Evaluation of different wheat genotypes for yield assessment under irrigated conditions of highlands of Balochistan.

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ABSTRACT
Wheat, across the world including Pakistan has the greatest cultivation ratio as a crop cereal. An experiment was conducted at Balochistan Agriculture College, Quetta during the year 2013-14. Ten advanced lines and two local check varieties of wheat were evaluated for yield assessment under irrigated condition of highlands of Balochistan. The genotype AZRI-49 performed best in four yield traits viz; number of tillers per m², number of spikelets per spike, total dry matters ha-1 and grain yield ha-1. Data was statistically analyzed by using Fisher’s technique of analysis of variance and the means of different treatments were tried at Least Significant Test (LSD) at 5% probability level. Correlation studies revealed that positive significant correlation was observed between grain yield ha-1 and plant height, grain yield ha-1 and number of tillers m-2, grain yield ha-1 and 1000-grain weight, grain yield ha-1 and total dry matters ha-1 whereas negative significant correlation was observed between grain yield ha-1 and spike length, grain yield ha-1 and number of grains spike-1 and also grain yield ha-1 and grain weight spike-1. Present study could be conducive for the development of improved variety in highland Balochistan.

INTRODUCTION
All over the world, including Pakistan, wheat is among the most significant of the cereal crops in terms of production. It is being grown on more than 240 million hectares and most leading important food grain source for humans (Lumpkin, 2009). To meet this growing demand, the world wide average grain yield should enhance from the existing 2.5 t/ha to 3.8 t/ha (Rajaram, 1999). Yield levels and grain having a better quality have a vital role in the prosperous, economic cultivation and market value of wheat. The focus on the quality of wheat program tends to promote grain yield because its economically very important character but it is one of the most complex characters. (Akramet al., 2008).

Mirza et al., (2003) suggested that improvement in yield up to 50% has been fulfilled by the entry of new extra yielding cultivars in Pakistan. In Balochistan, wheat is among the most significant crop also staple food of province people’s like the rest of the country (Khan et al., 2011). It is cultivated in Balochistan on an area of 340,778 hectares and the share of irrigated areas is 305,310 hectares with an average yield 2256 Kgs ha-1. The wheat cultivation in highlands of Balochistan especially Quetta District chip in 2700 and 400 hectares for irrigated and rainfed areas respectively, with an average yield 2,075 Kgs ha-1 and 1120 Kgs ha-1 respectively (Anonymous, 2010-11). Balochistan was confronting food scarcity. It requires 9,00,000 metric tons of wheat per annum so as to feed its 6.8 million of population. The Researchers have developed many wheat varieties, which have tremendous yield potential with four agro-ecological zones of both for plains and uplands in the province. But these Local varieties could not satiate the requisite of province for long time due to adulteration and heterozygosity. Balochistan needs 33,000 metric tons of quality seeds annually. But it gets only 4,000MT of certified seeds from various sources and the rest is acquired by farmers on their own previous produce seed because there is no seed producing corporation in the province. A
long-term strategy is needed to be devised to make the province self-reliant in wheat.

Most researchers have always a high desire to identify genotypes which could give higher yield across environments. Grain yield being a polygenic character shows association with a number of characters and these characters are greatly influenced by variant atmospheric factors. Thus, extensive research is needed to promote like cultivars that may produce high yield in various climatic zones (Khan et al., 2012). The focus on wheat quality program is to enhance grain yield. Such program so as to enhance yield asks for awareness on its material of origin regarding variation for yield and yield promoting factor, which further contributes to the role of breeder in improvement of the selection criteria. Therefore, researchers explored variation for yield and its promoting factors in wheat (Karim and Jahan, 2013). The focus of present study was to check out performance of advanced genotypes and to investigate their yield stability under irrigated conditions of upland Balochistan.

