

The effect of scheduling irrigation on yield, concentration and uptake of nutrient in zero tilled wheat (*Triticum aestivum* L.)

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Abstract

The rice–wheat rotation covering 13.5 million ha in the Indo-Gangetic Plains is vital for food security. Its sustainability is at risk as the current production practices are inadequate resulting in high cost of cultivation and inefficient use of inputs (i.e. water, labor and energy).As well as, the water quality and the natural environment are closely related; both are strongly influenced by water quantity and are interrelated with land use. Urban developments altered the vegetation cover and other human activities created point and diffuse sources of pollution, and change of regime adversely affecting quality, quantity and seasonal availability of water. Since water is a very costly monetary input, its efficient and economic use is a problem which confronts farmers and agriculture scientists in irrigated areas. Present study was conducted during Rabi 2004-05 on wheat (*Triticum aestivum* L.) crop variety PBW-343 to study the effect of irrigation scheduling on wheat NPK concentration, uptake and yield sown with the help of Pantnagar zero ferti seed drill .Four different irrigation schedules based on pan evaporation (mm/day) were replicated six times in a Randomized block design. It was observed that significant increase in grain yield was recorded due to increased IW:CPE ratios. The highest yield (40.1 q ha⁻¹) was obtained when irrigation water supplied at IW:CPE ratio of 1.2. Maximum concentration of nitrogen in grain and straw was recorded with IW:CPE 0.3, maximum phosphorus content and uptake was observed with IW:CPE ratio 1.2 and Concentration of K in grain and straw and their uptake increased with increase in irrigation schedules from 0.3 to 1.2 IW:CPE ratio and maximum potassium content and uptake was observed with IW:CPE ratio of 1.2.

Key words: wheat ,irrigation scheduling ,nutrient uptake, zero tillage

Introduction: Crop growth and development as well as yield are the result of the efficiency of the chosen agricultural management system within the boundaries of the agro-ecological environment. End-of-season yield results do not permit the evaluation of within-season management interactions with the production environment and do not allow for full understanding of the management practice applied. For full exploitation of yield potential of high yielding dwarf wheat (*Triticum aestivum* L.) water is of paramount importance to maintain optimum level of moisture supply at optimum time for proper growth, development and yield .Irrigation scheduling is used to determine time and depth of water

application for each irrigation. However it is not easy for common farmers to adopt proper irrigation scheduling practices. Since water is a very costly monetary input, its efficient and economic use is a problem which confronts farmers and agriculture scientists in irrigated areas.

Material and methods: A field study during Rabi 2004-05 was conducted on wheat (*Triticum aestivum* L.) crop variety PBW-343 to study the effect of irrigation scheduling on wheat NPK concentration, uptake and yield sown with the help of Pantnagar zero ferti seed drill on November 27, 2004 in Crop Research Centre (CRC), GBPUA&T., Pantnagar, U.S. Nagar, Uttarakhand located at 29°N latitude, 79.29°E longitude and an altitude of 243.84 m above the mean sea level in the *Tarai* belt of Shiwalik range of the Himalayan foot hills characterized by a sub-tropical and sub humid climate. The experimental plot had silty clay loam soil, in texture and classified as mollisol. Soil of the experimental plot was rich in organic carbon, low in available nitrogen and medium in available phosphorus and

potash and neutral in reaction. For the last several years rice - wheat cropping system was followed in the experimental field. Four treatments (different irrigation schedules (Irrigation at 0.3 IW/CPE ratio(I₁), Irrigation at 0.6 IW/CPE ratio(I₂), Irrigation at 0.9 IW/CPE ratio (I₃) and Irrigation at 1.2 IW/CPE ratio (I₄) based on pan evaporation (mm/day) were replicated six times in a Randomized block design. The crop was fertilized at the rate of 150 kg N, 60 kg P₂O₅ and 40 kg K₂O per hectare through urea, single super phosphate (SSP) and muriate of potash (MOP) respectively. Isoproturon @ 1.0 kg/ha was applied at 30-35 days after sowing for the control of weeds. At maturity, net plot area (8.4m²) was harvested manually and threshed with the help of Pullman thresher. The nitrogen, phosphorus and potash concentration (%) and uptake (kg/ha) in grain as well as straw at maturity were determined by modified micro kjeldahl method (Jackson 1973), molybdo vanado phosphoric acid method (Jackson 1973) with the help of spectrophotometer and flame photometer respectively. Nitrogen uptake (kg/ha) was calculated as follows:

$$\text{Total nitrogen uptake (kg/ha)} = \text{N uptake by straw (kg/ha)} + \text{N uptake by grain (kg/ha)}$$

