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# Genetic analysis of character association studies in okra (*Abelmoschus esculentus* (L.) Moench genotypes

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**Abstract**
An experiment was conducted at Kittur Rani Channamma College of Horticulture, Vegetable field unit, Arabhavi during, late *Kharif 2016.* The trial was laid out in a Randomized Complete Block Design (RCBD) with two replications. The character association studies revealed that the fruit yield per plant had significant and positive association with plant height at 45 DAS (0.308 and 0.343 respectively), plant height at 60 DAS (0.323 and 0.394 respectively), plant height at 90 DAS (0.493 and 0.226 respectively) and number of fruits per plant (0.865 and 0.710 respectively). While it was negatively and significantly associated with number of branches per plant (-0.256 and -0.184 respectively), days to to flowering (-0.567 and -0.378 respectively), days to fifty per cent flowering (-0.584 and -0.413 respectively) and vitamin C content (-0.364 and-0.261 respectively) at both genotypic and phenotypic level. Narrow differences between the genotypic and phenotypic correlation coefficients were observed for various traits in the present findings. This indicates the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits.

**Keywords:** Okra, character association, genotypes

## Introduction
Okra *[Abelmoschus esculentus* (L) Moench.] also known as lady's finger is an important vegetable crop cultivated in and sub-tropical parts of the world. Okra tender fruits are used as vegetable, eaten boiled or in culinary preparation as sliced and fried pieces. It is also used for thickening soups and gravies, because of its high mucilage content. Okra fruits are also sliced and sun dried or canned and pickled for offseason use. Increase in demand and the area under cultivation necessitates improved varieties in this crop. Unlike many other members of pod vegetable group, it is not strictly season-bound and hence can be gown twice a year. Being a warm season crop, it can be grown as spring-summer as well as rainy season crop in major agro-ecological zones of India. It fits well in sequential cropping systems due to its quick growing habit, medium duration and tolerance to drought, heat and wide variation in rainfall. Optimizing pod yield is one of the most important goals for most okra growers and consequently, most okra breeding programs. For improving this crop through conventional breeding and selection, adequate knowledge of association that exists between yield and yield related characters is essential for the identification of selection procedure. Hence, the gain from selection in a crop breeding programme is dependent on the amount of variability for the economic characters in the population. The selection process is complicated by the complex nature of yield by interplaying with its component characters. A better understanding of the contribution of each trait in building up the genetic makeup of the crop may be obtained through association studies. The present investigation was therefore undertaken to determine the nature and magnitude of character association among different traits and their association with fruit yield in okra. In plant breeding, correlation analysis provides information about yield components and thus helps in selection of superior genotypes from diverse genetic populations. The correlation studies simply measure the associations between yield and other traits.

## Material and Methods
Experimental material comprised 65 germplasm lines of okra. All germplasm lines were

evaluated in a randomized block design with two replications at K.R.C. College of Horticulture Arabhavi, during 2016. Rows were spaced at 60 cm, while plants were spaced at 30 cm in the rows so as to accommodate 15 plants per plot, row and genotype. Cultural and agronomic practices were followed as per the standard recommendations and need based plant protection measures were taken up to maintain healthy crop stand. Observations were recorded on five competitive plants excluding border plants in each replication in each genotype for plant height (cm) at 45,60 and 90 DAS, number of leaves per plant at 45,60 and 90 DAS, intermodal length (cm), number of branches per plant, number of nodes on main stem, days to first flowering days to 50 per cent flowering, node at first flowering, fruit length (cm), fruit diameter(mm), average fruit weight (g), fruit yield per plant (g), fruit yield per plot (kg), fruit yield per hectare (t), number of ridges on fruit surface, number of seeds per fruit and vitamin C content (mg/100g). Association of different characteristics under the study was analyzed by the working out genotypic and phenotypic degree of correlation coefficient for all the possible parts of characteristics combination by the method of (Hayes *et al.*, 1956) [9] and (Al-Jabouri *et al.*, 1958).

**Results and Discussion**

Complex characteristics such as yield must be related to many individually distinguishable characteristics. It is obvious that fruit yield is a complex character that depends up on many independent yield contributing characters, which are regarded as yield components. All changes in the components need not however, be expressed by changes in yield. This is due to varying degree of positive and negative associations between yield and its components and among components themselves. Therefore, selection should be based on these component characters after assessing their association with fruit yield per plant. From the perusal of the estimates of phenotypic and genotypic coefficients of variation (Table 1 and 2), in general, it was observed that estimates of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic correlation coefficients. The present findings are in consonance with the earlier findings of Akinyele and Osekita (2006) [2], Bello *et al*. (2006) [4], Mehta *et al*. (2006) [14] and Rashwan (2011) [17]. More significant genotypic ssociation between the different pairs of characters than the henotypic correlation means that there is strong association between those characters genetically, but the phenotypic value is lessened by the significant interaction of environment.

