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EVALUATING THE INFLUENCE OF SEED RATE AND NITROGEN FERTILIZATION ON PRODUCTIVITY OF LATE SOWN WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

The study evaluates the influence of seed rate and nitrogen application on the growth, yield attributes and yield of late sown wheat, addressing a critical need for optimized agronomic practices in challenging growing conditions. With global food security increasingly reliant on efficient wheat production, investigation on Effect of Seed Rate and Nitrogen Levels on Late Sown Wheat consist of four different seed rates (100, 125, 150 and 175 kg ha^{-1}) and four levels of nitrogen (80, 100, 120 and 140 kg ha^{-1}) addresses higher productivity. The treatments were replicated thrice in Split Plot Design to assess how varying seed rates and application of nitrogen rates affect key growth parameters such as plant height, tiller number, and biomass accumulation, as well as yield attributes including grain weight and overall yield. The findings indicate that both seed rate and nitrogen application had significant impact on growth, yield attributes and yield. Among seed rate, increase in seed rate from 100 to 150 kg ha^{-1}, seed rate of 150 kg ha^{-1} found better for all parameters and being statistically at par with 125 kg ha^{-1}. Among the nitrogen levels, 100 kg ha^{-1} was found most suitable for late sown wheat, and recorded significantly higher values of growth parameters, yield attributes and yield of late sown wheat. This study provides practical recommendations for adjusting seed rate and nitrogen management to maximize productivity and ensure sustainability in late sown wheat systems. The insights gained can guide farmers and agronomists in making informed decisions to enhance wheat cultivation practices under late sowing scenarios, ultimately contributing to more resilient and efficient agricultural systems.

***Keywords* :** Wheat, Seed rate, Nitrogen levels, Growth parameters, Yield.

Introduction

Wheat is a staple crop of global significance, underpinning food security and agricultural economies. Its cultivation practices are pivotal in determining yield and quality, particularly in regions where growing conditions are less than ideal. By 2018, Cultivated on an estimated 217 million ha of land and 752 million tons of production globally (FAOSAT 2020). Among the various agronomic practices that impact on wheat production, seed rate and nitrogen application stand out as crucial factors influencing growth and yield.

Seed rate, the number of seed sown per unit area, directly affects plant density, which in turn influences competition for resources such as light, water, and nutrients. An optimal seed rate ensures that plants are neither too sparse nor too crowded, balancing these factors to maximize yield (Singh *et al*. 2013). On the other hand, nitrogen, a vital nutrient, plays a critical role in wheat development by promoting vigorous vegetative growth, enhancing photosynthetic efficiency, and ultimately contributing to grain formation (Ali *et al.*, 2012 and Iqbal *et al.*, 2012).

The timing of sowing also significantly impacts wheat performance, with late sowing presenting unique challenges and opportunities (Ozturk *et al.*, 2006). Late sown wheat often faces reduced growing periods, altered temperature regimes, and potential exposure to unfavourable weather conditions, all of which can affect its growth dynamics and yield potential (Hiltbrunner *et al.*, 2007).

This study aims to evaluate how varying seed rates and nitrogen levels influence the growth and yield attributes and yield of late sown wheat. By investigating these factors in a late sowing context, we seek to identify optimal practices that can enhance productivity and ensure sustainable wheat production even under constrained growing conditions. The findings are expected to provide valuable insights for farmers and agronomists seeking to adapt and optimize their practices for improved outcomes in late sown wheat cultivation.

Materials and Methods

The experiment was conducted at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology in Kumarganj, Ayodhya, Uttar Pradesh, during the Rabi season of 2022-2023. The site, located at 26°47' N latitude, 82°12' E longitude, and 113 meters above sea level, lies in the subtropical Indo-Gangetic plains. The field was equipped with a tube well for irrigation and had proper drainage and levelling. The study employed a Split Block Design with three replications, testing 16 treatments with Seed rates of 100, 125, 150, and 170 kg/ha were applied in the main plots, and fertilizer levels of 80, 100, 120, and 140 kg/ha were applied in the subplots. Soil analysis prior to sowing indicated a pH of 8.4, an electrical conductivity (EC) of 0.31 dS/m through Electrical conductivity bridge method (Jackson 1973), nutrient levels of 185 kg/ha nitrogen (N) with Alkaline permanganate method (Subbiah and Asija, 1956), 15.3 kg/ha phosphorus (P) employed by Olsen's method (Olsen *et al.*, 1954), and 283 kg/ha potassium (K) based on Flame photometer method (Jackson, 1973). Different Growth and yield parameters were recorded and statistically analysed

Results and Discussion

Growth Parameters:

Plant population

At 15 days after sowing (DAS), there were no significant differences in plant population among different seed rates and nitrogen levels. However, a seed rate of 175 kg/ha resulted in the highest plant population (171.03 plants/m²), while a nitrogen level of 100 kg/ha achieved the highest population (166.13 plants/m²). Overall, neither seed rate nor nitrogen levels significantly impacted plant population throughout the experiment.

