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Genetic variability, heritability and Genetic advance in Okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract

The present experiment was carried out entitled “Genetic variability, heritability and Genetic advance in Okra [*Abelmoschus esculentus* (L.) Moench]” was conducted at Horticulture Research Farm of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya- Vihar, Rae Bareilly Road, Lucknow (U.P.) during the summer season from February 2017- May 2017. The experiment was laid out in Randomized Block Design with three replications. The experimental materials consisting sixteen genotypes of okra i.e. Pusa Sawani, Parbhani Kranti, IC-093724, Arka Abhay, IC-04484-B, VRO-4, VRO-5, IC-117263, VRO-6, Kashi Kranti, IC-128095, IC-117027, IC-033329, IC-117265, IC-042451 and IC-090184. The maximum phenotypic and genotypic variance, genetic advance was observed for fruit yield (q/ha) and fruit yield per plant. The highest of PCV and GCV was recorded in fruit yield per plot (kg) was estimated.

Keywords: genetic variability, heritability and genetic advance

Introduction

Okra or Lady’s finger [*Abelmoschus esculentus* (L.) Moench] belongs to family Malvaceae. Okra originated from tropical and sub-tropical Africa and is native to West Africa (Tindal, 1983). The crop was introduced to other parts of the world by the Portuguese (Sinnadurai, 1992). India is considered as the secondary center of diversity with a possibility of polyphyletic origin. In India, okra is commercially grown in state of Gujarat, Maharashtra, Tamil Nadu, Haryana, Punjab, Uttar Pradesh, Odisha, Bihar, West Bengal, Andhra Pradesh and Karnataka as a kharif as well as summer season crop. India is now, the second largest producer of vegetables in the world with a total production of 175.01 million tonnes from 10.29 million hectare area and grown in 2.8% of total cultivated land which share 13.38% of world production with a productivity of 17.01 million tons (NHB, 2016-17). The per capita availability of vegetables in India is low i.e. 175 g/day as against 285 g per day as per the recommendation of Food and Agriculture Organization (FAO). The prediction indicates that there is a further need of 27.2 million tons of vegetables other than potato and tubers to meet the nutritional requirements of the growing population i.e. 1200 million people by the year 2020- 2021. In India, okra covers an area of 0.538 million hectare and production of 6.145 million tones (NHB, 2016-17). It is an annual herbaceous vegetable crop that is grown for its tender fruits often consumed as vegetable (Chattopadhyay *et al.*, 2001) and other meal. The plant is a robust, erect, annual herb, ranging from 1-2m in height with simple leaves, which are alternate and palmately veined. It is generally amphidiploids in nature with $2n= 130$ chromosomes. It is often cross-pollinated where the natural cross pollination occurs from 8.75 – 9.61%. Okra is highly susceptible to frost and requires warm climate for fruit production. It has various uses as vegetables, soups, gravies stews in meat, seeds as a substitute for coffee and has nutritional and medicinal value. Okra is rich in vitamins, calcium, potassium and other minerals. Fresh okra fruit contains 2.1 g protein, 0.2 g fat, 8 g carbohydrate, 36 calories, 1.7 g fiber, 175.2 mg minerals and 88 ml of water per 100 g of edible portion (Tindal, 1983 and Berry *et al.*, 1988) [2].

Materials and Methods

The present investigation was done at Horticulture Research Farm of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya- Vihar, Rae Bareilly Road,

Lucknow (U.P.), during the summer season from February 2017- May 2017. The experiment was laid out in Randomized Block Design with three replications. Lucknow is characterized by sub-tropical climate with hot, dry summer and cold winter. The soil of experimental farm was saline with soil pH 8.2, Electrical conductivity 4.0 and sodium exchangeable percentage 15.0. During the period of experiment, meteorological observations were recorded from Indian Institute of Sugarcane Research, Lucknow. The experimental materials consisting sixteen genotypes of okra i.e. Pusa Sawani, Parbhani Kranti, IC-093724, Arka Abhay, IC-04484-B, VRO-4, VRO-5, IC-117263, VRO-6, Kashi Kranti, IC-128095, IC-117027, IC-033329, IC-117265, IC-042451 and IC-090184. Observations were recorded like number of leaves per plant, plant height (cm), stem diameter (cm), days to first flowering, flowers per plant, days to first fruit formation, branches per plant, fruits per branch, fruits per plant, fruit length (cm), fruit girth (cm), fruit weight (g), fruit acidity, vitamins c (mg/100g), fruits moisture (%) and fruit yield per plant were recorded. The heritable reported that the fruit yield, number of fruits per plant and plant height showed high to moderate heritability in both the years. Dhankar and Dhankar (2002) and Jindal *et al.*, (2009) [5] revealed that the mean sum of squares for genotypes were highly significant for all the characters indicating presence of genetic variability among the genotypes.

