Biological Forum – An International Journal **14(2): 1527-1530(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Character Association Studies in Okra [*Abelmoschus esculentus* (L.) Moench] for Yield and Yield contributing Traits

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(Received 26 April 2022, Accepted 18 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Knowledge on the contribution of various traits to yield is very important for the selection programme. Correlation and path coefficient analysis were carried out to know character association among yield and yield contributing traits of okra. Forty-eight okra genotypes were evaluated in randomized complete block design with two replications in the field of Vegetable Science unit of College of Horticulture, Bagalkot during late-*rabi* season. The genotypic correlation analysis revealed that the average pod weight, pod diameter, number of branches per plant, number of pods per plant and days to 50 % flowering were significantly associated with total yield per plant. These traits also showed positive direct relationship with total yield per plant. Selection based on these characters would result in an increase in total yield per plant, and it is also very useful to develop high yielding genotypes through hybridization programme with the combination of aforementioned characters.

Keywords: Okra, Correlation, Path coefficient**,** Genotype, Yield.

INTRODUCTION

Okra is an annual herbaceous plant belongs to the family *Malvaceae* having a somatic chromosome number 2n=130 in most of the Indian cultivars, and is considered to be an amphidiploid of *Abelmoschus tuberulatus* (2n=58) and unknown species with 20=72 (Datta and Naug 1968). Okra is especially valued for its tender and delicious green pods that are baked, canned and consumed in variety of forms in different parts of the country. It is considered as an important constituent of balanced food due to its rich dietary fibres and essential amino acids lysine and tryptophan (Hughes, 2009). India is the world's largest producer of okra and has significant potential as a source of foreign currency and accounts for about 60 % of export of fresh vegetables (Singh *et al.*, 2014).

It is often noted that some quantitative traits of economic importance are associated with one another. Correlation coefficient analysis measures the inter-relationship between several traits and identifies the constituent traits upon which selection would be based for genetic improvement of yield and yield related traits, and thus it assists in the selection of superior genotypes from diverse population (Singh and Narayanan, 2000). Yield is a complex character that is controlled by polygenes and also depends on various yield related traits (Samiksha *et al.*, 2021). Therefore it is important to know the inter-relationship between yield and yield related traits. Correlation and path coefficient analysis gives information on yield and yield attributing characters and this will helpful for selection of superior lines/genotypes from diverse population. Keeping these things in view, the study was planned to find out the association of different quantitative traits and their direct and indirect effects on total yield per plant.

MATERIAL AND METHODS

Forty-eight genotypes of okra collected from different sources *viz.*, NBPGR New Delhi, IIVR Varanasi, IIHR Bengaluru, KAU Kerala and Advanta Seeds were used for the present investigation. The okra genotypes are evaluated for yield and yield related traits in the field of

Vegetable Science unit of College of Horticulture, Bagalkot in randomized complete block design (RCBD) with two replications during late-*rabi* season 2019. Each treatment was represented by one row of 20 plants, spaced at 60 cm apart from row to row and 30 cm apart from plant to plant. Five plants from each genotype were selected randomly from each replication and evaluated for a several quantitative characters. The replicated mean values of these characters were then subjected to statistical analysis. Total yield per plant has been used as dependent variable with a set of nine independent characters *viz.*, plant height, number of branches per plant, number of nodes on main stem, internodal length, days to 50 per cent flowering, pod length, pod diameter, average pod weight and number of pods per plant. The correlation coefficient was calculated using the method described by Singh and Choudhary (1977) to understand the association among the characters. The path coefficient analysis suggested by Wright (1921) was used to determine the direct and indirect effects of quantitative traits on pod yield.

RESULTS AND DISCUSSION

The genotypic correlation, also known as the genotypic or breeding value of an individual, is the corresponding measure of association between genotypes of individuals. It is crucial for understanding the genetic relationship between traits and for forecasting the impact of selection on one trait on changes in other traits.

