Assessment of the Correlation and Path Analysis with Association of Growth and Yield Characteristics in Okra

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A B S T R A C T

The present investigations were conducted at Nursery area, Department of Horticulture, College of Agriculture, Indore, M.P. during kharif season of 2016. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications and eighteen genotypes were collected i.e. Shakti, Jhilmil, No. 55, Sahiba, No. 64, Harita, Saarika, Ns-801, Arya Mohini, Shaan, Hissar Unnat, Panchwati, Panchali, Swati, Lakshmi, OH-102, Shankar Ganga and Parbhani Kranti. The genotype Panchwati was recorded maximum in growth and yield characters like number of branches plant^{-1}, number of leaves plant^{-1}, fruit length (16.23 cm), fruit width (2.14cm), fruit weight (17.15 gm), number of fruit plant^{-1}(14.53), fruit yield plant^{-1} (292.17gm), fruit yield plot^{-1} (11.62 kg), and fruit yield ha^{-1} (161.28 q). The highest positive and significant correlation coefficient of fruit yield plant^{-1} was observed with number of fruits plant^{-1} and fruit length. The highest positive and significant correlation coefficient of fruit yield plant^{-1} has been noted with number of fruits plant^{-1} indicating that these characters is the primary yield determinant in okra. The yield attributing characters exhibited varying trend amongst them. Path coefficient analysis revealed that number of fruits plant^{-1} had highest positive direct effect followed by fruit weight, number of nodes to first flowering, number of branches plant^{-1} at 90 DAS (days after sowing), length of internodes, number of leaves plant^{-1} at 90 DAS, plant height at 90 DAS and fruiting span are the most important character contributing towards fruit yield and hence purposeful and balance selection based on these character would be rewarding improvement in okra. Direct selection of fruit yield plant^{-1}, days to 50% flowering, days to first flowering, fruit length and days to first picking should be avoided instead of direct selection.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the family Malvaceae having chromosome no. 2n=130 has captured a prominent position among vegetables. These studies along with the association analysis will be more useful in the estimation of inter-relationship among the growth and yield contributing components. It is essential to have detail information on the association among different yield components and their

relative contribution to yield. Association analysis of quantitative attributes would help in choosing component characters that are positively correlated.

In addition, an understanding of association between the component characters is essential to judge their rational importance. Path coefficient analysis is also very useful in formulating breeding strategy to develop elite genotypes through selection in advanced generations. Thus, the nature and magnitude of variability present in the gene pool for different characters and relationship with each other determine the success of genetic improvement of characters. Since the pattern of inheritance of quantitative characters is highly complex. Therefore the present investigation was undertaken to study the association among different components of growth and yield and their direct and indirect contribution to fruit yield in okra.

Materials and Methods

An experiment was conducted at Nursery area, Department of Horticulture, College of Agriculture, Indore, MP during Kharif season of 2016. The experiment was laid out in a Randomized Completely Block Design with three replications. The experimental material consisted of eighteen genotypes of okra. Seed of germplasm were collected from different location of India. The seeds were sown in July in field in fifty four separate plots. The plot size was kept 4.2 m x 2.5 m. Each plot consisted of thirty five plants. Correlation coefficients were calculated in all possible combinations taking all the characters into consideration at genotypic, phenotypic and environmental levels by using the formula as proposed by Miller *et al.,* (1958).The direct and indirect contribution of various independent characters on a dependent character yield were calculated through path coefficient analysis as suggested by Wright

(1921) and elaborated by Dewey and Lu (1959). The following set of simultaneous equation were formed and used for the estimation of direct and indirect effects. The analysis of variance was carried out as per methods suggested by Panse and Sukhatme (1967).

Results and Discussion

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 growth and yield characters of plant 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. Correlation coefficient 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 has been found higher than the phenotypic correlation for all the traits that indicated inherent association between various characters. The similar findings are in agreement with the finding of Niranjan and Mishra (2003), Kumar *et al.,* (2009), Senapati *et al.,* (2011), Saryam *et al.,* (2015) and Khajuria *et al.,* (2016) (Table 1 and 2).

