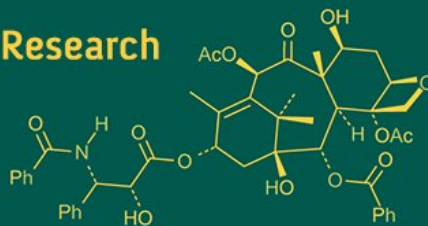


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## Heritability, correlation and genetic divergence studies in okra [*Abelmoschus esculentus* (L.) moench]

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### Abstract

Fruit yield per plant (g) and fruit production per kilogram (kg) were highest for the genotypes Rohini Bhindi Selection (211.37), 10.48. Variance values for the genotypic coefficient were classified as low (0-10%), moderate (10-20%), and high (20% and above). The heritability estimates in this study were broadly divided into three categories: low (<10%), moderate (20-30%), and high (>30%). It was discovered that the estimates of genetic advancement for plant height and yield plant-1 (g) were high. The following data showed high genetic advancement as a percentage of mean: plant height, number of leaves per plant, fruit, fruit surface (cm), fruiting span, and days until first picking. Genotypic and phenotypic coefficient analysis revealed that fruit yield per plant showed positive significant association with Plant height, Number of branches per plant). Genotypic Path coefficient analysis revealed that the maximum positive direct effect was observed for fruiting span (0.8599) followed by plant height (0.4411) and number of branches per plant (0.1223) on yield per plant. However, Fruit surface cm<sup>2</sup> (-0.8657), number of leaves per plant (-0.3862), number of fruits per plant (-0.1281), length of internodes (-0.1208) and days taken to 50% flowering (-0.111) had considerable negative direct effect on yield per plant. Length of internodes (0.2422) and Fruit width (0.1277) had considerable positive indirect effect on yield per plant via fruit surface cm<sup>2</sup>. The clustering pattern showed that cluster III is the biggest cluster, with 7 out of 21 genotypes. Cluster I had 5 genotypes, cluster II had 3 genotypes, and clusters IV, V, and VI had 2 genotypes each. The distance between clusters I and III was the greatest (88463.020), followed by the distance between clusters I and VI (46942.130), clusters III and V (38836.750), clusters V and VI (3609.836), and clusters II and IV (4500.390). Fruiting Span, Number of Fruit per Plant, Fruit weight (gm), and Yield per Plant had a large effect on genetic divergence.

**Keywords:** Genetic variability, correlation and path coefficient analysis, genetic divergence

### Introduction

Okra, or *Abelmoschus esculentus* L. Moench belong to the family called Malvaceae in the kingdom of plants. It is very nutritious and could be sold to other countries. It is annual herbaceous vegetable crop cultivated as a vegetable and in other dishes (Chattopadhyay *et al.*, 2011) [3]. It is regarded as a significant vegetable across tropical and subtropical regions of Africa and Asia (Bisht and Rana, 1995) [12], with an estimated annual production of six million tons.

A 100g edible portion of okra fruit contains 90g water, 2g protein, 1g fiber, 7g carbohydrates and has an energy value of 145 kg/100g. Okra contributes to source of vitamins, minerals and calcium (70-90 mg/100g) in the diet. It is considered as one of the important vegetable that is grown and consume in all parts of Bangladesh. Okra is reported to have good alkaline pH which contributes to its relieving effect in gastrointestinal ulcer by neutralizing digestive acid.

Mucilage from Okra have been reported to be effective as blood volume expander and has the potential to alleviate renal disease, reduce proteinuria and improve renal function. Crop improvement through successful selection programme is only achieved using valid information about the correlation and genetic variability of traits of interest knowing full well that improvement in any crop is dependent on the amount of genetic variability in the population. (Duzyaman and Vural, 2002) [13] reported that, phenotypically varied genotypes most probably of diverse source are often regarded as more effective in obtaining capable crosses.

