Genetic parameters of some morphological and physiological traits in durum wheat genotypes

(Triticum durum L.)

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In order to estimate the genetic parameters of some morphological and physiological traits in durum wheat, a simple lattice experimental was carried out by using 58 advanced lines and 6 landraces for two years during 2006 to 2008 at the Agriculture Research Station of Islamic Azad University, Tabriz Branch, Iran. In this investigation traits like plant height, stomatal resistance, stoma-density and stoma-dimension in under and over surface of flag leaf; flag leaf area, number of fertile tiller, number of grains/spike, 1000-grain weight, grain yield, biomass, and harvest index were measured. Combined analysis of data for two years showed that there were significant differences, for the traits among the genotypes under study at 1% probability level. Phenotypic correlation coefficients between traits revealed a significant and positive relationship of grain yield with traits such as number of fertile tiller, grains/spike, biomass and harvest index. Estimates of GCV (genetics coefficient variance) showed that, stoma-density and stoma-dimension in under and over surface of flag leaf; grains/spike and grain yields were high, as compares other traits. Also estimates of broad sense heritability showed that, traits such as plant height, stomatal resistance, stoma-density and stoma-dimension in under and over surface of flag leaf; and grains/spike were high, as compares other traits; but for traits like grain yields, biomass, harvest index and number of fertile tiller was moderate.

Key words: Durum wheat, genetic variance, genetic coefficient variance, broad sense heritability.

INTRODUCTION

The development of high yielding wheat cultivars is a major objective in breeding programs (Ehdaie and Waines, 1989). The genetic variation for the trait under selection and a higher heritability are necessary to have response to selection (Falconer and Mackay, 1996). Breeding programs depend on the knowledge of key traits, genetic systems controlling their inheritance, genetic and environmental factors that influence their expression (Kashif et al., 2003; Ali and Awan, 2009; Mohammadi et al., 2010). The study of statistical parameters like mean, variance, CV%, habitability and genetic advance is a measure to evaluate genetic potential, diversity and stability performance of any genotype for effective selection of particular traits in that genotype (Firouzian, 2003; Ali et al., 2009). Determination of correlation coefficients between various traits helps to obtain best combinations of attributes in crop for obtaining higher return per unit area.

Several researchers reported positive correlation of grain yield with plant height (Silva et al., 1998; Dokuyueu and Akkaya, 1999), number of seeds/spike (Feil, 1992; Calderini et al., 1995; Silva et al., 1998; Dokuyueu and...
Table 1. Combined analysis of traits in durum wheat genotypes based on RCB design.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>1</td>
<td>0.138**</td>
<td>0.002**</td>
<td>0.038**</td>
<td>0.022**</td>
<td>0.609**</td>
<td>2277.16</td>
<td>2277.16</td>
<td>0.0151</td>
<td>0.002**</td>
<td>0.002**</td>
<td>0.002**</td>
<td>0.002**</td>
<td>0.002**</td>
<td>0.002**</td>
</tr>
<tr>
<td>Error A</td>
<td>2</td>
<td>0.047</td>
<td>4.919</td>
<td>1.370</td>
<td>0.095</td>
<td>0.004</td>
<td>456.73</td>
<td>10184.62</td>
<td>14.26</td>
<td>1720081.94</td>
<td>529.71</td>
<td>670.43</td>
<td>35080.72</td>
<td>591.87</td>
<td>36.78**</td>
</tr>
<tr>
<td>Genotypes</td>
<td>63</td>
<td>0.168**</td>
<td>20.571**</td>
<td>56.347**</td>
<td>1.108**</td>
<td>1.561**</td>
<td>65.74**</td>
<td>377.44**</td>
<td>1.29**</td>
<td>1.29**</td>
<td>204.39</td>
<td>19.39</td>
<td>1219.67</td>
<td>35.71</td>
<td>1.29**</td>
</tr>
<tr>
<td>Years × genotypes</td>
<td>63</td>
<td>0.028**</td>
<td>0.014**</td>
<td>0.022**</td>
<td>0.008**</td>
<td>0.003**</td>
<td>38.58**</td>
<td>23.39</td>
<td>0.51**</td>
<td>22910.66</td>
<td>27.37</td>
<td>19.39</td>
<td>1219.67</td>
<td>35.71</td>
<td>1.29**</td>
</tr>
<tr>
<td>Error B</td>
<td>126</td>
<td>0.083</td>
<td>1.266</td>
<td>1.758</td>
<td>0.285</td>
<td>0.398</td>
<td>21.70</td>
<td>22.52</td>
<td>9.73</td>
<td>15235.63</td>
<td>67.00</td>
<td>14.51</td>
<td>885.10</td>
<td>35.71</td>
<td>1.29**</td>
</tr>
<tr>
<td>C.V.%</td>
<td>-</td>
<td>29.56</td>
<td>14.33</td>
<td>12.77</td>
<td>26.80</td>
<td>23.04</td>
<td>23.39</td>
<td>7.73</td>
<td>23.78</td>
<td>532.07</td>
<td>29.31</td>
<td>26.91</td>
<td>1502.72</td>
<td>35.71</td>
<td>1.29**</td>
</tr>
</tbody>
</table>

