E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(8): 407-410
Received: 01-05-2025
Accepted: 05-06-2025

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Integrated irrigation and nutrient management for sustainable wheat (*Triticum aestivum* L.) production in central Uttar Pradesh

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DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8Sf.3594

Abstract
The study, which was carried out on the agricultural farm of RAMA UNIVERSITY, KANPUR, 209217, (U.P.) INDIA, focused on "Integrated Irrigation and Nutrient Management for Sustainable Wheat (*Triticum aestivum* L.) Production in Central Uttar Pradesh" during the Rabi season of 2023-2024. Three replications of the experiment were conducted using a Factorial RBD design. In addition to four nutrient management schedules (N0 Control no fertilizer, N1 100% RDF (NPK 120:60:40), N2 NPK + FYM 10 t/ha, and N3NPK+ vermicompost 10 t/ha), the main plot was assigned four irrigation schedules: I_0 Control no irrigation, I_1 at CRI stage (25 DAS), I_2 at tillering stage (45 DAS), and I_3 at milking stage (105 DAS). In terms of biological yield, grain yield, straw yield, harvest index, and B:C ratio,and economics the irrigation schedule (I_1 at CRI stage (25 DAS)) and nutrient doses (N_2 NPK + FYM 10t/ha) were found to be the most effective among the factors used.

Keywords: Irrigation, NPK, FYM, vermicompost

Introduction
Wheat (*Triticum aestivum* L.) makes up 36.2% of the nation's total food grain reserves and is the second most significant food crop in India after rice. It has been cultivated in a wide range of agroclimatic conditions. There were 215.49 million hectares of wheat cropped worldwide, with a production of 730.84 million tonnes and a productivity of 3390 kg ha^{-1}. In terms of wheat production, the European Union leads the globe, followed by China, India, Russia, the United States, and Australia (FAOSTAT, 2018-19). With an average productivity of 3507 kg ha^{-1} and a total cultivated area of 29.65 million hectares, 103.6 million tonnes of wheat were produced in India (ANONYMOUS, 2018-19).

The Gramineae family includes the annual plant known as wheat (*Triticum aestivum* L.). It is the most extensively grown food crop in the world. Around the world, wheat is a significant staple food crop. India, an agrarian state that leads in both land and wheat output, is the world's second-largest producer of wheat, after China. After rice, wheat is the second most significant annual crop in the world. Runoff from agricultural fields that contain pesticides, fertilizers, waste chemicals from industries, and sewage from cities and rural areas depletes surface water. Additionally, excessive removal for agriculture and other uses, which require expensive fuel and electrical energy to draw groundwater, causes the ground water level to drop. However, the vertical effort has not been able to develop a holistic strategy to build integrated solutions for many problems.

Half of the nitrogen, all of the phosphorus and potash, and all of the cow dung should be mixed in the field during field preparation or during the final plowing. After the first irrigation (20-25 days) and the second irrigation (40-45 days), divide the residual nitrogen into two portions and use them. If the field lacks sulfur, sulfur-containing fertilizers like ammonium sulfate or single super sulfate should be applied. Always use sunlight and clear weather for spraying.

It is commonly known that organic matter controls microbial biomass, nutrient fluxes, and the enhancement of soil's physical, chemical, and biological characteristics. To keep the soil

healthy, additional nutrient mining will need to be resisted. To guarantee the nation's food and nutritional security, soil health must be maintained. All nutrients must be utilized in a balanced quantity for the best fertilizer utilization. However, nothing is known about how well nitrogen and FYM perform in terms of soil fertility and production when wheat is grown in the Agra area of Uttar Pradesh. The goal of the current study was to evaluate how nitrogen and FYM affected the wheat production.

Vermicompost has a higher concentration of microorganisms, which are in charge of the decomposition process, and is rich in plant nutrients. Many organic wastes can be treated with vermicompost, which is an inexpensive and environmentally friendly method. found that soils treated with vermicompost had higher amounts of organic matter, primary nutrients, and soluble salts and a lower pH. Vermicompost, particularly that derived from animal manure, typically contains more mineral components than commercial plant growth media, according to Edwards and Burrows (2010).

Materials and Methods

Grain yield (kgha^{-1})

A mini-plot thresher was used to separate the grains from the biological yield of each net-plot. The net-plot's grain yield was measured and expressed in kg per hectare.

