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GENETIC VARIABILITY AND HERITABILITY STUDIES IN OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH)

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Abstract

Thirty genotypes belonging to okra (*Abelmoschus esculentus* (L.) Moench) were undertaken in *kharif* season, to work out the variability and heritability. Analysis of variance showed that there was a high significant variation for all of the studied traits between genotypes. The genotypic coefficients of variation (GCV), phenotypic coefficient of variation (PCV) were highest for the character leaf area, diameter of fruit and number of primary branches plant^{-1}and lowest for the character crude fibre content of fruit and weight of fruit. Moderate GCV and PCV were recorded for the characters plant height and number of leaves plant^{-1}. High heritability as well as high values of genetic advance was observed in the characters leaf area (h^2 86.90 % and GA 57.83 %) and yield plant^{-1}(h^2 82.60% and GA 50.56 %) thus there is an ample scope for improving character through direct selection on the basis of the phenotype characters will lead to high pod yield in okra.

Key words: GCV, PCV, Variability, Heritability, Genetic advance.

Introduction

The okra (*Abelmoschus esculentus* (L.) Monech) is one of the commercially important annual vegetable crop in tropical and subtropical parts of the world. Its tender green fruits are used as a vegetable and are generally marketed in the fresh condition, but sometimes in canned or dehydrated form. Okra is rich in vitamins, calcium, potassium and mineral matters. Okra is grown for the fresh market and also for processing and export.

To improve the yield and other characters, information on genetic variability and interrelation among different traits is necessary. Good amount of variability has been reported in okra for various characters and can be well exploited for the crop improvement. The utilization of genetic variability in intensive breeding programme was resulted in identification and release of good number of varieties in okra. While, these released varieties cannot be continued longer due to genetic drift and susceptibility to diseases and pest. Progress in any breeding programme depends upon magnitude of useful variability present in the population and extend to which desirable characters are heritable. Genotypic coefficient of variation on together with heritability would furnish most reliable information on the amount of genetic advances to be expected for selection (Burton, 1952).

High heritability alone is not enough to make efficient selection unless the information is accompanied with substantial amount of genetic advances. The yield is ultimate objective of any crop improvement programme. The yield being a complex character with low heritability and results of interaction of number of factors inherent both in plant as well as environment in which plant grows. Therefore selection for such characters based on phenotypic expression is likely to be less efficient under such circumstances. The breeder has to modify the direction of selection after taking into consideration the relative influence of different yield contributing characters on yield.

Material and methods

Thirty genotypes of Okra obtained from National Bureau of Plant Genetic Resources, New Delhi and Department of Horticulture, Dr. PDKV, Akola. The experiment was laid out in randomized block design with

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three replications at Main Garden, Department of Horticulture, Dr. PDKV, Akola in kharif season 2014. The observations were recorded on five randomly selected plants in each replication for each genotype on 21 characters *viz.*, plant height, number of leaves plant-1, number of lobes leaves^{-1}, internodal length, days to first flowering, leaf area, node at which first fruit appear, number of primary branches plant^{-1}, days to first harvest, number of nodes plant^{-1}, length of fruit, diameter of fruit, weight of fruit, number of ridges fruit^{-1}, number of fruits plant^{-1}, chlorophyll content of leaves, incidence of YVMV, crude fibre content of fruit, yield plant^{-1}, yield plot^{-1} and yield ha^{-1}. Analysis of variance was carried out in order to partition the total variation showed by different characters under study into its components *viz.* replication, treatments, error. Analysis was carried out as per the standard method suggested by (Panse and Sukhatme, 1988). The genotypic and phenotypic coefficient of variance was calculated as per the formula suggested by Burton (1952) and Johnson *et al.*, (1995) for heritability and genetic advance.