Materials and Methods

This study was mainly conducted for the evaluation of different advanced wheat genotypes for yield assessment in experimental field area of Balochistan Agriculture College, Quetta during 2013-14. The experiment was laid out under Randomized Complete Block Design (RCBD) with three replications. The Spacing between rows was kept 25 cm and each plot had 5m length and 4 rows allocated for each entry. The Seed of each entry was planted by hand drill at the rate of 120kg/ha. First weeding was conducted for a period of 35 days after it emerged and second weeding was done at heading emergence. Neither herbicides nor insecticides were applied but the fertilizer Nitrophose and DAP were applied @ 34 and 30 kg/ha respectively. Normal irrigation doses were applied to each experimental unit as recommended for wheat crop. All necessary data were recorded for important parameters i.e. days to 50% heading, days to maturity, plant height (cm), spike length (cm), number of tillers m⁻², number of spikelets spike⁻¹, number of grains spike⁻¹, grain weight spike⁻¹ (g), 1000-grain weight (g), total dry matters (kg ha⁻¹) and grain yield (kg ha⁻¹). The experimental germplasm was obtained from Balochistan Agriculture Research and Development Centre (BARDC) with their codes (Table 2). The data thus collected were subjected to analysis of variance (ANOVA) technique as given by Steel et al. (1997) were statistically analyzed through (Statistix-10) computer software. The difference among the treatment means was compared by the Fisher least significant difference (LSD) test at 0.05 P-value and correlation coefficient was work out after Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Analysis of variance (Table 3) reveals that there were highly significant differences among the genotypes for days to 50% heading, plant height (cm), number of tillers per meter square, number of grains per spike, grain weight per spike, 1000-grain weight (g), total dry matters (kg ha⁻¹) and grain yield (kg ha⁻¹) but significant results were observed for days to maturity, spike length (cm) and number of spikelets per spike.

Days to 50% heading

Data concerning days to 50% heading indicated that differences among wheat genotypes were significant (Table 3). Mean of data disclosed (Table 4) that maximum days to heading for 50% was taken by genotype AZRI-46 (170.67) followed by AZRI-50 (170.67) while minimum days to 50% heading was recorded for AZRI-41 (156.33). The data in regards to correlation coefficient showed that grain yield and days to 50% heading association was positive and non significant (Table 5). Similar findings were confirmed by past researchers; Bukhtet al. (2007), Ahmad et al. (2013), Khan et al. (2012) and Naveed et al. (2014) while these results contradict with the findings of Rehmanet al. (2010).

Days to maturity

Data relating to days to maturity are shown in (Table 3). Statistical analysis of variance for days to maturity indicated that differences among the wheat genotypes were significant at (P ≤ 0.05). Mean of the data (Table 4) revealed that maximum days to maturity was taken by genotype AZRI-50 (208.67) while minimum days to maturity was observed for AZRI-41 (203.67). Correlation studies showed that days to maturity and grain yield interrelationship was negative and non significant (Table 5). These results are in accordance with the findings of Akram et al. (2008), Inamullahet al. (2011), khan et al. (2012) and Rehmanet al. (2010), while these results
contradict with the investigations of Ali et al. (2007).

**Plant height (cm)**

Statistical analysis of plant height indicated that differences among the wheat genotypes were significant at (P ≤ 0.05). Mean values in (Table 4) revealed that maximum plant height was gained by genotype AZRI-48 (92.130), followed by genotype Zardana-92 (90.220) whereas minimum plant height was attained by AZRI-43 (77.807). There was a positive significant (r= 0.4378*) interrelationship was observed (Table 5) between grain yield and plant height. It is indicated that with increasing plant height, the grain yield ha\(^{-1}\) will also increase significantly. The results concur with Ali et al. (2007), Mahpara et al. (2008), Manal et al. (2009), Al-Otayk (2010), Mushqaet al. (2011), and Hussain et al. (2013), while these results oppose with the findings of Naveed et al. (2014) and Hossain et al. (2009).

**Spike length (cm)**

Spike length of wheat is the contingent of more grains eventually leads to high yield. Statistical data analysis of spike length (Table 3) indicated that differences among the wheat genotypes were significant at P < 0.05. Mean of the data (Table 4) revealed that maximum spike length (cm) was recorded for genotype Zardana-92 (9.74), followed by genotype AZRI-46 (9.70). Minimum spike length (cm) was observed for AZRI-47 (7.85). Correlation studies (Table 5) suggested that grain yield and spike length relationship was non significant. Similar findings have been conveyed by Ubaidullah et al. (2007), Farooq et al. (2010), Ajmalet al. (2011), Shabbiret al. (2011), Laejet al. (2012), Karim and Jahan (2013) while these results deny the findings of Ali et al. (2007).

