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Correlation and Path analysis studies in okra (*Abelmoschus esculentus* L. Moench)

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Abstract

Correlation and path analysis utilizing 40 genotypes of okra was carried out during summer season 2015 and findings revealed that plant height exhibited positive and significant correlation with most of yield and yield contributing characters which indicated that these traits might be improved through direct selection. The path analysis study indicates that number of fruits/plant, number of branches per plant, number of nodes/plant exhibited maximum direct effect on yield per plant. It suggests that these attributes have strong influence on fruit yield. Hence, plant height, number of branches/plant, number of nodes/plant is the determiners of fruit yield/plant and require more attention in okra improvement programme while selecting okra genotypes.

Keywords: Correlation, path analysis, okra, genotypes

Introduction

Abelmoschus esculentus L. (Moench.) commonly known as okra, is believed to be native to tropical Africa. It is an important vegetable crop throughout the tropic and subtropics. Owing to its floral structure and absence of self in compatibility, okra produces much of its progeny through self-pollination. However, cross pollination to some extend is frequently mentioned in the literature. Progress in crop production depends to a great extent on the ability of the breeders to select high yielding varieties. Considerable effort is currently being made in number of okra breeding programmes to improve various quantitative traits such as seed yield, number of pods per plant, pod length and pod width. These traits are particularly important in the breeding of okra. The Vegetative traits are also measures of yield and should be considered, just as pod characteristics, during selection in breeding programme to improve yield (Ariyo 1992). Number of pods per plant, days to flowering and plant height are some of most variable quantitative characters of okra (Singh and Singh 1977). Variation is a necessary condition for selection programme aimed at improving yield and its contributing traits.

Correlation measures the mutual association between two variables while path coefficient analysis identifies the causes and measures the relative importance of the association. Correlation coefficient measures the mutual association between a pairs of variables independent of other variables to be considered. Therefore, when more than two variables are improved, the correlation *per se* does not give the complete picture of their interrelationship (Fakorde and Opeke 1985). To evaluate relationship, correlation analysis is used such that the values of two characters are analyzed on a paired basis, results of which may be either positive or negative. The results of correlation are of great value in the determination of the most effective procedure for selection of superior genotypes. When there is positive association of major effective but when these characters are negatively associated, it would be difficult to exercise simultaneous selection for them in developing a variety.

Multiple regression and path coefficient analysis are particularly useful for the study of cause and effect relationship because they are simultaneously considered several variables in the data set to obtain the coefficients (Fakorede and Opeke 1985). The establishment of positive or negative relationship does not lead to a direct cause and effect interpretation, but a path analysis measures a direct influence of one variable upon another and permits the separation of the correlation into components of direct and indirect effects. Waldia *et al.* (1979) observed in their study that path analysis may or may not give results identical to correlation studies and in case of disparities, reliance must be placed on path analysis because it provides better understanding of the cause and effect relationship between pairs of characters. Therefore, the aim of this work to investigate

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interrelationship of yield attributes with view to identifying the traits that contribute significantly to the yield in okra.

Materials and Methods

The experimental material comprised of forty genotypes of okra. All genotypes were sown at spacing 30x15 cm in randomized block design with three replication at All India coordinated Research project on vegetable crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra state during summer 2015. All the cultural practices and plant protection measures were adopted as per recommended practices for better crop establishment. The observations were recorded on five randomly selected plants of each genotypes in all the replications on thirteen important characters like plant height, days to 50% flowering, number of nodes/plant, number of lobes/leaf, number of branches/plant, number of ridges/fruit, internodal length, node at which first flower appear, length of fruit, diameter of fruit, average weight of fruit, number of fruits/plant and yield/plant. The data collected were subjected to standard analysis of variance as per method suggested by Panse and Sukhatme (1985). Genotypic correlation coefficients of the quantitative traits were estimated according to the method suggested by Aljibouri *et al* (1985) and phenotypic correlation coefficients according to the method of Steel and Torrie (1960). Path coefficient analysis was carried out using the method of Wright (1921) as modified by Dewey and Lu (1959).

