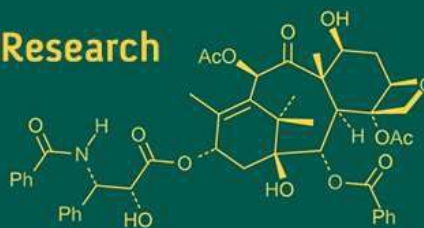
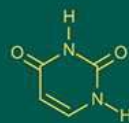


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Genetic variability, heritability and genetic advance for yield and yield attributing traits in okra (*Abelmoschus esculentus* (L.) Moench) genotypes

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Abstract

Forty genotypes of okra were studied for variability, heritability and genetic advance. The experiment was laid out in randomized block design at Kittur Rani Channamma College of Horticulture Arabhavi during *Kharif* season of 2016. Significant differences were observed for all the characters among forty diverse genotypes. Higher genotypic and phenotypic coefficients of variation were recorded for days to fruit maturity (21.73% and 22.00%), number of seeds per fruit (20.59% and 21.52%), yield per plant (17.47% and 18.60%) and 100 seed weight indicating that these traits had wide genetic variability and would be used for selection.

Keywords: Okra, genetic variability, heritability, genetic advance

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is commonly known as 'bhendi' or lady's finger in India. It is the choicest fruit vegetable grown extensively in the tropical, subtropical and warm area of the temperate zones of the world. It is a priced vegetable grown for its tender fruits in India. Okra is an annual herbaceous plant belongs to the family *Malvaceae* under the order *Malvales*, having a more common somatic 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 twenty percent by insects is reported which renders a considerable amount of variability. Emasculation and pollination processes are easier in okra due to large flower size and mono adelphous stamens (Singh *et al.*, 2014) ^[14].

Presence of sufficient variability in basic genetic material of any crop is a pre requisite for effective selection and improvement of superior genotypes. It is also equally important to assess the relative proportion of genetic and environmental components of variability, nature and extent of association between different yield attributes and relative importance of each component on yield.

Genetic advance denotes the improvement in the mean genotypic value of selected population over the parental population. Heritability estimates along with genetic advance are more helpful in predicting the improvement that can be made in a crop by selecting the elite genotypes for various characters. Hence there is need for estimation of genetic variability present in the okra genotypes for increasing the productivity. For this first step; evaluation of available variability in the germplasm so as to identify the potential genotypes for their use in breeding programmes as parents.

Materials and Methods

The present investigation was carried out at Kittur Rani Chanamma College of Horticulture Arabhavi. Forty diverse okra genotypes were collected from Kittur Rani Chanamma College of Horticulture Arabhavi and evaluated in a Randomized Complete Block Design with two replications during *Kharif* 2015-16. All the recommended cultural practices were followed to raise good crop. Observations were recorded from the five randomly selected plants in each experimental plot for the following parameters *viz.*, days to first flowering, days to 50 percent flowering, days to fruit maturity, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (mm), number of locules per fruit, yield per plant

(g), number of seeds per fruit and hundred seed weight (g)

Statistical analysis

The mean replicated data on various biometric traits were subjected to analysis of variance as per the standard statistical procedure (Panse and Sukhatme, 1957) [8]. Phenotypic and genotypic components of variance were estimated as per the formulae suggested by Burton and Devane (1953) [3]. Heritability in broad sense was estimated as per Weber and Moorthy (1952) [18]. Genetic advance was estimated as per the formula proposed by Johnson *et al.* (1955) [9]. The range of genetic advance as percent of mean was classified as low (< 10%), moderate (10–20%) and high (> 20%) as recommended by (Johnson *et al.* 1955) [19].

Table 1: Details of okra advanced lines which are used in the present investigation

Sl. No.	Genotype	Sl. No.	Genotype
1	Line-1	21	Line-21
2	Line-2	22	Line-22
3	Line-3	23	Line-23
4	Line-4	24	Line-24
5	Line-5	25	Line-25
6	Line-6	26	Line-26
7	Line-7	27	Line-27
8	Line-8	28	Line-28
9	Line-9	29	Line-29
10	Line-10	30	Line-30
11	Line-11	31	Line-31
12	Line-12	32	Line-32
13	Line-13	33	Line-33
14	Line-14	34	Line-34
15	Line-15	35	Line-35
16	Line-16	36	Line-36
17	Line-17	37	Line-37
18	Line-18	38	Line-38
19	Line-19	39	Line-39
20	Line-20	40	Line-40

Results and Discussion

Analysis of Variance

Significant difference was found for all the traits among forty genotypes. The analysis of variance for different quantitative and qualitative characters among forty genotypes of okra was represented in Table 2. The analysis of variance indicated significantly higher amount of variability among the genotypes for all the characters studied *viz.*, days to first flowering, days to 50 percent flowering, days to fruit maturity, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (mm), number of locules per fruit, yield per plant (g), number of seeds per fruit and hundred seed weight (g) indicates the presence of sufficient amount of variability in all the characters under study.

