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Influence of irrigation scheduling on moisture extraction pattern and water use efficiency of wheat (*Triticum aestivum* L.) varieties

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Abstract
A field experiment was conducted during the *Rabi* season of 2018-19 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology Kumarganj, Ayodhya (UP) to find out the influence of irrigation scheduling on growth and yield of wheat varieties. The experiment consisted of 12 treatment combinations comprised of three irrigation schedule (Irrigation at 0.6, 0.9 and 1.2 IW/CPE) tested on four wheat varieties (HD-2285, NW-1067, Kundan and Unnat Halna) in split plot design with three replications. The results indicated that different irrigation schedule on wheat significantly influenced moisture extraction pattern and water use efficiency of wheat varieties. Maximum water use efficiency (109.82 kg/ha/cm) was observed under I_1 (Irrigation at 0.6 IW/CPE) with V_1 (HD-2285).

Keywords: Irrigation scheduling, varieties, IW/CPE ratio, water use efficiency

1. Introduction

Wheat is regarded as one of the most important cereal crops not only in India but also in many other regions of the world. It contributes significantly to the overall goal of ensuring the nation's food supply. Wheat is a crop that is exceptionally flexible and may be cultivated in a diverse selection of soils and climates. The majority of it is cultivated on India's plains, in addition to the hilly regions of the country's north and south.

After China, India is the country that produces the second most wheat worldwide. Major wheat farming states in India are Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Gujarat and Maharashtra. The Indian state of Uttar Pradesh ranks first in both output and area, whereas the Indian state of Punjab rates first in productivity. Both of these rankings are based on the state's individual statistics. The crop is grown on an area of 9.65 million hectares in Uttar Pradesh, where it has a production of 26.87 million tonnes and a productivity of 2786 kg/ha on average; however, throughout India it is cultivated over an area of 29.58 million ha, where it has an output of 99.70 million tonnes and a productivity of 3.37 tonnes/ ha (Anonymous, 2018) [1]. It is well known that effective water management is one of the key elements in maximising agricultural yields. As irrigation water is a scarce resource, its optimization is essential to water resource management. Therefore, efforts for improving the water use efficiency should be prioritised. It also facilitates more efficient utilization of all other production factors, resulting in higher yields per unit of land and time. WUE is best defined as the relationship between harvested yield and water supplies (rainfall + irrigation water) available to the crop (Condon *et al.*, 2004) [4].

The practice of determining when to irrigate and how much water to apply per irrigation is known as irrigation scheduling. Proper irrigation scheduling is critical for making the most of water, energy, and other production inputs. Three key factors influence irrigation schedule: (a) crop water needs; (b) irrigation water availability; and (c) root zone water storage capacity. In irrigation scheduling based on the IW/CPE ratio in climatological techniques, when cumulative pan evaporation reaches a specified threshold, a known amount of irrigation water is applied in the IW/CPE technique. Consumptive use refers to the water needs of a crop, field, farm, enterprise, or valley. It is the sum of two elements, plant transpiration and evaporation from adjacent soil streams, etc. Water consumption can be measured directly or calculated using crop and climate information. It is critical to choose the right cultivar at the right time to achieve maximum yield.

Adaptation of good management practices along with suitable cultivar has not only improved the yield but also improved agricultural water conservation, and future use of that water for more efficient crop production is possible under both dry land and irrigated conditions,. (Wang *et al.*, 2001) [11].

2. Materials and Materials

During the 2018-2019, *Rabi* season, a field experiment was carried out at the Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, to investigate the effect of irrigation schedules on the growth and yield of wheat (*Triticum aestivum* L.) types. The farm is located in the Northern Gangetic Alluvial Plain at around $26^0 47''$ North latitude and $82^0 12''$ East longitude, at an elevation of 113 metres above mean sea level. The study was conducted in split plot design which included 12 treatment combinations comprising of 3 irrigation schedules *viz*., I_1 (Irrigation at 0.6 IW/CPE rato), I_2 (Irrigation at 0.9 IW/CPE), and I_3 (Irrigation at 1.2 IW/CPE) as main plots and four wheat varieties *viz*., V_1(HD-2285), V_2(NW-1067), V_3(Kundan) and V_4(Unnat Halna) as sub plot.

