International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 1254-1260

Received: 22-05-2019
Accepted: 24-06-2019

Jeetendra Chavan
M.Sc. Scholar, Department of Vegetable Science, College of Horticulture, SKLTSHU, Hyderabad, Telangana, India

N Seenivasan
Associate Professor, Department of Horticulture, College of Horticulture, Mojerla, SKLTSHU, Hyderabad, Telangana, India

P Saidaiah
Assistance Professor, Department of Genetics and Plant breeding, College of Horticulture, Rajendranagar, SKLTSHU, Hyderabad, Telangana, India

N Sivaraj
Principal Scientist (Economic Botany), NBPGR, Regional Station, Hyderabad, Telangana, India

Correspondence
Jeetendra Chavan
M.Sc. Scholar, Department of Vegetable Science, College of Horticulture, SKLTSHU, Hyderabad, Telangana, India

Estimation of correlation coefficient and path coefficient analysis for yield and yield components in okra [*Abelmoschus esculentus* (L.) Moench]

Jeetendra Chavan, N Seenivasan, P Saidaiah and N Sivaraj

Abstract
The present investigation was undertaken to estimate the correlation and path coefficient analysis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. Twenty six genotypes were sown in a randomized block design with three replications during *kharif*, 2018 in PG research block at College of Horticulture, Rajendranagar, Hyderabad. Fruit yield per plant (g) revealed positive and significant correlation association with plant height, internodal length, fruit length, fruit weight, number of fruits per plant, fruit yield per plot, fruit yield per hectare and crude fibre content. Path analysis studies revealed that the magnitude of direct effect were higher for plant height, number of branches per plant, internodal length, days to first harvest, average fruit weight, number of fruits per plant, number of nodes per plant, total phenolic content and total chlorophyll content on fruit yield per plant.

Keywords: Okra germplasm, character association, growth, fruit yield, yield components

Introduction
Okra [*Abelmoschus esculentus* (L) Moench.], family: Malvaceae, is a widely consumed vegetable crop commonly cultivated in India and some other tropical countries (John *et al*., 1992) [7]. Okra is an annual and day neutral plant cultivated in all seasons for its delicious tender pods in one and other different parts of the country (Balai *et al*., 2015) [4]. Fresh okra has high nutritive value, 86.1 per cent water, 0.2 per cent fat, 9.7 per cent carbohydrate, 2.2 per cent protein, 1.0 per cent fibre and 0.8 per cent of ash (Saifullah and Rabbani, 2009) [17] 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) [12]. The mucilage has been used as a plasma replacement or blood volume expander (Siemonsma and Kouame, 2004) [19]. The leaves are sometimes used as cattle feed. Sliced Okra fruits can also be used for off-season purpose after canning or pickling. In okra, all growth, earliness and yield associated traits are quantitative in nature. Such characters are controlled by polygenes and are much influenced by environmental fluctuations. Pod yield of okra is a complex quantitative trait, which is conditioned by the interaction of various growth and physiological processes throughout the life cycle (Adeniji and Peter, 2005) [1]. Improvement of complex characters such as pod yield may be accomplished through the component approach of breeding. The development of plant breeding strategy hinges mainly on the support provided by genetic information on inheritance and behavior of major quantitative characters associated with yield and yield components (Arunachalam, 1976) [3]. A better understanding of the contribution of each trait in building up the genetic makeup of the crop may be obtained through yield component analysis (Mehta *et al*., 2006) [10]. Determination of the yield components through correlation and path coefficient analyses will improve the efficiency of a breeding programme (Singh *et al*., 2006) [20]. Plant height, number of branches per plant, internodal length, fruit length, fruit weight and number of fruits per plant were identified as the yield components in okra (Bello *et al*., 2006) [5]. Correlation and path coefficient analyses are prerequisites for improvement of any crop including okra for selection of superior genotypes and improvement of any trait. In plant breeding, correlation analysis provides information about yield components and thus helps in selection of superior genotypes from diverse genetic populations. The correlation studies simply measure the associations between yield and other traits. Usefulness of the information obtained from the correlations coefficients can be enhanced by partitioning into direct and indirect effects for a

set of a pair-wise cause-effect inter relationships (Kang *et al*., 1983) [8]. Path coefficient analysis permits the separation of correlation coefficient into direct and indirect effects. It is basically a standardized partial regression analysis and deals with a closed system of variables that are linearly related. Such information provides realistic basis for allocation of appropriate weightage to various yield components.

