VARIABILITY PARAMETERS IN RABI SORGHUM (SORGHUM BICOLOR L. MOENCH) DROUGHT TOLERANT GENOTYPES

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KEYWORDS
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Heritability
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GCV
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The present study was conducted to assess genetic variability, heritability and genetic advance for grain yield and its component characters in 48 drought tolerant germplasm of \textit{sorghum} (durra type) to provide necessary information that could be useful in \textit{sorghum} improvement programmes aimed at improving grain yield. It was observed that the for grain yield per plant (gm) (35.36), seed vigor (34.11), panicle dry weight per plant (gm) (24.73), stem dry weight per plant (gm) (23.11), total biomass per plant (gm) (18.45), leaf dry weight per plant (gm) (13.77) and plant height (12.29) exhibited high genotypic coefficient of variation. The estimates of heritability in broad sense were high for total biomass per plant (95.1), grain yield per plant (92.5), panicle dry weight per plant (94.7), stem dry weight per plant (92.7), plant height (91.7), SPAD at 50 percent flowering (84.0), relative water content (%) (83.4), days to 50\% flowering (72.3), days to physiological maturity (65.2) and leaf dry weight per plant (68.2).

The highest value of expected genetic advance, expressed as per cent of mean was obtained for grain yield per plant (70.07), seed vigor (56.63), panicle dry weight per plant (49.59), stem dry weight per plant (45.86) and total biomass per plant (37.09). High heritability coupled with high genetic advance and high GCV was observed for grain yield per plant, leaf dry weight per plant, stem dry weight per plant and total biomass per plant indicating that these characters are controlled by additive gene action and phenotypic selection for these characters will be effective. These characters could be improved through pure line selection effectively. Genotypes which exhibited both high variability and heritability along with high genetic advance for certain characters may be evaluated in multi-location trials and isolated as donor for these characters or used as parent in hybrid development programme.

\textbf{INTRODUCTION}

Sorghum (\textit{Sorghum bicolor} L. Moench) is one of the important food crops in the world. It is cultivated in many parts of Asia and Africa, where its grains are used to make flat breads that form the staple food of many cultures.

The productivity of \textit{rabi} \textit{sorghum} in Maharashtra is very low. Efforts are being made to develop the varieties resistant to drought particularly post flowering stress. Advanced breeding lines, land races and promising lines for post flowering drought tolerance of post rainy \textit{sorghum} (\textit{Sorghum bicolor} L.) present in different tracts of \textit{sorghum} growing areas are very good source as donor parent to develop the drought tolerant varieties.

The success of any crop improvement programme not only dependent on the amount of genetic variability present in the population but also on the extent to which it is heritable, which sets the limit of progress that can be achieved through selection (Wankhede, et al., 1985). Genetic variability for agronomic characters therefore is a key component of breeding programmes for broadening the gene pool of crops (Wright, 1968). Heritability is a measure of the phenotypic variance attributable to genetic causes and has predictive function in plant breeding. It provides information on the extent to which a particular morphogenetic character can be transmitted to successive generations. Knowledge of heritability influences the choice of selection procedures used by the plant breeder to decide which selection methods would be most useful to improve the character, to predict gain from selection and to determine the relative importance of genetic effects (Narasimharao et al., 1964). The most important function of heritability in genetic studies of quantitative characters is its predictive role to indicate the reliability of phenotypic value as a guide to breeding value (House, 1985). Characters with high heritability can easily be fixed with simple selection resulting in quick progress. However, it has been accentuated that heritability alone has no practical importance without genetic advance (Mallinath et al., 2004). Genetic advance shows the degree of gain obtained in a character under a particular selection pressure. High genetic advance coupled with high heritability estimates offers the most suitable condition for selection. Mahdy, et al., 2011 reported the limitation of estimating heritability in narrow sense, as it included both additive and epistatic gene effects, and thereby suggested that heritability estimates in the broad sense will be reliable if accompanied by a high genetic advancement. Therefore, availability of good knowledge of these genetic parameters existing in different yield contributing characters and the relative proportion of this genetic information in various quantitative traits is a pre-requisite for effective crop improvement.

The present study was conducted to assess genetic variability, heritability and genetic advance for grain yield and its component characters in 48 drought tolerant germplasm of \textit{rabi} \textit{sorghum} (durra type) to provide necessary information that
could be useful in rabi sorghum improvement programmes aimed at improving grain yield.

