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Genetic analysis in okra [*Abelmoschus esculentus* (L.) Moench]

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ABSTRACT : Study of thirty three diverse genotypes of okra revealed the presence of high variability, for primary branches at flowering, internodal length, leaf area index, mucilage content, seed number and hundred seed weight. The traits *viz.*, days to flowering, plant height, primary branches at flowering, internodal length, relative water content, mucilage content, crude fibre content, pedicel length, fruit length, fruit girth, fruit weight, seed number and hundred seed weight were found to be highly heritable and hence, could be considered while selection. High heritability with high genetic gain observed for plant height, primary branches at flowering and internodal length indicate the predominance of additive genes, while high heritability with low genetic gain observed for days to flowering indicate the role of non-additive gene action.

KEY WORDS : Okra, Genotypic co-efficient of variation (GCV), Phenotypic co-efficient of variation (PCV), Heritability, Genetic gain

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Okra [*Abelmoschus esculentus* (L.) Moench] commonly known as lady's finger is an important malvaceous vegetable crop cultivated in tropical, sub-tropical and mild temperate parts of the world. It is cultivated in an area of 5.18 Lha with a production of 62.60 lit in our country (Tiwari *et al.*, 2012). Okra is also an important crop of Tamil Nadu and Puducherry. Annually 83,969 t of okra is produced from 8,564 ha in Tamil Nadu (Hortistics, 2012). As improvement in any crop through conventional breeding requires an insight on the magnitude of variability present in a crop species, the extent of heritability and expected genetic gain for different yield components the present study was takenup in okra to study the various genetic parameters so as to plan for a worthwhile breeding programme.

RESEARCH METHODS

Studies were taken up with thirty three genotypes of okra [*Abelmoschus esculentus* (L.) Moench] at the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Union Territory of Puducherry during summer 2012-2013 with the objective of exploring the variability existing among the genotypes. The soil of the experimental field was sandy loam with moderate fertility. A total of 33 genotypes including a variety Arka Anamika was used for the study. Thirty genotypes were collected from the Indian Institute of Vegetable Research (IIVR), Varanasi and two ecotypes, one each from Tiruchirappalli and Coimbatore of Tamil Nadu were also included for the study. The observations were recorded on five randomly selected plants per replication for each genotype on twenty important characters. The analysis of phenotypic and genotypic co-efficients of variation was performed as suggested by Burton (1952). Heritability in broad sense and expected genetic gain were estimated as per the formulae described by Johnson *et al.* (1955).

RESEARCH FINDINGS AND DISCUSSION

The extent of variability exiting among the okra genotypes was measured in terms of range, mean, co-efficient variation (CV), phenotypic co-efficient of variation (PCV), genotypic co-efficient of variation (GCV). There were significant differences among the 33 genotypes for various traits studied. Substantial variability as evidenced from range, PCV and GCV was noted for primary branches at flowering and internodal length (Table 1). Such a high variability offers greater scope for selection for these traits and similar finding had been reported earlier by Karri and Acharyya (2012). The variability observed at phenotypic level for plant height and primary branches at final harvest were found to be moderate. Moderate variability for plant height was reported earlier by Reddy *et al*. (2012). The growth traits *viz*., days to flowering, node of first flower and stem diameter were found to exhibit low variability. Low variability for days to flowering (Gangashetty *et al*., 2010) and node of first flower (Das *et al*., 2012) had also been reported earlier.

Among the physiological traits the estimates of PCV and GCV were of high magnitude for leaf area index and mucilage content (Table 2). The difference observed between PCV and GCV for leaf area index was also greater indicating the influence of environment on this important physiological trait. Such a variation for length and breadth of the leaf in okra had been reported earlier by Alam and Hossain (2008). The genotypic variability observed for crude fibre content was moderate, while a low variability has been recorded for relative water content and total chlorophyll content. Presence of high variability in terms of PCV and GCV for seed number and hundred seed weight were recorded (Table 3) in the present study. Similar finding had been reported earlier by Prakash and Pitchaimuthu (2010) for seed number and Osekita and Akinyele (2008) for hundred seed weight.