Straw yield (kgha^{-1})

By deducting the grain yield from the total amount of produce gathered and converting it to kilograms per hectare, the straw yield from net-plot area was calculated.

Biological yield (kgha^{-1})

Following harvesting, the wheat crop was allowed to sun-dry for a week before the weight of the net harvested area of wheat in each plot was measured and converted to kilograms per hectare.

Harvest index (HI)

Harvest index is economic yield expressed as percentage of biological yield and calculated as formula

Experimental Finding

Yield Parameters

Biological Yield (kg ha^{-1})

The biological yield (kg ha^{-1}) data as affected by different experimental variable treatments is shown in Table:1.

The impact of different irrigation schedules on biological yield (kg ha^{-1}) was determined to be non-significant. Importantly Wheat yielded 10,525 kg/ha at its maximum biological yield (kg ha^{-1}) when the irrigation schedule I1 (Irrigationat CRI stage(20-25 DAS)) was used. This was followed by other irrigation schedules at 10,152 and 10193 kg/ha, respectively, for I2 (Irrigation at Tillering Stage 40-45 DAS) and I3 (Irrigation at Milking Stage (100-105 DAS). Additionally, I0 (Control) had the lowest biological yield (kg ha^{-1}) at 9075.00 kg/ha.

When it came to nutrient management, N2 (50% RDF+NPK+10 t FYM+ha^{-1}) had the highest biological yield (kg ha^{-1}), at 10,488 kg/ha. N1 and N3 came in second and third, with 10,265 and 10228 kg/ha, respectively. Additionally, N0 (Control without fertilizer) had the lowest biological production (kg ha^{-1}) at 8934.00 kg/ha.

During the experiment, it was discovered that there was no significant interaction between the irrigation schedule and fertilizer management in terms of biological yield (kg ha^{-1}).

Grain yield (kg ha^{-1})

Table 1 shows the results on grain yield (kg ha^{-1}) as influenced by various experimental variable treatments.

The impact of different irrigation schedules on grain yield (kg ha^{-1}) was shown to be non-significant. Importantly The highest grain yield (kg ha^{-1}) was recorded in wheat (4237 kg/ha) when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was implemented. I2 (Irrigation at Tillering Stage 40-45 DAS) and I3 (Irrigation at Milking Stage (100-105 DAS)) had 4026 and 4136 kg/ha, respectively, and were the next irrigation schedules. Additionally, I0 (Control) had the lowest grain output (kg ha^{-1}) at 3948.00 kg/ha.

When it came to nutrient management, N2 (50% RDF+NPK+10 t FYM+ha^{-1}) had the highest grain yield (kg ha^{-1}), with 4221 kg/ha. N1 and N3 came in second and third, with 4137 and 4191 kg/ha, respectively. Additionally, N0 (Control without fertilizer) had the lowest grain output (kg ha^{-1}) at 3897.00 kg/ha.

During the experiment, it was discovered that there was no significant interaction between the irrigation schedule and fertilizer management in terms of grain yield (kg ha^{-1}).

Straw yield (kg ha^{-1})

Table 1 displays the data on straw yield (kg ha^{-1}) as impacted by various experimental variable treatments.

The impact of different irrigation schedules on straw yield (kg ha^{-1}) was determined to be non-significant. Importantly Using irrigation schedule I1 (irrigation at CRI stage (20-25 DAS)) resulted in the highest straw yield (kg ha^{-1}) in wheat, which was 6288 kg/ha. Following this were other irrigation schedules, such as I2 (Irrigation at Tillering Stage 40-45 DAS) and I3 (Irrigation at Milking Stage (100-105 DAS), which had respective rates of 6126 and 6057 kg/ha. Additionally, I0 (Control) had the lowest straw yield (kg ha^{-1}) at 5127.00 kg/ha.

When it came to nutrient management, N2 (50 percent RDF+NPK+10tFYM+/ha^{-1}) had the highest straw yield (kg ha^{-1}), at 6267 kg/ha. N1 and N3 came in second and third, with 6125 and 6037 kg/ha, respectively. Additionally, N0 (Control without fertilizer) had the lowest straw yield (kg ha^{-1}) at 5037.00 kg/ha.

During the experiment, it was discovered that there was no significant interaction between the irrigation schedule and nutrient management in terms of straw yield (kg ha^{-1}).

Harvest index (%)

The harvest index (%) data as impacted by various experimental variable treatments are shown in Table 1.

