Correlation and path coefficient studies on growth earliness and yield parameters in okra, *Abelmoschus esculentus* (L) Moench

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ABSTRACT

The character association and path analysis in fifty two genotypes of okra were studied for 10 important characters. The character association studies revealed that the fruit yield per plant had significant and positive association with number of leaves at 90 days after sowing (DAS) at both genotypic and phenotypic levels whereas number of branches per plant (90 DAS) at only genotypic level. It was significantly and negatively associated with internodal length (45 and 90 DAS) and days to first harvest. Presence of lower difference between the correlation coefficients at genotypic and phenotypic levels for various traits in the present findings indicates the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits. Path analysis studies revealed significant positive association at genotypic level among the traits viz number of leaves per plant (90 DAS) and number of branches per plant (45 DAS) and exhibited perfect association with direct effect on yield per plant. These traits can be viewed for direct selection for improvement in the total yield per plant.

Keywords: Okra; correlation; path analysis; growth; yield

INTRODUCTION

Okra, *Abelmoschus esculentus* (L) Moench is grown throughout the world and is the most important vegetable crop of tropical and sub-tropical parts. Due to excessive domestic demand and prevalence of favorable weather conditions for crop growth India stands first in the world in okra production. Tender fruits of okra are used as vegetable or in culinary preparation as sliced and fried pieces. It has high nutritive value containing 86.1 per cent water, 2.2 per cent protein, 0.2 per cent fat, 9.7 per cent carbohydrate, 1.0 per cent fibre and 0.8 per cent ash (Saifullah and Rabbani 2009) and is 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).

Correlation studies help in identifying the traits which have strong association with yield. The path coefficient analysis developed by Wright (1921) is useful for sorting out the total correlation into direct and indirect effects and 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 investigations were aimed at assessing the association of various characters and direct and indirect path effects of nine independent components on fruit yield in fifty two genotypes of okra.

MATERIAL and METHODS

The current studies on correlation and path coefficient analysis in okra were undertaken during the year 2014 in Kharif season at experimental site of Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka. The fifty two genotypes (Table 1) were evaluated in a randomized block design with two replications. 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 random viz plant height at 90 days after sowing (DAS), number of leaves (90 DAS), number of branches per plant (45 DAS), number of branches per plant (90 DAS), internodal length (45 DAS), internodal length (90 DAS), days to first flowering, days to first harvest, first flowering node and fruit yield per plant (g). The correlation coefficient among all possible character combinations at phenotypic (r_p) and genotypic (r_g) levels were estimated employing formula given by Al-Jibouri et al (1958). Path coefficient analysis as 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 genotypic and phenotypic correlation coefficient and also direct and indirect effects of path coefficient.

RESULTS and DISCUSSION

Correlation coefficient analysis

The association analysis (Table 2) showed highly significant and positive correlation of fruit yield per plant with number of leaves (90 DAS) both at genotypic (r_g = 0.415) and phenotypic (r_p = 0.292) levels indicating the possibility of simultaneous selection for these traits. It could be suggested from correlation estimates that yield would be improved through selection based on these particular characters. These findings are in agreement with those of Dwivedi and Sharma (2017), Balai et al (2014), Sibsankar et al (2012), Ahamed et al (2015), Reddy et al (1985), Korla and Rastogi (1978), Shukla (1990), Akinyele and Osekita (2006) and Kumar and Yadav (2009). Number of branches per plant (90 DAS) showed significantly positive correlation with fruit yield per plant only at genotypic (r_g = 0.272) level which suggests slight influence of external factors on this trait's association. Negative and significant association was observed between fruit yield per plant and internodal length (45 DAS) (r_g = -0.366), internodal length (90 DAS) (rg= -0.430, r_p = -0.231), days to first flowering ($r_{g=}$-0.219, r_p = -0.206) and days to first harvest (r_g = -0.292, r_p = -0.245) indicating that yield was quite high if flowers appeared early and intermodal length was less and vice versa. Guddadamath et al (2011), Singh et al (2017), Korla and Rastogi (1978) and Majumdar et al (1974) also reported same results in okra. Number of branches

