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# Genetic variability studies for yield and its contributing traits in okra [*Abelmoschus esculentus* (L.) Moench]

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**Abstract:** The experiment comprising 30 okra (*Abelmoschus esculentus*) genotypes were grown and analysed for yield and its attributing traits at the Department of Vegetable science, Kumarganj, Faizabad during Zaid (2011) period. All the characters studied showed a wide range of variation. The variability for yield among the accessions evaluated was also remarkable. The magnitude phenotypic coefficient of variation was higher than genotypic coefficient of variation for all traits. Both phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were high for plant height (11.10 and 10.60, respectively). Fruit weight exhibited low value of GCV (2.31) and PCV (4.74) and likely to show less response under selection. High heritability (91.3) with high genetic advance (26.74) was recorded for plant height, whereas, ridges per fruit had high heritability (97.0) with moderate genetic advance (18.45). This study aimed to evaluate okra genotypes for variability with a view to providing information on the development of high yielding genotypes to meet the growing food demand of the populace.

**Keywords:** *Abelmoschus esculentus,* Genetic advance, Heritability, Variability

## INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an important vegetable, mainly grown for its young immature fruits and consumed as a vegetable, raw, cooked, or fried. Also okra fruit has high nutritional value, which contains, carbohydrates, fats, fibres, oil, mineral and vitamins *viz.*, $B_1$, A and C (Rashwan, 2011). It is widely distributed and cultivated in the tropics, sub tropics, and warmer portions of the temperate region of the world on a varying scale. India ranks first in the world, it is commercially grown in the West Bengal, Gujarat, Bihar, Andhra Pradesh, Odisha, Uttar Pradesh, Tamil Nadu, Karnataka, Haryana, and Punjab and occupies 532.7 thousand hectare with the production of 6346.4 thousand million tonnes green fruits, where as the productivity is 11.9 MT/ha (Anonymous, 2015).

The low productivity is because of low yielding potential of current varieties and reduction in yield due to frequent attacks of pests and diseases, especially the fruit and shoot borer and yellow vein mosaic virus (Reddy *et al*., 2012). The success of a breeding programme depends mainly upon the promising genotypes from the gene pool. A clear understanding of components of variances and their effects, heritability, and genetic advance of the traits under consideration help to the breeders in deciding the appropriate breeding method to improve the genetic makeup. Genetic variability present in a population is of primary importance for any successful selection in plant breeding programme. Greater the variability in crop plants provides an opportunity for selecting desirable genotypes. Heritability is an index of transmissibility of a character from the parents to its offspring and thus, it is a suitable measure for assessing the magnitude of genetic portion of total variability and an aid to make improvement in crop by selection for various characters. Due consideration, therefore may be given to heritability estimates of the characters during selection. However, heritability alone does not give true picture of genetic improvement to be affected by selection. For crop improvement by selection, it is essential to study the extent of heritability along with genetic advance. The possibility of improvement in any crop is measured by variability available in the crop (Mohapatra *et al.*, 2007). Hence, it is essential to partition overall variability into its heritable and non-heritable components with the help of genetic parameters like coefficient of variation, heritability, and genetic advance.

## MATERIALS AND METHODS

Thirty okra, (*Abelmoschus esculentus*) genotypes were grown at main Experimental farm, Department of Vegetable science, Kumarganj, Faizabad during Zaid (2011). The source of the okra genotypes used in the study is presented in Table 1. All the genotypes were sown at a spacing of 60 × 30 cm in a randomized block design with three replications in a plot size of 2.4 metre × 1.2 metre. Recommended crop management practices were followed (Chadha, 2007).

The observations on the following characters were recorded from five randomly selected plants from each plot in each replication *viz*. days to 50% flowering, plant height (cm), nodes to first fruit set, nodes per plant, fruits per plant, fruit length (cm), fruit diameter (cm), internodal length (cm), fruit yield per plant, ridges per fruit and fruit weight (g). Days to 50 % flowering was taken from the day of sowing to the day at which 50% of the plants in each plot attained flowering. The data recorded from five randomly selected plants from experimental plot were used to calculate the mean values for each genotype per replication. The mean values obtained were used for analysis of variance and to estimate genotypic and phenotypic coefficient of variation, heritability and genetic advance as percentage of mean. The analysis of variance for each character was followed according to Panse and Sukhatme (1967). The phenotypic and genotypic coefficients of variation were estimated as per formula suggested by Burton and de Vane (1953). Heritability in broad sense ($h^2_{bs}$) was calculated using the formula suggested by Hanson *et al.* (1956) and genetic advance were calculated by using formula given by Johnson *et al.* (1955).

## RESULTS AND DISCUSSION

**Mean performance and genetic variability:** The analysis of variance for different characters is presented in Table 2. The mean sum of square due to replications was non-significant for all the characters. The variation due to treatments was highly significant for all the characters but fruit length (cm), fruit diameter (cm) and fruit weight (g) were significant. In other words the performance of the genotypes with respect to these characters was statistically different, suggesting that there is ample scope for selection of different traits for the improvement in okra. High magnitude of genetic variability for plant height, fruit weight, fruit diameter (Kumar *et al.*, 2006; Mulge *et al.*, 2006), fruit length (Singh *et al.*, 2006), fruit weight and inter nodal length (Kumar *et al.*, 2012) has been earlier reported in okra.

