Influence of Irrigation Scheduling on Crop Growth Yield and Quality of Wheat

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ABSTRACT

A field experiment was carried out at Agronomy Farm, Anand Agricultural University, Anand during rabi season in 2011-2012. The treatment comprised of five levels of irrigation schedule Viz., I₁ (CRI, TL, BT, FL, ML, DS), I₂ (0.4 IW: CPE ratio), I₃ (0.6 IW: CPE ratio), I₄ (0.8 IW: CPE ratio) and I₅ (1.0 IW: CPE ratio) in RBD within four replications. The growth attributes such as plant height (cm) and number of spike/ear were found significantly higher under I₁ (CRI, TL, BT, FL, ML, DS) treatment. The total number of tiller/plant, grain weight/ear (cm), ear length (cm), harvest index (%) and test weight (g) were found higher under I₁ (CRI, TL, BT, FL, ML, DS) and I₄ (0.8 IW: CPE ratio) treatment. The highest grain yield and straw yield (4380 & 4538 kg /ha) was recorded under I₁ treatment followed by I₄ and I₅ treatment. However the lowest grain and straw yield (3600 kg/ha) (4025 kg/ha) was recorded under I₂ (0.4 IW: CPE ratio) treatment. It is concluded that application of water at CRI, TL, BT, FL, ML and DS is more economic for wheat than other tested water management treatment.

Keywords: Growth parameters, Yield, scheduling of irrigation, Wheat.

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INTRODUCTION

Wheat (Triticum aestivum L.) is one of the most important cereal crops in large number of countries in the world. It provides about 20 per cent of total food calories for the human race (Meena et al., 2013). It is widely grown through in temperate zone and some tropical and sub-tropical areas at higher elevation. The major wheat growing countries in the world are USSR, USA, China, India, Canada, Australia, France, Turkey and Pakistan. Among the major cereal grown in India, wheat stands second next to rice in area and production, but stands first in productivity. India covers about 27.54 million hectares area with total production of 80.58 million tonnes and productivity 29.54 q/ha (Anonymous, 2009). The three main species of wheat viz., Triticum aestivum, Triticum durum and Triticum dicocum L. are being cultivated in India. Water is essential at every developmental phase starting from seed germination to plant maturation for harvesting the maximum potential yield of wheat. There is a positive correlation between grain yield and irrigation frequencies (Kumar et al., 2014). Availability of adequate amount of moisture at critical stages of plant growth not only optimizes the metabolic process in plant cell but also increases the effectiveness of the mineral nutrients applied to the crop. Normal irrigations are essential for bumper crop production, but when there is scarcity of water, it becomes imperative to differentiate the critical growth stages of the crop where irrigation could be missed, without reducing the grain yield significantly. Irrigation missing at some critical growth stage sometime drastically reduces grain yield (Kumar et al., 2014) due to lower test weight. Efficient water management, being one of the good agronomic management practices, it not only leads to improve crop productivity but also minimize susceptibility from disease and insect pest under favourable environment for flourishing these biotic stress (Singh et al., 2012).

A field experiment was carried out at Agronomy Farm, Anand Agricultural University, Anand during rabi season in 2011-2012. India situated at 22°35' N latitude and 72°55'E longitude and at an altitude of 45.1 m above mean sea level. The treatment comprised of five levels of irrigation schedule Viz., I₁ (CRI, TL, BT, FL, ML, SD), I₂ (0.4 IW: CPE ratio), I₃ (0.6 IW: CPE ratio), I₄ (0.8 IW: CPE ratio) and I₅ (1.0 IW: CPE ratio) in RBD within four replications.

Grain yield of wheat for each of the treatments under different replications from each of the net experimental plots was recorded by weighing the actual quantity of grains realized. This weight was subsequently converted into the weight of the grains on a hectare basis. Grain yield of wheat for each of the treatments under different replications from each of the net experimental plots was recorded by weighing the actual quantity of grains realized. This weight was subsequently converted into the weight of the grains on a hectare basis. Stover yield was obtained by subtracting the seed yield of each net plot from their respective total dry matter (above ground) or biological yield and computed in terms of kg/ha and converted it on hectare basis.
From the composite samples of seed drawn from the produce of the each net plot 1,000 seeds were counted and the total weight was recorded in gram for all the experimental plots.

Harvest index is ratio of economic yield to the biological yield per plot. It was calculated by using equation 1 (Donald and Hamblin, 1976).

\[
\text{Economic yield (kg/ha)} = \frac{\text{Harvest index (cm)}}{\text{Biological yield (kg/ha)}} \times 100
\]

After nipping the kernels, the straw was subjected to sun drying for over a period of a week till constant weight was obtained. The same weight was then converted on a hectare basis.