Material and Methods

The experimental material contains 26 genotypes of okra. The field experiment was carried out at College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad during *Kharif*- 2018. Each genotype was grown in two rows with the spacing of 45 × 30 cm which accommodated 14 plants per row. The observations were recorded from five randomly selected plants in each replication for each genotype on 20 characters *viz*., plant height, number of branches per plant, internodal length, days to first flowering, days to 50 per cent flowering, days to first harvest, days to last harvest, number of fruits per plant, fruit length, fruit girth, fruit weight, number of fruits per plant, fruit yield per plot, fruit yield per hectare, number of nodes per plant, number of ridges per fruit, total phenol content, total chlorophyll content, crude fibre and yellow vein mosaic virus infestation on plants were studied. Simple correlation coefficients between yield and yield components and intercorrelation among the various components were calculated using the formula suggested by Panse and Sukhatme (1967) [13].

$$Correlation\ coefficient\ 'r' = \frac{Cov.(X.Y)}{\sqrt{(Var\ X)}\ (Var\ Y)}$$

Path coefficient analysis was carried out using phenotypic correlation values of yield components on yield as suggested by Wright (1921) [24] and illustrated by Dewey and Lu (1959) [6] by partitioning the simple correlation coefficients into direct and indirect effects. The direct and indirect effects were ranked based on the scales of Lenka and Misra (1973) [9].

Result 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

The phenotypic (P) and genotypic correlation (G) coefficients were worked out for twenty characters in twenty six okra genotypes and the data is presented in Table 1. It was observed that genotypic correlation coefficients were higher than that of phenotypic correlation coefficients. From the estimates of phenotypic and genotypic coefficients of variation, in general, it was observed that the estimates of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic correlation coefficients.

Plant height noticed positive and significant correlation with number of branches per plant (0.0551 P, 0.0551 G), internodal length (0.4867 P, 0.5158 G), days to last harvest (0.1248 P, 0.1348 G), fruit length (0.0170 P, 0.0196 G), fruit weight (0.1647 P, 0.1655 G), fruit yield per plot (0.3186 P, 0.3366 G), fruit yield per hectare (0.3198 P, 0.3380 G), number of nodes per plant (0.0657 P, 0.0605 G), number of ridges per fruit (0.0940 P, 0.0934 G), crude fibre content (0.0851 P, 0.0886 G), and fruit yield per plant (0.3116 P, 0.3237 G). Reddy *et al*. (2013) **[16]** also found the same results. Ahamed *et al*. (2015) **[2]** observed positive and significant correlation with plant height and number of fruits per plant and yield per plant. Singh *et al*. (2006) **[20]** also recorded negative and significant correlation of plant height with fruit girth among 19 diverse okra genotypes.

Number of branches per plant registered positive and significant correlation with days to first flowering (0.8817 P, 0.9124 G), days to 50% flowering (0.7578 P, 0.9386 G), days to first harvest (0.8757 P, 0.9128 G), days to last harvest (0.7681 P, 0.8220 G), fruit girth (0.6668 P, 0.6957 G), number of fruits per plant (0.8814 P, 0.9039 G), number of nodes per plant (0.9202 P, 0.9492 G), total phenolic content (0.8359 P, 0.8644 G), total chlorophyll content (0.0226 P, 0.0246 G) and plant height. These results are in close harmony with the finding of Nirosha *et al*. (2014) [11] and Soni *et al.* (2018) [21].

Internodal length showed positive and significant correlation with fruit length (0.7622 P, 0.8039 G), fruit weight (0.7091 P, 0.7340 G), fruit yield per plot (0.3639 P, 0.3852 G), fruit yield per hectare (0.3638 P, 0.3853 G), crude fibre content (0.5370 P, 0.5570 G), yellow vein mosaic virus infestation (0.2415 P, 0.2499 G), fruit yield per plant (0.3605 P, 0.3752 G) and plant height and number of branches. This results are in corroborated the earlier finding of Singh *et al*. (2006) [20], Reddy *et al*. (2013) [16] and Soni *et al*. (2018) [21].

Fruit length was recorded highly significant and positive correlation with fruit weight (0.8099 P, 0.8269 G), fruit yield per plant (0.2687 P, 0.2904 G), fruit yield per plot (0.2759 P, 0.2759 G), fruit yield per hectare (0.2753 P, 0.2988 G), crude fibre content (0.6052 P, 0.6132 G) and yellow vein mosaic virus infestation (0.3611 P, 0.3645 G), plant height, number of branches, internodal length, days to first flowering, days to 50% flowering, days to first harvest and days to last harvest. These results are in corroborated with the finding of Singh *et al.* (2006) [20], Reddy *et al.* (2013) [16] and Umrao *et al*. (2015) [23].

This character showed positive and significant correlation with number of fruits per plant (0.4634 P, 0.4785 G), number of nodes per plant (0.5079 P, 0.5307 G), number of ridges per fruit (0.3945 P, 0.4213 G), total phenolic content (0.4391 P, 0.4618 G), total chlorophyll content (0.1161 P, 0.1233 G), plant height, number of branches, internodal length, days to first flowering, days to 50% flowering, days to first harvest, days to last harvest and fruit length. These results are in close harmony with the finding of Prajna *et al*. (2015) [15].

