WHEAT YIELD AND ITS COMPONENTS AS AFFECTED BY DIFFERENT IRRIGATION TREATMENTS

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ABSTRACT

An experiment was conducted to investigate the effect of different irrigations on yield and yield components of wheat varieties during 2011-12. The experiment was laid out in randomized complete block design (Factorial) replicated three times having net plot size of 6.0 m². Three wheat varieties i.e. Khirman, Sarsabz and Zardana were evaluated for their performance against two water regimes i.e. four irrigations (22, 60, 80 and 100 days after sowing), and two irrigations (22 and 70 days after sowing). The result revealed that Spike length was highly significant (P<0.01) for irrigation treatments and non-significant (P>0.05) for varieties as well as their interaction. The wheat crop irrigated four times (22, 60, 80 and 100 days after sowing) resulted maximum plant height (106.15 cm), tillers m⁻² (414.89), spike length (10.086 cm), and grain yield (7001 kg ha⁻¹) as compared to two irrigations (22 and 70 days after sowing). Among varieties Khirman ranked 1st in all traits studied particularly grain yield (5820 kg ha⁻¹) followed by Sarsabz (5409 kg ha⁻¹) and Zardana (5016 kg ha⁻¹). It is recommended therefore that wheat variety Khirman may be planted with four times irrigation (22, 60, 80 and 100 days after sowing) to achieve the optimum yield.

Key words: Irrigation frequency, wheat varieties, growth and yield components.

INTRODUCTION

Wheat, Triticum aestivum L. is a staple food of billions of people in the world. In Pakistan wheat is one of the major commodities essential to food security, supplying 72 % of the calories and protein in the average diet (Azam et al. 2007). Pakistan has been facing water shortages for the last several years due to lesser rains and high temperatures with the result wheat production both in irrigated and rain-fed areas is being hampered. In order to minimize the effects of drought and high temperatures, drought and heat tolerant varieties need to be evolved in addition to the judicial use of available irrigation water (Azam et al., 2007).

Plant water deficit during grain filling in wheat has been found to substantially affect grain yield. However, severe water deficits are rare in viable agriculture, and asking how crops respond to or survive extreme drought is unlikely to have much of a practical impact (Passioura, 2002). Maqsood et al. (2002) investigated effect of irrigation levels and obtained grain yield of 5.69 t ha⁻¹ with four standard irrigation (at crown root, booting, anthesis and grain filling stage) which attributed more availability of plant food nutrient favorable for increase in number of fertile tillers m⁻², number of grain per spike and 1000-grain weight. Ibrahim et al. (2007) investigated the effects of different water regimes on growth and yield components of wheat and found that grain yield was highest under four irrigations at 30 days interval but drastically decreased under five and six irrigations at 25 days interval. Khan et al. (2007) concluded that for maximum yield of wheat crop may be irrigated at five weeks interval. Gharib et al. (2009) evaluated productivity and seed quality of wheat in response to irrigation regimes and indicated that seeds produced at irrigation intervals of 7 or 14 days preserved their quality up to one year.

Keeping in view the facts stated above a study was carried out to investigate the effect of different water regimes on the yield and yield components of some of the wheat varieties.

MATERIAL AND METHODS

An experiment was conducted to evaluate three wheat varieties against two water regimes (four and two irrigations) during 2011-12 at Sindh Agriculture University, Tandojam. The experiment was laid out in randomized complete block design (factorial) with four replication having plot size of 5.0x1.2m (6.0m²). Three varieties (Khirman, Sarsabz and Zardana) and two irrigation frequencies (Four, and two) were included in this
experiment. Four irrigations were applied after 22, 60, and 100 days of sowing, while two irrigations were applied after 22 and 70 days of sowing. The seeds of wheat varieties were sown in third week of November 2011 with the help of single row hand drill.

The nitrogen was applied in the form of urea @ 168 kg ha\(^{-1}\) and phosphorus in the form of DAP @ 82 kg ha\(^{-1}\). All P (as mono ammonium phosphate) and 1/3rd of N (as urea) were applied at the time of sowing and remaining N was applied in two splits at first irrigation and at 2\(^{nd}\) irrigation, respectively. The irrigations were applied according to the treatment plan and the weeding was controlled using weedicides. For recording observations on various agronomical traits, five plants in each plot were selected at random and labeled. After completion of observations on growth parameters, and when crop matured, the labeled plants were harvested manually and tied in small bundles, and were shifted to threshing yard. Threshing was performed manually and carefully collected the grains for counting and yield measurements. The data were recorded on the studied parameters were: Plant height (cm), number of tillers m\(^{-2}\), spike length (cm), 1000 grain weight (g), and grain yield (kg ha\(^{-1}\)). The data thus collected were statistically analyzed using MSTAT-C. The LSD test was applied to compare treatments superiority, where ever necessary (Russel and Eisensmith, 1983).