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## Materials and Methods

The experiment was conducted during Summer Season 2019-2020 at Horticulture Research Field (HRF) Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Topography and climate the Allahabad district is situated at 25.28° N and 81.54° E with an altitude of 98m above sea level. Allahabad is located in the South-Eastern of Uttar Pradesh and has a sub-tropical climate with extremes of summer and winter. During winter season especially in month of November and March, temperature drops down to as low as 1-2 °C, while during summer the temperature reaches up to 43-48 °C. The experimental material consisting of 18 genotypes of Okra, Collected from different sources. The experiment was laid in randomized block design with 21 genotypes in three replications during summer 2019. In each replication each inbred line was raised in a single/row plot length and width of 2.00x2.00m<sup>2</sup>. Row- to- row spacing and plant to plant spacing 30cm was adopted. Biometric data on 21 quantitative characters were recorded on five competitive and randomly selected plants in each replication for plant height (cm), no. of branches per plant, internodal length (cm), Plant height (cm), Number of leaves per plant, Number of branches per plant, Length of internodes (cm), Number of nodes to first flowering, Days taken to first flowering, Days taken to 50% flowering, Days taken to first picking, Fruiting span (cm), Fruit length (cm), Fruit width (cm), Fruit weight (g), Fruit surface cm<sup>2</sup>, Number of fruits per plant, Yield per plant (g), Yield per plot (kg). Evaluated by Adeoluwa and Kehinde (2011)<sup>[14]</sup> for variability in 20 morphological and agronomic traits (qualitative and quantitative traits). Genotypic and phenotypic variances, genotypic (GCV) and phenotypic coefficients of variation (PCV), heritability, genetic advance of the characters were calculated.

## Results and Discussion

The analysis of variance was done for all the sixteen characters studied and their mean square values are presented in Table 4.1. The mean squares due to genotypes were highly significant for all the traits except days taken to 50% flowering, fruit length (cm), fruit width (cm) and number of fruits per plant. Whereas mean squares due to replication were found to be non-significant for days taken to first flowering, days taken to 50% flowering, days taken to first picking, fruit length (cm), fruit weight (g), number of fruits per plant, yield per plant (g) and yield per plot (kg). The overall analysis of ANOVA indicated the presence of ample genetic variability available in the experimental material under study that can be further exploited for okra improvement. This corroborates findings of Ade Oluwa. And Kehinde, O.B (2011).

Per Se performance of okra the overall mean and range of different traits for the experiment are presented in Table 2 while the mean performance of all the entries with respect to individual characters is presented in Appendix III. The character wise results are presented as under

Plant height (cm) the perusal of mean table revealed that the ROHINI BHINDI SELECTION (117.11cm) followed by PALAM KOMAL (99.70cm) and OKRA 472 (97.623) were found to be the highest in height whereas, INDAM 9821 (39.7033cm) was the tall among the test genotypes. The general mean for plant height was 76.7679cm.

Number of leaves per plant the genotypes Okra 472 (17.66), Okra 404 (16.66) and Okra 65 (16.33) were found to bear the maximum number of leaves per plant whereas, minimum number of leaves per plant was depicted by the genotype BHINDI S-15 (10). The mean of number of leaves per plant was recorded 13.32 for the experiment.

Genotypic coefficient of variation in the existence of high magnitude of genetic variability was evident through high values of genotypic coefficient of variation for majority of the characters. The highest genotypic coefficient of variation was observed for plant height (23.83%) followed by fruit weight (19.34%), number of leaves per plant (13.75%), length of internodes (12.04%), fruit surface cm<sup>2</sup> (11.14%), yield per plant (10.23%) and yield per plot (10.22%) whereas, it was moderate for Fruit length (9.89%), number of nodes to first flowering (9.54%), fruiting span (6.64%), fruit width (6.44%) number of branches per plant (6.08%), indicating the presence of genetic variability for the these traits while rest of the traits exhibited low genotypic coefficient of variation. (Kumar *et al.*, (2019)<sup>[8]</sup>.