The correlation coefficient of fruit weight was found to be significant and positive correlation with fruit yield per plant (0.3974 P, 0.4106 G), fruit yield per plot (0.3998 P, 0.4105 G), fruit yield per hectare (0.3990 P, 0.4101 G), number of ridges per fruit (0.3507 P, 0.3617 G), crude fibre content (0.7971 P, 0.8034 G), yellow vein mosaic virus infestation (0.4755 P, 0.4795 G), plant height, number of branches, internodal length, days to first flowering, days to 50% flowering, days to first harvest, days to last harvest, fruit length and fruit girth. These finding are in agreement with Yonus *et al*. (2014) [25].

The correlation coefficient of number of fruit per plant showed significant and positive correlation with fruit yield per

plant (0.0264 P, 0.0335 G), fruit yield per plot (0.0233 P, 0.0263 G), fruit yield per hectare (0.0239 P, 0.0258 G), number of nodes per plant (0.9418 P, 0.9535 G), total phenolic content (0.8472 P, 0.8621 G) and total chlorophyll content (0.1019 P, 0.1024 G), plant height, number of branches, internodal length, days to first flowering, days to 50% flowering, days to first harvest, days to last harvest, fruit length, fruit girth and fruit weight. These results are in corroborated with the finding of Pithiya *et al*. (2017) **[14]**.

This character exhibited positive and significant correlation with fruit yield per plant (0.9968 P, 0..9988 G), crude fibre (0.0188 P, 0.0144 G), plant height, number of branches, internodal length, days to first flowering, days to 50% flowering, days to first harvest, days to last harvest, fruit length, fruit girth, average fruit weight, number of fruits per plant and fruit yield per plot. These results are in close harmony with the finding of Yonus *et al*. (2014) **[25]**.

Based on the simple correlation coefficients, the characters plant height, internodal length, fruit length, fruit weight, number of fruits per plant, fruit yield per plot, fruit yield per hectare and crude fibre content were found to possess significant and positive association with fruit yield per plant. Such high association between fruit yield per plant, number of fruits per plant and average fruit weight was reported by Reddy *et al*. (2013) [16], Nirosha *et al*. (2014) [11], Prajna *et al*. (2015) [15], Umrao *et al*. (2015) [23] and Shashi and Medagam (2016) [18] in okra. The results of the present study on plant height, fruit length and fruit weight were in conformity with Yonus *et al*. (2014) [25] and Thulasiram *et al*. (2017) [22] in okra. Further, it indicates plant height, internodal length, days to last harvest, fruit length, fruit weight, number of fruits per plant, fruit yield per plot, fruit yield per hectare and crude fibre content had positive and significant association with fruit yield and these characters are highly reliable components of fruit yield and could very well be utilized as yield indicators, while exercising selection.

Path Coefficient Analysis

The path coefficient analysis indicates that the association of the independent character with dependent variable is due to their direct effect on it or is a consequence of their indirect effect through other characters. If the correlation between dependent variable and independent character is due to direct effects of the character, it reflects a true relationship between them and selection can be practiced for such a character in order to improve dependent variable. But, if the association is mainly through indirect effects of the character *i.e.,* through other component characters, the breeder has to select for the latter through which the indirect effect is influenced. Path coefficient analysis divides the correlation into direct and indirect effects and permits a critical look to recognize the specific forces acting to produce a given correlation and measures the relative importance of each factor. Such an analysis was carried out in the present study with all yield characters are presented as in Table 2.

Among all the traits under study, the traits like plant height, number of branches per plant, internodal length, days to last harvest, fruit weight, number of fruits per plant, fruit yield per hectare, number of nodes per plant, total chlorophyll content and total phenolic content showed positive direct effect on fruit yield per plant. This result are propinquity with Shashi and Medagam (2016) [18], Thulasiram *et al*. (2017) [22], Pithiya *et al*. (2017) [14], Singh *et al*. (2006) [20] and Soni *et al*. (2018) [21].

Conclusion

The direct effect of all above mentioned traits on fruit yield per plant favours yield improvement through selection. Direct selection of days to 50% flowering should be avoided. This suggested that indirect selection based on plant height will be effective in yield improvement.

