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GENETIC VARIABILITY, HERITABILITY AND CORRELATION COEFFICIENT IN OKRA *(ABELMOSCHUS ESCULENTUS* (L.) MOENCH) IN ALLAHABAD AGROCLIMATIC CONDITIONS

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Abstract

The present investigation entitled "Genetic variability, heritability and correlation coefficient in okra *(Abelmoschus esculentus* (L.) Moench)" was carried out in simple Randomized Block Design with 3 replications and 32 genotypes. It was observed that 12/OKHYB-5 was found superior in term of pod yield per plant (g). The genotypic and phenotypic variances was found highest for Pod yield per plant (g) 4056.04 and 4130.58 followed by Number of seed per fruit 30.69 and 31.17. High GCV and PCV was found for yield per plant 4130.581 and 25.743. Heritability in broad sense was noticed high for all the traits. Higher genetic advance was observed for pod yield per plant (g), number of seed per fruit. High genetic advance (as percent of mean) was found in days to 50% germination of seed (38.203), number of branches per plant (35.489), fruit length (29.680), fresh weight of fruit (29.754), number of seed per fruit (21.474), number of fruits per plant (21.137) and yield per plant (52.550), High heritability (bs) coupled with high genetic advance (% of mean) were observed for characters like pod yield per plant (98 & 52.550), number of branches per plant (98 & 35.489), days to 50% germination of seed (96 & 38.203), fresh weight of fruit (98 & 29.53), fruit length (99 & 29.680), number of seed per fruit (98 & 21.474), number of fruits per plant (94 & 21.137). Traits like Number of branches per plant, number of leaves per plant, fruit length, fruit girth, fresh weight of fruit, number of seed per fruit, number of fruit per plant and T.S.S. of fruit showed positive correlation at both genotypic and phenotypic level proved their genetic worth for selection and improvement of okra.

Key words: Okra, GCV, PCV, Heritability, Genetic advance and Correlation.

Introduction

Okra (*Abelmoschus esculentus* L. Moench), is a native of tropical Africa it is commonly known as okra or lady's finger in India. It is choicest fruit vegetable grown extensively in tropical and subtropical parts of the world. Its tender green fruits are used as a vegetable and are generally marketed in fresh form, but sometimes in canned or dehydrated form. Major areas of cultivation in India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam. West Bengal and Karnataka are major producers of okra. Okra is basically self pollinated crop, though essentially self-pollinated because of its showy corolla, the possibility of cross-pollination by insects cannot be ruled out. Consequently, cross pollination to the extent of 4.0-19.0 per cent (Purewell and Randhawa, 1947) with maximum of 42.2 per cent (Mitrideri and Vencovsky, 1974 and Kumar, 2006) is noticed with the insect assisted pollination. This accounts for considerable variation in fruit yield and its associated traits. Okra is cultivated for its fibrous fruits or pods containing round, white seeds. The fruits are harvested when immature and eaten as a vegetable. The roots and stems of okra are used for cleaning the cane juice from which gur or brown sugar is prepared (Chauhan, 1972). There is lack of suitable cultivars in Allahabad agro climatic condition. Therefore, there is need to evaluate genotypes of Okra their performance in Allahabad agro climatic conditions so the suitable variety can be identified for the region for higher productivity. The fruit is a capsule and grows quickly after flowering. The greatest increase in fruit length, height and diameter occurs during 4th to 6th day after pollination. It is at this stage that fruit is most often plucked for consumption. The okra pods are harvested when immature and high in

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mucilage, but before becoming highly fibrous. Generally the fibre production in the fruit starts from 6th day onwards of fruit formation and a sudden increase in fibre content from 9th day is observed (Nath, 1976). Its quick growth, short duration and photo-insensitive nature enable the geneticists and plant breeder to raise two crops in a year *viz.*, spring summer crop (early) and rainy season crop (late) and reduce the period of genetic advance (Gundane, 1989). However, *kharif* season is the main growing season for cultivation of okra. During this season the plants grow tall and vigorous. The plant bears more number of pods that contribute to the high yield per unit of area.

