GENETIC VARIABILITY AND CORRELATION STUDIES FOR QUANTITATIVE TRAITS IN FINGER MILLET [ELEUSINE CORACANA (L.) GAERTN] GERMPLASM

V. Ulaganathan and A. Nirmalakumari

KEYWORDS
Finger millet
Genetic variability
Heritability
Correlation coefficient
Selection
ABSTRACT

A total of 105 finger millet genotypes constituted of 100 germplasm accessions and five standard varieties were evaluated for 13 quantitative traits in randomized complete block design with three replications at Tamil Nadu Agricultural University, Coimbatore during 2011-2012. The objectives were to assess the variability and association of characters. High values for phenotypic and genotypic coefficients were recorded for grain yield per plant (29.48 and 28.93 %) and productive tillers per plant (23.96 and 22.74 %) indicating that more variability is present in the germplasm accessions. All the characters recorded high heritability in the present study ranged from 63.95 to 96.27 % indicated that these characters were relatively less influenced by environmental factors and phenotypic selection would be effective for the improvement of these characters. The higher heritability coupled with higher genetic advance noted for grain yield per plant (58.47 %), productive tillers per plant (44.45 %), flag leaf blade length (32.05 %), thousand grain weight (29.70 %), finger length (24.81 %), flag leaf sheath length (24.32 %), flag leaf sheath width (23.35 %), plant height (22.53 %), flag leaf blade width (21.66 %) and finger number per panicle (20.77) indicated that the ease of phenotype based selection for the improvement of those traits. However, days to 50 per cent flowering (0.93), productive tillers per plant (0.92), plant height (0.89), days to maturity (0.88), thousand grain weight (0.85), flag leaf sheath length (0.77) and flag leaf blade length (0.52) and finger width (0.17) are significant and positively correlated with grain yield per plant. Overall observations on variability and correlation studies for grain yield and its attributes in finger millet germplasm accessions indicated presence of ample variability for most of the traits.

INTRODUCTION

Finger millet (Eleusine coracana (L.) Gaertn) 2n = 4x = 36, belongs to the tribe Chloridae of the family Poaceae. The cultivated finger millet is commonly known as ragi. It is an important cereal crop classified under small millets is third in importance among millets in area and production after sorghum and pearl millet in India. It is cultivated mostly as a rained crop for its valued food grains, dry fodder and adaptability to wide range of geographical areas and agro-ecological diversity. Studying the genetic variation of a crop species is essential for effective utilization of germplasm in plant breeding programmes. Crop improvement activity largely depends upon the availability of diverse germplasm. Germplasm collections conserve the genetic diversity of crop species and their wild relatives. It allows identification of promising genes that can be incorporated to the breeding programme to develop promising cultivars.

Germplasm collection provides enormous scope for yield improvement by suitable breeding methods. The nature of variability occurring in the base population and the factors influencing the variability should be precisely assessed in order to exploit their utility in the breeding programmes. The observed variability may either be due to genotypic or environmental factors. Hence, it is essential to partition the observed variability into heritable and non heritable components by studying genotypic and phenotypic coefficients of variation. For assessing the heritable variation, the magnitude of heritability is the most important aspect in the breeding material which has close bearing on the response to selection. Knowledge on genetic advance that is expected by applying selection pressure to a population is useful in designing effective breeding programme.

Grain yield is a complex character influenced by a large number of other component characters. Knowledge on the association between yield and other biometrical traits and also among component traits helps in improving the efficiency of selection. An idea about the nature of association will be useful to identify the key characters for which selection can be fruitfully made. Hence the present investigation was undertaken to characterize the germplasm accessions, to assess the variability and to determine the interrelationship among yield and its contributing characters in finger millet.