Fruit yield per plant (Table 1) exhibited highly significant and positive association with plant height at 45 DAS (0.308), plant height at 60 DAS (0.323), plant height at 90 DAS (0.493), number of leaves per plant at 45 DAS (0.212), fruit length (0.224), average fruit weight (0.226), number of fruits per plant (0.865) and number of seeds per fruit (0.173). This vividly suggests the possibility of simultaneous improvement of these traits in improving fruit yield per plant. Similar results were reported by earlier workers *viz.*, Dhankar and Dhankar (2002) [17], Mehta *et al.* (2006) [14], Magar and Madrap (2009) [13], Gangashetty (2010) [7], Koujalagi *et al.* (2010) [11], Karri and Acharyya (2012) [10], Singh and Sharma (2012) for plant height, fruit length, average fruit weight and number of fruits per plant, Kumar *et al*. (2009) [12] for number of leaves per plant, Adiger *et al*. (2011) [1] for fruit length, Nwangburuka *et al*. (2012) [15], Simon *et al.* (2013) [13] for number of seeds per fruit. While, number of leaves per plant at 90 DAS, internodal length and number of nodes on main stem not having any significant association with fruit yield per plant. As expected, fruit yield per plant exhibited negative association with number of branches per plant, days to first flowering, days to 50 per cent flowering, node at first flowering, fruit diameter, number of ridges on fruit surface and vitamin C. In the same manner Rashwan (2011) [17] reported significantly negative association of number of branches per plant with fruit yield per plant. Pratap *et al.* (1979) [17], Gondane *et al.* (1995) [8], Dhankar Dhankar (2002) [17] and Celestin *et al.* (2012) also reported that days to first flowering, days to 50 per cent flowering, node at first flowering showed negative association with fruit yield per plant. Celestin *et al.* (2012) also reported that, fruit diameter showed negative correlation with fruit yield per plant.

**Table 1:** Genotypic correlation coefficients among growth, earliness, and yield and quality parameters in okra (Abelmoschus *esculentus* (L.) Moench.)

| @ | PH @ 45 | PH @ 60 | PH @ 90 | NL @ 45 | NL @ 60 | NL @ 90 | IL @ 60 | NBP @ 90 | NNMS | DFF | DFPF | NAFF | FL | FD | AFW | NFP | NRFS | NSP | VC | FYP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH @ 45 | 1.00 | 0.919** | 0.766** | -0.136 | 0.096 | 0.135 | -0.226** | -0.223* | 0.235** | -0.206* | -0.416** | -0.002 | 0.029 | -0.011 | 0.006 | 0.343** | -0.683** | 0.346** | -0.238** | 0.308** |
| PH @ 60 | | 1.00 | 1.013** | 0.100 | 0.235** | 0.398** | -0.039 | -0.052 | 0.465** | -0.316** | -0.547** | 0.849** | 0.006 | 0.032 | 0.167 | 0.346** | -0.764** | 0.405** | -0.216* | 0.323** |
| PH @ 90 | | | 1.00 | 0.191* | 0.256** | 0.679** | 0.056 | 0.179* | 0.094 | -0.172* | -0.251** | 0.897** | 0.065 | -0.126 | 0.132 | 0.615** | -0.297** | 0.054 | -0.008 | 0.493** |
| NL @ 45 | | | | 1.00 | 0.972** | 0.966** | -0.214* | 0.313** | -0.192* | 0.150 | 0.163 | -0.766** | 0.219* | -0.046 | 0.464** | 0.309** | 0.075 | -0.039 | -0.263** | 0.212* |
| NL @ 60 | | | | | 1.00 | 0.942** | -0.262** | 0.327** | -0.267** | 0.351** | 0.829** | -0.921** | 0.423** | 0.310** | 0.542** | 0.181** | 0.053 | -0.032 | -0.220* | -0.019 |
| NL @ 90 | | | | | | 1.00 | -0.130 | 0.468** | -0.345** | 0.360** | 0.120 | -0.818** | 0.532** | -0.068 | 0.824** | 0.574** | 0.199* | -0.201* | -0.073 | -0.023 |
| IL @ 60 | | | | | | | 1.00 | -0.105 | 0.094 | -0.028 | 0.007 | 0.361** | -0.403** | 0.037 | -0.564** | 0.080 | -0.060 | -0.136 | 0.323** | -0.047 |
| NBP @ 90 | | | | | | | | 1.00 | -0.442** | 0.470** | 0.527** | 0.880** | -0.095 | -0.009 | 0.143 | -0.229** | 0.346** | -0.058 | 0.366** | -0.256** |
| NNMS | | | | | | | | | 1.00 | -0.230** | -0.164 | 0.103 | -0.124 | 0.116 | 0.076 | -0.032 | -0.252 | 0.036 | 0.182* | -0.057 |
| DFF | | | | | | | | | | 1.00 | 0.908** | -0.963** | 0.057 | 0.365** | 0.344** | -0.735** | 0.355** | -0.270** | 0.013 | -0.567** |
| DFPF | | | | | | | | | | | 1.00 | 0.554** | -0.099 | 0.214** | 0.156 | -0.640** | 0.488** | -0.271** | 0.174* | -0.584** |
| NAFF | | | | | | | | | | | | 1.00 | -0.135** | -0.538** | 0.256** | -0.894** | 0.367** | 0.260** | 0.391** | -0.112** |
| FL | | | | | | | | | | | | | 1.00 | -0.117 | 0.787** | 0.058 | -0.018 | -0.122 | -0.266** | 0.224* |
| FD | | | | | | | | | | | | | | 1.00 | 0.003 | -0.625** | -0.089 | -0.242** | -0.155 | -0.485** |
| AFW | | | | | | | | | | | | | | | 1.00 | 0.013 | 0.191* | -0.266** | -0.211* | 0.226** |
| NFP | | | | | | | | | | | | | | | | 1.00 | -0.541** | 0.204* | -0.224* | 0.865** |
| NRFS | | | | | | | | | | | | | | | | | 1.00 | -0.429** | 0.502** | -0.394** |
| NSP | | | | | | | | | | | | | | | | | | 1.00 | -0.194* | 0.173* |
| VC | | | | | | | | | | | | | | | | | | | 1.00 | -0.364** |