Table 1: Phenotypic (P) and genotypic (G) correlation coefficients of yield and yield attributes in twenty six genotypes of okra

Characters		Plant height (cm)	No. of branches per plant	Internodal length (cm)	Days to first flowering	Days to 50% flowering	Days to first harvest	Days to last harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of fruits per plant	Fruit yield per plot (kg)	Fruit yield per hectare (t)	No. of nodes per plant	No. of ridges per fruit	Crude fibre content (%)	Total phenolic content (mg/100g	chlorophyll content (mg/100g)	YVMV DIP (%)	Fruit yield per plant (g)
Plant height (cm)	P	1.0000	0.0551	0.4867**	-0.1197	-0.0814	-0.0898	0.1248	0.0170	-0.0850	0.1647	-0.0606	0.3186**	0.3198**	0.0657	0.0940	0.0851	-0.0082	-0.4274**	-0.0359	0.3116
	G	1.0000	0.0551	0.5158	-0.1243	-0.0732	-0.0886	0.1384	0.0196	-0.0767	0.1655	-0.0649	0.3366	0.3380	0.0605	0.0934	0.0886	-0.0134	-0.4405	-0.0367	0.3237
Number of branches per plant	P		1.0000	-0.6902**	0.8817**	0.7578**	0.8757**	0.7681**	-0.9149**	0.6668**	-0.8197**	0.8814**	-0.1602	-0.1591	0.9202**	-0.0327	-0.6738**	0.8359**	0.0226	-0.4129**	-0.1561
	G		1.0000	-0.7402	0.9124	0.9386	0.9128	0.8220	-0.9515	0.6957	-0.8462	0.9039	-0.1772	-0.1764	0.9492	-0.0406	-0.6938	0.8644	0.0246	-0.4218	-0.1757
Intermodal length (cm)	P			1.0000	-0.7885**	-0.6394**	-0.7754***	-0.4987**	0.7622**	-0.6087**	0.7091**	-0.6777**	0.3639**	0.3638**	-0.6660**	-0.0228	0.5370**	-0.6044**	-0.2645*	0.2415*	0.3605
	G			1.0000	-0.8184	-0.7952	-0.8080	-0.5334	0.8039	-0.6432	0.7340	-0.7082	0.3852	0.3853	-0.6977	-0.0140	0.5570	-0.6313	-0.2715	0.2499	0.3752
Days to first flowering	P				1.0000	0.8560***	0.9921**	0.7868**	-0.8947** 8	0.7091**	-0.7583**	0.7436**	-0.3070**	-0.3060**	0.8079**	0.1300	-0.5786**	0.6876**	0.0794	-0.2132	-0.3012
	G				1.0000	0.9980	0.9957	0.8175	-0.9143	0.7253	-0.7691	0.7551	-0.3266	-0.3258	0.8189	0.1314	-0.5834	0.7054	0.0817	-0.2148	-0.3217
Days to 50% flowering	P					1.0000	0.8543**	0.7094**	-0.7411**	0.6517**	-0.6150**	0.6063**	-0.2355*	-0.2345*	0.6594**	0.1421	-0.4542**	0.4960**	0.0703	-0.1512	-0.2341
	G					1.0000	0.9883	0.8665	-0.8919	0.7686	-0.7328	0.7311	-0.2763	-0.2754	0.8135	0.1656	-0.5448	0.6619	0.1001	-0.1805	-0.2746
Days to first harvest	P						1.0000	0.7898**	-0.8911**	0.6939**	-0.7605**	0.7513**	-0.2814*	-0.2803*	0.8193**	0.1438	-0.5869** 0.6	0.6784**	0.0426	-0.2002	-0.2757
	G						1.0000	0.8216	-0.9134	0.7113	-0.7713	0.7638	-0.3002	-0.2994	0.8298	0.1449	-0.5937	0.7019	0.0450	-0.2025	-0.2957
Days to last harvest	P							1.0000	-0.7199**	0615**	-0.5309**	0.5507**	-0.1891	-0.1881	0.6797**	0.2149	-0.3395**	0.5829**	-0.0688	-0.0869	-0.1874
	G							1.0000	-0.7536	0.6693	-0.5559	0.5722	-0.2117	-0.2108	0.7107	0.2173	-0.3511	0.6031	-0.0710	-0.0898	-0.2125
Fruit length (cm)	P								1.0000	-0.7282**	0.8099**	-0.8144**	0.2759*	0.2753*	-0.8699**	-0.0570	0.6052**	-0.7874**	-0.0150	0.3611**	0.2687
	G								1.0000	-0.7586	0.8269	-0.8273	0.2994	0.2988	-0.8828	-0.0603	0.6132	-0.8056	-0.0162	0.3645	0.2904
Fruit girth (cm)	P									1.0000	-0.3504**	0.4634**	-0.0442	-0.0439	0.5079**	0.3945**	-0.2633*	0.4391**	0.1161	-0.1139	-0.0344
	G									1.0000	-0.3505	0.4785	-0.0248	-0.0247	0.5307	0.4213	-0.2659	0.4618	0.1233	-0.1163	-0.0165
Fruit weight (g)	P										1.0000	-0.8844**	0.3998**	0.3990**	-0.8411**	0.3507**	0.7971**	-0.7789**	-0.0687	0.4755**	0.3974
	G										1.0000	-0.8955	0.4105	0.4101	-0.8588	0.3617	0.8034	-0.8018	-0.0714	0.4795	0.4106
Number of fruits per plant	P											1.0000	0.0233	0.0239	0.9418**	-0.3052**	-0.8581**	0.8472**	0.1019	-0.6396	0.0264
	G											1.0000	0.0263	0.0258	0.9535	-0.3088	-0.8651	0.8621	0.1024	-0.6434	0.0335
Fruit yield per plot (kg)	P												1.0000	1.000**	-0.0431	-0.0212	0.0188	-0.1220	-0.0538	-0.2572	0.9967
	G												1.0000	1.0000	-0.0529	-0.0237	0.0144	-0.1474	-0.0628	-0.2779	0.9997
Fruit yield per hectare (t)	P													1.0000	-0.0423	-0.0210	0.0188	-0.1217	-0.0532	-0.2574	0.9968
	G													1.0000	-0.0521	-0.0226	0.0144	-0.1471	-0.0622	-0.2784	0.9988
Number of nodes per plant	P														1.0000	-0.1792	-0.7602**	0.8849**	-0.0168	-0.4878**	-0.0363
	G														1.0000	-0.1849	-0.7668	0.8995	-0.0179	-0.4919	-0.0475