Table 1. Details of okra genotypes with their sources

S/N	Genotype	S/N	Genotype	S/N	Genotype	S/N	Genotype
NBPGR							
1.	IC 15036	9.	IC 24137	17.	IC 48281	25	EC 693226
2.	IC 15537	10.	IC 24906-A	18.	IC 50418	26	EC 693228
3.	IC 16262-A	11.	IC 27826-A	19.	IC 90225	27	EC 693229
4.	IC 18073-A	12.	IC 27875-A	20.	IC 90231	28	EC 693233
5.	IC 18530	13.	IC 45893	21.	IC 90264	29.	EC 693234
6.	IC 22237	14.	IC 45980	22.	IC 90271	30.	EC 469409
7.	IC 22237-A	15.	IC 45992-B	23.	EC 693223		
8.	IC 23594	16.	IC 45995	24	EC 693224		
IIVR							
31.	DKHYS-1402	35.	SB-2	39.	SB-8	43.	VRO-13-178
32.	NO.315	36.	BO-2	40.	VRO-106	44.	BCO-1
33.	JBS-2	37.	307-10-1	41.	D1-87-5	45.	003163
34.	VRO-104	38.	HRB-55	42.	VRO-103	46	Khashi Pragathi
KRCCH							
47.	J-76	48.	N-59	49.	N-64		
CoH, Bagalkot							
50.	Melavanki Local						
IIHR							
51.	Arka Anamika						
Parbhani, Maharashtra							
52.	Parbhani Kranthi						

IC: Indigenous collection, EC: Exotic collection, NBPGR: National Bureau of Plant Genetic Resources, New Delhi, IIVR: Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh, KRCCH: Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka, CoH, Bagalkot: College of Horticulture, Bagalkot, Karnataka, IIHR: Indian Institute of Horticultural Research, Bengaluru, Karnataka

Table 2. Genotypic and phenotypic correlation coefficient for growth, earliness and yield parameters in okra genotypes

Character		NL	NB 45	NB 90	IL 45	IL 90	DFF	DFH	FFN	FY
PH: Plant height (cm) (90 DAS)	G	0.142	-0.142	-0.311**	0.365**	0.044	-0.325**	-0.348**	-0.091	0.110
	P	0.122	-0.125	-0.179	0.282**	0.091	-0.299**	-0.319**	-0.054	0.104
NL: Number of leaves (90 DAS)	G	**1.000**	-0.161	-0.090	-0.295**	-0.289**	-0.193*	-0.187	0.200*	0.415**
	P	**1.000**	-0.083	-0.006	-0.039	-0.086	-0.122	-0.124	0.137	0.292**
NB 45: Number of	G		**1.000**	1.117	0.178	0.0008	0.586**	0.572**	0.578**	0.144
branches/plant (45 DAS)	P		**1.000**	0.827**	0.110	0.017	0.501**	0.518**	0.334**	0.094
NB 90: Number of	G			**1.000**	0.288**	0.026	0.630**	0.625**	0.652**	0.272**
branches/plant (90 DAS)	P			**1.000**	0.038	-0.013	0.512**	0.551**	0.373**	0.051
IL 45: Internodal length (cm)	G				**1.000**	0.448**	0.186	0.271**	0.106	-0.366**
(45 DAS)	P				**1.000**	0.570**	0.014	0.022	0.040	-0.176
IL 90: Internodal length (cm)	G					**1.000**	0.123	0.242*	0.143	-0.430**
(90 DAS)	P					**1.000**	0.025	0.072	0.090	-0.231*
DFF: Days to first flowering	G						**1.000**	0.989**	0.876**	-0.219*
	P						**1.000**	0.959**	0.610**	-0.206*
DFH: Days to first harvest	G							**1.000**	0.889**	-0.292**
	P							**1.000**	0.599**	-0.245*
FFN: First flowering node	G								**1.000**	0.148
	P								**1.000**	0.088
FY: Fruit yield/plant (g)	G									**1.000**
	P									**1.000**

Critical r-value 1% = 0.251, 5%= 0.192, *Significant at 5%, **Significant at 1% , G= Genotypic correlation coefficient, P= Phenotypic correlation coefficient, DAS= Days after sowing

Table 3. Genotypic and phenotypic path coefficient analysis for growth, yield and its component characters in okra genotypes