Genetic variability, heritability and genetic advance

Days to first flowering

The okra genotype Line-38 took least number of days (39.40) and Line-24 took maximum number of days (48.31), on average okra genotype took 43.64 days for appearance of first flower. The genotypic and phenotypic variances were 1.77 and 6.77, respectively. The estimates of phenotypic coefficient of variation (5.96) and genotypic coefficient of variation (3.05) were low with low heritability (26.00%)

along with low genetic advance as percent of mean (3.22%) and genetic advance (1.40).

Days to 50 percent flowering

The okra genotype Line-40 took least number of days (44.23) for 50 percent flowering, while Line-24 took maximum number of days (55.64), on an average Okra genotype took 49.37 days for appearance of 50 percent flowering. The genotypic and phenotypic variances were 2.56 and 9.40 respectively. The estimates of GCV and PCV were low (3.24% and 6.21% respectively). Low heritability (27%) was observed along with low genetic advance as percent of mean (3.48%) and genetic advance (1.71) for this trait.

Days to fruit maturity

Days to fruit maturity ranged from 3.37 (Line-28) to 8.38 (Line-33) with a mean value of 5.70. The GV and PV were 1.54 and 1.57, respectively. The estimates of GCV and PCV were high (21.73% and 22.00%, respectively). Very high heritability (97.00%) was observed along with very high genetic advance as percent of mean (44.22%) and GA (2.52).

Number of fruits per plant

Number of fruits per plant ranged from 25.05 (Line-20) to 38.84 (Line-24) with a mean value of 31.1. The GV and PV were 11.27 and 15.52, respectively. The estimates of GCV and PCV were low (10.75% and 12.61%, respectively). High heritability (75%) was observed along with moderate genetic advance as percent of mean (18.89%) and GA (5.89).

Average fruit weight (g)

Average fruit weight was maximum in Line-07 (21.27 g) and minimum was observed in Line- 08 (13.83 g) and it was ranged from 13.83 to 21.27 g with a mean value of 17 g. The GV and PV were 3.69 and 4.76, respectively. The estimates of GCV and PCV were moderate (11.30 and 12.84%, respectively). High heritability (77%) was observed along with high genetic advance as percent of mean (20.49%) and GA (3.48).

Fruit length (cm)

Fruit length ranged from 10.13 (Line-29) to 16.47 cm (Line-26) with a mean value of 13.49 cm. The GV and PV were 1.53 and 2.30, respectively. The low estimates of GCV and moderate estimate of PCV (9.17% and 11.25%, respectively). High heritability (66%) was observed along with moderate genetic advance as percent of mean (15.39%) and GA (2.07).

Fruit diameter of the fruit (mm)

Fruit diameter ranged from 12.11 (Line-37) to 19.20 mm (Line-14) with a mean value of 16.21 mm. The GV and PV were 2.15 and 3.22, respectively. The low estimates of GCV and moderate estimate of PCV (9.04% and 11.09%, respectively). High heritability (66%) was observed along with moderate genetic advance as percent of mean (15.19%) and GA (2.46).

Number of locules per fruit

Number of locules per fruit ranged from 5 (Line-10) to 6.5 (Line-06) with a mean value of 5.49. The GV and PV were

0.08 and 0.30, respectively. The low estimates of GCV and moderate estimate of PCV (5.17% and 10.06%, respectively). Low heritability (26%) was observed along with low genetic advance as percent of mean (5.46%) and GA (0.3).

Fruit yield per plant (g)

Total yield per plant was maximum in Line-08 (657.17 g) and it was minimum in Line- 39 (292.85 g). Total yield per plant ranged from 292.85 g to 657.17 g with a mean value of 443.5 g. The GV and PV were 6009.87 and 6808.77, respectively. The estimates of GCV and PCV were moderate (17.47% and 18.6%, respectively). High heritability (88%) was observed along with high genetic advance as percent of mean (33.82%) and GA (150.03).

Number of seeds per fruit

Number of seeds per fruit ranged from 40.65 (Line-20) to 87.63 (Line-29) with a mean value of 64.61. The GV and PV were 177.09 and 193.41, respectively. The estimates of GCV and PCV were high (20.59% and 21.52%, respectively). Very high heritability (91.00%) was observed along with very high genetic advance as percent of mean (40.59%) and GA (26.22).

Hundred seed weight

Hundred seed weight ranged from 4 (Line-16) to 8.12 g

(Line-10) with a mean value of 5.93g. The GV and PV were 1.2 and 1.32, respectively. The estimates of GCV and PCV were moderate (18.49% and 19.40%, respectively). Very high heritability (90%) was observed along with high genetic advance as percent of mean (36.30%) and GA (2.15).

