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Correlation analysis for fruit yield and its related traits in genotypes of okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract
The study was conducted to determine the correlation coefficients among the fruit yield and yield contributing characters in 26 genotypes. The number of fruits per plant, fruit weight, leaf area, and harvest duration all significantly positively correlated with yield at phenotypic and Genotypic levels. The attributes days to 50% flowering, number of internodes per plant, days to first harvest, days to first flower open, fruit length and fruit diameter, however, showed a substantial negative (phenotypic and genotypic) correlation. Therefore, while choosing okra genotypes, primary should be given to improving these traits. The character number of fruits per plant should be considered as the best feature for enhancing fruit yield per plot.

Keywords: Character association, correlation, fruit yield, and okra

Introduction
Okra [*Abelmoschus esculentus* (L) Moench] is an annual herbaceous plant and belongs to the family Malvaceae under the order Malvales, having a somatic chromosome number 2n=130 and is considered to be an amphidiploid. Okra originated in the Hindustani centre of origin, chiefly India, Pakistan and Burma (Zeven and Zhukovsky, 1975) [13]. Okra is also known as the "Queen of Vegetables". Okra is known by many local names in a different part of the world. For example, commonly known as Bhindi in India, lady's finger in England, gumbo in the United States of America. Its fruits have high nutritive, medicinal and industrial value and export potential, its fruits reach in vitamins, calcium, potassium and other mineral matter. Crude fiber is present in mature pods and stems which is utilized by the paper industry. It is rich in iodine and other nutrients (Benchasri, 2012) [2]. The green tender fruits of okra are a good source of carbohydrates, protein, vitamins (A, B and C) and are rich in calcium, potassium and other mineral matters.
Knowledge of genetic diversity and relationships among okra germplasm may play a significant role in breeding programmes to the desired genotype for our trait of interest. Characterization and quantification of genetic diversity have long been a major goal in evolutionary biology and various genetic improvement programs. Information on the genetic diversity within and among closely related crop varieties is essential for rational use of plant genetic resources. The correlation coefficient is a statistical method which finds the degree and direction of relationship between two or more variable. Thus, correlation measures the magnitude of relationship between various characters that determines the components characters on which selection can be made for improvement in yield. It gives the mutual relationship of two or more variables. Therefore, correlation study was undertaken in 26 genotypes to find out inter relation of different yield components at genotypic and phenotypic levels.

Materials and Methods
The present research was conducted to estimate the correlation between characters and to identify major traits which correlated with yield. The experimental material comprising of 26 genotypes were evaluated at Custard Apple Research Station, Ambajogai. during *kharif*-2021. The material was sown in randomized block design with two replications.
Observations were recorded for fourteen characters *viz*., days to 50% flowering, first fruiting node, number of internodes per plant, plant height, days to first harvest, harvest duration, leaf area, days to first flower open, fruit length, fruit diameter, fruit weight, number of fruits per

plant, fruit yield per plot and fruit yield per hectare. The mean values of five randomly selected observational plants for fourteen different traits were used for statistical analysis. The mean data were subjected to analysis of variance technique based on model proposed by Panse and Sukhatme (1978) [7]. Genotypic, phenotypic and environmental correlation coefficients, between pairs of characters were computed by the procedure of Falconer (1964) [4]. For this purpose, the data was subjected to covariance analysis.

Result and Discussion

Analysis of variance of the result indicated highly significant differences among the genotype for all the characters studied, which revealed the existence of sufficient variations in all the characters for effective selection in the material under study.

