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Correlation coefficient analysis in okra

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Abstract
Plant height was recorded positive and significant correlation with length of internode (0.2871), days to 50% flowering (0.1882), fresh fruit weight (0.3387). A high significant and negative association of this trait was observed with length of internode (-0.1673), first fruiting node (-0.3138), days to first fruit length (-0.1665). Length of internode was recorded positive and significant correlation with days to 50% flowering (0.4420), days to first picking (0.1753) and highly significant to fresh weight (0.5021). Days to 50% flowering expressed a significant and positive association with first fruiting node (0.2019), days to first flowering (0.2132), days to first picking (0.3118), fruit length (0.1943) and fresh fruit weight (0.2525). Days to first flowering was recorded highly significant and positively correlated with days to first picking (0.2854**). Days to first picking was recorded highly significant and positively correlated with number of fruit per plant (0.3274**). Length of fruit was observed highly significant and positive correlation coefficient with fresh fruit weight (0.3107). Fresh fruit weight was observed positive correlation with yield per plant (0.5633). Number of fruits per plant was observed positive correlation with fresh fruit weight (0.0393).

Keywords: Okra, correlation, significant, positive, negative, association

1. Introduction
Okra (*Abelmoschus esculentus* L.) is one of the highly nutritious vegetable, usually eaten while the pod is green, tender and immature botanically this perennial plant belongs to the Malvaceae family. The plant is cultivated throughout the tropical and warm temperature region around the world for its fibrous fruits or pods. Fruits of okra contain a mucilaginous substance that thickens the soup and stews. According to Gopalan *et al*. (2007) [5] it has good nutritional value, particularly the high content of vitamin C (13.10mg/100g), calcium (66mg/100g), iron (35mg/100g), magnesium (53g/100g), potassium (103g/100g) and carbohydrates (6.4g/100g) and is said to be very useful against genito-urinary disorders. Mucilage from the stem and roots of okra is used for clarifying sugarcane juice in jaggery production. Fully ripened fruits and stem containing crude fibre which is used in the paper industry. India leading first in world and it is grown throughout the country in almost all states covering an area about 0.53 million ha area and producing 6.35 million tonnes with productivity of 12.0 t ha^{-1}. In India, among fresh vegetables, 60 per cent share of export goes to okra (Anonymous 2014-15). West Bengal is a leading okra producing state (14%), followed by Bihar (12%), Gujarat (12%), Andhra Pradesh (10%), Odisha (9%), Jharkhand (7%), Chhattisgarh (7%), Telangana (6%), Madhya Pradesh (5%), Maharashtra (4%), Haryana (3%), Assam (3%), Uttar Pradesh (2%), and others (6%) (Anonymous, 2014- 15) [2].
It is often cross pollinated crop and thus heterosis can be exploited in it. Breeding method for the improvement of a crop depends primarily on the nature and magnitude of gene action involved in the expression of quantitative and qualitative traits. Combining ability analysis helps in the identification of parents with high general combining ability (GCA) effects and cross combinations with high specific combining ability (SCA) effects. Additive and non-additive gene actions in the parents estimated through combining ability analysis may be useful in determining the possibility for commercial exploitation of heterosis and isolation of purelines among the progenies of the heterotic F_1. Good nutritive value popularity, medicinal value and high export potential are the aspects in favour of okra. However, pest such as the jassids, bollworm and diseases like yellow vein mosaic, powdery mildew etc. pose problems in okra cultivation by reducing the quality of produce and increasing the cost of cultivation. Yellow vein mosaic, a viral disease is a serious challenge in cultivation of okra. Some good varieties are developed in India in okra, but many of them suffer from one or other drawback.

Crop improvement in okra needs to focus on plant height, higher yield, early flowering, more branching, fruit length and tenderness, number of fruits, disease and pest resistance also.
Hence exploitation of hybrid vigour, understanding genetics of pest and disease resistance and improvements in quality aspects with eye on quality aspects and export potential need to be concerned upon in okra improvement programmes. Exploitation of hybrid vigour in okra has been recognized as a practical tool for increasing the yield. The knowledge of traits relationship in okra is very important to exploit the potentiality to develop heterosis. There is a need to generate more information on correlation of one trait with others. Hence, present investigation was carried out to estimate the correlation coefficient between yield and its component in okra.

