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# Variability, heritability and character association in okra [*Abelmoschus esculents* (L.) Moench]

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The genetic variability, heritability and correlation analysis were studied in 55 diverse genotypes including 10 parents and 45 crosses of okra for fruit yield and its component traits. From the analysis of variance, it was observed that mean squares due to genotypes were significant for all the traits, indicating the presence of genetic variability in the experimental material. The values of PCV were higher than that of GCV values for all the ten characters indicating influence of environmental effects in the expression of these characters indicating influence of environmental effects in the expression of these characters. The GCV, heritability and genetic advance over mean were higher for first fruiting node, days of first picking number of branches per plant, plant height, number of fruits per plant and yield per plant which might be indicative of likely effectiveness of selection for such characters.The total yield per plant has significantly positive correlation with first fruiting node, days of first flowering, and early yield per plant.

**Key words :** Okra, Variability, Correlation co-efficient

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## INTRODUCTION

Okra [*Abelmoschus esculents* (L.) Moench], belongs to family malvaceae. It is an important summer vegetable crop cultivated throughout India.It is native to tropical Africa. Okra fruit contains fairly good amount of vitamins A, B, C, Calcium, Iodine and phosphorus. Apart from these, okra also contains carbohydrate, protein, fat and fibre. Okra is generally culitivated for its immature fruits which are cooked as vegetable. Okra soups and stews are also popular dishes. The fruits can also be sun dried, pickled or canned for off season consumption. Plant stem roots are used for clearing the cane juice in the process of making gur (Chauhan, 1972). Matured fruits and stem containing crude fiber and used in the paper industry and stem of the plant is used for the extraction of the fibre. Present cultivars of Bhindi are capable of showing high variability in several characters including yield. But the yields of present cultivars per unit area of land and per unit of time are very low because of their very low yield potential (Balakrishnan and Balakrishnan, 1988).Singh *et al.* (1974) investigated variation in okra species and found out that a large number of okra characters such as pigment colour and spines on the fruit surfaces are inherited in a simple fashion, suggesting that these characters are controlled by relatively few genes.

## RESEARCH METHODOLOGY

Fifty five genotypes of okra were grown in a randomized block design with three replications during rainy season at the Farm of C.S.S.S. (PG) College, Machhra, Meerut. Each entry was grown in a single row of 3.60 meter length with row to row spacing of 45cm and plant to plant spacing of 30cm, accommodating 12 plant a in row. The uniformly recommended agronomic practices were followed to raise a good crop during the course of investigation. The observations were recorded on all ten plants, after avoiding end plant from both side of a line to avoid the border effects of a genotype in each replication. Observations were recorded on ten parameters namely first fruiting node, days of first flowering, days of first picking, number of branches per plant, plant height (cm), number of fruits per plant, length of fruit(cm), diameter of fruit(cm), early yield per plant(g) and total yield per plant(g). The various genetic parameters, *viz.*, genotypic co-efficient of variation and phenotypic co-efficient of variation, heritability in broadsense and the expected genetic advance were calculated as suggested by Burton and Devane (1953), Lush (1940) and Johnson *et al.* (1955).

## RESEARCH FINDINGS AND ANALYSIS

The findings of the present study as well as relevant discussion have been presented under following heads :

**Variability :**

Genetic variability is the tendency of individuals in a population to vary from one another. Variability is different from genetic variation, which is the actual amount of phenotypic variation seen in a particular population. The variability of a trait describes how much that trait tends to vary in resonse to changes in the genetics of a population. Genetic variability in a population is very important, because without variability, it becomes difficult for a population to adapt to environmental changes, creating a static population. Variability is an important factor in evolution since it provides the potential for genetic variation, the raw material for natural selection.

Statistically, the total variability is expressed in terms of phenotypic co-efficient of variation (PCV) and the genotypic variability is expressed in terms of genotypic co-efficient of variation (GCV). These parameters of variability are particularly very informative when a breeder is interested in having a stock of the comparative account of variability present in different traits, which might have been measured in different units. Variability in population, especially in respect to the characters for which improvement is sought, is a prerequisite for successful selection. The population under study was therefore examined to assess the amount of variability presented among different cultivars in respect to a number of metric traits. Patil *et al.* (1996) estimated genotypic and phenotypic co-efficient of variation for 11 characters in okra for two seasons, using 171 okra lines of diverse origin. Considerable differences were observed for some characters in the two seasons. Number of pods per plant, weight of good pods per plant, number of borer infested pods and weight of