The character days to 50% flowering recorded positive significant association with the traits first fruiting node, plant height, days to first harvest, days to first flower open, fruit length, fruit diameter at both genotypic and phenotypic level and positive non-significant association with number of internodes per plant at phenotypic level and positive significant with genotypic level. Whereas it showed negative and significant association with harvest duration, fruit weight, number of fruits per plant, fruit yield per hectare. However, positive non-significant association fruit yield per plot at both genotypic and phenotypic level. Similar results were obtained by Prasath *et al*. (2017) [8] and Rana *et al.* (2020) [9]. The character First fruiting node was significantly and positively correlated with plant height, days to 50% flowering, leaf area at both genotypic phenotypic levels. It showed positive non-significant association with number of internodes per plant, days to first harvest and harvest duration at both the levels. It exhibited negative and non-significant association with days to first flower open, fruit diameter, number of fruits per plant, fruit yield per plot, fruit yield per hectare at both the levels. Also, negatively significant association with fruit length. The trait fruit weight had positive non-significant at genotypic level, but it had negative non- significant correlation at phenotypic level. Similar results were found by Tudu *et al*. (2021) [12].

Number of internodes per plant had significant positive association with plant height and days to first flower open at both genotypic and phenotypic levels. Whereas, days to first harvest, leaf area, first fruiting node, fruit length, fruit diameter had positive non-significant association at both the levels. However, non-significant negative association with fruit weight, number of fruits per plant and fruit yield per plot. The trait harvest duration had positive non-significant association at genotypic level, but it had negative non-significant correlation at phenotypic level. The trait days to 50% flowering had positively significant correlated at genotypic level but positively non-significant at phenotypic level. These results were in coincidence with Alam *et al*. (2020) [1]. The character plant height showed positive significant association with days to 50% flowering, first fruiting node, number of internodes per plant and days to first harvest at both genotypic and phenotypic level. However, positively non-significant association with leaf area, days to first flower open, at both genotypic and phenotypic level. While negatively non-significant association with harvest duration, fruit length, fruit diameter, number of fruits per plant, fruit yield per plot and fruit yield per hectare. The trait fruit weight had positively non-significant at phenotypic level, but it had negatively significant correlation at genotypic level. These results were in coincidence with Alam *et al*. (2020) [1], Rana *et al*. (2020) [9], Kumar *et al*. (2019) [5] and Raval *et al*. (2019) [10]. Days to first harvest had significant positive association with days to 50% flowering, plant height, fruit length and fruit diameter at both genotypic and phenotypic level. Also, positively non-significant with days to first flower open, first fruiting node, number of internodes per plant and fruit yield per plot. Whereas negative and significant association with harvest duration, leaf area, number of fruits per plant and fruit yield per hectare, at both the levels. While negatively non-significant association with fruit weight at both the levels. Similar results with Narkhede *et al*. (2015) [6] and Raval *et al*. (2019) [10]. The character harvest duration showed positive significant association with leaf area, number of fruits per plant and fruit yield per hectare at both the genotypic and phenotypic levels. Also, positively non-significant with first fruiting node. While the traits negatively significant with days to 50% flowering, days to first harvest. While the traits days to first flower open, fruit length, fruit diameter, plant height and fruit yield per plot had negative non-significant association at both levels. The trait fruit weight and first had positively significant association at phenotypic level but positively non-significant association with genotypic level. The trait number of internode per plant had negatively non-significant at phenotypic level but positively non-significant at genotypic level. These results were in acceptance with Prasath *et al*. (2017) [8] and Simon *et al*. (2013) [11].

The character leaf area was significantly and positively correlated with fruit yield per hectare, first fruiting node and harvest duration at both genotypic and phenotypic levels. Also, positively non-significant with number of fruits per plant, plant height and number of internodes per plant at both the levels. While the trait days to first flower open, fruit length, days to first harvest, fruit diameter and fruit yield per plot had negatively significant at both genotypic and phenotypic levels. The trait days to 50% flowering were negatively non-significant at both genotypic and phenotypic levels. The trait fruit weight is positively non-significant at phenotypic level but negatively non-significant at genotypic level. Similar results found with Simon *et al*. (2013) [11]. Days to first flower open was significantly and positively correlated with fruit length, days to 50% flowering, fruit diameter and fruit weight at both genotypic and phenotypic levels. Also, positively non-significant with fruit yield per plot, plant height and days to first harvest, number of internodes per plant at both levels. However, number of fruits per plant, leaf area, harvest duration and fruit yield per hectare had negatively significant at both levels. The trait first fruiting node had negatively non-significant at both the levels. Similar results found with Simon *et al*. (2013) [11].

