Original Research Article

Effect of Nitrogen and Seed rate on growth and yield of Wheat (*Triticum aestivum* L.)

Abstract

A field experiment was conducted during *Rabi* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T_1: N 80kg/ha + seed rate 75kg/ha, T_2: N 100kg/ha + seed rate 75kg/ha, T_3: N 120kg/ha + seed rate 75kg/ha, T_4: N 80kg/ha + seed rate 100kg/ha, T_5: N 100kg/ha + seed rate 100kg/ha, T_6: N 120kg/ha + seed rate 100kg/ha, T_7: N 80kg/ha + seed rate 125kg/ha, T_8: N 100kg/ha + seed rate 125kg/ha, T_9: N 120kg/ha + seed rate 125kg/ha are used. The results showed that among different seed rate and nitrogen the treatment with N 120kg/ha and seed rate 75kg/ha produced significantly highest plant height(101.20 cm). The treatment combination with N 120kg/ha + seed rate 100kg/ha produced significantly higher No. of Tillers/plant (7.27), Plant dry weight (21.60 g/plant), Crop growth rate (0.48 g/m^2/day), Relative Growth Rate(0.014g/g/day), spikelets/spike (20.07), Grains/spike (58.53), Test weight (46.23 g) and Grain yield (5.91 t/ha). However, the treatment with N 120kg/ha and seed rate 100kg/ha was found to be effective in highest gross returns (89060.00 INR/ha), net return (58360.03 INR/ha) and benefit cost ratio (2.90) when compared to other thtreatments.

Key words: Wheat, Nitrogen, seed rate.

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1. Introduction

Wheat (Triticumaestivum L.), which triggered Green revolution in the Indian subcontinent, is an important food grain providing nourishment nearly to 35 per cent people of the world. On global scale, the crop is grown over an area of 211.06 million ha with a production of 566.8million tonnes. India is the second largest producer of wheat in the world next only to China and the crop has provided the fastest pace of growth to Indian agriculture. Among cereals, wheat is next to rice in area (24.23 million ha) and production (75.6 million tonnes) **(Jagshoran et al., 2004).** Wheat contributes about 60 per cent of daily protein requirement and more calories to world diet than any other food crop **(Mattern et al., 1970).** As main staple food, wheat continues to assume greater significance in the years to come both from grain productivity as well as quality point of view. Wheat is one of the most important cereal crops of India with diverse uses. Intensive cultivation has resulted in depletion of soil nutrients to a great extent thus nutrients requirement of crops has increased considerably during the last few years.

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In the world, (Triticum aestivum L.) bread wheat, holds a leading position among the food cereals. It contains carbohydrate (70 – 72%) with considerable amount of Protein(10–13%), Fiber (11%), Fat (3%), (**Kumar *et al*., 2011**).In a small part of the general population, gluten – the major part of wheat protein – can trigger coeliac disease, non coeliac gluten sensitivity, gluten ataxia, and dermatitis herpetiforms.

Nitrogen plays noticeable role in plant metabolism and all the vital physiological and metabolic processes in plant are associated with protein of which nitrogen is an essential constituent **(Adnan *et al.*,2016).** Nitrogen is the key nutrient element and plays an inevitable role to increase the tillering capacity which leads to higher potential yields **(Ames *et al.*, 2003).** Increasing nitrogen levels increases the plant height, tiller numbers/m leaf number/plant and dry matter accumulation and also yield attributing characters viz. ear weight, grain number/ear test weight significantly **(Sharma *et al.*,2001).**

Seeding rate is one of the important production factors. Higher wheat grain yield with better quality requires appropriate seeding rate for different cultivars. Increase in seed rate above optimum level may only enhance production cost without any increase in grain yield **(Rafique *et al.*, 2010).** The optimum seed rates for wheat alter with variety, location and method of planting **(Larson and Watson 2010).** Wheat sowing at higher seed rate produced greater plant height **(Soomro *et al.*, 2009)** and also higher yield attributes

such as grains/spike, grains weight/spike, 1,000 grains weight and no. Of effective tillers **(Kumar et al. 2002)**. With increasing seed rate there was an increase in yield mainly through morespikes pr plant, which compensated for a decrease in seeds per head **(Arian *et al.*, 2002)**.