2.1 Soil Moisture Depletion

The soil moisture depletion is the relative amount of moisture extracted from different depth within the crop root zone. Soil moisture depletion from four layers *viz*., 0-15, 15-30, 30-45 and 45-60 cm depth was computed. Moisture depleted from each layer was calculated by adding all the short period depletion at the respective depth till maturity of the crop and the percentage depletion at various depths to the total was worked out.

$$\text{Soil Moisture depletion from } i^{th} \text{ layer (cm)} = \frac{\text{Mai-Mbi}}{100} \times \text{ASi} \times \text{Di}$$

Where,
Mai= Moisture percentage after irrigation in i^{th} layer
Mbi= Moisture percentage before irrigation in i^{th} layer
Asi= Apparent specific gravity of i^{th} layer (Mg/m3)
Di= Depth of i^{th} layer in cm

2.2 Consumptive use of water (mm)

It was calculated based on the direct soil moisture determinations. The consumptive use of the crop was calculated as detailed by Dastane (1972).

$$\text{Consumptive use of water (cm)} = \sum_{i=1}^{n} \text{Total moisture depleted} + \text{soil moisture contribution} + \text{ER}$$

2.3 Water Use Efficiency (WUE)

Water Use Efficiency (WUE) was worked out by dividing the yield with the amount of water consumed by the crop (i.e., Crop evapotranspiration or crop water use, mm) during its growth period under different treatment of irrigation. Water use efficiency in different irrigation treatment was calculated by the following equation.

$$\text{WUE (Kg ha}^{-1}\text{cm)} = \frac{\text{Grain yield (Kg ha}^{-1}\text{)}}{\text{Total consumptive use of water (cm)}}$$

3. Result and Discussion

3.1 Soil moisture extraction

Data presented in Table 1 revealed that in general maximum moisture was depleted was noted from 0-15 cm depth followed by 15-30 cm depth for all the treatments combination. The moisture depletion increased with the increase in quantity of irrigation water from upper layer of soil (0-15 cm) and minimum was observed with respect to deeper soil layer (45-60 cm) during the course of investigation. The maximum moisture depletion was recorded with variety V_1 (HD-2285) followed by V_2 (NW-1067). The lowest moisture depletion was noted under V_3 (Kundan) at all soil depth, irrespective of irrigation schedules. However, depletion of moisture was increased with increasing irrigation supply with all varieties from 0-15 or 15-30 cm soil depth. This is due to the fact that deeper layers of soil have less density of crop roots than upper density of soil. Frequently irrigated wheat crop (1.2 IW/CPE ratio) extracted more water from the upper soil layer (0-30 cm) than the poorly irrigated crop because of the more availability of moisture in soil profile which increased the potential and greater stomatal conductance. When less amount of water is applied under 0.6 IW/CPE ratio, moisture availability in upper soil layers reduced. Under this situation deeper layers were subjected to more moisture depletion because plant is compelled to extract water from deeper layers which promotes extensive root growth in lower layers. These results are in analogous to those reported by Jana *et al.* (2001) [5] and Kibe and Singh (2003) [7]. Among the wheat cultivars, HD-2285 extracted more water from different soil depth as compared to other cultivars. The pattern of soil moisture depletion revealed that maximum utilization of moisture was from surface soil (0-15 cm) and slowly decreased with increasing depth of soil. This might be due to maximum concentration of roots in the upper layer. The result is in close proximity to that of Banyopadhyay (1997) [3].

Table 1: Soil moisture extraction pattern (cm) as affected by various treatment combinations

Treatment combination	Depth of soil				Soil moisture extraction (cm)
	0-15 cm	15-30 cm	30-45 cm	45-60 cm	
I_1V_1	12.11	9.87	7.25	6.21	35.44
I_1V_2	12.02	9.62	7.20	6.30	35.14
I_1V_3	11.98	9.42	7.11	6.11	34.62
$I_1 V_4$	12.00	9.54	7.14	6.14	34.82
I_2V_1	18.45	15.14	7.10	4.71	45.40
I_2V_2	18.35	15.11	7.01	5.20	45.67
$I_2 V_3$	18.12	16.21	6.88	5.01	46.22
$I_2 V_4$	18.15	16.32	6.68	4.92	46.07
I_3V_1	22.26	19.54	6.14	4.32	52.26
$I_3 V_2$	22.12	19.34	6.21	4.21	51.88
$I_3 V_3$	22.01	19.02	6.11	4.38	51.52
$I_3 V_4$	22.09	19.25	6.02	4.25	51.61

3.2 Consumptive use of water

Data presented in Table 2 indicates that different schedules of irrigation and varieties were found to vary in consumptive use during the investigation. Altogether, the treatment I_3 (1.2 IW/CPE ratio) exhibited the maximum value of consumptive use (51.81 cm). The lowest consumptive use (35.00 cm) was `brought by I_1 (0.6 IW/CPE ratio).On perusal of data in Table 2 further revealed that variety V_1 (HD-2285) recorded the maximum value of consumptive use (44.36 cm) followed by V_2 (NW-1067) and lowest with V_3 (Kundan). This was mainly due to better growth of crop and simultaneously the loss of water through evaporation under treatment. Inadequate moisture supply to the crop under irrigation scheduling at 0.6 IW/CPE ratio resulted in lowest consumptive use of water. Similar results were observed by Singh *et al.* (2003) [10] and Saren *et al.* (2004) [9].