Now days a large number of genotypes of okra are available in the market but all these genotypes are not adapted and suited to all the regions of the country. No specific recommendation about the suitability of genotypes for a particular area is available. Farmers face problems in selecting genotypes for a particular area for commercial cultivation. Considering the above mentioned facts there is a need to compare some of the available genotypes or genotypes and to select high yielding, better adaptable genotypes/cultivars for commercial cultivation in this area.

Materials and Methods

The present investigation "Genetic variability, heritability and correlation coefficient in okra (*Abelmoschus esculentus* (L.) Moench)" during the *kharif* season in the year, 2016 was conducted in the Vegetable Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Allahabad (Uttar Pradesh) during 2016. Allahabad is situated at an elevation of 78 meters above sea level at 25.87 degree North latitude and 81.15 degree E longitude. This region has a sub-tropical climate prevailing in the south-east part of U.P. with both the extremes in temperature, *i.e.* the winter and the summer. In cold winters, the temperature sometimes is as low as 32^0F in December – January and very hot summer with temperature reaching up to 115^0F in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The experimental material for this study comprised 32 genotypes with two checks (Arka Anamika, Pusa Sawani) collected from Indian Institute of Vegetable Research, Varanasi (U.P). Genotypes and commercial checks are presented in table 1.

Results and discussion

Range, mean, variance, coefficient of variation, heritability, genetic advance and genetic advance as percent of mean for different traits for 32 genotypes of Okra (*Abelmoschus esculentus* (L.) Moench) is given below in table 2. The mean performance for days to 50% germination ranged from 2.47 days (11/OKHYB-10) to 4.67 days (10/OKHYB-1) with a mean of 3.49 days, plant height (cm) ranged from 125.13cm (12/OKHYB-1) to 101.33cm (Pusa Sawani) with a mean of 113.62 cm, Number of branches per plant ranged from 5.55 (12/OKHYB-8) to 2.87 (Pusa Sawani) with a mean of 4.08, Number of leaves per plant ranged from 48.80 (12/OKHYB-8) to 36.33 (Pusa Sawani) with a mean of 39.44m, fruit length (cm) ranged from 13.47cm (12/OKHYB-5) to 8.07cm (10/OKHYB-1) with a mean of 10.02cm, fruit girth (cm) ranged from 6.87cm (12/OKHYB-5) to 4.89cm (10/OKHYB-1) with a mean of 5.80cm, fresh weight of fruit (g) ranged from 17.33g (12/

Table 1: List of genotypes using in the present investigation.

S. No.	No. of Genotypes	Name of genotypes	Source
1	G_1	10/OKHYB-1	IIVR, Varanasi
2	G_2	10/OKHYB-2	IIVR, Varanasi
3	G_3	10/OKHYB-3	IIVR, Varanasi
4	G_4	10/OKHYB-4	IIVR, Varanasi
5	G_5	10/OKHYB-5	IIVR, Varanasi
6	G_6	10/OKHYB-6	IIVR, Varanasi
7	G_7	10/OKHYB-7	IIVR, Varanasi
8	G_8	10/OKHYB-8	IIVR, Varanasi
9	G_9	10/OKHYB-9	IIVR, Varanasi
10	G_{10}	11/OKHYB-1	IIVR, Varanasi
11	G_{11}	11/OKHYB-4	IIVR, Varanasi
12	G_{12}	11/OKHYB-5	IIVR, Varanasi
13	G_{13}	11/OKHYB-6	IIVR, Varanasi
14	G_{14}	11/OKHYB-7	IIVR, Varanasi
15	G_{15}	11/OKHYB-8	IIVR, Varanasi
16	G_{16}	11/OKHYB-10	IIVR, Varanasi
17	G_{17}	11/OKHYB-11	IIVR, Varanasi
18	G_{18}	12/OKHYB-1	IIVR, Varanasi
19	G_{19}	12/OKHYB-2	IIVR, Varanasi
20	G_{20}	12/OKHYB-4	IIVR, Varanasi
21	G_{21}	12/OKHYB-5	IIVR, Varanasi
22	G_{22}	12/OKHYB-6	IIVR, Varanasi
23	G_{23}	12/OKHYB-8	IIVR, Varanasi
24	G_{24}	12/OKHYB-10	IIVR, Varanasi
25	G_{25}	12/OKHYB-12	IIVR, Varanasi
26	G_{26}	12/OKHYB-13	IIVR, Varanasi
27	G_{27}	12/OKHYB-14	IIVR, Varanasi
28	G_{28}	12/OKHYB-15	IIVR, Varanasi
29	G_{29}	12/OKHYB-16	IIVR, Varanasi
30	G_{30}	HOK – 152	IIVR, Varanasi
31	G_{31}	Arka Anamika (C)	IIVR, Varanasi
32	G_{32}	Pusa Sawini (C)	IIVR, Varanasi