Results and Discussion

The extent of variability present in genotypes of okra was measured in terms of mean performance, range, mean, genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability, genetic advance and genetic gain of 16 parents for 18 characters of okra. All the varieties differed significantly with respect of different characters studied.

The highest and the lowest value for leaves per plant were observed in case of VRO-5 (33.50) and IC-090184 (24.00) respectively and general mean for the character was (28.81), The highest and the lowest value for plant height was observed in case of IC-128095 (53.84 cm) and Pusa Sawani (45.50) respectively and general mean for plant height was (50.01 cm), the maximum and minimum value for stem diameter was recorded for Kashi Kranti (1.39cm) and VRO-6 (1.30 cm) the general mean for the characters was (1.36 cm), the highest and the lowest value for Days to first flowering was recorded for IC-128095 (43.67) and IC-090184 (40.00) the general mean for the characters was (41.46), the highest days to flower per plant was exhibited by IC-033329 (14.66), while lowest for Kashi Kranti (11.20) the mean of this parameter for all the genotypes was found to be (12.78), the highest and the lowest value for days to first fruit formation was recorded for VRO-6 (47.84) and Arka Abhay (46.56) the general mean for the characters was (47.03), the highest branches per plant 4.09 were produced by IC-042451. the highest and the lowest value for fruit per branch was found in IC- 093724 (7.37), while lowest for Kashi Kranti (5.91) the general mean for all the genotypes, The highest number of fruits per plant was observed in VRO-4 (14.46) whereas the lowest was Pusa Sawani (10.12). The general mean for all the genotypes was 11.88 Among 16 genotypes four genotypes namely VRO-6 (11.84), VRO-5 (12.31), IC- 093724 (13.70) and Arka Abhay (11.47) were in the order of merit, the maximum fruit length was exhibited by VRO-4 (11.57 cm.). Whereas, Okra IC-04484-B possessed lowest value of 10.48 cm. However, Pusa Sawani (11.45), Parbhani Kranti (11.45

cm). VRO-6 (10.77 cm) was found to be at par with highest fruit length, the highest fruit girth of head was IC-04484-B (1.32 cm). While lowest value for IC- 093724 (1.17 cm.), the highest fruit weight was observed by Kashi Kranti (8.93 g) whereas the lowest fruit weight was recorded for Pusa Sawani (7.02 g). The general mean for all the genotype was (8.07 g) among 16 genotypes, the maximum fruit yield per plant was exhibited by VRO-6(107.79g) whereas Okra IC-04484-B possessed lowest value (65.15 g). However, VRO-4 (87.67g) and VRO- 5 was (78.53 g) and IC- 093724 (102.08g) found to be at par with highest yield per hectare, The highest and the lowest value for fruit yield per plot was found in IC-033329 (3.38kg) While lowest for IC- 128095 (2.07kg), the maximum and minimum for fruit yield was found in IC-117027 (128.44 q/ha) While minimum for VRO-6 (79.26q/ha) the general mean for all the genotypes was (99.96 q/ha), the highest and the lowest value for fruit acidity was found in Parbhani Kranti (7.00 g/l), while lowest value for VRO-4 (3.27g/l) the general mean for all the genotypes was (5.39g/l), The highest and the lowest value for Vitamin- C was found in IC-117263 (20.84 mg/100gm), while lowest for Kashi Kranti (15.75 mg/100gm) the general mean for all the genotypes was (19.48 mg/100gm) and The highest and the lowest value for fruit moisture was found in Pusa Sawani (90.04%) While lowest for (84.24%) the general mean for all the genotypes was (86.97%) among 16 genotypes.

The range, mean, genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability, genetic advance and genetic gain of 16 parents for 18 characters are presented in Table no-2. The phenotypic coefficient of variation (PCV) was higher than their respective genotypic coefficient of variation (GCV) for all the traits under study.

The widest range was recorded for fruit yield (q/ha) (79.26-128.44) followed by fruit yield per plant (kg) (65.15-107.79), number of leaves per plant (24.00-33.50), plant height (cm) (45.50-53.84), fruit moisture (%) (84.24-90.04), vitamin-C (15.75-20.84) and fruits per plant (10.12-14.46).