Table 2: Consumptive use of water (cm) as affected by different treatment combinations.

Treatments	V1	V2	V3	V4	Mean
I_1	35.44	35.14	34.62	34.82	35.00
I_2	45.40	45.67	46.22	46.07	45.84
I_3	52.26	51.88	51.52	51.61	51.81
Mean	44.36	44.23	44.12	44.16	

3.3 Water use efficiency
An examination of Table 3 indicates that water use efficiency decreased markedly with increased supply of irrigation. The maximum water use efficiency (101.75 kg $ha^{-1}cm^{-1}$) was obtained under irrigation scheduling I_1 (0.6 IW/CPE ratio) followed by I_2 (0.9 IW/CPE ratio) and I_3 (1.2 IW/CPE ratio). WUE refers largely to the grain yield per unit of water consumed by the crop. The highest water use efficiency was recorded under 0.6 IW/CPE ratio followed by 0.9 IW/CPE ratio. This might be due to higher yield obtained with less amount of water used. Declined WUE under increasing level of irrigation at 1.2 IW/CPE ratio might be because the grain yield did not increased proportionately to the consumptive use under this treatment. Kolkar *et al*., (2010) [6], Ahmad (2002) [2], Rathore and Patel (1991) [8] and Singh *et al.* (2003) [10] were also of the same opinion. Wheat cultivar HD-2285 recorded highest water use efficiency followed by NW-1067. This might be due to the fact that under high yielding varieties plant consumes less water to produce more yield.

Table 3: Water use efficiency (kg/ha/cm) as affected by different treatment combinations

Treatments	V1	V2	V3	V4	Mean
I_1	109.82	103.93	94.02	99.22	101.75
I_2	97.44	91.35	83.41	86.13	89.58
I_3	88.63	84.19	77.33	80.68	82.70
Mean	98.63	93.15	84.92	88.67	

4. Conclusion
It can be concluded that mean highest consumptive use of water (51.81 cm) was found under six irrigation applied at 1.2 IW/CPE ratio (I_3) and highest water use use efficiency (88.63cm) was recorded under treatment I_1V_1 (irrigation at 0.6 IW/CPE ratio (I_1) with variety HD-2285 (V_1) in comparison to rest of the treatments.

5. References

1. Anonymous. Agricultural statistics at glance. Directorate of economics and statistics, DAC & FW, Govt. of India; c2018. p.78.
2. Ahmad A. Effect of irrigation scheduling on the performance of wheat genotypes in Vertisols, M.Sc. (Agri.) Thesis. University of Agricultural Sciences, Dharwad; c2002
3. Bandyopadhyay PK. Effect of irrigation schedules on evapotranspiration and water use efficiency of winter wheat (*Triticum aestivum* L.) Indian Journal of Agronomy. 1997;42(1):90-93.
4. Condon AG, Richards RA, Rebetzke GJ, Farquhar GD. Breeding for high water use efficiency. J Exp. Bot. 2004;55:2447-2460.
5. Jana PK, Bandyopadhyay P, Ray D, Bhowmick MK. Response of wheat to irrigation regimes in new alluvial Zone of West Bengal. Annals of Agricultural Research. 2001;22:498-502.
6. Khokhar B, Hussain I, Khokhar Z. Effect of different irrigation frequencies on growth and yield of different wheat genotypes in Sindh. Pakistan. J Agric. Res. 2010;23:108-113.
7. Kibe AM, Singh S. Influence of irrigation, nitrogen and zinc on productivity and water use of late sown wheat (*Triticum aestivum* L.). Indian Journal of Agronomy. 2003;48(3):186-191.
8. Rathore AL, Patel SL. Studied on nitrogen and irrigation requirement of late sown wheat. Indian J Agron. 1991;36(2):184-187.
9. Saren BK, Dey S, Mandal D. Effect of irrigation and sulphur on yield attributes, productivity, consumptive use, and consumptive use efficiency of wheat (*T. aestivum*). Indian J Agri. Sci. 2004;74(5):257-261.
10. Singh V, Bhunia SR, Chauhan RPS. Respnse of late sown wheat (*Triticum aestivum* L.) to row spacing-cumpopulation density and level of nitrogen and irrigation in north western Rajasthan. Indian Journal of Agronomy. 2003;48(3):178-181.
11. Huixiao Wang, Lu Zhang, Dawes WR, Changming Liu. Improving water use efficiency of irrigated crops in the North China Plain -measurements and modelling, Agricultural Water Management. 2001;48 (2):151-167.