Number of ridges per fruit	P															1.0000	0.4505**	-0.2060	0.1030	0.3877**	-0.0165
	G															1.0000	0.4586	-0.2158	0.1043	0.3961	-0.0223
Crude fibre content (%)	P																1.0000	-0.6422**	-0.1512	0.6191**	0.0182
	G																1.0000	-0.6505	-0.1523	0.6203	0.0147
Phenolic content (mg/100g)	P																	1.0000	-0.0641	-0.3720	-0.1134
	G																	1.0000	-0.0669	-0.3771	-0.1368
Chlorophyll content (mg/100g)	P																		1.0000	-0.2525	-0.0569
	G																		1.0000	-0.2531	-0.0657
YVMV disease incidence (%)	P																			1.0000	-0.2522
	G																			1.0000	-0.2731
Fruit yield per plant (g)	P																				1.0000
	G																				1.0000

*Significant at 0.5 per cent level; ** Significant at 0.1 per cent level

Table 2: Phenotypic (P) and genotypic (G) path coefficient analysis indicating direct and indirect effects of component characters on fruit yield in 26 genotypes of okra

Characters		Plant height (cm)	No. of branches per plant	Internodal length (cm)	Days to first flowering	Days to 50% flowering	Days to first harvest	Days to last harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of fruits per plant	Fruit yield per plot (kg)	Fruit yield per hectare (t)	Number of nodes per plant	Number of ridges per fruit	Crude fibre content (%)	Phenolic content (mg/100g)	Chlorophyll content (mg/100g)	YVMV DIP (%)	Fruit yield per plant (g)
Plant height (cm)	P	-0.0274	-0.0015	-0.0133	0.0033	0.0022	0.0025	-0.0034	-0.0005	0.0023	-0.0045	0.0017	-0.0087	-0.0087	-0.0018	-0.0026	-0.0023	0.0002	0.0117	0.001	0.3116
	G	0.1033	-0.0057	-0.0533	0.0128	0.0076	0.0092	-0.0143	-0.002	0.0079	-0.0171	0.0067	-0.0348	-0.0349	-0.0062	-0.0097	-0.0091	0.0014	0.0455	0.0038	0.3237
Number of branches per plant	P	-0.0026	-0.048	0.0331	-0.0423	-0.0364	-0.0421	-0.0369	0.0439	-0.032	0.0394	-0.0423	0.0077	0.0076	-0.0442	0.0016	0.0324	-0.0401	-0.0011	0.0198	-0.1561
	G	0.0057	0.1038	-0.0769	0.0947	0.0975	0.0948	0.0854	-0.0988	0.0722	-0.0879	0.0939	-0.0184	-0.0183	0.0986	-0.0042	-0.072	0.0898	0.0026	-0.0438	-0.1757
Intermodal length (cm)	P	0.0213	-0.0302	0.0437	-0.0345	-0.028	-0.0339	-0.0218	0.0333	-0.0266	0.031	-0.0296	0.0159	0.0159	-0.0291	-0.001	0.0235	-0.0264	-0.0116	0.0106	0.3605
