www.hortflorajournal.com
HortFlora Research Spectrum, 4(2): 139-143 (June 2015) ISSN : 2250-2823

CORRELATION AND PATH COEFFICIENT ANALYSIS OF YIELD COMPONENTS IN OKRA [*Abelmoschus esculentus* (L.) Moench]

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ABSTRACT : Phenotypic correlation and path coefficient analysis was worked out for eleven important characters in fifty genotypes of okra. The estimates of genotypic correlation coefficient were higher than the estimates of phenotypic correlation coefficient for all the character combinations. Fruit yield per plant (g) showed positive and significant correlation with number of first fruiting nodes / plant, final plant height (cm), no. of fruiting nodes /plant, length of fruit (cm), weight per fruit (g), and number of fruits per plant. The path coefficient analysis revealed that the magnitude of direct effect were higher for weight per fruit (0.506) followed by number of fruits per plant(0.326), length of fruit (0.2) and no. of first fruiting nodes /plant (0.190) while the magnitude of rest of the characters in all the environments were moderate to low. Further the indirect effect through weight per fruit and number of fruits per plant were important. Hence it is suggested that more emphasis should be given on weight per fruit, number of fruits per plant and plant height while executing the selection for genetic enhancement of fruit yield in okra.

Keywords: *Okra germplasm, character association, contribution, pod yield, yield components.*

Okra, or Ladies finger, which is also known as '*Bhindi* ', is one of the important vegetables of India. It is grown throughout the tropical and sub-tropical regions and also in the warmer parts of the temperate regions (Kochhar, 8). The nutritional value of 100g of edible okra is characterized as1.9 g protein, 0.2 g fat, 6.4 g carbohydrate, 0.7 g minerals and 1.2 g fibers. Okra has a good potential as a foreign exchanger crop and accounts for 60% of the export of fresh vegetables. India ranks first in the world with 3.5 million tonnes (70% of the total world production) of okra produced from over 0.35 million hectare land (FAOSTAT, 6). The major okra producing states are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh and Karnataka.It is native to Ethiopia from where it proliferated to other parts of the world.

The main objective for a plant breeder is to evolve high yielding varieties. Since the fruit yield per plant is a complex quantitative trait being controlled by many genes, therefore, environmental factors have great influence on performance. So it is better to make use of crucial components of the yield than yield itself in plant selection. Various component traits of fruit yield per plant very often exhibit varying degree of associations with fruit yield per plant as well as among themselves. Analysis of correlation coefficients between characters contributing directly or indirectly towards fruit yield per plant is a matter of considerable importance in exercising the selection. However, a study of correlation alone is not enough to provide an exact picture of relative importance of direct and indirect influences of each of the component traits on fruit/seed yield. In this context, path coefficient analysis is an important tool for plant breeders in partitioning the total correlation coefficients into direct and indirect effects of independent variables on dependent variable i.e. fruit yield per plant. In this study, therefore, an attempt was made to study the correlation and path coefficient analysis involving 50 genotypes of okra (*Abelmoschus esculentus* (L.) Moench) for the information of interrelationship between fruit yield per plant and other important yield components and to partition the observed phenotypic correlation's into their direct and indirect effects through other character which could be used as selection criteria in the breeding programme.

MATERIALS AND METHODS

The data were collected from an experiment conducted at the experimental farm of Ch. Shivnath Singh Shandilya (P. G.) College, Machhra, Meerut during summer Season 2007, for which sowing was done in II week of March, in order to find out the correlation and path coefficient analysis of cultivars of *Abelmoschus esculentus* (L.) Moench.The seeds of 50 genotypes were sown in a randomized complete block design with three replications. All 50 genotypes were

Received : 27-02-2015 *Accepted : 25-04-2015*

sown in two rows plots having 20 plants in each replication. Each genotype was raised in a plot of 1.5 meter square (2 rows × 3m length × 0.25m inter row distance) with a planting distance of 25 × 30 cm having 20 plants per plot in each replication. All the recommended agronomic practices were followed to raise a good crop. The inter-association between the important yield components were ascertained by working out the path coefficient analysis of phenotypic correlation coefficients. This was accomplished by partitioning the direct and indirect effects of various yield components upon the final yield. Fruit yield per plant (g) was considered as the resultant variable, whereas the other traits viz; number of days to first flower, plant height up to first fruiting node (cm), number of first fruiting nodes per plant, final plant height (cm), number of branches and fruiting nodes per plant, length and thickness (cm) of the fruit (cm), weight per fruit (g) and number of fruits per plant were supposed to be the causal variables. The residual 'X' was taken as the influence of other variables that could not be studied. Genotypic and phenotypic coefficient of correlation was computed according to Al Jibouri *et al.* (1) and the significance of the correlation coefficients was determined by comparing the observed correlation coefficients with the tabulated value of correlation coefficients in the correlation table at given degrees of freedom (d. f.) for 5% or 1% level of significance (Gomez and Gomez, 7). If the observed value of correlation coefficient at given d. f. was equal to or greater than the tabulated value of correlation coefficient at respective d. f., the observed correlation coefficient was significant. The values of observed correlation coefficients which were lower than the respective values in the 'correlation table' were declared non-significant. The correlations were further partitioned into direct and indirect effects as suggested Dewey and Lu (5).