Correlation between yield and its components

In the present findings significant positive phenotypic correlation of fruit yield plant[-1] has been observed with fruit weight, number of fruits plant[-1], number of branches plant[-1]at 90 DAS, number of leaves plant[-1]at 90 DAS, fruit width, days to first picking and days to 50% flowering. The highest positive and significant correlation coefficient of fruit yield plant[-1] has been recorded with fruit weight, number of fruits plant[-1], number of branches plant[-1] at 90 DAS, number of leaves plant[-1]at 90 DAS, fruit width, days to first picking and days to 50% flowering indicating that these characters are the primary yield determination in okra. These findings corroborated with the earlier findings of Gandhi *et al.,* (2002), Jaiprakashnarayan and Mulge (2004), Bhalekar *et al.,* (2005), Nimbalkar *et al.,* (2002), Niranjan and Mishra (2003), Ghosh (2005), Choudhary (2006) and Verma *et al.,* (2007) for fruit weight, number of fruit plant[-1], number of branches plant[-1] and fruit width. Yonas *et al.,* (2014) and Saryam *et al.,* (2015) for fruit weight, number of fruits plant[-1] and fruit width. Khajuria *et al.,* (2016) for number of fruits plant[-1].

Correlation between yield contributing characters

Plant height at 90 DAS was recorded highly significant and positive association with length of internodes. Whereas, highly significant and negative association with number of branches plant[-1] at 90 DAS. These results are in corroborated with the findings of Ali *et al.,* (2008) and Saryam *et al.,* (2015) for length of internodes. Association of number of branches plant[-1]at 90 DAS was recorded significant and positive with number of fruit plant[-1], fruit yield plant[-1], number of leaves plant[-1]at 90 DAS, fruit weight, fruit width and fruit length. These results are in close

harmony with the findings of Saryam *et al.,* (2015) for fruit length, fruit width, fruit weight and number of fruits plant[-1]and Sharma and Prasad (2015) for number of fruits plant[-1]. Association of number of leaves plant[-1]at 90 DAS was recorded significant and positive with fruit length, fruit width, fruit yield plant[-1], fruit weight and number of fruit plant[-1]. The positive correlation of number of leaves plant[-1] at 90 DAS with fruit length, fruit width, fruit yield plant[-1], fruit weight and number of fruit plant[-1] indicates that allocation and translocation of photosynthates from the source to the sink. These results are in close harmony with the findings of Nagre *et al.,* (2011) for fruit length and weight.

Association of days to first flowering was exhibited significant and positive with days taken to 50% flowering, days to first picking and number of fruits plant[-1]. These result closely similar with the finding of Sharma and Prasad (2015) for days to 50% flowering and days to first picking. Days to 50 % flowering was recorded highly significant and positive association with days to first picking, fruit length, number of fruit plant[-1] and fruit yield plant[-1]. These findings corroborated the earlier finding of Sharma and Prasad (2010) for days to first picking and Mishra *et al.,* (2015) for days to first picking. Association of days to first picking was exhibited highly significant and positive with fruit length, fruit weight, number of fruit plant[-1] and fruit yield plant[-1]. These findings corroborated the earlier finding of Sharma and Prasad (2015) for number of fruit plant[-1]. Fruit length expressed highly significant and positive correlation with fruit width, fruit weight, number of fruit plant[-1] and fruit yield plant[-1]. These findings corroborated the previously finding of Ghosh (2005) for fruit yield plant[-1], Osekita and Akinyele (2008) for fruit weight and Saryam *et al.,* (2015) for number of fruits plant[-1]and Pachiyappan and Saravannan (2016) for fruit length.

Table.1 Genotypic path coefficients showing direct and indirect effects of different characters on fruit yield per plant (g) in okra