**Table 1 : Analysis of variance for different characters**

| Characters | Mean Squares | | | |
|---|---|---|---|---|
| | Replications | | Treatments | Error |
| | d.f. | 2 | 54 | 108 |
| First fruiting node | | 0.914 | 1.702** | 0.016 |
| Days of first flowering | | 49.229 | 16.153** | 0.600 |
| Days of first picking | | 39.58 | 27.443** | 0.378 |
| Number of branches per plant | | 1.40 | 2.791** | 0.017 |
| Plant height (cm) | | 40.126 | 493.540** | 2.170 |
| Number of fruits per plant | | 2.695 | 5.448** | 0.035 |
| Length of fruit (cm) | | 2.22 | 5.881** | 0.038 |
| Diameter of fruit (cm) | | 0.626 | 0.76** | 0.010 |
| Early yield per plant (g) | | 165.56 | 1825.193** | 4.401 |
| Total yield per plant (g) | | 118.013 | 2227.511** | 10.511 |

** indicate significance of value at P=0.01, respectively

**Table 2 : Means and other variability parameters for different characters in okra**

| Character | Grand mean | Phenotypic variance | Genotypic variance | Phenotypic co-efficient of variation | Genotypic co-efficient of variation | Heritability in broad sense | Genetic advance | Genetic advance over mean |
|---|---|---|---|---|---|---|---|---|
| First fruiting node | 5.48 | 0.58 | 0.56 | 13.8 | 13.6 | 97.2 | 1.52 | 27.73 |
| Days of first flowering | 47.94 | 5.78 | 5.18 | 5.0 | 4.7 | 89.6 | 4.42 | 9.2 |
| Days of first picking | 53.34 | 9.39 | 9.02 | 57.0 | 56.0 | 96.0 | 6.06 | 11.35 |
| Number of branches per plant | 4.46 | 0.94 | 0.92 | 21.7 | 21.5 | 98.1 | 1.96 | 43.94 |
| Plant height (cm) | 136.23 | 165.96 | 163.79 | 9.4 | 9.3 | 98.6 | 26.16 | 19.20 |
| Number of fruits per plant | 12.84 | 1.835 | 1.80 | 10.6 | 10.4 | 98.0 | 2.73 | 21.26 |
| Length of fruit (cm) | 208.60 | 1.99 | 1.95 | 0.67 | 0.66 | 98.0 | 2.84 | 1.36 |
| Diameter of fruit (cm) | 5.15 | 0.032 | 0.022 | 34.7 | 28.8 | 68.7 | 0.25 | 4.87 |
| Early yield per plant (g) | 166.62 | 606.93 | 611.33 | 14.8 | 14.7 | 99.2 | 50.51 | 30.31 |
| Total yield per plant (g) | 206.55 | 749.51 | 739 | 13.2 | 13.1 | 98.5 | 55.55 | 26.91 |

borer infested pods per plant showed seasonal differences; they showed considerable variation during *Kharif* and *Rabi*. The estimates of PCV and GCV values ranged from 14.7 per cent for days to flowering (*Kharif*) to 71.6 per cent for weight of borer infested pods (*Kharif*).

From the analysis of variance, it was observed that mean squares due to genotypes were significant for all the traits, indicating there by the presence of genetic variability in the experimental material. Estimates of phenotypic co-efficient of variation (PCV) were comparable with genotypic co-efficient of variation (GCV) for all the traits studied. However, the estimates of PCV were higher than the estimates of GCV for all characters. This may be due to the involvement of environment and genotypic x environment effect in character expression. The GCV and PCV were high for days of first picking, no of branches/plant and diameter of fruit. High magnitude of genetic variance suggested the presence of high genetic variability. These results are in agreement with the results of Panda and Singh (1997).

**Heritability and expected genetic advance :**

High PCV or GCV did not provide a clear picture of the extend of genetic gain to be achieved from selection for the phenotypic traits unless the heritable fraction of the trait was known (Burton, 1953). Estimation of heritability is, therefore, important. The knowledge of heritability provides important information to the breeder. If the value of heritability in broad sense is high, it indicates that the character is least influenced by the environmental effects, and there exists sufficient genetic variability for that trait leading to the proposition that selection would be effective for improvement of such character. Broad sense heritability is based on total genetic variance which includes both fixable (additive) and non-fixable (dominance and epistatic) variances. If broad sense heritability is low, it reveals that the character is highly influenced by environmental effects and genetic improvement through selection will be difficult due to masking effects of the environment on the genotypic effects.

Some important inferences can be drawn about heritability and genetic advance. If the value of genetic advances under selection is high, it shows that the character is governed by additive gene action and selection will be rewarding for improvement of such trait. If the value of genetic advances under selection is low, it indicates that the character is governed by non-additive gene action and heterosis breeding may be useful.