Critical r value = 0.225 at 1per cent and 0.172 at 5 per cent * and ** indicate significant at 5 and 1 per cent probability level, respectively @ = Characters

1. PH @ 45 = Plant height (cm) at 45 DAS
2. PH @ 60 = Plant height (cm) at 60 DAS
3. PH @ 90 = Plant height (cm) at 90 DAS
4. NL @ 45 = Number of leaves at 45 DAS
5. NL @ 60 = Number of leaves at 60 DAS
6. NL @ 90 = Number of leaves at 90 DAS
7. IL @ 60 = Intermodal length (cm)
8. NB @ 90 = Number of branches per plant
9. NNMS= Number of nodes on main stem
10. DFF = Days to first flowering
11. DFPF = Days to 50 per cent flowering
12. NAFF = Node at first flowering
13. FL= Fruit length (cm)
14. FD = Fruit diameter (mm)
15. AFW = Average fruit weight (g)
16. NFP= Number of fruits per plant
17. NRFS= Number of ridges on fruit surface
18. NSP= Number of seed per fruit
19. VC= Vitamin C (mg/100g)
20. FYP= Genotypic correlation with fruit yield per plant

**Table 2:** Phenotypic correlation coefficients among growth, earliness, Yield and quality parameters in okra (*Abelmoschus esculentus* (L.) Moench)