2. Material and Methods

The experiment was conducted at Horticulture complex, Department of Horticulture, J.N.K.V.V. Jabalpur (M.P.) during *Kharif*–2016, *summer*-2017and *Kharif*-2017. Jabalpur is situated in "Kymore plateau and Satpura Hills" agro-climatic region of Madhya Pradesh. It falls on 23.9° North latitude and 79.58° East longitudes with an altitude of 411.8 meters above mean sea level. The tropic of cancer passes through the middle of the district. Jabalpur is situated in the semi-arid region having sub-tropical climate with cool winter and hot dry summer. The fourteen diverse genotypes of okra selected on the basis of genetic variability.
Following are parental lines and tester

S. No.	Lines	S. no.	Testers
1.	JO-11	1.	Phule Utkarsha
2.	JO-4	2.	JO-15
3.	JO-9	3.	JO-14
4.	JO-7	4.	JO-12
5.	JO-3		
6.	JO-10		
7.	JO-6		
8.	JO-8		
9.	JO-13		
10.	Deepika		

3. Result and Discussion

3.1 Correlation coefficient analysis

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. Investigation regarding the presence of component and nature of association among themselves is essential and pre-requisite for improvement in yield. Coefficient of correlation provides a clear picture of the extent of association between a pair of traits and indicates whether simultaneous improvement of the correlated traits may be possible or not. The knowledge of genetic association between yield and its component characters help in improving the efficiency of selection for yield by making proper choice and balancing one component with another.The magnitude of genotypic correlation was higher than the phenotypic correlation for all the traits that indicated inherent association between various characters. The findings were in agreement to Niranjan and Mishra (2003) [13], Kumar *et al*. (2009) [7], Senapathi *et al*. (2011) [15] and Saryam *et al*. (2015) [14]

3.2 Plant height

Plant height was recorded positive and significant correlation with length of internode (0.2871), days to 50% flowering (0.1882), fresh fruit weight (0.3387). Plant height was recorded positive and significant correlation with length of internode, days to 50% flowering, fresh fruit weight. These results are in corroborated with the findings of Shazia Ali *et al*. (2008) [1], Kunodia *et al*. (2013) [9] and Saryam *et al*. (2015) [14] for length of internodes.

3.3 Number of branches per plant

A high significant and negative association of this trait was observed with length of internode (-0.1673), first fruiting node (-0.3138), days to first fruit length (-0.1665). A high significant and negative association of this trait was observed with length of internode, first fruiting node, days to first fruit length. These results are in close harmony with the findings of Saryam *et al*. (2015) [14] for length of internodes and fruit width and Sharma and Prasad (2015) [16] for length of internodes and fruit width and Sharma and Prasad (2015) [16] for fruit width.

3.4 Length of internode

Length of internode was recorded positive and significant correlation with days to 50% flowering (0.4420), days to first picking (0.1753) and highly significant to fresh weight (0.5021). Length of internode was recorded positive and significant correlation with days to 50% flowering, days to first picking and highly significant to fresh weight. It is closely similar to Verma *et al*. (2007) [17].

3.5 Days to 50% flowering

Days to 50% flowering expressed a significant and positive association with first fruiting node (0.2019), days to first flowering (0.2132), days to first picking (0.3118), fruit length (0.1943) and fresh fruit weight (0.2525). Days to 50% flowering expressed a significant and positive association with first fruiting node, days to first flowering, days to first picking, fruit length and fresh fruit weight. These results are in close harmony with the findings of Mishra *et al*. (2015) [11] for days to first picking and Mehta *et al*. (2006) [10] for fruiting span.

3.6 First fruiting node

First fruiting node was observed significant and positive correlation coefficient with fruit length (0.1915). First fruiting node was observed significant and positive correlation coefficient with fruit length. These results are in close harmony with the finding of Mishra *et al*. (2015) [11], for days to first flowering and days to 50% flowering and Saryam *et al*. (2015) [14] for fruit width.

3.7 Days to first flowering

Days to first flowering was recorded highly significant and positively correlated with days to first picking (0.2854**). Days to first flowering was recorded highly significant and positively correlated with days to first picking. These results are in close harmony with the findings of Kumar *et al.* (2011) [8] for fruit length.

3.8 Days to first picking
Days to first picking was recorded highly significant and positively correlated with number of fruit per plant (0.3274**). Days to first picking was recorded highly significant and positively correlated with number of fruit per plant.

3.9 Fruit length
Length of fruit was observed highly significant and positive correlation coefficient with fresh fruit weight (0.3107). Length of fruit was observed highly significant and positive correlation coefficient with fresh fruit weight. These results are in close harmony with the findings of Saryam *et al*. (2015) [14] for number of fruits per plant and Ghosh (2005) [4] for fruit yield per plant.