The plant height was significantly influenced by different irrigation schedules. All the treatments were significantly differ from each other (Table 1). A reference to the results in respect to plant height indicated appreciable influence of different irrigation schedule. Treatment I (CRI, TL, BT, FL, ML, DS) recorded maximum plant height of 90 cm, which was at par with treatment I (0.8 IW: CPE ratio) and I (1.0 IW: CPA ratio). The treatment I (0.4 IW: CPE ratio) recorded significantly the lowest plant height (82 cm). The per cent increase in plant height at harvest under treatment of I, I, I, and I was by 9.7, 4.8, 7.3, and 6.0 over treatment I (0.4 IW: CPE ratio), respectively. The increase in the plant height under the treatment I might be due to optimum supply of soil moisture. The other reason for increasing plant height might be due to optimum soil moisture supply promoted the cell division and cell expansion and there by stem elongation, which virtually increased the plant height. The lowest plant height of 82 cm at harvest was observed under treatment I (0.4 IW: CPE ratio).

The reason for lower plant height might be due to severe moisture stress condition which affected plant growth. Similar results were found by Brahma et al. (2007).

The results pertaining to number of tillers/plant (Table 1) showed non-significant response to irrigation schedule. However, it was observed that higher number of tillers/plant (3.4) was recorded under treatments I (CRI, TL, BT, FL, ML, DS) and I (0.8 IW: CPE ratio) over treatment I. The increase in number of tillers might be due to enhanced vegetative growth, due to of beneficial role of water in maintaining cell turgidity, cell elongation and cell division and also meristmatic cell elongation in the axillary buds in turn trigged the various activities and increases the supply of photosyneths and thereby increase in number of tillers. Similar results were also observed by Nand et al. (2011).

It is evident from the results that the differences in spike/ear to different irrigation schedules were found significant. However, treatment I (CRI, TL, BT, FL, ML, DS) and I (0.8 IW: CPE ratio) recorded the highest number of spike/ear (11), and lowest (10) under I (0.4 IW: CPE ratio) treatment (Table 1). The increase in number of spike/ear might be due to ample supply of soil moisture may lead to profuse root development. Thereby absorption of nutrients may be more at critical stages and beneficial role of water in maintaining cell turgidity, cell elongation and cell division for a longer period of growth which ultimately increased the number of spike/ear and yield. Similar results were found by Jain (2001) and Behera et al. (2002).

The statistical comparison of the results of grain yield revealed (Table 1) that differences in yield due to differences in the different irrigation treatments were found statistically significant. I treatment yielded the highest (4380 kg/ha) as compared to I, I, and I treatment. However, I, and I were found to be at par with each other in respect of their respective yields. The increased in seed yield under treatments I (CRI, TL, BT, FL, ML, DS), I (1.0 IW: CPE) and I (0.8 IW: CPE) were to the extent of 21.6, 16.0, and 14.2 per cent, respectively over the treatment I (0.4 IW: CPE ratio). It was also found that with sufficient moisture in the soil profile, the nutrient were more

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of spike/ear</th>
<th>Grain yield (kg/ha)</th>
<th>Straw yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (CRI, TL, BT, FL, ML, DS)</td>
<td>90</td>
<td>3.4</td>
<td>11.0</td>
<td>4380</td>
</tr>
<tr>
<td>I (0.4 IW: CPE)</td>
<td>82</td>
<td>2.9</td>
<td>10.0</td>
<td>3600</td>
</tr>
<tr>
<td>I (0.6 IW: CPE)</td>
<td>86</td>
<td>3.3</td>
<td>10.5</td>
<td>4088</td>
</tr>
<tr>
<td>I (0.8 IW: CPE)</td>
<td>88</td>
<td>3.4</td>
<td>11.0</td>
<td>4114</td>
</tr>
<tr>
<td>I (1.0 IW: CPE)</td>
<td>87</td>
<td>3.2</td>
<td>10.5</td>
<td>4178</td>
</tr>
<tr>
<td>S. Em</td>
<td>0.75</td>
<td>0.16</td>
<td>0.73</td>
<td>165.4</td>
</tr>
<tr>
<td>CD (P&lt;0.05)</td>
<td>2.31</td>
<td>NS</td>
<td>2.26</td>
<td>509.83</td>
</tr>
<tr>
<td>CV %</td>
<td>3.15</td>
<td>10.1</td>
<td>13.8</td>
<td>8.12</td>
</tr>
</tbody>
</table>
Table 2: Test weight, harvest index, ear length and grain weight per ear of wheat as influenced by different irrigation levels

