Studies on Genetic Variability, Heritability and Genetic Advances for Quantitative Characters in Finger millet (*Eleusine coracana* (L.) Gaertn.)

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**Abstract**

The present investigation was carried out to study the genetic variability, heritability and genetic advance among 137 finger millet genotypes for fifteen characters during Kharif 2018. Analysis of Variance showed significant differences for all the characters under study except for leaf width, number of panicle per plant and test weight indicating the presence of a substantial amount of genetic variability thus revealed that these genotypes have been developed from the different genetic background. On the basis of *per se* performance for different quantitative traits, genotype IE4734 was found to be the best genotype in Allahabad agro-climatic conditions. High estimates of GCV and PCV were observed for harvest index. High heritability coupled with high genetic advance was recorded for leaf width followed by test weight and grain yield per plant indicating the predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters.

**Keywords**

Finger millet (*Eleusine coracana* (L.)Gaertn.), genetic variability, heritability

**Introduction**

Finger millet is an important staple food crop widely grown in Africa and South Asia. Among the millets, finger millet has a high amount of calcium, methionine, tryptophan, fiber, and sulfur-containing amino acids.

In addition, it has C₄ photosynthetic carbon assimilation mechanism, which helps to utilize water and nitrogen efficiently under hot and arid conditions without severely affecting yield Hittalmani (2017).

Finger millet is highly nutritious as its grain contains high-quality protein (7-10%). It is the richest source of calcium (344mg/100g), iron (3.9mg/100g) and other minerals. It is also rich in phosphorus (283mg/100g) and potassium (408mg/100g). The cereal has low-fat content (1.3%) and contains mainly unsaturated fat 100 g of finger millet has
roughly on an average of 336 Kcal of energy. The higher fiber content of finger millet helps in many ways as it prevents constipation, high cholesterol formation, and intestinal cancer. Hence, people suffering from diabetes are advised to eat finger millet and other small millets instead of rice Hadimani and Malleshi, (1993).

Assessment of genetic variability is a basic step in the crop improvement program. Yield is being a complex character it is influenced by a number of yield contributing characters controlled by polygenes and also influenced by the environment. Genotypic and phenotypic association reveals the degree of association between different characters and thus, aids in selection to improve the yield and yield attributing characters. Heritability measures the relative amount of the heritable portion of variation while the genetic advance helps to measure the amount of progress that could be expected with selection in a character.

**Materials and Methods**

The experimental material consisted of 137 finger millet genotypes collected from ICRISAT, Hyderabad and NBPG, New Delhi (Table 1). The experiment was conducted in randomized block design with three replications during Kharif-2018 at Field Experimentation Centre of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad) U.P. All the recommended agronomic and cultural practices were followed for raising a healthy crop. Data were recorded on five randomly taken plants per replication of each genotype for fifteen characters viz., days to 50% flowering, days to maturity, plant height (cm), leaf length (cm), leaf width (cm), leaf area index, number of panicles per plant, number of fingers per panicle, finger length (cm), finger width (cm), stem girth (cm), biological yield per plant (g), grain yield per plant (g), harvest index, seed index. The analysis of variance was done as suggested by Punse and Sukhatme (1985). The genotypic and phenotypic coefficient of variation was calculated by the formulae as suggested by Burton (1952), heritability as per formulae suggested by Burton and Devane (1953) and genetic advance (Johnson et al., 1955).

**Results and Discussion**

The analysis of variance showed a wide range of variation and significant differences for all the characters under study except for leaf width, number of panicles per plant and test weight. This indicates that there was ample scope for selection of promising lines from the present gene pool for yield and its components in finger millet (Table 2).

Estimation of genotypic variance ($\sigma^2_g$) and phenotypic variance ($\sigma^2_p$) was obtained for different characters and wide range of variance were observed for all the characters. The highest genotypic variance ($\sigma^2_g$) and phenotypic variance ($\sigma^2_p$) were recorded for plant height (124.74 and 176.25) followed by days to 50% flowering (90.06 and 94.13), days to maturity (90.06 and 94.13), leaf area index (54.63 and 63.38), leaf length (33.29 and 51.02), biological yield per plant (23.81 and 24.87). While moderate genotypic variance ($\sigma^2_g$) and phenotypic variance ($\sigma^2_p$) were recorded for harvest index (16.20 and 17.15).

