Effect of moisture regimes and level of nitrogen on growth, yield and economics of Wheat (Triticum aestivum L.)

Urvashi Chaurasia[1], Deepak Pandey[2], Sudhakar Singh[3] and Swaha Shee Chanda[4]

Department of Agronomy

Chandra Bhanu Gupta Ag. Pg. Collage, B.K.T., Lucknow, Uttar Pradesh

Corresponding author: urvashichaurasiamahoba@gmail.com

https://doie.org/10.0512/AE.2024945623

ABSTRACT

The experiment was carried out during the Rabi season of 2022 at the Shradhay Bhagwati Singh Agricultural Research Farm (Hajipur), Chandra Bhanu Gupta Krishi Snatkottar Mahavidyalaya, BKT Lucknow (Uttar Pradesh). In addition, context offers 90mm CPE irrigation. Nitrogen (N1-60 kg/ha), N2-120 kg/ha, N3-180 kg/ha, Phosphorus (27 kg/ha), and potassium (262 kg/ha). According to CRI (I1), N, P, and K levels in rice and straw were greater during the first irrigation. N, P, and K uptake were higher in grains and straw irrigated with 90 mm of CPE (I4). Plants treated with 180 kg/ha N (more than 120 kg/ha N and 60 kg/ha N) outperformed in terms of growth, yield, and nutrition, as well as yield/price ratios.

Keywords: Economics, Fertilizer, Growth, irrigation regimes, wheat and Yield.

INTRODUCTION

Wheat (Triticum aestivum L.) is a grass plant whose seeds and grains represent a global food source (Belderok et al., 2000). Wheat is the most essential food in the planet. It is a staple food for 10 billion people globally, is primarily supplied in 43 countries, amounts for 30% of global food demand, and is classified as a grain product. Wheat is an essential nutrient and a rich source of carbohydrates for humans and animals, and wheat grains provide humans with more energy and protein than other grains (Reddy, 2004). The global crop is 764.4 million tons, the cultivated area is 219 million hectares and the average yield is 3.47 tons/ha. The total population is approximately 2.5 billion (FAO, 2020). The cultivated area in India is approximately 29.32 square kilometers, production is 103.6 million tons, and the average production is 3.53 tons/hectare. As of 2020-21, the top three states in rice production in India are Uttar Pradesh, Madhya Pradesh and Punjab, accounting for 32.42%, 16.08% and 15.65% of India's production, respectively. About 64% of India's total rice production comes from these three states. Uttar Pradesh has 9.2 million hectares of cropland spread across three agro-climatic zones: Western Uttar Pradesh has 3.29 million hectares, followed by Eastern Uttar Pradesh with 5.24 million hectares and Central Uttar Pradesh with 0.68 million hectares. hectares (2019). Nitrogen is an important nutrient that reduces rice yield if it is not used in quantity and time, because nitrogen is needed for rapid growth and high yield per hectare. Nitrogen plays an important role in all metabolic processes in plants. Nitrogen is an essential and important element in the production of plants, especially living tissues. All-important processes in plants involve protein, the building block of which is nitrogen. Nitrogen is the building block of proteins, phytochromes, compounds, coenzymes, chlorophyll and nucleic acids. Nitrogen and related components dominate all biochemical processes in plants, making them critical for rice growth and development (Kutman et al., 2011). To achieve the greatest results, nitrogenous fertilizers should be administered to the soil (Ali et al., 2000).

Nitrogen deficit has an impact on biomass synthesis and solar energy usage in crop production, as well as crop output and yield efficiency (Heinemann et al. 2006). Soil and climate disturbances that impact nitrogen formation in the root zone and its relationship with plants might result in variations in nitrogen availability and crop suitability (Espindula et al., 2010). However, sometimes excessive nitrogen use can harm and damage the environment, causing nitrate leaching pollution (Riley et al., 2001) and volatilization in the form of ammonia (Ma et al., 2010). This leads to high production costs and reduces farmers' income because only 1/3 of the nitrogen fertilizer is absorbed by crops instead of rice (Raun and Johnson, 1999).