Character		PH	NL	NB 45	NB 90	IL 45	IL 90	DFF	DFH	FFN	CFY
PH: Plant height (cm) (90 DAS)	G	**-0.022**	-0.003	0.003	0.007	-0.008	-0.001	0.0074	0.0079	0.0021	0.110
	P	**0.055**	0.0068	-0.0069	-0.0099	0.015	0.0050	-0.016	-0.017	-0.0030	0.104
NL: Number of leaves (90 DAS)	G	-0.055	**-0.392**	0.063	0.035	0.115	0.113	0.075	0.073	-0.078	0.415**
	P	-0.013	**-0.109**	0.0007	0.0007	0.0043	0.0094	0.013	0.013	-00151	0.292**
NB 45: Number of branches /plant (45 DAS)	G	-0.059	-0.067	**0.419**	0.468	0.074	0.0003	0.246	0.240	0.242	0.144
	P	-0.014	-0.0093	**0.092**	0.092	0.012	0.0019	0.056	0.058	0.037	0.094
NB 90: Number of branches /plant (90 DAS)	G	0.063	0.018	-0.226	**-0.203**	-0.058	-0.005	-0.127	-0.126	-0.132	0.272**
	P	-0.0022	-0.0001	0.010	**0.012**	0.0005	-0.0002	0.0063	0.0067	0.0046	0.051
IL 45: Internodal length (cm) (45 DAS)	G	-0.017	0.013	-0.0084	-0.013	**-0.046**	-0.021	-0.008	-0.012	-0.0050	-0.366**
	P	-0.0044	0.0006	-0.0017	-0.0006	**-0.015**	-0.0088	-0.0002	-0.0003	-0.0006	-0.176
IL 90: Internodal length (cm) (90 DAS)	G	-0.0003	0.0022	0.000	-0.0002	-0.0033	**-0.007**	-0.0009	-0.0018	-0.0011	-0.430**
	P	0.0043	-0.0040	0.0008	-0.0006	0.026	**0.046**	0.0012	0.0034	0.042	-0.231*
DFF: Days to first flowering	G	0.170	0.101	-0.308	-0.331	-0.097	-0.064	**-0.525**	-0.519	-0.460	-0.219*
	P	0.012	0.0050	-0.020	-0.021	-0.0006	-0.0011	**-0.040**	-0.039	-0.025	-0.206*
DFH: Days to first harvest	G	-0.056	-0.030	0.093	0.102	0.044	0.039	0.161	**0.163**	0.145	-0.292**
	P	0.0065	0.0025	-0.010	-0.011	-0.0004	-0.0015	-0.0196	**-0.020**	-0.012	0.245*
FFN: First flowering node	G	-0.0091	0.020	0.057	0.065	0.010	0.014	0.087	0.088	**0.099**	0.148
	P	0.0013	-0.0033	-0.008	-0.0089	-0.0010	-0.0011	-0.014	-0.014	**-0.023**	-0.088

Diagonal indicates direct effect, Genotypic residual effect= 0.2142, Phenotypic residual effect= 0.3156, *Significant at 5%, **Significant at 1%,
DAS = Days after sowing, CFY: Correlation with fruit yield/plant (g)

per plant both at 45 and 90 days after sowing reported positive and significant correlation both at genotypic level with days to first flowering (r_g = 0.586, r_p = 0.501 and r_g = 0.630, r_p = 0.512 respectively), days to first harvest (r_g = 0.572, r_p = 0.518 and r_g = 0.625, r_p = 0.551 respectively) and first flowering node (r_g =0.578, r_p = 0.334 and r_g = 0.652, r_p = 0.373 respectively) indicating that the change in one will bring simultaneous positive change in another character. In general the genotypic correlation coefficient was observed to be higher than the corresponding phenotypic correlation 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.

Path coefficient analysis

The values of path coefficient analysis for different characters at genotypic and phenotypic levels are presented in Table 3. The number of branches per plant at 45 DAS resulted in maximum positive direct contribution towards fruit yield both at genotypic (0.419) and phenotypic (0.092) levels followed by days to first harvest, first flowering node and plant height at 90 DAS (0.163, 0.099 and 0.055 respectively) at genotypic level. Days to first flowering (-0.525 and -0.040) and number of leaves at 90 DAS (-0.392 and -0.109) exhibited highest negative direct effect both at genotypic and phenotypic levels respectively followed by number of branches per plant (-0.203) at genotypic level and first flowering node (-0.023) at phenotypic level. These important traits may be viewed in selection programme for the further improvement in okra. Similar observations were also made by Yadav et al (2017), Dwivedi and Sharma (2017), Balai et al (2014), Ariyo et al (1987), Mishra and Singh (1985) and Reddy et al (1985). All characters mentioned earlier which contributed directly and positively to fruit yield per plant possessed significant correlations suggesting that the association between these traits was perfect.

The data given in Table 3 also exhibit highly positive indirect effect in case of number of branches per plant (45 DAS) through number of branches per plant (90 DAS) (0.468), days to first flowering (0.246) and days to first harvest (0.240) at genotypic level. Days to first flowering was related in negatively indirect manner through days to first harvest (-0.519), first flowering node (0.460) and number of branches per plant at 45 DAS (-0.308) at genotypic level. Almost same results were also obtained by Yadav et al (2017), Sibsankar et al (2012), Solankey and Singh (2009), Ariyo et al (1987), Mishra and Singh (1985) and Reddy et al (1985). Therefore one can rely upon number of branches per plant at 45 days after sowing while selecting the okra genotypes with high fruit yield.

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