	G	0.0207	-0.0297	0.0401	-0.0328	-0.0319	-0.0324	-0.0214	0.0323	-0.0258	0.0295	-0.0284	0.0155	0.0155	-0.028	-0.0006	0.0224	-0.0253	-0.0109	0.0100	0.3752
Days to first flowering	P	-0.0042	0.0309	-0.0277	0.0351	0.0300	0.0348	0.0276	-0.0314	0.0249	-0.0266	0.0261	-0.0108	-0.0107	0.0284	0.0046	-0.0203	0.0241	0.0028	-0.0075	-0.3012
	G	0.0517	-0.3798	0.3406	-0.4162	-0.4154	-0.4144	-0.3403	0.3806	-0.3019	0.3201	-0.3143	0.1359	0.1356	-0.3408	-0.0547	0.2428	-0.2936	-0.034	0.0894	-0.3217
Days to 50% flowering	P	0.0009	-0.0081	0.0069	-0.0092	-0.0107	-0.0092	-0.0076	0.008	-0.007	0.0066	-0.0065	0.0025	0.0025	-0.0071	-0.0015	0.0049	-0.0053	-0.0008	0.0016	-0.2341
	G	0.001	-0.0128	0.0108	-0.0136	-0.0136	-0.0135	-0.0118	0.0121	-0.0105	0.0100	-0.0100	0.0038	0.0038	-0.0111	-0.0023	0.0074	-0.0090	-0.0014	0.0025	-0.2746
Days to first harvest	P	0.0023	-0.0228	0.0202	-0.0258	-0.0222	-0.026	-0.0205	0.0232	-0.018	0.0198	-0.0195	0.0073	0.0073	-0.0213	-0.0037	0.0153	-0.0176	-0.0011	0.0052	-0.2757
	G	-0.0368	0.3787	-0.3352	0.4131	0.41	0.4149	0.3408	-0.3789	0.2951	-0.3200	0.3169	-0.1245	-0.1242	0.3443	0.0601	-0.2463	0.2912	0.0187	-0.084	-0.2957
Days to last harvest	P	-0.002	-0.0121	0.0078	-0.0124	-0.0111	-0.0124	-0.0157	0.0113	-0.0099	0.0083	-0.0087	0.003	0.003	-0.0107	-0.0034	0.0053	-0.0092	0.0011	0.0014	-0.1874
	G	-0.0041	-0.0245	0.0159	-0.0243	-0.0258	-0.0245	-0.0298	0.0224	-0.0199	0.0165	-0.0170	0.0063	0.0063	-0.0212	-0.0065	0.0105	-0.0180	0.0021	0.0027	-0.2125
Fruit length (cm)	P	-0.0002	0.0090	-0.0075	0.0088	0.0073	0.0087	0.0071	-0.0098	0.0071	-0.0079	0.008	-0.0027	-0.0027	0.0085	0.0006	-0.0059	0.0077	0.0001	-0.0035	0.2687
	G	-0.0026	0.1279	-0.1081	0.1229	0.1199	0.1228	0.1013	-0.1345	0.102	-0.1112	0.1112	-0.0403	-0.0402	0.1187	0.0081	-0.0825	0.1083	0.0022	-0.049	0.2904
Fruit girth (cm)	P	-0.0026	0.0207	-0.0189	0.022	0.0202	0.0216	0.0196	-0.0226	0.0311	-0.0109	0.0144	-0.0014	-0.0014	0.0158	0.0123	-0.0082	0.0136	0.0036	-0.0035	-0.0344
	G	0.0003	-0.0003	0.0002	-0.0003	-0.0003	-0.0003	-0.0002	0.0003	-0.0004	0.0001	-0.0002	0.0002	0.0003	-0.0002	-0.0002	0.0001	-0.0002	0.0000	0.0000	-0.0165