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2. Materials and Methods

The present examination was carried out during rabi 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28°N latitude, 81.54°E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of nine treatments with T_1: N 80kg/ha + seed rate 75kg/ha, T_2: N 100kg/ha + seed rate 75kg/ha, T_3: N 120kg/ha + seed rate 75kg/ha, T_4: N 80kg/ha + seed rate 100kg/ha, T_5: N 100kg/ha + seed rate 100kg/ha, T_6: N 120kg/ha + seed rate 100kg/ha, T_7: N 80kg/ha + seed rate 125kg/ha, T_8: N 100kg/ha + seed rate 125kg/ha, T_9: N 120kg/ha + seed rate 125kg/ha are used. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}). In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded. The growth parameters plant height, no. of tillers/plant, plant dry weight, Crop Growth Rate and Relative Growth Rate are recorded. The yield parameters like No. of spikelets/spike, grains/spike, grain yield, test weight, stover yield and harvest index were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design **(Gomez KA. and Gomez AA. 1984).**

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3. Results and Discussion

3.1 Growth attributes

3.1.1 Plant height (cm)

The results in Table (1) showed that the plant height was significantly increased with the increase in crop age during the experimentation. At 100 DAS, highest plant height (101.20cm) was recorded with application of N 120 kg/ha and seed rate 75 kg/ha over all the other treatments. Where, the application of N 100 kg/ha and seed rate 75 kg/ha (100.1 cm) was found to be statistically at par with the application of N 120 kg/ha and seed rate 75 kg/ha as compared to all the treatments.

Increase in plant height at medium and high fertilizer level might be due to proper nutrition availability which resulted in increase in vegetative growth of the plants. It might be of healthy seedlings which increase the height of plants or probably due to positive effect of increasing rate of levels of nitrogen. Similar results were reported by **Thakur *et al.*, (2007).**

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3.1.2 Number of tillers/plant

It is noticed from Table (1) that the number of tillers per plant was progressively increased with the increase in crop age during the experimentation. At 100 DAS highest number of tillers per plant (7.27) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments.Where, the application of N 100 kg/ha and seed rate 100 kg/ha (7.23) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments.

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The number of tillers were increased due to the greater availability of nutrients in soil due to increasing application of Nitrogen doses might have enhanced multiplication and elongation of cells leading to increased number of tillers as reported by **Sharma *et al.*,(2011)**.

3.1.3 Plant dry weight (g/plant)

It is noticed from Table (1) that the plant dry weight(g) was progressively increased with the increase in crop age during the experimentation. At 100 DAS highest plant dry weight (21.60 g) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha (21.37 g) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments.

The plants attained more vigour with nitrogen , due to adequate supply and availability of nitrogen and seed rate in balanced combination, resulting in increased dry weight of the plant. The application of Nitrogen 120 kg/ha to wheat significantly increased dry matter production. The results were found to be similar with **Khan *et al*., (2017).**

3.1.4 Crop Growth Rate

It is noticed from Table (1) that the Crop Growth Rate (g/day/m^2) was progressively increased with the increase in crop age during the experimentation. At 100 DAS highest Crop Growth Rate (0.48 g/day/m^2) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N

100 kg/ha and seed rate 100 kg/ha (0.46 g/day/m^2) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments.

3.1.5 Relative Growth Rate

It is noticed from Table (1) that the Relative Growth Rate (g/day/m^2) was progressively increased with the increase in crop age during the experiment. At 100 DAS highest Relative Growth Rate (0.014 g/g/day) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha (0.013 g/g/day) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments.

3.2 Yield attrubutes and Yield

3.2.1 Number of spikelets/spike

It is noticed from Table (2) that the highest number of spikelets/spike (20.07) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha recording (19.33) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments. The minimum(16.93) number of spikelets/spike was recorded with the application of N 80 kg/ha and seed rate 125 kg/ha.

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3.2.2 Number of grains/spike

It is noticed from Table (2) that the highest number of grains/spike (58.53) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha recording (56.83) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments. The minimum number of grains/spike (42.60) was recorded with the application of N 80 kg/ha and seed rate 125 kg/ha.

Increase in value of yield contributing characters with higher doses of nitrogen was due to the facts that the optimum seed rate also plays major role in better vegetative growth and development of wheat. The results were found to be similar with **Sharma *et al.*, (2003).**

3.2.3 Test weight (g)

It is noticed from Table (2) that the highest test weight(46.23g) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha recording (45.60g) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments. The minimum number of grains/spike (39.30g) was recorded with the application of N 80 kg/ha and seed rate 125 kg/ha.

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Higher vigour and growth attained by the plants due to sufficient absorption of nutrients might have resulted in higher test weight **Noonari *et al*., (2016).**

3.2.4 Grain yield (t/ha)

It is noticed from Table (2) that the highest grain yield(5.91t/ha) was reported with application of N 120 kg/ha and seed rate 100 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 100 kg/ha recording (5.87t/ha) was found to be statistically at par with the application of N 120 kg/ha and seed rate 100 kg/ha as compared to all the treatments. The minimum grain yield (4.91t/ha) was recorded with the application of N 80 kg/ha and seed rate 75 kg/ha.

