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Genetic variability, heritability and genetic advance for selection parameters of genotypes in okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract
Present investigation was carried out at the Horticulture Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during summer season -2019. Analysis of variance revealed significant variability among the strains of okra for all character's studied. Heritability estimates varied from 42.97 percentage for duration of crop to 97.07 percent for plant height. Number of primary branches showed high (>25%) GCV. Moderately high variability for GCV coupled with high estimates of heritability were observed for length of internode, number of nodes per plant, plant height, number of fruits per plant, fruit yield per plant and fruit yield (q/ha). High heritability (>60%) was obtained for plant height, number of fruits per plant, fruit yield per plant, number of nodes per plant, number of primary branches, fruit yield (q/ha), length of internode, days to first flower initiation, days to 50% flowering, and days to first fruit set. The moderate heritability (<60%) was observed for days to first fruit picking, days to second fruit picking, fruit length and duration of crop. The genetic advancement as percent of mean (>20%) was found to be highest for number of primary branches, length of internode, number of nodes per plant, plant height, number of fruits per plant and fruit yield per plant, while the moderate genetic advance (<20 to >10%) was observed for fruit yield, days to first flower initiation, days to first fruit set, days to 50% flowering, days to first fruit picking, days to second fruit picking and fruit length.

Keywords: genetic variability, heritability, genetic advance, okra, *Abelmoschus esculentus*

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is one of the most important members of the family Malvaceae. It is native to Northern Africa including the area of Ethiopia and Sudan. It is closely related to the tropical flowering hibiscus and cotton having somatic chromosome number 2n = 130. Okra is distinctly grown on two seasons growing seasons *i.e.*, summer and rainy seasons. The flowers of okra are naturally self-fertile but belong to an often-cross-pollinated crop and found out crossing at an extent of about 20% by insects (Patil, 1995) [7]. Okra fruits are used as culinary preparation as sliced and fried pieces. It is also used for thickening soups and gravies, because of high content of mucilage. Okra fruits are also sliced for sun drying or canning or pickled for off season utilization of processed food. The pollen grain is large in size with many pores, and every pore have a potential tube source; therefore, many tubes can develop from one pollen grain (Purewal and Randhawa 1947) [9]. Fruit is capsule, light green or sometimes red in colour pyramidal-oblong, beaked, longitudinally furrowed, 10-30 cm long, dehiscing longitudinally when ripe. The genetic improvement in okra depends upon the different selection parameters *viz.* genetic variability, heritability, genetic advance, correlation, path coefficient analysis and genetic divergence of the newly introduced genotypes. Genetic variability is an essential perquisite for crop improvement programme for obtaining high yielding varieties. On the other hand, yield being complex character is associated with some yield contributing characters. The understanding of association of characters is of prime importance in developing an efficient breeding programme.

Materials and Methods

An experiment was conducted at Horticulture Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during summer season-2019. The research materials comprised forty number of genotypes of diverse nature namely (Table-1). The genotypes were evaluated in RBD with three replications with row to row and plant to plant 60x30 cm sown in order to test the validity of performance of each variety statistical analysis was done for all the morphological observations. Observations were recorded on five randomly selected plants in each replication and each plot for days to first flower initiation, days to 50% flowering, plant height, number of primary branches, number of nodes per plant, length of internode, fruit length, days to first fruit set, number of fruits per plant, days to first fruit picking, days to second fruit picking, duration of crop, fruit yield per plant and fruit yield. The data for quantitative characters were subjected to analysis of variance (ANOVA) for randomized completely block design statistically analysed. The difference between treatments means were compared using 'F' value at 1% and 5% probability levels.

