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Studies on Character Association in Bhendi [*Abelmoschus Esculentus* (L.) Moench]

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ABSTRACT: A study was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, UT of Puducherry with 11 diverse genotypes of bhendi during Rabi/Summer 2021 to assess the association between yield and other yield related traits as well as among the yield contributing traits and to partition the correlation coefficients in to effects of direct and indirect causes so as to predict the most dependable characters for effective selection involving more than one trait for a given environment. The significance of the study lies in finding out the major traits directly and indirectly contributing for the fruit yield in bhendi as this would ease the process of selection or development of a suitable genotype for a given situation. The experiment was conducted in a randomised block design with three replications and observations were recorded on 14 biometric traits. The data were subjected to association and path coefficient studies to elucidate the importance of observed traits on exercising simultaneous selection for more than one character. The study revealed the importance of traits *viz*., number of fruits plant^{-1}, plant height at flowering and number of seeds fruit^{-1} as primary yield determinants as these traits had shown significant positive association with yield. Hence, selection involving these traits would be of greater significance in enhancing yield of bhendi and these traits could be used as indices for simultaneous selection involving multiple traits for enhanced productivity of bhendi in the region.

Keywords: Bhendi, selection, correlation, path coefficient, direct effect, indirect effect.

INTRODUCTION

Bhendi, popularly known as Okra in India is a multipurpose vegetable crop valued for its green tender fruits. Bhendi is considered to be the queen of all vegetables and it belongs to the family Malvaceae (Niruba *et al*., 2022). Grown widely in tropics and sub tropics, it is regarded as superior to many other vegetables in its average nutritive value (Sanjay *et al*.., 2021). It has greater export potential as fresh vegetable. Even the ripe seeds of bhendi are dried, roasted and ground for use as a substitute for coffee (Gemede *et al*., 2015) and the area under bhendi in India is estimated to be around 5.09 L ha with a production of 60.95 L MT (Horticultural Statistics, 2018-19). The average productivity of okra in India is only 10.50 MT ha^{-1} as against the highest productivity of 15.70 MT ha^{-1} recorded in Egypt (Bencharsi, 2012). Considering the need for enhancing the productivity and to match the existing demand supply gap, enhancing productivity in spite of increasing biotic and abiotic stresses through consistent breeding efforts becomes inevitable. Bhendi is a crop capable of performing well in hot weather especially in regions with warm night temperature (Ndunguru and Rajabu 2004). Selection from a base population of bhendi for yield would be more effective only if the direction and magnitude of association of yield and yield contributing traits are assessed, as yield is a complex trait influenced by many other inter related component traits. Further, partitioning of association into effect of direct and indirect causes makes the selection process simple and more meaningful. Hence, the present study was focussed on estimation of correlation coefficients and path coefficients in bhendi.

MATERIALS AND METHODS

The present investigation involving 11 bhendi genotypes of diverse genetic architecture from different parts of the country *viz*., CoBh 4, Arka Nikitha, BHS 120, BHS 240, BHS 480, BHS 680, Jahnvi, VNR 999, NOH 1648, NOH 1684 and NOH 1758 was taken up at the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, UT of Puducherry during Rabi/Summer 2022.

The experiment was laid out in a randomised block design with three replications. The experimental plot was thoroughly prepared to form beds and furrows on which sowing was done in double rows, maintaining a spacing of 90 × 60 × 30 cm. Uniform cultural practices were adopted as recommended (Crop Production Techniques of Horticultural Crops, 2020). Observations on 14 growth and yield contributing traits *viz*., days to first flowering, plant height at flowering (cm), plant height at final harvest (cm), node at which first flower appears, internodal length on main stem at flowering (cm), number of primary branches plant^{-1} at flowering, number of primary branches plant^{-1} at final harvest, fruit length (cm), fruit girth (cm), fruit weight (g), number of seeds fruit^{-1}, fresh weight of seeds fruit^{-1} (g), number of fruits plant^{-1} and fruit yield plant^{-1} (kg). The data was subjected to statistical analysis as suggested by Miller *et al*. (1958); Dewey and Lu (1959).