Where,

$$\text{Nitrogen uptake by grain (kg/ha)} = \frac{\text{Nitrogen concentration in grain (\%)} \times \text{grain yield (kg/ha)}}{100}$$

$$\text{Nitrogen uptake by straw (kg/ha)} = \frac{\text{Nitrogen concentration in straw (\%)} \times \text{straw yield (kg/ha)}}{100}$$

Same procedure was adopted both for phosphorus and potassium.

Results and discussion

Effect on NPK concentration

Nitrogen concentration in grain and straw

The maximum concentration of nitrogen in grain and straw was due to treatment IW:CPE 0.3, which was significantly higher than other IW/CPE ratio (0.6, 0.9 and 1.2) (Table-1). The N concentration in grain due to IW:CPE 1.2 and 0.9 being at par among them selves and significantly lower than due to IW/CPE 0.6. Due to IW/CPE 0.6 and 0.9, the nitrogen concentration in straw was at par among them selves insignificantly higher than IW/CPE 1.2.

Phosphorus concentration in grain and straw

The maximum concentration of P in grain and straw was due to IW/CPE 1.2, which was significantly higher than IW/CPE 0.9, 0.6 and 0.3. The P concentration in grain due to IW/CPE 0.9 and 0.6 being significant to each other and also both had significantly higher value of P concentration than IW/CPE 0.3 (Table-1). The P concentration in straw due to IW:CPE 0.6 and 0.9 being at par with each other and significantly higher than IW/CPE ratio of 0.3.

Potassium concentration in grain and straw

The maximum concentration of K in grain and straw was due to IW/CPE 1.2, which was significantly higher than IW/CPE 0.9, 0.6 and 0.3 (Table-1). The K concentration in grain and straw due to IW:CPE 0.9 and 0.6 being significant to

each other and also both had significantly higher value of K concentration than IW/CPE 0.3.

Effect on NPK uptake

N uptake of grain and straw

The maximum uptake of N of grain and straw was due to IW/CPE 1.2, which was significantly higher than other ratio (IW/CPE 0.3, 0.6 and 0.9). The N uptake of grain due to IW/CPE 0.6, 0.3 and 0.9 were at par among themselves (Table-2). The N uptake of straw due to IW:CPE 0.6 and 0.9 being at par among them selves and significantly higher than IW/CPE0.3. The total uptake of N by plant was significantly higher due to IW/CPE 1.2. Total uptake of N by plant due to IW:CPE 0.3 and 0.6 being at par among them selves and significantly lower than IW/CPE 0.9.

P uptake of grain and straw

Highest P uptake due to IW/CPE 1.2, which was significantly higher than other treatments (IW:CPE 0.3, 0.6 and 0.9) (Table-2). The P uptake by grain and straw due to IW/CPE 0.9 was at par with IW:CPE 0.6 and significantly higher than IW:CPE 0.3. The total uptake was significantly high due to IW:CPE 1.2 than other treatments (IW/CPE 0.6, 0.9 and 0.3). The total uptake by plant at IW/CPE 0.6 and 0.9 were at par with each and significantly higher than IW/CPE 0.3.

K uptake of grain and straw

The maximum uptake of K of grain and straw was due to IW/CPE 1.2, which was significantly higher than other ratio (IW/CPE 0.3, 0.6 and 0.9) (Table-2). The K uptake of grain and straw due to IW:CPE 0.6 and 0.9 being at par among them selves and significantly higher than IW/CPE 0.3. The total uptake was maximum at IW/CPE 1.2, which was significantly higher than rest of IW/CPE ratio. The total uptake due to IW/CPE 0.6 and 0.9 were significantly among them selves and also significant over IW/CPE 0.3.

