Genetic variability studies in Okra [*Abelmoschus esculentus* (L.) Moench] germplasm

Abstract

An experiment was carried out at College of Horticulture, Rajendranagar, Hyderabad during the period during summer, 2023 to study the variability, heritability and genetic advance for different morphological and agronomic traits. Analysis of variance revealed significant variability among the genotypes of okra for all character's studied. Genetic variability revealed that a lot of variation among the genotypes. In general, the lowest difference in phenotypic and genotypic coefficients of variation indicates lowest environmental influence in controlling the expression of the traits. Based on genetic variability studies, high PCV and GCV and high heritability coupled with high genetic advance as per cent of mean were recorded for number of branches per plant at 60 DAS, number of branches per plant at 90 DAS, fruit yield per plant and yield per hectare indicating the existence of wider genetic variability for these traits in the germplasm under study.

INTRODUCATION

Okra [*Abelmoschus esculentus* (L.) Moench] is an economically important vegetable crop widely cultivated in tropical and sub-tropical regions of the world. Okra is a fast growing annual which has captured a prominent position among the vegetables. It is primarily grown for tender fruits both in spring summer and rainy season throughout India. It is commonly known as bhendi or lady's finger or gumbo. It belongs to the family Malvaceae, having a somatic chromosome number of cultivated species 2n = 82-130 comes under the order Malvales and is considered to be an amphidiploid. India is the largest producer of okra (57.1 % of total world production). Okra has a great potential as foreign exchange earner vegetable which accounts for about 60 % of the export of total fresh vegetables excluding potato, onion and garlic. The total acreage and output of okra in India are estimated to be 555 thousand ha and 6819 thousand metric tonnes. With a production of over 413.66 thousand tonnes over an area of 25.86 thousand ha (NHB, 2021-22). Genetic variability is a very important component of plant breeding which is a major tool being used to cope with the ever-increasing pressure of an expanding world population on food production (Ariyo, 1990). Information on genetic variability of different characters of a crop and about the useful genes

in each accession which is properly evaluated to identify the potential accessions is necessary prior to breeding programme for improvement in any crop. In effecting improvement in yield, selection of superior genotypes is based on the outward appearance (phenotype) which is subject to variation due to fluctuating environmental factors. Under similar environmental conditions, any progress in a breeding programme depends on the magnitude of genetic variability in a population and the extent to which the desirable traits are heritable (heritability). Therefore, it is necessary to evaluate the genetic stocks acclimatized to local conditions (Osekita and Akinyele, 2008).

Materials and Methods

Thirty two okra genotypes are collected from different sources *viz*., NBPGR New Delhi, IIHR Bengaluru and Periyapatna, Mysore, Karnataka were used for the present investigation are enlisted in Table 1. The okra genotypes were evaluated for yield and yield contributing traits at PG research block, College of Horticulture, Rajendranagar, Hyderabad, India. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications during summer season 2023. Each treatment or a genotype in each replication was represented by one row each accommodating 10 plants at a row to row spacing of 60 cm and 30 cm from plant to plant. Five plants were randomly selected for each genotype from each replication and evaluated for different quantitative characters and the replicated mean values of various characters were subjected to statistical analysis. Analysis of variance was carried out in order to partition the total variation showed by different characters under the study into its components *viz.*, replication, treatments and error. Genotypic and phenotypic coefficients of variation were estimated according to Burton and Devane (1953)and heritability estimates as per Falconer (1981) and genetic advance estimates according to Johanson *et al.* (1995).

RESULTS AND DISCUSSION

The components of genetic parameters of variation for yield and its attributes exhibited a wide range of variability for the parameters studied (Table 2). The values of phenotypic coefficient of variation (PCV) were of higher in magnitude than that of genotypic coefficient of variation (GCV) for all the characters indicating that the environment played an important role in influencing the expression of the traits. The relative values of genotypic and phenotypic coefficient of variation gives an idea about the magnitude of variability present in

a population. The results obtained from the statistical analysis revealed high, medium and low estimates of genotypic and phenotypic coefficient of variation among the genotypes for different characters studied (Table 3).

