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The impact of irrigation scheduling and integrated nutrient management on wheat growth (*Triticum aestivum* L.)

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Abstract
The current study was designed and carried out over two consecutive *rabi* seasons, 2018-19 and 2019-20, at the Agricultural Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The experiment was designed in a split plot design with three replications and four irrigation scheduling options. i.e. I_1: Irrigation at 1.0 IW/CPE ratio, I_2: Irrigation at 0.6 IW/CPE ratio during vegetative phase + 1.0 IW/CPE ratio during reproductive phase, I_3: Irrigation at 0.8 IW/CPE ratio during vegetative phase + 1.0 IW/CPE ratio during reproductive phase and I_4: Irrigation at 1.0 IW/CPE ratio during vegetative phase + 1.2 IW/CPE ratio during reproductive phase in main plot and five nutrient management practices i.e. M_0: 100% RDF (150,60,40 kg NPK ha^{-1}), M_1: 75% RDF + 25% N through NADEP compost, M2: 75% RDF + 25% N through NADEP compost + consortia of bio inoculants (Azotobacter, Phosphate solubilising bacteria, Zinc solubilising bacteria), M_3: 75% RDF + 25% N through municipal solid waste compost & M_4: 75% RDF + 25% N through municipal solid waste compost + consortia of bio-inoculants (Azotobacter, Phosphate solubilising bacteria, Zinc solubilising bacteria) in sub plot. Among the irrigation scheduling, irrigation applied at 1.0 IW/CPE ratio and among nutrient management, crop fertilized with 75% RDF + 25% N through NADEP compost + consortia of bio inoculants (*Azotobacter*, Phosphate solubilising bacteria, Zinc solubilising bacteria), resulted better growth *i.e.* plant height and leaf area index of crop (wheat).

Keywords: IW/CPE, wheat-maize, wheat growth, INM

Introduction

In terms of cultivated cereals, wheat is one of the most significant food crops in the world. (Waines and Hegde, 2003) [13]. Wheat growing has acted as a symbol of the green revolution, hence it is also known as the wheat revolution. Wheat is the second most important staple crop in India after rice, according to Mishra *et al*. (2005) [7], and ranks first in dietary proportions in northern India, which is represented by the Gangetic plains. India has the most wheat farming area in the world, producing 99.70 million tonnes of wheat each year. With 121.72 million tonnes, China produces the most wheat (Agricultural Statistics at a Glance, 2018) [1]. Wheat yield varies greatly across India's agro-ecologies due to various meteorological conditions, moisture stress, genotypes, uneven fertiliser use, sowing timings and practises, and other management practises (Kantwa *et al*., 2015) [4]. Furthermore, because it is often grown in light-textured soils with limited water-holding capacity, low levels of nitrogen, phosphate, and organic matter, it produces poor growth and yield. Wheat's nutritional value is equivalent to that of other important cereals.

Irrigation scheduling is a critical component of effective water management. Moisture stress during some of the most critical growth periods might result in reduced test weight and significantly poorer grain yield (Kumar *et al*., 2015) [5]. Efficient water management is one of the best agronomic management strategies since it not only enhances crop yield but also minimises the risk of insect pest proliferation through proper moisture and heat control (Singh *et al*., 2012) [9]. The IW/CPE ratio is one of the most important irrigation scheduling approaches for water conservation. Organic manures are natural substances that are prepared to decompose into the soil and supply food and nutrients to plants by promoting the development of vital soil microbes. The microorganisms change the nutrients in the soil and manure into a form that plants can easily absorb. Its primary purposes include naturally supplying nutrients, maintaining the soil's capacity to store water, supplying organic acids to dissolve nutrients, balancing soil pH, and promoting the development of vital microorganisms. Biofertilizers are widely acknowledged as an essential component of integrated plant nutrition management for long-term agriculture. As biofertilizers for cereals, oilseeds, vegetables, and other economically important crops, microorganisms such as *Azotobacter*, *Azospirillum*, *Pseudomonas*, and *Acetobacter* are commonly utilised. *Azotobacter* is a widely isolated and studied free-living nitrogen fixer that contributes to nitrogen economy and soil fertility. When utilised as bio-inoculants, *Azotobacter* has a range of useful properties, some of which can be exploited to improve agricultural yields. High nitrogen fixation, ammonia excretion (Narula *et al*., 1981) [8], growth stimulants (Verma *et al*., 2001a) [11], siderophore synthesis (Suneja *et al*., 1996) [10], and antifungal qualities (Verma *et al*., 2001b) [12] are among these advantageous characteristics.