Whereas, finger length (1.94 and 2.04), number of fingers per panicle (0.85 and 0.89), grain yield per plant (0.52 and 0.53), finger width (0.03 and 0.04), stem girth (0.02 and 0.03), number of panicle per plant (0.00 and 0.01) showed genotypic variance ($\sigma^2_g$) and phenotypic variance ($\sigma^2_p$). The phenotypic variance was higher than the genotypic
variance for all the yield and yield attributing characters indicates that the influence of environmental factors on these traits. Less difference in the estimates of genotypic and phenotypic variance for all the characters suggested that the variability present among the genotypes were mainly due to genetic reason with minimum influence of environment and hence heritable. The genotypic estimates of variability (Vg) being the most important, helps in the measurement of a particular character and gives a clue to compare the genetic variability for different characters. Similar results have been reported by John (2006), Ganapathy et al. (2011) and Karad and Patil (2013).

Phenotypic coefficient of variation ranged from 8.70 (days to maturity) to 41.45 (harvest index). Highest PCV was recorded for harvest index (41.45), whereas the lowest was recorded for days to maturity (8.70). Genotypic coefficient of variation ranged from 4.80 (number of panicles per plant) to 40.30 (harvest index). Highest GCV was recorded for Harvest index (40.30), whereas the lowest was recorded for a number of panicles per plant (4.80).

The coefficient of variation at phenotypic and genotypic levels was high for harvest index, grain yield per plant, biological yield per plant, leaf area index, test weight, finger width and finger length. Similar results were also obtained by Kumari and Singh (2015) for Harvest index and leaf area index, Patil (2013) for Grain yield per plant, finger length and test weight. Moderate for the traits like leaf width, number of fingers per panicle, plant height, stem girth, leaf length. Similar results were also obtained by Ulaganathan and Nirmalakumari (2011) for leaf length, leaf width and number of fingers per panicle, Ganapathy et al. (2011) for plant height. Low PCV and GCV were observed for days to maturity. Similar results were obtained by Ganapathy et al. (2011) for days to maturity. The magnitude of high GCV and PCV suggests that enough genetic variability is present among the finger millet genotypes for traits where PCV and GCV are moderate to low, the scope of selection for suitable characters is limited.

In present study, high heritability was recorded for leaf width, test weight, grain yield per plant, biological yield per plant, number of panicles per plant, days to flowering, days to maturity, finger length, harvest index, finger width, leaf area index, plant height, stem girth and leaf length. The maximum value was recorded for leaf width (99%) and the minimum was recorded for number of panicles per plant (21%). High heritability coupled with high genetic advance as percent mean in the present set of genotypes were recorded for leaf width (99% and 37.59%), test weight (97% and 47.34%), grain yield per plant (97% and 77.41%), days to 50% flowering (96% and 22.11%), number of fingers per panicle (96% and 32.87), biological yield per plant (96% and 50.34%), finger length (95% and 44.22%), finger width (94% and 46.12%), harvest index (94% and 80.67%), leaf area index (86% and 47.15%), plant height (71% and 25.24%), stem girth (69% and 22.64%) and leaf length (65% and 21.38%) indicating a predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters. Similar results were also obtained by John 2006 for Test weight and harvest index, Ganapathy et al. (2011) for grain yield per plant, finger length and plant height, Kumari and Singh (2015) for leaf area index and days to 50% flowering, Ulaganathan and Nirmalakumari (2011) for leaf length. High heritability coupled with moderate genetic advance was recorded for days to maturity (96% and 17.5%), suggesting the greater role of both additive and non-additive gene action in their inheritance.
**Table.1** List of finger millet genotypes used in the present investigation