Plant height

At 30 DAS, plants from the 150 kg/ha seed rate were significantly taller (24.08 cm) compared to those from 125 kg/ha and 175 kg/ha seed rates. At 60, 90 DAS, and harvest, plant height for the 150 kg/ha seed rate was higher while comparable to that of the 125 kg/ha seed rate. Conversely, the 100 kg/ha seed rate produced the shortest plants. Although the interaction between seed rate and nitrogen levels did not significantly affect plant height, Patra and Ray (2018) Rahman *et al*. (2011) and Liaqat *et al*. (2003) who also reported that nitrogen application generally enhances plant height.

Number of Tillers

At harvest, the 150 kg/ha seed rate yielded the highest number of tillers (400.08 tillers/m²), which was statistically similar to the 125 kg/ha seed rate (381.60 tillers/m²). The 100 kg/ha seed rate produced the fewest tillers (327.50 tillers/m²). Among the nitrogen treatments, 100 kg N/ha resulted in the maximum number of tillers (382.02 tillers/m²),which was comparable to 120 kg N/ha (379.80 tillers/m²) and 140 kg N/ha (364.91 tillers/m²). The lowest number of tillers was observed with 80 kg N/ha (340.23 tillers/m²). There was no significant interaction effect between seed rate and nitrogen levels on tillering.

Dry matter accumulation

The 150 kg/ha seed rate produced the highest dry matter at all growth stages, except at 90 DAS, where it was similar to the 125 kg/ha seed rate. The lowest dry matter production occurred with a seed rate of 100 kg/ha. Among the nitrogen levels, 100 kg N/ha resulted in the highest dry matter production, which was comparable to 120 kg N/ha at all growth stages. The lowest dry matter was recorded with 80 kg N/ha. Similar results were reported by Musaddique *et al.* (2000), Jat and Singh (2004**).**

Leaf area index

The 150 kg/ha seed rate consistently resulted in the highest LAI compared to other seed rates. At 30, 60, and 90 DAS, it was significantly higher, though at 30 DAS, it was comparable to the 125 and 175 kg/ha seed rates. The 100 kg/ha seed rate exhibited the lowest LAI. Among the nitrogen levels, 100 kg N/ha achieved the highest LAI, similar to 120 kg N/ha at all growth stages, except at 30 DAS where it was comparable to both 120 and 140 kg N/ha. The lowest LAI was associated with 80 kg N/ha have been noticed by Alemu (2018), Alam *et al*. (2013) and Suleiman *et al.* (2014)

Yield and yield attributes:

The highest number of effective tillers was recorded with a seed rate of 150 kg/ha, which was statistically comparable to the 125 kg/ha seed rate. In contrast, the seed rate of 100 kg/ha resulted in the lowest number of effective tillers. This finding aligns with previous studies by Mishra *et al*. (2003) and Singh and Singh (2006). Nitrogen levels significantly influenced the number of effective tillers; specifically, 100 kg N/ha resulted in a higher number of effective tillers compared to 80 kg N/ha, but was statistically similar to 120 kg N/ha and 140 kg N/ha. The lowest number of effective tillers was observed with the 80 kg N/ha treatment.

The 150 kg/ha seed rate yielded the highest number of grains per spike, comparable to the 125 kg/ha seed rate. The lowest number of grains per spike was found with the 100 kg/ha seed rate, due to fewer fertile tillers, shorter spike length, and fewer grains per spike. These results are consistent with those of Mishra *et al*. (2003) and Singh and Singh (2006). Among nitrogen levels, 100 kg N/ha produced the maximum number of grains per spike, which was statistically similar to 120 kg N/ha, and significantly higher than 80 kg N/ha and 140 kg N/ha, as corroborated by Hussain *et al*. (2006).

The longest spike length was observed with the 150 kg/ha seed rate, which was comparable to the 120 kg/ha and 175 kg/ha seed rates, but significantly greater than the 100 kg/ha seed rate. For nitrogen levels, the maximum spike length was achieved with 100 kg N/ha, similar to 120 kg N/ha and 140 kg N/ha, and significantly longer than the 80 kg N/ha treatment. These findings are consistent with the results reported by Hussain *et al.* (2006).

