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Research Note

Variability studies for yield and its contributing traits in okra

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Abstract:
Twelve okra genotypes were crossed in diallel fashion excluding reciprocals to generate 66 one-way hybrids. All the F_1's along with their parents were grown at Vegetable Research Farm of the Department of Vegetable Crops, Punjab Agricultural University, Ludhiana, Punjab during the rainy season of 2004-05. High genotypic and phenotypic coefficients of variation were noticed for number of primary branches per plant indicating maximum variability among the different genotypes. High estimates of heritability coupled with high genetic advance obtained for number of branches per plant, total yield per plant and marketable yield per plant indicating presence of additive gene effects which indicated the effectiveness of selection for these traits. Presence of high heritability coupled with low genetic advance for days to fruit picking, average fruit weight, plant height, internodal length, number of fruits per plant, fruit diameter and average fruit length revealed that straight selection has limited scope for further improving these traits.

Keywords: Genetic Advance, Heritability, Variability

Introduction

Okra (*Abelmoschus esculentus* L. *Moench*) is one of the most important vegetable crops grown for its immature fruits in spring and rainy season from tropical to subtropical regions of the country. Breeding for crop improvement involves measures to boost yield potential, maturity and quality. The possibility of improvement in any crop is depended on variability available in the crop, wider the genetic variability in trait, better the chances of improvement of it through selection. An evaluation to detect extent of variability available for the yield attributes and their heritability values is of immense help to the breeders to select the breeding methods for improvement of that trait. Hence, an attempt was made to assess the available genetic variability in okra by partitioning of overall variability into its heritable and non-heritable components based on genetic parameters likes genotypic coefficient of variation, heritability and expected genetic advance. Therefore, the present study was undertaken with the objective of assessing the phenotypic and genotypic variability, heritability and genetic advance for yield and yield components.

The source and main features of the okra genotypes used as parents to develop F_1s are given in Table 1. Twelve okra genotypes viz., IIVR-11, HRB-107-4, Hisar Unnat (HU), VRO-4, Punjab Padmini (PP), VRO-3, Pusa A-4 (PA-4), Varsha Uphar (VU), NDO-10, Pant Bhindi-1 (PB-1), HRB-108-2 and Selection-2 (S-2) were crossed in diallel mating design to generate 66 one-way hybrids. All the F_1s along with their parents were grown at Vegetable Research Farm of the Department of Vegetable Crops, Punjab Agricultural University, Ludhiana, Punjab during the rainy season of 2004-05. All the F_1s along with their parents were sown at a spacing of 45 cm x 30 cm in a Randomized Block Design with three replications in a plot size of 4m x 3.5m accommodating eight rows. Recommended cultural practices were followed to raise a good crop.

Observations were recorded on five randomnly tagged plants in each replication on node at which first flower appears, days to fruit picking, plant height (cm), internodal length (cm), number of primary branches per plant, fruit diameter (cm), average fruit weight (g), average fruit length (cm), number of fruits per plant, total yield per plant (g) and marketable yield per plant (g). The data recorded on five randomly chosen competitive plants from experimental plot were used to calculate the mean values for each genotype/ replication. The mean values obtained were used for analysis of variance and to estimate genotypic and phenotypic coefficient of variation and genetic advance as percent of mean. The analysis of variance for each trait was based on the linear model of Fisher (1954). The phenotypic and genotypic coefficients of variation were

estimated as per formula suggested by Burton & De Vane (1953). Heritability in broad sense and genetic advance were calculated by using formula given by Hanson *et al* (1956) and Johnson *et al* (1955).

The analysis of variance revealed highly significant differences among the genotypes for all the traits under study (Table 2) which indicated that the genotypes differ significantly for all the traits. The mean and range values for all the traits evaluated are presented in Table 3. The range of average fruit weight varied from 5.33 g to 8.70 g; for fruit diameter it varied from 1.46 cm to 1.96 cm; for average fruit length it varied from 9.73 cm to 12.53 cm and number of fruit per plant varied from 17.10 to 27.23. Variation for average fruit length and number of fruits per plant is found to be quite high which might be responsible for the wide range in yield potential of different genotypes. Jeyapandi and Balakrishnan (1992) also reported variation in fruit length in okra, whereas, Thaker *et al* (1981) and Vijay and Manohar (1990) reported wide range of variability for average fruit weight and number of fruits per plant in okra. The mean for total yield per plant and marketable yield per plant varied from 102.55g to 201.43g and from 93.85g to 174.64g, respectively. A lot of variability for yield indicates a great scope for selection of desirable type/s. The results collaborated the findings of Vijay and Manohar (1990), Panda and Singh (1997) and Dhall *et al* (2001).