RESULTS AND DISCUSSION

Yield is a complex trait influenced by several component traits as well as environment. Understanding the interaction of component traits with yield and the interaction among themselves is found to be of greater help in any crop improvement programme. The studies on character association would throw light on the nature and extent of association between metric traits, while the study of path coefficient helps in partitioning the correlation coefficient into direct and indirect effects, so that the relative merit of each trait in influencing yield could be well understood.

In the present study, the highest positive and significant correlation with yield was found to get exerted by number of fruits plant^{-1} (0.629), followed by plant height at flowering (0.454) and number of seeds fruit^{-1} (0.446) as evidenced from Table 1. Positive and significant association of number of fruits plant^{-1} with yield has been reported earlier by Sanganamoni *et al*. (2016); Thulasiram *et al*. (2017). Significant positive association of plant height at flowering and number of seeds fruit^{-1} with fruit yield of bhendi has been reported earlier by Meenakshee and Sharma (2017); Dash and Mishra (1995) respectively. However, the association between plant height at final harvest and fruit yield plant^{-1} was observed to be negative and highly significant as reported earlier by Mohammed and Marker (2017).

Table 1: Genotypic correlation among various yield traits in bhendi.

Characters	Days to first flowering	Plant height at flowering (cm)	Plant height at final harvest (cm)	Node at which first flower appears	Internodal length on main stem at flowering (cm)	Number of primary branches plant^{-1} at flowering	Number of primary branches plant^{-1} at final harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of seeds fruit^{-1}	Fresh weight of seeds fruit^{-1}	Number of fruits plant^{-1}	Fruit yield plant^{-1}
Days to first flowering	1.000	-0.853**	0.410*	-0.316	-0.424*	-0.659**	-0.625**	0.442**	0.972**	0.583**	0.423**	0.693**	-0.101	-0.106
Plant height at flowering (cm)		1.000	-0.092	-0.355**	-0.028	0.028	0.034	0.288	0.141	0.140	0.088	-0.017	0.208	0.454**
Plant height at final harvest (cm)			1.000	-0.274	0.266	-0.189	-0.202	0.247	0.355	0.305	-0.307	-0.109	-0.384	-0.664
Node at which first flower appears				1.000	0.533**	0.533**	0.528**	-0.880**	-0.892**	-0.897**	-0.171	-0.584**	0.367*	0.273
Internodal length on main stem at flowering (cm)					1.000	0.739**	0.735**	-0.642**	-0.531**	-0.374*	0.068	-0.503**	0.364*	0.101
Number of primary branches plant^{-1} at flowering						1.000	1.0318**	-0.555**	-0.780**	-0.566**	-0.241	-0.690**	0.037	0.278
Number of primary branches plant^{-1} at final harvest							1.000	-0.568**	-0.824**	-0.585**	-0.233	-0.692**	0.035	0.272
Fruit length (cm)								1.000	0.748**	0.816**	-0.053	0.408*	-0.528**	-0.206
Fruit girth (cm)									1.000	0.908**	0.364*	0.712**	-0.170	-0.304
Fruit weight (g)										1.000	0.444**	0.719**	-0.153	-0.202
Number of seeds fruit^{-1}											1.000	0.709**	0.793**	0.446**
Fresh weight of seeds fruit^{-1}												1.000	0.307	0.065
Number of fruits plant^{-1}													1.000	0.629**
Fruit yield plant^{-1}														1.000

* Significant at 5 per cent level; Significant at 1 per cent level

The study of intercorrelation among yield contributing traits revealed the highest positive significant association between number of primary branches plant^{-1} at flowering and primary branches plant^{-1} at final harvest (1.0318), followed by days to first flowering with fruit girth (0.972), fruit girth with fruit weight (0.908) and fruit length with fruit weight (0.816). Positive and significant association between days to first flowering and fruit girth had been reported earlier by Kumar *et al*. (2009), while Kerure *et al*. (2017) reported positive significant association of fruit girth and fruit weight. The association of number of seeds fruit^{-1} with number of fruits plant^{-1} (0.793), fruit weight and fruit girth with fresh weight of seeds fruit^{-1} (0.719

and 0.712 respectively), number of seeds fruit^{-1} with fresh weight of seeds fruit^{-1} (0.709) were all found to be positive and significant. These findings are in conformity to the earlier observations of Osekita and Akinyere (2008).