MATERIALS AND METHODS

The field experiment was conducted during Rabi 2022 at Shradhay Bhagwati Singh Agricultural Research Farm (Hajipur), Chandra Bhanu Gupta Krishi Snatkottar Mahavidyalaya, BKT, Lucknow (Uttar Pradesh). East longitude °C, altitude 123 meters. The soil in the trial area is silty loam, slightly alkaline (pH 8.00), low organic carbon (0.70%), moderate nitrogen content (270 kg/ha), phosphorus (27 kg/ha) and potassium (262 kg).). . /Ha). The twelve treatments include four irrigation methods (I1- CRI one irrigation, I2- CRI + tiller two irrigation, I3- CRI + tiller + boot three irrigation, and I4- 90mm CPE irrigation) and four levels of nitrogen fertilizer fertilization (N1-60). kg/ha, N2- 120 kg/ha, N3- 180 kg/ha) were tested in triplicate in a split plot design. Urea, SSP and MOP are used as nitrogen source, phosphorus source and potassium source. Apply half the nitrogen fertilizer before planting and use sufficient phosphorus and potassium fertilizer as treatment. The trial fields were irrigated before planting and then prepared for soil preparation. Level twice with a rake and then plow twice with a cultivator, lay the ground after plowing and after the layout is completed. Clean rice seed DBW-303 was sown with the help of a seeder at a rate of 100 kg/ha in a row spacing of 20 cm. Planting was completed on November 11, 2022. Plant rows were cut by 10 cm and dry matter samples were collected. The sample was dried on the first day and stored in an oven at 72°C ± 0.5°C for 48 hours until the weight was constant. Select 5 ears from each grid to save the results. During harvest, grain and straw yields of rice are recorded and the harvest amount is calculated by dividing the yield by the total harvest and dividing by hundred. Feed consumption was calculated by multiplying grain and straw content by yield. The cost of different treatments is calculated based on current market prices. Laboratory methods were used to determine the N, P and K content in rice and straw.

RESULT AND DISCUSSION

Growth and yield attributes

Plant height (cm), number of tillers (m-2), leaf index, dry matter accumulation (g·m-2), number. Different treatments and nitrogen applications had significant effects on the effective tiller number (m-2), bunch grain weight (g) and thousand grain weight (Table 1). Maximum plant height (102.41 cm), 90 mm CPE no. Recorded in processed crop irrigated with 1. Number of tillers (419.68 m-2), measured area (6.51), dry matter (716.24 m-2), number of good tillers (325.89 m-2), cluster grain weight (1.92 g), thousand Rice weight (37.42 g) Higher results of good results in 90 mm CPE submersion than irrigation system, providing a good balance between water and nutrients transferred to plants at faster metabolism and higher level, compared to the main phase of the crop It may be due to the presence of active water. photosynthesis of plants. Idnani and Kumar (2012) also reported similar findings. Maximum plant height (105.54 cm), no. Number of tillers (419.76 m-2), leaf index (6.47), dry matter (682.55 m-2), number of good tillers (306.33 m-2), cluster grain weight (1.63 g), thousand grain weight (180 kg N Significant) 33.99 g per ha-1 was recorded). The increase in results with increasing nitrogen level may be due to the increase in nitrogen improving photosynthetic synthesis and its transfer to plants increases the size of the lake and ultimately increases the benefit yield. Jan et al (2013), Suryawansiet et al (2014), Hasan et al (2016), Meena et al (2015) recorded similar results for crop yields from nitrogen source.