| @ | PH @ 45 | PH @ 60 | PH @ 90 | NL @ 45 | NL @ 60 | NL @ 90 | IL @ 60 | NBP @ 90 | NNMS | DFF | DFPF | NAFF | FL | FD | AFW | NFP | NRFS | NSP | VC | FYP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PH @ 45 | 1.00 | 0.814** | 0.380** | 0.008 | 0.108 | 0.148 | -0.101 | -0.180* | 0.083 | -0.211* | 0.329** | -0.117 | -0.027 | 0.045 | 0.010 | 0.249** | -0.352** | 0.100 | -0.187* | 0.343** |
| PH @ 60 | | 1.00 | 0.469** | 0.063 | 0.136 | 0.159 | -0.008 | -0.184 | 0.077 | -0.216* | 0.304** | -0.092 | -0.056 | -0.012 | 0.018 | 0.325** | -0.332** | 0.185* | -0.156 | 0.394** |
| PH @ 90 | | | 1.00 | 0.099 | 0.052 | 0.136 | 0.051 | 0.128 | 0.054 | -0.138 | 0.207* | -0.276** | 0.092 | -0.060 | 0.129 | 0.335** | -0.301** | 0.016 | -0.012 | 0.226** |
| NL @ 45 | | | | 1.00 | 0.657** | 0.570** | -0.121 | 0.254** | -0.102 | -0.014 | -0.036 | 0.045 | 0.105 | 0.024 | 0.177* | 0.109 | -0.009 | 0.001 | -0.162 | 0.075 |
| NL @ 60 | | | | | 1.00 | 0.791** | -0.212* | 0.204* | -0.083 | 0.029 | 0.026 | -0.064 | 0.152 | 0.046 | 0.202* | -0.006 | -0.028 | 0.106 | -0.128 | 0.066 |
| NL @ 90 | | | | | | 1.00 | -0.174* | 0.124 | -0.020 | 0.043 | 0.020 | -0.078 | 0.157 | 0.017 | 0.220* | 0.103 | 0.011 | 0.085 | -0.049 | 0.123 |
| IL @ 60 | | | | | | | 1.00 | -0.046 | 0.098 | -0.024 | 0.043 | 0.106 | -0.182 | 0.052 | -0.218* | 0.117 | -0.030 | -0.125 | 0.266** | -0.017 |
| NBP @ 90 | | | | | | | | 1.00 | -0.111 | 0.212** | 0.233** | 0.109 | -0.037 | 0.115 | 0.112 | -0.152 | 0.075 | 0.054 | 0.219* | -0.184* |
| NNMS | | | | | | | | | 1.00 | -0.036 | 0.036 | 0.058 | 0.030 | 0.162 | -0.021 | 0.082 | -0.125 | 0.008 | 0.125 | -0.036 |
| DFF | | | | | | | | | | 1.00 | 0.760** | -0.061 | 0.037 | 0.234** | 0.056 | -0.316** | 0.276** | -0.140 | 0.002 | -0.378** |
| DFPF | | | | | | | | | | | 1.00 | -0.035 | -0.049 | 0.073 | 0.006 | -0.346** | 0.322** | -0.121 | 0.127 | -0.413** |
| NAFF | | | | | | | | | | | | 1.00 | 0.019 | -0.014 | -0.026 | -0.123 | 0.048 | 0.003 | 0.232** | -0.032 |
| FL | | | | | | | | | | | | | 1.00 | 0.039 | 0.542** | 0.016 | -0.057 | 0.057 | -0.169 | 0.091 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FD | | | | | | | | | | | | | | 1.00 | 0.079 | -0.078 | -0.010 | -0.022 | -0.080 | -0.099 |
| AFW | | | | | | | | | | | | | | | 1.00 | 0.052 | 0.069 | 0.047 | -0.115 | 0.144 |
| NFP | | | | | | | | | | | | | | | | 1.00 | -0.230** | 0.048 | -0.126 | 0.710** |
| NRFS | | | | | | | | | | | | | | | | | 1.00 | -0.315** | 0.406** | -0.158 |
| NSP | | | | | | | | | | | | | | | | | | 1.00 | -0.126 | 0.123 |
| VC | | | | | | | | | | | | | | | | | | | 1.00 | -0.261** |

Critical r value = 0.225 at 1per cent and 0.172 at 5 per cent * and ** indicate significant at 5 and 1 per cent probability level, respectively @ = Characters

1. PH @ 45 = Plant height (cm) at 45 DAS
2. PH @ 60 = Plant height (cm) at 60 DAS
3. PH @ 90 = Plant height (cm) at 90 DAS
4. NL @ 45 = Number of leaves at 45 DAS
5. NL @ 60 = Number of leaves at 60 DAS
6. NL @ 90 = Number of leaves at 90 DAS
7. IL @ 60 = Intermodal length (cm)
8. NB @ 90 = Number of branches per plant
9. NNMS= Number of nodes on main stem
10. DFF = Days to first flowering
11. DFPF = Days to 50 per cent flowering
12. NAFF = Node at first flowering
13. FL= Fruit length (cm)
14. FD = Fruit diameter (mm)
15. AFW = Average fruit weight (g)
16. NFP= Number of fruits per plant
17. NRFS= Number of ridges on fruit surface
18. NSP= Number of seed per fruit
19. VC= Vitamin C (mg/100g)
20. FYP= Phenotypic correlation with fruit yield per plant

From above discussion confirmed that plant height at 45 DAS, plant height at 60 DAS, plant height at 90 DAS, number of leaves at 45 DAS, fruit length, average fruit weight, number of fruits per plant and number of seeds per fruit as these exhibited/ showed significant and positive association with fruit yield per plant and these are the important traits to be considered for crop improvement programme. The selection pressure in these available genotype of okra for above traits would be rewarding in improving fruit yield.

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