In conformity to the findings Patro and Ravisankar (2004); Nasit *et al.* (2009); a high variability at phenotypic level was recorded for yield plant^{-1} in okra. However, the GCV recorded for this trait was found low. The most important yield contributing traits *viz*., fruit length, fruit weight and fruit number had shown a moderate level of variability. Moderate variability for fruit length had also been reported earlier by Gangashetty *et al*. (2010); Das *et al.* (2012) and Jagan *et al.* (2013), while Prakash and

Table 1 : Genetic parameters for growth traits of okra

Characters	DF	NFF	PH (cm)	PBF	PBFH	IL (cm)	SD (cm)
Range	35.66-39.26	3.20-3.86	18.79-33.20	0.73-2.53	2.13-3.33	3.54-9.51	6.08-8.86
Mean	37.14	3.48	25.66	1.42	2.58	7.12	7.75
Phenotypic variance (PV)	1.38	0.06	13.25	0.23	0.10	2.31	0.49
Genotypic variance (GV)	0.96	0.02	12.09	0.19	0.05	2.16	0.29
Phenotypic co-efficient of variation (PCV) in per cent	3.16	6.92	14.19	33.79	12.50	21.39	9.05
Genotypic co-efficient of variation (GCV) in per cent	2.63	3.72	13.55	30.83	8.45	20.65	6.89
Heritability in broadsense (h^2) in per cent	69.26	28.87	91.24	83.27	45.73	93.16	57.96
Genetic advance (GA)	1.68	0.14	6.84	0.82	0.30	2.92	0.84
GA as per cent of mean	4.51	4.12	26.66	57.96	11.77	41.06	10.80

DF - Days to flowering; NFF- Node of first flower; PH - Plant height (cm); PBF - Primary branches at flowering; PBFH - Primary branches at final harvest; IL - Internodal length (cm); SD - Stem diameter (cm)

Table 2 : Genetic parameters for physiological and quality traits of okra

Characters	LAI	RWC (per cent)	TC (mg g^{-1})	MC (per cent)	CFC (per cent)
Range	0.48-1.56	48.41-67.16	0.90-1.51	2.16-6.59	16.92-32.54
Mean	0.93	58.70	1.21	3.48	23.96
Phenotypic variance (PV)	0.09	18.36	0.03	1.20	13.26
Genotypic variance (GV)	0.04	16.91	0.01	1.06	12.93
Phenotypic co-efficient of variation (PCV) in per cent	32.21	7.30	13.85	31.44	15.20
Genotypic co-efficient of variation (GCV) in per cent	20.40	7.01	9.57	29.65	15.01
Heritability in broadsense (h^2) in per cent	40.14	92.14	47.74	88.93	97.51
Genetic advance (GA)	0.25	8.13	0.17	2.00	7.32
GA as per cent of mean	26.63	13.85	13.63	57.60	30.54

LAI - Leaf area index RWC - Relative water content (per cent) TC - Total chlorophyll (mg g $^{-1}$) MC - Mucilage content (per cent) CFC - Crude fibre content (per cent)

Pitchaimuthu (2010) had reported moderate variability for fruit number. Moderate variability for fruit weight was reported earlier by Pradip *et al*. (2010). The variability for pedicel length and fruit girth were found low and such a low variability for fruit girth has been reported earlier by Karri and Acharyya (2012). The study on variability reveals the importance of primary branches at flowering, internodal length, leaf area index, mucilage content, seed number, hundred seed weight and yield plant^{-1} in exercising selection as they had greater variability either at phenotypic level (or) both at phenotypic and genotypic level.

