first fruiting

Table 1 Correlation coefficients analysis in okra

Characters		Days to flowering	Plant height (cm)	Number of branches/ plant	No. of first fruiting node	Length of first fruiting node (cm)	Length of internode (cm)	Length of fruits (cm)	Width of fruits (cm)	No. of fruits/ plant	Yield/ plants (g)
Days to flowering	G	1.000	0.052	0.304*	0.510**	–0.346*	–0.320*	0.210	0.050	–0.357**	–0.494**
	P	1.000	0.043	0.277	0.403**	–0.328*	–0.278	0.180	0.038	–0.322**	–0.454**
Plant height (cm)	G		1.000	0.005	–0.044	0.227	0.524**	0.597**	0.472**	0.217	0.264
	P		1.000	0.005	–0.051	0.215	0.469**	0.543**	0.407**	0.213	0.261
No. branches/plant	G			1.000	–0.043	–0.192	–0.266	–0.102	0.141	0.366**	–0.163
	P			1.000	–0.035	–0.100	–0.172	–0.049	0.028	0.270	–0.111
No. of first fruiting node	G				1.000	–0.133	–0.228	–0.097	0.311	–0.056	–0.338*
	P				1.000	–0.153	–0.078	–0.067	0.232	–0.048	–0.269*
Length of Ist fruiting node (cm)	G					1.000	0.115	0.294*	0.574**	0.044	0.044
	P					1.000	0.080	0.297*	0.486**	0.049	0.046
Length of internode (cm)	G						1.000	0.293*	0.354**	0.171	0.251
	P						1.000	0.192	0.308*	0.144	0.226
Length of fruits (cm)	G							1.000	0.238	0.134	0.028
	P							1.000	0.187	0.120	0.027
Width of fruits (cm)	G								1.000	0.137	0.003
	P								1.000	0.107	0.002
No. of fruits /plant	G									1.000	0.462**
	P									1.000	0.453**
Yield/plants (g)	G										1.000
	P										1.000

node (0.044), length of internode (0.171), length of fruits (0.134) and with width of fruits (0.137). Positive correlation observed in width of fruits with days to flowering (0.050), number of branches per plant (0.141) and with length of fruits (0.238). Positive correlation observed in length of fruits with days to flowering (0.210) and with number of nodes per plant (0.079), length of internode with number of nodes per plant (0.123) and with length of first fruiting nodes (0.115), length of first fruiting node with plant height (0.227) and with number of nodes per plant (0.142), number of nodes per plant with plant height (0.309), number of branches per plant with plant height (0.005) and plant height with days to flowering (0.052).

Phenotypic correlation

The positive and significant correlation was observed for green fruit yield per plant with number of fruits per plant (0.453). The positive significant association of number of fruits per plant was recorded with width of fruits with plant height (0.407), number of nodes per plant (0.445), length of first fruiting node (0.486) and with length of internode, length of fruits with plant height (0.543) and with length of first fruiting node (0.297), length of internode with plant height (0.469). The positive correlation was observed for green fruit yield per plant with plant height (0.261), length of first fruiting node (0.046), length of internode (0.226), length of fruits (0.027) and with width of fruits (0.002). Positive correlation was observed for number of fruits per plant with plant height (0.213), number of branches per plant (0.270), length of first fruiting node (0.049), length of internode (0.144), length of fruits (0.120) and with width of fruits (0.107). Positive correlation observed in width of fruits with days to flowering (0.038), number of branches per plant (0.028) and with length of fruits (0.187). Positive correlation observed in length of fruits with days to flowering (0.180), number of nodes per plant (0.114) and with length of internode (0.192), length of internode with number of nodes per plant (0.146) and with length of first fruiting node (0.080), length of first fruiting nodes with plant height (0.215) and with number of nodes per plant (0.134), number of nodes per plant with plant height (0.295) and with number of branches per plant (0.277), number of branches per plant with days to flowering (0.277) and with plant height (0.005) and plant height with days to flowering (0.043).

Path coefficient analysis

To obtain clear understanding of association of the genotypic and phenotypic correlation coefficient was partitioned into direct and indirect effects through path coefficient analysis in Table 2. Days to flowering vs fruit yield per plant, the genotypic coefficient between these two characters was negative and highly significant (–0.494). This is due to negative non-significant direct effect (0.189). The indirect effect via. plant height (0.016), number of branches per plant (–0.286), number of first fruiting node (–0.441), length of first fruiting node (0.188), length of internodes (0.169), length of fruits (–0.072), width of fruits (0.036) and number of fruits per plant (–0.293). Plant height vs fruit yield per plant, for this trait genotypic correlation coefficient was found positive and significant (0.263). This was due to direct positive effect (0.309). The indirect effect via. days to flowering (0.010), number of branches per plant (–0.005), number of first fruiting node (0.038), length

