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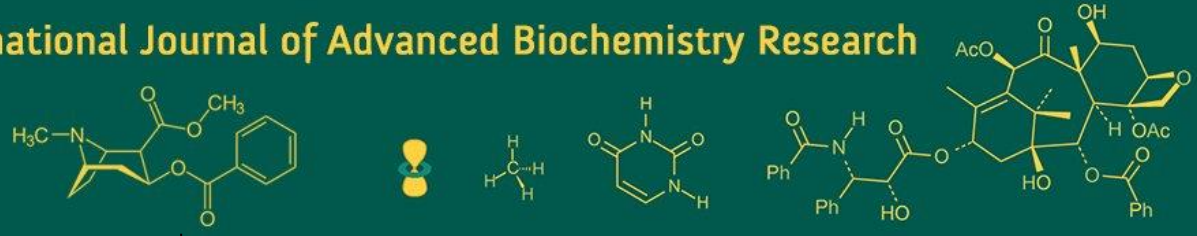

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Correlation and path coefficient analysis studies in okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract
The present investigation was undertaken to estimate the correlation and path analysis for fruit yield and yield contributing characters in okra [*Abelmoschus esculentus* (L.) Moench]. Forty genotypes were sown in a randomized block design with three replications during late *kharif* 2023. The characters studied were plant height (cm), number of branches per plant, number of nodes on main stem, internodal length (cm), days to first flowering, days to first picking, days to last picking, number of picking, number of fruits per plant, green fruits weight (g), green fruit yield per plant (g), fruit length (cm) and fruit width (cm). Highly significant and positive correlation of fruit yield per plant was found with number of nodes on main stem, days to last picking, number of picking, number of fruits per plant, green fruits weight and fruit length at both genotypic and phenotypic levels. The path coefficient analysis revealed high and positive direct effects of number of fruits per plant and number of nodes on main stem on fruit yield per plant. Plant height had low and positive direct effect. Thus, these characters turned-out to be the major components of green fruit yield per plant.

Keywords: Correlation, path analysis, fruit yield, yield components and okra

Introduction
Okra (*Abelmoschus esculentus* L.) is one of the most widely known and utilized species of the malvaceae family. An economically important vegetable crop originating in Tropical Africa, the subtropics and India. Okra is a tropical and subtropical plant that is primarily cultivated in warm tropical and subtropical climates around the world (Charrier, 1984) [4]. In Gujarat, it is grown either as sole or intercrop (Hathi, *et al.* 2022) [9]. Okra is a polyploid and a self-pollinated crop. Occurrence of out crossing to an extent of 4 to 19 %with the maximum of 42.2 % is noticed with the insect assisted pollination. Okra is mainly propagated by seeds. It grows well with mulching practices (Vasava, *et al*. 2023) [11]. Okra is a powerhouse of variable nutrients. It is cultivated for its green fleshy pods. They are found to be an excellent source of iodine, which is effective in controlling goiter. Immature okra fruit contain 3100 calorie energy, 90 mg calcium, 1.8 g protein and 1.0 mg iron (Aykroyd, 1941) [3]. Okra is rich in vitamins, calcium, potassium and other mineral matters. Tender fruits of okra are used as vegetable or in culinary preparation as sliced and fried pieces. It also used for thickening soups and gravies, because of its high mucilage content. Okra fruits are also sliced for sun drying or canning or pickled for off-season use. Okra leaves are used in inflammation and dysentery.

A wide range of variation in quantitative characters provides the basis for selection in plant breeding programme. The knowledge of association among the characters is useful to the breeder for improving the efficiency of selection. Correlation coefficient analysis measures the mutual relationship between plant characters and determines the component character on which selection can be made for genetic improvement of yield. Path analysis helps in partitioning the correlation into direct and indirect effects of various yield components on yield. Yield being a complex character, is the result of action and interaction of more than one yield contributing character which effect directly or indirectly on yield.

Materials and Methods
The present investigation was conducted to assess the correlation and path coefficient analysis studies in okra [*Abelmoschus esculentus* (L.) Moench].