| S. No | Designation        | Source          | S. No | Designation        | Source          | S. No | Designation        | Source          | S. No | Designation        | Source          |
|-------|--------------------|-----------------|-------|--------------------|-----------------|-------|--------------------|-----------------|-------|--------------------|-----------------|
| 1     | IE3978             | ICRISAT, Hyderabad | 29    | IE4121             | ICRISAT, Hyderabad | 57    | IE3104             | ICRISAT, Hyderabad | 85    | GE4                | NBPGR, New Delhi |
| 2     | IE2043             | ICRISAT, Hyderabad | 30    | IE4734             | ICRISAT, Hyderabad | 58    | IE3391             | ICRISAT, Hyderabad | 86    | GE62               | NBPGR, New Delhi |
| 3     | IE4797             | ICRISAT, Hyderabad | 31    | IE5066             | ICRISAT, Hyderabad | 59    | IE3614             | ICRISAT, Hyderabad | 87    | GE236              | NBPGR, New Delhi |
| 4     | IE5106             | ICRISAT, Hyderabad | 32    | GE86               | NBPGR, New Delhi  | 60    | IE4565             | ICRISAT, Hyderabad | 88    | GE51               | NBPGR, New Delhi |
| 5     | GE229              | NBPGR, New Delhi  | 33    | GE237              | NBPGR, New Delhi  | 61    | IE6240             | ICRISAT, Hyderabad | 89    | GE21               | NBPGR, New Delhi |
| 6     | GE93               | NBPGR, New Delhi  | 34    | GE228              | NBPGR, New Delhi  | 62    | GE238              | NBPGR, New Delhi  | 90    | GE196              | NBPGR, New Delhi |
| 7     | GE82               | NBPGR, New Delhi  | 35    | GE52               | NBPGR, New Delhi  | 63    | GE87               | NBPGR, New Delhi  | 91    | GE76               | NBPGR, New Delhi |
| 8     | GE83               | NBPGR, New Delhi  | 36    | GE200              | NBPGR, New Delhi  | 64    | GE81               | NBPGR, New Delhi  | 92    | GE80               | NBPGR, New Delhi |
| 9     | GE231              | NBPGR, New Delhi  | 37    | GE235              | NBPGR, New Delhi  | 65    | GE213              | NBPGR, New Delhi  | 93    | GE224              | NBPGR, New Delhi |
| 10    | GE13               | NBPGR, New Delhi  | 38    | GE276              | NBPGR, New Delhi  | 66    | GE191              | NBPGR, New Delhi  | 94    | GE207              | NBPGR, New Delhi |
| 11    | GE277              | NBPGR, New Delhi  | 39    | IE3470             | ICRISAT, Hyderabad | 67    | GE44               | NBPGR, New Delhi  | 95    | GE274              | NBPGR, New Delhi |
| 12    | GE193              | NBPGR, New Delhi  | 40    | GE245              | NBPGR, New Delhi  | 68    | GE76               | NBPGR, New Delhi  | 96    | GE223              | NBPGR, New Delhi |
| 13    | GE271              | NBPGR, New Delhi  | 41    | GE2               | NBPGR, New Delhi  | 69    | GE85               | NBPGR, New Delhi  | 97    | IE4671             | ICRISAT, Hyderabad|
| 14    | GE278              | NBPGR, New Delhi  | 42    | GE86               | NBPGR, New Delhi  | 70    | GE55               | NBPGR, New Delhi  | 98    | IE4673             | ICRISAT, Hyderabad|
| 15    | GE202              | NBPGR, New Delhi  | 43    | GE77               | NBPGR, New Delhi  | 71    | GE79               | NBPGR, New Delhi  | 99    | IE4757             | ICRISAT, Hyderabad|
| 16    | GE199              | NBPGR, New Delhi  | 44    | GE227              | NBPGR, New Delhi  | 72    | GE60               | NBPGR, New Delhi  | 100   | IE2872             | ICRISAT, Hyderabad|
| 17    | GE234              | NBPGR, New Delhi  | 45    | GE228              | NBPGR, New Delhi  | 73    | GE203              | NBPGR, New Delhi  | 101   | GE12               | NBPGR, New Delhi |
| 18    | GE53               | NBPGR, New Delhi  | 46    | GE214              | NBPGR, New Delhi  | 74    | GE243              | NBPGR, New Delhi  | 102   | GE19               | NBPGR, New Delhi |
| 19    | GE63               | NBPGR, New Delhi  | 47    | IE6154             | ICRISAT, Hyderabad | 75    | IE2072             | ICRISAT, Hyderabad | 103   | IE2437             | ICRISAT, Hyderabad|
| 20    | GE197              | NBPGR, New Delhi  | 48    | GE19               | NBPGR, New Delhi  | 76    | IE790              | ICRISAT, Hyderabad | 104   | IE6294             | ICRISAT, Hyderabad|
| 21    | GE233              | NBPGR, New Delhi  | 49    | GE50               | NBPGR, New Delhi  | 77    | IE3475             | ICRISAT, Hyderabad | 105   | IE5817             | ICRISAT, Hyderabad|
| 22    | GE87               | NBPGR, New Delhi  | 50    | GE239              | NBPGR, New Delhi  | 78    | IE9345             | ICRISAT, Hyderabad | 106   | IE3045             | ICRISAT, Hyderabad|
| 23    | GE198              | NBPGR, New Delhi  | 51    | GE205              | NBPGR, New Delhi  | 79    | IE4073             | ICRISAT, Hyderabad | 107   | IE5537             | ICRISAT, Hyderabad|
| 24    | GE85               | NBPGR, New Delhi  | 52    | GE219              | NBPGR, New Delhi  | 80    | IE4570             | ICRISAT, Hyderabad | 108   | IE7079             | ICRISAT, Hyderabad|
| 25    | GE275              | NBPGR, New Delhi  | 53    | GE79               | NBPGR, New Delhi  | 81    | IE9091             | ICRISAT, Hyderabad | 109   | GE68               | NBPGR, New Delhi |
| 26    | GE76               | NBPGR, New Delhi  | 54    | GE279              | NBPGR, New Delhi  | 82    | IE5367             | ICRISAT, Hyderabad | 110   | GE240              | NBPGR, New Delhi |
| 27    | GE518              | ICRISAT, Hyderabad | 55    | IE1055             | ICRISAT, Hyderabad | 83    | IE5367             | ICRISAT, Hyderabad | 111   | GE195              | NBPGR, New Delhi |
| 28    | GE4028             | ICRISAT, Hyderabad | 56    | IE1055             | ICRISAT, Hyderabad | 84    | GE273              | NBPGR, New Delhi  | 112   | GE210              | NBPGR, New Delhi |

