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# Estimation of Simple Correlation and Genetic Variability Studies in F2 Population of Three Different Crosses in Bhendi (*Abelmoschus esculentus* L. Moench)

**Y. Madhumitha, P. Senthil Kumar**

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## ABSTRACT

Simple correlation analysis and variability analysis was done in three crosses of bhendi viz., IC 049972 x Arka Anamika, IC 058704 × Arka Anamika, IC 045993 × Pusa - A4 at Annamalai University, Chidambaram. The correlation analysis for eight characters plant height, days to first flowering, number of branches per plant, number of fruits per plant, fruit length, fruit girth, fruit weight, fruit yield per plant was done. The result showed that number of branches per plant, numbers of fruits per plant, fruit weight are highly correlated with fruit yield per plant. Genetic variability parameters like GCV, PCV, heritability and genetic advance as percent of mean were estimated. In all the three crosses PCV was higher in magnitude than GCV which may be due to the effect of environment. High heritability coupled with high genetic advance was observed in two crosses. This indicates the effect of additive gene action. From the above study it can be seen that fruit yield improvement in bhendi can be done by selection based on fruit weight, number of fruits per plant and number of branches per plant.

**Keywords** Correlation analysis, Genetic variability, GCV, PCV, Heritability, Genetic advance, Additive gene action, Yield improvement.

## INTRODUCTION

*Abelmoschus esculentus* (L.) Moench locally known as bhendi or okra or vendai belong to the family Malvaceae. It is commercially grown in many countries like India, Pakistan, Nigeria, Cameroon, Iraq and Ghana. Okra is enriched in iodine and help in preventing goiter (Jatav *et al.* 2018). The fruits are enriched in Iron, Calcium, Manganese, Vitamins A, B, C, and K (USDA National Nutrient Database 2006). Nearly 30 – 40 % oil content is found in okra seeds.

Okra is a prevalent vegetable crop that has certain medicinal properties in addition to strong nutritional significance, making it possible for usage in a range of nutraceuticals. The mucilage, seeds, and pods of the okra fruit contain specific vital bioactive elements that give its therapeutic powers. Okra is widely recognized as a readily available, inexpensive vegetable crop with a range of beneficial nutrients and possible benefits for health (Elkhalifa *et al.* 2021).

Y. Madhumitha[1]*, P. Senthil Kumar[2]

[1]PhD Scholar, [2]Professor
[1,2]Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar 608002, Tamil Nadu, India

Email: madhumithayoga1997@gmail.com
*Corresponding author

Okra is an annual, herbaceous plant having erect growth habit and have bisexual flowers The chromosome number of *A. esculentus* varies as 2n = 72, 108, 120, 132, 144 (Datta and Noug 1968). In order to develop new genotypes that have greater genetic potential, it is important to identify genotypes with significant variation and heritability (Rynjah *et al.* 2020). Correlation analysis is a significant and efficient tool to gain knowledge about the interactions between several traits and is helpful for breeder to develop high yielding cultivars by identifying several characters that can be used for producing high yield. The efficiency of selection for yield relies mainly on the direction and degree of relationship between yield and yield component traits and also within component traits (Janarthanan and Sundaram 2020).

The mutual relationship between plant characteristics is assessed using correlation coefficient analysis, which also identifies the component characters from which selections for enhancement of yield can be made. Such knowledge makes it possible to enhance a number of traits, and it also improves the effectiveness of selecting complex inherited traits. It is crucial to assess genotypes in order to estimate genetic diversity for yield and yield-contributing traits, and knowledge of the variation present in available breeding materials aids in the effective selection of parents for utilization in crop improvement. By estimating heritability and genetic advance, genetic variation and genetic gain brought about by selection are studied.

The study of F2 generation can serve as a suitable population for choosing genotypes with desired traits. The estimation of the hereditary portion of measured variability and expected genetic advance may be of more significance for yield improvement in bhendi under a given situation in addition to estimating the degree of variability in the segregating population for yield and its component traits. The yield is also correlated with YVMV disease. YVMV is a viral disease transferred by white fly (*Bermisia tabaci*) and cause heavy loss to the crop hence correlation analysis is also to be studied for YVMV disease along with yield attributing characters. Keeping this in view, the present investigation was aimed at assessing the correlation coefficient and variation analysis for yield attributing characters and YVMV disease resistance in F2 generation of three different crosses viz., IC 049972 ×Arka Anamika, IC 058704 × Arka Anamika, IC 045993 × Pusa - A4.