The character Length of fruit was significantly positive with fruit diameter, days to 50% flowering, days to first harvest and days to first flower open at both genotypic and phenotypic levels. Also, positively non- significant with fruit yield per plot and number of internodes per plant at both the levels. While, negatively significant with number of fruits per plant, fruit yield per hectare, harvest duration, leaf area and first fruiting node at both levels. The trait fruit weight is positively significant at genotypic level but negatively non-significant at phenotypic level. Similar results with Narkhede *et al*. (2015) [6] and Rana *et al*. (2020) [9]. The character Fruit

diameter was significantly and positively correlated with days to 50% flowering, days to first harvest, days to first flower open, fruit yield per plot, fruit length at both genotypic and phenotypic levels. While negatively significant with harvest duration, leaf area, number of fruits per plant and fruit yield per at both the levels. The trait fruit weight is positively significant at genotypic level but negatively significant at phenotypic level. Also, the trait TSS is negatively significant at genotypic level and negatively non-significant at phenotypic level. However, the trait number of internodes per plant had positively non-significant at both phenotypic and phenotypic level. While trait plant height and first fruiting node had negatively non-significant at both levels. These results were in acceptance with Biswas *et al*. (2018) [3] and Prasath *et al*. (2017) [8].

The character fruit weight had positively significant association with days to first flower open, number of fruits per plant and fruit yield per plot at both the genotypic and phenotypic levels. Also, positively non-significant with fruit yield per hectare and harvest duration at both the levels. The trait days to 50% flowering had negatively significant at both the levels. While the trait number of internodes per plant and days to first harvest had negatively non-significant at both the levels. The trait first fruiting node was negatively non-significant at phenotypic level but positively non-significant at the genotypic level. While the trait leaf area had positively non-significant at phenotypic level but negatively non-significant at genotypic level. Also, the trait fruit length showed the negatively non-significant at phenotypic level but positively significant at genotypic level. The trait plant height showed negatively at genotypic level but positively non-significant at phenotypic level. The trait fruit diameter had positively significant at genotypic level but negatively significant at phenotypic level. Similar results with Narkhede *et al*. (2015) [6] and Rana *et al*. (2020) [9].

Number of fruits per plant was significantly and positively correlated with harvest duration, fruit weight and fruit yield per hectare at both genotypic and phenotypic levels. Also, the trait days to 50% flowering, days to first harvest, days to first flower open, fruit length and fruit diameter, fruit yield per plant had negatively significant at both the levels. While the trait first fruiting node, number of internodes per plant plant height had negatively non-significant at both levels. positively non-significant with leaf area at both levels. These results were in harmony with Simon *et al*. (2013) [11]. The character fruit yield per plot had positively significant with fruit weight, fruit diameter and fruit yield per hectare at both genotypic and phenotypic levels. While, the trait plant height, harvest duration, leaf area and number of fruits per plant had negatively significant at both the levels. The traits first fruiting node and number of internodes per plant had negatively non-significant at both the levels. Whereas, the traits days to 50% flowering, days to first harvest and days to first flower open and fruit length had positively non-significant at both levels. These results were in acceptance with Tudu *et al*. (2021) [12]. Fruit yield per hectare was significantly and positively correlated with harvest duration, leaf area, number of fruits per plant and fruit yield per plot at both levels. While the traits days to 50% flowering, number of internodes per plant, days to first harvest, days to first flower open, fruit length and fruit diameter had negatively significant at both levels. Also, the trait first fruiting node, plant height had negatively non-significant at both levels. while the trait fruit weight had positively non-significant at both levels. These results were in acceptance with Alam *et al*. (2020) [1] and Tudu *et al*. (2021) [12].

Table 1: Phenotypic and Genotypic coefficient of correlation among different traits in okra.

