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Short Note

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

MK NAYAK*, HR PATEL, VED PRAKASH[1] AND ANIL KUMAR

Department of Agricultural Meteorology, Anand Agricultural University, Anand, Gujarat (India)

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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, 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. 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.

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.*, I_1 (CRI, TL, BT, FL, ML, SD), I_2 (0.4 IW: CPE ratio), I_3 (0.6 IW: CPE ratio), I_4 (0.8 IW: CPE ratio) and I_5 (1.0 IW: CPE ratio) in randomized block design 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.

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.

[1]**Department of Agricultural Meteorology, CCSHAU, Hisar, Haryana (India)**

Corresponding author Email: mknagritech@gmail.com

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).

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100 \qquad \text{[Eq.1]}$$

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_1 (CRI, TL, BT, FL, ML, DS) recorded maximum plant height of 90 cm, which was at par with treatment I_4 (0.8 IW: CPE ratio) and I_5 (1.0 IW: CPA ratio). The treatment I_2 (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_1, I_3, I_4 and I_5 was by 9.7, 4.8, 7.3, and 6.0 over treatment I_2 (0.4 IW: CPE ratio), respectively. The increase in the plant height under the treatment I_1 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_2 (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_1 (CRI, TL, BT, FL, ML, DS) and I_4 (0.8 IW: CPE ratio) over treatment I_2. 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 photosynthets 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_1 (CRI, TL, BT, FL, ML, DS) and I_4 (0.8 IW: CPE ratio) recorded the highest number of spike/ear (11), and lowest (10) under I_2 (0.4 IW: CPE ratio) treatment (Table 1).The increase in number of **s**pike/ 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 **s**pike/ 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_1 treatment yielded the highest (4380 kg/ha) as compared to I_2, I_3 and I_4 treatment. However, I_1 and I_5 were found to be at par with each other in respect of their respective yields. The increased in seed yield under treatments I_1 (CRI, TL, BT, FL, ML, DS), I_5 (1.0 IW: CPE) and I_4 (0.8 IW: CPE) were to the extent of 21.6, 16.0, and 14.2 per cent, respectively over the treatment I_2 (0.4 IW: CPE ratio). It was also found that with sufficient moisture in the soil profile, the nutrient were more

Table1: Plant height, no. of tillers, no. of spike, grain yield and straw yield of wheat as influenced by different irrigation levels

Treatments	Plant height (cm)	Tillers/ plant	No. of spike/ear	Grain yield (kg/ ha)	Straw yield (kg/ ha)
Irrigation levels (I)					
I_1 - (CRI, TL, BT, FL, ML, DS)	90	3.4	11.0	4380	4538
I_2 - (0.4 IW: CPE)	82	2.9	10.0	3600	4025
I_3 - (0.6 IW: CPE)	86	3.3	10.5	4088	4327
I_4 - (0.8 IW: CPE)	88	3.4	11.0	4114	4525
I_5 - (1.0 IW: CPE)	87	3.2	10.5	4178	4517
S. Em±	0.75	0.16	0.73	165.4	178.8
CD (P=0.05)	2.31	NS	2.26	509.83	551.0
CV %	3.15	10.1	13.8	8.12	8.15

Table 2: Test weight, harvest index, ear length and grain weight per ear of wheat as influenced by different irrigation levels

Treatments	Test weight (gm)	Harvest index (%)	Ear length (cm)	Grain weight/ ear (gm)
Irrigation levels (I)				
I_{1} – (CRI, TL, BT, FL, ML, DS)	48	49.0	7.3	1.8
I_{2} - (0.4 IW: CPE)	44	48.0	5.6	1.4
I_{3} - (0.6 IW: CPE)	45	48.0	6.4	1.6
I_{4} - (0.8 IW: CPE)	47	49.0	7.0	1.8
I_{5} - (1.0 IW: CPE)	46	48.0	6.5	1.7
S. Em±	0.72	0.33	0.20	0.11
CD (P=0.05)	2.23	NS	NS	NS
CV %	3.15	1.36	6.19	14.0

available and translocated to produce more dry matter. Better growth and yield under the treatment I_1 (CRI, TL, BT, FL, ML, DS) may be due to good maintenance of required hydration of protoplasm might have reduced viscosity and increase the permeability of both water and nutrient. Remarkably lower seed yield was registered under irrigation at I_2 (0.4 IW : CPE ratio) might be due to moisture stress increased soil strength and decreased the root growth and also its proliferation, thereby decreasing the absorption of nutrients leading to root growth and yield. Result of seed yield clearly suggested that optimum soil moisture play a vital role in enhancing wheat yield under I_1 and I_5 treatment as compared to other treatments. These results were substantiated with Maliwal *et al.* (2000).

The differences in straw yields were found statistically significant. Highest straw yield (4538 kg /ha) was recorded in I_1 treatment and lowest (4025 kg/ ha) under I_2 treatment. Treatment I_4 and I_5 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 I_1 (CRI, TL, BT, FL, ML, DS) produced significantly higher straw yield (4538 kg/ ha) as compared to I_2 (0.4 IW: CPE ratio), but it was at par with treatment I_4 (0.8 IW: CPE). The per cent increase in straw yield was 12.9 and 12.7 under treatment I_4 (0.8 IW: CPE ratio) and I_1 (CRI, TL, BT, FL, ML, DS), respectively over the treatment I_2 (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 I_1 (CRI, TL, BT, FL, ML, DS) produced maximum grain weight/ear (1.8 gm) as compared to treatment I_2 (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 schedule (Table 2). However, treatment I_1 (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 I_2 treatment might be due to higher moisture stress. Similar results were obtained by Nand *et al.* (2011) and Jana *et al.* (2001).

The difference in harvest index of different irrigation treatments were found non-significant (Table 2) however the highest harvest index was found in treatment I_1 (49.0) and I_4 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 I_1 (CRI, TL, BT, FL, ML, DS) recorded significantly the highest test weight (48.0 g), however, it was found at par with treatment I_4 (0.8 IW: CPE ratio). Significantly the lowest test weight (44.0 g) was recorded under treatment I_2 (0.4 IW: CPE ratio) because due to less number of irrigation and it was found at par with I_3 and I_5 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.

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