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Test weight (gm)</th>
<th>Harvest index (%)</th>
<th>Ear length (cm)</th>
<th>Grain weight/ ear (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation levels (I)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I₁ (CRI, TL, BT, FL, ML, DS)</td>
<td>48</td>
<td>49.0</td>
<td>7.3</td>
<td>1.8</td>
</tr>
<tr>
<td>I₂ (0.4 IW: CPE)</td>
<td>44</td>
<td>48.0</td>
<td>5.6</td>
<td>1.4</td>
</tr>
<tr>
<td>I₃ (0.6 IW: CPE)</td>
<td>45</td>
<td>48.0</td>
<td>6.4</td>
<td>1.6</td>
</tr>
<tr>
<td>I₄ (0.8 IW: CPE)</td>
<td>47</td>
<td>49.0</td>
<td>7.0</td>
<td>1.8</td>
</tr>
<tr>
<td>I₅ (1.0 IW: CPE)</td>
<td>46</td>
<td>48.0</td>
<td>6.5</td>
<td>1.7</td>
</tr>
<tr>
<td>S. Em±</td>
<td>0.72</td>
<td>0.33</td>
<td>0.20</td>
<td>0.11</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.23</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>3.15</td>
<td>1.36</td>
<td>6.19</td>
<td>14.0</td>
</tr>
</tbody>
</table>

The differences in straw yields were found statistically significant. Highest straw yield (4538 kg/ha) was recorded in I₁ treatment and lowest (4025 kg/ha) under I₃ treatment. Treatment I₁ and I₅ treatment were found to be at par with each other (Table 1). The better vegetative growth might have obviously resulted into higher straw yield. The treatment I₁ (CRI, TL, BT, FL, ML, DS) recorded significantly higher straw yield (4538 kg/ha) as compared to I₁ (0.4 IW: CPE ratio) but it was at par with treatment I₅ (0.8 IW: CPE). The per cent increase in straw yield was 12.9 and 12.7 under treatment I₅ (0.8 IW: CPE ratio) and I₁ (CRI, TL, BT, FL, ML, DS), respectively over the treatment I₁ (0.4 IW: CPE ratio). This might be attributed to maintenance of favourable soil moisture balance in the crop root zone resulting in higher biomass production. Similar results were found by Shivani et al. (2003) and Maliwal et al. (2000).

Grain weight/ear at harvest was not affected significantly due to either levels of irrigation schedule. The results presented to (Table 2) grain weight ear⁻¹ showed non-significant response to irrigation schedule, however, treatment I₁ (CRI, TL, BT, FL, ML, DS) produced maximum grain weight/ear (1.8 gm) as compared to treatment I₃ (0.4 IW: CPE ratio). These results are substantiated with Pandey et al. (2008).

The ear length (cm) at harvest was not affected significantly due to either levels of irrigation treatment (Table 2). However, treatment I₁ (CRI, TL, BT, FL, ML, DS) recorded higher length of ear (7.3 cm) as compared to other irrigation treatments. Lowest ear length (5.6 cm) was recorded under I₅ treatment might be due to higher moisture stress. Similar results were obtained by Nand et al. (2011) and Jana et al. (2001).

The differences in harvest index of different irrigation treatments were found non-significant (Table 2) however the highest harvest index was found in treatment I₁ (49.0) and I₅ as compared to other treatment. The experimental results in respect of harvest index indicated that the different irrigation treatment did not exert any significant variation on harvest index of wheat. The finding confirms the results obtained by Behera et al. (2002) and Bastia and Rout (2001).

The differences in test weight under different irrigation schedules were found significant (Table 2). Treatment I₁ (CRI, TL, BT, FL, ML, DS) recorded significantly the highest test weight (48.0 g), however, it was found at par with treatment I₅ (0.8 IW: CPE ratio). Significantly the lowest test weight (44.0 g) was recorded under treatment I₃ (0.4 IW: CPE ratio) because due to less number of irrigation and it was found at par with I₁ and I₅ treatments. Similar results were found by Patil et al. (1996) and Jain (2001).

CONCLUSION

Results of this field experiment i.e. irrigation scheduling of wheat at Anand Gujarat condition, revealed that application of water at CRI, TL, BT, FL, ML and DS is more economic that other tested water management treatment.

REFERENCES

Anonymous. 2009. Source- www.dacnet.nic.in


**Correct Citation**