EFFECT OF DIFFERENT IRRIGATIONS ON YIELD AND ITS ASSOCIATED TRAITS IN WHEAT (*Triticum aestivum* L.)

*Piar Ali Shar*¹, Shabana Memon²,³, Akhtar Hussain Shar¹, Abdul Ghaffar Shar⁴ and Sadaf Memon³

¹College of Life Sciences, Northwest A & F University, Yangling 712100, Shaanxi, China
²School of life Sciences, Nanjing University, Nanjing, 210093, China
³Department of Plant Breeding and Genetics, Faculty of Crop Production, Sindh Agriculture University, Tando Jam, 70060, Sindh, Pakistan
⁴College of Natural Resources and Environment Northwest A & F University, Yangling 712100, Shaanxi

E-mail: drpiaralishar@gmail.com (*Corresponding Author*)

Abstract: Drought is a severe abiotic stress reducing yield as well as affecting its associated traits. Morphological attributes directly leading to yield has its own importance to the crop. Presently, six valuable wheat genotypes and there hybrids were exposed to three different irrigations: T₁, contributing all normal irrigations; T₂, one irrigation escaped at tillering stage and T₃, one irrigation escaped at booting stage. The stress during tillering and booting stages affected many of the progenies and produced reduced harvest index (%), biological yield (kg ha⁻¹) and grain yield⁻¹. However, few progenies TD-1 × Imdad, Sarsabz × TJ-83, Sarsabz × Khirman and Kiran-95 × Khirman were predominant and gained more, biological yield (kg ha⁻¹), harvest index (%) and grain yield kg⁻¹ in different irrigations,

Introduction

Wheat (*Triticumaestivum* L.) is the major cereal crop of Pakistan grown as a mono-crop for cultivation(Khakwani et al., 2011). It is the nutritious and cheap source food of many Pakistani people (Noorka and Schwarzacher, 2013). Pakistan is one the largest growing countries of wheat occupying 10ᵗʰ position in the world(Shirazi et al., 2010). Most of the one third area of Pakistan is rainfed and remaining area is canal irrigated, hence sometimes severe moisture is encountered due to less rainfall effecting tillering and grain filling stages of wheat (Abdul Ghani et al 2000). Nonetheless, increase in temperature and less rainfall often reduce plant growth and crop yields (Kilic and YAĞBASANLAR, 2010). In this drought
situationsome suitable wheat genotypes are to be needed that can adapt them in reduced moisture and improve crop yield (Shafeeq and Zafar, 2006, Shirazi et al., 2010).

Among abiotic stresses, drought stress is one of the crucial problems spreading worldwide and generating a huge loss to agriculture (Ali et al., 2013). Plants response to stress conditions is very complex and depends upon the intensity and length of stress provided to the crop (Akram, 2011, Ali et al., 2013). Different growth stages of wheat have its own importance in the development of the wheat crop. Hence, efficient utilization of water is important under moisture stress conditions (Akram, 2011). It has been observed that plants during stress maintain their metabolic activity and structure capacity to improve their potential under varied stress environments (Ali et al., 2013). From many years, conventional breeding techniques have been an efficient tool for improving crop yield (Noorka and Schwarzacher, 2013). Agronomical traits with limited water environments express variably and could be improved through selection programs (Jatoi et al., 2011). Hence, escape of water or stress avoidance depends upon the genotype (Ali et al., 2013). Keeping in view the above findings, the present research was carried out to determine the response of some important morphological traits on wheat genotypes under different stress environments.

Material and Methods

A field experiment was conducted to determine the sensitivity of wheat under different stress conditions in some important morphological traits. Six wheat genotypes were utilized for the experiment viz. Imdad, TD-1, Kiran-95, Khirman, Sarsabz and TJ-83. A split plot experiment was carried out at Latif farm of Sindh Agriculture University, Tando Jam, Hyderabad, Pakistan, for continuously two years 2011-12 and 2012-13. In the 1st year water was escaped at tillering and booting stages of wheat and the genotypes were exposed to these water irrigations. Then on the basis of morphological traits the genotypes were crossed with each other as to produce efficient combinations. Six valuable segregating populations were produced i.e.TD-1 × Imdad, Sarsabz × TD-1, TJ-83 × Khirman, Kiran-95 × Khirman, Sarsabz × TJ-83 and Sarsabz × Khirman and utilized for the 2nd generation. They were grown under different irrigations, evaluating under water stress and non-stress conditions.

T1: All normal 5 irrigations were applied.
Effect of Different Irrigations on Yield and its Associated Traits in Wheat ….

T2: one water application was escaped during tillering stage.

T3: In this stage one water irrigation was escaped during booting stage.

Few important morphological traits were studied viz. harvest index (%), biological yield (kg ha\(^{-1}\)) and grain yield plant\(^{-1}\) (g)

**Statistical analysis**

The entire data was statistically analyzed using Analysis of variance (ANOVA) according to (Gomez and Gomez, 1984). Standard error for difference between means (SED) and Least Significant Difference (LSD) were calculated using the following formula:

\[
SED = \left( \frac{2EMS}{N} \right)^{1/2} \times \frac{LSD}{t(0.05)} \times df
\]

Where \(EMS = \) error mean square \(n = \) number of replications.

