Heritability of yield and yield components in hexaploid wheat

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ABSTRACT

The present study was conducted to estimate the heritability and genetic advance of yield and yield components in wheat. Seven F2 and their parents were selected for the experiment. Data were collected for plant height, number of tillers per plant, spike length, number of spikelets per spike, number of grains per spike, 1000-grain weight and yield per plant. The result indicated that maximum heritability and genetic advance were observed in plant height, number of grains per spike and 1000-grains weight. The result suggested that these characters are highly transferred to the next generation and improvement can be obtained by the further selection as additive gene action is observed.

Keywords: Hexaploid wheat (Triticum aestivum L.), heritability, yield, yield components

INTRODUCTION

Wheat is the main grain crop in the world which provides food 36% of the world population. Due to increasing shortage of water resources and climatic changes, wheat production is greatly influenced (Singh and Chaudhry, 2006). As increasing population and changing circumstances in Pakistan, the breeder needs further breakthrough in this food crop.

Wheat yield is associated with the number of spikes per unit area, number of grains per spike and grain weight. Its increase is the major factor that cause increase in yield. Yield and yield component traits are polygenic in nature whose expression is highly affected by environments (Ahmad et al., 2007). Therefore, heritability provides information about index of transmission of yield and yield related components for successful crop breeding. The magnitude of heritability and genetic advance helps in predicting the behavior of succeeding generations for appropriate selection criteria and precise view of segregating generations for possible selection. The higher the heritability estimates becomes the simpler the selection procedure. Therefore, the genetic studies on wheat were done to calculate the heritability and genetic advance of yield and yield related components.
Table 1. variances and coefficient of variability.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Plant height</th>
<th>spike length</th>
<th>Tillers per plant</th>
<th>Spikelets per spike</th>
<th>Grain per spike</th>
<th>1000-grain weight</th>
<th>Yield per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>var cv.%</td>
<td>var cv.%</td>
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</tr>
<tr>
<td>DN-1 X FARID-2006</td>
<td>275.99 15.56</td>
<td>1.52 8.54</td>
<td>9.20 28.61</td>
<td>5.61 12.05</td>
<td>49.57 13.06</td>
<td>40.72 13.95</td>
<td>40.72 13.95</td>
</tr>
<tr>
<td>DN-47 X SAHAR-2006</td>
<td>306.09 16.21</td>
<td>1.19 8.97</td>
<td>5.05 18.73</td>
<td>3.95 10.74</td>
<td>67.88 14.48</td>
<td>37.15 13.51</td>
<td>26.27 22.04</td>
</tr>
<tr>
<td>DN-51 X FARID-2006</td>
<td>34.83 5.77</td>
<td>1.22 8.37</td>
<td>11.89 24.63</td>
<td>2.77 8.92</td>
<td>77.52 18.96</td>
<td>11.19 7.02</td>
<td>27.55 18.82</td>
</tr>
<tr>
<td>DN-49 X - SAHAR 2006</td>
<td>177.69 12.42</td>
<td>3.31 14.66</td>
<td>11.14 26.18</td>
<td>4.68 10.28</td>
<td>38.79 11.33</td>
<td>57.31 15.59</td>
<td>34.40 20.73</td>
</tr>
</tbody>
</table>

Table 2. Heritability and genetic advance.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Plant height</th>
<th>spike length</th>
<th>Tillers per plant</th>
<th>Spikelets per spike</th>
<th>Grain per spike</th>
<th>1000-grain weight</th>
<th>Yield per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>h²% G.A.</td>
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<td>h²% G.A.</td>
<td>h²% G.A.</td>
</tr>
<tr>
<td>DN-1 X SAHAR-2006</td>
<td>87.98 11.98</td>
<td>70.13 1.59</td>
<td>60.14 2.64</td>
<td>67.60 2.10</td>
<td>58.59 8.72</td>
<td>68.79 5.59</td>
<td>55.61 5.00</td>
</tr>
<tr>
<td>DN-1 X FARID-2006</td>
<td>98.25 28.64</td>
<td>61.17 1.33</td>
<td>69.28 3.69</td>
<td>58.41 2.43</td>
<td>80.85 9.99</td>
<td>67.85 7.60</td>
<td>79.83 13.4</td>
</tr>
<tr>
<td>DN-47 X CHAKWAL-86</td>
<td>95.82 28.32</td>
<td>64.87 1.48</td>
<td>72.94 4.00</td>
<td>64.94 2.08</td>
<td>69.94 10.52</td>
<td>65.10 6.11</td>
<td>54.58 5.39</td>
</tr>
<tr>
<td>DN-47 X SAHAR-2006</td>
<td>96.78 29.72</td>
<td>61.39 1.17</td>
<td>64.32 2.54</td>
<td>66.49 2.32</td>
<td>75.70 10.95</td>
<td>84.51 9.04</td>
<td>61.22 5.51</td>
</tr>
<tr>
<td>DN-51 X FARID-2006</td>
<td>76.81 7.96</td>
<td>68.28 1.32</td>
<td>72.97 4.42</td>
<td>63.84 1.86</td>
<td>61.56 9.51</td>
<td>64.29 3.77</td>
<td>65.40 6.02</td>
</tr>
<tr>
<td>DN-47 X FARID-2006</td>
<td>92.27 15.72</td>
<td>72.85 2.01</td>
<td>62.47 3.34</td>
<td>54.87 1.86</td>
<td>67.21 7.21</td>
<td>54.71 3.03</td>
<td>53.34 5.10</td>
</tr>
<tr>
<td>DN-49 X - SAHAR 2006</td>
<td>87.76 20.53</td>
<td>88.68 2.83</td>
<td>60.63 3.55</td>
<td>68.61 2.61</td>
<td>65.52 7.16</td>
<td>65.04 8.64</td>
<td>66.60 6.85</td>
</tr>
</tbody>
</table>