Table 2 Path coefficients analysis in okra

Character		Days to flowering	Plant height (cm)	Number of branches/ plant	No. of first fruiting node	Length of first fruiting node (cm)	Length of internode (cm)	Length of fruits (cm)	Width of fruits (cm)	No. of fruits/ plant	Yield/ plants (g)
Days to flowering	G	**0.189**	0.016	–0.286	–0.441	0.188	0.169	–0.072	0.036	–0.293	–0.494**
	P	**–0.285**	0.013	–0.045	–0.063	0.044	0.015	–0.017	0.000	–0.116	–0.454**
Plant height (cm)	G	0.010	**0.309**	–0.005	0.038	–0.123	–0.277	–0.206	0.339	0.178	0.263
	P	–0.012	**0.295**	–0.001	0.008	–0.029	–0.025	–0.050	–0.002	0.077	0.261
No. branches/plant	G	0.058	0.002	**–0.942**	0.037	0.104	0.141	0.035	0.101	0.301	–0.163
	P	–0.079	0.002	**–0.164**	0.005	0.013	0.009	0.004	0.000	0.097	–0.113
No. of first fruiting node	G	0.096	–0.014	0.041	**–0.865**	0.072	0.121	0.034	0.223	–0.046	–0.338*
	P	–0.115	–0.015	0.006	**–0.157**	0.021	0.004	0.006	–0.001	–0.017	–0.268
Length of Ist fruiting node (cm)	G	–0.065	0.070	0.181	0.115	**–0.543**	–0.061	–0.101	0.412	0.036	0.044
	P	0.093	0.063	0.016	0.024	**–0.135**	–0.004	–0.027	–0.003	0.018	0.045
Length of internode (cm)	G	–0.061	0.162	0.250	0.197	–0.062	**–0.529**	–0.101	0.254	0.141	0.251
	P	0.079	0.138	0.028	0.012	–0.011	**–0.054**	–0.018	–0.002	0.052	0.224
Length of fruits (cm)	G	0.040	0.185	0.096	0.084	–0.159	–0.155	**–0.344**	0.171	0.110	0.028
	P	–0.051	0.160	0.008	0.010	–0.040	–0.010	**–0.092**	–0.001	0.043	0.027
Width of fruits (cm)	G	0.009	0.146	–0.133	–0.269	–0.311	–0.188	–0.082	**0.717**	0.113	0.002
	P	–0.011	0.120	–0.005	–0.036	–0.065	–0.017	–0.017	**–0.006**	0.039	0.002
No. of fruits/plant	G	–0.068	0.067	–0.345	0.048	–0.024	–0.091	–0.046	0.098	**0.821**	0.460**
	P	0.092	0.063	–0.044	0.008	–0.007	–0.008	–0.011	–0.001	**0.361**	0.453**

of first fruiting node (–0.123), length of internodes (–0.277), length of fruits (–0.206), width of fruits (0.339) and number of fruits per plant (0.178). Number of branches per plant vs fruit yield per plant, genotypic non = significant negative correlation was found for this trait (–0.163). This was due to negative direct effect (–0.942). The indirect effect via. days to flowering (0.058), plant height (0.002), number of first fruiting node (0.037), length of first fruiting node (0.104), length of internodes (0.141), length of fruits (0.035), width of fruits (0.101) and number of fruits per plant (0.301). Number of first fruiting node vs fruit yield per plant, the negative and non-significance genotypic correlation was found (–0.338). This was due to negative direct effect (–0.865). The indirect effect via. days to flowering (0.096), plant height (–0.014), number of branches per plant (0.041), length of first fruiting node (0.072), length of internodes (0.121), length of fruits (0.034), width of fruits (0.223) and number of fruits per plant (–0.046). Length of first fruiting node vs. fruit yield per plant, the negative and significant genotypic correlation coefficient was found (0.044). This was due to positive direct effect (–0.543). This indirect effect via. days to flowering (–0.065), plant height (0.071), number of branches per plant (0.181), number of first fruiting node (0.115), length of internodes (–0.061), length of fruits (–0.101), width of fruits (0.412) and number of fruits per plant (0.036). Length of internode vs fruit yield per plant, the negative and significant genotypic correlation coefficient was found (0.251). This was due to negative direct effect (–0.529). The indirect effect via. days to flowering (–0.061), plant height (0.162), number of branches per plant (0.250), number of first fruiting node (0.197), length of first fruiting node (–0.062), length of fruits (–0.101), width of fruits (0.252) and number of fruits per plant (0.141). Length of fruits vs fruit yield per plant, the positive and non-significant genotypic correlation coefficient was found (0.028). This was due to negative direct effect (-0.034). The indirect effect via. days to flowering (0.040), plant height (0.185), number of branches per plant (0.096), number of first fruiting node (0.084), length of first fruiting node (–0.159), length of internodes (–0.155), width of fruits (0.171) and number of fruits per plant (0.110). Width of fruits vs fruit yield per plant, the negative and highly significant genotypic correlation coefficient was found (0.002). This was due to positive direct effect (0.717). The indirect effect via. days to flowering (0.009), plant height (0.146), number of branches per plant (–0.133), number of first fruiting node (–0.269), length of first fruiting node (–0.311), length of internodes (–0.188), length of fruits (–0.082) and number of fruits per plant (0.113). Number of fruits per plant vs fruit yield per plant, the positive and highly significant genotypic correlation coefficient was found (0.460). This was due to positive direct effect (0.821). The indirect effect via. days to flowering (–0.068), plant height (0.120), number of branches per plant (–0.005), number of first fruiting node (–0.036), length of first fruiting node (–0.065), length of internodes (–0.017), length of fruits (–0.017) and width of fruits (0.098).