The study was carried out during late *kharif* 2023 at the Instructional farm, Jambuvadi, College of Horticulture, Junagadh Agricultural University, Junagadh. The experimental material consisted of 40 genotypes and was evaluated in randomized block design with three replications. The genotypes were randomly allotted to the plots in each replication. Each genotype was sown with a spacing of 60 × 30 cm. The observations were recorded on five randomly selected plants in each genotype from each replication. The observations were recorded for plant height (cm), number of branches per plant, number of nodes on main stem, internodal length (cm), days to first flowering, days to first picking, days to last picking, number of picking, number of fruits per plant, green fruits weight (g), green fruit yield per plant (g), fruit length (cm) and fruit width (cm). Correlation coefficient were calculated for all quantitative character combinations at phenotypic, genotypic and environmental levels, method suggested by Al-Jibouri *et al.* (1958) [2] and path coefficient were worked out as per the method given by Wright and elaborated by Dewey and Lu (1959) [5].

Results and Discussion

In order to find out the association between thirteen characters in the given genotypes the genotypic and phenotypic correlation coefficients were worked out and are interpreted in Table 1. Yield is highly complex character and polygenic in nature which is influenced by environment. Hence, the study of inter association is essential to understand the relationship of simple traits with complex yield attributing traits. The study of genetic correlation gives an idea about the extent of which the characters are under the control of same set of genes. The pleiotropy assumes importance if the correlation is high, whereas, the independent inheritance of traits may be perceived if the correlation is found to be low.

The present evaluation revealed that the fruit yield per plant showed highly significant and positive correlations with number of nodes on main stem, days to last picking, number of picking, number of fruits per plant, green fruits weight and fruit length at both genotypic and phenotypic levels. Similar results were also reported by Vinod and Gabriyal (2023) [12] for number of nodes on main stem; Ahamed *et al*. (2015) [1] for total number of picking; Ghadage *et al*. (2024) [7] for number of fruits per plant; Hallur *et al*. (2017) [8] for fruit weight and Ghadage *et al*. (2024) [7] for fruit length. Days to first flowering and days to first picking had highly significant and negative association at genotypic and phenotypic level which is an important component in identifying and deciding the duration of the crop. Similar results were reported by Gangashetti *et al*. (2013) [6] and Ahamed *et al*. (2015) [1] for days to first flowering and Ahamed *et al*. (2015) [1] for days to first picking. Days to first flowering and days to first picking had negative correlation with fruit yield per plant which is important for earliness in okra crop.

In the current study, each component has two actions *viz.*, direct effect on yield and indirect effect through components which are not revealed by correlation studies. The results of path coefficient is presented in Table 2. Path coefficient analysis revealed that number of fruits per plant had highest positive direct effect on fruit yield per plant. This is reflected in their significant and positive association with fruit yield. These results are in close harmony with the findings of Ranga and Darvhankar *et al*. (2022) [10] for number of fruits per plant.

Table 1: Genotypic (r_g) and phenotypic (r_p) correlation coefficients among 13 characters in okra

