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# Estimation of genetic parameters in okra for quantitative traits

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## ABSTRACT

**Ten genetically diverse okra genotypes were taken for the present investigation. All possible single crosses excluding reciprocals were made among these parents and all the 10 parents and 45 $F_1$s were sown in a randomized block design with three replications. Observations recorded on quantitative traits showed considerable genetic variability. High heritability estimates were recorded for plant height, fruit width, fruit length, number of fruits per plant and weight of fruit per plant in both parents and $F_1$ generation. Genetic advance and genetic gain varied from 0.13 to 79.62 and 3.03 to 37.14, respectively. On the basis of correlation studies, fruit width was negatively correlated with fruit length (- 0.792) and positively correlated with weight of fruits per plant (0.662). Fruit length was positively correlated with weight of fruit per plant (0.703). Fruit width, fruit length, number of fruit per plant and weight of fruits per plant are most desirable characters, which affect the yield and such characters should be taken into consideration while making selection for overall improvement.**

**Key words**: Okra, *Abelmoschus esculentus,* genetic parameters, quantitative traits.

## INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench.) popularly known as *Bhindi* is one of the important vegetable crops grown extensively in the plains in summer and rainy season and in the hills in rainy season. It is thus available in fresh, right from April to November. Its immature fruits are generally cooked as vegetable. Improved genotype with resistance to yellow vein mosaic virus (YVMV) is an indispensable factor for enhancing productivity (Joshi, 5). Therefore it is important to select genotypes with high yield and YVMV. Collection, evaluation and storage of germplasm become the most important steps in this direction. Knowledge of genetic diversity and relationships among okra germplasm may play significant role in breeding programmes (Aladele, 1). However, in the past, main emphasis was laid on the improvement of variety through pureline selection out of limited stock available. Therefore, the present study was undertaken to investigate the amount of variability and the degree of relationship among traits of economic importance in a collection of okra cultivars as an aid to improvement.

## MATERIALS AND METHODS

The experimental materials were comprised of ten genetically diverse varieties/strains for different traits of okra. All possible single crosses excluding reciprocals were made among 10 parents and the 45 $F_1$s were grown at the Janta Vedic (P.G.) College, Baraut (Baghpat), U.P. Seeds of the parents and $F_{1S}$ were sown at a distance of 50 cm × 50 cm in a randomized block design with three replications. Data were recorded on plant height (cm), number of branches/plant, days to flowering, first fruiting node, internodal length (cm), fruit width and length (cm), number of fruits/branch, number of fruits/plant, fruit weight/plant (g), number of seeds/fruit, seed viability and 100-seed weight (g). The variability, heritability, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and correlation coefficient were worked out using the formula suggested by Singh and Choudhary (8) along with genetic advance by Johnson *et al*. (6).

## RESULTS AND DISCUSSION

The extent of variability with respect to 13 quantitative characters in different genotypes for parent and $F_1$ populations, measured in terms of mean performance, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and genetic gain are given in Table 1. The considerable amount of variation was observed for all the characters under study. Fruit weight, number of seeds/fruit, seed viability was better in parents than $F_1$s. In parent population, genotypic coefficient of variance showed a range of variation from 2.42 to 17.85 for days to flowering and fruit weight per plant, respectively, however in $F_1$ generation maximum genotypic coefficient of variance was recorded for number of fruits per branch (20.25)

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**Table 1**. Estimates of mean performance, heritability, genetic advance and genetic gain for parents and $F_1$ population in okra.