The range, general mean, phenotypic and genotypic coefficient of variation, heritability (bs), genetic advance in per cent of mean for different characters in okra genotypes are presented in Table 3. The phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the traits, which indicates that environment played a considerable role in the expression of their traits. Among the eleven traits showed a range of GCV for various characters varied from 2.31 (fruit weight) to 10.60 (plant height). The GCV and PCV values were found to be very distant to each other for most of the characters suggesting the presence of large amount of variability. Variability is a very important and essential pre-requisite in any breeding programme and such variability will be driving force for improving the crop plants (Harlan, 1956 and Simmond, 1962). The range of variability of different traits alone does not allow a decision as to which character was showing the highest degree of variability. Therefore, accurate relative comparison can be made with the help of phenotypic and genotypic coefficient of variation. Phenotypic variation was partitioned into genotypic and environmental component.

The significant differences were observed among genotypes for all the characters studied. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels observed for nodes per plant, plant height and nodes to first fruit set. Phenotypic variation was highest for nodes per plant (11.96), followed by plant height (11.10) at final harvest. Genotypic variation was highest for plant height (10.60) followed by nodes per plant (9.02). Indurani and Veeraragavathatham (2005) have also reported similar results in their studies. Moderate variation was noted in case of ridges and yield per plant, while low GCV and PCV observed for fruit weight (2.31 and 4.74) and days to 50% flowering (3.66 and 4.93), respectively. Moderate to low variation exerted for these traits revealed that there is a reasonable scope for improvement in these traits. Low variability for days to 50% flowering, fruit lenght and

**Table 1.** Okra genotypes used for its genetic analysis of yield characters.

| S. N. | Genotypes | Source | S. No. | Genotypes | Source |
|---|---|---|---|---|---|
| 1 | IC-81218874 | IIVR, Varanasi | 16 | 145 | IIVR, Varanasi |
| 2 | EC-3016556 | IIVR, Varanasi | 17 | IC-22283 | IIVR, Varanasi |
| 3 | HRB-55 | IIVR, Varanasi | 18 | VRO-5 | IIVR, Varanasi |
| 4 | SB-4 | IIVR, Varanasi | 19 | 409 | IIVR, Varanasi |
| 5 | 814-k | IIVR, Varanasi | 20 | 1998 | IIVR, Varanasi |
| 6 | VRO-22 | IIVR, Varanasi | 21 | EC-169367 | IIVR, Varanasi |
| 7 | IC-111527 | IIVR, Varanasi | 22 | IC-85595 | IIVR, Varanasi |
| 8 | 165-A | IIVR, Varanasi | 23 | 335 | IIVR, Varanasi |
| 9 | IC-282280 | IIVR, Varanasi | 24 | IC-18537 | IIVR, Varanasi |
| 10 | NDO-10 | NDUA & T Faizabad | 25 | 1773 | IIVR, Varanasi |
| 11 | 1769 | IIVR Varanasi | 26 | IC-282237 | IIVR, Varanasi |
| 12 | IC-90184 | IIVR Varanasi | 27 | 1789 | IIVR, Varanasi |
| 13 | 193 | IIVR Varanasi | 28 | IC-52310 | IIVR, Varanasi |
| 14 | IC-111532 | IIVR Varanasi | 29 | VRO-6 | IIVR, Varanasi |
| 15 | 467 | IIVR Varanasi | 30 | ParbhaniKranti (c) | MKVP,Parbhani (MH) |

**Table 2.** Analysis of variance (mean sum of squares) for 11 characters in okra.

| S.N. | Characters | Source of variation | | |
|---|---|---|---|---|
| | | Replications | Treatments | Error |
| | d. f. | 2 | 29 | 58 |
| 1. | Days to 50% flowering | 0.411 | 10.132** | 2.170 |
| 2. | Plant height (cm) | 0.576 | 311.452** | 9.590 |
| 3. | Nodes to first fruit set | 0.300 | 1.327** | 0.158 |
| 4. | Internodal length (cm) | 0.209 | 0.431** | 0.084 |
| 5. | Nodes per plant | 0.664 | 10.913** | 2.204 |
| 6. | Ridges/fruit | 0.007 | 0.396** | 0.004 |
| 7. | Fruits/plant | 0.330 | 1.357** | 0.338 |
| 8. | Fruit length (cm) | 0.251 | 1.369* | 0.725 |
| 9. | Fruit diameter (cm) | 0.003 | 0.019* | 0.010 |
| 10. | Fruit weight (g) | 0.291 | 0.456* | 0.235 |
| 11. | Fruit yield/plant | 3.118 | 223.568** | 7.313 |

*, ** - Significant at 5% and 1% probability level, respectively

**Table 3.** Estimates of range, grand mean, phenotypic and genotypic coefficients of variation, heritability in broad sense ($h^2_{bs}$) and genetic advance in per cent of mean (GA) for 11 characters in okra.