Character	Corr.	Plant height	No. of branches per plant	No. of nodes on main stem	Internodal length	Days to first flowering	Days to first picking	Days to last picking	Number of picking	No. of fruits per plant	Green fruits weight	Fruit length	Fruit width	Green fruit yield per plant
Plant height	r_g	1.0000	-0.0682	-0.0890	0.0704	0.0048	0.0300	-0.0048	-0.0401	0.0447	-0.0284	-0.1013	-0.3362*	0.0090
	r_p	1.0000	-0.0621	-0.0886	0.0598	0.0011	0.0177	-0.0066	-0.0473	0.0454	-0.0339	-0.1014	-0.2986	0.0085
No. of branches per plant	r_g		1.0000	0.0962	-0.2046	0.1943	-0.1128	0.0171	0.0620	0.0633	0.3331*	0.1341	0.0855	0.1107
	r_p		1.0000	0.0902	-0.1948	0.1382	-0.0768	0.0241	0.0636	0.0540	0.2810	0.1305	0.0765	0.1067
No. of nodes on main stem	r_g			1.000	-0.7012**	-0.9124**	-0.9438**	0.4984**	0.3252*	0.5809**	0.4535**	0.4673**	0.1034	0.6409**
	r_p			1.0000	-0.6404**	-0.6315**	-0.5888**	0.3615*	0.2952	0.5251**	0.3966*	0.4392**	0.1220	0.5941**
Internodal length	r_g				1.0000	0.2153	0.1641	-0.1683	-0.1353	-0.2406	-0.1078	-0.1550	-0.0112	-0.2617
	r_p				1.0000	0.1613	0.0861	-0.1127	-0.0937	-0.2190	-0.1029	-0.1375	-0.0201	-0.2378
Days to first flowering	r_g					1.0000	0.8488**	-0.7780**	-0.5145**	-0.6718**	-0.2883	-0.4663**	-0.0244	-0.4962**
	r_p					1.0000	0.7787**	-0.3490	-0.2981	-0.4541**	-0.2381	-0.3325*	-0.0452	-0.3630*
Days to first picking	r_g						1.0000	-0.7001**	-0.5909**	-0.6911**	-0.5628**	-0.7087**	-0.2628	-0.6750**
	r_p						1.0000	-0.3818*	-0.3364*	-0.4693**	-0.3150*	-0.4541**	-0.1605	-0.4249**
Days to last picking	r_g							1.0000	1.4264**	0.5461**	0.8957**	0.5312**	0.1743	0.9033**
	r_p							1.0000	0.9577**	0.4382**	0.6277**	0.3931*	0.1449	0.6781**
Number of picking	r_g								1.0000	0.4927**	0.7486**	0.3951*	0.1878	0.7411**
	r_p								1.0000	0.4084**	0.5941**	0.3414*	0.1541	0.6278**
No. of fruits per plant	r_g									1.0000	0.5092**	0.4361**	0.2552	0.9002**
	r_p									1.0000	0.4268**	0.3973*	0.2266	0.8458**
Green fruits weight	r_g										1.0000	0.6056**	0.2250	0.8009**
	r_p										1.0000	0.5319**	0.1815	0.7036**
Fruit length	r_g											1.0000	0.2617	0.5585**
	r_p											1.0000	0.2229	0.5297**
Fruit width	r_g												1.0000	0.3509*
	r_p												1.0000	0.2935

Table 2: Phenotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on green fruit yield per plant in okra

Characters	Plant height	No. of branches per plant	No. of nodes on main stem	Internodal length	Days to first flowering	Days to first picking	Days to last picking	Number of picking	No. of fruits per plant	Green fruits weight	Fruit length	Fruit width	Phenotypic correlation with green fruit yield per plant
Plant height	0.0322	-0.0020	-0.0028	0.0019	0.0000	0.0006	-0.0002	-0.0015	0.0015	-0.0011	-0.0033	-0.0096	0.0085
No. of branches per plant	0.0019	-0.0305	-0.0028	0.0059	-0.0042	0.0023	-0.0007	-0.0019	-0.0016	-0.0086	-0.0040	-0.0023	0.1067
No. of nodes on main stem	-0.0277	0.0282	0.3123	-0.2000	-0.1972	-0.1839	0.1129	0.0922	0.1640	0.1239	0.1372	0.0381	0.5941**
Internodal length	0.0063	-0.0204	-0.0672	0.1049	0.0169	0.0090	-0.0118	-0.0098	-0.0230	-0.0108	-0.0144	-0.0021	-0.2378
Days to first flowering	0.0002	0.0266	-0.1217	0.0311	0.1927	0.1500	-0.0672	-0.0574	-0.0875	-0.0459	-0.0641	-0.0087	-0.3630*
Days to first picking	0.0012	-0.0054	-0.0141	0.0062	0.0543	0.0697	-0.0266	-0.0235	-0.0327	-0.0220	-0.0317	-0.0112	-0.4249**
Days to last picking	-0.0020	0.0073	0.1093	-0.0341	-0.1055	-0.1154	0.3022	0.2894	0.1324	0.1897	0.1188	0.0438	0.6781**
Number of picking	0.0029	-0.0038	-0.0178	0.0057	0.0180	0.0203	-0.0578	-0.0604	-0.0247	-0.0359	-0.0206	-0.0093	0.6278**
No. of fruits per plant	0.0267	0.0317	0.3085	-0.1286	-0.2667	-0.2756	0.2574	0.2399	0.5874	0.2507	0.2334	0.1331	0.8458**
Green fruits weight	-0.0078	0.0643	0.0908	-0.0235	-0.0545	-0.0721	0.1436	0.1360	0.0977	0.2288	0.1217	0.0415	0.7036**
Fruit length	-0.0041	0.0053	0.0179	-0.0056	-0.0136	-0.0185	0.0160	0.0139	0.0162	0.0217	0.0408	0.0091	0.5297**
Fruit width	-0.0212	0.0054	0.0087	-0.0014	-0.0032	-0.0114	0.0103	0.0109	0.0161	0.0129	0.0158	0.0711	0.2935