Traits		DTFPF	FFN	NIPP	PH	DTFH	HD	LA	DTFFO	FL	FD	FW	NFPP	FYPP	FYPH
DTFPF	P	1.00	0.347**	0.269	0.487**	0.828**	-0.685**	-0.113	0.807**	0.357**	0.413**	-0.289*	-0.730**	0.101	-0.655**
	G	1.00	0.366**	0.288*	0.493**	0.842**	-0.693**	-0.112	0.817**	0.367**	0.426**	-0.413**	-0.740**	0.099	-0.699**
FFN	P		1.000	0.081	0.691**	0.246	0.084	0.369**	-0.065	-0.276*	-0.232	-0.085	-0.144	-0.132	-0.103
	G		1.000	0.074	0.725**	0.248	0.078	0.377**	-0.072	-0.313*	-0.226	0.121	-0.122	-0.124	-0.095
NIPP	P			1.000	0.623**	0.194	-0.001	0.113	0.298*	0.054	0.050	-0.238	-0.218	-0.242	-0.321*
	G			1.000	0.658**	0.193	0.006	0.108	0.313*	0.051	0.087	-0.260	-0.218	-0.270	-0.342*
PH	P				1.000	0.379**	-0.017	0.140	0.238	-0.093	-0.013	0.244	-0.167	-0.300*	-0.236
	G				1.000	0.381**	-0.016	0.136	0.243	-0.093	-0.005	-0.305*	-0.169	-0.310*	-0.257
DTFH	P					1.000	-0.820**	-0.307*	0.870	0.583**	0.592**	-0.129	-0.689**	0.151	-0.706**
	G					1.000	-0.840**	-0.319*	0.884	0.597**	0.640**	-0.157	-0.702**	0.160	-0.749**
HD	P						1.000	0.494**	-0.808**	-0.740**	-0.696**	0.185**	0.701**	-0.329*	0.718**
	G						1.000	0.502**	-0.821**	-0.763**	-0.730**	0.233	0.720**	-0.333*	0.775**
LA	P							1.000	-0.436**	-0.787**	-0.821**	0.009	0.116	-0.314*	0.351*
	G							1.000	-0.443**	-0.811**	-0.842**	-0.003	0.122	-0.314*	0.390**
DTFFO	P								1.000	0.646**	0.686**	0.176**	-0.714**	0.211	-0.775**
	G								1.000	0.660**	0.719**	0.253**	-0.724**	0.223	-0.809**
FL	P									1.000	0.918**	-0.078	-0.490**	0.223	-0.653**
	G									1.000	0.959**	0.163**	-0.495**	0.234	-0.717**
FD	P										1.000	-0.061*	-0.484**	0.348*	-0.606**
	G										1.000	0.164*	-0.517**	0.378**	-0.718**
FW	P											1.000	0.084**	0.176*	0.104
	G											1.000	0.095**	0.251**	0.243
NFPP	P												1.000	-0.291*	0.757**
	G												1.000	-0.306*	0.808**
FYPP	P													1.000	0.226*
	G													1.000	0.255*
FYPH	P														1.000
	G														1.000

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

Where, DTFPF=Days to 50% flowering, FFN=First fruiting node, NIPP= No. of internodes per plant, PH=Plant height, DTFH= Days to first harvest, HD=Harvest duration, LA= Leaf area, DTFFO= Days to first flower open, FL= Fruit length, FD= Fruit diameter, FW= Fruit weight, NFPP= Number of fruits per plant, FYPP= Fruit yield per plot, FYPH= Fruit yield per hectare.

Conclusion

A highly significant positive (genotypic and phenotypic) correlation of yield was found with number of fruits per plant, fruit weight, leaf area and harvest duration, Whereas, significant negative (genotypic and phenotypic) correlation was found with the traits days to 50% flowering, number of internodes per plant, days to first harvest, days to first flower open, fruit length and fruit diameter. Therefore, main emphasis on improvement of these characters should be given, While making the selection in okra genotypes. The trait number of fruit per plant should be considered as the best character for improving fruit yield per plot because of its nearly equal values of direct effects and correlations with fruit yield per hectare.

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