Fruit weight (g)	P	0.0099	-0.0494	0.0428	-0.0457	-0.0371	-0.0459	-0.032	0.0488	-0.0211	0.0603	-0.0533	0.0241	0.0241	-0.0507	0.0211	0.0481	-0.047	-0.0041	0.0287	0.3974
	G	-0.005	0.0256	-0.0222	0.0233	0.0222	0.0233	0.0168	-0.025	0.0106	0.0303	0.0271	-0.0124	-0.0124	0.0260	-0.0109	-0.0243	0.0243	0.0022	-0.0145	0.4106
Number of fruits per plant	P	-0.003	0.044	-0.0338	0.0371	0.0303	0.0375	0.0275	-0.0407	0.0231	-0.0441	0.0499	0.0012	0.0012	0.0470	-0.0152	-0.0428	0.0423	0.0051	-0.0319	0.0264
	G	0.0248	-0.3455	0.2707	-0.2886	-0.2795	-0.292	-0.2187	0.3162	-0.1829	0.3423	0.3823	0.0024	0.0022	-0.3645	0.1180	0.3307	-0.3296	-0.0391	0.246	0.0035
Fruit yield per plot (kg)	P	-0.7917	0.3980	-0.9043	0.763	0.5852	0.6993	0.4700	-0.6856	0.1098	-0.9935	-0.0578	-2.4852	-2.4851	0.1071	0.0527	-0.0467	0.3032	0.1338	0.6392	0.9967
	G	-3.7369	1.9670	-4.2764	3.6249	3.0675	3.3321	2.3502	-3.3237	0.2752	-4.5564	0.0703	-11.1003	-11.1003	0.5867	0.0414	-0.1599	1.6359	0.6973	3.0850	1.0002
Fruit yield per hectare (t)	P	1.1027	-0.5485	1.2544	-1.0554	-0.8086	-0.9667	-0.6487	0.9493	-0.1515	1.3759	0.0824	3.4482	3.4483	-0.1459	-0.0693	0.0648	-0.4196	-0.1835	-0.8877	0.9968
	G	4.1155	-2.1476	4.6908	-3.9666	-3.3536	-3.6446	-2.5660	3.6382	-0.3013	4.9935	-0.0711	12.1749	12.1749	-0.6339	-0.0321	0.1756	-1.7912	-0.7573	-3.389	1.0000
Number of nodes per plant	P	0.0045	0.0627	-0.0454	0.0551	0.045	0.0559	0.0463	-0.0593	0.0347	-0.0573	0.0642	-0.0029	-0.0029	0.0682	-0.0122	-0.0518	0.0603	-0.0011	-0.0333	-0.0363
	G	0.003	0.0468	-0.0344	0.0404	0.0401	0.0409	0.035	-0.0435	0.0262	-0.0423	0.047	-0.0026	-0.0026	0.0493	-0.0091	-0.0378	0.0443	-0.0009	-0.0242	-0.0475
Number of ridge per fruit	P	0.0000	0.0000	0.0000	-0.0001	-0.0001	-0.0001	-0.0001	0.0000	-0.0002	-0.0002	0.0002	0.0000	0.0000	0.0001	-0.0005	-0.0002	0.0001	-0.0001	-0.0002	0.0165
	G	-0.004	0.0017	0.0006	-0.0056	-0.0071	-0.0062	-0.0093	0.0026	-0.0181	-0.0155	0.0133	0.0002	0.0001	0.0079	-0.043	-0.0197	0.0093	-0.0045	-0.017	0.0023
Crude fibre content (%)	P	-0.0004	0.003	-0.0024	0.0026	0.002	0.0026	0.0015	-0.0027	0.0012	-0.0035	0.0038	-0.0001	-0.0001	0.0034	-0.002	-0.0044	0.0028	0.0007	-0.0027	0.0182
	G	-0.0047	0.0371	-0.0298	0.0312	0.0292	0.0318	0.0188	-0.0328	0.0142	-0.043	0.0463	-0.0008	-0.0008	0.0411	-0.0246	-0.0535	0.0348	0.0082	-0.0332	0.0147
Phenolic content (mg/100g)	P	0.0000	-0.0003	0.0002	-0.0002	-0.0002	-0.0002	-0.0002	0.0003	-0.0001	0.0003	-0.0003	0.0000	0.0000	-0.0003	0.0001	0.0002	-0.0003	0.0000	0.0001	-0.1134
	G	-0.0011	0.0701	-0.0512	0.0572	0.0537	0.0569	0.0489	-0.0653	0.0374	-0.065	0.0699	-0.0119	-0.0119	0.0729	-0.0175	-0.0527	0.0811	-0.0054	-0.0306	-0.1368
Chlorophyll content (mg/100g)	P	0.0044	-0.0002	0.0027	-0.0008	-0.0007	-0.0004	0.0007	0.0002	-0.0012	0.0007	-0.0011	0.0006	0.0005	0.0002	-0.0011	0.0016	0.0007	-0.0103	0.0026	-0.0569
	G	-0.0011	0.0001	-0.0007	0.0002	0.0003	0.0001	-0.0002	0.0000	0.0003	-0.0002	0.0003	-0.0002	-0.0002	0.0000	0.0003	-0.0004	-0.0002	0.0026	-0.0006	-0.0657
YVMV disease incidence (%)	P	-0.0003	-0.0033	0.0019	-0.0017	-0.0012	-0.0016	-0.0007	0.0029	-0.0009	0.0038	-0.0051	-0.0021	-0.0021	-0.0039	0.0031	0.005	-0.003	-0.0020	0.0080	-0.2522
	G	0.001	0.0111	-0.0066	0.0057	0.0048	0.0054	0.0024	-0.0096	0.0031	-0.0127	0.017	0.0073	0.0074	0.0130	-0.0105	-0.0164	0.0100	0.0067	-0.0264	-0.2731
Phenotypic Residual effect = 0.0733; Genotypic Residual effect=0.0141; Diagonal (under lined) values indicate direct effects																					