Table. 1: Growth and yield attributes of wheat as affected by Irrigation regimes and Nitrogen levels

Treatments	Plant height (cm) at harvest	No. oftillers (m^{-2}) at harvest	Leaf area index at 90 DAS	Dry matter accumulation (gm^{-2}) at harvest	No. of effective tillers (m^{-2})	Grain weight/spike (g)	1000 grain weight(g)
				Irrigation regimes			
I1	**92.83**	**374.87**	**5.71**	**610.20**	**283.44**	**1.18**	26.69
I2	**94.96**	**405.66**	**5.95**	**644.64**	**294.63**	**1.40**	29.22
I3	**98.57**	**410.66**	**6.31**	**680.31**	**308.21**	**1.45**	33.73
I4	**102.41**	**419.68**	**6.51**	**716.24**	**325.89**	**1.92**	37.42
SEm±	**0.28**	**1.66**	**0.09**	**6.08**	**0.58**	**0.01**	0.36
CD (0.05)	**0.99**	**1.12**	**0.32**	**2.46**	**2.05**	**0.03**	1.27
				Nitrogen Level			
N1	**95.91**	**390.38**	**5.16**	**620.65**	**299.16**	**1.41**	29.02
N2	**99.10**	**401.14**	**6.11**	**670.09**	**304.05**	**1.51**	32.94
N3	**105.54**	**419.76**	**6.47**	**682.55**	**306.33**	**1.63**	33.99
Sem±	**0.21**	**1.12**	**0.08**	**4.89**	**0.44**	**0.01**	0.24
CD (0.05)	0.65	3.39	0.26	1.81	1.33	0.09	0.61

*(**I1**- One irrigation at CRI, **I2**- Two irrigation at CRI + Tillering, **I3**- Three irrigation at CRI + Tillering +Booting, **I4**- Irrigation at 90mm CPE, **N1**- 60 kg/ha, **N2**- 120 kg/ha, **N3**- 180 kg/ha)*

Yield studies

A perusal of data revealed that increasing irrigation regimes increased the all-yield studies significantly. Crop received with irrigation at 90mm CPE produced significantly the highest grain yield (41.64 q ha-1), straw yield (63.71 q ha-1), total biological yield (105.35 q ha-1) and harvest index (41.01 %) which was significantly superior rest of the irrigation regimes. Maximum yield (40.91 q ha-1), straw yield (60.48 q ha-1), total organic matter (101.39 q ha-1) and harvest index (40.34%) 180 kg N ha Obtained using -1 nitrogen fertilizer. . It is better than 60 and 120 kg N ha-1. When the nitrogen application rate was 60 kg ha-1, rice yield (31.88 q ha-1), straw yield (46.04 q ha-1), total crop (77.92 q ha-1) and harvest index (38%), 91). Everything is at its lowest level. Compared to 120 kg N ha-1 and 60 kg N ha-1, 180 kg N ha-1 nitrogen application increased the crop yield by 12.60% and 28.32%, respectively.

Applying nitrogen to plants increases growth and yield as it is constantly supplied and used by the plants. Higher photosynthetic efficiency leads to the production of more photosynthetic products, which are transferred to the child parts of the plant, thus improving quality and ultimately increasing crop yield. Similar results were also reported by Sharma et al (2013), Chauhan et al (2014), Hasan et al (2016) and Negi et al. As nitrogen application rates increase, crop yield decreases. This may be because as nitrogen levels increase, grain yield decreases compared to straw yield. These results are supported by Tripathi et al (2013) and Ayed et al (2016).

Table 2: Yield studies of wheat as affect by Irrigation regimes and Nitrogen levels.

Treatment	**Yield studies**			
	Grain yield(q ha^{-1})	**Straw yield(q ha^{-1})**	**Total biological yield (q ha^{-1})**	**Harvest index (%)**
	Irrigation Regimes			
One irrigation at CRI	**30.78**	**45.91**	**85.38**	28.84
Two irrigations at CRI + Tillering	**35.02**	**50.36**	**88.57**	
Three irrigations at CRI + Tillering +Booting	**35.36**	**53.21**	**98.09**	39.01
Irrigation at 90mm CPE	**41.64**	**63.71**	**105.35**	41.01
SEm±	**1.26**	**0.66**	**1.92**	0.66
CD (0.05)	**4.44**	**0.24**	**5.41**	0.23
	Nitrogen Level			
60 kg/ha	**31.88**	**46.04**	**77.92**	38.91
120kg/ha	**36.33**	**58.44**	**94.77**	39.33
180kg/ha	**40.91**	**60.48**	**101.39**	40.34
SEm±	**1.08**	**0.12**	**1.20**	0.06
CD (0.05)	3.27	0.37	0.62	0.66

