Vegetable Science (2021) 48 (1) : 105-107

Short Communication

Genetic variability, correlation and path analysis of yield and its components characters in okra (*Abelmoschus esculentus* L. Moench)

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Received: March 2021/ Accepted: June 2021

Okra [*Abelmoschus esculentus* (L.) (Moench)], is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. It is commonly known as okra or lady's finger in India. Its tender green fruits are used as a vegetable and are generally marketed in fresh form, but sometimes in canned or dehydrated form. Major states of cultivation in India are Gujarat, West Bengal, Bihar, Madhya Pradesh, Orissa, Chhattisgarh, Uttar Pradesh, Haryana, (NHB 2017-18). In India, it is grown inan area of 5.09 lakh hectare with a production of 6095000 metric tons and productivity of 12 tons/ha with first position in area and production in the world(NHB, 2017-18). It is an autogamous crop, having an outcrossing rate to an extent of 4 to 19% with the maximum of 42.2%. Genetic variability plays an important role in crop breeding for selecting the elite genotypes for making rapid improvement in yield and other desirable characters as well as to select the potential parent for hybridization programme. The success of a breeding programme for the improvement of quantitative attributes depends on the magnitude of genetic variability existing in the germplasm. Burton (1952) suggested that genetic variability along with heritability should be considered for assessing the maximum and accurate effect of selection. Studies on the variability using genetic parameters like phenotypic coefficient of variation (PCV), heritability and genetic advance is essential for initiating an efficient breeding programme. However, direct selection for yield alone is usually not very effective or may often be misleading. Hence, selection based on its contributing characters could be more efficient and reliable. For sorting out the total correlation into direct and indirect effects path coefficient analysis helps and is useful for choosing the most useful traits to be used for yield improvement through selection. The study of correlation between plant characters is of great importance to a plant breeder as it provides a measure of the degree of association between yield and other yield attributes. The path coefficient analysis is partitioned the correlation in direct and indirect effects and thus may be useful in choosing the characters that have direct and indirect effects on yield. Hence, study of correlations (phenotypic) and path coefficient analysis of yield would be of help in selection of yield component traits in the genetic improvement of quantitative traits, which are positively correlated. In complex inherited traits, such information reveals the possibility of simultaneous improvement of different attributes and also helps in increasing the efficiency of selection. Keeping in the view of above facts, the objectives of the present investigation was to study the association of yield and its component traits and the direct and indirect effects of yield component traits on fruit yield in okra genotypes.

The experiment consisted of ten characters of 14 okra hybrids (NS-7772, Lucky Asha, Bhindi No. 10, Anmol, Maury No.1, Somaya, SW 001, Mona 002, NOH-05, SW 005, Suprim, SW 006, NOH-1053 and Indu) following Randomized Block Design with three replications at Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh during summer season, 2020. Five randomly selected plants from each replication were taken to record 10 quantitative traits viz., days to 50% germination, plant height (cm), number of nodes per plant, length of internodes (cm), number of primary branches per plant, number of pods per plant, length of pod (cm), pod diameter (cm), 10-pod weight (gm) and yield per plant (g). Data were subjected to analysis of variance (Panse and Sukhatme 1984). The phenotype co-efficient of variation (PCV) were calculated by following the formula given by Burton (1952). For the estimates of heritability and genetic advance, the method of Hanson et al. (1956) was followed. Later, correlation coefficients at genotypic and phenotypic levels were calculated (Johnson *et al.,* 1955). Path coefficient was done as per Dewey and Lu (1959).

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The present study was initiated to examine the nature of variability in different characters of okra genotypes. Analysis of variance of 10 traits revealed that mean squares due to genotypes were highly significant for all traits. Phenotypic co-efficient of variation (PCV) agreed closely with the genotypic co-efficient of variation (GCV) but the magnitude of PCV was higher than GCV for almost all the characters (Table 1). High PCV and GCV values were shown by no. of primary branches per plant followed by length of nodes per plant and plant height. On the other hand, low PCV and GCV values were shown by 10 pod weight, pod diameter and no. of nodes per plant. The result corroborates the earlier findings of Jaiprakashnarayan et al (2006). Broad sense heritability values were higher for plant height (85.08%), no of primary branches per plant(79.44%), length of internodes (78.72%) and no. of pod per plant (78.71) which corroborates with the findings of earlier workers (Sarkar et al. 2005; Mehta et al. 2006; Magar and Madrap 2009). The heritability estimates were, therefore, to be considered with these limitations in view. However, genetic advance (GA) expressed as percentage of mean was high for the characters like no. of primary branches per plant (29.09%), followed by length of internodes(27.87%), plant height(27.60%) and yield per plant(24.25). According to Johnson et al. (1955) and Ghandi et al. (1964), high heritability estimates along with high genotypic coefficient of variation and genetic advance is usually more useful in predicting the response of an individual to selection than heritability values alone. In the present study, high heritability coupled with high genetic advance was observed for plant height, yield per plant and no. of pod per plant indicating good response to selection for these characters. High heritability and high genetic advance for the above-mentioned characters revealed that such characters are controlled additive gene action (Panse 1957) and selection based on these characters will be effective. These results find support with the observations of earlier workers Jayapandi and Balakrishnan (1992); Sarkar et al. (2005); Mehta et al. (2006); Magar and Madrap (2009); Guddadamath et al. (2011). The low heritability may be exhibited due to high environmental effects. High heritability accompanied with low genetic advance for the characters like no. of primary branches per plant and length of internodes suggest that these characters were affected by thefavorable influence of environment rather than genotypes.

