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Genetic variability, heritability and genetic advance studies in okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract
An effort was made to create and assess the variability through hybridization using parameters like PCV, GCV, heritability, genetic advance and to figure out the inter-relationships among the yield components for fruit yield/plant with path and correlation analysis in okra (*Abelmoschus esculentus* (L.) Moench). The present experiment is comprised of two parents; female VRO-6 and male AOL-09-02, its F_1 and F_2 population. The material was evaluated in non-replicated trial as segregating F_2 generation is involved. Observations were recorded on twelve characters showing considerable variability. PCV was higher than the respective GCV for all the traits. The high magnitude of PCV and GCV was observed for number of branches/plant at final harvest followed by fruit yield/plant, internodal length, number of fruits/plant and plant height at final harvest. High genetic advance coupled with high heritability was observed for most of the characters. It indicated that additive gene action was more important for these characters.

Keywords: okra, variability, heritability, genetic advance as per cent of mean

Introduction
Okra belongs to family Malvaeace and is polyploid in nature. It is also known as bhendi or lady's finger. It is an important vegetable crop cultivated throughout the world and is native of tropical Africa. It is grown in tropical and sub-tropical parts of the world. It is a self-pollinated crop, however occurrence of out crossing to an extent of 4 to 19 per cent (Choudhury and Choonsai, 1970) by insects has been reported which renders considerable genetic diversity. Creation and utilization of variability using proper breeding procedure is a pre-requisite for the genetic improvement of any crop. Generally, amount of variability is more in the early segregating generations as compared to later generations. The phenotypic expression of the plant character is mainly controlled by the genetic makeup of the plant and the environment in which it is growing. Therefore, it becomes necessary to partition the observed phenotypic variability into its heritable components with suitable parameters such as phenotypic and genotypic coefficient of variation, heritability and genetic advance as per cent of mean.

Material and Methods
Experimental material comprised of ten plants from each parent (female VRO - 6 and male AOL - 09 - 02), twenty plants of F_1 and 296 F_2 plants. Plants were sown at 60 cm between rows and 30 cm between plants. Experimental material was evaluated in non replicated trials as segregating F_2 generation was involved at Regional Horticultural Research Station, Navsari Agricultural University, Navsari during *kharif*-2016. Recommended cultural practices for okra were followed. Data was recorded on twelve parameters *viz.*, days to first flowering, days to first picking, fruit length, fruit girth, fruit weight, plant height at final harvest, number of branches/plant at final harvest, number of fruits/plant, internodal length, number of seeds/fruit, 100 seed weight and fruit yield/plant. The GCV and PCV were determined according to Burton and Devane (1953). Heritability in broad sense was calculated using formula proposedby Hanson *et al.*, (1956) and expressed in percentage. Genetic advance was computed according to the formula proposed by Johnson *et al.* (1955).

Results and Discussion

The PCV and GCV measure the extent of variation present in the population in the particular character. PCV was higher than the respective GCV for all the traits (Table 1), denoting the environmental factors influencing their expression to some degree which is in accordance with findings of Katagi *et al.* (2013) [10], Dhankar *et al.* (2013) [5], Kumar and Kumar (2014) [13, 14], Patel *et al.* (2014) [16], Kumar *et al.* (2014) [13, 14], Sundaram and Rajkumar (2015) [21, 22], Saryam *et al.* (2015) [19], Sundaram (2015) [21, 22], Khajuria *et al.* (2015) [12], Kandasamy *et al.* (2015) [9] and Jadhav *et al.* (2016) [7]. The high magnitude of PCV and GCV was observed for number of branches/plant at final harvest followed by fruit yield/plant, internodal length, number of fruits/plant and plant height at final harvest. This high magnitude of PCV and GCV for above characters suggested greater phenotypic and genotypic variability among the F_2 segregating populations and indicated that these characters can be improved through phenotypic selection. The high PCV and GCV were observed by Kumar and Kumar (2014) [13, 14], Patel *et al.* (2014) [16], Saryam *et al.* (2015) [19] and Jadhav *et al.* (2016) [7] for number of branches/plant at final harvest; Kandasamy *et al.* (2015) [9], Sundaram (2015) [21, 22], Jadhav *et al.* (2016) [7], Shivaramegowda *et al.* (2016) [20] and Kerure *et al.* (2017) [11] for fruit yield/plant; Chaukhande *et al.* (2011) [2], Prakash *et al.* (2011) [17], Vani *et al.* (2012) [23], Sundaram and Rajkumar (2015) [21, 22] for internodal length; Kandasamy *et al.* (2015) [9], Khajuria *et al.* (2015) [12], Sundaram (2015) [21, 22] and Kerure *et al.* (2017) [11] for number of fruits/plant and Kandasamy *et al.* (2015) [9], Khajuria *et al.* (2015) [12], Jadhav *et al.* (2016) [7] and Shivaramegowda *et al.* (2016) [20] for plant height at final harvest.

The heritability estimate provide the information on the magnitude of inheritance of quantitative characters but does not indicate the magnitude of genetic gain obtained by selection of best individual from the best population. So, heritability along with genetic advance is more useful than the heritability alone. In present study, high genetic advance coupled with high heritability was observed for most of the characters. It indicated that additive gene action was more important for these characters which was in accordance to the findings of Mazid *et al.* (2013) [15], Patel *et al.* (2014) [16], Deo (2014) [4], Saryam *et al.* (2015) [19], Sundaram (2015) [21, 22], Khajuria *et al.* (2015) [12] Rao *et al.* (2015) [18], Shivaramegowda *et al.* (2016) [20], Jadhav *et al.* (2016) [7] and Kerure *et al.* (2017) [11]. Therefore, improvement in these traits would be more effectively be done through selection in the present material.

Table 1: Genotypic and phenotypic coefficient of variation, heritability and genetic advance as per cent of mean for various traits in okra

	Character	Range	GCV %	PCV %	h^2 (%)	GAM %
1	Days to first flowering	37.00-55.00	7.81	10.25	57.99	12.25
2	Days to first picking	43.00-61.00	6.34	8.60	54.31	9.62
3	Plant height at final harvest (cm)	24.30-112.80	22.61	26.15	74.73	40.26
4	Number of branches/plant at final harvest	0.00-5.00	47.91	62.58	58.62	75.57
5	Internodal length (cm)	1.10-10.20	32.40	43.75	54.85	49.44
6	Fruit length (cm)	10.43-20.20	3.56	12.91	7.59	2.02
7	Fruit girth (cm)	1.30-1.63	1.13	5.05	5.03	0.52
8	Fruit weight (g)	10.45-22.90	12.03	13.59	78.36	21.93
9	Number of fruits/plant	1.00-23.00	32.14	35.34	82.74	60.23
10	100 seed weight (g)	2.40-5.60	1.37	20.70	0.44	0.19
11	No. of seeds/ fruit	30.00-49.00	12.18	15.42	62.45	19.84
12	Fruit yield/plant (g)	15.33-328.90	37.22	39.86	87.20	71.60

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