**MATERIALS AND METHODS**

48 drought tolerant germplasm of rabi sorghum (durra type) were evaluated for the study of the genetic variability, heritability and genetic advance. The experiment was conducted in complete randomized block design with three replications during rabi 2012 under rainfed condition at Sorghum Research Station, Vasantrao Naik Krishi Vidyapeeth, Parbhani. Each genotype was assigned to a single row per plot of 3 m length in each replication. The row to row and plant to plant distance was kept at 45 and 15 cm, respectively. During sowing only pre-sowing irrigation was applied to ensure proper seed germination. NPK 60:40:00 kg fertilizer was applied at the time of sowing. The all other recommended agronomical practices were followed to raise a good crop. Data were collected on Plant stand, Plant height (cm), Seed vigour, Days 50% flowering, Days to physiological maturity, Total number of leaves per plant, Leaf dry weight per plant (gm), Stem dry weight per plant (gm), panicle dry weight per plant (gm), Relative water content (%), SPAD at 50% flowering, Total biomass per plant (gm), 1000 grain weight, Grain yield per plant (gm). Leaves, panicle and stem were separated from 5 randomly selected plants from each entry, were sun-dried and weighed by electronic balance again to record air-dry weight in grams. Phenotypic and genotypic coefficients of variation were calculated according to Burton (1952). Heritability (hs) and expected genetic advance were estimated according to Burton 1952 and Burton and Devane (1953).

**RESULTS AND DISCUSSION**

Highly significant genotypic differences were observed for all the characters under study. The genotypic coefficient of variation and phenotypic coefficient of variation for various characters studied are presented in Table 2. Since most of the economic characters (grain yield) are complex in inheritance and are greatly influenced by several genes interacting with various environmental conditions, the study of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) is not only useful for comparing the relative amount of phenotypic and genotypic variations among different traits but also very useful to estimate the scope for improvement by selection. The reliability of a parameter to be selected for breeding programme among other factors is dependent on the magnitude of its coefficient of variations (CV) especially the GCV. However, the differences between genotypic and phenotypic coefficient of variability indicate the environmental influence. While a lower value of CV generally depicts low variability among the tested sample; a high proportion GCV to the PCV is desirable in breeding works. The results given in Table 2 depicted that phenotypic variances (ó2p) and PCVs were slightly higher than genetic variances (ó2g) and GCVs for all the characters, suggesting the least influence of environment in the expression of these characters. Similar results have also been reported by (Wankhede, et al., 1985).
It was observed that the grain yield per plant (35.36 gm), seed vigor (34.11), panicle dry weight per plant (24.73 gm), stem dry weight per plant (23.11 gm), total biomass per plant (18.45 gm), leaf dry weight per plant (13.77 gm), and plant height (12.29) exhibited high genotypic coefficient of variation. However, moderate genotypic coefficient of variation was observed for leaf dry weight per plant (13.77 gm), plant height (12.29). Rest of the characters showed low values of genotypic coefficient of variation. On the other hand, phenotypic coefficient of variation also exhibited similar trend of high, moderate and low variations with slightly higher values (Ambekar, et al., 2000). Arum Kumar (2013) also reported high GCV and PCV for grain yield and low GCV and PCV for test weight and days to 50% flowering.

The differences between GCV and PCV were found to be less for all the traits except plant stand. The narrow differences between PCV and GCV suggested their relative resistance to environmental alterations, whereas magnitude of phenotypic coefficient of variation (PCV) was higher than the corresponding genotypic coefficient of variation (GCV) denoting environmental factors influencing their expression to some degree or other (Table 1). The high values of GCV and PCV for grain yield and total biomass suggested that there was a possibility of improvement of grain and fodder yield through direct selection. The estimate of GCV and PCV alone was not much helpful in determining the heritable portion. The amount of advance to be expected from selection can be achieved by estimating heritability along with coefficient of variability. Burton (1952) also suggested that GCV and heritability estimate would give better information about the efficiency of selection. The estimates of heritability in broad sense and expected genetic advance for various characters studied are presented in Table 2. The heritability in broad sense was observed to be moderate to high for total number of leaves per plant (35.9) to 95.1 (total biomass) for all the traits which had significant differences among the accessions. The estimates of heritability in broad sense were high for total biomass per plant (95.1), grain yield per plant (92.5), panicle dry weight per plant (94.7), stem dry weight per plant (92.7), plant height (91.7), SAD at 50 percent flowering (84.0) and relative water content (%) (83.4), days to 50% flowering (72.3), days to physiological maturity (65.2) and leaf dry weight per plant (68.2). Moderate heritability estimates were observed for 1000 grain weight (57.5). The high degree of heritability estimates for most of the traits suggested that the characters were under genotypic control. The highest value of expected genetic advance, expressed as per cent of mean was obtained for grain yield per plant (70.07), seed vigor (56.63), panicle dry weight per plant (49.59), stem dry weight per plant (45.86) and total biomass per plant (37.09) (Godbharle, 2010). Arun Kumar (2013) reported high genetic advance for grain yield. While rest of the characters showed moderate to low values of genetic advance as per cent of mean. High heritability coupled with high genetic advance and high GCV was observed for grain yield per plant, leaf dry weight per plant, stem dry weight per plant and total biomass per plant indicating that these characters are controlled by additive gene action and phenotypic selection for these characters will be effective (Rao, et al., 1996). High heritability coupled with high genetic advance was also reported by Arun Kumar (2013). These characters could be improved through pure line selection effectively. The heritability, which is a ratio of genotypic and phenotypic variance, is mainly due to the additive gene effects in narrow sense, but in the broad sense it includes both additive as well as non additive gene effects. The heritability values estimated in the present study are expressed in broad sense. Broad sense heritability, however gives only a rough estimate. If heritability was mainly due to additive effects, it would be associated with high genetic gain and if it is due to non-additive, genetic gain would be low (Panse, 1957).