The characters viz., no. of pod per plant, 10 pod weights, pod diameter, no. of primary branches per plant, pod length and length of internodes exhibited significantly positive correlation co-efficient with yield per plant. Besides, the character like plant height and no. of nodes per plant showed positive but non-significant correlation with fruit yield per plant (Table 2). However, 50% germination exhibited non-significantly negative correlation with fruit yield per plant. The inter-relationships among the characters showed that 9 correlation co-efficient were significantly positive. They also showed high phenotype correlations as well. Such positive and significant association with yield per plant had already been reported by previous

Table 1: Genetic variability for morphological traits among okra genotypes.

Traits	Mean	Heritability (%)	GCV	PCV	GA	GA %mean
50% germination	4.03	60.76	9.08	11.65	0.60	14.58
Plant Height (cm)	115.27	85.08	14.52	15.75	31.81	27.60
No. of nodes per plant	22.33	48.23	7.18	10.34	2.29	10.27
Length of nodes (cm	4.89	78.72	15.25	17.19	1.36	27.87
No. of primary branches	2.79	79.44	15.84	17.78	0.81	29.09
No. of pod per plant	24.26	78.71	9.69	10.93	4.30	17.72
Pod length (cm)	11.06	68.49	11.27	13.61	2.12	19.21
Pod diameter (cm)	1.56	41.17	6.17	9.61	0.13	8.15
10 pod weight (g)	144.43	27.45	4.28	8.16	6.67	4.61
Yield per plant (g)	358.03	78.27	13.31	15.04	86.82	24.25

Table 2: Phenotypic correlation coefficients of ten characters of okra.

Traits	50% germination	Plant Height (cm)	No. of nodes per plant	Length of nodes (cm)	No. of primary branches	No. of pod per plant	Pod length (cm)	Pod diameter (cm)	10 pod weight (g)	Yield per plant (g)
50% germination	1	0.288	0.388*	0.232	0.215	-0.008	-0.212	0.085	0.052	-0.027
Plant Height (cm)		1	0.501**	0.867**	0.539**	0.193	-0.134	0.038	0.030	0.144
No. of nodes per plant			1	0.142NS	0.303	-0.160	-0.058	0.049	0.320*	0.036
Length of nodes (cm				1	0.544**	0.295	0.106	0.283	0.127	0.311*
No. of primary branches					1	0.257	0.012	-0.147	0.252	0.373*
No. of pod per plant						1	-0.144	0.116	0.177	0.738**
Pod length (cm)							1	0.769**	0.698**	0.328*
Pod diameter (cm)								1	0.689**	0.490**
10 pod weight (g)									1	0.728**

Table 3: Path-coefficient analysis of the components of fruit yield per plant at phenotypic level in okra.

Traits	50% germination	Plant Height (cm)	No. of nodes per plant	Length of nodes (cm)	No. of primary branches	No. of pod per plant	Pod length (cm)	Pod diameter (cm)	10 pod weight (g)	Yield per plant (g)
50% germination	-0.14306	-0.02998	-0.04448	0.02259	0.03867	-0.00349	0.07483	0.01977	0.03772	-0.027
Plant Height (cm)	-0.04117	-0.10417	-0.05749	0.08434	0.0969	0.08829	0.04724	0.00889	0.02135	0.144
No. of nodes per plant	-0.05546	-0.0522	-0.11474	0.01381	0.05447	0.07307	0.02052	0.01125	0.23138	0.036
Length of nodes (cm	-0.03322	-0.09029	-0.01629	0.0973	0.09783	0.13529	-0.03731	0.06543	0.09215	0.311*
No. of primary branches	-0.03075	-0.05611	-0.03475	0.05292	0.17988	0.11761	-0.00419	-0.03401	0.18213	0.373*
No. of pod per plant	0.00109	-0.02008	0.01831	0.02875	0.0462	0.45792	0.05065	0.02671	0.12825	0.738**
Pod length (cm)	0.03037	0.01396	0.00668	0.0103	0.00214	-0.0658	-0.35248	0.17791	0.50503	0.328*
Pod diameter (cm)	-0.01223	-0.00401	-0.00558	0.02753	-0.02646	0.05289	-0.27122	0.23121	0.4983	0.490**
10 pod weight (g)	-0.00746	-0.00308	-0.03671	0.0124	0.0453	0.08121	-0.24614	0.15931	0.72321	0.728**

workers like Gondane et al. (1995); Chandra Deo et al. (1996), Dhankar and Dhankar (2002); Sarkar et al. (2005); Mehta et al. (2006); Magar and Madrap (2009) and Rashwan (2011).

The path coefficient analysis results (Table 3) indicated that high positive direct effects on yield per plant were noted for 10 pod weight, no. of pod per plant, pod diameter and length of internodes. Whereas, pod length, 50% germination, no. of nods per plant and plant height showed high negative direct effects on yield per plant. No. of nod per plant, no. of primary branches per plant, length of internodes and no. of pod per plant showed high positive indirect effects through each other. Pod diameter, 10 pod weights, length of internodes and no. of nodes per plant showed high negative indirect effects through each other. The results are in conformity with the observations of previous workers (Vijoy and Monohar 1990; Mishra et al. 1996; Mandal and Dana 1994; Gondane et al. 1995; Dash and Mishra 1995; Chandra Deo et al. 1996; Singh et al. 2007; Magar and Madrap 2009). Thus, based on results of present study it is suggested that the characters like pod diameter, no. of pod per plant, pod length, 10 pod weight and no. of primary branches per plant be given due weightage for improving yield per plant in okra.

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