Estimation of Variability: Different parameters such as mean, coefficient of variation etc. were used to estimate to the diversity present among the genotypes for different quantitative traits and genotypic variances and coefficient of variation using formula suggested by Burton [1] as:

Genotypic variance ($\sigma^2 g$)

$$= \frac{MSg - Mse}{r}$$

Where, r is numbers of replications, MSg is mean square due to genotypes, MSe is mean square of error (Environmental variance), Environmental variance (σ^2 e) is error mean square, Phenotypic variance ($\sigma^2 p$) is $\sigma^2 g$ + MSe where, $\sigma^2 g$ is genotypic variance and phenotypic coefficient variation (PCV) estimated as the following formula:

$$PCV = \frac{\sqrt{\sigma^2 p}}{GM} \times 100$$

Where, GM is an overall mean of character and $\sigma^2 p$ is $\sigma^2 g$ + MSe

$$GCV = \frac{\sqrt{\sigma^2 g}}{GM} \times 100$$

Where, GM is an overall mean of character and $\sigma^2 g$ is MSg + MSe/ Replications

$$H \text{ (board sense)} = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

Where
$\sigma^2 g$ = Genotypic variance
$\sigma^2 p$ = phonotypic variation (Variance genotypic + variance environmental)

Estimation of Heritability: Heritability is the ratio of the genotypic variance to the total variance i.e., phenotypic variance (genotypic and environmental), and it denotes the proportion of phenotypic variance that is due to genotypic i.e., heritable and calculated as per the formula given by (Hasan *et al.*, 1956) [2].

Estimation of Genetic Advance: it is the improvements in the mean genotypic value of the selected families over the base population.

Genetic advance was calculated in percent of mean according to Johnson *et al.*, (1955) [3].

$$GA \text{ (\% of mean)} = \frac{\sigma^2 g \times (K)}{(\sigma^2 \rho) \times mean} \times 100$$

Where
K, Selection differential at 5% selection intensity (K = 2.06)
$\sigma^2 g$ = Genotypic variance
$\sigma^2 \rho$ = Phenotypic stand and deviation of the character

Result and Discussion

Variability Parameters

The analysis of variance revealed a significant variance (Table-2) among the genotypes for all traits *viz*., days to first flower initiation (54.73**), days to 50% flowering (52.77**), plant height (428.93**), number of primary branches (1.73**), number of nodes per plant (33.75**), length of internode (1.81**), fruit length (2.25**), days to first fruit set (52.96**), number of fruits per plant (6.29**), days to first fruit picking (49.82**), days to second fruit picking (50.88**), duration of crop (56.28**), fruit yield per plant (502.64**) and fruit yield (152.76**) indicated that presence of wide spectrum of variability among the genotypes. The mean values of all traits present in (Table-3) and Genetic variability parameters like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as percent of mean at 5% are mentioned in (Table-4) respectively. Estimation of mean for all the characters studied where, a wide range was observed for maximum days to first flower initiation was showed in cultivar EC-305768 (56.47 days) and the minimum days to first flower initiation was observed in Pusa Sawani (38.80 days) with an overall mean value (44.52), coefficient of variation (4.36), standard error (1.59) and critical difference (3.16). The variety EC-305768 (59.40 days) had maximum days to 50% flowering and Pusa Sawani (47.56 days) was showed minimum days 50% flowering with an overall mean value (47.56), coefficient of variation (4.10), standard error (1.59) and critical difference (3.1). The genotype VRO-3 (105.10 cm) recorded the highest plant height and minimum plant height occurred EC-305644 (62.60 cm) with an overall mean value (79.39), coefficient of variation (2.61), standard error (1.69) and critical difference (3.37). The germplasm EC-359637 (5.07) showed maximum number of primary branches and IC-014026, IC-013664 (1.67) showed minimum number of primary branches with an overall mean value (2.39), coefficient of variation (10.00), standard error (0.20) and critical difference (0.39). The genotype EC-305642 has been recorded maximum number of nodes per plant (32.85) and genotype VRO-4 recorded the minimum number of nodes per plant (14.62) with an overall mean value (19.96), coefficient of variation (5.24), standard error (0.86) and critical difference (1.71). The maximum length of internode was recorded in Arka Anamika (5.33 cm) and the minimum length of internode was exhibited for EC-305642 (2.11 cm) with an overall mean value (4.16), coefficient of variation (8.46),