**Number of tillers per m\(^2\)**

Number of tillers per m\(^2\) is indicating that plant population exhibits per unit area, statistical analysis of number of tillers per m\(^2\) (Table 3) indicated that differences among the wheat genotypes were significant at P < 0.05. Mean of data (Table 4) revealed that maximum number of tillers per m\(^2\) was recorded for AZRI-49 (487.00), followed by genotype AZRI-48 (443.67) while least minimum number of tillers per m\(^2\) was observed for AZRI-45 (270.33). These two parameters (grain yield and number of tillers per meter square) were positive and highly significantly correlated with each other (0.6246**), showing that as the number of tillers per meter square increases, the grain yield per hectare will also increase significantly. Comparable results have also been reported by Shah et al. (2007), Hossain et al. (2009), Tahir et al. (2009), Lagharet et al. (2011), Karim and Jahan (2013).

**Number of spikelets per spike**

Number of spikelets per spike has paramount importance in economical yield of wheat crop. Data concerning number of spikelets spike\(^{-1}\) are presented in (Table 3) indicated that differences among the wheat genotypes were significant at P < 0.05. Mean data (Table 4) revealed that maximum number of spikelets spike\(^{-1}\) was recorded for genotype AZRI-49 (17.267), followed by AZRI-41 (17.133). Minimum number of spikelets spike\(^{-1}\) was recorded for AZRI-47 (13.933). Correlation studies indicate that grain yield and number of spikelets spike\(^{-1}\) interrelationship was negative and non significant. These results are agreed with Farooq et al. (2006), Said et al. (2007), Hossain et al. (2009), Shabbiret et al. (2011), Karim and Jahan (2013), while these results are contradict with the findings of Ali et al. (2007).

**Number of grains spike\(^{-1}\)**

Data relating to number of grains spike\(^{-1}\) indicated that differences among the wheat genotypes were significant at P < 0.05. Mean of the data revealed that maximum number of grains spike\(^{-1}\) was recorded for genotype AZRI-45

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### Table 1: Monthly average weather data for the site during growing season

<table>
<thead>
<tr>
<th>Months</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Relative</th>
<th>Total</th>
</tr>
</thead>
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<tr>
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<td>18.41</td>
<td>21.56</td>
<td>17.77</td>
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<tr>
<td>Dec 2013</td>
<td>0.29</td>
<td>15.11</td>
<td>19.11</td>
<td>0.5</td>
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<tr>
<td>Jan 2014</td>
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<td>22.78</td>
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</tr>
<tr>
<td>Feb 2014</td>
<td>0.56</td>
<td>12.24</td>
<td>27.79</td>
<td>35.04</td>
</tr>
<tr>
<td>Mar 2014</td>
<td>4.99</td>
<td>17.96</td>
<td>23.33</td>
<td>77.7</td>
</tr>
<tr>
<td>Apr 2014</td>
<td>11.09</td>
<td>24.72</td>
<td>18.29</td>
<td>30.45</td>
</tr>
<tr>
<td>Ma 2014</td>
<td>15.46</td>
<td>29.02</td>
<td>16</td>
<td>46.13</td>
</tr>
</tbody>
</table>

Source: BARDC Metrological Data Unit.

### Table 2: Name of genotypes being studied in experiment

<table>
<thead>
<tr>
<th>No</th>
<th>Genotype</th>
<th>No</th>
<th>Genotype</th>
<th>No</th>
<th>Genotype</th>
<th>No</th>
<th>Genotype</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>AZRI-41</td>
<td>4</td>
<td>AZRI-44</td>
<td>7</td>
<td>AZRI-47</td>
<td>10</td>
<td>AZRI-50</td>
</tr>
<tr>
<td>2</td>
<td>AZRI-42</td>
<td>5</td>
<td>AZRI-45</td>
<td>8</td>
<td>AZRI-48</td>
<td>11</td>
<td>Zardana-92</td>
</tr>
<tr>
<td>3</td>
<td>AZRI-43</td>
<td>6</td>
<td>AZRI-46</td>
<td>9</td>
<td>AZRI-49</td>
<td>12</td>
<td>Tijaban-10</td>
</tr>
</tbody>
</table>