The coefficient of variation was estimated on sixteen genotypes for 18 character viz., the fruit yield Q/ha (222.46) showed the higher range followed by fruit yield per plant (g) (171.17), plant height (10.90), leaves per plant (8.58) and fruit moisture 6.28. The remaining characters viz. fruit per plant (1.93), fruit length (0.18), branches per plant (0.21), fruit per branches (0.26), fruit girth (0.00), stem diameter (0.00) and fruit yield per plot (0.29), vitamin-C (2.74), fruit acidity 1.58, fruit weight (0.39), flower per plant (1.49), days to first flowering (1.08) and days to first fruit formation (0.20) showed low range.

The genotypic coefficient of variation was estimated on sixteen genotypes for 18 characters viz., the fruit yield q/ha (163.78) showed the higher range followed by fruit yield per plant (g) (107.12), number leaves per plant (3.39) and plant height (3.60). The remaining character viz. Vitamin- c (1.63), fruit moisture % (1.56), fruit per plant (1.49), fruit acidity (1.19), flower per plant (1.03), days to first flowering (0.48), fruit weight(g) (0.30), fruit yield per plot (0.15), fruit per branch (0.10), days to first fruit formation (0.10), fruit length (0.08) and branch per plant (0.09).

Highest heritability (Broad Sense) was noticed for fruit per plant (0.77%), fruits weight (0.77%), fruit acidity (0.76%), fruit yield q/ha (0.74%), stem diameter (0.71%), flower per plant (0.69%), fruit yield per plant (0.63) showed moderate heritability vitamin – C (0.60%), fruit yield per plot (0.52%), days to first fruit formation (0.52%), fruit girth (0.51%), whereas, days to first flowering (0.44%), fruit length (0.44%),

fruit per branch (0.40%) branches per plant (0.41%), leaves per plant (0.38%), plant height (0.33%) and fruit moisture showed low heritability.

The genetic advance in percent of mean was highest in case of fruit Acidity (36.36%) followed fruit yield (q/ha) (22.63 %), days to first flowering (22.29%), fruit yield per plot (20.99%), fruit yield per plant (20.33%), fruit per plant (18.64%) flower

per plant (13.62%), fruit weight (12.27%), branches per plant (10.65%), vitamin-C (10.43 %) whereas, low genetic advance in % of mean observed in case of leaves per plant (8.02 %), fruit per branch (6.37%), fruit girth (5.32), plant height (4.49%), fruit length (3.40 %), stem diameter (2.42 %), fruit moisture (1.47 %) and days to first fruit formation (1.02%).

Table 1: Mean performance of 16 parents for 18 characters of okra

Genotypes	Symbol	Number of Leaves per plant	Plant height (cm)	Stem Diameter (cm)	Days to first Flowering	Flower per Plant	Days to first Fruit formation	Branches per plant	Fruit Per Branch	Fruit per plant	Fruit length	Fruit girth (cm)	Fruit weight (g)	Fruit Yield per Plant (g)	Fruit yield per plot (kg)	Fruit yield Q/h	Fruit acidity(*1000)	Vitamin C	Fruit Moisture %
Pusa Sawani	T1	27.92	45.50	1.38	41.66	11.78	47.33	3.67	6.67	10.12	11.25	1.28	7.02	70.34	3.23	98.06	6.97	7.00	90.04
Parbhanikranti	T2	27.75	47.10	1.35	42.00	13.66	46.70	3.58	6.33	11.35	11.45	1.17	8.84	85.25	2.54	103.23	7.00	19.63	88.18
IC-093724	T3	28.95	50.26	1.35	40.67	12.12	46.69	3.83	7.37	13.70	11.54	1.17	8.58	102.08	3.27	99.27	4.57	19.00	84.51
Arka Abhay	T4	30.25	49.40	1.36	41.00	12.11	46.56	2.92	6.87	11.47	10.97	1.29	8.37	78.70	2.11	97.96	4.60	20.67	86.52
IC-04484-B	T5	25.33	53.08	1.37	40.67	11.60	46.91	2.84	6.37	11.89	10.48	1.32	8.15	65.15	2.47	99.18	5.70	20.33	84.24
VRO-4	T6	31.17	49.75	1.37	41.67	14.04	47.35	4.00	6.38	14.46	11.57	1.25	8.27	87.67	2.40	110.30	3.27	20.27	88.44
VRO-5	T7	33.50	47.50	1.35	41.33	14.53	47.39	3.75	7.02	12.31	11.54	1.17	7.81	78.53	2.59	89.28	5.63	19.52	86.19
IC-117263	T8	30.75	49.67	1.36	40.67	13.33	47.30	3.88	6.54	10.31	10.79	1.25	7.01	86.40	3.23	85.59	3.70	20.84	86.41
VRO-6	T9	30.00	52.13	1.30	42.00	12.34	47.84	3.50	6.05	11.84	10.70	1.27	7.90	107.79	2.41	79.26	5.13	18.33	85.56
Kashi Kranti	T10	29.25	49.24	1.39	41.67	11.21	47.35	3.55	5.91	10.51	10.85	1.31	8.93	76.43	3.35	96.93	4.87	15.75	85.32
IC-128095	T11	27.75	53.84	1.34	43.67	11.87	46.64	3.83	7.02	11.84	11.41	1.21	7.80	73.51	2.07	112.01	4.60	20.67	86.12
IC-117027	T12	28.00	47.50	1.37	42.00	13.90	46.94	3.97	6.39	14.24	11.25	1.32	8.41	84.14	2.40	128.44	6.27	19.50	87.47
IC-033329	T13	28.50	51.01	1.37	41.67	14.67	47.01	3.83	6.80	11.56	11.29	1.30	8.58	71.99	3.38	118.03	6.63	19.08	87.80
IC-117265	T14	29.83	48.42	1.35	41.33	12.55	46.59	3.33	6.13	11.72	11.47	1.23	7.91	94.11	2.99	111.22	5.00	20.27	90.03
IC-042451	T15	28.00	53.08	1.36	41.33	12.48	47.09	4.09	6.85	10.98	10.95	1.30	7.44	86.20	2.97	88.95	5.33	20.43	86.05
IC-090184	T16	24.00	52.50	1.35	40.00	12.24	46.77	3.58	6.52	11.78	11.07	1.26	7.97	81.08	2.80	81.66	6.97	20.33	88.64
SEM		1.33	1.56	0.01	0.45	0.39	0.18	0.20	0.23	0.38	0.18	0.03	0.17	4.62	0.22	4.42	0.36	0.61	1.25
CD at 5%		3.84	6.07	0.02	1.30	1.13	0.52	0.59	0.66	1.10	0.52	0.07	0.50	13.35	0.63	12.77	1.03	1.76	3.62