Qualitative studies- Nutrient uptake

Irrigation at 90 mm CPE recorded the maximum value of N, P and k uptake (kg/ha) in grain and straw i. e. 71. 20, 24. 56 and 17. 48 in grain and 54. 15, 28. 03 and 86. 55 in straw, respectively which was followed by three irrigations at CRI + Tillering + Booting. The best nutritional value (kg/ha) of nitrogen, phosphorus and potassium in rice and straw was recorded in crops treated with 180 kg of nitrogen per hectare. to. This is followed by 71.59, 26.81 and 18.00 in grains, and 120 kg N/ha in straw with 46.56, 35.68 and 91.31.

As nitrogen input increases, crop yield in terms of nitrogen, phosphorus and potassium increases, and as nitrogen levels increase, grain and straw yield increases. This may be because increased rhizosphere nitrogen application increases dry matter yield, nutrient utilization, increases photosynthesis rate, and finally increases nutrient supply and its nutrition from grain and straw. Increased food consumption is also possible in terms of crop and biomass yields and increased tissue content with increased nitrogen content. Similar findings have also been reported Kumar and Yadav (2005), Singh et al., (2007), Sharma et al., (2013) and Chauhan et al., (2014).

Table 3: Nutrients uptake (kg/ha) of N, P and K by grain and straw

Treatment	**Nutrient uptake (kg/ha)**					
	Grain			**Straw**		
	N	**P**	**K**	**N**	**P**	**K**
Irrigation Regimes						
One irrigation at CRI	**56.01**	**22.16**	**15.08**	**44.98**	**24.79**	67.02
Two irrigations at CRI + Tillering	61.63	24.16	16.10	46.33	26.69	77.05
Three irrigations at CRI + Tillering + Booting	61.17	22.27	15.91	46.82	25.00	80.87
Irrigation at 90mm CPE	**71.20**	**24.56**	**17.48**	**54.15**	**28.03**	86.55
SEm±	**1.71**	**0.83**	**0.19**	**2.43**	**0.89**	1.26
CD (0.05)	**6.05**	**0.77**	**0.69**	**7.12**	**1.16**	4.45
Nitrogen Level						
60 kg/ha	**56.10**	**21.04**	**14.66**	**41.89**	**30.38**	70.44
120kg/ha	**63.57**	**23.61**	**16.34**	**46.16**	**35.06**	88.12
180kg/ha	**71.59**	**26.81**	**18.00**	**46.56**	**35.68**	91.32
SEm±	**1.48**	**0.17**	**0.27**	**2.33**	**0.41**	1.04
CD (0.05)	4.49	0.53	0.81	0.02	1.26	3.15

Economics

I4N3 combined application (water 90 mm CPE + 180 kg/ha) showed the best total return (Rs.161796 ha-1), net return (Rs.118664 ha-1) and profit: value ratio (2.75), followed by I4N2 arrived (Rs. 161796 ha-1) 90 mm CPE + 120 kg/ha irrigation), gross return (Rs. 143326 ha-1), net return (Rs. 100970 ha-1) and BC value (2.38). I1N1 treatment (CRI + 60 kg/ha primary irrigation) achieved the lowest revenue (Rs. 89578.5 ha-1) and profit (Rs. 55194.72 ha-1) with the following results: price ratio (1.60). The main reason for this is due to the process that leads to low productivity and hay yield.

Table 4: Economics of wheat as affect by Irrigation regimes and Nitrogen levels.