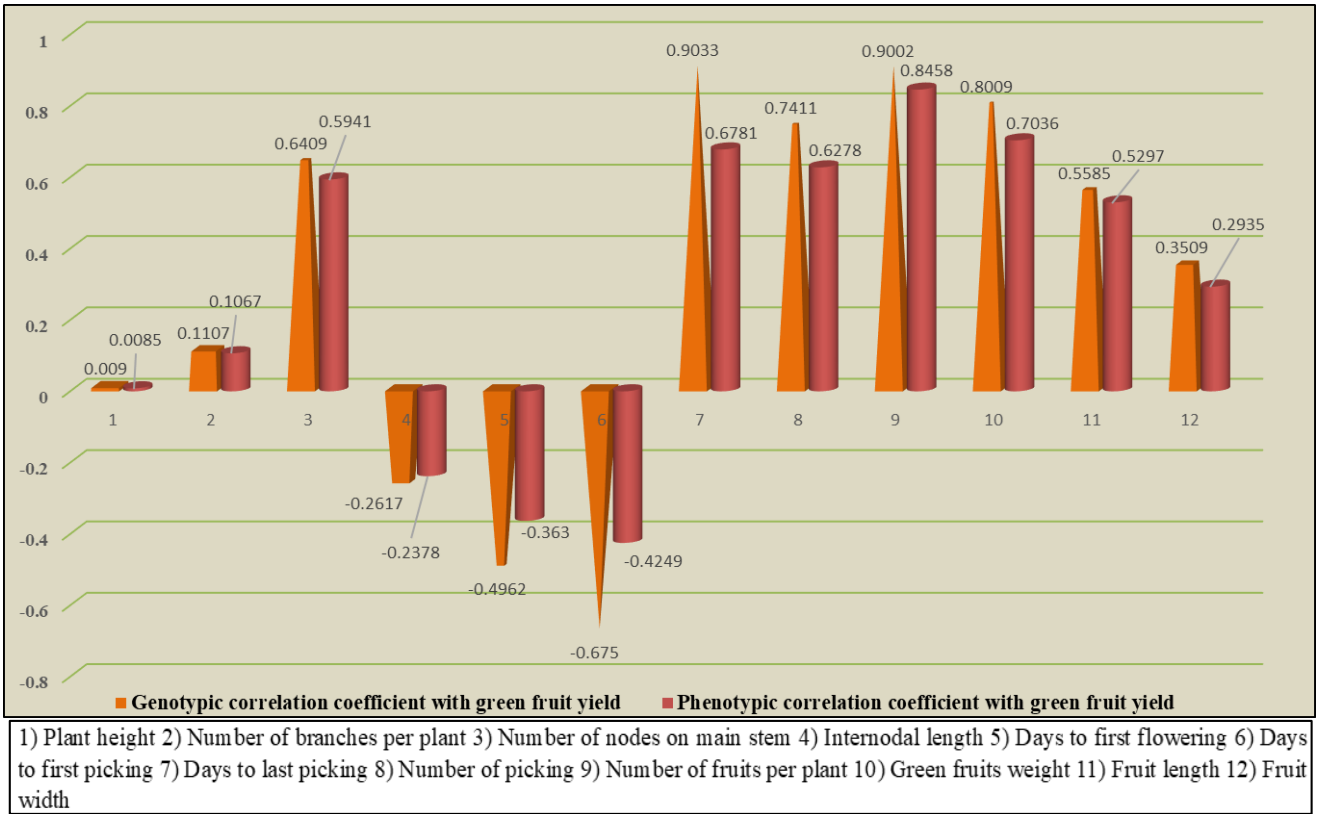

Fig 1: Genotypic and phenotype correlation coefficient of different traits with green fruit yield

Conclusion

Highly significant and positive correlation of fruit yield per plant was found with number of nodes on main stem, days to last picking, number of picking, number of fruits per plant, green fruits weight and fruit length at both genotypic and phenotypic levels**.** The path coefficient analysis revealed high and positive direct effects of number of fruits per plant and number of nodes on main stem on fruit yield per plant. Plant height had low and positive direct effect. Thus, these characters turned-out to be the major components of green fruit yield per plant. For improvement of green fruit yield per plant in okra through selection programme, more emphasis should be given to number of fruits per plant and number of nodes on main stem for direct selection.

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