The seed rate of 150 kg/ha resulted in the highest grain weight per spike, statistically similar to the 125 kg/ha seed rate. The lowest grain weight per spike was recorded with the 100 kg/ha seed rate. These results are in agreement with Mishra *et al.* (2003) and Singh and Singh (2006). Among nitrogen levels, the 100 kg N/ha treatment achieved the highest grain weight per spike, similar to the 120 kg N/ha treatment. The lowest grain weight per spike was found with 80 kg N/ha. The highest test weight was associated with the 150 kg/ha seed rate, while the highest test weight for nitrogen levels was noted with 100 kg N/ha.

The highest biological yield was achieved with the 150 kg/ha seed rate, which was significantly greater than other seed rates and similar to the 125 kg/ha seed rate. Conversely, the lowest biological yield was recorded with the 100 kg/ha seed rate. The 100 kg N/ha treatment resulted in the maximum biological yield, comparable to the 120 kg N/ha treatment, and significantly higher than other nitrogen levels. The highest grain yield of 40.30 q/ha was observed with the 150 kg/ha seed rate, significantly surpassing other treatments, while the lowest yield was recorded with the 100 kg/ha seed rate. The increased grain and straw yields with the 150 kg/ha seed rate suggest that an optimal plant population contributes to higher biological yield. The maximum grain yield of 36.57 q/ha was achieved with 100 kg N/ha, similar to 120 kg N/ha, and the lowest yield of 30.46 q/ha was found with 80 kg N/ha. For straw yield, the 150 kg/ha seed rate produced the highest yield (58.91 q/ha), comparable to the 125 kg/ha seed rate, while the lowest straw yield (44.08 q/ha) was observed with the 100 kg/ha seed rate. The highest straw yield of 55.75 q/ha was recorded with 100 kg N/ha, similar to the 120 kg N/ha treatment, and significantly higher than the 80 kg N/ha treatment. These observations align with the findings of Sardana (2001).

The highest harvest index was observed with the 150 kg/ha seed rate. Nitrogen levels did not significantly affect the harvest index, though the highest harvest index was recorded with 100 kg N/ha.

Conclusion

The optimum plant density of the crop for producing maximum plant growth parameters and higher yields can be obtained by using the seed rate 150 kg ha^{-1}in late sown wheat. Nitrogen rates concerned; there was yield increase up to addition of 100 kg ha^{-1} nitrogen, further incremental dose of 140 kg ha^{-1} of nitrogen recorded yield reduction against the yield achieved with 100 kg ha^{-1} of nitrogen application in late sown wheat. Maximum values of growth parameters, yield attributes and yield were found with 150 kg ha^{-1} seed rate and 100 kg ha^{-1} nitrogen application in late sown wheat.

Table 1: Effect of different seed rate and nitrogen levels on growth parameters of late sown wheat

Treatment	Initial plant population (m^{-2})	No. of Tillers (m^{-2})				Plant height (cm)				Dry matter accumulation (g m^{-2})			
Main plot (Seed rate)		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
S_1: 100 kg ha^{-1}	155.73	168.63	251.48	360.01	327.5	22.36	38.99	72.01	78.96	33.68	270.27	534.34	694.04
S_2: 125 kg ha^{-1}	163	191.06	320.05	399.86	381.6	23.53	52.86	89.77	94.07	49.64	337.5	692.72	863.74
S_3: 150 kg ha^{-1}	167.9	193.75	329.25	407.72	400.08	24.08	53.99	90.83	95.13	55.27	373.24	733.94	954.16
S_4:175 kg ha^{-1}	171.03	179.85	288.12	378.56	357.79	22.54	47.59	84.11	87.35	46.65	297.05	627.22	768.71
SEm±	3.49	3.92	6.38	8.26	7.82	0.48	1.04	1.81	1.9	1	6.8	14.03	17.45
CD at 5%	NS	13.85	22.51	29.16	27.59	NS	3.7	6.4	6.72	3.53	23.99	49.25	61.58
Sub plot (Nitrogen levels)													
N1: 80 kg ha^{-1}	162.92	176.37	269.75	362.9	340.23	22.55	36.74	70.05	76.16	43.73	303.77	593.17	771.02
N2:100 kg ha^{-1}	166.13	188.95	315.22	401.44	382.02	23.72	55.85	92.88	96.66	49.94	333.72	678.67	856.74
N3:120 kg ha^{-1}	164.79	186.84	311.36	399.48	379.8	23.41	53.71	90.84	94.51	46.9	325.21	668.68	841.91
N4:140 kg ha^{-1}	163.83	183.11	292.56	386.14	364.91	22.82	47.13	82.96	88.19	44.67	315.35	647.71	810.99
SEm±	2.81	3.12	5.07	6.58	6.25	0.39	0.82	1.42	1.5	0.81	5.53	11.13	14.18
CD at 5%	NS	9.17	14.99	19.33	18.37	NS	2.4	4.17	4.41	2.38	16.26	32.68	41.65