MATERIALS AND METHODS

A total of 105 finger millet germplasm accessions were taken to assess the magnitude of heritable variability and correlation for 13 yield and yield attributing traits. The study was conducted at Department of Millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore during rabi, 2011-2012. This is situated at about 11ºN latitude and 77ºE longitude at an altitude of 427 m above MSL and the average annual rainfall is around 700mm. The field experiment was laid out in randomized complete block design with three replications. The checks used in this experiment were CO 9, CO (Ra) 14, TRY 1, Paiyur (Ra) 2 and GPU 28. Each accession was grown in single row of 3 metre length with a spacing of 30 cm x 10 cm. The recommended agronomical practices relevant to the crop
were followed throughout the experimental period to raise a good crop.

Observations were recorded from five randomly selected plants in each accession for all the quantitative characters except days to 50 per cent flowering and days to 50 per cent flowering was noted on single row basis. In addition, the characters namely plant height (cm), productive tillers per plant, flag leaf sheath length (cm), flag leaf sheath width (cm), flag leaf blade length (cm), flag leaf blade width (cm), finger number per panicle, finger length (cm), finger width (mm), days to maturity, thousand grain weight (g) and grain yield per plant (g) as per descriptors for *Eleusine coracana* (IBPGR, 1985). The data collected for all quantitative characters were subjected to analysis of variance according to the method suggested by Panse and Sukhatme (1985). Phenotypic and genotypic coefficients of variation were computed according to the method suggested by Burton (1952). Heritability in broad sense was calculated as per the formula given by Allard (1960). Genetic advance was expressed as per cent of mean by using the formula suggested by Johnson et al. (1955). Correlation coefficients were worked out using the formula as suggested by Falconer (1960).

## RESULTS

The estimates of mean, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense (h^2 (BS)) and genetic advance as per cent of mean (GAM) are presented in Table 1. Grain yield per plant exhibited the widest range (15.12 and 45.39 g) followed by productive tillers per plant (5.59 and 12.83), Flag leaf blade length (20.18 and 43.28 cm) and thousand grain weight (1.61 and 3.29 g). In general, phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the characters under study. The values for genotypic coefficients of variation ranged from 6.53 to 28.93 per cent. The highest GCV was observed for grain yield per plant (28.93 %) followed by productive tillers per plant (23.96 %). Moderate PCV was recorded for thousand grain weight (18.63 %), flag leaf blade length (18.39 %), finger number per panicle (15.76 %), flag leaf sheath length (15.75 %), finger length (14.65 %), flag leaf sheath width (14.08 %), plant height (13.76 %) and flag leaf blade width (13.03 %). The lowest PCV was recorded for days to 50 per cent flowering (9.59 %), finger width (8.89 %) and days to maturity (6.72 %).

The genotypes under study showed high heritability values for all the characters under study. Estimates of heritability ranged from 63.95 to 96.27 per cent. Grain yield per plant (96.27 %) recorded highest heritability followed by days to maturity (94.33 %), days to 50 per cent flowering (93.64 %), productive tillers per plant (90.07 %), flag leaf blade length (84.59 %), finger length (82.19 %), flag leaf blade width (80.68 %), flag leaf sheath width (80.49 %), plant height (79.50 %), thousand grain weight (77.37 %), finger width (76.85 %), flag leaf sheath length (74.96 %) and finger number per panicle (63.93 %). Genetic advance as per cent of mean ranged from 13.06 to 58.47 per cent. Grain yield per plant (58.47 %) recorded the highest genetic advance followed by productive tillers per plant (44.45 %), flag leaf blade length (32.05 %), thousand grain weight (29.70 %), finger length (24.81 %), flag leaf sheath length (24.32 %), flag leaf sheath width (23.35 %), plant height (22.53 %), flag leaf blade width (21.66 %) and finger number per panicle (20.77). Moderate GAM was recorded for days to 50 per cent flowering (18.50 %) followed by finger width (14.08 %) and days to maturity (13.06 %).