Where:
- $h^2$ = heritability
- $\sigma^2$ = The phenotypic standard deviation
- $i$ = Constant value that reflects the selection intensity.
- $G.A. = \sigma F_2 \times h^2 \times i$

RESULTS AND DISCUSSION

The variances and co-efficient of variability are presented in Table 1. Plant height, number of tillers per plant, number of grains per spike and yield per plant have high co-efficient of variability indicating a wide range of variation. Similarly, spike length, number of spikelets per spike and 1000-grains weight have low coefficient of variability suggesting that there is a little variation in these characters.

Broad sense heritability for plant height ranged from 76.81 to 98.25%. The value of genetic advance ranged from 11.98 to 29.72 (Table 2). The highest value of heritability 98.25% was found in cross combination DN-1 × Farid-2006 having the value of genetic advance 28.64. Transgressive segregation...
with high heritability and genetic advance for plant height indicated that genetic variability was present in the F2 population in reasonable quantities which could imply that different plant height level can be effectively selected from these cross combinations. The result obtained through the present research is in agreement with the finding reported earlier by Rafi et al. (2007), Ali et al. (2008), Ajmal et al. (2009) and Mohsin et al. (2009).

Spike length is an important character as it contributes to the grain yield. As the spike length increases the number of grains per spike also increases ultimately increasing the yield. The highest value of heritability 88.68% was found in cross combination DN-49 × Saher-2006 having the value of genetic advance 2.83. Spike length has high heritability with low genetic advance indicating that these characters are influenced by environment. Hence, selection for such character should be carefully done. The results are in accordance with findings reported earlier by Ali et al. (2008), Eid (2009), Mohsin et al. (2009) and Laghari et al. (2010). For number of spikelets per spike, the highest value of heritability 68.61% was found in cross combination DN-49 × Saher-2006 having the value of genetic advance 2.61. These results are verified earlier by Rafi et al. (2007), Ali et al. (2008) and Mohsin et al. (2009). The highest value of heritability 72.97% was found in cross combination DN-51 × Farid-2006 having the value of genetic advance 4.42 for number of tillers per plant. These results are earlier verified by Rafi et al. (2007), Shar et al. (2007) and Ajmal et al. (2009).

For number of grains per spike, highest value of heritability 80.85% was found in cross combination DN-1 × FARID-2006 having the value of genetic advance 9.99. These results are earlier verified by Ahmed et al. (2007), Memon et al. (2007), Ali et al. (2008), Waqar et al. (2008) and Ajmal et al. (2009).

For 1000 grains weight, the highest value of heritability 84.51% was found in cross combination DN-47 × Saher-2006 having the value of genetic advance 9.04. These results are earlier verified by Dhayal et al. (2003), Firozian et al. (2003), Katiyar (2003) and Khan et al. (2003).

The highest value of heritability 79.83% was found in cross combination DN-1 × Farid-2006 having the value of genetic advance 13.40 for yield per plant. These results were earlier verified by Ali et al. (2008), Waqar et al. (2008), Ajmal et al. (2009), Mohsin et al. (2009) and Laghari et al. (2010).

Number of tillers per plant, number of grains per spike, 1000 grains weight and yield per plant has high heritability with medium genetic advance indicating that these characters are little influenced by environment and additive gene action is present. Hence, selection for these characters for further breeding program ultimately improve the yield.

Over all, crosses, DN-1× Farid-2006, DN-47 × Chakwal-86 and DN-47 × Seher-2006 have better results. So selection of these crosses for yield components traits in successive generation will improve the grain yield.

CONCLUSION

Among all the studied traits, plant height and number of grains per spike showed maximum variability. Progenies had high heritability percentage in broad sense (h2) and high genetic advance (G.A) for plant height, spike length while other traits showed less than 70% but more than 55% heritability. These results further portrayed that these progenies showed genetic improvement in terms of more heritability percentage in broad sense (h2) and genetic advance possess better potential to transfer the heritable traits; therefore could be effectively used to select the superior hybrid plants with desirable genes in successive generations. The information generated through this study will be obviously useful to breeders for future breeding keeping in view the selection of promising lines endowed with better yield potential, good quality and tolerance/resistance to biotic and abiotic stresses.

REFERENCES


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