Materials and Method

The current investigation was carried out in Gangetic Alluvial soil (entisols), which is a sandy clay loam with a slightly alkaline response, low in organic carbon and available nitrogen, and medium in available phosphorus and potassium. The current study was designed and carried out over two consecutive *rabi* seasons, 2018-19 and 2019-20, at the Agricultural Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The experiment was designed in a split plot design with three replications and four irrigation scheduling options *i.e.* I_1: Irrigation at 1.0 IW/CPE ratio, I_2: Irrigation at 0.6 IW/CPE ratio during vegetative phase + 1.0 IW/CPE ratio during reproductive phase, I_3: Irrigation at 0.8 IW/CPE ratio during vegetative phase + 1.0 IW/CPE ratio during reproductive phase and I_4: Irrigation at 1.0 IW/CPE ratio during vegetative phase + 1.2 IW/CPE ratio during reproductive phase in main plot and five nutrient management practices *i.e.* M_0: 100% RDF (150,60,40 kg NPK ha^{-1}), M_1: 75% RDF + 25% N through NADEP compost, M_2: 75% RDF + 25% N through NADEP compost + consortia of bio inoculants (*Azotobacter*, Phosphate solubilising bacteria, Zinc solubilising bacteria), M_3: 75% RDF + 25% N through municipal solid waste compost & M_4: 75% RDF + 25% N through municipal solid waste compost + consortia of bio-inoculants (*Azotobacter*, Phosphate solubilising bacteria, Zinc solubilising bacteria) in sub plot. Thus, a total of 20 treatment combinations were examined and duplicated three times in the study. HD 2967 wheat variety was utilised. Other crop management practises were implemented in accordance with the area's recommendations.

Experimental finding

Plant height

Plant height of wheat was affected by various irrigation scheduling treatments over both years' during entire crop growth period. The analysis of the data revealed that plant height increased steadily as crop age advanced, and that was increased up to at harvest stage. At 30 DAS, the 1.0 IW/CPE-VP + 1.2 IW/CPE-RP showed the maximum plant height which was at par with 1.0 IW/CPE-VP & RP and significantly superior over rest of the treatments during both of years of experiment. However, at 60 DAS, 1.0 IW/CPE was showed the maximum plant height and it was at par with 1.0 IW/CPE-VP + 1.2 IW/CPE-RP. The lowest plant height was recorded in 0.6 IW/CPE-VP + 1.0 IW/CPE-RP at 30 DAS and 60 DAS during both year of experiment. At 90 DAS much larger plant heights was achieved by 1.0 IW/CPE which was statistically comparable to 1.0 IW/CPE-VP + 1.2 IW/CPE-RP. When crop came to the harvest stage, 1.0 IW/CPE-VP & RP treatment produced noticeably taller plants, which was statically at par with 1.0 IW/CPE-VP + 1.2 IW/CPE-RP in both years of the trial. At all growth stages throughout the course of the two research years, 0.6 IW/CPE-VP + 1.0 IW/CPE-RP treatments were shown to result in the smallest plant height.

Plants of wheat at all development stages had a strong impact from integrated nutrient management. Application of 100% RDF, shown superiority in plant height (20.3 and 22.50 cm) at 30 DAS, which was statistically comparable to 75% RDF + 25% N-NADEP + Consortia of bio-inoculants and 75% RDF + 25% N-MSWC + Consortia of bio-inoculants throughout both research years. At 60 DAS, application of 75% RDF + 25% N-NADEP + Consortia of bio-inoculants resulted in considerably highest plant height, which was statistically comparable to 75% RDF + 25% N-MSWC + Consortia of bio-inoculants for both experimental years. At 90 DAS, 75% RDF + 25% N-NADEP + Consortia of bio-inoculants treatment exerted noticeably highest plant height and it was comparable to 75% RDF + 25% N-MSWC + Consortia of bio-inoculants in 2018-19 and 2019-20. Over the course of the two testing years, a similar pattern was also seen at the harvest stage. Whereas, the treatment 75% RDF + 25% N-NADEP was produced the smallest plant height during 30, 60, 90 and at harvest period of both year.