ns, · and -: non significant, significant at 0.05 and 0.01 of probability levels respectively.

Akkaya, 1999), number of tillers (Sedgley, 1991; Reynolds et al., 1999; Silva et al., 1998; Dokuyueu and Akkaya, 1999), grain weight (Hucl and Baker, 1987; Nabi et al., 1998; Amar, 1999; Shah et al., 1999) and harvest index (Feil, 1992 and Reynolds et al., 1994) both at genotypic and phenotypic levels in wheat. Ehdaije and Waines (1899) reported moderate to high heritability for developmental and quantitative traits in Iranian wheat landraces. Several researchers obtained the value of grain yield heritability to be low (Zaheer and Ahmad, 1991; Fida et al., 2001; Aycicek and Yildirim, 2006), but some authors reported moderate values of grain yield heritability in wheat (Moghaddam et al., 1997). Sharma and Sharma (2007) reported high heritability values for grain yield/plant also they were estimated high GCV (genetic coefficient of variation), broad sense heritability and relationships of traits with yield in durum wheat genotypes under environmental conditions of Tabriz, Iran.

**MATERIALS AND METHODS**

Sixty-four durum genotypes (58 exotic and 6 locals' genotypes) were included in this study. This experiment was conducted using a simple lattice (8 x 8) at Research Station of Tabriz Islamic Azad University, Iran, during 2006 to 2008 growing seasons. Each plot consisted of a three row with 20 and 5 cm between and within rows respectively. All agronomic works in plots were similar. In this research several traits including plant height, stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; flag leaf area, number of fertile tiller, number of grains/spike, 1000-grain weight, grain yield, biomass, and harvest index were measured. Combined analysis of variance was computed for two years based on complete randomized block design (because the lattice analysis has not efficiency for any traits). Mean comparisons were made using LSD test at 5% probability level. The phenotypic variance (σ²p) will be constituted basically by three components:

\[ \sigma^2_p = \sigma^2_G + \sigma^2_E + \sigma^2_{GE} \]

Here, σ²G is the variance of genetic effect, σ²E is the environmental variance and σ²GE is the variance of genotype × environmental interaction effects. Broad sense heritability of traits was computed by using expected value of variance (E (MS)) and equation of

\[ h^2 = \frac{\sigma^2_G}{\sigma^2_p} \]

that in these equation h² is the heritability.

**RESULTS AND DISCUSSION**

Combined analysis of variance showed that, values of F-test were significant for all of traits at 1% probability level (Table 1). This indicates that...
Table 2. Ranges, total means, LSD5% and traits means of superior lines in durum wheat genotypes.