Phenotypic coefficient of variation in the highest phenotypic coefficient of variation was observed for plant height (26.07%), fruit weight (26.01%), fruit length (25.43%), fruit width (21.89%), number of fruits per plant (19.64%) and length of internodes (19.09%). Number of leaves per plant (17.40%), number of nodes to first flowering (15.03%), number of branches per plant (12.74%), fruit surface cm<sup>2</sup> (11.17%) exhibited moderate values for phenotypic coefficient of variation. Whereas, yield per plant (10.76%), yield per plot (10.76%), days taken to first flowering (8.09%) days taken to first picking (7.21%), fruiting span (6.64%) and had low phenotypic coefficient of variation.

The heritability was high for most of the characters. Fruiting span showed maximum heritability (100%), followed by fruit surface cm<sup>2</sup> (99.60%), yield per plant (90.30%), yield per plot (90.30%), plant height (83.60%), number of leaves per plant (62.50%) and days taken to first picking (62.50%). Fruit weight exhibited moderate heritability (55.3 0%) followed by number of nodes to first flowering (40.30%) and length of internodes (39.8 0%). However, and remaining of the characters viz., number of branches per plant (22.8 %), days taken to first flowering (16.80%), fruit length (15.10%), fruit width (8.7%), days taken to 50% flowering (8.60%) and number of fruits per plant (8.50%) showed low estimates of heritability supported by Prakash *et al.*, (2017)<sup>[15]</sup> Genetic advance (GA) was exhibited maximum for Plant height (34.46%) and Yield per plant (33.66%) The characters namely fruit surface (9.29%), fruiting span (9.26%), days taken to first picking (3.768%), fruit weight (2.99%) and number of leaves per plant (2.98%) exhibited moderate genetic advance and remaining traits had low genetic advance.

Correlation between yield per plant exhibited highly significant and significant positive correlation with plant height (0.512\*\*) and number of branches per plant (0.260\*) respectively at genotypic level. Number of leaves per plant negative significant association with seed yield per plant (-0.339\*\*), Days taken to 50% flowering (-0.594\*\*), Fruit width (-0.841\*\*) and at genotypic level Claimed by Khatik *et al.*, (2012)<sup>[16]</sup>.

Plant was exhibited by Fruit surface cm<sup>2</sup> (9.585) followed by plant height (0.5898), length of internodes (0.226), days taken to first picking (0.1633) and fruit weight (0.0712). in contrast fruiting span (-9.5686), number of nodes to first

flowering (-0.6983), number of leaves per plant (-0.3814), days taken to first flowering (-0.2467), fruit width (-0.1157), fruit length (-0.0601), number of fruits per plant (-0.0532), days taken to 50% flowering (-0.0147), number of branches per plant (-0.0039) were contributed negative direct effect on yield per plant. Fruiting span (9.559), fruit length (6.4554), days taken to 50% flowering (3.6607), number of leaves per plant (2.5979), number of branches per plant (1.6375), fruit weight (1.5413) exhibited considerable positive indirect effect on yield per plant via fruit surface cm<sup>2</sup>. but, fruit width (-5.2324), length of internodes (-4.3231), number of fruits per plant (-2.8855), days taken to first flowering (-2.0408) and number of nodes to first flowering (-0.588) showed considerable negative indirect

effect on it via fruit surface cm<sup>2</sup>. (Dwivedi and Sharma (2017)<sup>[4]</sup>, Ahamed *et al.*, (2015)<sup>[1]</sup>, Rambabu *et al.*, (2019)<sup>[10]</sup>.

The highest positive direct effect yield per Clustering pattern indicated that cluster III is largest cluster comprising 7 out of Twenty-one genotype. On the other hand, cluster, I, comprised 5 genotype, cluster II, comprised 3 genotypes, IV, V, VI, cluster comprised 2 genotypes.

The inter-cluster distance was maximum between Cluster I and Cluster III (88,463.020), followed by Cluster I and Cluster VI (46,942.130), Cluster III and Cluster V (38,836.750), Cluster V and Cluster VI (3,609.836), and Cluster II and Cluster IV (4,500.390) (Thirupathi *et al.*, 2012)<sup>[17]</sup>.