Total ten characters namely, total biomass per plant, grain yield per plant, panicle dry weight per plant, stem dry weight per plant, plant height, SAD at 50 percent flowering, relative water content, days to 50% flowering, days to physiological maturity and leaf dry weight per plant showed high heritability. It indicates that these characters were less influenced by the environment. Table 2 revealed that SPAD values at 50% flowering, relative water content, days to physiological maturity and days to 50% flowering showed high heritability. It did not show equally high genetic advance. The characters with high heritability coupled with high genetic advance would respond to selection better than those with high heritability and low genetic advance. On the other hand days to 50% flowering and days to physiological maturity showed low GCV and genetic advance with high heritability indicating non-additive gene effect and for improving these characters heterosis breeding should be followed. Genotypes which exhibited both

<p>| Table 2: Variability, Heritability and expected genetic advance for quantitative characters |
|---------------------------------|----------|----------|--------|--------|--------------------------------|-------------------|</p>
<table>
<thead>
<tr>
<th>Range</th>
<th>Mean</th>
<th>GCV%</th>
<th>PCV%</th>
<th>Heritability</th>
<th>Expected genetic advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant stand</td>
<td>16.33-18.66</td>
<td>17.7</td>
<td>0.625</td>
<td>0.0148</td>
<td>-0.156</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>136-247</td>
<td>199.2</td>
<td>12.29</td>
<td>12.82</td>
<td>0.917</td>
</tr>
<tr>
<td>Seed vigor</td>
<td>1.33-4.66</td>
<td>2.2</td>
<td>34.11</td>
<td>42.32</td>
<td>0.649</td>
</tr>
<tr>
<td>Days 50% flowering</td>
<td>71.66-79.66</td>
<td>75.06</td>
<td>2.89</td>
<td>3.39</td>
<td>0.723</td>
</tr>
<tr>
<td>Days to physiological maturity</td>
<td>112.66-121.33</td>
<td>117.22</td>
<td>1.61</td>
<td>1.99</td>
<td>0.652</td>
</tr>
<tr>
<td>Total number of leaves per plant</td>
<td>6.66-11</td>
<td>9.79</td>
<td>8.27</td>
<td>13.8</td>
<td>0.359</td>
</tr>
<tr>
<td>Leaf dry weight (g/plant)</td>
<td>96.33-184</td>
<td>141.76</td>
<td>13.77</td>
<td>16.68</td>
<td>0.682</td>
</tr>
<tr>
<td>Stem dry weight (g/plant)</td>
<td>272.66-948</td>
<td>658.8</td>
<td>23.11</td>
<td>23.99</td>
<td>0.927</td>
</tr>
<tr>
<td>Panicle dry weight (g/plant)</td>
<td>199.33-829.33</td>
<td>518.36</td>
<td>24.73</td>
<td>25.4</td>
<td>0.947</td>
</tr>
<tr>
<td>Relative water content (%)</td>
<td>39.76-88.56</td>
<td>77.56</td>
<td>9.85</td>
<td>10.78</td>
<td>0.834</td>
</tr>
<tr>
<td>SPAD at 50% flowering</td>
<td>41.33-56.93</td>
<td>50.96</td>
<td>8.24</td>
<td>8.99</td>
<td>0.84</td>
</tr>
<tr>
<td>Total biomass (g/plant)</td>
<td>617.66-1820</td>
<td>1318.89</td>
<td>18.45</td>
<td>18.92</td>
<td>0.951</td>
</tr>
<tr>
<td>1000 grain weight (g)</td>
<td>27.06-39.23</td>
<td>32.68</td>
<td>8.17</td>
<td>10.78</td>
<td>0.575</td>
</tr>
<tr>
<td>Grain yield (g/plant)</td>
<td>11.56-64.00</td>
<td>35.22</td>
<td>35.36</td>
<td>36.76</td>
<td>0.925</td>
</tr>
</tbody>
</table>
high variability and heritability along with high genetic advance for certain characters may be evaluated in multi-location trials and isolated as donor for these characters or used as parent in hybrid development programme.

REFERENCES