Results and Discussion

The analysis of variance (Table 1) revealed that, mean sum of squares were significant for all most all the characters studied. Genetic variability is the basic need for a plant breeder to initiate any breeding programme. Among the horticultural traits (Table 2) Data pertaining to the values of mean, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), and heritability in broad sense (h^2) and expected genetic advance (EGA) over mean for different characters is presented in (Table 2) The high value of GCV and PCV were recorded for the characters, leaf area (24.45, 26.23) diameter of fruit (19.15, 19.77), number of primary branches plant^{-1} (18.56, 23.80). Similar finding were also reported by Bindu *et al.,* (1997) for the characters leaf area, number of fruits plant-^{1}, length of fruit, number of primary branches plant^{-1} and height of the plant. Similar findings pertaining to different traits including the characters like plant height, number of fruits plant^{-1} and yield plant^{-1} in okra Dhall *et al.,* (2003). Moderate value of GCV and PCV was observed for the characters, chlorophyll content of leaves (16.40, 19.90), yield plant^{-1} (16.23, 17.86), length of fruit (15.46, 16.27), number of fruits plant^{-1} (13.02, 17.59), low magnitude values of GCV and PCV was observed for characters crude fibre content of fruit (2.70, 2.78), weight of fruit (4.23, 5.25) and days to first harvest (3.32, 4.23). The above findings stood parallel with Singh *et al.,* (2007)

Table 1: Analysis of variance for various characters in okra.

Sr. No	Characters	Mean Sum of squares		
		Replication	Treatment	Error
1.	Plant height(cm)	2.78	431.15**	46.49
2.	Number of leaves plant^{-1}	2.77	55.15**	1.47
3.	Number of lobes leaves^{-1}	0.10	0.23	0.11
4.	Internodal length (cm)	1.14	1.75**	0.38
5	Days to first flowering	5.43	10.84**	2.05
6	Leaf area (cm^2)	314.68	2856.88**	136.49
7	Node at which first fruit appears	0.01	0.60**	0.15
8	Number of primary branches plant^{-1}	0.67	2.02**	0.35
9	Number of nodes plant^{-1}	3.65	39.22**	1.28
10	Days to first harvest	3.87	7.37**	1.26
11	Length of fruit (cm)	0.56	5.56**	0.19
12	Diameter of fruit (cm^2)	0.01	0.28	0.006
13	Weight of fruit (g)	0.12	0.41*	0.06
14	Number of ridges fruit $^{-1}$	0.07	1.20**	0.02
15	Number of fruits plant^{-1}	8.35	26.61**	5.74
16	Chlorophyll content of leaves (mgg^{-1})	0.03	0.17	0.02
17	Incidence of YVMV (%)	0.95	50.74**	2.63
18	Crude fibre content (%)	0.001	0.02	0.0005
19	Yield plant^{-1}	351.07	2342.98**	153.95
20	Yield plot^{-1}	0.22	0.84**	0.08
21	Yield ha^{-1}	153.28	649.44**	58.83

** Significant at 1% level, * significant at 5% level

with high magnitude of GCV and PCV for number of branches plant^{-1}, plant height, number of fruits plant^{-1} and total fruit yield. Similar observations were also observed in okra by Panda and Singh, (1997) and Sharma *et al.* (2007)

The character like leaf area, diameter of fruit, number of primary branches plant^{-1} chlorophyll content of leaves and yield plant-^{1} exhibited almost equal magnitudes of GCV and PCV. The data presented in (Table 2) indicated that the estimates of genotypic coefficient of variation were low as compared to phenotypic coefficient of variation for all the characters.

The genotypic coefficient of variation is not sufficient to determine the amount of variation which is heritable. Burton (1952) also made clear that the heritable variation cannot be estimated through genotypic coefficient of variation and as such the genotypic coefficient of variation together with heritability would furnish the most reliable information on the magnitude of genetic advance to be expected from selection.