**Table 1:** Mean sum of square for different characters studied in Okra

| Traits                             | Replication | Treatment  | Error |
|------------------------------------|-------------|------------|-------|
|                                    | 2           | 20         | 40    |
| Plant height (cm)                  | 326.90*     | 1,070.36** | 65.72 |
| Number of leaves per plant         | 6.68*       | 12.08**    | 2.02  |
| Number of branches per plant       | 1.38**      | 0.36*      | 0.19  |
| Length of internodes (cm)          | 16.95**     | 3.71**     | 1.24  |
| Number of nodes to first flowering | 2.79**      | 1.42**     | 0.47  |
| Days taken to first flowering      | 2.33        | 10.82      | 6.73  |
| Days taken to 50% flowering        | 3.26        | 9.07       | 7.07  |
| Days taken to first picking        | 0.42        | 19.27**    | 3.21  |
| Fruiting span                      | 27.24**     | 60.74**    | 0.002 |
| Fruit length (cm)                  | 2.26        | 9.39       | 6.12  |
| Fruit width (cm)                   | 2.88**      | 0.11       | 0.08  |
| Fruit weight (g)                   | 4.45        | 14.55**    | 3.09  |
| Fruit surface cm <sup>2</sup>      | 95.97**     | 61.38**    | 0.09  |
| Number of fruits per plant         | 0.67        | 4.69       | 3.67  |
| Yield per plant (g)                | 29.73       | 918.40**   | 31.66 |
| Yield per plot (kg)                | 0.07        | 2.11**     | 0.07  |