Results and Discussion

Mean squares of different characters studied are presented in Table 1 revealed significant differences among the genotypes used in present investigation for the characters like plant height, days to 50% flowering, number of nodes/plant, length of fruit, number of fruits/ plant, fruit yield/plant, yield per plot and per hectare. The significant differences revealed by the above listed attributes of yield may be due to environmental influences on the parental genetic constitution. The non-significant differences observed in number of lobes/leaf, number of branches/plant number of ridges per fruit, node at which first flower appear, diameter of fruit and average weight of fruit indicate that the genetic components of the parental material are intact. Similar findings are reported by Singh and Singh (1977) and Akinyele and Osekita (2006). The mutual association of characters is often expressed by phenotypic and genotypic correlations.

The plant height exhibited positive significant genotypic and phenotypic correlation with number of nodes/plant, internodal length; length of fruit and number of fruits/ plant. This mean performance of okra plant in terms of fruit yield and should be selected for as component of yield. The negative significant association of plant height with days to 50% flowering, number of branches /plant and diameter of fruit indicate that the performance of crop plant in terms of final yield will be reduced because considerable height at flowering favors production of more fruits than shorter heights. The association of days to 50% flowering with number of branches/plant and diameter of fruit showed that there is strong relationship between days to 50% flowering and number of branches/plant and diameter of fruit and hence indicative of strong relationship between these traits. The negative but highly signify cant correlation of days to 50% flowering with internodal length, and length of fruit sows that varieties with shorter days to flowering tend to produce more yield having considerable fruit length and internodal length. The number of nodes per plant showed significant positive correlation with number of fruits /plant shows that as node increases

Table 1: Analysis of variance (ANOVA) for different characters in okra

Sr. No.	Characters	Mean sum of squares		
		Replications (2)	Treatments (39)	Error (78)
1	Plant height (cm)	12.10	15865.85**	1543.15
2	Days to 50 % flowering	7.20	544.95**	77.80
3	Number of nodes/plant	1.06	581.79**	117.42
4	Number of lobes/leaf	0.05	39.55	5.95
5	Number of branches/plant	0.39	33.23	5.25
6	Number of ridges / fruit	0.0005	18.76	1.94
7	Internodal length (cm)	0.17	50.80	9.26
8	Node at which 1St flower appear	0.80	4.44	2.16
9	Length of the fruit (cm)	0.15	114.01**	22.33
10	Diameter of fruit (cm)	0.0002	0.07	0.004
11	Average weight of fruit (g)	1.01	81.84	15.21
12	Number of fruits /plant	1.04	807.05**	171.07
13	Fruit yield / plant (g)	1.01	63854.19**	14132.49

Figures inscribed in parentheses indicate degree of freedom.

the number of fruit increase and final yield of fruits per plant. The significant and positive correlation of number of branches per plant with diameter of fruit and number of fruits/plant indicate that more the branches per plant, more the fruits/plant and this will simultaneously increase fruit yield.

The internodal length was negatively significant correlation with number of fruit/plant indicates lesser the internodal length decreases number of fruits per plant

Table 2: Estimates of Genotypic (G) and Phenotypic (P) correlation of 13 characters in okra