## MATERIALS AND METHODS

The present study was undertaken at Annamalai University, Chidambaram. The trial plot was laid out in an un replicated design using 100 seeds generated from each cross combination of the F2 generation of three different crosses viz., IC 049972 × Arka Anamika, IC 058704 ×Arka Anamika, IC 045993 ×Pusa - A4, at a spacing of 45 cm ×30 cm. The observations recorded on eight characters were plant height, number of branches per plant, number of fruits per plant, fruit length, fruit girth, fruit weight and fruit yield per plant from 25 randomly selected plants of F2 population in all the three crosses. The degree of association of the yield components towards yield and yield components and degree of YVMV resistance was calculated as simple phenotypic correlation coefficients (r). Phenotypic and genotypic co-efficient of variation, heritability in broad sense and genetic advance were calculated by using formula given by Hanson *et al.* (1956), Johnson *et al.* (1955).

## RESULTS AND DISCUSSION

Among the eight characters studied from the three crosses, fruit yield per plant had significant and positive association with number of fruits per plant and fruit girth in F2 population of all the crosses viz., IC 049972 × Arka Anamika, IC 058704 × Arka Anamika and IC 045993 ×Pusa –A 4. However, the F2 populations of both crosses IC 049972 ×Arka Anamika and IC 058704 × Arka Anamika showed significant and positive correlation between fruit yield per plant and number of branches per plant. Fruit yield per plant has significant and positive association with fruit girth in F2 population of IC 049972 × Arka Anamika.

Days to first flowering had showed significant and positive correlation with plant height in F2 population, viz., IC 049972 × Arka Anamika. Days to first flowering has showed significant and positive correlation with fruit length in F2 population of IC 049972 × Arka Anamika alone (Rathava *et al.* 2019).

**Table 1.** Simple correlation coefficients among yield, yield components in F2 population IC 049972 × Arka Anamika.

| | DFF | PH | NBPP | NFPP | FL | FG | FW | FYPP |
|---|---|---|---|---|---|---|---|---|
| DFF | 1.00 | 0.37** | -0.36** | -0.35** | 0.36** | -0.37** | -0.37** | -0.52** |
| PH | | 1.00 | -0.49** | -0.28** | 0.32** | -0.44** | -0.16* | -0.54** |
| NBPP | | | 1.00 | 0.47** | -0.21** | 0.46** | 0.26** | 0.46** |
| NFPP | | | | 1.00 | -0.39** | 0.40** | 0.07 | 0.50** |
| FL | | | | | 1.00 | -0.14 | -0.12 | -0.51** |
| FG | | | | | | 1.00 | 0.12 | 0.47** |
| FW | | | | | | | 1.00 | 0.21** |

*, ** significant at 5 % and 1 % level of probability, respectively.

Plant height had positive and significant correlation with fruit length in F2 population of two crosses, viz., IC 049972 ×Arka Anamika and IC 058704× Arka Anamika. Plant height had positive and significant correlation with fruit girth in F2 population of IC 058704× Arka Anamika alone. Plant height had positive and significant correlation with number of branches per plant in F2 population of IC 045993 × Pusa –A 4 alone.

Number of branches per plant had positive and significant correlation with fruit girth in F2 population, viz., IC 049972 × Arka Anamika. Number of branches per plant had positive and significant correlation with number of fruits per plant and fruit girth in $F_2$ population of IC 049972 × Arka Anamika alone.

Number of fruits per plant had significant and positive association with fruit girth in F2 population of all crosses viz., IC 049972 × Arka Anamika, IC 058704 ×Arka Anamika and IC 045993 ×Pusa –A4. Number of fruits per plant had significant and positive association with fruit length in F2 population of IC 045993 × Pusa –A 4 alone (Rynjah *et al*. 2020).

Fruit length had significant and positive association with fruit girth in F2 population of IC 045993 × Pusa –A 4 alone.