3.10 Fresh fruit weight
Fresh fruit weight was observed positive correlation with yield per plant (0.5633). Fresh fruit weight was non-significant correlation among yield per plant. These results are in close harmony with the findings of Niranjan and Mishra (2003) [13], Bendale *et al*. (2003) [3], Kumar *et al*. (2011) [8].

3.11 Number of fruit per plant
Number of fruits per plant was observed positive correlation with fresh fruit weight (0.0393). Number of fruit per plant observed significant correlation among fresh fruit weight. These results are in close harmony with the findings of Mishra *et al* (2015) [11].

3.12 Fruit yield per plant and its components
Correlation coefficient of fruit yield per plant was expressed significant and positive with plant height (0.1350), length of internode (0.6475), days to 50% flowering (0.2809), first fruiting node (0.4222), days to first picking (0.0835), fruit length (0.2732), fresh fruit weight (0.5633).Whereas, association of this trait was recorded significant and negative with number of branches per plant (-0.1847), days to first flowering (-0.0788), number of fruits per plant (-0.0585). Correlation coefficient of fruit yield per plant was expressed significant and positive with plant height, length of internode, days to 50% flowering, first fruiting node, days to first picking, fruit length, fresh fruit weight. Whereas, association of this trait was recorded significant and negative with number of branches per plant, days to first flowering, number of fruits per plant. These results are in close harmony with the findings of Ghosh *et al*. (2002) [4], Nimbalkar *et al*. (2002) [12], Niranjan and Mishra (2003) [13], Jaiprakas Narayan and Mugle (2004) [6], Ghosh (2005) [4], Verma *et al*. (20015) [17] and Saryam *et al*. (2015) [14] for number of fruits per plant.

Table 1: Estimates of phenotypic and genotypic correlation coefficient of fruit yield plant with its contributing traits in okra (Pooled)

Characters		Number of branches per plant	Length of internode (cm)	Days to 50% flowering	First fruiting node	Days to first flowering	Days to first picking	Fruit length (cm)	Number of fruits per plant	Fresh fruit weight(g)	Yield per plant
Plant height (cm)	P	0.0597	0.2871 **	0.1882 *	0.0151	0.0887	0.0036	0.0897	0.0522	0.3387**	0.1350*
	G	0.0891	0.4587	0.3048	0.0247	0.2044	-0.0804	0.1435	0.0730	0.5317	0.2267
Number of branches per plant	P		-0.1673*	-0.1228	-0.3138*	-0.2186*	-0.3368**	-0.1665*	-0.1039	-0.1263	-0.1847
	G		-0.1887	-0.1518	-0.3518	-0.3976	0.3934	-0.3031	-0.1143	-0.1391	-0.1948
Length of internode (cm	P			0.4420*	0.0628	0.1093	01688*	0.1753*	-0.1104	0.5021**	0.6475**
	G			0.4546	0.0618	0.1396	0.1715	0.2921	-0.1094	0.5211	0.6563
Days to 50% flowering	P				0.2019*	0.2132	0.3118**	0.1943*	0.0012	0.2525*	0.2809**
	G				0.2067	0.02658	0.3123	0.2783	0.001	0.2626	0.2944
First fruiting node	P					0.1420	0.1053	0.1915*	-0.1139	0.1708	0.4222**
	G					0.1724	0.1055	0.3149	-0.1120	0.1757	0.4263
Days to first flowering	P						0.2854**	-0.0529	0.0876	-0.0524	-0.0788
	G						0.3682	0.0639	0.1319	-0.0669	-0.0762
Days to first picking	P							0.0083	0.3274**	0.0154	0.0835*
	G							-0.0080	0.3351	0.0186	0.0908
Fruit length (cm	P								0.0897	0.3107**	0.2732**
	G								0.1611	0.5539	0.4784
Number of fruits per plant	P									0.0393	-0.0585
	G									0.0363	-0.0585
Fresh fruit weight(g	P										0.5633**
	G										0.5837

**Significant at 1%, *Significant at 5%

4. Conclusion
On the basis of pooled analysis, correlation coefficient of fruit yield per plant was expressed significant and positive with plant height, length of internode, days to 50% flowering, first fruiting node, days to first picking, fruit length, fresh fruit weight. However, association of this trait was recorded significant and negative with number of branches per plant, days to first flowering, number of fruits per plant which indicated that effective improvement in yield through these components could be achieved**.**

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