Effect on yield:

Although, all yield attributes are decided by genetic makeup of that particular crop and variety, but the agronomic manipulation also affect them to a great extent. The reproductive growth depends on vegetative growth of plant, more

vegetative growth increase number of leaves and supply photosynthates for the formation of spike, grains in spike and other yield attributes.

In present study, it was observed that significant increase in grain yield was recorded due to increased IW:CPE ratios. The highest yield (40.1 q ha⁻¹) was obtained when irrigation water supply at IW:CPE ratio of 1.2 (Table-3). Increase in grain yield was due to increase in yield attributes and more so due to significant increase in number of spike per m², number of grains per spike, fertile spikelets per spike, spike length, 1000-grain weight and grain to straw ratio. Patel and Upadhyay, (1993) reported that the higher grain yield IW:CPE ratio 1.2, was the result of improved yield attributes, viz. effective tiller per meter row length, spikelets per spike, number of grains per spike, grain weight per spike and 1000-grain weight. Similar findings have also been reported by Khola *et al.* (1989), Sharma *et al.* (1990) and Gupta *et al.* (1990). The highest straw yield was observed at IW:CPE 1.2, which was significantly higher than IW:CPE 0.9, 0.6 and 0.3. The straw yield with IW:CPE 0.9 and 0.6 being at par among them-selves and significantly higher than that of IW:CPE 0.3. The biological yield (98.4 q ha⁻¹) and harvest index (43.4%) was also maximum at IW:CPE ratio 1.2 followed by 0.9, similar results were also confirmed by Patel and Upadhyay (1993).

Conclusion: From the above study, it may be concluded that, application of irrigation water at IW:CPE 1.2 prove to be optimum for exploiting the full production potential of wheat cv. PBW-343 grown in zero tillage (after harvest of rice crop) under shallow water table condition of the *Tarai* region of Uttaranchal. However, these finding are single crop based which in future need to be confirmed on system basis.

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Table . 1. N, P and K concentration of grain and straw as influenced by different irrigation schedules

Treatment	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
IW:CPE = 0.3	1.799	0.523	0.342	0.073	0.336	1.251
IW:CPE = 0.6	1.755	0.510	0.351	0.080	0.346	1.314
IW:CPE = 0.9	1.711	0.504	0.363	0.085	0.355	1.405
IW:CPE = 1.2	1.706	0.493	0.373	0.096	0.363	1.49
S.Em±	0.011	0.003	0.002	0.002	0.002	0.007
C.D. at 5%	0.032	0.008	0.007	0.006	0.007	0.021

Table 2. N, P and K uptake by Grain, Straw and Total as influenced by different irrigation schedules.

Treatment	Nitrogen (kg ha ⁻¹)			Phosphorus (kg ha ⁻¹)			Potassium (kg ha ⁻¹)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total

IW:CPE = 0.3	57.2	26.3	83.61	11.40	3.7	15.19	11.1	73.4	84.57
IW:CPE = 0.6	59.9	29.0	88.36	12.09	4.6	16.75	11.7	79.2	90.97
IW:CPE = 0.9	60.7	30.3	91.12	12.53	5.0	17.54	12.2	82.5	94.85
IW:CPE = 1.2	71.8	32.1	103.9	4.94	5.8	20.80	14.5	86.9	101.55
S.Em±	1.12	0.46	1.03	0.26	0.16	0.29	0.23	1.28	1.25
C.D. at 5%	3.37	1.4	3.12	0.80	0.50	0.87	0.71	3.87	3.76

Table :3. Effect of different irrigation schedules on grain yield, straw yield, Biological yield of wheat

Treatments	Grain (q ha ⁻¹)	Straw (q ha ⁻¹)
IW: CPE = 0.3	32.6	50.0
IW:CPE = 0.6	33.4	53.6
IW: CPE = 0.9	34.1	55.5
IW: CPE = 1.2	40.1	58.3
S.Em±	0.62	0.87
C.D. at 5%	1.89	2.63