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Grain weight spike\(^1\) (g)
Data concerning grain weight spike\(^1\) (g), statistical analysis (Table 3) showed that difference among wheat genotypes was significant at P < 0.05. Mean of the data revealed that maximum grain weight spike\(^1\) was shown by genotype AZRI-42 (2.6433), while minimum grain weight spike\(^1\) was recorded for Tijaban-10 (1.5500). Results (Table 5) revealed that correlation for grain yield and grain weight per spike of *Triticum aestivum* was negative significant to each other. These results are in agreement with Ubaidullah et al. (2007), Laghari et al. (2011), Khan et al. (2012), Laeiet al. (2012), Karim and Jahan (2013), while these results oppose the finding of Naveed et al. (2014).

1000-grain weight (g)
Maximum grain weight is the cardinal source of high yield in any crop species. Large and bold grain produce more weight thus increase over all yield. Data regarding 1000-grain weight indicated that differences among the wheat genotypes were significant at P < 0.05. Mean of the data revealed that maximum 1000-grain weight (g) was recorded for genotype AZRI-42 (44.377) whereas minimum 1000-grain weight (g) was observed for Tijaban-10 (35.047). Correlation between grain yield and 1000-grain weight was non significant. These results are agreed with Abbas et al. (2009), Tahir et al. (2009) and Hussain et al. (2013), while these results are contrary with Shah et al. (2007) and Hussain et al. (2009).

Total dry matters (kg ha\(^{-1}\))
In Balochistan straw is the main source of feeding livestock therefore, more dry matters in wheat directly benefits farmer community. Data concerning total dry matters (kg ha\(^{-1}\)) indicated that differences among the wheat genotypes were significant at P < 0.05 (Table 3). Mean of the data revealed that total dry matters (kg ha\(^{-1}\)) were recorded for genotype AZRI-49 (19333) while minimum total dry matters (kg ha\(^{-1}\)) were recorded for AZRI-45 (8333). Grain yield ha\(^{-1}\) (kg) and total dry matters ha\(^{-1}\)(kg) were positively significant correlated with each other. These findings were confirmed by past researchers; Inamullah et al. (2011), Mushtaqt et al. (2011), Khan et al. (2012), Laei et al. (2012) and Naveed et al. (2014). While these results refute to the result of Ali et al. (2007) and Hossain et al. (2009).

Grain yield (kg ha\(^{-1}\))
Grain yield is the paramount need of a producer. Data analysis of grain yield (kg ha\(^{-1}\)) indicated that differences among the wheat genotypes were significant at P < 0.05. Maximum yield was recorded for genotype AZRI-49 (6846.7), followed by AZRI-47 (6506.7) while minimum grain yield (kg ha\(^{-1}\)) was observed for AZRI-45 (2193.3).

On the basis of results and performance recorded during filed experiment, advanced line AZRI-49 performed best in four economical traits viz; number of tillers m\(^{-2}\), number of spikelets per spike, total dry matters ha\(^{-1}\) (kg) and grain yield ha\(^{-1}\) (kg). Therefore, it is may concluded that genotype AZRI-49 was found to be a promising future variety for the cultivation of uplands of Balochistan, but it must be tested at various locations of province for stability and yield performance in multi location yield trail. The significantly positive correlation was observed in plant height (cm), number of tillers m\(^{-2}\) and total dry matters ha\(^{-1}\) (kg) with grain yield ha\(^{-1}\) (kg). These results showed that selected plant genotype has promising agronomic characters.

REFERENCES


Table 3: Mean squares from analysis of variance for various morphological traits of *Triticum aestivum*.