Table 2: Estimation of range, mean, genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability, genetic advance and genetic gain of 16 parents for 18 characters of okra.

S/No.	Character	Range		Mean	Variance		PCV (%)	GCV (%)	h ² (%)	Genetic Advance	GA % of mean
		Min.	Max.		Phenotypic	Genotypic					
1.	Number of leaves per plant	24.00	33.50	28.81	8.58	3.29	10.17	6.29	0.38	2.31	8.02
2.	Plant height (cm)	45.50	53.84	50.01	10.90	3.60	6.60	3.80	0.33	2.25	4.49
3.	Stem diameter (cm)	1.30	1.39	1.36	0.00	0.00	1.65	1.39	0.71	0.03	2.42
4.	Days to first flowering	40.00	43.67	41.46	1.08	0.48	2.51	1.67	0.44	0.95	22.29
5.	Flowers per plant	11.21	14.67	12.78	1.49	1.03	9.54	7.94	0.69	1.74	13.62
6.	Days to first fruit formation	46.56	47.84	47.03	0.20	0.10	0.95	0.69	0.52	0.48	1.02
7.	Branches per plant	2.84	4.09	3.64	0.21	0.09	12.64	8.08	0.41	0.39	10.65
8.	Fruits per branch	5.91	7.37	6.58	0.26	0.10	7.77	4.90	0.40	0.48	6.37
9.	Fruits per plant	10.12	14.46	11.88	1.93	1.49	11.69	10.28	0.77	2.21	18.64
10.	Fruit length (cm)	10.48	11.57	11.17	0.18	0.08	3.75	2.49	0.44	0.38	3.40
11.	Fruit girth (cm)	1.17	1.32	1.26	0.00	0.00	5.07	3.62	0.51	0.07	5.32
12.	Fruit weight (g)	7.02	8.93	8.07	0.39	0.30	7.74	6.79	0.77	0.99	12.27
13.	Fruit yield per plant (kg)	65.15	107.79	83.09	171.19	107.12	15.75	12.46	0.63	16.46	20.30
14.	Fruit yield per plot (kg)	2.07	3.38	2.77	0.29	0.15	19.61	14.13	0.52	0.58	20.99
15.	Fruit yield (q/ha)	79.26	128.44	99.96	222.46	163.78	14.92	12.80	0.74	22.62	22.63
16.	Fruit acidity	3.27	7.00	5.39	1.58	1.19	23.31	20.27	0.76	0.0018	36.30
17.	Vitamins C	15.75	20.84	19.48	2.74	1.63	8.50	6.56	0.60	1.96	10.43
18.	Fruit Moisture %	84.24	90.04	86.97	6.28	1.56	2.88	1.43	0.25	2.03	1.47

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