Table 2: Range, mean, variance, coefficient of variation, heritability, genetic advance and genetic advance as percent of mean for 11 characters in okra.

Character	Range		Mean	GV	PV	CV		h2 (bs)	GA		GA as percent on mean	
	Max.	Min.				GCV	PCV	(%)	5 %	1 %	5 %	1 %
Days to 50% germination of seed	4.666	2.466	3.489	0.435	0.451	18.896	19.253	96	1.333	1.708	38.203	48.959
Plant height (cm)	125.130	101.330	113.619	30.166	34.101	4.834	5.140	88	10.642	13.638	9.366	12.003
Number of branches per plant	5.550	2.870	4.079	0.501	0.507	17.344	17.461	98	1.448	1.855	35.489	45.481
Number of Leaves per plant	48.800	36.333	39.441	7.088	7.182	6.750	6.795	98	5.449	6.983	13.815	17.704
Fruit length (cm)	13.466	8.066	10.020	2.096	2.108	14.448	14.488	99	2.974	3.812	29.680	38.036
Fruit girth (cm)	6.866	4.886	5.798	0.296	0.335	9.381	9.985	88	1.053	1.349	18.154	23.265
Fresh weight of fruit (g)	17.333	10.333	12.941	3.539	3.584	14.535	14.628	98	3.851	4.935	29.753	38.130
Number of seed per fruit	65.333	44.866	52.725	30.686	31.173	10.506	10.589	98	11.322	14.510	21.474	27.520
Number of fruits per plant	23.666	16.266	18.833	3.968	4.217	10.577	10.903	94	3.981	5.102	21.137	27.089
T.S.S. of fruit	2.980	2.490	2.743	0.015	0.016	4.538	4.598	97	0.253	0.324	9.2236	11.824
Yield per plant (g)	410.093	168.093	247.395	4056.043	4130.581	25.743	25.979	98	130.006	166.610	52.550	67.346

GV= Genotypic variance, PV= Phenotypic variance, GCV= Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h2 (bs) = Heritability (broad Sense), GA=Genetic advance, GAM= Genetic advance as percent of mean

Table 3 : Genotypic and phenotypic correlation coefficient for 11 characters for okra genotypes