The presence of significant and very high magnitude of negative association was observed between node at which first flower appears and fruit weight (0.897) in the present study as reported by Rajeev *et al*. (2017). A similar trend was also noticed between first flowering node and fruit length (-0.880), which was found to be in conformity to the findings of Karadi *et al*. (2018). The correlation between days to first flowering and plant height at flowering (-0.853) was also found to show similar trend as observed by Meenakshee and Sharma (2017). The study of genotypic association thus revealed the significance of number of fruits plant^{-1}, plant height at flowering, fruit girth, fruit length and number of seeds fruit^{-1} as important traits for exercising selection in bhendi. Similar findings had been reported earlier by Shweta *et al*. (2022).

The association of traits on yield and their inter association alone is not significant to decide the primary yield determinants as each and every associated traits are either complemented or counteracted by various other biometric traits. This could be untangled by partitioning the association into effect of direct and indirect causes through path coefficient analysis. In the present study the highest positive direct effect (3.453) on yield was exerted by number of seeds fruit^{-1}, followed by fruit length (2.9068), number of primary branches plant^{-1} at final harvest (2.5865), plant height at final harvest (2.3093) and number of fruits plant^{-1} (1.6737). These results are in conformity to the earlier findings of Gangashetty *et al*. (2010); Abishekkatagi *et al.* (2013); Thulasiram *et al*. (2017); Sharma and Prasad (2015). However, the direct influence of fruit weight (-3.8304), internodal length on main stem at flowering (-2.6305) and node at which first flower appears (-2.0690) were negative and highly significant as recorded earlier by Kumar and Reddy (2016) for fruit weight, Meenakshee and Sharma (2017) for internodal length and Singh *et al*. (2017) for node at which first flower appears in bhendi.

The negative direct effect of node at which first flower appears on fruit yield plant^{-1} was found to be counteracted by its indirect positive influence through fruit weight on yield and was in conformity to the earlier report of Rajeev *et al*. (2017). Similarly the direct negative influence of fruit girth and fruit weight on yield were found to be counteracted by its positive effect through fruit length and such a finding had already been recorded in bhendi by Mehta *et al*. (2006).

Table 2: Direct and indirect effects of various yield components in bhendi.

Characters	Days to first flowering	Plant height at flowering (cm)	Plant height at final harvest (cm)	Node at which first flower appears	Internodal length on main stem at flowering (cm)	Number of primary branches plant^{-1} at flowering	Number of primary branches plant^{-1} at final harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of seeds fruit^{-1}	Fresh weight of seeds fruit^{-1}	Number of fruits plant^{-1}	Correlation with fruit yield plant^{-1} (r)
Days to first flowering	**-0.2008**	0.7081	0.9464	0.6528	1.1141	0.5473	-1.6160	1.2847	-1.7039	-2.2334	1.4620	-0.8987	-0.1683	-0.1056
Plant height at flowering (cm)	-0.1712	**-0.8306**	-0.2114	0.7348	0.0743	-0.0235	0.0880	0.8378	-0.1834	-0.5343	0.3033	0.0222	0.3483	0.4543
Plant height at final harvest (cm)	0.0823	0.0760	**2.3093**	0.5670	-0.7003	0.1572	-0.5215	0.7164	-0.6230	-1.1666	-1.0604	0.1416	-0.6425	-0.6644
Node at which first flower appears	-0.0633	0.2950	-0.6329	**-2.0690**	-1.4006	-0.4429	1.3659	-2.5591	1.5634	3.4338	-0.5892	0.7579	0.6142	0.2729
Internodal length on main stem at flowering(cm)	-0.850	0.0235	0.6148	-1.1017	**-2.6305**	-0.6140	1.9001	-1.8648	0.9303	1.4324	0.2350	0.6520	0.6093	0.1014
Number of primary branches plant^{-1} at flowering	-0.1323	-0.0235	-0.4369	-1.1032	-1.19442	**-0.8307**	2.6687	-1.6141	1.4019	2.1685	-0.8332	0.8954	0.0617	0.2781
Number of primary branches plant^{-1} at final harvest	-0.1259	-0.0283	-0.4656	-1.0926	-1.9324	-0.8571	**2.5865**	-1.6513	1.4453	2.2396	-0.8032	0.8975	0.0592	0.2720
Fruit length (cm)	0.0887	-0.2394	0.5692	1.8215	1.6875	0.4613	-1.4693	**2.9068**	-1.3122	-3.1262	-0.1817	-0.5297	-0.8829	-0.2064
Fruit girth (cm)	0.1951	-0.0869	0.8205	1.8449	1.3957	0.6642	2.1321	2.1754	**-1.7533**	-3.4762	1.2566	-0.9322	0.2556	-0.3044
Fruit weight (g)	0.1171	-0.1159	0.7034	1.8548	0.9834	0.4703	1.5213	2.3724	-1.5912	**-3.8304**	1.5337	-0.9322	-0.2566	-0.2022
Number of seeds fruit^{-1}	0.0850	-0.0729	-0.7091	0.3530	-0.1790	0.2004	-0.6016	-0.1529	-0.6380	-1.7012	**3.4533**	-0.9189	1.3276	0.4457
Fresh weight of seeds fruit^{-1}	0.1391	0.0142	-0.2522	1.2089	1.3223	0.5735	-1.7896	1.1871	-1.2484	-2.7529	2.4465	**-1.2970**	0.5317	0.0653
Number of fruits plant^{-1}	-0.0202	-0.1728	-0.8865	-0.7593	-0.9576	-0.0306	0.0914	-1.5334	0.2985	0.5849	2.7393	-0.3981	**1.6737**	0.6291