standard error (0.29) and critical difference (0.57). The germplasm IC-013664 (11.20 cm) showed maximum fruit length and Y.V.S-9 (7.70 cm) showed minimum fruit length with an overall mean value (9.09), coefficient of variation (8.95), standard error (0.66) and critical difference (1.33). Maximum days to first fruit set was recorded in cultivar EC-305768 (58.43 days) and minimum days to first fruit set was observed in cultivar Pusa Sawani (40.40 days) with an overall mean value (46.44), coefficient of variation (4.23), standard error (1.60) and critical difference (3.20). The maximum number of fruits per plant was observed in germplasm VRO-3 (15.40) and minimum number of fruits per plant was observed in germplasm EC-305637 (8.37) with an overall mean value (10.24), coefficient of variation (4.02), standard error (0.34) and critical difference (0.67). The genotype EC-305768 (63.03 days) takes maximum days to first fruit picking and cultivar Pusa Sawani (44.60 days) takes minimum days to first fruit picking with an overall mean value (51.33), coefficient of variation (4.36), standard error (1.83) and critical difference (3.64). The genotype EC-305768 (66.90 days) takes maximum days to second fruit picking and cultivar Pusa Sawani (48.73 days) takes minimum days to second fruit picking with an overall mean value (56.18), coefficient of variation (4.07), standard error (1.87) and critical difference (3.72). The genotype EC-305768 (110.70 days) had maximum and the genotype Pusa Sawani (85.97 days) had minimum duration of crop with an overall mean value (97.18), coefficient of variation (4.27), standard error (3.39) and critical difference (6.77). The maximum fruit yield per plant was observed in cultivar VRO-3(146.97 gm) and the minimum fruit yield per plant was observed in cultivar EC-305637(87.00 gm) with an overall mean value (104.98), coefficient of variation (3.57), standard error (3.06) and critical difference (6.10). The genotype VRO-3 (92.15 q/ha) exhibited the maximum fruit yield and the genotype EC-305637 (58.83 q/ha) shows minimum fruit yield (q/ha) with an overall mean value (68.88), coefficient of variation (4.69), standard error (2.64) and critical difference (5.26). (Phanikrishna *et al.*, 2015, Mudhalvan *et al.*, 2018 and Kumar *et al.*, 2019) [8, 6, 4].

Analysis of GCV, PCV, heritability and genetic advance as percent of mean was observed for days to first flower initiation GCV (9.26), PCV (10.23), heritability (81.83) and genetic advance as percent increase over mean (17.25). Days to 50% flowering was showed the values of GCV (8.50), PCV (9.43), heritability (81.12) and genetic advance as percent increase over mean (15.76). Plant height was exhibited values of GCV (14.99), PCV (15.21), heritability (97.07) and genetic advance as percent increase over mean (30.42). The GCV (31.24), PCV (32.80), heritability (90.70) and genetic advance as percent increase over mean (61.28) were observed for number of primary branches. Length of internode was observed for GCV (17.99), PCV (19.88), heritability (81.89) and genetic advance as percent increase over mean (33.53). Fruit length was showed the values for GCV (8.00), PCV (12.01), heritability (44.42) and genetic advance as percent increase over mean (10.99). Days to first fruit set was exhibited values of GCV (8.71), PCV (9.68), heritability (80.91) and genetic advance as percent increase over mean (16.14). The variability parameters *viz;* GCV (13.96), PCV (114.52), heritability (92.34) and genetic advance as percent increase over mean (27.63) were recorded from the number of fruits per plant. Days to first fruit picking were displayed an estimate for GCV (7.53), PCV (8.70), heritability (74.91) and genetic advance as percent increase over mean (13.43). Days to second fruit picking had estimates for GCV (6.94), PCV (8.05), heritability (74.45) and genetic advance as percent increase over mean (12.34). The GCV (3.71), PCV (5.66), heritability (42.97) and genetic advance as percent increase over mean (5.01) were observed for duration of crop. Fruit yield per plant was observed for GCV (12.16), PCV (12.67), heritability (92.08) and genetic advance as percent increase over mean (24.03). Fruit yield (q/ha) was displayed an estimation for GCV (10.00), PCV (11.04), heritability (82.01) and genetic advance as percent increase over mean (18.66) in this study. A crossing between genotypes having higher values for the useful traits will helps an improvement of characters and in development of new genotypes with increase in fruit yield (Sravanthi *et al.*, 2017, Syfullah *et al.*, 2018 and Kumari *et al.*, 2019) [11, 12, 5]. A close resemblance between the corresponding estimates of phenotypic coefficient of variation and genotypic coefficient of variation suggested that little role of environment in the expression of different traits.