Table 2: Effect of different seed rate and nitrogen levels on yield attributes and yield of late sown wheat

Treatment	Effective tillers m^{-2}	Grains $spike^{-1}$ (No.)	Spike length (cm)	Grain weight (g) $spike^{-1}$	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Main plot (Seed rate)									
S_1: 100 $kgha^{-1}$	294.14	43.25	9.51	1.24	38.86	25.44	44.08	69.53	36.55
S_2: 125 $kgha^{-1}$	365.14	51.5	10.5	1.37	40.45	36.52	57.05	93.57	38.95
S_3: 150 $kgha^{-1}$	378.36	54.49	10.68	1.46	42.08	40.3	58.91	99.22	40.62
S_4:175 $kgha^{-1}$	335.57	48.51	10.15	1.35	40.13	31.99	49.12	81.12	39.43
SEm±	7.39	1.05	0.21	0.02	0.85	0.72	1.12	1.85	0.82
CD at 5%	26.08	3.72	0.76	0.1	NS	2.56	3.97	6.53	NS
Sub plot (Nitrogen levels)									
N1:80 $kgha^{-1}$	325.28	47.01	9.85	1.27	39.72	30.46	49.01	79.48	38.15
N2:100 $kgha^{-1}$	356.08	52.24	10.55	1.45	40.85	36.57	55.75	92.32	39.47
N3:120 $kgha^{-1}$	351.02	50.24	10.34	1.4	40.75	35.15	53.72	88.39	39.05
N4:140 $kgha^{-1}$	340.83	48.27	10.1	1.31	40.18	32.55	50.68	83.24	38.88
SEm±	5.85	0.84	0.17	0.02	0.68	0.58	0.89	1.47	0.66
CD at 5%	17.19	2.48	0.51	0.06	NS	1.71	2.61	4.32	NS

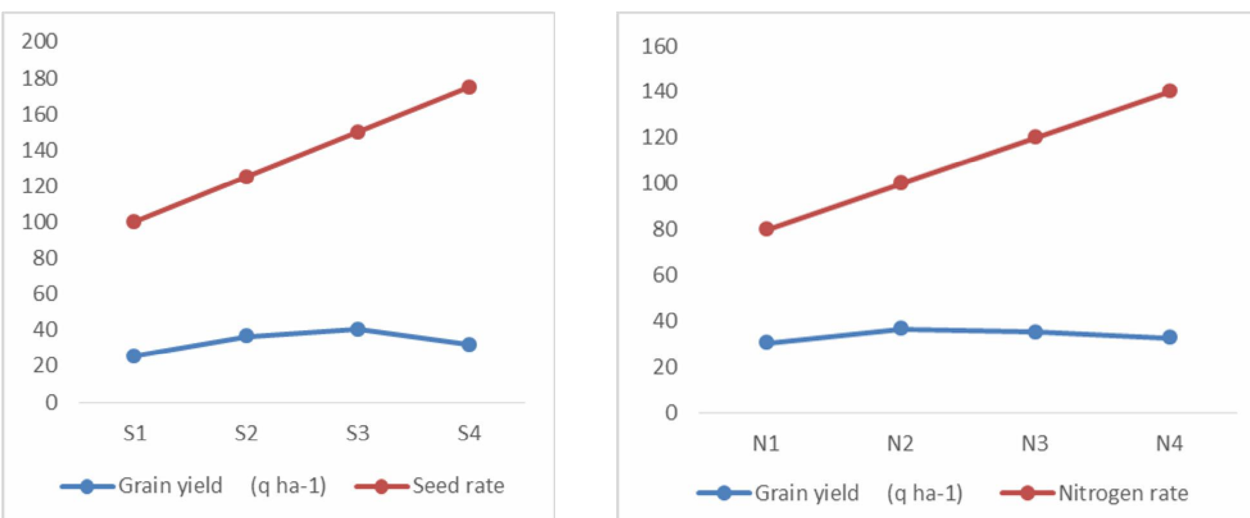

Fig 1: Shows how different seed rates and nitrogen applications affect grain yield. The cumulative impact of input levels on the end grain production is depicted in the figure.