| Character | Mean performance | | Coefficient of variance | | | | Heritability broad sense | | Genetic advance | | Genetic gain | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Genotypic | | Phenotypic | | | | | | | |
| | Parents | $F_1$ | Parents | $F_1$ | Parents | $F_1$ | Parents | $F_1$ | Parents | $F_1$ | Parents | $F_1$ |
| Plant height (cm) | 50.50 | 63.67 | 15.21 | 6.71 | 15.53 | 7.32 | 0.959 | 0.831 | 15.50 | 8.07 | 30.69 | 12.67 |
| No. of branches/ plant | 2.03 | 2.10 | 8.68 | 19.18 | 12.77 | 20.46 | 0.662 | 0.879 | 0.28 | 0.78 | 13.79 | 37.14 |
| Days to flowering | 32.15 | 39.51 | 2.42 | 3.72 | 4.46 | 5.68 | 0.695 | 0.429 | 1.09 | 1.99 | 3.39 | 5.04 |
| First fruiting node | 8.04 | 9.21 | 9.40 | 7.05 | 10.33 | 8.47 | 0.361 | 0.602 | 1.56 | 1.11 | 19.40 | 12.05 |
| Internode length | 11.42 | 13.47 | 10.82 | 9.38 | 11.30 | 9.76 | 0.391 | 0.253 | 2.44 | 2.38 | 21.37 | 17.67 |
| Fruit width (cm) | 1.58 | 1.54 | 7.60 | 3.72 | 12.15 | 7.41 | 0.918 | 0.923 | 0.15 | 0.06 | 9.49 | 3.90 |
| Fruit length (cm) | 12.06 | 12.13 | 5.38 | 8.82 | 7.52 | 9.91 | 0.912 | 0.793 | 0.96 | 1.96 | 7.96 | 16.16 |
| No. of fruits/ branch | 1.74 | 2.23 | 9.16 | 20.25 | 24.78 | 26.56 | 0.571 | 0.597 | 0.13 | 0.69 | 7.74 | 30.94 |
| No. of fruits/plant | 9.47 | 11.41 | 16.25 | 8.96 | 19.36 | 10.73 | 0.905 | 0.897 | 2.66 | 1.76 | 28.09 | 15.42 |
| Fruit weight/ plant (g) | 248.24 | 230.84 | 17.85 | 14.31 | 20.46 | 16.49 | 0.931 | 0.894 | 79.62 | 58.88 | 32.07 | 25.51 |
| No. of seeds/ fruit | 40.08 | 38.38 | 5.42 | 14.31 | 6.75 | 16.49 | 0.745 | 0.732 | 3.59 | 5.76 | 8.96 | 15.01 |
| Seed viability | 38.50 | 37.02 | 2.44 | 4.06 | 4.07 | 5.29 | 0.137 | 0.581 | 3.29 | 5.54 | 8.54 | 14.96 |
| 100-seed weight (g) | 52.08 | 55.26 | 2.44 | 4.06 | 4.10 | 5.24 | 0.829 | 0.693 | 1.58 | 3.41 | 3.03 | 6.17 |

**Table 2**. Correlation of genotypic (above diagonal) and phenotypic (below diagonal) level among different characters in okra (parent genotype).

| Character | Plant height | No. of branches/ plant | Days of flowering | First fruiting node | Length of node | Fruit width | Fruit length | No. of fruits/ branch | No. of fruits/ plant | Wt. of fruits/ plant | No. of seeds/ fruit | Viability | 100-seed wt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant height | 1.00 | 0.501 | - 0.299 | - 0.243 | - 0.087 | - 0.714* | 0.067 | 0.348 | - 0.133 | - 0.698* | 0.074 | 0.201 | 0.556 |
| No. of branches / plant | 0.610* | | 0.096 | 0.081 | 0.496 | 0.445 | 0.575 | 0.354 | 0.545 | 0.188 | 0.076 | 0.048 | 0.056 |
| Days to flowering | - 0.193 | 0.359 | | 0.238 | 0.357 | - 0.147 | 0.351 | - 0.353 | - 0.270 | - 0.398 | 0.138 | - 0.102 | - 0.428 |
| First fruiting node | - 0.206 | - 0.154 | 0.609* | | - 0.456 | 0.588 | 0.232 | - 0.474 | - 0.856** | - 0.333 | 0.259 | - 0.297 | - 0.593 |
| Internode length | - 0.082 | 0.299 | - 0.221 | - 0.365 | | 0.305 | 0.053 | 0.689* | 0.539 | 0.350 | 0.197 | - 0.032 | - 0.212 |
| Fruit width | - 0.512 | 0.343 | 0.159 | 0.330 | 0.216 | | 0.469 | - 0.394 | 0.146 | 0.412 | 0.020 | - 0.066 | - 0.555 |
| Fruit length | 0.036 | 0.525 | 0.148 | 0.071 | 0.014 | - 0.792** | | -1.191** | 0.407 | - 0.084 | 0.071 | 0.095 | 0.009 |
| No. of fruits/ branch | 0.172 | 0.611* | - 0.202 | - 0.053 | 0.397 | 0.123 | - 0.164 | | 0.034 | - 0.113 | 0.038 | 0.298 | 0.625* |
| No. of fruits/ plant | 0.718* | 0.349 | - 0.267 | - 0.692* | 0.442 | 0.018 | 0.196 | - 0.689* | | 0.617* | 0.276 | 0.291 | 0.121 |
| Fruit weight/ plant | - 0.614* | - 0.024 | - 0.092 | - 0.277 | 0.340 | 0.662* | 0.703* | - 0.044 | 0.502 | | 0.504 | 0.468 | - 0.226 |
| No. of seeds/ fruit | 0.650* | 0.140 | 0.063 | 0.148 | 0.313 | - 0.633* | - 0.686* | 0.060 | 0.122 | 0.317 | | 0.213 | 0.222 |
| Seed viability | 0.132 | - 0.092 | - 0.022 | - 0.149 | - 0.013 | - 0.008 | - 0.026 | 0.111 | 0.098 | 0.314 | 0.521 | | 0.045 |
| 100-seed weight (g) | 0.314 | - 0.013 | - 0.166 | - 0.406 | - 0.215 | - 0.508 | - 0.060 | - 0.275 | 0.227 | - 0.800** | 0.760** | - 0.021 | 1.00 |