It is evident from the Table 3 that phenotypic variances ranging between duration of crop (5.66) and number of primary branches (32.80) and genotypic variances ranging between duration of crop (3.71) and number of primary branches (31.24). The estimates of phenotypic coefficient of variation (PCV) for different characters. The phenotypic coefficient of variation (>25%) was observed for number of primary branches (32.80). The moderate phenotypic co-efficient of variation (10-25%) was observed for length of internode (19.88), number of nodes per plant (17.34), plant height (15.21), number of fruits per plant (14.52), fruit yield per plant (12.67), fruit length (12.01), fruit yield (11.04) and days to first flower initiation (10.23). However, low phenotypic co-efficient variation (<10%) was observed for days to first fruit set (9.68), days to 50% flowering (9.43), days to first fruit picking (8.70), days to second fruit picking (8.05) and duration of crop (5.66). The genotypic coefficient of variation (GCV) was found to be less than phenotypic coefficient of variation (PCV) for all traits studied, which indicated that these characters were having interaction with environment to some extent. The high percentage of genotypic coefficient of variation (>25%) was observed number of primary branches (31.24). The moderate genotypic coefficient of variation (10-25%) was observed for length of internode (17.99), number of nodes per plant (16.53), plant height (14.99), number of fruits per plant (13.96) fruit yield per plant (12.16) and fruit yield (10.00). However, low genotypic coefficient of variation (<10%) was observed for days to first flower initiation (9.26) followed by days to first fruit set (8.71), days to 50% flowering (8.50), fruit length (8.00), days to first fruit picking (7.53), days to second fruit picking (6.94) and duration of crop (3.71).

The present finding showed that estimates of PCV were generally higher than their corresponding GCV for all the characters studied, indicated that the influence of environment in expressing the variability with traits. (Thulasiram *et al.*, 2017, Syfullah *et al.*, 2018 and Kumari *et al.*, 2019) [13, 12, 5]. The data revealed that the heritability in broad sense ranged from (42.97) for duration of crop to (97.07) for plant height. High heritability (>60%) was obtained for plant height (97.07), number of fruits per plant (92.34), fruit yield per plant (92.08), number of nodes per plant (90.86), number of primary branches (90.70), fruit yield (82.01), length of internode (81.89), days to first flower initiation (81.83), days to 50% flowering (81.12), and days to first fruit set (80.91). The moderate heritability (<60%) was observed for days to

first fruit picking (74.91), days to second fruit picking (74.45), fruit length (44.42) and duration of crop (42.97), denotes high proportion of additive genetic components in the inheritance of these attributes. (Sravanthi *et al.,* 2017, Verma *et al.,* 2018 and Kumari *et al.,* 2019) [11, 14, 5]. The data showed that the genetic advance expressed as percentage of mean was high (>20%) for number of primary branches (61.28), length of internode (33.53), number of nodes per plant (32.45), plant height (30.42), number of fruits per plant (27.63) and fruit yield per plant (24.03). While the moderate genetic advance (<20 to 10%) was observed for fruit yield (18.66), days to first flower initiation (17.25), days to first fruit set (16.14), days to 50% flowering (15.76), days to first fruit picking (13.43), days to second fruit picking (12.34) and fruit length (10.99), whereas, duration of crop (5.01) showed low genetic advance (<10%). Thereby, suggesting average response for selection based on *per se* performance. (Syfullah *et al.,* 2018 and Rambabu *et al.,* 2019) [12, 10].