Heritability was found to be high for majority of the growth traits studied *viz*., days to flowering, plant height, primary branches at flowering and internodal length. However, high heritability with high genetic gain was observed only for plant height, primary branches at flowering and internodal length (Table 1). Dhankhar and Dhankhar (2002) had reported high heritability and high genetic advance for primary branches at flowering, while such an estimate for internodal length had been reported earlier by Reddy *et al.* (2012) and Pradip *et al.* (2010). High heritability and high genetic advance as percentage of mean for plant height was reported earlier by Patro and Ravisankar (2004) and Nasit *et al*. (2009). The heritability estimate as well as genetic gain were moderate for primary branches at final harvest and stem diameter. Such a finding in okra for stem diameter had been reported earlier by Guddadamath *et al.* (2011) and Kumar *et al.* (2013).

The quality parameter *viz*., crude fibre content and mucilage content were found to be top ranking traits as they had registered high heritability with high genetic gain. However, Karri and Acharyya (2012) had reported high heritability with low genetic gain for crude fibre in okra. The heritability and genetic advance recorded for leaf area index as well as total chlorophyll were of moderate magnitude. But Karri and Acharyya (2012) had observed moderate heritability with low genetic advance for number of leaves plant^{-1}.

Six of the seven fruit related traits were found to record high heritability estimates of which, high heritability coupled with high genetic gain was observed for seed number, hundred seed weight and fruit weight (Table 3). Such a finding was reported earlier by Das *et al.* (2012) for seed number, Celestin *et al.* (2012) for hundred seed weight and Reddy *et al.* (2012) for fruit weight. The traits *viz*., pedicel length, fruit length and fruit girth were found to have high heritability with moderate genetic gain, while moderate heritability estimate with high genetic gain was observed for fruit number. High heritability with moderate genetic advance was reported earlier by Hazra and Basu (2000) for fruit girth, while moderate heritability and high genetic gain was reported for fruit number by Dhankhar and Dhankhar (2002).

The presence of high heritability with high genetic gain for plant height, primary branches at flowering, internodal length, mucilage content, crude fibre content, fruit weight, seed number and hundred seed weight indicate the predominance of additive gene action and thereby indicate the probability for a high genetic advancement during selection. In addition, the traits *viz*., days to flowering , relative water content , pedicel length, fruit length and fruit girth also assumes significance owing to high heritability estimates, as the population can be easily subjected to progeny selection (or) mass selection. High heritability with low genetic gain observed for days

Table 3 : Genetic parameters for fruit related traits and yield of okra

Characters	PL (cm)	FL (cm)	FG (cm)	FW (g)	FN	SN	HSW (g)	YPP (g)
Range	2.23-3.12	10.69-16.42	5.08-6.82	12.19-25.28	17.56-31.80	24.00-63.16	5.66-14.25	263.29-463.49
Mean	2.68	13.58	5.96	19.42	24.72	39.26	8.06	340.85
Phenotypic variance (PV)	0.06	2.49	0.32	10.73	16.97	89.16	3.08	4659.28
Genotypic variance (GV)	0.04	2.07	0.21	8.68	9.89	82.80	2.84	801.99
Phenotypic co-efficient of variation (PCV) in per cent	8.95	11.61	9.49	16.86	16.83	24.05	21.81	20.03
Genotypic co-efficient of variation (GCV) in per cent	7.45	10.60	7.72	15.16	12.85	23.17	20.96	8.31
Heritability in broadsense (h^2) in per cent	69.41	83.44	66.20	80.90	58.30	92.86	92.31	17.21
Genetic advance (GA)	0.34	2.71	0.77	5.46	5.00	18.06	3.34	24.20
GA as per cent of mean	12.79	19.95	12.94	28.09	20.21	46.00	41.48	7.10

PL- Pedicel length (cm) FL- Fruit length (cm) FG- Fruit girth (cm) FW- Fruit weight (cm)
FN- Fruit number SN- Seed number HSW- Hundred seed weight (g) YPP- Yield plant^{-1} (g)

to flowering indicates the role of non-additive genes. The role of dominance and non-allelic interaction could be observed for node of first flowering and yield plant^{-1} as they had low level of heritability and genetic gain (Katagi *et al.*, 2013; Meena *et al*., 2013 and Solankey and Singh, 2009.

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