Grain yield per plant had significant positive phenotypic correlation with days to 50 per cent flowering (0.93), productive tillers per plant (0.92), plant height (0.89), days to maturity (0.88), thousand grain weight (0.85), flag leaf sheath length (0.77), flag leaf blade length (0.52) and finger width (0.17) (Table 2). Finger number per panicle (-0.75), flag leaf sheath width (-0.81), finger length (-0.80) and flag leaf blade width (-0.52) showed significantly negative phenotypic correlation with grain yield per plant. Positive and significant phenotypic inter-correlation were observed for days to 50 per cent flowering

<table>
<thead>
<tr>
<th>Characters</th>
<th>Range Minimum</th>
<th>Range Maximum</th>
<th>Mean</th>
<th>PCV(%)</th>
<th>GCV(%)</th>
<th>h^2 (BS) (%)</th>
<th>GAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to 50 per cent flowering</td>
<td>58.40</td>
<td>80.18</td>
<td>68.99</td>
<td>9.59</td>
<td>9.28</td>
<td>93.64</td>
<td>18.50</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>61.22</td>
<td>106.01</td>
<td>85.14</td>
<td>13.76</td>
<td>12.26</td>
<td>79.50</td>
<td>22.53</td>
</tr>
<tr>
<td>Productive tillers per plant</td>
<td>5.59</td>
<td>12.83</td>
<td>9.21</td>
<td>23.96</td>
<td>22.74</td>
<td>90.07</td>
<td>44.45</td>
</tr>
<tr>
<td>Flag leaf sheath length (cm)</td>
<td>8.11</td>
<td>14.17</td>
<td>10.62</td>
<td>15.75</td>
<td>13.64</td>
<td>74.96</td>
<td>24.32</td>
</tr>
<tr>
<td>Flag leaf blade length (cm)</td>
<td>0.75</td>
<td>1.22</td>
<td>0.97</td>
<td>14.08</td>
<td>12.63</td>
<td>80.49</td>
<td>23.35</td>
</tr>
<tr>
<td>Flag leaf blade width (cm)</td>
<td>0.81</td>
<td>1.32</td>
<td>1.04</td>
<td>13.03</td>
<td>11.70</td>
<td>80.68</td>
<td>21.66</td>
</tr>
<tr>
<td>Finger number per panicle</td>
<td>6.86</td>
<td>13.41</td>
<td>9.44</td>
<td>15.76</td>
<td>12.61</td>
<td>63.95</td>
<td>20.77</td>
</tr>
<tr>
<td>Finger length (cm)</td>
<td>7.00</td>
<td>12.45</td>
<td>9.13</td>
<td>14.65</td>
<td>13.29</td>
<td>82.19</td>
<td>24.81</td>
</tr>
<tr>
<td>Finger width (mm)</td>
<td>7.30</td>
<td>12.36</td>
<td>9.70</td>
<td>8.89</td>
<td>7.80</td>
<td>76.85</td>
<td>14.08</td>
</tr>
<tr>
<td>Days to maturity</td>
<td>89.76</td>
<td>114.36</td>
<td>100.99</td>
<td>6.72</td>
<td>6.53</td>
<td>94.33</td>
<td>13.06</td>
</tr>
<tr>
<td>Thousand grain weight (g)</td>
<td>1.61</td>
<td>3.29</td>
<td>2.38</td>
<td>18.63</td>
<td>16.39</td>
<td>77.37</td>
<td>29.70</td>
</tr>
<tr>
<td>Grain yield per plant (g)</td>
<td>15.12</td>
<td>45.39</td>
<td>30.24</td>
<td>29.48</td>
<td>28.93</td>
<td>96.27</td>
<td>58.47</td>
</tr>
</tbody>
</table>
with days to maturity, thousand grain weight, productive tillers per plant, flag leaf sheath length, plant height and flag leaf blade length. Phenotypic inter-correlation of plant height were significant and positive with flag leaf sheath length, productive tillers per plant, thousand grain weight, days to maturity and flag leaf blade length. Productive tillers per plant recorded significant positive inter-correlation with four traits namely thousand grain weight, days to maturity, flag leaf sheath length and flag leaf blade length. Three traits namely thousand grain weight, days to maturity and flag leaf blade length showed significant positive inter-correlation with flag leaf sheath length. Positive and significant inter-correlation was observed between flag leaf sheath width with finger number per panicle, finger length and flag leaf blade width. Flag leaf blade length showed positive and significant inter-correlation with two traits namely thousand grain weight and days to maturity. Positive and significant inter-correlation was observed between flag leaf blade width with finger number per panicle and finger length. Finger number per panicle exhibited significant and positive inter-correlation with finger length. Finger width showed significant and positive inter-correlation with thousand grain weight. Significant and positive phenotypic inter-correlation was observed between days to maturity and thousand grain weight.