No	Character	Days to 50% germination of seed	Plant height (cm)	No. of branches per plant	No. of Leaves per plant	Fruit length (cm)	Fruit girth (cm)	Fresh weight of fruit (g)	No. of seed per fruit	No. of fruits per plant	T.S.S. of fruit	Yield per plant (g)
1	Days to 50% germination of seed	**1.0000**	-0.9854**	-0.9842**	-0.8551**	-0.9458**	-0.9833**	-0.9643**	-0.9255**	-0.9599**	-0.8440**	-0.9396**
2	Plant height (cm)	**-0.9171****	**1.0000**	0.9661**	0.9259**	0.9722**	0.9140**	0.9808**	0.9586**	0.9840**	0.7752**	0.9666**
3	Number of branches per plant	**-0.9625****	**0.9393****	**1.0000**	0.9338**	0.9699**	0.9884**	0.9831**	0.9645**	0.9861**	0.7776**	0.9702**
4	Number of Leaves per plant	**-0.8319****	**0.8616****	**0.9207****	**1.0000**	0.9232**	0.9078**	0.9283**	0.9312**	0.9393**	0.5982**	0.9355**
5	Fruit length (cm)	**-0.9234****	**0.9050****	**0.9602****	**0.9159****	**1.0000**	0.9987**	0.9976**	0.9645**	0.9946**	0.6847**	0.9986**
6	Fruit girth (cm)	**-0.9403****	**0.8986****	**0.9445****	**0.8449****	**0.9308****	**1.0000**	0.9606**	0.9737**	0.9822**	0.8150**	0.9961**
7	Fresh weight of fruit (g)	**-0.9365****	**0.9198****	**0.9705****	**0.9196****	**0.9886****	**0.9414****	**1.0000**	0.9618**	0.9919**	0.7225**	0.9816**
8	Number of seed per fruit	**-0.9019****	**0.8996****	**0.9491****	**0.9211****	**0.9552****	**0.9039****	**0.9501****	**1.0000**	0.9717**	0.7077**	0.9594**
9	Number of fruits per plant	**-0.9214****	**0.8971****	**0.9492****	**0.9042****	**0.9709****	**0.9257****	**0.9721****	**0.9330****	**1.0000**	0.7109**	0.9986**
10	T.S.S. of fruit	**-0.8282****	**0.7495****	**0.7662****	**0.5846****	**0.6683****	**0.7585****	**0.7085****	**0.6868****	**0.6852****	**1.0000**	0.9837**

Note : (1) * and ** indicate significant at 5% and 1% level respectively. **(2)** Bold numericals indicate phenotypic correlation.

OKHYB-5) to 10.33g (10/OKHYB-1) with a mean of 12.94g, number of seed per fruit ranged from 65.33 (12/ OKHYB-1) to 44.87 (HOK-152) with a mean of 52.73, Number of fruits per plant ranged from 23.67 (12/ OKHYB-5) to 16.27 (10/OKHYB-1) with a mean of 18.83, T. S. S. of fruit ranged from 2.98 (12/OKHYB-10) to 2.49 (10/OKHYB-5) with a mean of 2.74, pod yield per plant (g) ranged from 410.09g (12/OKHYB-5) to 168.09g (10/OKHYB-1) with a mean of 247.40g

Genetic variability plays an important role in crop breeding for selecting the elite genotypes for making rapid improvement in yield and other desirable characters as well as to select the potential parent for hybridization programme, heritability is an index for calculating the relative influence of environment on expression of genotypes. The genotypic and phenotypic variances was found highest for Pod yield per plant (g) 4056.04 and 4130.58 followed by Number of seed per fruit 30.69 and 31.17, respectively given in table 2. The phenotypic coefficient of variation (PCV) was much higher than genotypic coefficient of variation (GCV) for all the characters, indicating that all the characters under study are influenced to various degrees by the environmental factors. The estimates of genotypic and phenotypic coefficient of variation indicates the extent of genetic variability present in a given germplasm but, significance lies in the amount of heritable portion of the variation that play significant role in improvement of a trait by selection. High GCV and PCV was found for yield per plant 4130.581 and 25.743 followed by moderate GCV and PCV was found for days to 50 % germination of seed, number of branches per plant, fruit length, fresh weight, number of seed per fruit, number of fruits per plant and low GCV and PCV was found for plant height, number of leaves per plant, fruit girth and T.S.S of fruit given in table 2. Moderate to low genotypic and phenotypic coefficient of variation were noticed for characters like number of branches per plant, fruit length and fruit weight. The present findings were in conformity with the findings of Hazra and Basu (2000).