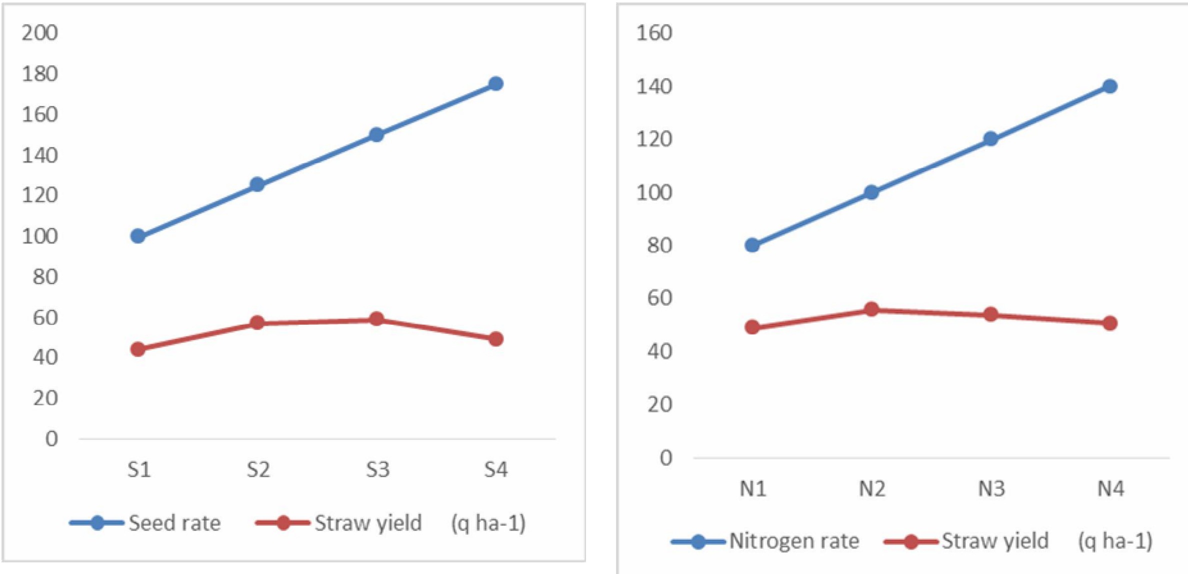

Fig 2: Response of straw yield to varying nitrogen dosages and seed rates. The findings demonstrate the relationship between input selection and variations in vegetative biomass.

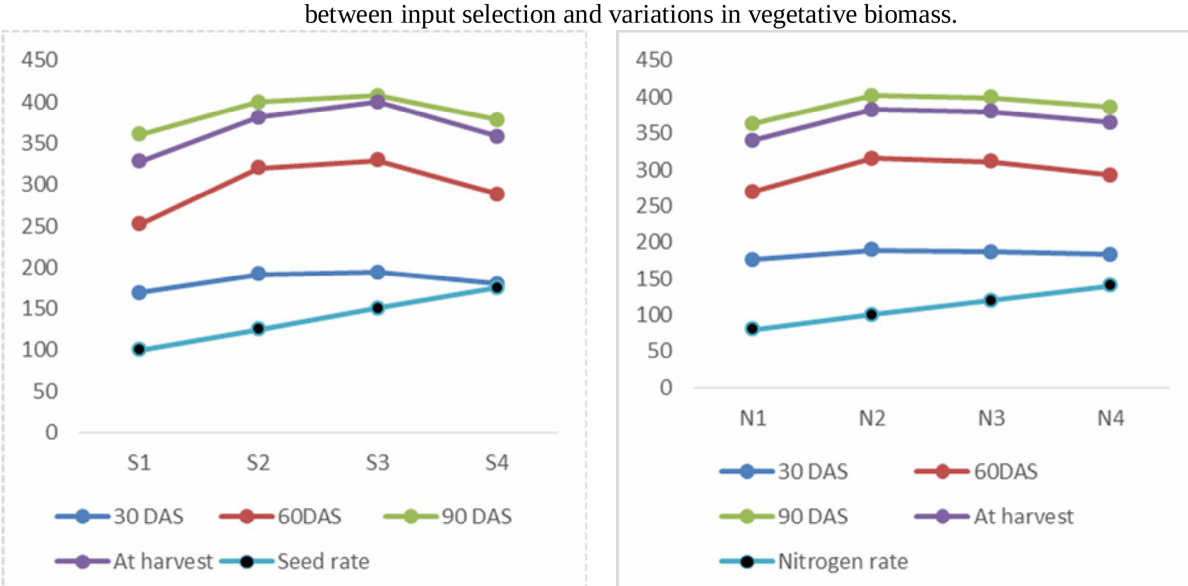

Fig 3: Shows how nitrogen level and seed rate interact during the crop's four crucial growth stages. Different physiological reactions to input variations are highlighted at each stage.

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