RESULT AND DISCUSSION

Plant height (cm)
The data regarding the plant height of wheat varieties as influenced by different irrigation regimes are presented in Table-1. The results of the analysis of variance suggested significant (P<0.05) effect of irrigation regimes and varieties on the plant height, while their interaction did not show significant effect (P>0.05) on this trait. The crop receiving four irrigations (22, 60, 80 and 100 DAS) grew tallest (106.125 cm), while the wheat crop given two irrigations (22 and 70 DAS) ranked second with average plant height of 102.23 cm. In case of varieties, the plant height was higher (102.82 cm) in variety Khirman (NIA, Tandojam), while variety Zardana (ARI, Quetta) ranked second with average plant height of 100.52 cm; while the lowest plant height of 98.89 cm was recorded in variety Sarsabz (NIA, Tandojam). The interaction 4 irrigations x variety Khirman resulted in maximum plant height (109.99 cm), while the interaction 2 irrigation x variety Zardana resulted in minimum plant height of 88.26 cm.

Number of Tillers m\(^{-2}\)
Wheat crop irrigated four times (22, 60, 80 and 100 DAS) had maximum number of tillers (414.89) plant\(^{-1}\), followed by two irrigations (22 and 70 DAS) with 376.56 tillers plant\(^{-1}\). Wheat variety Khirman recorded significantly maximum number of tillers (370.11) plant\(^{-1}\), while the second position was occupied by variety Sarsabz with 354.56 tillers plant\(^{-1}\). The interaction studies indicated that 4 irrigations x variety Khirman resulted in maximum number of tillers (427.88) plant\(^{-1}\), and the minimum tillers (273.54) plant\(^{-1}\) was recorded in interaction of 2 x variety Zardana. The LSD test showed that there was straight effect of irrigation regimes on the number of tillers plant\(^{-1}\), while the varieties also showed varied response to this trait under all circumstances.

Spike length (cm)
The results pertaining to spike length of wheat varieties as affected by various irrigation regimes are given in Table-1. The analysis of variance indicated significant (P<0.05) effect of irrigation regimes on the spike length of wheat, while the effect of varieties and interaction between irrigation regimes and varieties on the spike length was statistically non-significant (P>0.05). It is evident from the results that the crop receiving four irrigations (22, 60, 80 and 100) resulted in maximum spike length of 12.29 cm, followed by two irrigations (22 and 70) with 12.14 cm spike length. In case of varieties, the maximum spike length of 11.35 cm was noted in variety Khirman followed by variety Sarsabz with average spike length of 11.25 cm; while the lowest spike length of 10.85 cm was observed in case of variety Zardana. The interaction, “4 irrigations x variety Khirman” resulted in maximum spike length of 12.40 cm, while the interaction “two irrigation x variety Sarsabz” resulted in minimum spike length of 9.22 cm. The results further showed that variety Khirman showed its superiority for this trait over Sarsabz and Zardana.

1000 grain weight (g)
The results showed that the highest 1000 grain weight (54.32 g) was recorded in wheat crop receiving four irrigations (22, 60, 80 and 100 DAS), while the crop receiving two irrigations (22 and 70 DAS) ranked second with 50.32 g 1000-grain-weight. The maximum seed index (50.83 g) was recorded in variety Khirman followed by variety Sarsabz with average seed index of 50.73 g; while the lowest seed index value of 49.41 g was noted in variety Zardana.
Grain yield (kg ha\textsuperscript{-1})