The traits like days to first flowering, days to 50 percent flowering, days to fruit maturity, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (mm), number of locules per fruit, yield per plant (g), number of seeds per fruit and hundred seed weight (g). These results suggested that the inheritance of such traits governed mainly by additive gene effects hence selection based on phenotypic performance may performed useful. As high heritability accompanied with high genetic advance as percent mean indicates the prevalence of additive gene action, selection would be most effective.

The results are in consonance with by Bello *et al.* 2006 [2], Prakash and Pitchaimuthu (2010) [9], Reddy *et al.* (2012) [12], Kamalpreeth *et al.* (2013) [4], Ahamed *et al.* (2015) [20], Nikitha *et al.* (2016) [7], Thulasiram *et al.* (2017) [15], Kumar *et al.* (2019) [6], Kerure *et al.* (2017) [5] for pod length, Verma *et al.* (2018) [16], Rambabu *et al.* (2019) [10], Alam *et al.* (2020) [21], Ashraf *et al.* (2020) [1], Walling *et al.* (2020) [17] for number of seeds per pod, Singh *et al.* (2020) [13] and Ranga *et al.* (2021) [11].

Table 2: Analysis of variance for different characters in okra genotype

Sl. No.	Characters	Mean Sum of Squares			SEm±	CD @ 5%	CD @ 1%
		Replication	Genotype	Error			
1	Days to first flowering	142.23	8.55**	5.00	1.58	4.52	6.05
2	Days to 50 percent flowering	58.72	11.97**	6.84	1.85	5.29	7.09
3	Days to fruit maturity	32.11	3.10**	0.038	0.13	0.39	0.52
4	Number of fruits per plant	563.44	26.79**	4.24	1.45	4.16	5.57
5	Average fruit weight (g)	47.06	8.46**	1.07	0.73	2.09	2.80
6	Fruit length (cm)	102.83	3.83**	0.77	0.62	1.78	2.38
7	Fruit diameter (mm)	174.87	5.38**	1.08	0.73	2.10	2.81
8	Number of locules per fruit	0.175	0.38NS	0.22	0.33	0.96	1.28
9	Fruit yield per plant (g)	528.80	12818.64**	798.89	19.96	57.17	76.53
10	Number of seeds per fruit	0.26	370.48**	16.33	2.85	8.17	10.94
11	100 seed weight (g)	0.488	2.53**	0.12	0.24	0.70	0.94

Table 3: Different genetic parameters for quantitative and qualitative traits in okra germplasm

Sl. No.	Characters	Mean	Range	(GV)	(PV)	(GCV %)	(PCV %)	(h ² %)	(GA) at 5%	(GAM %) at 5%
1	Days to first flowering	43.64	39.40-48.31	1.77	6.77	3.05	5.96	26	1.40	3.22
2	Days to 50 percent flowering	49.37	44.23-55.64	2.56	9.40	3.24	6.21	27	1.71	3.48
3	Days to fruit maturity	5.70	3.37-8.38	1.53	1.57	21.73	22	97	2.52	44.22
5	Number of fruits per plant	31.21	25.05-38.84	11.27	15.52	10.75	12.61	75	5.89	18.89
4	Average fruit weight (g)	17.00	13.83-21.27	3.69	4.76	11.30	12.84	77	3.48	20.49
6	Fruit length (cm)	13.49	10.13-16.47	1.53	2.30	9.17	11.25	66	2.07	15.39
7	Fruit diameter (mm)	16.21	12.11-19.20	2.15	3.22	9.04	11.09	66	2.46	15.19
8	Number of locules per fruit	5.49	5.00-6.50	0.08	0.30	5.17	10.06	26	0.30	5.46
9	Yield per plant (g)	443.50	292.85-657.17	6009.87	6808.77	17.47	18.60	88	150.03	33.82
10	Number of seeds per fruit	64.61	40.65-87.63	177.09	193.41	20.59	21.52	91	26.22	40.59
11	100 seed weight (g)	5.93	4.00-8.12	1.20	1.32	18.49	19.40	90	2.15	36.30

GV- Genotypic variance; PCV- Phenotypic co-efficient of variation; GAM- Genetic advance as percent over mean

PV - Phenotypic variance; GCV- Genotypic co- efficient of variation; GA- Genetic advance;

Conclusion

The analysis of variance revealed significant variability among forty okra genotypes for various traits, indicating the potential for selection in breeding programs. Notably, traits such as days to fruit maturity, number of seeds per fruit, and

fruit yield exhibited high heritability and genetic advance, suggesting that additive gene effects predominantly govern their inheritance. This indicates that selecting based on phenotypic performance could be effective. The findings align with previous studies, reinforcing the importance of

these traits in okra improvement efforts. Overall, the results emphasize the potential for enhancing yield and quality through targeted selection.

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