The impact of different irrigation schedules on the harvest index (%) was determined to be non-significant. The highest harvest index (%) was found to be 42.65% when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was used. Another irrigation program, I2 (Irrigation at Tillering Stage 40-45 DAS) and I3 (Irrigation at Milking Stage (100-105 DAS), came next, with 40.89 and 41.35 percent, respectively. Additionally, I0 (Control) had the lowest harvest index (%) at 40.21 percent.

Regarding nutrient management, N2 (50% RDF+NPK+10 t FYM +ha^{-1}) had the highest harvest index (%) at 42.89%, followed by N1 and N3 at 40.49 and 41.38%. Furthermore, N0 (Control without fertilizer) had the lowest harvest index (%) at 39.89%.

It was determined that there was no significant interaction between the irrigation schedule and nutrient management on the harvest index (%) during the trial.

(G) Economics of the treatments

The treatments' economics were examined using the current rates listed in Table 2.

Table 2 displays the B:C ratio and net return statistics for the different treatment combinations. Following four irrigations at the CRI, tillering, and lactation stages and fertilization with RDFof (NPK+FYM 10 t ha^{-1}) (13N3), followed by 13N2 (Rs. 47592/ha), and 13N1 (Rs. 47157/ha), the crop yielded the highest net profit of Rs. 46290/ha. However, the treatment combination 12N0 (3.25) produced the highest B:C ratio, which was closely followed by I1N0 (3.15) and I0N0 (3.03).

Table 1: Effects of nutrient management and irrigation schedules on biological yield.

Treatment	Biological yield (kgha^{-1})	Grain yield kg ha^{-1}	Straw Yield kg ha^{-1}	Harvest Index%
Irrigation schedules				
I_0 Control without irrigation	9075.00	3948	5127	40.21
I_1 Irrigation at CRI stage (20-25 DAS)	10,525	4237	6288	42.65
I_2 Irrigation at tillering stage (40-45 DAS)	10,152	4026	6126	40.89
I_3 Irrigation at milking stage (100-105 DAS)	10,193	4136	6057	41.35
S.E(m)+-	3.671	6.451	3.564	0.564
C.D. (at 5%)	7.268	12.842	7.951	1.012
Nutrient Management				
N_0 Control without fertilizer	8934	3897	5037	39.89
N_1 (50% RDF + NPK + 120:60:40:kg/ha^{-1})	10,265	4137	6128	40.49
N_2 (50% RDF+NPK+10t FYM ha^{-1})	10,488	4221	6267	42.89
N_3 (50% RDF + NPK +10t VC/ha^{-1})	10,228	4191	6037	41.38
S.E (m)+-	4.261	6.592	3.948	0.948
C.D. (at5%)	8.452	1.351	7.895	1.821
Interaction(AXB)	NS	NS	NS	NS
SE (m)	3.645	6.342	2.954	0.856
CD 5%	7.261	13.264	5.893	1.501

Table 2: Economics of treatment

	Treatment	Grain yield (q/ha)	Straw yield (q/ha)	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	B.C Ratio
1	I_0N_0	40.32	60.24	57585	18980	38605	3.03
2	I_0N_1	42.31	63.24	60423	22493	37930	2.68
3	I_0N_2	44.22	65.72	63089	24993	38096	2.52
4	I_0N_3	46.18	69.11	65978	27493	38485	2.39
5	I_1N_0	43.09	64.20	61508	19480	42028	3.15
6	I_1N_1	45.64	67.99	65148	22993	42155	2.83
7	I_1N_2	53.04	68.28	7556	20493	-12937	0.36
8	I_1N_3	49.34	73.96	70523	27993	42530	2.51
9	I_2N_0	44.37	66.24	63363	19480	43883	3.25
10	I_2N_1	46.50	69.46	66413	22993	43420	2.88
11	I_2N_2	49.07	71.19	69664	25493	44171	2.73
12	I_2N_3	52.47	74.54	74176	27993	46183	2.64
13	I_3N_0	47.41	7034	67618	20493	47125	3.29
14	I_3N_1	54.57	70.02	76146	22393	53753	3.40
15	I_3N_2	55.34	72.38	77259	23592	53667	3.27
16	I_3N_3	56.16	76.24	78896	24876	54020	3.17