**DISCUSSION**

Grain yield per plant exhibited the widest range followed by productive tillers per plant, flag leaf blade length and thousand grain weight. Similar to this study, a wide range of variations for grain yield per plant (Narasamha Rao and Parathasarathi, 1968), for productive tillers per plant (Prasada Rao et al., 1994) were reported earlier. The magnitude of PCV was higher than that of GCV for all characters under study it indicated that apparent variation is not only due to genotypes but also due to the influence of environment. Similar reports were earlier reported by Kebere Bezaweletaw et al. (2006). The genotypic and phenotypic coefficients of variation levels were high for grain yield per plant and productive tillers per plant indicating that these characters are more variable in the germplasm. There is a great scope for improvement of this character by direct selection among the genotypes. Similar reports were reported by Dagnachew Lule et al. (2012) and Kebere Bezaweletaw et al. (2006). Heritability estimates were more than 75 per cent for all the characters studied except flag leaf sheath length and finger number per panicle which indicated that these characters were relatively less influenced by environmental conditions and phenotypic selection would be effective for these characters with high probability of success. Similarly high heritability for all the characters studied reported by Nagy et al. (2013), Rakesh Kumar Dhanwani et al. (2013) and Ganapathi et al. (2011). The estimates of heritability help the plant breeder in selection of elite genotypes from divergent population. But heritability itself does not provide any indication towards the amount of genetic progress that would result in selecting best individual; rather it depends upon the amount of genetic advance.

Genetic advance as per cent of mean was high for all characters except days to 50 per cent flowering, finger width and days to maturity. High heritability coupled with high genetic advance as per cent of mean was observed for all characters except days to 50 per cent flowering, finger width and days to maturity. This indicated that most likely the high heritability might be due to additive gene effects and hence, it could be improved by simple selection methods like pureline selection, progeny selection or family selection. High heritability coupled with medium genetic advance as per cent of mean was observed for plant height which indicated the presence of both additive and non additive gene actions for the inheritance of these characters and high genotype x environment interaction. These characters could be improved suitably by modified selection procedure for mixed effects of additive and non additive gene actions like cyclic hybridization followed by selection.
Correlation coefficient helps to differentiate vital associations from those of the non-vital ones. The positive and significant correlation observed between days to 50 per cent flowering, productive tillers per plant, plant height, days to maturity, thousand grain weight, flag leaf sheath length, flag leaf blade length and finger width with grain yield per plant were the important yield components and due weightage should be given on these characters in selection programme for yield improvement in finger millet. In previous studies by Kadam et al. (2009) for days to 50 per cent flowering and thousand grain weight; Shinde et al. (2010) for plant height; Dagnachew Lule et al. (2012) for productive tillers per plant and thousand grain weight have also reported high positive correlations with grain yield per plant. Characters like finger number per panicle, flag leaf sheath width, finger length and flag leaf blade width showed negative and significant correlation with grain yield. Significant negative correlation between these components with grain yield suggested some sort of multiple selection criteria for simultaneous yield improvement through these component traits which would prove useful.

ACKNOWLEDGMENT

The authors would like to acknowledge International Development Research Centre (IDRC) and Canadian International Development Agency (CIDA), Canada for funding the research work.

REFERENCES