Sr. No	Characters		Plant heigh (cm)	Days to 50 % flowering	Number of nodes/ plan	Number of lobes / leaf	Number of branches/ plant	Number of ridges /frui	Internodal length (cm)	Node at which 1St flower appear	Length of fruit (cm)	Diameter o fruit (cm)	Average weight of fruit (g)	Number of fruits /plant	Fruit yield / plant (g)
1	Plant height (cm)	G	1.0	-0.4950**	0.3833**	0.3392	-0.4892**	-0.3163**	0.7710**	0.0390	0.4612**	-0.4696**	0.0419	0.2585*	0.2187
		P	1.0	-0.3876***	0.3523 **	0.2173	-0.3598**	-0.2935 **	0.7138 ***	0.0885	0.4503***	-0.3728***	0.0311	0.2841*	0.2887
2	Days to 50 % flowering	G		1.0	-0.0114	-0.6126**	0.6198**	0.3213**	-0.4961**	-0.2359	-0.7077**	0.8592**	0.1751	-0.0066	0.0965
		P		1.0	-0.0207	-0.3918***	0.4838***	0.27098*	-0.3355 **	-0.0296	-0.5683***	0.7154***	0.0834	0.0073	0.0422
3	Number of nodes /plant	G			1.0	-0.3949**	0.0948	0.0739	-0.2916**	0.0922	-0.3955	-0.0134	-0.2802	0.9703**	0.8504*
		P			1.0	-0.3150**	0.1263	0.0156	-0.3674***	0.1025	-0.1952	0.0044	-0.2162	0.9144 ***	0.8207
4	Number of lobes/leaf	G				1.0	-0.4696*	-0.5128**	0.5518**	0.1257	0.5954**	-0.4430**	-0.0530	-0.4559**	-0.5072
		P				1.0	-0.2648 *	-0.3324**	0.3818***	0.0635	0.3812***	-0.3538**	-0.0084	-0.3706***	-0.4072
5	Number of branches/ plant	G					1.0	0.4518**	-0.5224**	-0.0501	-0.8135**	0.7194**	-0.0693	0.0484*	0.0382
		P					1.0	0.3732***	-0.4055***	0.1255	-0.5079***	0.6291***	0.0240	0.0562*	0.0725*
6	Number of ridges / fruit	G						1.0	-0.3088*	-0.3472	-0.5379**	0.3738**	0.2104	0.0664	0.1517
		P						1.0	-0.2381*	-0.1737	-0.3894* **	0.3458 **	0.2053	0.0006	0.0790
7	Internodal length (cm)	G							1.0	-0.1891	0.7186**	-0.4344**	0.2103*	-0.3965**	-0.3306
		P							1.0	0.0068	0.5595***	-0.3198**	0.2297*	-0.3884***	-0.2835
8	Node at which 1St flower appear	G								1.0	0.0318	-0.2160	-0.6450**	0.1068	-0.1634
		P								1.0	0.0719	-0.1235	-0.3062**	0.0352	-0.0796
9	Length of the fruit (cm)	G									1.0	-0.7852**	0.2083**	-0.3651*	-0.2748*
		P									1.0	-0.5337 ***	0.3115**	-0.1907*	-0.0378
10	Diameter of fruit (cm)	G										1.0	0.2684*	-0.0578	0.0483*
		P										1.0	0.2608 *	-0.0327	0.0726*
11	Average weight of fruit (g)	G											1.0	-0.2933*	0.1724*
		P											1.0	-0.2389*	0.1967*
12	Number of fruits /plant	G												1.0	0.8820**
		P												1.0	0.8907**
13	Fruit yield per plant (g)	G													0.0
		P													0.0

*, ** Denotes significance at 5% and 1% levels, respectively

Table 3: Direct and indirect effects of various yield and yield components in okra

Sr. No	Characters	Plant height (cm)	Days to 50 % flowering	Number of nodes/ plant	Number of lobes / leaf	Number of branches/ plant	Number of ridges/ fruit	Inter-nodal length (cm)	Node at which 1St flower appear	Length of fruit (cm)	Diameter of fruit (cm)	Average weight of fruit (g)	Number of fruits /plant	Correlation value of fruit yield / plant at genotypic levels
1	Plant height (cm)	0.1961	-0.0707	0.0151	0.0169	-0.0893	-0.0267	-0.2420	0.0001	0.1900	-0.0042	-0.0175	0.2462	0.2187
2	Days to 50 % flowering	-0.0971	0.1429	-0.0004	-0.0304	0.1132	0.0271	0.1557	-0.0005	-0.2916	0.0076	0.0731	-0.0063	0.0965
3	Number of nodes /plant	0.0752	-0.0016	0.0393	-0.0196	0.0173	0.0062	0.0915	0.0002	-0.1630	-0.0001	-0.1170	0.9241	0.8504
4	Number of lobes/ leaf	0.0665	-0.0875	-0.0155	0.0497	-0.0858	-0.0433	-0.1732	0.0003	0.2454	-0.0039	-0.0221	-0.4342	-0.5072
5	Number of branches/ plant	-0.0959	0.0886	0.0037	-0.0233	0.1826	0.0381	0.1640	-0.0001	-0.3352	0.0064	-0.0289	0.0461	0.0382
6	Number of ridges / fruit	-0.0620	0.0459	0.0029	-0.0255	0.0825	0.0843	0.0969	-0.0007	-0.2217	0.0033	0.0879	0.0632	0.1517
7	Internodal length (cm)	0.1512	-0.0709	-0.0115	0.0274	-0.0954	-0.0260	-0.3139	-0.0004	0.2961	-0.0038	0.0878	-0.3776	-0.3306
8	Node at which 1St flower appear	0.0077	-0.0337	0.0036	0.0062	-0.0091	-0.0293	0.0594	0.0021	0.0131	-0.0019	-0.2693	0.1017	-0.1634
9	Length of the fruit (cm)	0.0905	-0.1011	-0.0155	0.0296	-0.1485	-0.0454	-0.2256	0.0001	0.4121	-0.0070	0.0870	-0.3477	-0.2748
10	Diameter of fruit (cm)	-0.0921	0.1228	-0.0005	-0.0220	0.1314	0.0315	0.1363	-0.0004	-0.3236	0.0089	0.1121	-0.0551	0.0483
11	Average weight of fruit(g)	-0.0082	0.0250	-0.0110	-0.0026	-0.0127	0.0177	-0.0660	-0.0013	0.0858	0.0024	0.4175	-0.2794	0.1724
12	Number of fruits /plant	0.0507	-0.0009	0.0381	-0.0227	0.0088	0.0056	0.1245	0.0002	-0.1504	-0.0005	-0.1252	0.9524	0.8820

