ASSESSMENT OF GENETIC VARIABILITY IN OKRA (*Abelmoschus esculentus* L. Moench) GENOTYPES

ABSTRACT

The present investigation was carried out at New Orchard, Main Agricultural Research Station, UAS, Raichur, during late *Kharif* 2021-22 using thirty-one genotypes and laid out in Randomized Block Design (RBD) with three replications. High magnitude GCV and PCV were reported for the traits *viz.*, fruit yield per hectare, fruit yield per plant, number of fruits per plant, plant height, leaf area per plant, number of ridges on fruit surface, fruit girth and fibre content. The traits *viz.*, number of nodes per plant, fruit length, ten fruits weight, shelf-life, stem girth, harvesting period and first flowering node recorded the medium GCV and PCV values. While, low GCV and PCV values were observed for the characters *viz.*, number of leaves per plant, chlorophyll content, days to 50 per cent flowering and days to first flowering. High heritability accompanied by high genetic advance over per cent mean was observed for number of ridges on fruit surface, number of fruits per plant, fruit yield per plant, fruit yield per hectare, fruit girth, leaf area per plant, plant height, number of nodes per plant, fruit length, fibre content, stem girth and ten fruits weight. Hence, characters showing high to moderate values of PCV, GCV and high estimate of heritability and genetic advance as per cent mean were considered as most important characters and selection of these traits will be more effective in improvement of fruit yield per plant.

Key words: Okra genotypes, Variability and Heritability

1. INTRODUCTION

Okra, scientifically known as Abelmoschus esculentus L. Moench and also referred to as lady's finger and bhendi, is a significant vegetable crop grown during the spring-summer and rainy seasons in tropical and sub-tropical regions worldwide. In areas with mild winters, it can be cultivated year-round. India is the largest producer of okra in the world with an

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annual production of 6.87 million tonnes from an area of 550 thousand hectares in 2019 - 2020 **(NHB-2019)**. Major okra-producing states in India include Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka, and Assam. The Agricultural and Processed Food Products Export Development Authority (APEDA) has established Agriculture-Export Zones in Punjab, Uttar Pradesh, Gujarat, Andhra Pradesh, Bihar, and West Bengal to boost vegetable exports, including okra. Okra holds substantial potential as a fresh vegetable crop contributing to India's foreign exchange earnings. Currently, it is exported to the United Arab Emirates, United Kingdom, Nepal, Bahrain, Saudi Arabia, Singapore, Kuwait, Qatar, and Sri Lanka (Anon., 2020).

It is an annual herbaceous plant and belongs to the family Malvaceae under the order Malvales, having a chromosome number of 2n=130 and is considered to be an amphidiploid. Okra being an often cross-pollinated crop, out crossing to an extent of 20 percent by insects, which renders a considerable amount of variability. Emasculation and pollination processes are easier in okra due to large flower and monadelphouss tamens.

The present investigation was conducted to study the variability, heritability, and genetic advance for different quantitative traits in okra, aiming to evaluate the potentialities of existing genotypes. This evaluation is crucial as it illustrates the genetic diversity of the base materials, which underpins the promise for further improvement. The success of a breeding programme targeting quantitative attributes heavily relies on the extent of genetic variability within the germplasm. Breeders can utilize heritability and genetic advance estimates to employ appropriate breeding methodologies in crop improvement, with economic yield being a complex, inheritably quantitative character influenced by multiple yield components and environmental factors (Johnson e*t al.*, 1955). Evaluating genetically different genotypes and cultivars requires observing various traits influencing yield, complicated by genotype by environment interactions. Hence, providing breeders with information on genetic coefficient of variation (GCV), broad-sense heritability (h^2), genetic advance (GA), and genetic advance as a percentage of the mean (GAM) offers insights into the nature of gene action governing specific traits, facilitating effective genotype-based selection (Burton and Devane, 1953).

2. MATERIAL AND METHODS

The study was conducted at New Orchard, Department of Horticulture, MARS, UAS, Raichur during late Kharif (2021 - 2022). Laboratory studies were performed at the Department of Agriculture Biochemistry, College of Agriculture, Raichur. The experimental materials included 31 okra genotypes (including check variety Arka Anamika) obtained from ICAR- National Bureau of Plant Genetic Resources (NBPGR), New Delhi, and ICAR- Indian Institute of Horticultural Research (IIHR), Bengaluru. These genotypes were evaluated in a Randomized Block Design (RBD) with three replications. Each plot measured 3.6 m in length and 2.4 m in width, spaced at 60 cm × 45 cm. Recommended agronomic practices and plant protection measures were followed as per the package of practices, UHS, Bagalkot (Anon., 2013).