**Results and Discussion**

Many plant species have the ability to tolerate the stress environments whether it is abiotic or biotic stress. Presently, in our experiment different genotypes explored variably at different irrigations. The pooled ANOVA depicted that six F\(_2\) segregating populations and their parental wheat varieties for the traits grain yield plant\(^{-1}\) (g) and harvest index (%) were significantly different at P ≤ 0.05; while biological yield (kg ha\(^{-1}\)) was highly significant at P ≤ 0.01 level of probability (Table 1). Genotypes × treatment interactions (G × E) also seem to be highly significant (P ≤ 0.01) (Table 1). Previous studies also reveal significant differences between genotypes and treatments observed in different characters (Sial et al., 2010). The mean performance varied with different irrigations treatments in the population. Among the six progenies Sarsabz xTD-1, TJ-83 × Khirman, Sarsabz × TJ-83 hybrids contributed maximum performance in harvest index (%), biological yield (kg ha\(^{-1}\)) and grain yield plant\(^{-1}\) during normal irrigations (Fig 1-3). In T\(_2\) the progeny TD-1 × Imdad, TJ-83 × Khirman, Sarsabz × TJ-83 and Sarsabz × Khirman revealed high performance during stress at tillering stage for biological yield (kg ha\(^{-1}\))(Fig 2). However, Sarsabz × TJ-83 showed higher grain yield plant\(^{-1}\) in this stress stage (Fig 3). Some of the progenies were affected by reduced yield, emphasizing that they might have provoked difficulties in stress conditions (Chen et al., 2012). TD-1 × Imdad and Kiran-95 × Khirman also contributed maximum harvest index (%) during T\(_2\) (Fig 1). During escape of irrigation at booting stage most of the genotypes/hybrids revealed decreased
harvest index (%), biological yield (kg ha\(^{-1}\)) and grain yield\(^{-1}\) (Fig 1-3). However, in T\(_3\), the progenies TD-1 × Imdad, Sarsabz × TD-1 and Kiran-95 × Khirman attributed maximum grain yield plant\(^{-1}\) (Fig 3). For the trait biological weight (kg ha\(^{-1}\)) the cross Sarsabz × TJ-83 increased in T\(_3\) (Fig 2). Also two progenies Sarsabz × TJ-83 and Kiran-95 × Khirman performed better for the trait harvest index (%) (Fig 1). Previous studies report that harvest index (%) is the most significant trait for screening drought resistance in genotypes under stress environment (Khakwani et al., 2011).

Previous studies declare that some stages of wheat can cope under moisture stress, where others might be susceptible and enhance low yield (Akram, 2011). It is suggested from our results that the progenies TD-1 × Imdad, Sarsabz × TJ-83, Sarsabz × Khirman and Kiran-95 × Khirman gained more, biological yield (kg ha\(^{-1}\)), harvest index (%) and grain yield kg\(^{-1}\) in different irrigations, thus emphasizing that they can be used at stress conditions.

**Table 1.** Pooled Analysis of variance (ANOVA) of some agronomical traits of wheat (*Triticum aestivum* L.) under normal and water stress conditions

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Harvest Index (%)</th>
<th>Biological Yield (Kg/ha)</th>
<th>Grain yield/plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replications</td>
<td>2</td>
<td>10.534</td>
<td>456734</td>
<td>0.18</td>
</tr>
<tr>
<td>Treatments water (T)</td>
<td>2</td>
<td>25.711*</td>
<td>2668746**</td>
<td>0.07*</td>
</tr>
<tr>
<td>Error</td>
<td>4</td>
<td>24.066</td>
<td>269051</td>
<td>0.06</td>
</tr>
<tr>
<td>Varieties (V)</td>
<td>11</td>
<td>172.762*</td>
<td>3825399**</td>
<td>0.12*</td>
</tr>
<tr>
<td>Treatments x Varieties(TxV)</td>
<td>22</td>
<td>14.574</td>
<td>582191**</td>
<td>0.085*</td>
</tr>
<tr>
<td>Error</td>
<td>44</td>
<td>13.712</td>
<td>28880</td>
<td>0.081</td>
</tr>
</tbody>
</table>

** = Significant at P≤ 0.01, * = Significant at P≤ 0.05.

The T represents the water treatments applied, V is for genotypes/varieties used and T x V is the interaction between treatment of water and genotypes.
**Fig 1.** Mean performance of six $F_2$ progenies and their respective parental lines of wheat for the trait harvest index (%) at different irrigations.

T1: normal irrigation, T2: escape of irrigation at tillering stage and T3: escape of irrigation at booting stage.

**Fig 2.** Mean performance of six $F_2$ progenies and their respective parental lines of wheat for the trait biological yield kg ha$^{-1}$ at different irrigations.

T1: normal irrigation, T2: escape of irrigation at tillering stage and T3: escape of irrigation at booting stage.
Fig 3. Mean performance of six F₂ progenies and their respective parental lines of wheat for the trait grain yield plant⁻¹ (g) at different irrigations

T1: normal irrigation, T2: escape of irrigation at tillering stage and T3: escape of

References


Agric 27: 59-65.