<table>
<thead>
<tr>
<th>Traits</th>
<th>Range</th>
<th>Total mean</th>
<th>Superior line</th>
<th>LSD5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>33</td>
<td>55</td>
</tr>
<tr>
<td>Somatal resistance.</td>
<td>0.40 to 1.40</td>
<td>0.91</td>
<td>1.11</td>
<td>0.83</td>
</tr>
<tr>
<td>Somat density in under F. L.</td>
<td>2.16 to 13.55</td>
<td>7.58</td>
<td>10.05</td>
<td>6.30</td>
</tr>
<tr>
<td>Somat density in over F. L.</td>
<td>1.50 to 16.10</td>
<td>10.38</td>
<td>13.45</td>
<td>11.26</td>
</tr>
<tr>
<td>Somat dimensione in under F. L.</td>
<td>1.55 to 4.55</td>
<td>2.35</td>
<td>2.40</td>
<td>2.40</td>
</tr>
<tr>
<td>Somat dimensione in over F. L.</td>
<td>1.60 to 3.98</td>
<td>2.73</td>
<td>1.62</td>
<td>2.32</td>
</tr>
<tr>
<td>Flag leaf area (cm$^2$).</td>
<td>11.31 to 30.56</td>
<td>19.92</td>
<td>18.39</td>
<td>15.97</td>
</tr>
<tr>
<td>Plant height (cm).</td>
<td>50.05 to 110.5</td>
<td>61.40</td>
<td>57.65</td>
<td>61.53</td>
</tr>
<tr>
<td>Number of fertile tiller.</td>
<td>3.02 to 6.40</td>
<td>3.59</td>
<td>4.13</td>
<td>3.03</td>
</tr>
<tr>
<td>Grains/spike.</td>
<td>19.34 to 52.70</td>
<td>32.95</td>
<td>47.76</td>
<td>33.51</td>
</tr>
<tr>
<td>1000 grain weight (g).</td>
<td>32.09 to 47.70</td>
<td>42.60</td>
<td>44.45</td>
<td>43.26</td>
</tr>
<tr>
<td>Grain yield (g).</td>
<td>47.09 to 160.5</td>
<td>92.52</td>
<td>160.50</td>
<td>156.41</td>
</tr>
<tr>
<td>Biomass (g).</td>
<td>306.16 to 850.02</td>
<td>481.75</td>
<td>575.45</td>
<td>550.28</td>
</tr>
<tr>
<td>Harvest index.</td>
<td>9.86 to 32.80</td>
<td>19.98</td>
<td>28.58</td>
<td>27.55</td>
</tr>
</tbody>
</table>

The genetic variance, heritability and genetic CV% showed that there were differences between of traits in durum wheat (Table 3). Heritability estimates showed that broad sense heritability of traits such as stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; plant height, grains/spike and 1000-grain weight were higher than those of other characters. Broad sense heritability of grain yield, biomass, harvest index, fertile tiller and leaf area was moderate (Table 3). The heritability of grain yield and yield components in this study were generally moderate. These results supported by Moghaddam et al. (1997), but heritability value estimated by Zaheer and Ahmad (1991) and Fida et al. (2001) were low. Whereas Sharma and Sharma (2007) reported high heritability values for grain yield/plant and Ajmal et al. (2009) found high broad sense heritability values of plant height, tillers per plant, grains per spike and grain yield with values 0.94, 0.98, 0.92 and 0.91 respectively, and was low in case of number of spikelets per spike (0.24). Estimates of GCV (genetic coefficient of variation) showed that stoma-density and stomata-dimensions in under and over surface of flag leaf, spike length, grains/spike and grain yields were high, as compares other traits. So it was showed that genetic diversity in durum wheat for these traits were high as compared as other traits.

Sharma and Sharma (2007) were estimated high GCV for number of effective tillers, grain yield/plant, harvest index and 1000-grain weight.

Conclusion

Heritability estimates showed that broad sense heritability of traits such as stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; plant height, grains/spike and 1000-grain weight were high, but heritability of traits such as grain yield, biomass, harvest index, fertile tiller and leaf area were moderate. Generally in this research, genetic parameters for the traits was reasonable as expected, because this experiment was conducted for two consecutive years and also evaluation of genotypes was based on genetics variance. Moderate heritability and low G × E interactions indicate that yield and yield components of durum wheat can be improved by pure line selection.

