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Studies on genetic variability in okra [*Abelmoschus esculents* (L.) Moench]

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Abstract

The present investigations entitled “Studies on genetic variability in okra (*Abelmoschus esculentus* (L.) Moench)” were carried out at the Horticulture Research Farm-I of the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University vidya Vihar Raebareilly road Lucknow- 226025(U.P.), India during the rainy season 2018. The experiment was laid out in an RBD randomized block design with three replications. The present study involved evaluation of seventeen genotypes of okra. The observations on various attributes recorded revealed that the maximum germination percent (71.67), days to 50% flowering (47.00), plant height (24.87), stem diameter (1.07), no. of branches per plant (6.32), leaves per plant (8.08), fruit length (13.43), fruits circumference (6.20), average fruit weight (21.33), no. of fruits per plant (12.73), acidity (0.74), TSS (7.43), ascorbic acid (11.62), moisture percent (83.73) and total fruit yield per plant (134.20). Analysis of variance showed significant differences among all the genotypes for all the characters studied. Genotypes Punjab Padmini, Kashi Pragti, Kasha Kranti, D-1-875, Pusa Sawani gave higher yield and also performed better for other horticultural traits under Lucknow conditions of Uttar Pradesh.

Keywords: Okra, analysis of variance, genotypes, heritability and genetic advance

Introduction

Okra [*Abelmoschus esculents* (L.) Moench $2n = 2x=130$] is one of the important members of the family Malvaceae and is well-known by many regional names as lady’s finger in England, Gumbo in USA, Bhindi in Pakistan and India. Okra is an African word and is native to northern Africa including the area of Ethiopia and Sudan. It is a summer and rainy season crop and is widely cultivated from tropics to sub tropics (Kochar, 1986) [4]. Okra (*Abelmoschus esculentus* L.) is probably an amphidiploid (allo-tetraploid) derived from *Abelmoschus tuberculatus* ($2n = 58$), a wild species from India, and a species (*Abelmoschus ficulneus* (L.) Wight with $2n = 72$ chromosomes. The highest chromosome number $2n=196$ reported in *Abelmoschus manihot* var. *Caillei* (Singh and Bhatnagar, 1975, Siemonsma, 1982a, 1982b) [9, 10, 11]. Okra plants are characterized by indeterminate growth. Okra is a herbaceous, annual, 1-2 m tall, stem erect, green or with reddish tinge, leaves alternate, broadly cordate, palmately 3-7 lobed, hirsute and serrate. The flower structure combines hermaphroditism and self-compatibility. Flowers are solitary, auxiliary with about 2 cm long peduncle, epicalyx up to 10, narrow hairy bracteoles which fall before the reaches maturity, calyx split longitudinally as flowers opens, petals 5, yellow with crimson spot on claw, 5-7 cm long, staminal column united to the base of petals with numerous stamens, ovary superior, stigma 5-9 deep red. The style is surrounded by a staminal column which may bear more than 100 anthers. The pollen may come in contact with the stigmas through a lengthening of the staminal column or through insect foraging. Thus, the flowers of okra are self-fertile. The pollen grain is large with many pores, and every pore a potential tube source; therefore, many tubes can develop from one pollen grain (Purewal and Randhawa 1947) [6]. Fruit is capsule, light green or sometimes red in colour pyramidal-oblong, beaked, longitudinally furrowed, 10-30 cm long, dehiscing longitudinally when ripe. Seeds green to dark brown, rounded with numerous stamens, ovary superior, stigma 5-9 deep red. The style is surrounded by a staminal column which may bear more than 100 anthers.