*,**Significant at 5 and 1%, respectively.

**Table 3.** Correlation of genotypic (above diagonal) and phenotypic (below diagonal) level among different characters in okra ($F_1$ generation).

| Character | Plant height | No. of branches/ plant | Days of flowering | First fruiting node | Length of node | Fruit width | Fruit length | No. of fruits/ branch | No. of fruits/ plant | Wt. of fruits/ plant | No. of seeds/ fruit | Viability | 100-seed wt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant height | 1.00 | 0.257 | 0.075 | 0.028 | 0.136 | - 0.219 | 0.011 | 0.150 | - 0.123 | 0.189 | - 0.014 | - 0.016 | - 0.239 |
| No. of branches/ plant | 0.430** | | - 0.042 | - 0.202 | 0.276 | 0.061 | 0.138 | - 0.099 | 0.215 | 0.108 | 0.133 | 0.384* | - 0.112 |
| Days to flowering | - 0.026 | 0.012 | | 0.115 | 0.029 | 0.026 | 0.125 | - 0.030 | - 0.247 | - 0.218 | - 0.136 | - 0.139 | 0.038 |
| First fruiting node | 0.035 | - 0153 | 0.318* | | - 0.037 | - 0.058 | 0.312* | 0.301 | 0.203 | 0.190 | - 0.033 | 0.162 | 0.032 |
| Internode length | - 0.386* | 0.261 | 0.031 | - 0.064 | | 0.166 | 0.185 | - 0.012 | 0.393* | 0.321* | 0.216 | 0.140 | 0.107 |
| Fruit width | - 0.058 | 0.037 | - 0.022 | 0.065 | 0.056 | | - 0.051 | 0.047 | 0.126 | 0.334* | - 0.247 | - 0.128 | - 0.018 |
| Fruit length | 0.058 | 0.065 | 0.015 | 0.234 | 0.150 | - 0.360* | | 0.279 | 0.163 | 0.379* | 0.211 | 0.203 | - 0.041 |
| No. of fruits/ branch | 0.099 | - 0.381* | 0.045 | 0.209 | 0.110 | - 0.071 | 0.165 | | 0.623** | 0.259 | 0.409** | 0.217 | 0.012 |
| No. of fruits/ plant | - 0.397** | 0.145 | - 0.194 | 0.186 | 0.323* | 0.064 | 0.214 | 0.465** | | 0.403** | 0.432** | 0.312* | - 0.072 |
| Fruit weight/ plant | 0.457** | 0.078 | - 0.145 | 0.120 | - 0.258 | 0.313* | 0.466** | 0.175 | 0.347* | | 0.060 | 0.131 | - 0.039 |
| No. of seeds/ fruit | - 0.045 | 0.051 | - 0.084 | - 0.056 | 0.220 | - 0.479** | - 0.419** | 0.253 | 0.302 | 0.337* | | 0.260 | 0.051 |
| Seed viability | - 0.033 | 0.270 | - 0.052 | 0.096 | 0.158 | - 0.044 | 0.193 | 0.125 | 0.195 | 0.081 | 0.230** | | - 0.092 |
| 100-seed weight (g) | - 0.185 | - 0.076 | - 0.004 | 0.033 | 0.074 | - 0.072 | - 0.043 | 0.090 | - 0.095 | - 0.358* | 0.461** | - 0.044 | 1.00 |