Plant height at 30 days after sowing showed low GV (0.52) and PV (1.55), combined with low GCV and PCV of 5.14 % and 8.86 % respectively. Heritability (33.66 %) and genetic advance over mean (6.14%) were recorded moderate and low respectively.The high GV (47.53) and PV (51.95), coupled with moderate GCV (18.41 %) and PCV (19.25 %) were observed. The character is combined with high heritability (91.48 %) and genetic advance over mean (36.28 %)were reported for plant height at 60 days after sowing.Plant height at 90 DAS showed high GV (280.99) and PV (305.46), coupled with moderate GCV (19.8 %) and PCV (20.65 %) were reported for this character along with high heritability (91.99 %) and genetic advance over a mean (39.12 %).Stem diameter at 30 DAS showed low GV (0.26) and PV (0.41) with moderate GCV (15.93 %) and PCV (20.19 %) as a variability component. High heritability (62.27 %) and GAM of 25.9 % were recorded.Stem diameter at 60 DAS recorded low GV (0.99) and PV (0.143) with moderate GCV (11.02 %) and PCV (13.26 %) were recorded for the character and high heritability (69.01 %) and moderate GAM (18.85 %) were recorded.Stem diameter at 90 DAS recorded low GV (4.44) and PV (5.84) with moderate GCV (13.69 %) and PCV (15.7 %) as variability components were enlisted indicating high heritability (76.03 %) and GAM (24.59 %).Number of leaves per plant after 30 days of sowing recorded low GV (0.31) and PV (0.21) along with low GCV (6.22 %) and PCV (8.06 %) as a variability component, while moderate heritability (59.55 %) and low GAM of 9.88 % were recorded. Plant data of 60 days after sowing for number of leaves per plant showed low GV (5.62) and PV (6.45) with moderate GCV (16.11 %) and PCV (17.24 %) were recorded for the character, whereas high heritability (87.25 %) and GAM (30.99 %) were observed.Number of leaves per plant at 90 DAS showed low GV (8.63) and moderate PV (10.10) along with moderate GCV (12.73 %) and PCV (13.77 %) as variability components were enlisted indicating high heritability (85.45 %) and GAM (24.24 %).Plant data of 60 days after sowing for number of branches per recorded low GV (0.37) and PV (0.41) with high GCV (50.19 %) and PCV (52.35 %), very high heritability (91.93 %) and very high GAM (99.14 %) were recorded.Number of branches per plant at 90 DAS showed low GV (0.70) and PV (0.72) with high GCV (34.10 %) and PCV (34.55 %) as variability components and very high heritability (97.41 %) and GAM (69.33 %) were reported.

Days to first flowering recorded high GV and PV (20.99 and 29.13 respectively) with low GCV (9.78 %), moderate PCV (11.52 %), high heritability (72.08 %) and moderate GAM (17.10 %) were observed for this trait.Days to 50 per cent floweringshowed moderate GV and high PV (14.60 and 23.23 respectively) with low GCV (7.65 %) and PCV (9.64 %), high heritability (62.87 %) and moderate GAM (12.49 %) were recorded.Days to fruit set showed moderate GV (16.58) and high PV (24.07) with low GCV (8.51 %) and low PCV (10.25 %), high heritability (68.88 %) and moderate GAM (14.54 %) were recorded for this trait.Days to first fruit harvest recorded moderate GV (17.20) and high PV (24.87) with low GCV (7.49 %) and PCV (9 %) were recorded as a variability component. Number of days to first fruit harvest are recorded high heritability (69.16 %) and moderate GAM (12.82 %).

Number of locules per fruit showed low GV and PV (0.80 and 1.00 respectively) were recorded with moderate GCV (16.09 %) and PCV (17.93 %). High heritability (80.49 %) and GAM (29.74 %) were recorded with this character.Number of fruits per plant showed low GV and PV (2.01 and 3.54 respectively) with moderate GCV (12.83 %) and PCV (17.04 %) and high heritability (56.67 %) and moderate GAM of 19.89 % were recorded.Fruit length showed low GV and PV (3.01 and 4.64 respectively) were recorded with moderate GCV (13.95 %) and PCV (17.32 %). Fruit length has estimated to have high GAM (23.14 %) and heritability (64.85 %).Fruit diameter recorded low GV and PV (6.10 and 7.08 respectively) were recorded with moderate GCV (15.73 %) and PCV (16.94 %). Estimates of heritability (86.22 %) and GAM (30.09 %) were high for the character.Fruit weight showed low GV and PV (5.92 and 8.28 respectively) with moderate GCV (17.53 %) and PCV (20.73 %) as variable component estimates were recorded. The outcome of data indicates high GAM (30.54 %) and heritability (71.52 %).Fruit yield per plant recorded high GV and PV (1247.98 and 1704.33 respectively) were recorded with high GCV (23.07 %) and PCV (26.96 %). High heritability (73.22 %) and GAM (40.67 %) were combined with this character.Fruit yield per hectare showed low GV and PV (3.85 and 5.26 respectively) were recorded with high GCV (23.07 %) and PCV (26.96 %) for fruit yield per hectare. High heritability (73.22 %) and GAM (40.67 %) were combined with this character.