Materials and Methods

The present investigations entitled “Studies on genetic variability in okra (*Abelmoschus esculentus* (L.) Moench)” were carried out at the Horticulture Research Farm-I of the

Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University vidya vihar Raebareli road Lucknow- 226025 (U.P.), India during the rainy season 2018. The experiment was laid out in an RBD randomized block design with three replications. The present study involved evaluation of 17 genotypes of okra like Arka anamika, Kashi lila, Arka abhaya, Pusa Sawani, Kashi satdhari, Kashi vibhuti, Kashi Pragti, Kashi meghali, Kashi vardan, Kashi mohini, Kasha kranti, Prabhani kranti, Punjab - 7, Punjab padmini, D-1-875, HRB-55 and Pusa makhmali. Observations were recorded on five plants from each genotype in each replication. *Viz*, germination percent, days to 50% flowering, plant height, stem diameter, no. of branches per plant, leaves per plant, fruit length, fruits circumference (cm), average fruit weight, no. of fruits per plant, acidity, TSS, ascorbic acid, moisture percent and total fruit yield per plant. Statistical analysis of data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme.

Results and Discussion

Perusal of data on various 'Studies on genetic variability in okra (*Abelmoschus esculentus* (L.) Moench)' presented in Table-I reveals that there was a significant variation in different genotypes. The result obtained in the present investigation indicated that the genotypes evaluated differed significantly for all the 15 characters. Thus, suggested existence of sufficient variability in the genotypes. The average value of the genotypes for different characters and their range indicated that the materials used for estimating genetic and statistical information were suitable for the study. The observations were recorded on germination percent, days to 50% flowering, plant height, stem diameter, no. of branches per plant, leaves per plant, fruit length, fruits circumference (cm), average fruit weight, no. of fruits per plant, acidity, TSS, ascorbic acid, moisture percent and total fruit yield per plant. The assessment of existing variability in the materials was done by computing coefficient of variability at genotypic and phenotypic level Burton and de Vane (1953)^[2]. The heritability in broad sense Johnson *et al.* (1955)^[3] was calculated to understand the transmissibility of the traits.

The highest germination percent was exhibited by HRB-55 (71.67) and while lowest value was recorded in Kashi Kranti (35.00). The highest day to 50% flowering was exhibited by D-1-87-5 (47.00 days) while lowest value was recorded in Pusa Sawani (38.00 days). The highest and lowest values for plant height were observed in case of Pusa Makhmali (24.87

cm) and Kashi satdhari (22.89 cm) respectively. Stem diameter ranged from lowest value HRB-55 (0.94) to highest value Kashi Pragti (1.07). Number of leaves ranged from the highest value was recorded in case of Pusa Makhmali (8.08) and lowest value in Punjab -7 (6.54). number of branches per plant ranged the highest value was recorded in case of Prabhani Kranti (6.32) and lowest value in Pusa Makhmali (4.59). The highest and lowest values for fruit length were observed in case of HRB-55 (13.43) and lowest value in Punjab Padmini (9.74). The highest value was recorded in case of Punjab Padmini (6.20) and lowest value in HRB-55 (4.47) of fruit circumference. The highest value was recorded in case of Pusa Sawani (21.33) and lowest value in Kashi Vardan (16.67) of average fruit weight. The highest value was recorded in case of Punjab Padmini (12.73) and lowest value in Pusa Makhmali (7.42) of number of fruits per plant. The highest value was recorded in case of Kashi Lila (149.20) and lowest value in Punjab -7 (134.20) of total fruit yield per plant. The highest value was recorded in case of D-1-875 (0.74) and lowest value in Arka Anamika (0.63) of acidity. The highest value was recorded in case of Prabhani Kranti (6.32) and lowest value in Pusa Makhmali (4.59) of TSS. The highest value was recorded in case of Kashi Pragti (7.43) and lowest value in Pusa Makhmali (6.03) of ascorbic acid. The highest value was recorded in case of Kashi Meghali (83.73) and lowest value in Kashi Lila (76.65) of moisture percent.

The estimates of heritability in broad sense ranged from - 22.30 (leaves per plant) to 98.20 per cent (total fruit yield per plant). Highest estimates of heritability were observed for total fruit yield per plant (98.20%) followed by stem diameter (97.60%) and plant height (96.00%). The estimate of genetic advance in per cent of mean was recorded maximum in total fruit yield per plant (53.91%) while minimum was recorded in moisture percent (5.45%).