The data recorded during late-*rabi* season revealed that (Table 1), total yield per plant had positive and significant association with average pod weight (0.830), pod diameter (0.639), number of branches per plant (0.589), number of pods per plant (0.504) and days to 50 per cent flowering (0.256). Number of nodes on main stem showed positive and significant association with plant height (0.247). Internodal length exhibited significantly positive association with plant height (0.705) and significantly negative association with number of nodes on main stem (-0.592). Days to 50 per cent flowering showed positive and significant association with number of branches per plant (0.508) and significant negative association with plant height (-0.412) and internodal length (-0.216). Pod length recorded significant positive association with internodal length (0.499), number of branches per plant (0.286) and plant height (0.257), and showed significant negative association with number of nodes on main stem (-0.225). Pod diameter showed significant negative association with pod length (-0.234) and number of nodes on main stem (-0.204). Average pod weight recorded significant positive association with pod diameter (0.864) and significant negative association with number of nodes on main stem (-0.314). Number of pods per plant exhibited positive and significant association with number of branches per plant (0.815), number of nodes on main stem (0.713), days to 50 per cent flowering (0.457), plant height (0.256) and pod length (0.200), and showed significant negative association with internodal length (-0.211) and pod diameter (-0.208). These results were parallel to the findings of Kerure *et al.* (2017); Maurya *et al.* (2018); Verma and Singh (2020); Komolafe *et al.* (2021); Ranga *et al.* (2021); Samiksha *et al.* (2021); Sravanthi *et al.* (2021).

The correlation would not clearly indicate the causes and effects relation between the independent and dependent variables. The path coefficient analysis was used to determine the desirable qualities during selection and to ascertain the nature of association between dependent and independent characters. Path coefficients were calculated at genotypic level for all the quantitative characters to assess the direct and indirect relationship of one character through another on the economic yield. The estimates of genotypic path coefficients of yield and yield attributing traits in late-*rabi* seasons are presented in the Table 2.

Average pod weight (1.000) had highest positive direct effect on total yield per plant followed by number of branches per plant (0.453), plant height (0.333) number of nodes on main stem (0.163) and days to 50 per cent flowering (0.089). The characters, pod diameter (-0.221), pod length (-0.090), internodal length (-0.089) and number of pods per plant (-0.013) had negative direct effect on total yield per plant.

Table 1: Genotypic correlation coefficients for pod yield and its component characters in okra.

Character	Plant height (cm)	Number of branches/ plant	Number of nodes on main stem	Internodal length (cm)	Days to 50 % flowering	Pod length (cm)	Pod diameter (mm)	Average pod weight (g)	Number of pods/plant
Plant height (cm)	1.000								
Number of branches/ plant	-0.174	1.000							
Number of nodes on main stem	0.247*	0.078	1.000						
Internodal length (cm)	0.705**	-0.106	-0.592**	1.000					
Days to 50 % flowering	-0.412**	0.508**	-0.132	-0.216*	1.000				
Pod length (cm)	0.257*	0.286**	-0.225*	0.499**	0.065	1.000			
Pod diameter (mm)	0.109	-0.038	-0.204*	0.191	0.047	-0.234**	1.000		
Average pod weight (g)	0.038	0.154	-0.314**	0.144	0.098	0.080	0.864**	1.000	
Number of pods/ plant	0.256*	0.811**	0.713**	-0.211*	0.457**	0.200*	-0.208*	-0.140	1.000
Total yield/plant (g)	0.182	0.589**	0.064	0.041	0.256*	0.179	0.639**	0.830**	0.504**

*Significant @ 5% level of significance **Significant @ 1% level of significance

Table 2: Genotypic path coefficient analysis of yield and its component characters in okra.

Character	Plant height (cm)	Number of branches/ plant	Number of nodes on main stem	Internodal length (cm)	Days to 50 % flowering	Pod length (cm)	Pod diameter (mm)	Average pod weight (g)	Number of pods/plant
Plant height (cm)	**0.333**	-0.058	0.082	0.234	-0.137	0.085	0.036	0.013	0.085
Number of branches/ plant	-0.079	**0.453**	0.035	-0.048	0.230	0.129	-0.017	0.070	0.367
Number of nodes on main stem	0.040	0.013	**0.163**	-0.097	-0.022	-0.037	-0.033	-0.051	0.116
Internodal length (cm)	-0.063	0.010	0.053	**-0.089**	0.019	-0.045	-0.017	-0.013	0.019
Days to 50 % flowering	-0.037	0.045	-0.012	-0.019	**0.089**	0.006	0.004	0.009	0.041
Pod length (cm)	-0.023	-0.026	0.020	-0.045	-0.006	**-0.090**	0.021	-0.007	-0.018
Pod diameter (mm)	-0.024	0.009	0.045	-0.042	-0.010	0.052	**-0.221**	-0.191	0.046
Average pod weight (g)	0.038	0.154	-0.314	0.144	0.098	0.080	0.864	**1.000**	-0.140
Number of pods/ plant	-0.003	-0.010	-0.009	0.003	-0.006	-0.003	0.003	0.002	**-0.013**
Genotypic correlation with total yield/plant (g)	0.182	0.589**	0.064	0.041	0.256*	0.179	0.639**	0.830**	0.504**