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Table 2: Analysis of Variance for different quantitative parameters in finger millet

| S. No. | Parameters                          | Mean Sum of Squares | Replications (d.f = 2) | Treatments (d.f = 136) | Error (d.f = 272) |
|--------|------------------------------------|---------------------|------------------------|-------------------------|-------------------|
| 1      | Days to 50% flowering              | 5.70                | 274.25**               | 4.06                    |
| 2      | Days to maturity                   | 5.70                | 274.25**               | 4.06                    |
| 3      | Plant height                       | 140.73              | 425.73**               | 51.51                   |
| 4      | Leaf length                        | 44.97               | 117.59**               | 17.73                   |
| 5      | Leaf width                         | 0.00                | 0.08                   | 0.00                    |
| 6      | Leaf area index                    | 19.08               | 172.64**               | 8.76                    |
| 7      | Finger length                      | 0.21                | 5.92**                 | 0.10                    |
| 8      | Finger width                       | 0.01                | 0.10**                 | 0.00                    |
| 9      | No. of panicle per plant           | 0.00                | 0.02                   | 0.01                    |
| 10     | No. of fingers per panicle         | 0.04                | 2.59**                 | 0.03                    |
| 11     | Stem girth                         | 0.02                | 0.06**                 | 0.01                    |
| 12     | Biological yield per plant         | 1.54                | 72.48**                | 1.06                    |
| 13     | Harvest Index                      | 0.25                | 49.54**                | 0.95                    |
| 14     | Test weight                        | 0.00                | 0.01                   | 0.00                    |
| 15     | Grain yield per plant              | 0.02                | 1.57**                 | 0.02                    |

** indicates 1% level of significance
Table 3: Genetic parameters for 15 quantitative characters in 137 finger millet genotypes.