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The observations were recorded on twenty different growth, reproductive, yield, and quality characters, with five randomly selected plants per plot in each replication. These characters included plant height, number of leaves per plant, leaf area per plant, internodal length, number of nodes per plant, stem girth, chlorophyll content (SPAD readings), days to first flowering, days to 50 per cent flowering, first flowering node, fruit length, fruit girth, ten fruits weight, number of fruits per plant, harvesting period, fruit yield per plant, fruit yield per hectare, number of ridges on fruit surface, shelf-life, and fibre content. Genotypic and phenotypic variances were calculated using mean square from variance tables (Johnson *et al.*, 1955). Genotypic coefficient of variation and phenotypic coefficient of variation were categorized as low (0-10 %), moderate (11-20 %), and high (21 % and above) following the method suggested by Burton and Devane (1953). Broad-sense heritability was calculated using the method suggested by Weber and Moorthy (1952) and categorized as low (0-30 %), moderate (30-60 %), and high (60 % and above) as given by Robinson *et al.* (1949). Genetic advance as a percentage over mean was calculated and categorized as low (0-10 %), moderate (11-20 %), and high (21 % and above) according to Johnson *et al.* (1955).

3. RESULTS AND DISCUSSION

Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance as per cent over mean (GAM) of the important characters were analyzed to record the degree of variability in okra genotypes and presented in Table 1.

3.1 Genotypic co-efficient of variation

High genotypic co-efficient of variation was reported for the traits *viz.*, fruit yield per hectare (55.93 %), fruit yield per plant (55.83 %), number of fruits per plant (55.62 %), plant height (27.26 %), leaf area per plant (24.01 %), number of ridges on fruit surface (24.06 %), fruit girth (22.94 %) and fibre content (20.52 %). Number of nodes per plant (18.87 %), followed by fruit length (13.80 %), ten fruits weight (13.72 %), shelf-life (13.05 %), stem girth (12.02 %), harvesting period (10.19 %) and first flowering node (10.44 %) recorded the medium GCV values. While, low GCV values were observed for the characters *viz.*,internodal length (9.94 %), number of leaves per plant (8.24 %), chlorophyll content (5.12 %), days to 50 per cent flowering (4.52 %) and days to first flowering (3.73 %).

The high GCV values indicated that maximum variability exists in these traits and there is enough scope for further improvement. The results of high GCV were in consonance to the earlier findings of Singh *et al.* (2017) for plant height, fruit girth and number of ridges on fruit surface, Priyanka *et al.* (2018), Samim *et al.* (2018) and Ranga *et al.* (2021) for number of fruits per plant and fruit yield per plant, Karadi *et al.* (2018) for fruit yield per hectare and Rambabu *et al.* (2019) for fiber content in okra.

3.2 Phenotypic co-efficient of variation

High phenotypic co-efficient of variation was reported for the traits *viz.*, fruit yield per hectare (57.23 %), fruit yield per plant (57.06 %), number of fruits per plant (55.62 %), plant height (28.23 %), leaf area per plant (24.83 %), number of ridges on fruit surface (24.06 %), fruit girth (23.59 %) and fibre content (21.69 %). Number of nodes per plant (19.92 %), shelf-life (19.09 %), internodal length (17.45 %), ten fruits weight (17.25 %), fruit length (14.69 %), stem girth (13.45 %), harvesting period (12.48 %) and first flowering node (11.85 %) recorded the medium PCV values. While, low PCV values were observed for the characters *viz.*, number of leaves per plant (9.80 %), chlorophyll content (8.68 %), days to 50 per cent flowering (6.10 %) and days to first flowering (4.33 %).

The results of high PCV were in consonance to the earlier findings of Singh *et al.* (2017) for plant height, fruit girth and number of ridges on fruit surface, Priyanka *et al.* (2018), Samim *et al.* (2018) and Ranga *et al.* (2021) for number of fruits per plant and fruit yield per plant, Karadi *et al.* (2018) for fruit yield per hectare and Rambabu *et al.* (2019) for fiber content in okra.

The per cent value of PCV was found to be greater than GCV for all the characters studied. The difference between GCV and PCV values was higher for the traits *viz.*, internodal length, chlorophyll content, shelf-life and days to 50 per cent flowering indicating that, influence of environment was more. While, the per cent values of GCV and PCV for remaining all traits under study were very close to each other indicating the influence of environment was minor and selection based upon phenotypic expression for these traits would be effective for improvement of this crop.

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3.3 Heritability and genetic advance as per cent over mean

Heritability plays an important role in estimating the heritable variations because GCV does not offer full scope to estimate the heritable variations. In present investigation, heritability was ranged between 32.46 to 100 per cent and genetic advances as per cent of mean was ranged between 6.23 to 114.56 per cent.