RESULTS AND DISCUSSION

Complex trait such as yield must be related to many individually distinguishable characteristics. It is obvious that fruit yield is also a complex trait that depends upon many independent yield contributing traits, 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.

The analysis of variance (ANOVA) presented in Table 1 showed that all the genotypes differed significantly at $P<0.01$ for all the characters. This provided the evidence for the significant genetic variability present for these traits among the genotypes.

Table 1: Mean squares corresponding to various sources of variation for fruit yield and other quantitative traits in okra.

Characters	Replication	Genotypes	Error
d.f.	2	49	98
Number of days to first flower	0.79	88.22**	0.94
Plant height up to first fruiting node (cm)	2.14	59.35**	1.08
No. of first fruiting nodes/plant	0.008	10.63**	0.37
Final plant height (cm)	4.06	29.33**	9.15
No. of branches/ plant	0.04	4.77**	0.55
No. of fruiting nodes/plant	0.86	33.57**	1.37
Length of the fruit (cm)	3.21	7.08**	0.53
Thickness of the fruit (cm)	0.008	0.24**	0.04
Weight per fruit (g)	0.22	9.96**	0.28
Number of fruit per plant	1.70	10.40**	0.42
Fruit yield per plant (g)	145.50	3865.4**	119.68

The matrix of genotypic and phenotypic correlation coefficients among eleven characters has been worked out and is presented in Table 2. In the present experiment, the values of correlation at genotypic level were higher than the phenotypic correlation indicating that there is a strong inherent association between the various characters studied and relatively poor association at phenotypic level is due to significant GXE interaction. The present finding is in consistent with the earlier findings of Akinyele and Osekita (2), Bello *et al.* (3), Mehta *et al.* (9), Rashwan (11) and Somashekhar *et al.* (12). Plant height, number of first fruiting node per plant (first flowering node), number of fruiting nodes per plant, length of the fruit, weight per fruit and number of fruits per plant are considered important as far as fruit yield is concerned. The higher the plant height, as the higher is the number of fruits per plant because of accommodation of a greater number of nodes for a given inter-nodal length.

In the present study, plant height had significant positive correlation with fruit length, total number of fruits per plant, fruit yield per plant and number of first fruiting nodes per plant (first flowering node) and had significant negative correlation with days to first flower. Positive association of plant height with internodal lengthand total number of fruits per plant was reported by Somashekhar *et al.* (12).

which reduced the association. Every component character has direct effect on yield. In addition, it will also exert indirect effects via other component characters. It has been generally observed that if the correlation between fruit yield and a character is due to direct effect of that character, it reveals true relationship between them and direct selection for this trait will be rewarding for yield improvement. On the other hand, if the correlation is mainly due to indirect effect of the character through another component trait, in such cases, indirect selection through such trait will be effective. In cases where the direct effect is positive and high but the correlation is negative direct selection for such traits should be practiced to reduce the undesirable indirect effect. It was concluded that weight per fruit, number of fruit per plant, length of the fruit had highest direct positive effect on fruit yield per plant at genotypic and phenotypic level. For rest of the

Table 2 : Phenotypic and genotypic correlation among eleven quantitative traits of okra.

Ch	G/P Cor.	No. of days to first flower	Plant height up to Ist fruiting node (cm)	No. of first fruiting nodes/ plant	Final plant height (cm)	No. of branches/ plant	No. of fruiting nodes /plant	Length of the fruit (cm)	Thickness (girth) of the fruit (cm)	Weight per fruit (g)	No. of fruits per plant	Fruit yield/ plant (g)
1	G	1.000	0.537**	-0.072	-0.400*	0.305	-0.327*	-0.260	0.145	0.107	-0.401*	-0.114
	P	1.000	0.513**	-0.072	-0.373*	0.254	-0.310	-0.227	0.123	0.106	-0.365*	-0.096
2	G		1.000	0.078	-0.032	0.173	-0.110	-0.059	0.169	0.409**	-0.364*	0.132
	P		1.000	0.077	-0.024	0.146	-0.100	-0.045	0.134	0.376*	-0.340*	0.118
3	G			1.000	0.416**	-0.196	0.316*	0.266	-0.242	0.371*	0.340*	0.612**
	P			1.000	0.375*	-0.164	0.295	0.204	-0.203	0.338*	0.317*	0.534**
4	G				1.000	-0.264	0.205	0.495**	-0.027	0.234	0.298*	0.415**
	P				1.000	-0.217	0.199	0.396*	0.005	0.220	0.273*	0.381*
5	G					1.000	-0.152	-0.352*	-0.131	-0.042	-0.128	-0.229
	P					1.000	-0.081	-0.298	-0.037	-0.054	-0.109	-0.165
6	G						1.000	0.377*	-0.151	0.389*	0.451**	0.575**
	P						1.000	0.316*	-0.076	0.355*	0.406**	0.512**
7	G							1.000	-0.138	0.306*	0.418**	0.602**
	P							1.000	-0.101	0.281	0.359*	0.496**
8	G								1.000	-0.060	-0.242	-0.255
	P								1.000	-0.035	-0.170	-0.151
9	G									1.000	-0.025	0.704**
	P									1.000	-0.020	0.654**
10	G										1.000	0.494**
	P										1.000	0.452**
11	G											1.000
	P											1.000

*,**Significant at 5% and 1% level, respectively.