**Table 2.** Mean and range of different traits for the experiment studied in Okra

| Genotypes               | Plant height (cm) | Days taken to first flowering | Days taken to 50% flowering | Days taken to first picking | Fruiting span | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Number of fruits per plant | Yield per plant (g) | Yield per plot (kg) |
|-------------------------|-------------------|-------------------------------|-----------------------------|-----------------------------|---------------|-------------------|------------------|------------------|----------------------------|---------------------|---------------------|
| Verma                   | 60.90             | 33.17                         | 35.92                       | 41.12                       | 69.90         | 10.57             | 1.33             | 7.87             | 8.62                       | 174.35              | 8.37                |
| Palam Komal             | 99.70             | 38.43                         | 40.52                       | 41.55                       | 64.79         | 10.34             | 1.21             | 8.21             | 8.58                       | 165.80              | 7.96                |
| NIDHI                   | 71.43             | 38.47                         | 41.35                       | 41.32                       | 70.80         | 11.64             | 1.31             | 10.04            | 9.06                       | 169.68              | 8.14                |
| Rohini Bhindi Selection | 117.11            | 35.07                         | 37.32                       | 34.82                       | 64.81         | 10.84             | 0.94             | 8.91             | 10.79                      | 211.37              | 10.14               |
| Indam 9821              | 39.70             | 35.43                         | 38.68                       | 41.28                       | 60.79         | 9.41              | 1.55             | 7.41             | 11.72                      | 154.67              | 7.42                |
| Jyoti                   | 57.42             | 33.90                         | 36.32                       | 40.12                       | 74.79         | 10.11             | 1.28             | 12.24            | 11.83                      | 167.99              | 8.06                |
| Kerala Research Variety | 75.99             | 33.67                         | 39.28                       | 38.58                       | 70.79         | 10.97             | 1.19             | 8.21             | 11.25                      | 166.34              | 7.98                |
| Joya                    | 97.32             | 34.11                         | 37.35                       | 38.38                       | 69.79         | 8.91              | 1.52             | 8.54             | 11.55                      | 169.63              | 8.14                |
| IC-288892               | 72.37             | 33.45                         | 36.28                       | 39.03                       | 63.06         | 9.48              | 1.72             | 8.87             | 11.98                      | 178.00              | 8.54                |
| OKRA 238                | 60.05             | 34.21                         | 37.26                       | 36.67                       | 66.26         | 10.94             | 1.50             | 8.07             | 11.98                      | 146.39              | 7.03                |
| OKRA 320                | 61.50             | 33.71                         | 36.70                       | 38.20                       | 65.76         | 14.81             | 1.33             | 9.07             | 11.80                      | 156.02              | 7.49                |
| OKRA 65                 | 60.52             | 33.04                         | 40.03                       | 47.63                       | 67.86         | 13.31             | 1.72             | 12.81            | 10.57                      | 134.34              | 6.45                |
| OKRA 1680               | 73.07             | 36.17                         | 40.16                       | 38.10                       | 76.86         | 11.64             | 1.18             | 8.17             | 10.11                      | 150.99              | 7.25                |
| OKRA 472                | 97.62             | 37.24                         | 41.30                       | 40.00                       | 66.56         | 8.81              | 1.29             | 14.24            | 8.72                       | 140.99              | 6.77                |
| IC-015537               | 95.70             | 38.03                         | 38.06                       | 39.74                       | 61.22         | 8.17              | 1.50             | 9.14             | 9.34                       | 165.99              | 7.97                |
| OKRA 214                | 63.64             | 35.14                         | 38.42                       | 42.28                       | 64.92         | 7.54              | 1.42             | 14.87            | 9.41                       | 165.99              | 7.97                |
| BHINDI S-15             | 64.15             | 35.37                         | 37.98                       | 40.68                       | 62.92         | 8.37              | 1.42             | 10.94            | 9.48                       | 171.00              | 8.21                |
| 198                     | 73.26             | 37.67                         | 40.95                       | 41.21                       | 66.02         | 10.11             | 1.42             | 12.41            | 9.67                       | 185.98              | 8.93                |
| Okra 404                | 85.18             | 36.04                         | 39.72                       | 40.64                       | 75.62         | 11.51             | 1.56             | 11.77            | 8.95                       | 182.76              | 8.77                |
| Okra 1858               | 91.67             | 33.68                         | 38.85                       | 42.08                       | 71.02         | 12.41             | 1.19             | 11.14            | 9.13                       | 186.22              | 8.94                |
| SB-1x1101               | 93.83             | 32.31                         | 36.82                       | 41.41                       | 67.72         | 11.84             | 1.33             | 9.24             | 9.47                       | 184.05              | 8.83                |
| Mean                    | 76.77             | 35.16                         | 38.54                       | 40.23                       | 67.73         | 10.56             | 1.38             | 10.10            | 10.19                      | 168.03              | 8.06                |
| C.V.                    | 10.56             | 7.38                          | 6.90                        | 4.45                        | 0.07          | 23.43             | 20.93            | 17.40            | 18.80                      | 3.35                | 3.35                |
| S.E.                    | 4.68              | 1.50                          | 1.54                        | 1.03                        | 0.03          | 1.43              | 0.17             | 1.01             | 1.11                       | 3.25                | 0.16                |
| C.D. 5%                 | 13.38             | 4.28                          | 4.39                        | 2.96                        | 0.08          | 4.08              | 0.48             | 2.90             | 3.16                       | 9.29                | 0.45                |
| C.D. 1%                 | 17.90             | 5.73                          | 5.87                        | 3.96                        | 0.10          | 5.46              | 0.64             | 3.88             | 4.23                       | 12.43               | 0.60                |
| Range Lowest            | 39.70             | 32.31                         | 35.92                       | 34.82                       | 60.79         | 7.54              | 0.94             | 7.41             | 8.58                       | 134.34              | 6.45                |
| Range Highest           | 117.11            | 38.47                         | 41.35                       | 47.63                       | 76.86         | 14.81             | 1.72             | 14.87            | 11.98                      | 211.37              | 10.14               |