Summary and Conclusion

The following is a summary of the various growth, yield attribute, yield parameters, and quality parameters of the experiment "Integrated Irrigation and Nutrient Management for Sustainable Wheat (*Triticum aestivum* L.) Production in Central Uttar Pradesh" that was carried out at the Agricultural Farm RAMA University, Kanpur 20917 (U.P.), India, during 2023-24. With three replications and two factors—nutrient management and irrigation schedule—the experiment was set up in RBD. The following is a summary of the key findings:-

It was discovered that different watering schedules had a substantial impact on biological production (kg ha^{-1}). Importantly Wheat produced the highest biological yield (kg ha^{-1}) at 10,525 kg/ha when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was implemented. The N2 (50% RDF+NPK+10 t FYM ha^{-1}) had the highest biological yield (kg ha^{-1}) in the scenario of nutrient management, at 10,488 kg/ha.

It was discovered that different irrigation schedules had a considerable impact on grain yield (kg ha^{-1}). Importantly The highest grain yield (kg ha^{-1}) was recorded at 4237 kg/ha when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was used. When it came to nutrient management, the N2 (50% RDF+NPK+10 t FYM ha^{-1}) produced the highest grain production (kg ha^{-1}) at 4221 kg/ha.It was discovered that different watering schedules had a substantial impact on straw yield (kg ha^{-1}). Significantly, when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was used, the maximum strawyield (kg ha^{-1}) in wheat was recorded at 6288 kg/ha. When it came to nutrient management, the N2 (50% RDF+NPK+10 t FYM ha^{-1}) had the highest straw production (kgha^{-1}) at 6267 kg/ha.It was discovered that different irrigation schedules had a substantial impact on the harvest index (%). Significantly, when the irrigation schedule I1 (Irrigation at CRI stage (20-25 DAS)) was implemented, the maximum harvest index (%) in wheat was

42.65%. Regarding nutrient management, the N2 (50% RDF+NPK+10 t FYM ha^{-1}) had the highest harvest index (%) at 42.89 percent.

When the crop was irrigated five times at the CRI, tillering, boot, flowering, and milk stages and fertilized with RDF of (NPK+FYM 10 t ha^{-1}), the highest net profit of Rs. 53753/ha was achieved. The treatment combination 11N2 produced the highest B:C ratio (3.67).

Conclusion

Our results indicate that the factors I1 and N2, as well as their combination, were the best in terms of growth characteristics, yield attributes, yield parameters, soil studies, study quality criteria related to nutrient uptake, and benefit-cost ratio.

Reference

1. Chaturvedi I. Effect of phosphorus levels alone or in combination with phosphate-solubilizing bacteria and farmyard manure on growth, yield and nutrient uptake of wheat (*Triticum aestivum* L.). J Agric Soc Sci. 2006;2:96-100.
2. Gholve SG, Kamble SK, Shinde SN. Effect of integrated nutrient management in rice (Oryza sativa)-wheat (*Triticum aestivum*) cropping system in Western Maharashtra. Biofertil Technol. 2004:187-192.
3. Haghverdi A, Leib BG, Washington-Allen RA, Buschermohle MJ, Ayers PD. Studying uniform and variable rate center pivot irrigation strategies with the aid of site-specific water production function. Comput Electron Agric. 2016;123:327-340.
4. Khokhar B, Hussain I, Khokhar Z. Effect of different irrigation frequencies on growth and yield of different wheat genotypes in Sindh. Pak J Agric. 2010;23(3-4):3-4.
5. Mohammed SS, Osman AG, Mohammed AM, Abdall AS, Rugheim AME. Effects of organic and microbial fertilization on wheat growth and yield. Int Res J Agric Sci. 2012;2(4):149-154.
6. Pal SK, Verma UN, Thakur R, Singh MK, Upasani RR. Dry-matter partitioning of late sown wheat under different irrigation schedules. Indian J Agric Sci. 2000;70(12):831-834.
7. Yadav R, Verma S. Productivity, nutrient uptake and water use efficiency of wheat under different irrigation levels and fertility sources. Indian J Ecol. 2010;37(1):13-17.
8. Youssef RA, El-Sharkawy HM, Sawan OM, Eissa MA. Impact of organic manure, biofertilizer and irrigation intervals on wheat growth and grain yield. Am-Eurasian J Agric Environ Sci. 2013;13(11):1488-1496.
9. Zheng H. Limited irrigation for improving water use efficiency of winter wheat in the Guanzhong Plain of Northwest China. Trans ASABE. 2016;59(6):1841-1852.