Considering the fruit yield per plant as the effect and ten component traits as causes, the path coefficient analysis was done to find out the direct and indirect contributions of component traits towards fruit yield per plant in okra.The estimates of direct and indirect effects of the ten yield related characters on fruit yield are presented in Table 3. Like correlation, genotypic direct and indirect effect was higher than corresponding phenotypic estimates. Such a situation has usually been attributed to environmental forces,

Table 3: Direct (diagonal) and indirect (off diagonal) effects of quantitative traits on fruit yield per plant of okra

Ch	G/P Path	No. of days to first flower	Plant height up to Ist fruiting node (cm)	No. of first fruiting nodes / plant	Final plant height (cm)	No of branches/ plant	No of fruiting nodes /plant	Length of the fruit (cm)	Thickness (girth) of the fruit (cm)	Weight per fruit (g)	No. of fruit/ plant	Fruit yield/ plant (g)
1	G	**0.082**	0.020	-0.014	-0.004	-0.026	-0.032	-0.052	-0.013	0.054	-0.131	-0.114
	P	**0.077**	0.009	-0.012	-0.023	-0.008	-0.038	-0.035	-0.004	0.051	-0.113	-0.096
2	G	0.044	**0.037**	0.015	0.000	-0.015	-0.011	-0.012	-0.015	0.207	-0.118	0.132
	P	0.040	**0.018**	0.013	-0.002	-0.005	-0.012	-0.007	-0.005	0.182	-0.105	0.118
3	G	-0.006	0.003	**0.190**	0.004	0.016	0.031	0.053	0.021	0.188	0.111	0.612**
	P	-0.006	0.001	**0.174**	0.023	0.005	0.036	0.032	0.007	0.163	0.098	0.534**
4	G	-0.033	-0.001	0.079	**0.011**	0.022	0.020	0.099	0.002	0.118	0.097	0.415**
	P	-0.029	0.000	0.065	**0.062**	0.007	0.024	0.062	0.000	0.106	0.084	0.381*
5	G	0.025	0.006	-0.037	-0.003	**-0.084**	-0.015	-0.070	0.011	-0.021	-0.042	-0.229
	P	0.020	0.003	-0.028	-0.014	**-0.031**	-0.010	-0.047	0.001	-0.026	-0.034	-0.165
6	G	-0.027	-0.004	0.060	0.002	0.013	**0.099**	0.075	0.013	0.197	0.147	0.575**
	P	0.024	-0.002	0.051	0.012	0.002	**0.122**	0.049	0.003	0.171	0.125	0.512**
7	G	-0.021	-0.002	0.050	0.005	0.030	0.037	**0.200**	0.012	0.155	0.136	0.602**
	P	-0.018	-0.001	0.035	0.025	0.009	0.039	**0.156**	0.004	0.136	0.111	0.496**
8	G	0.012	0.006	-0.046	0.000	0.011	-0.015	-0.028	**-0.086**	-0.031	-0.079	-0.255
	P	0.010	0.002	-0.035	0.000	0.001	-0.009	-0.016	**-0.035**	-0.017	-0.052	-0.151
9	G	0.009	0.015	0.070	0.002	0.004	0.039	0.061	0.005	**0.506**	-0.008	0.704**
	P	0.008	0.007	0.059	0.014	0.002	0.044	0.044	0.001	**0.482**	-0.006	0.654**
10	G	-0.033	-0.014	0.065	0.003	0.011	0.045	0.084	0.021	-0.013	**0.326**	0.494**
	P	-0.028	-0.006	0.055	0.017	0.003	0.050	0.056	0.006	-0.010	**0.309**	0.452**

Residual Genotypic = 0.002

characters the magnitude of direct effects was moderate to low. These observations are in conformity with the finding of some earlier workers in okra by Patro *et al.* (10) and Chaukhande *et al.* (4).

Path coefficient analysis identified weight per fruit, number of fruit per plant, length of the fruit and plant height as the important characters which not only expressed highest direct effects towards fruit yield but almost all other characters also showed indirect contribution towards fruit yield via these characters.

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Citation : Umrao V., Sharma, S.K., Kumar V., Kumar R., Sharma A. and Kumar, J. (2015). Correlation and path coefficient analysis of yield components in okra [*Abelmoschus esculentus* (L.). Moench]. *HortFlora Res. Spectrum*, **4**(2) : 139-143.