The results regarding grain yield ha\textsuperscript{-1} of wheat varieties as affected by different irrigation regimes are shown in Table-1, which shows that the crop irrigated four times (22, 60, 80 and 100 DAS) produced significantly maximum grain yield of 7001 kg ha\textsuperscript{-1}, followed by two irrigations (22 and 70 DAS) with average grain yield of 5763 kg grain yield ha\textsuperscript{-1}. Khirman wheat variety produced significantly highest grain yield of 5820 kg ha\textsuperscript{-1}, followed by Sarsabz with grain yield of 5409 kg ha\textsuperscript{-1}; and the lowest grain yield of 5016 kg ha\textsuperscript{-1} was obtained from variety Zardana. Result indicated that the grain yield ha\textsuperscript{-1} of wheat was significantly (P<0.05) influenced by irrigation regimes, varieties as well as by interaction between irrigation regimes and varieties. The results showed that with decreasing irrigation from four irrigations to two irrigations, the grain yield of wheat was markedly decreased. Moreover, genetically, Khirman proved to be a superior variety over Sarsabz and Zardana. Furthermore, the interaction of “4 irrigations x Khirman” resulted in maximum grain yield of 7446 kg ha\textsuperscript{-1}, while the lowest grain yield of 3509 kg ha\textsuperscript{-1} was obtained in interaction between “two irrigations x Sarsabz”. The LSD test suggested a linear difference in grain yield either between irrigation regimes or when wheat varieties were compared.

These results are in accordance with those of Bunyolo, (2000) who found a significant improvement in wheat yields with increasing irrigation frequency; while Munyindaa and Bunyolo (2000) applied irrigations at tillering either on a weekly, every two week, or every three week basis and obtained maximum yields with weekly irrigation. Haj et al. (2005) studied effects of irrigation regimes on wheat and reported significant differences were noted regarding these parameters due to irrigation regimes. Significant effects of the water regime were found on all measured traits by Ibrahim et al. (2007) and the studies carried out by Khan et al. (2007); Lin et al. (2007) and Shao et al. (2009) indicated that at least four to five irrigations are needed for obtaining desired results in wheat. Considerable research has been carried out by researchers in different parts of the world on the effect of irrigation frequencies on wheat. Gharib et al. (2009) evaluated productivity and seed quality of wheat variety (Elnilain) in response to irrigation regimes at 7, 14 and 21 days interval and indicated that seeds produced at irrigation intervals of 7 or 14 days and emphasized the necessity of avoiding the use of seeds that had been under storage for 18 month or more in future wheat cultivation.

Conclusions

The data concluded that among water regimes four irrigations (22, 60, 80 and 100 DAS) produced maximum yield and its components particularly grain yield (7001 kg ha\textsuperscript{-1}) as compared to two irrigations (22 and 70 DAS). Among varieties, Khirman gave superior performance particularly grain yield (5820 kg ha\textsuperscript{-1}) than Sarsabz and Zardana. Hence Khirman x four irrigation interaction was found most suitable for obtaining maximum grain yield (7446 kg ha\textsuperscript{-1}) of wheat.

Table-1: Yield and yield components of three wheat varieties as affected by irrigation frequencies

<table>
<thead>
<tr>
<th>Details</th>
<th>Plant height (cm)</th>
<th>Number of tillers m\textsuperscript{2}</th>
<th>Spike length (cm)</th>
<th>1000-grain weight (g)</th>
<th>Grain yield (kg ha\textsuperscript{-1})</th>
</tr>
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<tbody>
<tr>
<td>Varieties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khirman</td>
<td>102.82 a</td>
<td>372.32 a</td>
<td>11.35 a</td>
<td>50.83 a</td>
<td>5820 a</td>
</tr>
<tr>
<td>Sarsabz</td>
<td>98.89 c</td>
<td>356.77 b</td>
<td>11.25 a</td>
<td>50.73 a</td>
<td>5409 b</td>
</tr>
<tr>
<td>Zardana</td>
<td>100.52 b</td>
<td>344.21 c</td>
<td>10.85 b</td>
<td>49.41 b</td>
<td>5016 c</td>
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</table>

<table>
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<th>No. of Irrigations</th>
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<th></th>
<th></th>
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</thead>
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<tr>
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<td>108.36 a</td>
<td>417.1 a</td>
<td>12.29 a</td>
<td>54.32 a</td>
<td>7001 a</td>
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<td>Two irrigations</td>
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<td>378.77 b</td>
<td>12.14 a</td>
<td>50.32 b</td>
<td>5763 b</td>
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</table>

<table>
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<td>12.4</td>
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<td>296.88</td>
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<tr>
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<td>2</td>
<td>106.21</td>
<td>414.54</td>
<td>12.29</td>
<td>54.73</td>
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<tr>
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<td>88.26</td>
<td>273.54</td>
<td>9.22</td>
<td>46.68</td>
</tr>
</tbody>
</table>

LSD at 5%

| Variety                     | 1.74               | 6.17                                   | 0.47              | 0.57                   | 41.79                                  |
| Irrigation frequencies      | 1.76               | 6.17                                   | 0.50              | 0.46                   | 51.79                                  |

Note: Means followed by similar letters are not significant from each other.
REFERENCES