Days to first flowering had showed significant and negative correlation with number of fruits per plant and fruit girth in $F_2$ population viz., IC 045993 × Pusa –A 4. Days to first flowering had showed significant and negative correlation with number of branches per plant in F2 population of IC 049972 × Arka Anamika alone.

Plant height had negative and significant correlation with number of fruits per plant and fruit girth in F2 population viz., IC 049972 × Arka Anamika. Plant height had negative and significant correlation with number of branches per plant in F2 population of two crosses, viz., IC 049972 ×Arka Anamika and IC 058704 ×Arka Anamika. Plant height had negative and significant correlation with fruit girth in F2 population of IC 049972 × Arka Anamika alone.

Number of branches per plant had significant and negative association with fruit length in F2 population of all crosses viz., IC 049972 × Arka Anamika, IC

**Table 2.** Simple correlation coefficients among yield, yield components in F2 population IC 058704 × Arka Anamika.

| | FF | PH | NBPP | NFPP | FL | FG | FW | FYPP |
|---|---|---|---|---|---|---|---|---|
| FF | 1.00 | -0.01 | 0.12 | 0.07 | 0.02 | 0.05 | 0.09 | 0.11 |
| PH | | 1.00 | -0.24** | 0.06 | 0.25** | 0.15* | -0.05 | 0.01 |
| NBPP | | | 1.00 | 0.06 | -0.38** | 0.09 | 0.19** | 0.16* |
| NFPP | | | | 1.00 | 0.02 | 0.18** | 0.02 | 0.69** |
| FL | | | | | 1.00 | -0.04 | -0.08 | -0.04 |
| FG | | | | | | 1.00 | -0.04 | 0.08 |
| FW | | | | | | | 1.00 | 0.72** |

*, ** significant at 5 % and 1 % level of probability, respectively.

**Table 3.** Simple correlation coefficients among yield, yield components in F2 population IC 045993 × Pusa - A4.

| | FF | PH | NBPP | NFPP | FL | FG | FW | FYPP |
|---|---|---|---|---|---|---|---|---|
| FF | 1.00 | 0.42** | 0.11 | -0.52** | -0.09 | -0.48** | 0.01 | -0.06 |
| PH | | 1.00 | 0.17* | -0.30** | 0.01 | -0.25** | 0.13 | -0.12 |
| NBPP | | | 1.00 | -0.21** | -0.15* | -0.17* | -0.19 | 0.02 |
| NFPP | | | | 1.00 | 0.19** | 0.39** | 0.01 | 0.18** |
| FL | | | | | 1.00 | 0.17* | -0.05 | 0.06 |
| FG | | | | | | 1.00 | 0.01 | 0.05 |
| FW | | | | | | | 1.00 | 0.17** |

*, ** significant at 5% and 1% level of probability, respectively.

058704 × Arka Anamika and IC 045993 ×Pusa –A 4. Number of branches per plant had significant and negative association with number of fruits per plant and fruit girth in F2 population of IC 045993 × Pusa –A 4 alone (Tables 1–3).

Number of fruits per plant had significant and negative association with fruit length in F2 population of IC 049972 × Arka Anamika alone. Similar results were obtained by Prabhu and Warade (2009), Mahalik (2018), Sharma *et al.* (2007), Yadav *et al.* (2017).

Based on the results of the present investigation, it is clear that yield component traits viz., number of fruits per plant and fruit girth were correlated with fruit yield per plant. Hence these traits can be considered as selection indices for improvement of fruit yield per plant.

Mean and variability of populations for various traits in three crosses are presented in (Tables 4–6). The results indicated that the estimates of phenotypic coefficient of variation were higher than the genotypic coefficient of variation for all the characters studied indicating the environmental influence over the traits. The high or moderate estimates of GCV were observed for day of first flowering, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit girth, and fruit yield per plant in the three crosses. These results are in accordance with findings of similar results were obtained by Pachiyappan and Saravanan (2016), Janarthanan and Sundaram (2020), Alam and Hossain (2008), Prakash *et al*. (2011), Nwang burka *et al.* (2012), Kavya *et al.* (2019), Kumar *et al.* (2011) Selection based on these characters with high / moderate GCV will be effective for improvement of these traits.