High PCV and GCV for the traits *viz.,* observed fornumber of branches per plant at 60 days after sowing, number of branches per plant at 90 days after sowing, plant height at 90 days after sowing, fruit yield per plant and fruit yield per hectare. The difference between PCV and GCV values were minimum, indicating that the traits under study were less influenced by environment and these characters could be improved by following phenotypic

selection.These results obtained from the studies carried out in okra are in accordance with Bello and Aminu (2017), Verma *et al*. (2018), Melaku *et al*. (2020) and Ashraf *et al.* (2020).

Low PCV and GCV for the traits *viz.*,plant height at 30 DAS, number of leaves per plant at 30 DAS, days to first flowering, days to 50 per cent flowering, days to fruit set and days to first fruit harvest.The low estimates of coefficient of variation indicated that the genotypes included in the present study possessed less genetic variability for these characters, while characters having high estimates of coefficient of variation indicated greater genetic variability among the genotypes for these attributes for making effective selection. Similar results were found by Kumar *et al.* (2019), Makhdoomi*et al.* (2018) and Rambabu *et al.* (2019).

High heritability coupled with high genetic advance as per cent of mean indicates operation of additive gene action which was observed in characters *viz.*,plant height at 60 DAS, plant height at 90 DAS, stem diameter at 30 DAS, stem diameter at 90 DAS, number of leaves per plant at 60 DAS, number of leaves per plant at 90 DAS, number of branches per plant at 60 DAS, number of branches per plant at 90 DAS, number of locules per fruit, fruit length, fruit diameter, fruit weight, fruit yield per plant and fruit yield per hectare.These results are in agreement with the findings of Alam *et al*. (2020), Ashraf *et al.* (2020), Melaku *et al.* (2020), Singh *et al*. (2020) and Ranga *et al.* (2021).

Moderate genetic advance as per cent of mean with high or moderate heritability suggests the action of both additive and non additive genes thereby favourable influence of environment in the expression. The same was reported in case of stem diameter at 60 DAS, days to first flowering, days to 50 per cent flowering, days to fruit set and days to first fruit harvest. Similar observations were recorded by Sharma *et al.* (2016), Kerure*et al*. (2017) and Melaku *et al*. (2020).

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Table 1: List of germplasm lines of okra selected for genetic diversity studies

Sl.no	**Genotype**	**Source of collection**
1	EC-305621	NBPGR, New Delhi
2	EC-305609	NBPGR, New Delhi
3	EC-305610	NBPGR, New Delhi
4	EC-280756	NBPGR, New Delhi
5	EC-169509	NBPGR, New Delhi

6	EC-305618	NBPGR, New Delhi
7	EC-305616	NBPGR, New Delhi
8	EC-305617	NBPGR, New Delhi
9	EC-169506	NBPGR, New Delhi
10	EC-169505	NBPGR, New Delhi
11	EC-305623	NBPGR, New Delhi
12	IC-42472	NBPGR, New Delhi
13	IC-39132	NBPGR, New Delhi
14	IC-42491	NBPGR, New Delhi
15	IC-34124	NBPGR, New Delhi
16	IC-42490	NBPGR, New Delhi
17	IC-42464	NBPGR, New Delhi
18	IC-42484	NBPGR, New Delhi
19	IC-40289	NBPGR, New Delhi
20	IC-42451	NBPGR, New Delhi
21	IC-39136	NBPGR, New Delhi
22	IC-39133	NBPGR, New Delhi
23	IC-42456	NBPGR, New Delhi
24	IC-39135	NBPGR, New Delhi
25	IC-39134	NBPGR, New Delhi
26	IC-39137	NBPGR, New Delhi
27	IC-42494	NBPGR, New Delhi
28	P-1	Periyapatna, Mysore, Karnataka
29	P-2	Periyapatna, Mysore, Karnataka
30	P-3	Periyapatna, Mysore, Karnataka
31	Arka Anamika	IIHR, Bangalore
32	Adilabad Local	Adilabad, Telangana