CONCLUSION

The significant positive genotypic correlation was observed for green fruit yield per plant with number of fruits per plant. The significant positive genotypic correlation was observed for green fruit yield per plant with number of fruits per plant. To obtain clear understanding of association of the genotypic and phenotypic correlation coefficient was partitioned in to direct and indirect effect through path coefficient analysis. Days to flowering vs fruit yield per plant, the genotypic coefficient between these two characters was negative and highly significant; plant height vs fruit yield per plant, for this trait genotypic correlation coefficient was found positive and significant; number of branches per plant vs fruit yield per plant, genotypic non = significant negative correlation; number of fruits per plant vs fruit yield per plant, the positive and highly significant genotypic correlation coefficient; number of first fruiting node vs fruit yield per plant, the negative and non-significance genotypic correlation; length of first fruiting node vs fruit yield per plant, the negative and significant genotypic correlation coefficient; length of internode vs fruit yield per plant, the negative and significant genotypic correlation coefficient; number of fruits per plant vs fruit yield per plant, the positive and highly significant genotypic correlation coefficient was found that the characters should be considered in okra improvement programme.

REFERENCES

Adeniji O T and Peter J M. 2005. Stepwise regression analysis of pod and seed yield characters in segregating F2 population of West African okra (*Abelmoschus caillei*). (*In*) *Proceedings of 30th Conference*, Genetics Society of Nigeria, pp 250–8.

AL-Jibouri H A, Miller P A and Robinson H F. 1958. Genotypic and environmental variances and co-variances in an upland cotton cross of interspecific origin. *Agronomy Journal* **50**: 633–6.

Bello D, Sajo A A, Chubado D and Jellason J J. 2006. Variability and correlation studies in okra (*Abelmoschus esculentus* (L.) Moench). *Journal of Sustainable Development in Agriculture and Environment* **2**(1): 120–6.

Bendale V W, Kadam S R , Bhave S G, Mehta J L and Pethe U B. 2003. Genetic variability and correlation studies in okra. *Orissa Journal of Horticulture* **31**(2): 1–4.

Camciuc M, Bessifre J M, Vilarem G and Gaset A. 1981. Volatile components in okra seed coat. *Phytochemistry* **48**: 311–5.

Dewey D R and Lu K H. 1959. A correlation and path coefficient analysis of component of crested wheatgrass seed production. *Agronomy Journal* **52**: 515–8.

Jaiprakashnarayan R P and Mulge R. 2004. Correlation and path analysis in okra (*Abelmoschus esculentus* (L.) Moench). *Indian Journal of Horticulture* **61**(3): 232–5.

Kang M S, Miller J D and Tai P P. 1983. Genetic and phenotypic path analyses and heritability in sugarcane. *Crop Science* **23**: 643–7.

Kochhar S L. 1986. *Tropical Crops,* pp 467. Macmillan Publishers Ltd, London and Basingstoke.

Mehta D R, Dhaduk L K and Patel K D. 2006. Genetic variability, correlation and path analysis studies in okra (*Abelmoschus esculentus* (L.) Moench). *Agricultural Science Digest* **26**(1):

15–8.

Medagam Thirupathi Reddy, Kadiyala Hari Babu, Mutyala Ganesh, Konda Chandrasekhar Reddy, Hameedunnisa Begum, Reddivenkatagari Subbarama Krishna Reddy, and Jampala Dilip Babu 2013. Correlation and path coefficient analysis of quantitative characters in okra (*Abelmoschus esculentus* (L.) Moench). *Songklanakarin Journal of Science Technology* **35**(3): 243–50.

Mohapatra M R, Acharyya P and Sengupta S. 2007. Variability and association analysis in okra. *Indian Agriculturist* **51**(1 & 2): 17–26.

Pal A K, Das N D and De D K. 2008. Studies on association of important yield components in okra. *Indian Journal of Horticulture* **65**(3): 356–61.

Patro T S K K K and Sankar C R. 2006. Character association and path coefficient analysis in okra (*Abelmoschus esculentus* (L.) Moench). *Journal of Research ANGRAU* **34**(1): 8–14.

Rashwan A M A. 2011. Study of genotypic and phenotypic correlation for some agroeconomic traits in okra (*Abelmoschus esculentus* (L.) Moench). *Asian Journal of Crop Science* **3**(2): 85–91.

Singh B, Pal A K and Singh S. 2006. Genetic variability and correlation analysis in okra (*Abelmoschus esculentus* (L.) Moench). *Indian Journal of Horticulture* **63**(3): 63–6.

Somashekhar G, Mohankumar H D and Salimath P M. 2011. Genetic analysis of association studies in segregating population of okra. *Karnataka Journal of Agricultural Science* **24**(4): 432–5.

Wright S. 1921. Correlation and causation. *Journal of Agricultural Research* **20**: 557–85.