Residual Factor (R) = 0.2759

CONCLUSION

The present investigation on character association and path coefficient analysis involving bhendi genotypes revealed the significance of traits *viz*., number of fruits plant^{-1}, plant height at flowering and number of seeds fruit^{-1} as primary yield determinants, while fruit length and plant height at final harvest and number of primary branches at final harvest could be regarded as second order determinants of yield in bhendi.

FUTURE SCOPE

The identification bhendi genotypes through selection for direct adoption or for utilisation in further breeding programmes is a continuous process with the changing crop cultivation scenario. This study would help the breeders in exercising indirect selection of suitable genotypes of bhendi for higher yield under a given situation.

Author contribution. Both authors had contributed equally in raising of crop and data collection. The analysis part was done by the second author and the first author had prepared the manuscript.

Conflict of Interest. None

REFERENCES

Abishekkatagi, Shantappatriakannavar, R. C. Jagadeesha, J. Jeyappa and Shankarappa, K. (2013). Genetic analysis of association studies in segregating population of okra [*Abelmoschus esculentus* (L) Moench]. *Int. J. forestry and Crop Improv*., *4*(1): 13-18.

Bencharsi, S. (2012). Okra [*Abelmoschus esculentus* (L) Moench] as a valuable vegetable of the World. *Ratar. Povrt., 49*: 105–112.

Crop Production Techniques of Horticultural Croops (2020). Directorate of Horticulture and Plantation Crops, Chennai and Tamil Nadu Agricultural University, Coimbatore. p. 364.

Dash, G. B. and Mishra, P. K. (1995). Variation and character association of fruit yield and its component character in okra [*Abelmoschus esculentus* (L) Moench]. *Current Agric. Res., 8*(3/4): 123-127.

Dewey, D. R. and Lu, K. H. (1959). Correlation and path analysis of components of crested wheat grass seed production. *Agron. J., 51*: 515-518.

Gangashetty, P. I., Santhakumar, G. Salimath, P. M. and Sridevi, O. (2010). Comparison of variability, nature and magnitude of associationof productivity traits in single and double cross progenies of bhendi [*Abelmoschus esculentus* (L) Moench]. *Karnataka J. Agric. Sci*., *23*(3): 413-417.

Gemede, H. F., Ratta, N., Haki, G. D., Ashagire, Z., Woldegiorgis and Beyene, F. (2015). Nutritional quality and helath benefits of okra (*Abelmoschus esculentus*): A review. *Int. J. of Nutri. Food Sci*., *4*: 208-215.

Horticultural Statistics (2018-19). Department of Agricultural Cooperation and Farmers Welfare. Ministry of Agri., Govt. of India.