High heritability accompanied with high genetic advance indicates that most likely the heritability is due to additive gene effects and selection may be effective. High heritability accompanied with low genetic advance is indicative of non-additive gene action. Low heritability accompanied with high genetic advance reveals that the character is governed by additive gene effects. Selection may be effective in such cases. Low heritability accompanied with low genetic advance indicates that the character is highly influenced by environmental effects and hence selection would be ineffective. Nwangburuka *et al.* (2012) studies twenty nine okra accessions from different agro - ecological regions in Nigeria were grown during the rainy and dry seasons and assessed to determine their genetic variability, heritability and genetic advance from eight yield related characters. There was high genotypic co-efficient of variability, per cent broad sense heritability and genetic advance in traits such as plant height, fresh pod length, fresh pod width, mature pod length, branching per plant and pod weight per plant, suggesting the effect of additive genes and reliability of selection based on phenotype of these traits for crop improvement.

The efficiency of selection not only depends on the magnitude of genetic variability but also on the heritability of the characters. Heritability estimates are said to be satisfactory tools for selection based on phenotypic performance. The heritability in broad sense were high for all the traits except

**Table 3 : Values of correlation co-efficient among different characters in okra**

| Character | First fruiting node | Days of first flowering | Days of first picking | Number of branches per plant | Plant height (cm) | Number of fruits per plant | Length of fruit (cm) | Diameter of fruit (cm) | Early yield per plant (g) | Total yield per plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 1.00 | 0.675** | 0.427** | -0.085 | 0.003 | 0.069 | 0.118 | 0.262 | 0.267* | 0.464** |
| 2. | | 1.00 | 0.700** | 0.046 | -0.046 | -0.032 | 0.095 | 0.145 | 0.248 | 0.420** |
| 3. | | | 1.00 | 0.660** | 0.416** | -0.085 | -0.008 | 0.056 | 0.109 | 0.263 |
| 4. | | | | 1.00 | 0.698** | 0.045 | -0.044 | -0.030 | 0.102 | 0.147 |
| 5. | | | | | 1.00 | 0.656** | 0.416** | -0.086 | -0.006 | 0.054 |
| 6. | | | | | | 1.00 | 0.699** | 0.054 | -0.042 | -0.027 |
| 7. | | | | | | | 1.00 | 0.662** | 0.411** | -0.085 |
| 8. | | | | | | | | 1.00 | 0.689** | 0.052 |
| 9. | | | | | | | | | 1.00 | 0.670** |
| 10. | | | | | | | | | | 1.00 |

* and ** indicate significance of values at P=0.05 and 0.01, respectively

diameter of fruit (68.7%). Rajani and Manju (1997) and Dhankhar and Dhankhar (2002) also observed high heritability for fruit field and its components. The information on heritability alone may be misleading but when used in combination with genetic advance, the utility of heritability estimate increases. In the present study high genetic advance over mean coupled with high heritability was observed for first fruiting node, days of first picking, number of branches per plant. plant height,number of fruit per plant early yield per plant and total yield per plant. It indicated that additive gene effect was more important for these traits. Therefore, improvement in these traits would be more effective by selection in the present materials studied.

**Character association :**

Correlation study provides better understanding of yield components and helps the plant breeder in developing an effective selection strategy in plant breeding (Robinons *et al.*, 1951; Johnson *et al.*, 1955). There are three main implications of correlations in plant breeding (Simmonds, 1979): (1) A positive correlation between desirable characters is favourable to the plant breeder because it helps in simultaneous improvement of both the characters. A negative correlation, on the other hand, will hinder the simultaneous expression of both the characters with high values. In such a situation some economic compromise has to be made. (2) The genetic improvement in traits can be achieved by strong selection to a character which is genetically correlated with the dependent character *i.e.* correlated response. (3) Some times a character has low heritability. Under such a situation another character having high heritability and high correlation with the former trait is chosen to make selection more effective. The genetic improvement is achieved using indirect selection through component characters with high heritability.

Plant breeders usually select for yield components, which directly increase grain yield. Yield component breeding to enhance grain yield would be most effective, if the component traits (e.g. number of grains per ear, and grain weight) involved are highly heritable and genetically independent or positively correlated. The value of r bears negative (-) sign it means that increase in one character will lead to decrease in second and *vice versa*. Similarly, if it bears the positive (+) sign it means that increase in one variable will be the cause for increase in the other and *vice versa*. The value of r is zero insignificant; it means that these two characters are independent. Sharma and Prasad (2010) reported, the positive significant correlations for plant height with number of branches, days to 50 per cent flowering with days to first harvest, pod yield per plant with pod yield per plot, number of pods per plant with plant yield and plant yield per plot and for number of pods per plant with plant height and number of branches were found, while pod weight was negatively correlated with number of pods per plant.

The correlation co-efficients among 10 characters of okra are presented in Table 3. The 16 correlation co-efficients were positive and significant. For the remaining combinations of characters, the correlation co-efficients were not statistically significant, suggesting that such characters are not associated and selection for one trait will not accompany a change in the other trait of the pair. Total yield was significantly and positively correlated with first fruiting node, days of first flowering and early yield per plant. Early yield also showed significant and positive association with length of fruit and diameter of fruit. It could be suggested from correlation estimates that yield could be improved through selection based on these characters.

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