Table 2: Analysis of variance for twenty two characters in okra

Sl. No.	Source of variations	Replication	Genotype	Error
Degrees of Freedom		2	31	62
1	Plant height (cm) at 30 DAS	15.31	2.59**	1.02
2	Plant height (cm) at 60 DAS	34.32	147.01**	4.43
3	Plant height (cm) at 90 DAS	161.81	867.43**	24.47
4	Stem diameter (mm) at 30DAS	0.67	0.93**	0.16
5	Stem diameter (mm) at 60DAS	0.2	3.41**	0.44
6	Stem diameter (mm) at 90DAS	4	14.73**	1.4
7	Number of leaves per plant at 30 DAS	0.04	0.46	0.09
8	Number of leaves per plant at 60 DAS	1.49	17.69**	0.82
9	Number of leaves per plant at 90 DAS	0.92	27.36**	1.47
10	Number of branches per plant at 60 DAS	0.19	1.16**	0.03
11	Number of branches per plant at 90 DAS	0.25	2.11**	0.02
12	Days to first flowering	3.49	71.12**	8.13
13	Days to 50 per cent flowering	1.32	52.44**	8.63
14	Days to fruit set	0.8	57.22**	7.49
15	Days to first fruit harvest	4.71	59.27**	7.67
16	Number of locules per fruit	1.29	2.61**	0.19
17	Number of fruits per plant	7.54	7.56**	1.53
18	Fruit length (cm)	2.37	10.65**	1.63
19	Fruit diameter (mm)	0.57	19.29**	0.98
20	Fruit weight (g)	6.81	20.13**	2.36
21	Fruit yield per plant (g)	195.32	4200.3**	456.34
22	Fruit yield per hectare (t)	0.6	12.96**	1.41

*** and ** significant at P = 0.05 and P = 0.01 level of significance respectively**

Table 3: Estimation of different genetic parameters in okra genotypes for growth, flowering and yield traits.

Sl. No	Character	Mean	Range		GV	PV	GCV (%)	PCV (%)	H^2	GAM
			Max.	Min.						
1	Plant height (cm) at 30 DAS	14.03	16.35	12.41	0.52	1.55	5.14	8.86	33.66	6.14
2	Plant height (cm) at 60 DAS	37.44	51.20	23.36	47.53	51.95	18.41	19.25	91.48	36.28
3	Plant height (cm) at 90 DAS	84.65	139.10	47.61	280.99	305.46	19.80	20.65	91.99	39.12
4	Stem diameter(mm) at 30 DAS	3.19	4.59	2.25	0.26	0.41	15.93	20.19	62.27	25.90
5	Stem diameter(mm) at 60 DAS	9.03	11.37	7.14	0.99	1.43	11.02	13.26	69.01	18.85
6	Stem diameter (mm) at 90 DAS	15.40	19.70	11.78	4.44	5.84	13.69	15.70	76.03	24.59
7	Number of leaves at 30 DAS	5.70	6.47	5.20	0.13	0.21	6.22	8.06	59.55	9.88
8	Number of leaves at 60 DAS	14.72	20.40	11.33	5.62	6.45	16.11	17.24	87.25	30.99
9	Number of leaves at 90 DAS	23.08	29.40	17.37	8.63	10.10	12.73	13.75	85.45	24.24
10	Number of branches at 60 DAS	1.22	2.73	0.00	0.37	0.41	50.19	52.35	91.93	99.14
11	Number of branches at 90 DAS	2.45	4.27	0.00	0.70	0.72	34.10	34.55	97.41	69.33
12	Days to first flowering	46.86	56.87	36.40	20.99	29.13	9.78	11.52	72.08	17.10
13	Days to 50 per cent flowering	49.97	58.67	40.00	14.60	23.23	7.65	9.64	62.87	12.49
14	Days to fruit set	47.86	57.00	38.00	16.58	24.07	8.51	10.25	68.88	14.54
15	Days to first fruit harvest	55.40	64.67	44.33	17.20	24.87	7.49	9.00	69.16	12.82
16	Number of locules per fruit	5.57	8.67	5.00	0.80	1.00	16.09	17.93	80.49	29.74
17	Number of fruits per plant	11.05	15.20	8.33	2.01	3.54	12.83	17.04	56.67	19.89
18	Fruit length (cm)	12.44	15.73	8.03	3.01	4.64	13.95	17.32	64.85	23.14
19	Fruit diameter (mm)	15.71	24.29	12.08	6.10	7.08	15.73	16.94	86.22	30.09
20	Fruit weight (g)	13.88	19.22	7.89	5.92	8.28	17.53	20.73	71.52	30.54
21	Fruit yield per plant (g)	153.12	256.67	86.84	1247.98	1704.33	23.07	26.96	73.22	40.67
22	Yield per hectare (t)	8.51	14.26	4.82	3.85	5.26	23.07	26.96	73.22	40.67

GCV (%): Genotypic Coefficient of Variation **PCV (%):** Phenotypic Coefficient of Variation

GV: Genotypic Variance **PV:** Phenotypic Variance **H^2:** Heritability **GAM %:** Genetic Advance Mean