**Table 3:** Estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense ( $h^2$ ), genetic advance (GA) and genetic gain (GG) for different characters in Okra

| Traits                             | GCV   | PCV   | Heritability $h^2$ (Broad Sense) | Genetic Advancement 5% (GA) | Genetic gain (GG) |
|------------------------------------|-------|-------|----------------------------------|-----------------------------|-------------------|
| Plant height (cm)                  | 23.84 | 26.07 | 83.60                            | 34.47                       | 44.90             |
| Number of leaves per plant         | 13.76 | 17.40 | 62.50                            | 2.98                        | 22.40             |
| Number of branches per plant       | 6.09  | 12.74 | 22.80                            | 0.23                        | 5.99              |
| Length of internodes (cm)          | 12.04 | 19.10 | 39.80                            | 1.18                        | 15.65             |
| Number of nodes to first flowering | 9.55  | 15.03 | 40.30                            | 0.74                        | 12.49             |
| Days taken to first flowering      | 3.32  | 8.09  | 16.80                            | 0.99                        | 2.81              |
| Days taken to 50% flowering        | 2.12  | 7.22  | 8.60                             | 0.50                        | 1.29              |
| Days taken to first picking        | 5.75  | 7.27  | 62.50                            | 3.77                        | 9.37              |
| Fruiting span                      | 6.64  | 6.64  | 100.00                           | 9.27                        | 13.69             |
| Fruit length (cm)                  | 9.90  | 25.43 | 15.10                            | 0.84                        | 7.94              |
| Fruit width (cm)                   | 6.45  | 21.90 | 8.70                             | 0.05                        | 3.91              |
| Fruit weight (g)                   | 19.35 | 26.02 | 55.30                            | 2.99                        | 29.64             |
| Fruit surface cm <sup>2</sup>      | 11.15 | 11.17 | 99.60                            | 9.29                        | 22.91             |
| Number of fruits per plant         | 5.72  | 19.65 | 8.50                             | 0.35                        | 3.44              |
| Yield per plant (g)                | 10.23 | 10.77 | 90.30                            | 33.66                       | 20.03             |

**Table 4:** Genotypic ( $r_g$ ) correlation coefficients between different characters in okra

| Traits                             | Plant height (cm) | Number of leaves per plant | Number of branches per plant | Length of internodes (cm) | Number of nodes to first flowering | Days taken to first flowering | Days taken to 50% flowering | Days taken to first picking | Fruiting span | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Fruit surface cm <sup>2</sup> | Number of fruits per plant | Yield per plant (g) |
|------------------------------------|-------------------|----------------------------|------------------------------|---------------------------|------------------------------------|-------------------------------|-----------------------------|-----------------------------|---------------|-------------------|------------------|------------------|-------------------------------|----------------------------|---------------------|
| Plant height (cm)                  | 1.000             | 0.292*                     | 0.345**                      | 0.094                     | 0.018                              | 0.445**                       | 0.536**                     | -0.359**                    | 0.022         | -0.089            | -0.954**         | -0.032           | 0.026                         | -0.785**                   | 0.512**             |
| Number of leaves per plant         |                   | 1.000                      | 0.529**                      | -0.595**                  | 0.564**                            | 0.453**                       | 1.171**                     | 0.608**                     | 0.227         | 0.441**           | 0.496**          | 0.650**          | 0.271*                        | -0.820**                   | -0.339**            |
| Number of branches per plant       |                   |                            | 1.000                        | 0.291*                    | 0.427**                            | 0.382**                       | -0.010                      | 0.330**                     | 0.128         | 0.022             | 0.087            | 0.629**          | 0.171                         | -1.618**                   | 0.260*              |
| Length of internodes (cm)          |                   |                            |                              | 1.000                     | 0.111                              | 0.977**                       | 0.462**                     | -0.421**                    | -0.421**      | -1.295**          | -0.812**         | -0.258*          | -0.451**                      | -0.274*                    | -0.012              |
| Number of nodes to first flowering |                   |                            |                              |                           | 1.000                              | 0.698**                       | 1.029**                     | 0.381**                     | -0.140        | -0.064            | 0.551**          | 0.624**          | -0.061                        | -0.884**                   | -0.224              |
| Days taken to first flowering      |                   |                            |                              |                           |                                    | 1.000                         | 2.207**                     | -0.075                      | -0.228        | -0.893**          | -0.838**         | 0.222            | -0.213                        | -1.610**                   | -0.079              |
| Days taken to 50% flowering        |                   |                            |                              |                           |                                    |                               | 1.000                       | 0.834**                     | 0.327**       | 0.510**           | 0.427**          | 0.907**          | 0.382**                       | -1.081**                   | -0.594**            |
| Days taken to first picking        |                   |                            |                              |                           |                                    |                               |                             | 1.000                       | -0.001        | 0.047             | 1.092**          | 0.594**          | 0.028                         | -1.160**                   | -0.378**            |
| Fruiting span                      |                   |                            |                              |                           |                                    |                               |                             |                             | 1.000         | 0.669**           | -0.560**         | 0.108            | 0.997**                       | -0.216                     | 0.013               |
| Fruit length (cm)                  |                   |                            |                              |                           |                                    |                               |                             |                             |               | 1.000             | -1.209**         | -0.263*          | 0.673**                       | -0.236                     | -0.122              |
| Fruit width (cm)                   |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   | 1.000            | 0.416**          | -0.546**                      | 0.307*                     | -0.841**            |
| Fruit weight (g)                   |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  | 1.000            | 0.161                         | -0.870**                   | -0.140              |
| Fruit surface cm <sup>2</sup>      |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  |                  | 1.000                         | -0.301*                    | -0.003              |
| Number of fruits per plant         |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  |                  |                               | 1.000                      | -0.320**            |