Characters	Plant height (cm) at 90 DAS	No. of branches plant[-1] at 90 DAS	No. of leaves plant[-1] at 90 DAS	No. of nodes at 1st flowering	Length of internodes (cm)	Days to 1st flowering	Days to 50% flowering	Days to first picking	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	No. of fruit plant[-1]	"r" value Fruit yield plant[-1] (g)
Plant height (cm) at 90 DAS	**0.2485**	-0.5142	-0.0940	-0.0107	-0.0073	0.2541	-0.1270	0.0843	-0.0085	0.1272	0.0107	0.0210	-0.016
No. of branches plant[-1] at 90 DAS	-0.0933	**1.3702**	-0.3310	-0.0059	0.0009	-0.2212	0.2041	0.0179	0.1026	-0.3050	0.1463	-0.1657	0.720
No. of leaves plant[-1] at 90 DAS	0.0437	0.8489	**-0.5342**	0.0062	-0.0038	0.0222	0.1568	0.0800	0.1620	-0.3132	0.1166	-0.0843	0.501
No. of nodes at first flowering	0.0622	0.1905	0.0769	**-0.0427**	0.0006	-0.0697	-0.1856	0.1793	-0.0223	0.0337	0.0281	-0.0568	0.194
Length of internodes (cm)	0.1256	-0.0855	-0.1410	0.0018	**-0.0144**	0.0385	0.0167	-0.1594	-0.0177	0.1392	-0.0453	0.0061	-0.135
Days to 1st flowering	-0.0610	0.2926	0.0115	-0.0029	0.0005	**-1.0357**	0.7214	0.3261	0.0104	0.0946	0.0431	-0.0939	0.307
Days to 50% flowering	-0.0372	0.3300	-0.0988	0.0094	-0.0003	-0.8814	**0.8477**	0.3189	0.1026	-0.1573	0.0864	-0.0921	0.428
Days to1st picking	0.0338	0.0395	-0.0689	-0.0124	0.0037	-0.5446	0.4358	**0.6201**	0.1070	-0.0830	0.1140	-0.1039	0.541
Fruit length (cm)	-0.0098	0.6496	-0.3999	0.0044	0.0012	-0.0496	0.4020	0.3065	**0.2164**	-0.4878	0.1571	-0.1138	0.676
Fruit width (cm)	-0.0537	0.7105	-0.2845	0.0024	0.0034	0.1666	0.2267	0.0875	0.1795	**-0.5882**	0.1053	-0.0834	0.472
Fruit weight (g)	0.0126	0.9521	-0.2957	-0.0057	0.0031	-0.2119	0.3479	0.3357	0.1615	-0.2940	**0.2106**	-0.1917	1.025
No. of fruits plant[-1]	-0.0263	1.1455	-0.2272	-0.0122	0.0004	-0.4906	0.3938	0.3251	0.1243	-0.2475	0.2036	**-0.1982**	0.991

Residual effect Genotypic: 0.0229

Table.2 Phenotypic path coefficients showing direct and indirect effects of different characters on pod yield plant^{-1}(g) in okra

Characters	Plant height (cm) at 90 DAS	No. of branches plant^{-1} at 90 DAS	No. of leaves plant^{-1} at 90 DAS	No. of nodes at 1st flowering	Length of internodes (cm)	Days to 1st flowering	Days to 50% flowering	Days to first picking	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	No. of fruit plant^{-1}	"r" value Fruit yield plant^{-1} (g)
Plant height (cm) at 90 DAS	0.1024	-0.0405	-0.0076	-0.0048	-0.0268	-0.0064	-0.0008	-0.0037	-0.0006	-0.0080	0.0093	-0.0391	-0.027
No. of branches plant^{-1} at 90 DAS	-0.0295	0.1405	-0.0306	-0.0007	0.0073	0.0036	0.0013	-0.0001	0.0202	0.0179	0.2431	0.2672	0.640
No. of leaves plant^{-1} at 90 DAS	0.0122	0.0674	-0.0638	0.0030	-0.0125	-0.0003	0.0014	-0.0028	0.0313	0.0205	0.2351	0.1762	0.468
No. of nodes at first flowering	0.0224	0.0044	0.0088	-0.0218	-0.0020	0.0055	-0.0009	-0.0056	-0.0072	0.0004	0.0776	0.0665	0.148
Length of internodes (cm)	0.0464	-0.0173	-0.0135	-0.0008	-0.0591	-0.0014	-0.0003	0.0071	-0.0036	-0.0084	-0.0479	-0.0160	-0.115
Days to 1st flowering	-0.0178	0.0136	0.0005	-0.0033	0.0022	0.0370	0.0050	-0.0112	-0.0004	-0.0062	0.0891	0.1164	0.225
Days to 50% flowering	-0.0112	0.0238	-0.0115	0.0025	0.0022	0.0248	0.0075	-0.0155	0.0165	0.0068	0.0873	0.1484	0.282
Days to1st picking	0.0110	0.0005	-0.0053	-0.0036	0.0122	0.0121	0.0034	-0.0342	0.0222	0.0032	0.2367	0.1454	0.404
Fruit length (cm)	-0.0011	0.0545	-0.0384	0.0030	0.0041	-0.0003	0.0024	-0.0146	0.0520	0.0271	0.3089	0.2110	0.609
Fruit width (cm)	-0.0199	0.0610	-0.0317	-0.0002	0.0121	-0.0055	0.0012	-0.0027	0.0341	0.0413	0.2155	0.1390	0.444
Fruit weight (g)	0.0018	0.0650	-0.0285	-0.0032	0.0054	0.0063	0.0013	-0.0154	0.0306	0.0169	0.5255	0.3020	0.908
No. of fruitsplant^{-1}	-0.0099	0.0926	-0.0277	-0.0036	0.0023	0.0106	0.0028	-0.0123	0.0270	0.0142	0.3915	0.4054	0.893