The increase in grain yield due to the optimum seed rate 100kg/ha application is attributed to better crop stand and decreased competition. It appears that greater translocation of photosynthates from source to sink might have increased seed yield. Increased N fertilizer and its availability to the plants and favourable environments in the rhizosphere. The results were in according with **Sandana and Pinochet (2014).**

3.2.5 Straw yield (t/ha)

It is noticed from Table (2) that the highest straw yield(9.80t/ha) was reported with application of N 120 kg/ha and seed rate 125 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 125 kg/ha recording (9.75t/ha) was found to be statistically at par with the application of N 120 kg/ha and seed rate 125 kg/ha as compared to all the treatments. The minimum straw yield (7.30t/ha) was recorded with the application of N 80 kg/ha and seed rate 75 kg/ha.

3.2.6 Harvest index

It is noticed from Table (2) that the highest harvest index(40.24%) was reported with application of N 120 kg/ha and seed rate 125 kg/ha which was significantly superior over all the treatments. Where, the application of N 100 kg/ha and seed rate 125 kg/ha and N 80 kg/ha and seed rate 125 kg/ha recording (39.55%) were found to be statistically at par with the application of N 120 kg/ha and seed rate 125 kg/ha as compared to all the treatments. The minimum harvest index (35.70%) was recorded with the application of N 80 kg/ha and seed rate 75 kg/ha.

CONCLUSION

It is concluded that the application of Nitrogen 120 kg/ha and Seed rate 100 kg/ha was found to be more productive and economically viable.

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Table 1: Effect of Nitrogen and Seed rate on Growth parameters of Wheat

Treatments	Plant height(cm)	Tillers/ plant	Dry weight(g)	Crop Growth Rate(g/day/m^2)	Relative Growth Rate(g/g/day)
1. Nitrogen 80kg /ha+seed rate 75 kg /ha	98.77	6.70	19.67	0.39	0.012
2. Nitrogen 100 kg /ha+seed rate 75 kg /ha	100.10	7.15	19.97	0.41	0.012
3. Nitrogen 120 kg /ha+seed rate 75 kg /ha	**101.20**	7.23	20.80	0.41	0.011
4. Nitrogen 80 kg /ha+seed rate 100 kg /ha	98.00	6.73	19.53	0.39	0.013
5. Nitrogen 100 kg /ha+seed rate 100kg /ha	99.23	6.83	21.37	0.46	0.013
6. Nitrogen 120 kg /ha+seed rate 100 kg /ha	99.73	**7.27**	**21.60**	**0.48**	**0.014**
7. Nitrogen 80 kg /ha+seed rate 125 kg /ha	96.00	6.77	17.83	0.45	0.012
8. Nitrogen 100 kg /ha+seed rate 125 kg /ha	96.60	6.70	18.90	0.39	0.012
9. Nitrogen 120 kg /ha+seed rate 125kg /ha	97.13	6.93	19.03	0.45	0.011
F test	**S**	**S**	**S**	**S**	**S**
S. Em (±)	0.19	0.07	0.30	0.032	0.001
CD (P = 0.05)	1.58	0.21	0.89	-	0.001

Table 2. Effect of Nitrogen and Seed rate on Yield attributes and Yield of Wheat

Treatments	Spikelets/ spike	Grains/ spike	Test Weight (g)	Grain yield (t/ha)	Straw yield(t/ha)	Harvest Index(%)
1. Nitrogen 80kg /ha+seed rate 75 kg /ha	17.33	50.25	40.57	4.91	7.30	35.70
2. Nitrogen 100 kg /ha+seed rate 75 kg /ha	17.53	50.67	43.40	5.02	7.48	36.12
3. Nitrogen 120 kg /ha+seed rate 75 kg /ha	18.87	52.80	44.60	5.09	7.78	39.24
4. Nitrogen 80 kg /ha+seed rate 100 kg /ha	19.20	51.07	42.10	5.28	8.18	37.90
5. Nitrogen 100 kg /ha+seed rate 100kg /ha	19.33	56.83	45.47	5.64	8.98	39.49
6. Nitrogen 120 kg /ha+seed rate 100 kg /ha	**20.07**	**58.53**	**46.23**	**5.91**	9.07	40.19
7. Nitrogen 80 kg /ha+seed rate 125 kg /ha	16.93	42.60	39.30	5.34	8.76	39.55
8. Nitrogen 100 kg /ha+seed rate 125 kg /ha	18.13	46.42	41.77	5.41	9.75	39.55
9. Nitrogen 120 kg /ha+seed rate 125kg /ha	17.73	42.60	43.03	5.54	**9.80**	**40.24**
F test	**S**	**S**	**S**	**S**	**S**	**S**
S. Em (±)	0.79	2.38	0.05	1.63	2.49	0.51
CD (P = 0.05)	1.68	5.05	1.16	4.9	5.29	4.21