High/moderate heritability and GAM were observed for all traits in three crosses. The present findings were in agreement with the finding of (Pachiyappan and Saravanan 2016, Chandra *et al.*

**Table 4.** Variability parameters for different characters of IC 049972 × Arka Anamika in F2 population.

| | Mean | PCV | GCV | $h^2$ | GAM |
|---|---|---|---|---|---|
| FF | 43.52 | 14.00 | 12.80 | 83.58 | 26.10 |
| PH | 71.94 | 20.78 | 20.07 | 93.31 | 22.66 |
| NBPP | 5.70 | 21.88 | 20.05 | 83.91 | 72.43 |
| NFPP | 22.51 | 22.44 | 20.10 | 80.21 | 34.82 |
| FL | 16.50 | 23.26 | 20.01 | 73.95 | 37.50 |
| FG | 5.37 | 21.04 | 20.03 | 90.61 | 80.52 |
| FW | 14.15 | 23.86 | 20.01 | 70.37 | 38.54 |
| FYPP | 342.31 | 20.35 | 20.20 | 98.56 | 10.97 |

*, ** significant at 5% and 1% levels, respectively.
PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, $h^2$ = Heritability (%), GAM = Genetic advance as per cent of mean.

**Table 5.** Variability parameters for different characters of IC 058704 × Arka Anamika in F2 population.

| | Mean | PCV | GCV | $h^2$ | GAM |
|---|---|---|---|---|---|
| FF | 41.74 | 11.45 | 10.19 | 79.08 | 25.22 |
| PH | 88.96 | 20.85 | 20.28 | 94.61 | 20.66 |
| NBPP | 5.81 | 21.93 | 20.17 | 84.62 | 72.29 |
| NFPP | 20.09 | 22.65 | 20.01 | 78.02 | 35.86 |
| FL | 16.12 | 20.03 | 16.65 | 69.04 | 35.42 |
| FG | 5.55 | 21.07 | 20.12 | 91.23 | 79.75 |
| FW | 15.45 | 24.20 | 20.71 | 73.25 | 38.39 |
| FYPP | 320.68 | 25.62 | 25.46 | 98.78 | 11.36 |

*, ** significant at 5 % and 1 % levels, respectively.
PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, $h^2$ = Heritability (%), GAM = Genetic advance as per cent of mean.

**Table 6.** Variability parameters for different characters of IC 045993 × Pusa - A4 in F2 population .

| | Mean | PCV | GCV | $h^2$ | GAM |
|---|---|---|---|---|---|
| FF | 41.89 | 21.32 | 20.09 | 88.80 | 28.26 |
| PH | 77.48 | 20.74 | 20.09 | 93.78 | 21.95 |
| NBPP | 4.72 | 34.69 | 21.65 | 38.94 | 36.92 |
| NFPP | 20.28 | 22.92 | 20.31 | 78.49 | 35.90 |
| FL | 13.92 | 24.03 | 20.12 | 70.11 | 38.71 |
| FG | 5.41 | 23.09 | 10.31 | 19.93 | 17.65 |
| FW | 15.68 | 23.45 | 20.01 | 72.81 | 37.88 |
| FYPP | 329.81 | 59.52 | 59.37 | 99.49 | 11.29 |

*, ** significant at 5 % and 1 % levels, respectively.
PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, $h^2$ = Heritability (%), GAM = Genetic advance as per cent of mean.

2014), Shanthakumar and Salimath 2010, Prakash and Pitchamuthu 2010, Makhdoomi (2018), Ranga *et al.* 2019). High heritability and genetic advance as percent indicated that prevalence of additive gene action in their inheritance. Hence early generation selection may be effective to improve these traits due to the presence of additive gene action.

The present study revealed high / moderate heritability coupled with high / moderate genetic advance as percent of mean recorded for plant height, number of branches per plant, number of fruits per plant, fruit length, fruit girth, and fruit yield per plant in the three crosses of F2 populations. Therefore, these traits should be considered while selecting superior and desirable plants that would offer scope for developing high yielding in bhendi breeding program.

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