| S. N. | Characters | Range | | Grand mean | PCV (%) | GCV (%) | Heritability Broad Sense (%) ($h^2_{bs}$) | Genetic Advance in per cent of mean (gs %) |
|---|---|---|---|---|---|---|---|---|
| | | Lowest | Highest | | | | | |
| 1. | Days to 50% flowering | 41.00 | 47.33 | 44.51 | 4.93 | 3.66 | 55.0 | 7.17 |
| 2. | Plant height (cm) | 76.47 | 111.03 | 94.62 | 11.10 | 10.60 | 91.3 | 26.74 |
| 3. | Nodes to first fruit set | 6.00 | 8.23 | 7.13 | 10.37 | 8.75 | 71.2 | 19.49 |
| 4. | Internodal length (cm) | 4.33 | 5.87 | 4.83 | 9.25 | 7.04 | 57.8 | 14.13 |
| 5. | Nodes per plant | 16.07 | 22.23 | 18.90 | 11.96 | 9.02 | 56.8 | 17.95 |
| 6. | Ridges/ fruit | 5.00 | 7.00 | 5.09 | 7.21 | 7.10 | 97.0 | 18.45 |
| 7. | Fruits/ plant | 9.97 | 13.47 | 11.24 | 7.32 | 5.19 | 50.2 | 9.70 |
| 8. | Fruit length (cm) | 10.57 | 13.20 | 12.11 | 8.00 | 3.83 | 22.9 | 4.83 |
| 9. | Fruit dia. (cm) | 1.63 | 1.93 | 1.78 | 6.45 | 3.04 | 22.3 | 3.79 |
| 10. | Fruit weight (g) | 10.70 | 12.30 | 11.73 | 4.74 | 2.31 | 23.9 | 2.99 |
| 11. | Fruit yield/ plant | 116.23 | 145.47 | 131.43 | 6.78 | 6.46 | 90.8 | 16.25 |

fruit weight were also reported by Jaiprakashnarayan *et al.*(2006) and Goswami *et al.* (2012).

**Heritability and genetic advance:** Heritability in broad sense of a character is important to the breeder since it indicates the possibility and extent to which improvement is possible through selection. It also indicates direction of selection pressure to be applied for the traits during selection because it measures relationship between parent and their progeny, widely used in determining the degree to which a character may be transmitted from parent to offspring. However, high heritability alone is not enough to make efficient selection in advanced generations unless accompanied by substantial amount of genetic advance (Burton, 1952). High estimates of heritability along with high genetic advance provide good scope for further improvement in advance generations. The result of present investigation revealed that low to high heritability estimates were present in almost all the characters. The heritability estimates for different characters ranged from 22.3 to 97 per cent. High heritability was recorded for ridges per fruit and plant height, whereas, nodes to first fruit set, internodal length, nodes per plant, days to 50% flowering and fruits per plant showed moderate level of heritability. Low heritability was recorded for fruit weight, fruit length and fruit diameter indicated more influence of environmental effect, which may be due to presence of non-additive gene action in expression of the character. It was obvious that improvement of the character exhibiting high heritability would be more efficient by adopting normal selection procedures and for those having lower value, some other suitable breeding techniques, as population improvement programme would have to be adopted. These results are in close conformity with the findings of (Bendale *et al.*, 2004; Patro and Ravishankar, 2005; Kumar *et al.*, 2012), who also reported high, low and moderate heritability for different growth and yield traits in okra. The genetic advance is commonly predicted as a product of heritability ratio and selection differentials.

Panse (1967) mentioned that where high heritability value is accompanied by high genetic advance. The progress realized by selection would be most appropriate. In the present study, the highest estimates of heritability were observed in case of ridges per plant (97.0) and the highest genetic advance showed in plant height (26.74). High heritability coupled with high genetic advance in per cent of mean was recorded for plant height indicating that these traits were less influenced by environment. Similar results of high heritability and high genetic advance were also reported by Indurani and Veeraragavathatam (2005), Mehta *et al.* (2006) for plant height. On the other hand, the traits namely nodes to first fruit set (19.49), ridges per fruit (18.45) and nodes per plant (17.95) showed moderate genetic advance also revealed the additive gene action for these traits. Moderate heritability coupled with moderate genetic advance was recorded for nodes to first fruit set and nodes per plant. The heritability associated with low genetic advance for fruit length, fruit diameter and fruit weight revealed that non-additive gene action was prevailing for these characters.

## Conclusion

The estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters. PCV was high for nodes per plant followed by plant height, nodes to first fruit set and internodal length however, high GCV was recorded for plant height followed by nodes per plant and nodes to first fruit set. Moderate variation was noted in case of ridges per plant and fruit yield per plant. The occurrence of moderate values for these parameters reveals reasonable scope of improvement through selection. Fruit weight exhibited low value of GCV and PCV and likely to show less response under selection. Heritability in broad sense ranged from 22.3% to 97.0%. High heritability coupled with high genetic advance in per cent of mean were observed for plant height, however high heritability with moderate genetic advance was recorded for ridges per fruit and fruit yield per plant. In future, these experimental results may prove very useful for development of high yielding genotypes in okra.

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