Leaf area index (LAI)

Analysis of the data showed that varied irrigation scheduling had a substantial impact on the test crop's leaf area index at different times. At 30 DAS, the 1.0 IW/CPE-VP + 1.2 IW/CPE-RP treatment exerted a much larger leaf area index than the other treatments during both years of experiment. However, at 60 and 90 DAS, the maximum leaf area index was seen in 1.0 IW/CPE-VP & RP which was statically at par with 1.0 IW/CPE-VP + 1.2 IW/CPE-RP for both years (2018-19 and 2019-20). While the least leaf area index was noticed under 0.6 IW/CPE-VP + 1.0 IW/CPE-RP treatments in entire research period of both year at all growth stages.

In application of integrated nutrients management treatments, 100% RDF generated considerably highest leaf area indices at 30 DAS which was statistically comparable to the rest of treatments during both year of experiment. At 30 DAS data showed non significant relation between all the nutrient management treatments but at 60 and 90 DAS 75% RDF + 25% N-NADEP + Consortia of bio-inoculants was statically at par with the 75% RDF + 25% N-MSWC + Consortia of bio-inoculants and significantly superior over the rest of treatments. A similar pattern was seen for both of the experimental years. While 75% RDF + 25% N-NADEP treatments had the lowest leaf area index in both year of experiments at all growth stages.

Table 1: Plant height of wheat at different growth stages as influenced by irrigation scheduling and integrated nutrient management system.

Treatments	Plant height (cm)							
	30 DAS		60 DAS		90 DAS		At Harvest	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Irrigation Scheduling								
1.0 IW/CPE	18.7	20.4	42.2	44.8	95.2	100.3	99.8	101.7
0.6 IW/CPE-VP + 1.0 IW/CPE-RP	17.2	18.3	35.5	37.5	85.8	91.2	89.7	91.0
0.8 IW/CPE-VP + 1.0 IW/CPE-RP	18.3	19.6	38.2	40.1	88.8	93.4	92.3	93.8
1.0 IW/CPE-VP + 1.2 IW/CPE-RP	19.5	21.2	40.3	42.9	92.8	97.8	96.4	98.0
SEm ±	0.33	0.35	0.65	1.04	1.50	1.58	1.90	1.99
LSD (P=0.05)	0.93	1.02	1.98	3.12	4.53	4.73	5.72	5.95
Nutrient Management								
100% RDF	20.3	22.50	37.8	39.6	90.4	95.4	95.3	95.3
75% RDF + 25% N-NADEP	16.8	17.3	35.3	37.5	85.0	89.7	84.9	89.8
75% RDF + 25% N-NADEP + Consortia of bio-inoculants	18.9	20.6	44.2	46.8	95.3	101.8	102.7	103.2
75% RDF + 25% N-MSWC	17.7	18.6	36.1	38.8	88.6	93.6	90.2	92.4
75% RDF + 25% N-MSWC + Consortia of bio-inoculants	18.4	19.9	41.5	43.9	93.9	98.2	99.6	99.8
SEm ±	0.63	0.87	0.91	0.98	1.23	1.26	1.42	1.63
LSD (P=0.05)	1.90	2.62	2.70	2.93	3.60	3.82	4.20	4.82
Irrigation Scheduling x Nutrient Management	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Leaf area index of wheat at different growth stages as influenced by irrigation scheduling and integrated nutrient management system.

Treatments	Leaf Area Index					
	30 DAS		60 DAS		90 DAS	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Main Plot: Irrigation Scheduling						
1.0 IW/CPE	1.23	1.27	4.59	4.73	4.97	5.30
0.6 IW/CPE-VP + 1.0 IW/CPE-RP	1.10	1.16	3.73	3.77	3.94	4.07
0.8 IW/CPE-VP + 1.0 IW/CPE-RP	1.16	1.21	3.97	4.02	4.26	4.23
1.0 IW/CPE-VP + 1.2 IW/CPE-RP	1.29	1.31	4.35	4.52	4.72	4.91
SEm ±	0.06	0.07	0.19	0.21	0.23	0.34
LSD (P=0.05)	NS	NS	0.60	0.65	0.70	1.01
Sub Plot: Nutrient Management						
100% RDF	1.34	1.50	4.14	4.18	4.32	4.42
75% RDF + 25% N-NADEP	1.01	1.05	4.03	4.07	4.26	4.35
75% RDF + 25% N-NADEP + Consortia of bio-inoculants	1.28	1.32	4.67	4.65	4.98	5.15
75% RDF + 25% N-MSWC	1.09	1.11	3.74	3.95	4.15	4.33
75% RDF + 25% N-MSWC + Consortia of bio-inoculants	1.24	1.20	4.22	4.45	4.64	4.87
SEm ±	0.14	0.16	0.15	0.15	0.18	0.23
LSD (P=0.05)	NS	NS	0.46	0.46	0.56	0.70
Irrigation Scheduling x Nutrient Management	NS	NS	NS	NS	NS	NS