ACKNOWLEDGEMENTS

The author acknowledged Dr. H. Kazemi Arbat, for reviewing the manuscript and Dr. M. Yarnia, Dr. A. R. Tarinajad and other cooperators for their recommendations during research.
Table 3. Phenotypic, genetic and environmental variances; Phenotypic and genetic SD and CV and heritability of traits in durum wheat.

<table>
<thead>
<tr>
<th>Genetic parameter</th>
<th>Stomatal resistance</th>
<th>Stomata-density in under F. L.</th>
<th>Stomata-density in over F. L.</th>
<th>Stomata-dimension in under F. L.</th>
<th>Stomata-dimension in over F. L.</th>
<th>Flag leaf area</th>
<th>Plant height</th>
<th>Number of fertile tiller</th>
<th>Biomass</th>
<th>Number of grains/spike</th>
<th>1000 grain weight</th>
<th>Grain yield</th>
<th>Harvest index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenotypic variance</td>
<td>0.042</td>
<td>5.142</td>
<td>14.086</td>
<td>0.277</td>
<td>0.390</td>
<td>16.43</td>
<td>94.36</td>
<td>0.32</td>
<td>11028.66</td>
<td>51.09</td>
<td>18.08</td>
<td>748.19</td>
<td>19.09</td>
</tr>
<tr>
<td>Genetic variance</td>
<td>0.035</td>
<td>5.139</td>
<td>14.081</td>
<td>0.275</td>
<td>0.389</td>
<td>6.79</td>
<td>82.76</td>
<td>0.19</td>
<td>5300.99</td>
<td>44.16</td>
<td>13.23</td>
<td>443.27</td>
<td>9.92</td>
</tr>
<tr>
<td>Environmental variance</td>
<td>0.007</td>
<td>0.003</td>
<td>0.005</td>
<td>0.002</td>
<td>0.001</td>
<td>9.64</td>
<td>11.60</td>
<td>0.13</td>
<td>5727.67</td>
<td>6.93</td>
<td>4.85</td>
<td>304.92</td>
<td>9.17</td>
</tr>
<tr>
<td>Broad sense heritability</td>
<td>0.83</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
<td>0.41</td>
<td>0.87</td>
<td>0.59</td>
<td>0.48</td>
<td>0.86</td>
<td>0.73</td>
<td>0.59</td>
<td>0.51</td>
</tr>
<tr>
<td>Phenotypic SD</td>
<td>0.20</td>
<td>2.26</td>
<td>3.76</td>
<td>0.52</td>
<td>0.62</td>
<td>4.05</td>
<td>9.71</td>
<td>0.56</td>
<td>105.01</td>
<td>7.14</td>
<td>4.25</td>
<td>27.35</td>
<td>4.36</td>
</tr>
<tr>
<td>Genetic SD</td>
<td>0.18</td>
<td>2.26</td>
<td>3.75</td>
<td>0.52</td>
<td>0.62</td>
<td>2.60</td>
<td>9.09</td>
<td>0.43</td>
<td>72.80</td>
<td>6.64</td>
<td>3.63</td>
<td>21.05</td>
<td>3.14</td>
</tr>
<tr>
<td>Phenotypic CV%</td>
<td>21.97</td>
<td>29.81</td>
<td>36.12</td>
<td>22.12</td>
<td>22.71</td>
<td>20.33</td>
<td>15.81</td>
<td>11.97</td>
<td>15.11</td>
<td>20.15</td>
<td>8.52</td>
<td>22.75</td>
<td>15.71</td>
</tr>
<tr>
<td>Genetic CV%</td>
<td>19.78</td>
<td>29.81</td>
<td>36.12</td>
<td>22.12</td>
<td>22.71</td>
<td>13.05</td>
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<td>22.75</td>
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REFERENCES