| Parameters                      | Genotypic variance | Phenotypic variance | Coefficient of variance (%) | Heritability (%) | Genetic advance at 5% | Genetic advance as a percent of mean |
|---------------------------------|--------------------|---------------------|-----------------------------|-----------------|----------------------|-------------------------------------|
| Days to 50% flowering           | 90.06              | 94.13               | 10.97                       | 11.22           | 96.00                | 19.12                               |
| Days to maturity                | 90.06              | 94.13               | 8.51                        | 8.70            | 96.00                | 19.12                               |
| Plant height                    | 124.74             | 176.25              | 14.56                       | 17.31           | 71.00                | 19.36                               |
| Leaf length                     | 33.29              | 51.02               | 12.85                       | 15.91           | 65.00                | 9.60                                |
| Leaf width                      | 0.03               | 0.03                | 18.32                       | 18.39           | 99.00                | 0.33                                |
| Leaf area index                 | 54.63              | 63.38               | 24.65                       | 26.55           | 86.00                | 14.14                               |
| Finger length                   | 1.94               | 2.04                | 22.02                       | 22.60           | 95.00                | 2.96                                |
| Finger width                    | 0.03               | 0.04                | 23.09                       | 23.82           | 94.00                | 0.36                                |
| No. of panicle per plant        | 0.00               | 0.01                | 4.80                        | 10.55           | 21.00                | 0.05                                |
| No. of fingers per panicle      | 0.85               | 0.89                | 16.26                       | 16.61           | 96.00                | 1.86                                |
| Stem girth                      | 0.02               | 0.03                | 13.25                       | 15.98           | 69.00                | 0.23                                |
| Biological yield per plant      | 23.81              | 24.87               | 24.97                       | 25.52           | 96.00                | 9.84                                |
| Harvest Index                   | 16.20              | 17.15               | 40.30                       | 41.45           | 94.00                | 8.07                                |
| Test weight                     | 0.00               | 0.00                | 23.29                       | 23.29           | 97.00                | 0.12                                |
| Grain yield per plant           | 0.52               | 0.53                | 38.18                       | 38.18           | 97.00                | 1.46                                |
Similar findings were reported by Ulaganathan and Nirmalakumari (2011) and Karad and Patil (2013). Low heritability coupled with low genetic advance was recorded for number of panicles per plant (21% and 4.50%). It is indicative of non-additive gene action. The low heritability is being exhibited due to the favorable influence of environment rather than genotype and selection for such traits may not be rewarding (Table 3).

In the present study, the characters, leaf width followed by test weight and grain yield per plant had high heritability coupled with high genetic advance as percent means indicating the predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters.

References

Burton, G. W. (1952). Quantitative inheritance in grasses. Pro VI International Grassland Congress, 1952: 277–283.

Burton, G. W. and Devane, E. H. (1953). Estimating heritability in tall fescue (Festuca arundinacea) from replicated clonal material 1. Agronomy Journal, 45 (10): 478–481.

Ganapathy, S., Nirmalakumari, A. and Muthiah, A. R. (2011). Genetic variability and interrelationship analyses for economic traits in finger millet germplasm. World Journal of Agricultural Sciences, 7 (2): 185–188.

Hadimani, N. A. and Malleshi, N. G. (1993). Studies on milling, physico-chemical properties, nutrient composition and dietary fiber content of millets. Journal of Food Science and Technology, 30 (1): 17–20.

Hittalmani, S., Mahesh, H. B., Shirke, M. D., Biradar, H., Uday, G., Aruna, Y. R. and Mohanrao, A. (2017). Genome and transcriptome sequence of finger millet (Eleusine coracana (L.) Gaertn.) provides insights into drought tolerance and nutraceutical properties. BMC genomics, 18 (1): 465.

Johnson, H. W., Robinson, H. F. and Comstock, R. (1955). Estimates of genetic and environmental variability in soybeans 1. Agronomy Journal, 47 (7): 314–318.

John, K. (2006). Variability and correlation studies in quantitative traits of finger millet (Eleusine coracana Gaertn). Agricultural Science Digest, 26 (3): 166–169.

Karad, S. and Patil, J., (2013). Assessment of Genetic Diversity Among Finger Millet (Eleusine coracana L.) Genotypes. International Journal of Integrative Sciences, Innovation and Technology, 2 (4): 37–43.

Kumari, S. and Singh, S. K. (2015). Assessment of genetic diversity in promising finger millet [Eleusine coracana (L.) Gaertn] genotypes. The Bioscan, 10 (2): 825–830.

Patil, J. V. (2013). Assessment of genetic diversity among finger millet (Eleusine coracana L.) genotypes. International Journal of Innovation Technology and Science, 2 (4): 37–43.

Ulaganathan, V. and Nirmalakumari, A. (2011). Genetic Variability for Yield and Yield Related Traits in Fingermillet [Eleusine coracana (L.) Gaertn] Genotypes. Department of Millets, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, India.
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