High heritability (bs) coupled with high genetic advance is a reliable measure of the genetic gain through selection of best individual from the variable population. High heritability (bs) coupled with high genetic advance (% of mean) were observed for characters like pod yield per plant (98 & 52.550), number of branches per plant (98 & 35.489), days to 50% germination of seed (96 & 38.203), fresh weight of fruit (98 & 29.53), fruit length (99 & 29.680), number of seed per fruit (98 & 21.474), number of fruits per plant (94 & 21.137) given in table 2 similar results were obtained by various workers for different characters in okra *viz*. Aakansha (2012), Ramanjinappa *et al.* (2011). High heritability for fruit yield per plant and fruit weight by Sateesh *et al.* (2011), fruit length and number of fruits per plant by Kumar *et al.* (2011). High heritability coupled with moderate genetic advance was found for number of per plant (98 & 13.815), fruit girth (88 & 18.154), whereas high heritability coupled with low genetic advance was found for plant height (88 & 9.336), number of fruits per plant (94 & 5.102) and T.S.S of fruit (97 & 0.324). Genetic advance reflect on the improvement in the performance of the selected lines over the base or original population. High genetic advance gives substantial scope for selection to improve the yield and its attributing characters. A high heritability is not always accompanied by high genetic advance (Panse, 1957). That is why high heritability coupled with high genetic advance is a reliable measure of the genetic gain. High genetic advance for fruit yield per plant was reported by Prakash (2011).

Correlation furnishes information regarding the nature and magnitude of various associations. The correlation coefficient indicates the degree of relationship between two or more character *i.e.* clear picture of association between yield and its contributing traits. Correlation between characters was studied at genotypic and phenotypic levels. Correlation coefficient is often influenced by the population handled and observation made (Dewey and Lu, 1959). Griffing (1956) opined that there is no genes as such governing yield. Therefore, for improving yield, breeder most often try to select on the basis of component characters, which are less complex as compared to yield. A character like yield is dependent on several mutually associated component characters. The knowledge of association alone however is often misleading as the correlation observed may not reflect true nature of association. Since two characters may show association just because they are correlated with a common third one (Jaiswal and Gupta, 1967). Among the 11 characters studied, the characters, such as plant height (0.966), number of branches per plant (0.970), number of leaves per plant (0.935), fruit length (0.998), fruit girth (0.996), fresh weight of fruit (0.981), number of seed per fruit (0.959), number of fruit per plant (0.998) and T.S.S. of fruit (0.983) showed positive significant correlation with pod yield (g/ plant) at genotypic level. Plant height (0.902), number of branches per plant (0.954), number of leaves per plant (0.922), fruit length (0.986), fruit girth (0.928), fresh weight of fruit (0.969), number of seed per fruit (0.943), number of fruits per plant (0.972) and T.S.S. of fruit (0.966) showed positive significant correlation with pod yield (g/ plant) at phenotypic level. The correlation values among the yield components showed that days to 50% germination (-9396) and (-0.9155) had negative significant correlation given in table 3.

Conclusion

On the basis of performance of 32 genotypes of okra 2012/OKHYB-5 was found superior in term of yield per plant (g). Larger amount of variability exhibited in the

genotypes for selection. The trait like pod yield per plant, number of branches per plant, days to 50% germination of seed, fresh weight of fruit, fruit length, number of seed per fruit, number of fruits per plant was found high heritability coupled with high genetic advance providing good scope for further improvement in advance generation. Number of branches per plant, number of leaves per plant, fruit length, fruit girth, fresh weight of fruit, number of seed per fruit, number of fruit per plant and T.S.S. of fruit showed positive correlation at both genotypic and phenotypic level proved their genetic worth for selection and improvement of okra.

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