<table>
<thead>
<tr>
<th>Sources</th>
<th>d.f.</th>
<th>Days to 50% heading</th>
<th>Days to maturity</th>
<th>Plant height (cm)</th>
<th>Spike length (cm)</th>
<th>Number of tillers m$^{-2}$</th>
<th>Number of spikelets spike$^{-1}$</th>
<th>Number of grains spike$^{-1}$</th>
<th>Grain weight spike$^{-1}$</th>
<th>1000-grain weight</th>
<th>Total dry matters (kg ha$^{-1}$)</th>
<th>Grain yield (kg ha$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>2</td>
<td>33.445</td>
<td>3.084</td>
<td>229.43</td>
<td>1.734</td>
<td>21998.5</td>
<td>1.605</td>
<td>56.340</td>
<td>0.222</td>
<td>3.331</td>
<td>347778</td>
<td>39858</td>
</tr>
<tr>
<td>Genotypes</td>
<td>11</td>
<td>64.876**</td>
<td>5.334*</td>
<td>73.055**</td>
<td>0.796*</td>
<td>11835**</td>
<td>2.503*</td>
<td>80.462**</td>
<td>0.292**</td>
<td>31.433**</td>
<td>2295271.81**</td>
<td>4177346**</td>
</tr>
<tr>
<td>Error</td>
<td>22</td>
<td>4.323</td>
<td>2.508</td>
<td>13.824</td>
<td>0.320</td>
<td>1437.6</td>
<td>1.109</td>
<td>13.598</td>
<td>0.047</td>
<td>4.498</td>
<td>417778</td>
<td>22116</td>
</tr>
</tbody>
</table>

*Significant) = 5%  **Highly Significant= 1%  

Table 4: Mean performance of *Triticum aestivum* genotypes for various morphological traits

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Days to 50% heading</th>
<th>Days to maturity</th>
<th>Plant height (cm)</th>
<th>Spike length (cm)</th>
<th>Number of tillers m$^{-2}$</th>
<th>Number of spikelets spike$^{-1}$</th>
<th>Number of grains spike$^{-1}$</th>
<th>Grain weight spike$^{-1}$</th>
<th>1000-grain weight</th>
<th>Total dry matters (kg ha$^{-1}$)</th>
<th>Grain yield (kg ha$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZRI-41</td>
<td>156.33</td>
<td>203.67</td>
<td>78.197</td>
<td>8.6133</td>
<td>334.00</td>
<td>17.133</td>
<td>46.600</td>
<td>1.9733</td>
<td>42.530</td>
<td>15867</td>
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<tr>
<td>AZRI-42</td>
<td>159.00</td>
<td>207.00</td>
<td>82.580</td>
<td>9.0733</td>
<td>282.33</td>
<td>16.933</td>
<td>53.800</td>
<td>2.6433</td>
<td>44.377</td>
<td>14000</td>
<td>5463.3</td>
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<tr>
<td>AZRI-43</td>
<td>158.00</td>
<td>206.33</td>
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<td>407.33</td>
<td>16.667</td>
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<td>206.67</td>
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<td>35.270</td>
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</table>

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Table 5: Correlation coefficients of various morphological traits with yield

<table>
<thead>
<tr>
<th>Characters</th>
<th>Days to 50% heading</th>
<th>Days to maturity</th>
<th>Plant height (cm)</th>
<th>Spike length (cm)</th>
<th>Number of tillers m⁻²</th>
<th>Number of spikelets spike⁻¹</th>
<th>Number of grains spike⁻¹</th>
<th>Grain weight spike⁻¹</th>
<th>1000-grain weight</th>
<th>Total dry matters (kg ha⁻¹)</th>
<th>Grain yield (kg ha⁻¹)</th>
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<tbody>
<tr>
<td>Grain yield (kg ha⁻¹)</td>
<td>0.1154&lt;sup&gt;NS&lt;/sup&gt;</td>
<td>-0.0016&lt;sup&gt;NS&lt;/sup&gt;</td>
<td>0.4378*</td>
<td>-0.2002&lt;sup&gt;NS&lt;/sup&gt;</td>
<td>0.6246**</td>
<td>-0.2774&lt;sup&gt;NS&lt;/sup&gt;</td>
<td>-0.6111&lt;sup&gt;**&lt;/sup&gt;</td>
<td>-0.4279*</td>
<td>0.1628&lt;sup&gt;NS&lt;/sup&gt;</td>
<td>0.9346**</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<sup>NS</sup> Non-significant

<sup>*</sup> Significant at the 0.05 level

<sup>**</sup> Significant at the 0.01 level