Conclusion

Among the irrigation scheduling, irrigation applied at 1.0 IW/CPE ratio and among nutrient management, crop fertilized with 75% RDF + 25% N through NADEP compost + consortia of bio inoculants (*Azotobacter*, Phosphate solubilising bacteria, Zinc solubilising bacteria), resulted better growth *i.e.* plant height and leaf area index value of wheat.

Discussion

Regarding irrigation scheduling, when apply irrigation at 1.0 IW/CPE-VP & RP resulted in higher values for most of the growth parameters compared to other irrigation schedules. This demonstrates that irrigation at 1.0 IW/CPE-VP & RP provided most favorable and adequate soil moisture throughout the wheat crop during growth period. In the presence of sufficient soil moisture supply regulates metabolic processes in plants, maintains cell turgidity, and promotes cell division and elongation. For getting early vegetative growth, nitrogen is essential component in cell differentiation and elongation. When the nutrients supply by organic sources leads to slow release of nutrient. In this experiment, nitrogen was supplied through various sources such as NADEP and municipal solid waste component. When the nutrient supplied by 75% RDF + 25% N-NADEP + Consortia of bio-inoculants resulted in obtaining higher growth parameter compression to the rest of treatment at maximum growth stages.

References

1. Agricultural Statistics at a Glance, Government of India, Ministry of Agricultural & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics; c2018.
2. Bhardwaj V, Yadav V, Chauhan BS. Effect of nitrogen application timings and varieties on growth and yield of wheat grown on raised beds. Archives of Agronomy and Soil Science. 2010 Apr 1;56(2):211-222.
3. Cala V, Cases MA, Walter I. Biomass production and heavy metal content of *Rosmarinus officinalis* grown on organic waste-amended soil. Journal of Arid Environments. 2005 Aug 1;62(3):401-412.
4. Kantwa SR, Choudhary U, Sai Prasad SV. Tillage x early sown wheat genotypes interaction effect on nutritional

quality, productivity and profitability in central India. Green farming. 2015;6(5):1098-1101.
5. Kumar B, Dhar S, Vyas AK, Paramesh V. Impact of irrigation schedules and nutrient management on growth, yield and root traits of wheat (*Triticum aestivum*) varieties. Indian Journal of Agronomy. 2015;60(1):87-91.
6. Logan TJ, Lindsay BJ, Goins LE, Rayan JA, Field assessment of sludge metal bioavailability to crops: Sludge rate response, Journal of Environmental Quality. 1997;26(2):534-550.
7. Mishra B, Shorean J, Chatrath R, Sharma AK, Gupta RK, Sharma RK, *et al*. Cost effective and Sustainable Wheat Production Technology, Directorate of wheat research, Karnal, Technical Bulletein. 2005;8:1.
8. Narula N, Lakshminarayana K, Tauro P. Ammonia excretion in *Azotobacter chroococcum*. Biotechnol Bioengin. 1981;23(2):467-470.
9. Singh L, Singh CM, Singh GR. Response of bed planted wheat (*Triticum aestivum* L.) under the different moisture regime on water use and it's efficiency. Journal of Chemical and Pharmaceutical Research. 2012;4(11):4941-4945.
10. Suneja S, Narula N, Anand RC, Lakshminarayana K. Relationship of *Azotobacter chroococcum* siderophores with nitrogen fixation, Folia Microbiology. 1996;41(2):154-158.
11. Verma A, Kukreja K, Pathak DV, Suneja S, Narula N. In vitro production of plant growth regulators (PGRs) by *Azotobacter chroococcum*, Indian Journal of Microbiology. 2001a;41:305-307.
12. Verma S, Kumar V, Narula N, Merbach W. Studies on in vitro production of antimicrobial substances by *Azotobacter chroococcum* isolates/ mutants. Journal of Plant Disease Protect. 2001b;108:152-165.
13. Waines JG, Hegde SG. Intraspecific gene flow in bread wheat as affected by reproductive biology and pollination ecology of wheat flowers. Crop Science. 2003 Mar;43(2):451-463.