Table 2: Range, mean and estimates of genetic parameters in okra genotypes

Sr. No.	Characters	Range	Mean	GCV	PCV	h^2 (%)	EGA	EGA over mean (%)
1	Plant height (cm)	71.60-120.88	87.50	12.94	15.10	73.40	19.98	22.83
2	No. of leaves plant^{-1}	20.53-40.56	29.36	14.40	14.98	92.40	8.37	28.51
3	No. of lobes leaves^{-1}	4.70-5.96	5.24	3.83	7.43	26.60	0.21	4.07
4	Internodal length (cm)	3.93-6.93	5.03	13.42	18.28	53.90	1.02	20.31
5	Days to first flowering	33.0-40.66	37.46	4.56	5.95	58.80	2.70	7.21
6	Leaf area (cm^2)	85.80-222.95	123.13	24.45	26.23	86.90	57.83	46.96
7	Node at which first fruit appears	5.16-6.73	5.83	6.65	9.49	49.10	0.56	9.60
8	No. of primary branches plant^{-1}	2.66-5.66	4.01	18.56	23.80	60.80	1.19	29.82
9	No. of nodes plant^{-1}	18.83-35.23	27.24	13.05	13.70	90.80	6.97	25.61
10	Days to first harvest	39.0-46.0	42.91	3.32	4.23	61.60	2.30	5.37
11	Length of fruit (cm)	6.03-10.90	8.65	15.46	16.27	90.40	2.62	30.29
12	Diameter of fruit (cm)	1.16-2.34	1.59	19.15	19.77	93.80	0.61	38.22
13	Weight of fruit (g)	6.71-8.76	8.11	4.23	5.25	65.00	0.57	7.04
14	No. of ridges fruit^{-1}	4.93-7.36	5.73	10.92	11.28	93.73	1.24	21.79
15	No. of fruits plant^{-1}	12.58-28.70	20.25	13.02	17.59	54.80	4.02	19.85
16	Chlorophyll content of leaves (mg g^{-1})	0.89-2.10	1.36	16.40	19.90	67.90	0.38	27.83
17	Incidence of YVMV (%)	20.54-37.85	28.16	14.21	15.34	85.90	7.64	27.14
18	Crude fibre content (%)	3.42-3.80	3.59	2.70	2.78	94.60	0.19	5.40
19	Yield plant^{-1} (g)	84.02-226.70	166.36	16.23	17.86	82.60	50.56	30.39
20	Yield plot^{-1} (kg)	1.67-4.09	3.28	15.37	17.72	75.28	0.90	27.48
21	Yield ha^{-1}(q)	46.55 -113.57	91.14	15.39	17.54	76.99	25.36	27.82

The results pertaining to heritability and genetic advance obtained is presented in (Table 2) indicated that high heritability was recorded for the character crude fiber content of fruit (94.60%) followed by diameter of fruit (93.80 %), number of ridges fruit^{-1} (93.73 %), number of leaves plant^{-1} (92.40 %), number of nodes plant^{-1} (90.80 %), length of fruit (90.40 %), leaf area (86.90 %), incidence of YVMV (85.90 %), yield plant^{-1} (82.60 %), Yield ha^{-1} (76.99 %), Yield plot^{-1} (75.28 %) and plant height (73.40 %). However, the characters number of primary branches plant^{-1}, internodal length, days to first flowering, days to first harvest, number of fruits plant^{-1} weight of fruit and chlorophyll content of leaves recorded medium heritability (53 – 67 %). The remaining characters like number of lobes leaves^{-1}, node at which first fruit appear were recorded low heritability (26 – 49 %).

The genetic advance varied from (0.19 %) for crude fibre content of fruit to (57.83 %) for leaf area. Leaf area showed highest genetic advance (57.83%) followed by yield plant^{-1} (50.56 %), Yield ha^{-1} (25.36 %) and plant height (19.98 %). Low values of genetic advance were also recorded for number of lobes leaves^{-1} (0.21%), node at which first fruit appears (0.56 %), weight of fruit (0.57 %) chlorophyll content of leaves (0.38 %), yield plot^{-1} (0.90 %) number of primary branches plant^{-1} (1.19 %), internodal length (1.02 %), number of ridges fruit^{-1} (1.24 %), length of fruit (2.62 %), days to first flowering (2.70 %), days to first harvest (2.30 %) and number of fruits plant^{-1} (4.02 %). Moderate values were also recorded for number of leaves plant^{-1}(8.37 %), incidence of YVMV (7.64 %) and number of nodes plant^{-1} (6.97 %). High heritability as well as high values of genetic advance was observed in the characters leaf area and yield plant^{-1} High heritability and moderately high genetic advance for leaf area, weight of fruit, number of fruits plant^{-1} and height of plant. Similar findings with high EGA were pertaining to different traits reported for the characters weight of fruit, number of fruits plant^{-1} in okra by Bindu *et al.*,(1997).

The mean sum of squares for all the characters studied was found to be significant, indicating the variation for the characters under study.

Genotypic coefficient of variation in general were greater in magnitude than the corresponding phenotypic ones, High values of GCV and heritability estimates supplemented with greater genetic gains are also indicative

of additive gene effects regulating the inheritance of such traits therefore these characters reflect greater selective value and offer ample scope for selection and phenotypic coefficient of variation was lessened under the influence of environment.

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