The high magnitude of heritability in broad sense was observed for most of the traits except total fruit yield per plant. The presence of high heritability coupled with high genetic advance in per cent of mean were observed for total fruit yield per plant, number of fruits per plant and germination percent which indicated that these characters may also provide good response to selection owing to their high transmissibility and variability and genetic advance showing additive gene effect. The above-mentioned findings are in agreement with earlier reports Rajput *et al.* (1996) and Singh *et al.* (2006)^[8] in bitter gourd; Amaral *et al.* (1994) in pumpkin and Karuppaiah *et al.* (2005) in ridge gourd genotypes.

Table 1: Analysis of variance of 15 characters in okra

S. No.	Characters d. f.	Source of variation		
		Replication (2)	Treatments (16)	Error (32)
1.	Germination percent	297.55	388.92	250.02
2.	Days to 50% flowering	12.96*	19.59**	3.67
3.	Plant height	0.17*	1.30**	0.05
4.	Stem diameter	0.001**	0.005**	0.000
5.	No. of branches per plant	10.80**	0.45*	0.21
6.	Leaves per plant	12.97**	0.41	0.50
7.	Fruit length	1.49	2.65**	0.88
8.	Fruits circumference (cm)	1.21**	0.65**	0.16
9.	Average fruit weight	11.66*	4.80	2.70
10.	No. of fruits per plant	4.13	9.16**	1.42
11.	Acidity	0.006	0.003	0.004
12.	TSS	0.10	0.55*	0.24
13.	Ascorbic acid	0.04	1.01*	0.51

14.	Moisture percent	0.68	13.82**	3.20
15.	Total fruit yield per plant	46.61	2,958.91**	51.86

** Significant at 1 per cent probability level.

Table 2: Estimates of range, grand mean, phenotypic, genotypic coefficients of variation (PCV, GCV), heritability in broad sense, genetic advance (\overline{GA}) in percent of mean for the 15 characters in okra

S. No.	Characters	Range		Grand mean	Variability		Heritability in broad sense (%) (h^2_{bs})	Genetic Advance in percent of mean
		Min.	Max.		PCV (%)	GCV (%)		
1	Germination Percent	35.00	71.67	49.95	22.79	13.62	35.70	21.49
2	days to 50% flowering	38.00	47.00	42.51	6.01	5.42	81.30	12.90
3	Plant height (cm)	22.89	24.87	23.76	2.77	2.71	96.00	7.01
4	Stem diameter (cm)	0.94	1.07	1.00	4.14	4.09	97.60	10.67
5	No. of branches per plant	4.59	6.32	5.10	7.60	5.54	53.00	10.64
6	Leaves per plant	6.54	8.08	7.39	4.98	2.35	-22.30	-2.93
7	Fruit length (cm)	9.74	13.43	11.33	8.29	6.78	66.80	14.63
8	Fruit circumference (cm)	4.47	6.20	5.27	8.82	7.70	76.10	17.74
9	Average fruit weight (gm)	16.67	21.33	19.21	6.58	4.35	43.60	7.59
10	No. of fruits per plant	7.42	12.73	9.34	18.71	17.20	84.50	41.75
11	Acidity	0.63	0.74	0.70	4.43	2.92	-43.30	-5.07
12	TSS	6.03	7.43	6.91	6.22	4.66	56.30	9.24
13	Ascorbic Acid	9.71	11.62	10.42	5.58	3.91	49.20	7.25
14	Moisture percent	76.65	83.73	79.90	2.69	2.36	76.80	5.45
15	Total fruit yield per plant	94.10	195.50	151.10	20.78	20.60	98.20	53.91