Karadi, S. M., Hanchinamani, C. N., Baswaraja, N., Kulkarni, M. S., Tatagara, M. H. and Satish, D. (2018). Genetic analysis of character association studies in okra [*Abelmoschus esculentus* (L) Moench] genotypes. *Int. J. chemical Studies*, *6*(6): 2066-2070.

Kerure, P., Pitchaimuthu, M. and Hosmani, A. (2017). Studies on variability, correlation and path analysis of traits contributing to fruit yield and its components in okra [*Abelmoschus esculentus* (L) Moench]. *Electronic J. Plant Breeding*, *8*(1): 134-141.

Kumar, S., Annapurna and Yadav, Y. C. (2009). Correlation coefficient and path analysis studies in okra [*Abelmoschus esculentus* (L) Moench]. *Annals of Hort*., *2*(2): 166-170.

Kumar, S. and Reddy, M. T. (2016). Variability, heritability and character association in okra [*Abelmoschus esculentus* (L) Moench]. *Ad. Agric. Sci*., *4*(4): 72-83.

Meenakshee, D. and Sharma, D. P. (2017). Correlation and path analysis studies in okra [*Abelmoschus esculentus* (L) Moench] under Jabalpur condition. *Int. J. Agric. Sci*., *9*(34): 4504-4509.

Mehta, D. R., Dhaduk, L. K. and Patel, K. D. (2006). Genetic variability, correlation and path analysis studies in okra [*Abelmoschus esculentus* (L) Moench]. *Agric. Sci. Digest*, *26*(1): 15-18.

Miller, P. A., Williams, J. C., Robinson, H. F. and Comstock, R. E. (1958). Estimation of genotypic and environmental variances and covariance in upland cotton and their implication in selection. *Agron. J.*, *50*: 126-131.

Mohammad, S. and Marker, S. (2017). Correlation and path coefficient analysis for yield attributing traits in okra [*Abelmoschus esculentus* (L) Moench]. *Int. J. Pure App. Biosci*., *5*(4): 1795-1799.

Niruba, D., Chandrasekaran, M., Gailce Leo Justin, C., Rajanbabu, V. and Sathya, V. K. (2022). Screening and identification of resistance sources of okra, *Abelmoschus esculentus* L. accessions against whitefly *Bemiciatabaci* Gennadius. *Biological Forum – An International Journal*, *14*(2a): 378-385.

Osekita, O. S. and Akineyele, B. O. (2008). Genetic analysis of quantitative traits in ten cultivars of okra [*Abelmoschus esculentus* (L) Moench]. *Asian J. Plant Sci*., *7*(5): 510-513.

Rajeev, K. Y., Syamal, M. M., Manish, K., Pandiyaraj, P., Kattula, N. and Ashish, K. (2017). Correlation and path analysis for fruit yield and its component traits in okra [*Abelmoschus esculentus* (L) Moench] genotypes. *Int. J. Agric. Sci*., *9*(13): 4063-4067.

Sanganamoni, M., Revanappa, S., Shivasankar, S., Prabhakar, B. and Muthaiah, K. (2016). Correlation and path coefficient studies in okra [*Abelmoschus esculentus* (L) Moench]. *Res. Environ. Life Sci*., *9*(8): 999-1001.

Sanjay, M., Chaurasia, A. K., Singh, V. and Verma, G. (2021). Seed enhancement technique to alleviate the effect of salinity stress in okra (*Abelmoschus esculentus*). *Biological Forum – An International Journal*, *13*(2): 637-641.

Sharma, R. K. and Prasad, K. (2015). Genetic divergence, correlation and path coefficient analysis in okra. *Ind. J. Agric. Res*., *49*(1): 77-82.

Shewtha, A., Basavaraja, N., Ragavendra, 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.

Singh, N., Singh, D. K., Pandey, P., Panchabhaiya, A. And Rawat, M. (2017). Correlation and path coefficient studies in okra [*Abelmoschus esculentus* (L) Moench]. *Int. J. Current Microbiology and App. Sci*., *6*(7): 1096-1101.

Thulasiram, L. B., Bhople, S. R. and Ranjith, P. (2017). Correlation and path analysis in okra [*Abelmoschus esculentus* (L) Moench]. *Electronic J. Pl. Breed*., *8*(2): 620-625.

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