*,**Significant at 5 and 1%, respectively.

followed by number of branches per plant (19.18) and minimum was recorded for days to flowering (3.72) and fruit width (3.72). Maximum phenotypic coefficient of variance was observed for number of fruits per branch (24.78) followed by weight of fruit per plant (20.46) in parent population while minimum was recorded for seed viability (4.07). In the $F_1$ generation variation was observed 5.24 and 26.56 for 100-seed weight and number of fruits per branch, respectively.

A vast variation was recorded for heritability in both parents and $F_1$ generation. Maximum heritability was recorded for plant height (0.959), while minimum was recorded for viability (0.137) in parent population. Alam and Hossain (2) also reported that the plant height was highly potential characters for selection in okra, however, the environmental influence was considerable for this trait which could be observed from the differences between genotypic coefficient of variation and phenotypic coefficient of variation. In $F_1$ generation range of variation was recorded from 0.253 to 0.923 for length of node and fruit width, respectively. Minimum genetic advance in parent (0.13) and $F_1$ (0.69) population was recorded for number of fruits/ branch, however maximum genetic advance in both parent (79.62) and $F_1$ generation (58.88) was observed in fruit weight per plant. In parent population, maximum (32.07) genetic gain was recorded for fruit weight per plant while minimum (3.03) was observed with 100 seed weight. A range of variation, *i.e.*, 3.90 and 37.14 was recorded for fruit width and number of branches per plant, respectively in $F_1$ generation.

Correlation among different quantitative characters in parent and $F_1$ generation of okra were worked out at genotypic and phenotypic levels and was presented in Tables 2 & 3, respectively. In the present investigation genotypic correlations in general were higher than corresponding phenotypic ones in most of the traits with little difference in magnitude indicating that these characters are least influenced by environment and correlation may be due to genotype mainly. In parent population, the plant height was positively and significantly correlated with number of branches per plant (0.610), number of fruits per plant (0.718) and number of seeds per fruit (0.650), while it was negatively significant with weight of fruit per plant (-0.614). Korla and Rastogi (7) also studied the

correlation in okra crop and revealed that plant height had a positive and significant correlation with number of fruits and number of seeds per plant. Number of branches and days to flowering was positively and significantly correlated with number of fruit per branches (0.611) and fruit fruiting node (0.609), respectively. Significantly negative association was observed for first fruiting node and number of fruits per plant (-0.692). Similar results with respect to the growth and fruiting characters was also noted by Vijay and Manohar (11), and Indurani and Veeraragavathatham (4). Fruit width has highly negative correlation with the fruit length (-0.792) which was also reported by Bello *et al*. (3) that any increase in fruit length will reduce the fruit diameter. However, fruit width was positively and significantly correlated with weight of fruit per plant (0.662), while negatively and significantly with number of seeds per fruit (-0.633). Fruit length was significantly and positively correlated with weight of fruit per plant (0.703) and have negative significant correlation with number of seeds per plant (-0.686), respectively. While working on the growth and productivity parameters of okra (Thamburaj and Kamalnattan, 10) observed positive association of the fruiting characters with each other. Number of fruits per branch was significantly negatively correlated with number of fruits per plant (-0.689). Fruit weight per plant was negatively and significantly correlated with 100-seed weight (-0.800), while number of seeds per fruit was positively and significantly correlated with 100-seed weight (0.760). Singh and Sharma (9) also reported inter relationship between different characters of okra plant material.

However, in $F_1$ generation similar correlation was noticed among all the characters except plant height which was negatively correlated with internodal length (-0.386) and internodal length was positively correlated with number of fruits per plant (0.323). Number of fruits per plant and weight of fruits per plant was positively correlated with weight of fruits per plant (0.347) and number of seeds per fruit (0.337), respectively. From the above discussion, it can be concluded that internodal length, fruit width, fruit length, number of fruits per plant and weight of fruit per plant are most desirable characters and should be taken into consideration while making selection for overall improvement of okra.

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