Treatment combination	Total cost	Gross income	Net income	B:C
I1N1	**34383.7**	**89578.5**	**55194.7**	1.60
I1N2	**35156**	**97813.0**	**62657**	1.78
I1N3	**34930**	**108433**	**73503**	2.10
I2N1	**36183.7**	**99597**	**63413.2**	1.75
I2N2	**36956**	**110400**	**73444.5**	1.98
I2N3	**37728**	**122656**	**84928**	2.25
I3N1	**37983.7**	**102121.5**	**64137.7**	1.68
I3N2	**38756**	**114987.5**	**76231.5**	1.96
I3N3	**39528**	**129726.0**	**90198**	2.28
I4N1	**41583.7**	**112412.0**	**70828.2**	1.70
I4N2	**42356**	**143326.0**	**100970**	2.38
I4N3	43132	161796	118664	2.75

REFERENCES

Ayed, (2016). Yield of durum when cultivar grown under different nitrogen regimes and rainfed conditions Journal of Agriculture and Sustainability 13:31-42.

Belderok, R.B., Mesdag, H., and Donner, D, A. (2000). Bread-Making Quality of Wheat, Springer.

Chauhan, Javed, S.P., and Singh, T.M., (2014). Effect of nitrogen and zinc nutrition on yield, quality and uptake of nutrients by wheat. Annals of Plant and Soil Research, 16(2): 98-101.

FAO (2020) World Agriculture production, circular Series WAP, Food and Agriculture Organization of the United Nations, Roma, Italy.

Idanani, LK and Kumar, (2012) A, Relative efficiency of different irrigation schedules for conventional, ridge and raised bed seeding of wheat (Triticum aestivum). Indian Journal of Agronomy, 57, 148-151.

Jan, Wasim, M. and Amanullah and J. (2013). Interactive effects of Zinc and nitrogen application on wheat growth and grain yield. Journal of Plant Nutrition, 36(10), 1506-1520.

Kumar, Ramesh and Yadav, (2005). Effect of zero and minimum tillage in conjuction with nitrogen management in wheat (Triticum aestivum) after rice (Oryza sativa). Indian Journal of Agronomy, 50(1): 54-57.

Kutman, U.B., Yildiz, B.,and Cakmak, I. (2011). Effect of nitrogen on uptake, remobilization and partitioning of zinc and iron throughout the development of durum wheat. Plant and Soil. v. 342, n. 1-2, p. 149-164.

Ma, B.L., WU, T.Y., Tremblay, N., Deen, W., Mclaughlin, N.B., Morrison, M.J, and Stewart, G. (2010). On-farm assessment of the amount and timing of nitrogen fertilizer on ammonia volatilization. Agronomy Journal. v. 102, n. 1, p. 134-144.

Meena, S.R. and V.S., (2015). Effect of Nitrogen levels and Chlormequat on growth and yield of wheat. Journal of Soils and Crops, 25(1):238-241

Negi SSC Shekhar, J. Maskotia, RS and Singh Churudev (2013). Fertilizer schedule under limited irrigation with zero-tilled wheat (Triticum aestivum) after rice (Oryza sativa) in north west Himalayas Indian Journal of Agronomy, 58(2), 187-191.

Raun, W.R. and Johnson, G.V. (1999). Improving nitrogen use efficiency for cereal production. Agronomy Journal. v. 91, n. 3, p. 357-363.

Riley, W.J., (2001). Nitrogen leaching and soil nitrate, nitrite, and ammonium levels under irrigated wheat in Northern Mexico. Nutrient Cycling in Agroecosystems. vol. 61, no. 3, pp: 223-236.

Sharma, Y.K., Singh and Mandal, N., (2013). Effect of nitrogen and copper levels on yield and uptake of nutrients by wheat crop. Annals of Plant und Sal Research, 15(1), 4346.

Suryawansi, PK, Patel, JB and Kumbhar, NM., (2014). Assessment of SWI techniques with varying nitrogen levels for improving yield and quality of wheat (Triticum aestivum L.). Crop Research, 48(1- 3), 6-9.

Tripathi SC, Chunder, Subhash and Meena, Raj Pal. (2013). Effect of early sowing. N levels and seed rates on yield and yield attributes of different wheat (Triticum aestivum) varieties. Indian Journal of Agronomy, 58(1), 63-66.

*****