R Square = 0.9906 Residual effect = 0.0971

increases. These results are inconformity with those reported by Ariyo *et al* (1987), and Akinyele and Osekita (2006). The length of fruit have significant positive correlation with average weight of fruit indicate that length increases the average weight of fruit increases and which increase more fruit yield/plant. The fruit diameter have strong significant positive association with average weight of fruit and yield per plant showed that as diameter increase it gives more weight and ultimately final plant yield. The number of fruits per plant has strong positive correlation with yield/plant indicate this character should be improved through selection. Although some characters that exercise negative correlation with one another will be difficult to select for characterization of desirable traits, those with negative association but non-significant correlation will be disregarded in selection for crop or variety improvement (Ariyo *et al*. 1987, Henry and Krishna 1990, and Newall and Eberhart 1961).

The data presented in Table 3 revealed that among the 12 traits under path analysis study, it was observed that number of fruits/plant exhibited significant and positive correlation with yield/plant and maximum direct effect on yield per plant followed by average weight of fruit and plant height. This indicated the true association between these characters and one could rely upon these traits while selecting high yielding genotypes in okra. Similar finding were reported by Mishra and Singh (1985), and Chaukande (2010) for average weight of fruit and Saryam (2015) for number of fruits per plant and number of nodes/plant.

Likewise, number of branches/plant, number of nodes/ plant, node at which first flower appear, diameter of exhibited desirable effect on yield per plant. These traits had significant correlation with yield signifying that increase in branches, number of nodes and fruit diameter increases yield per plant. Hence, prior attention should be given to these traits in okra improvement programme as they have major influence on yield. These findings are in conformity with those obtained by Yadav (1996), Gandhi (2000) and Dhall *et al.* (2003).

सारांश

भिण्डी के 40 जीनप्ररूपों में सहसम्बन्ध एवं पथ विश्लेषण ज्ञात करने के लिए अध्ययन वर्ष 2015 (ग्रीष्म काल) में किया गया तथा परिणाम से स्पष्ट हुआ कि अधिकांश उपज एवं उपज घटकों के लिए पौध लम्बाई से धनात्मक एवं सार्थक सह सम्बन्ध है जो संकेत देता है कि इन सभी घटकों में उन्नयन सीधे चयन पद्धति से किया जा सकता है। पथ विश्लेषण से स्पष्ट हुआ कि फल/पौध, शाखाओं की संख्या पौध तथा पार्श्व गांठों की संख्या प्रति पौध के उपज पर सीधा प्रभाव प्रदर्शित किया। इससे सुझाव व संकेत मिलता है कि ये सभी गुण उपज पर अधिक प्रभाव डालते है। चूँकि पौध लम्बाई, शाखाओं की संख्या/पौध एवं पाईव गांठों की संख्या/पौध निश्चित तौर पर कुल फल उपज/पौध को सुनिश्चित करता है। अतः भिण्डी के जीनप्रारूप का चयन व उन्नयन करते समय इन गुणों पर अधिक ध्यान देने की आवश्यकता है।

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