\*, \*\* Significant at 5% and 1% level of significance, respectively

**Table: 5.**Phenotypic ( $r_g$ ) correlation coefficients between different characters in Okra

| Traits                             | Plant height (cm) | Number of leaves per plant | Number of branches per plant | Length of internodes (cm) | Number of nodes to first flowering | Days taken to first flowering | Days taken to 50% flowering | Days taken to first picking | Fruiting span | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Fruit surface cm <sup>2</sup> | Number of fruits per plant | Yield per plant (g) |
|------------------------------------|-------------------|----------------------------|------------------------------|---------------------------|------------------------------------|-------------------------------|-----------------------------|-----------------------------|---------------|-------------------|------------------|------------------|-------------------------------|----------------------------|---------------------|
| Plant height (cm)                  | 1.000             | 0.201                      | 0.216                        | 0.056                     | 0.037                              | 0.137                         | -0.023                      | -0.241                      | 0.019         | -0.085            | -0.297*          | 0.021            | 0.022                         | -0.238                     | 0.446**             |
| Number of leaves per plant         |                   | 1.000                      | 0.260*                       | -0.219                    | 0.266*                             | 0.044                         | 0.299*                      | 0.291*                      | 0.181         | 0.052             | 0.046            | 0.385**          | 0.219                         | -0.259*                    | -0.256*             |
| Number of branches per plant       |                   |                            | 1.000                        | -0.013                    | 0.041                              | 0.171                         | 0.146                       | 0.088                       | 0.057         | -0.113            | 0.071            | 0.235            | 0.079                         | -0.203                     | 0.103               |
| Length of internodes (cm)          |                   |                            |                              | 1.000                     | -0.007                             | 0.150                         | -0.205                      | -0.267*                     | -0.264*       | -0.243            | -0.055           | -0.093           | -0.280*                       | 0.019                      | 0.015               |
| Number of nodes to first flowering |                   |                            |                              |                           | 1.000                              | 0.307*                        | 0.315*                      | 0.281*                      | -0.090        | -0.139            | -0.003           | 0.328**          | -0.041                        | -0.227                     | -0.114              |
| Days taken to first flowering      |                   |                            |                              |                           |                                    | 1.000                         | 0.341**                     | -0.007                      | -0.095        | -0.163            | 0.016            | 0.088            | -0.096                        | -0.220                     | -0.003              |
| Days taken to 50% flowering        |                   |                            |                              |                           |                                    |                               | 1.000                       | 0.172                       | 0.095         | -0.084            | -0.181           | 0.157            | 0.103                         | -0.381**                   | -0.149              |
| Days taken to first picking        |                   |                            |                              |                           |                                    |                               |                             | 1.000                       | -0.001        | 0.147             | 0.210            | 0.340**          | 0.025                         | -0.097                     | -0.246*             |
| Fruiting span                      |                   |                            |                              |                           |                                    |                               |                             |                             | 1.000         | 0.263*            | -0.165           | 0.080            | 0.995**                       | -0.061                     | 0.012               |
| Fruit length (cm)                  |                   |                            |                              |                           |                                    |                               |                             |                             |               | 1.000             | 0.084            | -0.154           | 0.281*                        | 0.226                      | -0.041              |
| Fruit width (cm)                   |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   | 1.000            | 0.024            | -0.147                        | 0.232                      | -0.247*             |
| Fruit weight (g)                   |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  | 1.000            | 0.113                         | -0.150                     | -0.072              |
| Fruit surface cm <sup>2</sup>      |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  |                  | 1.000                         | -0.067                     | -0.003              |
| Number of fruits per plant         |                   |                            |                              |                           |                                    |                               |                             |                             |               |                   |                  |                  |                               | 1.000                      | -0.119              |