Table 1: List of germplasm/cultivar included in the trial

S. No.	No. of germplasm	Source	S. No.	No. of germplasm	Source
1.	Hisar Naveen	HAU, Hisar	21.	368-A	IARI, New Delhi
2.	Varsha Uphar	HAU, Hisar	22.	Hisar Unnat	HAU, Hisar
3.	Punjab Kranti	PAU, Ludhiana	23.	IC-18530	Dr. PDKV, Akola
4.	Arka Anamika	IIHR, Bengaluru	24.	EC-305642	Dr. PDKV, Akola
5.	Arka Abhay	IIHR, Bengaluru	25.	EC-305643	Dr. PDKV, Akola
6.	Pusa Sawani	IARI, New Delhi	26.	EC-305644	Dr. PDKV, Akola
7.	Pusa A-4	IARI, New Delhi	27.	EC-305645	Dr. PDKV, Akola
8.	Parbhani Kranti	MPKV, Rahuri	28.	EC-305639	Dr. PDKV, Akola
9.	Kashi Pragati	IIVR, Varanasi	29.	IC-014026	Dr. PDKV, Akola
10.	Mona	Lawad, Meerut	30.	EC-305638	Dr. PDKV, Akola
11.	Kashi Kranti	IIVR, Varanasi	31.	EC-305637	Dr. PDKV, Akola
12.	U.S-8063	IARI, New Delhi	32.	EC-305635	Dr. PDKV, Akola
13.	IC-090491	IARI, New Delhi	33.	EC-305768	Dr. PDKV, Akola
14.	Y.V.S-9	IARI, New Delhi	34.	IC-013356	Dr. PDKV, Akola
15.	IC-316/2,4,5	IARI, New Delhi	35.	IC-013664	Dr. PDKV, Akola
16.	IIVR-II	IIVR, Varanasi	36.	EC-359637	Dr. PDKV, Akola
17.	VRO-3	IIVR, Varanasi	37.	IC-15027	Dr. PDKV, Akola
18.	VRO-4	IIVR, Varanasi	38.	EC-305640	Dr. PDKV, Akola
19.	VRO-5	IIVR, Varanasi	39.	IC-010265	Dr. PDKV, Akola
20.	VRO-6	IIVR, Varanasi	40.	IC-14909	Dr. PDKV, Akola

Table 2: Analysis of variance for 14 characters in Okra [*Abelmoschus esculentus* (L.) Moench]

Source of variation	DF	Days to first flower initiation	Days to 50 % flowering	Plant height (cm)	Number of primary branches	Number of nodes per plant	Length of internode (cm)	Fruit length (cm)
Replication	2	1.25	3.48	0.08	0.03	0.67	0.04	0.24
Treatment	39	54.73**	52.77**	428.93**	1.73**	33.75**	1.81**	2.25**
Error	78	3.77	3.80	4.28	0.06	1.10	0.12	0.66

Source of variation	DF	Days to first fruit set	Number of fruits per plant	Days to first fruit picking	Days to second fruit picking	Duration of crop	Fruit yield per plant (gm)	Fruit yield (q/ha)
Replication	2	0.49	0.29	3.71	0.38	7.78	17.69	3.09
Treatment	39	52.96**	6.29**	49.82**	50.88**	56.28**	502.64**	152.76**
Error	78	3.86	0.17	5.00	5.22	17.25	14.01	10.41

*, ** significant at 5% and 1% level, respectively

Table 3: Mean performance of 40 genotypes and 14 characters of okra [*Abelmoschus esculentus* (L.) Moench]

S. No.	Genotypes	Days to first flower initiation	Days to 50 % flowering	Plant height (cm)	Number of primary branches	Number of nodes per plant	Length of internode (cm)	Fruit length (cm)	Days to first fruit set	Number of fruits per plant	Days to first fruit picking	Days to second fruit picking	Duration of crop	Fruit yield per plant (gm)	Fruit yield (q/ha)
1	Hisar Naveen	41.47	44.20	79.60	2.23	20.05	4.39	9.34	43.47	8.93	48.47	52.53	93.33	92.47	61.87
2	Varsa Uphar	41.13	44.17	85.27	2.60	18.53	4.90	10.62	42.80	10.90	47.27	52.23	94.67	104.58	68.60
3	Punjab Kranti	43.67	46.67	86.73	2.77	19.22	4.93	9.61	45.40	10.60	49.97	54.60	97.20	106.70	69.78
4	Arka Anamika	43.27	45.63	88.47	3.67	18.26	5.35	9.35	45.33	9.52	50.43	55.97	100.80	104.60	68.61
5	Arka Abhay	43.27	46.67	97.60	3.10	20.07	5.33	9.27	45.40	11.67	50.37	55.80	101.37	111.93	72.68
6	Pusa sawani	38.80	42.50	95.07	2.00	19.14	4.99	8.15	40.40	10.03	44.60	48.73	85.97	105.33	69.02
7	Pusa A-4	43.60	45.90	86.73	2.47	22.70	3.82	8.63	45.30	10.93	49.80	53.90	96.91	101.81	67.06
8	Parbhani Kranti	42.53	46.80	99.03	2.40	20.55	5.24	10.11	45.47	12.07	50.30	55.13	95.83	123.13	78.91
9	Kashi Pragati	39.53	43.00	88.42	2.39	19.97	4.89	10.17	41.53	10.80	46.53	49.33	94.83	114.23	73.96
10	Mona	42.33	45.93	73.00	2.00	20.99	3.89	8.63	44.67	9.33	48.67	53.80	94.57	98.43	65.19
11	Kashi Kranti	42.27	45.27	87.67	3.03	19.64	4.72	8.85	44.27	9.13	48.70	53.47	97.23	104.20	68.24
12	U.S-8063	51.47	54.47	75.77	2.47	17.19	4.61	8.33	52.87	9.40	58.53	63.37	100.77	94.50	64.43
13	IC-090491	53.00	55.80	81.93	2.80	20.36	4.57	10.42	54.53	9.47	56.73	61.80	100.91	95.83	63.61
14	Y.V.S-9	41.83	45.00	78.17	2.07	20.31	3.70	7.70	43.37	9.27	48.30	53.37	95.80	93.07	62.20