High heritability (h^2 BS) accompanied by high genetic advance over mean (GAM) was observed for number of ridges on fruit surface (h^2 BS= 100 % and GAM= 49.56 %), number of fruits per plant (h^2 BS= 99.98 % and GAM= 114.56 %), fruit yield per plant (h^2 BS= 95.71 % and GAM= 112.51 %), fruit yield per hectare (h^2 BS= 95.51 % and GAM= 112.60 %), fruit girth (h^2 BS= 94.59 % and GAM= 45.97 %), leaf area per plant (h^2 BS= 93.47 % and GAM= 47.82 %), plant height (h^2 BS= 93.26 % and GAM= 54.23 %), number of nodes per plant (h^2 BS= 89.82 % and GAM= 36.85 %), fruit length (h^2 BS= 88.24 % and GAM= 26.71 %), fibre content (h^2 BS= 80.97 % and GAM= 36.19 %), stem girth (h^2 BS= 79.88 % and GAM= 22.13 %) and ten fruits weight (h^2 BS= 63.23 % and GAM= 22.47 %) indicates involvement of additive gene effect, characters are heritable to next generation and selection based on these characters would be more effective. The results of high heritability coupled with high genetic advance over per cent mean in the present investigation are in agreement with the earlier findings of Kumari *et al.* (2017) for fruit yield per hectare, Singh *et al.* (2017) for plant height, stem girth, number of fruits per plant, fruit yield per plant and number of ridges on fruit surface, Morey *et al.* (2012) and Rambabu *et al.* (2019) for fibre content, Samim *et al.* (2018) for number of nodes per plant and ten fruits weight and Ranga *et al.* (2021) for fruit length and fruit girth in okra.

High heritability with moderate genetic advance over mean was observed for first flowering node (h^2 BS= 77.70 % and GAM= 18.96 %), number of leaves per plant (h^2 BS=

70.76 % and GAM= 14.28 %) and harvesting period (h^2 BS= 66.74 % and GAM= 17.15 %) while high heritability with low genetic advance over mean was observed for days to first flowering (h^2 BS= 74.43 % and GAM= 6.64 %). Days to 50 per cent flowering (h^2 BS= 54.93 % and GAM= 6.91 %) and chlorophyll content (h^2 BS= 34.81 % and GAM= 6.23 %) showed moderate heritability with low genetic advance over mean. Shelf-life (h^2 BS= 46.72 % and GAM= 18.38 %) and internodal length (h^2 BS= 32.46 % and GAM= 11.66 %) showed moderate heritability with moderate genetic advance over mean indicates involvement of non-additive gene effects which can be exploited by hybridization or heterosis breeding.

CONCLUSION

In present investigation high genetic variability in GCV and PCV indicating that characters offers great scope for selection due to high variation in genotypes. High heritability coupled with high GAM was observed for number of ridges on fruit surface, number of fruits per plant, fruit yield per plant, fruit yield per hectare, fruit girth, leaf area per plant, leaf area index, plant height, number of nodes per plant, fruit length, fibre content, stem girth and ten fruits weight and selection based on these traits will be effective.

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Table 1. Estimates of genotypic and phenotypic coefficient of variation, heritability and genetic advances as per cent of mean for different parameters in okra genotypes

Sl. No.	Characters	Range		GrandMean	GCV (%)	PCV (%)	h^2 BS(%)	GA (%)	GAM (%)
		Lowest	Highest						
	Growthparameters								
1	Plantheight (cm)	49.61	131.06	72.92	27.26	28.23	93.26	39.54	54.23
2	Numberofleavesper plant	16.92	29.29	22.41	8.24	9.80	70.76	3.20	14.28
3	Leafarea per plant (cm^2)	1105.46	6968.71	3833.98	24.01	24.83	93.47	1833.45	47.82
4	Internodallength (cm)	4.94	12.64	7.62	9.94	17.45	32.46	0.88	11.66
5	Number of nodes per plant	7.10	16.51	10.60	18.87	19.92	89.82	3.90	36.85
6	Stemgirth (mm)	10.74	20.83	15.19	12.02	13.45	79.88	3.36	22.13
7	Chlorophyll content (SPAD readings)	41.32	64.26	55.51	5.12	8.68	34.81	6.77	6.23
	Floweringparameters								
8	Days tofirstflowering	34.00	41.00	37.01	3.73	4.33	74.43	2.45	6.64
9	Daysto50 percent flowering	28.00	45.00	40.30	4.52	6.10	54.93	2.78	6.91
10	First flowering node	4.00	5.80	4.55	10.44	11.85	77.70	0.86	18.96
	Yieldparameters								
11	Fruitlength (cm)	7.66	19.06	14.22	13.80	14.69	88.24	3.80	26.71
12	Fruitgirth (mm)	14.44	44.72	19.08	22.94	23.59	94.59	8.77	45.97
13	10fruitsweight (g)	121.30	264.20	168.63	13.72	17.25	63.23	37.90	22.47
14	Harvesting period (days)	40.00	64.00	47.59	10.19	12.48	66.74	8.16	17.15
15	Numberoffruitsper plant	13.81	77.70	35.72	55.62	55.62	99.98	40.92	114.56
16	Fruityieldper plant (g)	207.36	1522.10	608.49	55.83	57.06	95.71	684.67	112.51
17	Fruityield per hectare (t)	2.28	16.73	6.82	55.93	57.23	95.51	7.68	112.60
	Quality parameters								
18	Number of ridges on fruit surface	8	5	6.16	24.06	24.06	100.00	3.01	49.56

19	Shelf life (days)	3.00	5.50	4.24	13.05	19.09	46.72	0.78	18.38
20	Fibre content (%)	6.75	16.09	11.45	20.52	21.69	80.97	4.14	36.19