**Table: 6.** Cluster Mean values for sixteen growth and yield characters of Okra (*Abelmoschus esculentus* L.)

| Characters                              | Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 | Cluster 5 |
|-----------------------------------------|-----------|-----------|-----------|-----------|-----------|
| Plant Height (cm)                       | 67.981    | 79.461    | 77.175    | 81.840    | 71.890    |
| No. of leaves/plant                     | 12.167    | 13.000    | 14.667    | 13.524    | 14.000    |
| No. of branches/ plant                  | 3.874     | 3.927     | 3.840     | 3.865     | 3.911     |
| Length of internodes (cm)               | 8.225     | 7.703     | 5.683     | 7.740     | 7.006     |
| No. of nodes 1 <sup>st</sup> flowering  | 6.158     | 5.405     | 5.800     | 6.030     | 6.128     |
| Days taken to 1 <sup>st</sup> flowering | 35.572    | 34.618    | 32.675    | 35.925    | 35.372    |
| Days taken to 50% flowering             | 37.753    | 38.550    | 38.423    | 38.922    | 38.732    |
| Days taken to 1 <sup>st</sup> picking   | 40.184    | 40.295    | 40.295    | 39.246    | 39.620    |
| Fruiting span                           | 61.998    | 70.463    | 67.788    | 65.588    | 75.757    |
| Fruiting length (cm)                    | 8.858     | 10.901    | 12.573    | 10.483    | 11.086    |
| Fruit width(cm)                         | 1.548     | 1.307     | 1.527     | 1.527     | 1.340     |
| Fruit weight(g)                         | 9.090     | 9.160     | 9.160     | 10.826    | 10.729    |
| Fruit surface(cm <sup>2</sup> )         | 34.809    | 43.027    | 40.965    | 40.965    | 48.681    |
| No. of fruit/plant                      | 10.629    | 9.921     | 10.020    | 10.137    | 10.299    |
| Yield /plant(kg)                        | 167.417   | 173.245   | 159.193   | 167.507   | 167.249   |
| Yield/plant                             | 8.035     | 8.315     | 7.640     | 8.040     | 8.028     |

## Conclusion

The present investigation on *Abelmoschus esculentus* (L.) Moench revealed considerable genetic variability among the 21 genotypes studied for growth, yield, and yield-attributing traits. High heritability coupled with high genetic advance was observed for plant height, number of leaves per plant, fruit surface area, fruiting span, and yield per plant, suggesting the predominance of additive gene action and the possibility of effective selection for these traits. Correlation studies showed that yield per plant was positively and significantly associated with plant height and number of branches per plant, indicating their importance as reliable selection indices in breeding programs. Path coefficient analysis further highlighted fruiting span, plant height, and number of branches per plant as major contributors to yield through direct positive effects, while characters such as fruit surface area and number of leaves per plant exerted considerable negative effects. Cluster analysis revealed the existence of substantial genetic divergence, with the maximum inter-cluster distance observed between Cluster I and Cluster III, suggesting that genotypes from these clusters could serve as promising parents for hybridization to exploit heterosis. Overall, the study underscores the scope of selecting diverse and high-performing genotypes for genetic improvement of okra to achieve enhanced productivity and sustainability.

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