15	IC-316/2,4,5	50.27	53.87	80.53	2.07	20.35	3.96	9.47	52.13	10.43	57.00	62.23	104.27	105.00	68.83
16	IIVR-II	46.27	49.30	75.43	2.03	17.51	4.25	9.67	48.40	9.33	52.33	57.53	102.63	99.67	65.87
17	VRO-3	42.27	45.27	108.60	2.77	20.57	5.26	10.37	44.20	15.40	48.67	54.47	97.67	146.97	92.15
18	VRO-4	42.57	45.53	67.17	1.77	14.62	3.58	9.93	44.67	9.80	49.30	54.33	99.33	97.40	64.67
19	VRO-5	48.33	51.20	105.10	2.97	20.40	5.06	10.67	50.20	14.07	55.47	60.40	102.33	134.97	85.48
20	VRO-6	41.93	45.00	67.20	1.77	20.20	3.52	7.73	43.30	8.80	48.60	54.53	94.77	89.73	60.35
21	368-A	42.20	45.27	94.84	2.60	20.23	4.80	9.33	44.20	11.53	50.63	55.67	97.43	119.53	76.91
22	Hisar Unnat	41.37	44.40	70.33	2.20	18.47	3.81	8.39	43.23	10.13	49.23	54.70	98.53	107.50	70.23
23	IC-18530	43.73	46.67	82.03	2.20	22.18	3.72	8.20	45.73	10.73	51.21	56.13	99.73	110.33	71.79
24	EC-305642	53.07	55.40	69.33	1.73	32.85	2.11	8.31	54.43	8.90	59.37	64.47	99.90	93.73	62.58
25	EC-305643	52.60	55.60	68.20	2.33	29.44	2.36	8.47	54.33	8.67	59.27	64.43	97.07	91.13	61.13
26	EC-305644	44.13	47.17	62.60	1.87	16.40	3.82	9.35	46.23	8.80	51.30	56.40	94.78	93.75	62.58
27	EC-305645	42.27	45.17	77.80	2.07	19.49	4.13	9.19	44.27	10.87	49.43	54.27	91.87	114.83	74.30
28	EC-305639	41.27	44.17	81.63	2.07	19.69	4.29	8.78	43.23	10.73	48.27	53.30	90.80	110.93	72.13
29	IC-014026	41.20	44.20	68.20	1.67	17.61	3.88	8.67	43.03	9.70	48.40	53.57	91.40	99.53	65.80
30	EC-305638	39.93	42.87	74.77	1.87	14.98	4.85	9.12	42.07	9.30	47.07	51.90	95.10	98.17	65.04
31	EC-305637	46.20	49.10	66.80	2.07	18.70	4.03	7.77	48.20	8.37	52.50	57.60	90.17	87.00	58.83
32	EC-305635	43.13	46.20	92.63	2.47	21.46	3.96	9.17	45.27	12.30	50.17	55.23	98.13	126.17	80.61
33	EC-305768	56.47	59.40	63.87	5.00	16.75	3.79	9.17	58.43	10.87	63.03	66.90	110.70	118.73	76.46
34	IC-013356	43.17	46.20	67.27	1.87	16.58	4.41	9.17	44.80	9.50	49.50	54.87	95.47	94.73	63.13
35	IC-013664	44.20	46.93	71.80	1.67	21.63	3.28	11.20	46.10	8.80	51.00	55.70	94.07	95.87	63.76
36	EC-359637	50.33	53.30	64.63	5.07	23.47	2.77	8.47	52.30	9.43	57.60	61.57	99.70	90.80	62.52
37	IC-15027	40.10	43.33	74.03	1.73	17.97	4.12	9.00	42.23	10.57	48.90	53.33	96.13	105.27	68.98
38	EC-305640	48.30	51.30	65.07	1.87	23.20	3.03	8.03	50.33	9.67	54.87	59.53	99.10	98.00	64.02
39	IC-010265	43.27	46.27	68.90	1.97	15.75	4.48	8.72	45.20	9.30	50.20	53.53	96.07	99.17	66.15
40	IC-1409	44.23	47.27	83.37	2.07	21.02	3.91	8.13	46.23	11.37	51.27	56.43	99.97	119.43	76.85
	Mean	44.52	47.56	79.39	2.39	19.96	4.16	9.09	46.44	10.24	51.33	56.18	97.18	104.98	68.88
	Min	38.80	42.50	62.60	1.67	14.62	2.11	7.70	40.40	8.37	44.60	48.73	85.97	87.00	58.83
	Max	56.47	59.40	108.60	5.07	32.85	5.35	11.20	58.43	15.40	63.03	66.90	110.70	146.97	92.15
	SE(d)	1.59	1.59	1.69	0.20	0.86	0.29	0.66	1.60	0.34	1.83	1.87	3.39	3.06	2.64
	C.D. at 5%	3.16	3.17	3.37	0.39	1.71	0.57	1.33	3.20	0.67	3.64	3.72	6.77	6.10	5.26
	C.V. (%)	4.36	4.10	2.61	10.00	5.24	8.46	8.95	4.23	4.02	4.36	4.07	4.27	3.57	4.69