*Significant @ 5% level of significance **Significant @ 1% level of significance

It is obvious to observe that, the number of branches per plant had positive direct effect (0.453) on total yield per plant (rg=0.589). However, its strong positive association was mainly due to its positive indirect effect through average pod weight (0.154), days to 50 per cent flowering (0.045), number of nodes on main stem (0.013), internodal length (0.010) and pod diameter (0.009). The traits, number of pods per plant (-0.010), pod length (-0.026) and plant height (-0.058) had negative indirect effect.

Days to 50 per cent flowering showed positive direct effect (0.089) and had positive association with total yield per plant (rg=0.256). This is mainly because of its indirect positive effect through number of branches per plant (0.230), average pod weight (0.098) and internodal length (0.019), and negative indirect effect through number of pods per plant (-0.006), pod length (-0.006), pod diameter (-0.010), number of nodes on main stem (-0.022) and plant height(-0.137).

Pod diameter showed negative direct effect (-0.221) on total yield per plant (rg=0.639). Despite its negative direct effect on total yield per plant, it had positive indirect effect through average pod weight (0.864), plant height (0.036), pod length (0.021), days to 50 per cent flowering (0.004) and number of pods per plant (0.003). The negative indirect effect was observed *via* internodal length (-0.017), number of branches per plant (-0.017) and number of nodes on main stem (-0.033).

It is really interesting to note that, the average pod weight showed highest positive direct effect (1.000) on total yield per plant (rg=0.830), which was mainly contributed by positive indirect effect through number of branches per plant (0.070), plant height (0.013), days to 50 per cent flowering (0.009) and number of pods per plant (0.002). The negative indirect of trait *via* pod length (-0.007), internodal length (-0.013), number of nodes on main stem (-0.051) and pod diameter (-0.191).

Number of pods per plant exhibited negative direct effect (-0.013), despite its negative direct effect it had strong positive association with total yield per plant (rg=0.504). This is mainly because of its indirect positive effect through number of branches per plant (0.367), number of nodes on main stem (0.116), plant height (0.085), pod diameter (0.046), days to 50 per cent flowering(0.041) and internodal length (0.019), and negative indirect effect through pod length (-0.018) and average pod weight(-0.140).

The traits *viz.*, average pod weight, number of branches per plant, plant height and number of nodes on main stem showed high and positive direct relationship towards total yield per plant. These characters have significant positive correlation with total yield per plant, suggesting the importance of these traits in yield determination. This also implies that direct selection for all these traits would directly lead to increase in total yield. These results were in accordance with the findings of Pithiya *et al.* (2017); Gatade *et al.* (2019); Rathava *et al.* (2019); Sujata *et al.* (2019); Ashraf *et al.* (2020); Ranga *et al.* (2021); Samiksha *et al.* (2021) in okra.

FUTURE SCOPE

The correlation and path analysis revealed that the average pod weight, pod diameter, number of branches per plant and number of pods per plant were the most important yield contributing traits in this study and selection based on these traits would be helpful in improving yield potential in okra hybrids/varieties.

Acknowledgement. The author would like to acknowledge INSPIRE, Department of Science and Technology, Ministry of Science and Technology, Government of India for providing the Ph.D fellowship for first author.
Conflict of interest. None.

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How to cite this article: Shwetha A., Basavaraja N., Raghavendra G., Pitchaimuthu M., Mesta R.K., Jagadeesha R.C. and Ganiger V.M. (2022). Character Association Studies in Okra [*Abelmoschus esculentus* (L.) Moench] for Yield and Yield contributing Traits. *Biological Forum – An International Journal, 14*(2): 1527-1530.