References

1. Adeniji OT, Peter JM. Stepwise regression analysis of pod and seed yield characters in segregating F2 population of West African okra (*Abelmoschus caillei*). Proceedings of 30th Conference, Genetics Society of Nigeria, 2005, 250-258.
2. Ahamed KU, Akter B, Ara N, Hossain MF, Moniruzzaman M. Heritability, correlation and path coefficient analysis in fifty seven okra genotypes. Inter. J Applied Scie. and Biotech. 2015; 3(1):127-133
3. Arunachalam V. Evaluation of diallel crosses graphical and combining ability method. Indian Journal of Genetics. 1976; 36:358-366.
4. Balai TC, Maurya IB, Verma S, Kumar N. Genetic divergence studies in okra [*Abelmoschus esculentus* (L.) Moench] genotypes. Electronic J. Plant Breed. 2015; **6**(2):619-624.
5. Bello D, Sajo D, Chubado, Jellason JJ. Variability and correlation studies in okra (*Abelmoschus esculentus* (L.) Moench). J Sustainable Dev. Agric. Environ. 2006; 2(1):120-126.
6. Dewey DR, Lu KH. Correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agro. J. 1959: 51(9):515-518.
7. John MS, George W, Collum JP. Producing Vegetable Crops. (4th Edn.) International Book Distribution Co. Lucknow, 1992.
8. Kang MS, Miller JD, Tai PP. Genetic and phenotypic path analyses and heritability in sugarcane. Crop Science. 1983; 23:643-647
9. Lenka D, Mishra B. Path coefficient analysis of yield in rice varieties. Indian J Agric. Sci. 1973; 43:376-379.
10. Mehta DR, Dhaduk LK, Patel KD. Genetic variability, correlation and path analysis studies in okra. Agri. Sci. Digest. 2006; 26(1):15-18.
11. Nirosha K, Vethamoni PI, Sathiyamurthy VA. Correlation and path analysis in okra [*Abelmoschus esculentus* (L.) Moench]. Agri. Sci. Digest. 2014; 34(4):313.
12. Pal BP, Singh HB, Swarup V. Taxonomic relationship and breeding possibilities of species of okra [*Abelmoschus esculentus* (L.) Monech]. *Bt. Gaz.* 1952; 113:455-464.
13. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR, New Delhi. 1967, 134-192.
14. Pithiya PH, Kulkarni GU, Jalu RK, Thumar DP. Correlation and path coefficient analysis of quantitative characters in okra [*Abelmoschus esculentus* (L.) Moench]. J Pharmacognosy Phytochemi. 2017; 6(6):1487-1493.
15. Prajna SP, Gasti VD, Evoor S. Correlation and path analysis in okra [*Abelmoschus esculentus* (L.) Moench]. Hort. Flora Res. Spectrum. 2015; 4(2):123-128.
16. Reddy MT, Babu KH, Ganesh M, Reddy CK, Begum H, Reddy RSK Babu JD. Correlation and path coefficient analysis of quantitative characters in okra. Songklanakarin J Sci. Tech. 2013; 35(3):243-250.
17. Saifullah M, Rabbani MG. Evaluation and characterization of okra [*Abelmoschus esculentus* (L.) Moench] genotypes. SAARC J Agric. 2009; **7**:92-99.
18. Shashi K, Medagam TR. Correlation and path coefficient analysis for yield and its components in okra [*Abelmoschus esculentus* (L.) Moench]. Advances Agri. Sci. 2016; 4(4):72-83.
19. Siemonsma JS, Kouame C. Vegetable plant resource of tropical Africa. PROTA Foundation, Wageningen. 2004, 21-22.
20. Singh B, Pal AK, Singh S. Genetic variability, correlation and path analysis in okra [*Abelmoschus esculentus* (L.) Moench]. Indian J Hort. 2006; 63(3):281-285.
21. Soni O, Jain PK, Nilesh S. Genetic variability, correlation and path analysis in okra. Int. J Applied Agri. & Horti. Sci. 2018; 9(3):430-433.
22. Thulasiram LB, Bhople SR, Mekala S, Ravi NB. Genetic variability and heritability studies in okra [*Abelmoschus esculentus* (L.) Moench]. Electronic J Plant Breed. 2017; 8(2):620-625.
23. Umrao V, Sharma SK, Kumar V, Kumar R, Sharma A, Kumar K. Correlation and path coefficient analysis of yield components in okra [*Abelmoschus esculentus* (L.) Moench]. Hort. Flora Res. Spectrum. 2015; 4(2):139-143.
24. Wright S. Correlation and causation. J Agric. Res. 1921; 20:557-587.
25. Yonus M, Garedew W, Debela A. Variability and association of quantitative characters among okra [*Abelmoschus esculentus* (L.) Moench] collection in south western Ethiopia. J Biol. Sci. 2014; 14(5):336-342.