Table 4: Estimates of genetic variability parameters for fourteen characters of okra [*Abelmoschus esculentus* (L.) Moench]

Characters	Mean	Mean		PCV (%)	GCV (%)	Heritability (%)	GA	Genetic advance as % mean
		Min	Max					
Days to first flower initiation	44.52	38.80	56.47	10.23	9.26	81.83	7.68	17.25
Days to 50 % flowering	47.56	42.50	59.40	9.43	8.50	81.12	7.50	15.76
Plant height (cm)	79.39	62.60	108.60	15.21	14.99	97.07	24.15	30.42
Number of primary branches	2.39	1.67	5.07	32.80	31.24	90.70	1.47	61.28
Number of nodes per plant	19.96	14.62	32.85	17.34	16.53	90.86	6.48	32.45
Length of internode (cm)	4.16	2.11	5.35	19.88	17.99	81.89	1.40	33.53
Fruit length (cm)	9.09	7.70	11.20	12.01	8.00	44.42	1.00	10.99
Days to first fruit set	46.44	40.40	58.43	9.68	8.71	80.91	7.50	16.14
Number of fruits per plant	10.24	8.37	15.40	14.52	13.96	92.34	2.83	27.63
Days to first fruit picking	51.33	44.60	63.03	8.70	7.53	74.91	6.89	13.43
Days to second fruit picking	56.18	48.73	66.90	8.05	6.94	74.45	6.93	12.34
Duration of crop	97.18	85.97	110.70	5.66	3.71	42.97	4.87	5.01
Fruit yield per plant (gm)	104.98	87.00	146.97	12.67	12.16	92.08	25.23	24.03
Fruit yield (q/ha)	68.88	58.83	92.15	11.04	10.00	82.01	12.85	18.66

Conclusion

Generally, significant genetic variability in the considered traits in okra genotypes was observed and this might be used as important input for the future crop improvement. It is expected that from these results new okra genotypes can be developed to increase the production and productivity to the crop substantially.

From the results of the investigation, it could be concluded that PCV and GCV were high for number of primary branches which indicated that high degree of variability in this character and suggests that simple selection could be effective for yield improvement through this trait.

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