The range of mean values could present a rough estimate about the variation of magnitude of divergence present among different genotypes. But the estimates of genotypic and phenotypic coefficients are of greater use in determining the content of variability present within the material. The estimates of variability and genetic parameters are given in Table 3. The range of genotypic coefficient of variation was 6.46 (node at which the first flower appears) to 32.71 (numbers of primary branches per plant). Phenotypic coefficient of variation (PCV) was highest for number of primary branches per plant (33.24). Moderate values of PCV were observed for yield per plant (16.67) followed by marketable yield per plant (15.90), days to fruit picking (12.55), average fruit weight (12.55), plant height (11.77), internodal length (11.23), number of fruits per plant (11.14) and node at which first flower appears (10.02). Low values of PCV were recorded for fruit diameter (7.52) and average fruit length (6.88). The genotypic coefficient of variation (GCV) was highest for number of primary branches per plant (32.71). Moderate values of GCV were obtained for total yield per plant (16.62) followed by marketable yield per plant (15.79), days to fruit picking (12.16), average fruit weight (12.16), plant height (11.72), inter nodal length (11.12) and number of fruits per plant (10.86). Low values of GCV were observed for fruit diameter (7.46), average fruit length (6.73) and node at which first flower appears (6.46). These results are in agreements with the findings of Yadav (1986), Vijay & Manohar (1990) and Dhall *et al* (2001). High genotypic and phenotypic coefficients of variation was noticed for number of primary branches per plants indicating maximum variability among the genotypes selected for evaluation and thus this trait provides better chance of selection of desirable genotypes.

Heritability values were generally high for all the characters under study except for node at which first flower appears which registered moderate value. It ranged from 41.48 % to 99.48%. Highest heritability suggests that selection would be successful for these traits. El Maksoud *et al* (1984) and Panda & singh (1997) also reported high heritability for most of the yield component characters. The highest value of genetic advance as per cent of mean was obtained for number of primary branches per plant, total yield per plant and marketable yield per plant. Low values for genetic advance as per cent of mean were observed for days to fruit picking, average fruit weight, plant height, internodal length, number of fruits per plant, fruit diameter, average fruit length and node at which first flower appears.

The knowledge of the heritability along with genetic advance aids in drawing valuable conclusions for selection of breeding methods to be employed for further improvement of the traits. Detection of significant genetic variability indicates that genetic variance exists in the genotypes but says nothing about the range of genetic variability within a particular population. A broad sense heritability estimate provides information on relative magnitude of genetic and environmental variation in germplasm pool. High estimates of heritability coupled with high genetic advance observed for number of branches per plant, total yield per plant and marketable yield per plant indicating additive gene effects shows the effectiveness of selection for these traits. Vashistha *et al* (1982) also observed high heritability coupled with high genetic advance for fruit yield per plant and number of fruits per plant. High heritability coupled with low genetic advance for days to fruit picking, average fruit weight, plant height, internodal length, number of fruits per plant, fruit diameter and average fruit length may be attributed to the action of non-additive gene effects including dominance and

epistasis. Hence, straight selection has limited scope for improving these traits.