Residual effect Phenotypic: 0.0535

Fruit width expressed highly significant and positive correlation with fruit weight, number of fruit plant[-1] and fruit yield plant[-1]. These results are in close agreement with the findings of Bendale *et al.,* (2003), Pawar (2005) and Choudhary (2006), Yonas *et al.,* (2014), Sreenivas *et al.,* (2015) and Saryam *et al.,* (2015) for fruit yield plant[-1] and fruit weight. Fruit weight expressed highly significant and positive correlation with number of fruit plant[-1] and fruit yield plant[-1]. These findings corroborated the earlier finding of Sharma and Prasad (2015), Saryam *et al.,* (2015), Sreenivas *et al.,* (2015) and Shivaramegowda *et al.,* (2016) for number of fruit plant[-1] and fruit yield plant[-1].The correlation coefficient of number of fruits plant[-1] was noticed to be significant and it was positively correlated with fruit yield plant[-1]. These findings corroborated the earlier finding of Nagre *et al.,* (2011), Saryam *et al.,* (2015), Sharma and Prasad (2015) and Shivaramegowda *et al.,* (2016).

Path coefficient analysis

Correlation coefficient is the indication of simple association between variables. In a biological system, however the relationship may exist in a very complex form. It is therefore, essential to study the relationship among variables in a comprehensive way. Path coefficient analysis is a powerful tool. Which enable portioning of the given relationship in its further components. In other words, it takes into account not only the relationship of components character with the dependent character, but simultaneously takes care of its relationship with other components also. Thus, it helps in understanding the casual system in a better way because it enables portioning the total correlation coefficient into direct and indirect effects of various growth and yield characters. In order to see the casual factor and so as to identify the components which are responsible for producing fruit yield plant[-1]. In general, the genotypic direct as well as indirect effects were slightly higher in magnitude as compared to corresponding phenotypic direct and indirect effects indicating that the masking effects of the environment. Path coefficient analysis of different characters contributing towards fruit yield plant[-1] showed that number of branches plant[-1] at 90 DAS had highest positive direct effect followed by days to 50% flowering, days to first picking, plant height at 90 DAS, fruit length and fruit weight. The results are in propinquity with Sarkar *et al.,* (2004), Magar *et al.,* (2009), Ramanjinappa *et al.,* (2011), Das *et al.,* (2012) and Gangashetti *et al.,* (2013). Yonas *et al.,* (2014) for fruit weight and Saryam *et al.,* (2015) for number of branches plant[-1], Kumar *et al.,* (2016) for fruit weight.

The character fruit yield plant[-1] showed that number of branches plant[-1] at 90 DAS had highest positive direct effect followed by days to 50% flowering, days to first picking, plant height at 90 DAS, fruit length and fruit weight had correlation coefficient value at par with direct effect on fruit yield plant[-1] and direct selection for these traits would result in higher breeding efficiency for improving yield. Thus, these traits might be reckoned as the most important components traits for fruit yield plant[-1]. Whereas, days to first flowering had the highest negative direct effect on fruit yield plant[-1] followed by fruit width, number of leaves plant[-1] at 90 DAS, number of fruits plant[-1], number of nodes at first flowering and length of internodes. The result are in propinquity with Sharma and Prasad (2015) and Sreenivas *et al.,* (2015) for days to first picking and Sharyam *et al.,* (2015) for number of fruits per plant. An overall observation of path coefficient analysis of fruit yield plant[-1] with its components viz., plant height at 90 DAS, number of branches plant[-1] at 90 DAS, number of leaves plant[-1] at 90 DAS, days to first flowering, days to 50%

flowering, days to first picking, fruit length, fruit weight, fruit width, number of fruits per plant, number of nodes at first flowering and length of internodes, played an important role in determining the fruit yield plant[-1,] Kumar *et al.,* (2016).

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