Table 3: Mean Performance of 17 genotypes for 15 characters in okra

S. No.	Genotypes	Germination percent	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	No. of Branches per plant	Leaves per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (gm)	No. of fruits per plant	Acidity (%)	TSS (%)	Ascorbic Acid (%)	Moisture percent	Total fruit yield per Plant
1	T ₁	38.33	42.67	23.45	1.04	4.70	7.57	11.66	6.00	20.50	7.81	0.63	6.77	9.97	76.95	144.53
2	T ₂	38.33	42.00	23.01	1.04	4.96	7.92	12.51	5.37	19.50	7.61	0.67	6.73	10.10	76.65	149.20
3	T ₃	42.50	40.00	23.83	1.07	4.82	6.94	11.32	5.93	19.83	8.64	0.68	6.40	11.42	78.34	134.20
4	T ₄	40.83	38.00	23.56	1.00	5.03	7.36	9.74	5.70	21.33	11.44	0.72	6.73	10.16	79.57	175.90
5	T ₅	45.00	40.67	22.89	0.97	5.10	7.37	11.12	5.23	19.33	7.86	0.69	6.47	9.82	79.51	115.40
6	T ₆	45.83	41.00	24.01	1.02	5.18	7.29	11.28	5.27	19.00	9.51	0.72	7.23	10.07	77.98	156.03
7	T ₇	46.67	39.67	22.94	1.07	5.28	7.52	11.04	5.00	19.50	11.84	0.68	7.43	10.65	80.64	189.23
8	T ₈	62.50	41.00	23.91	0.97	4.72	7.48	11.27	5.50	20.17	8.09	0.72	6.47	10.53	83.73	132.73
9	T ₉	54.17	42.00	23.01	0.98	5.20	7.59	10.20	4.77	16.67	7.42	0.72	7.37	10.28	83.68	94.10
10	T ₁₀	56.67	43.67	23.29	0.98	5.37	7.06	11.29	5.13	18.33	7.69	0.64	6.47	11.37	78.99	128.23
11	T ₁₁	35.00	41.00	23.55	1.00	5.11	7.46	10.77	5.20	21.00	11.42	0.68	7.23	10.72	77.55	185.57
12	T ₁₂	41.67	46.33	23.49	1.00	6.32	7.32	11.13	4.87	18.00	7.84	0.68	7.23	9.76	82.58	127.47
13	T ₁₃	42.50	44.67	24.22	0.96	5.20	6.54	9.84	5.03	18.33	8.23	0.69	7.40	11.62	81.68	106.23
14	T ₁₄	55.00	45.33	24.56	0.97	4.95	7.54	11.67	6.20	18.33	12.73	0.73	7.20	10.24	80.94	195.50
15	T ₁₅	63.33	47.00	24.68	0.97	5.32	6.94	12.22	5.10	19.17	10.63	0.74	7.07	10.19	80.51	183.77
16	T ₁₆	71.67	45.67	24.69	0.94	4.87	7.59	13.43	4.47	17.33	9.60	0.70	7.23	9.71	79.25	174.87
17	T ₁₇	69.17	42.00	24.87	0.95	4.59	8.08	12.22	4.90	20.17	10.40	0.73	6.03	10.55	79.79	175.77
	Mean	49.95	42.51	23.76	1.00	5.10	7.39	11.33	5.27	19.21	9.34	0.70	6.91	10.42	79.90	151.10
	CV %	31.66	4.51	0.95	1.11	9.02	9.53	8.27	7.46	8.56	12.74	9.19	7.11	6.88	2.24	4.77
	S.E.(M)	9.13	1.11	0.13	0.01	0.27	0.41	0.54	0.23	0.95	0.69	0.04	0.28	0.41	1.03	4.16
	CD 5%	26.30	3.19	0.38	0.02	0.77	1.17	1.56	0.65	2.73	1.98	0.11	0.82	1.19	2.98	11.98
	CD 1%	35.36	4.28	0.51	0.02	1.03	1.57	2.10	0.88	3.68	2.66	0.14	1.10	1.60	4.00	16.10
	Lowest	35.00	38.00	22.89	0.94	4.59	6.54	9.74	4.47	16.67	7.42	0.63	6.03	9.71	76.65	149.20
	Highest	71.67	47.00	24.87	1.07	6.32	8.08	13.43	6.20	21.33	12.73	0.74	7.43	11.62	83.73	134.20

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