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Table 1. Source and salient features of the okra genotypes used as parents

Name	Source	Salient features of the genotype
IIVR-11	IIVR, Varanasi	Plants are tall and prolific bearer, large leaves with prominent veins. Fruits are long, green and six ridged. Plants are resistant to Yellow Vein Mosaic Virus.
HRB-107-4	HAU, Hisar	Fruits are medium green with five ridged. It takes 53 days to first harvest. It is tolerant to YVM virus.
Hisar Unnat (HU)	HAU, Hisar	It has a medium plant height with short Internodal distance. Splashes of purple pigmentation present on stem. The fruits are green with five ridges. It is tolerant to YVM virus.
VRO-4	IIVR, Varanasi	It is an early bearing variety with short Internodal distance. The plants are medium tall with splashes of pigmentation present on the stem. The fruits are green with five ridges. It carries resistance to YVM virus and is tolerant to borer.
Punjab Padmini (PP)	PAU, Ludhiana	Plants are tall; stem, shoots, petiole and basal veins of the lower surface of the lamina are mildly scarlet red. Fruits are dark green, thin, long and remain tender for long time. It is tolerant to YVM virus.
VRO-3	IIVR, Varanasi	Fruits are tender, green and five ridged. It takes 42-45 days to first flowering and 46-48 days to first picking. It is resistant to YVMV.
Pusa A-4 (PA-4)	IARI, New Delhi	The leaves are broad and medium lobed. The fruits are five ridged, attractive dark green having excellent shelf life. It is resistant to YVMV and tolerant to jassids and fruit and shoot borer.
Varsha Uphar (VU)	HAU, Hisar	Fruits are smooth, dark green, attractive with long tapering tip. It has resistance to YVMV and field tolerance to leaf hopper.
NDO-10	NDUAT, Faizabad	Plants are tall. Stem is green with light purple pigmentation and fruits are light green. Plants are tolerant to YVMV.
Pant Bhindi-1 (PB-1)	GBPUAT, U.P.	Plants are erect. Fruits are five ridged and dark green in colour. It is resistant to YVMV.
HRB-108-2	HAU, Hisar	Plants are medium tall with short internodes. Fruits are dark green, tender, medium long with five ridged. It carries field resistance to YVMV.
Selection-2 (S-2)	IIHR, Bangalore	Plants grow to a height of 110 cm. Fruits are green, long, tender and five ridged. It is tolerant to YVM virus.

Table 2. Analysis of variance for experimental design for important characters

Character	Mean Squares		
	Replications (2)	Treatments (77)	Error (154)
Node at which the first flower appears	0.21	0.67**	0.21
Days to fruit picking	0.07	2.24**	0.97
Average fruit weight (g)	0.07	2.24**	0.05
Fruit diameter (cm)	0.00	0.05**	0.00
Average fruit length (cm)	0.46**	1.72**	0.03
Number of fruits per plant	0.19	16.86**	0.29
Plant height (cm)	27.04**	737.47**	2.18
Internodal length (cm)	0.08**	2.18**	0.01
Number of primary branches per plant	0.14**	1.71**	0.02
Total yield / plant (g)	10.63*	1923.36**	3.35
Marketable yield/ plant (g)	15.35	1383.52**	6.68

Figures in parentheses shows degree of freedom
*, ** Significant at 5% and 1% level, respectively

Table3. Estimates of heritability, genetic advance and coefficients of variation for important traits

Characters	General Mean	Range	PCV	GCV	h^2	GA	% GA
Node at which the first flower appears	6.03	5.33-7.00	10.02	6.46	41.48	0.52	8.56
Days to fruit picking	7.03	46.00-49.00	12.55	12.16	93.93	1.71	24.27
Average fruit weight (g)	7.03	5.33-8.70	12.55	12.16	93.93	1.71	24.27
Fruit diameter (cm)	1.68	1.46-1.90	7.52	7.46	98.38	0.26	15.24
Average fruit length (cm)	11.16	9.73-12.53	6.88	6.73	95.46	1.51	13.54
Number of fruits per plant	21.65	17.10-27.23	11.14	10.86	94.94	4.72	21.79
Plant height (cm)	133.55	101.33-174.53	11.77	11.72	99.12	32.11	24.04
Internodal length (cm)	7.64	6.07-9.47	11.23	11.12	98.07	1.73	22.68
Number of primary branches per plant	2.30	1.13-3.80	33.24	32.71	96.81	1.52	66.30
Total yield / plant (g)	152.20	102.55-201.43	16.67	16.62	99.48	51.98	34.15
Marketable yield/ plant (g)	135.70	93.85-174.64	15.90	15.79	98.57	43.81	32.29