



International Journal of Agriculture and Food Science

ISSN Print: 2664-844X
 ISSN Online: 2664-8458
 NAAS Rating (2026): 4.97
 IJAFA 2026; 8(10): 174-178
www.agriculturaljournals.com
 Received: 29-07-2026
 Accepted: 27-09-2026
 Published: 07-10-2026

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Impact of nitrogen levels and varieties on growth, development and yield attributing characters of wheat (*Triticum aestivum* L.) under timely sown conditions in western Uttar Pradesh

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DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i10c.2016>

ABSTRACT

The present investigation entitled “Performance of Wheat (*Triticum aestivum* L.) Varieties at Different Levels of Nitrogen Under Timely Sown Conditions in North Western Uttar Pradesh” was carried out during Rabi season 2024-25 under Department of Agronomy at R.B.S. College, Agriculture Research Farm Bichpuri, Agra. The variable involved in this study were four nitrogen levels N_0 ($N @ 0 \text{ kg ha}^{-1}$), N_1 ($N @ 75 \text{ kg ha}^{-1}$), N_2 ($N @ 150 \text{ kg ha}^{-1}$), and N_3 ($N @ 225 \text{ kg ha}^{-1}$), and three varieties V_1 -(DBW-303), V_2 -(DBW-371) and V_3 -(HD-3298) thus in all 12 treatment combinations were compared in Factorial Randomized Block Design (FRBD) with three replications. The results indicated that the Germination count at 15 DAS was not significantly influenced by nitrogen levels or varieties. However, the number of shoots m^{-1} row length, plant height and dry matter accumulation at harvest increased significantly with increasing nitrogen levels up to $N @ 225 \text{ kg ha}^{-1}$ (N_3), remaining statistically at par with $N @ 150 \text{ kg ha}^{-1}$ (N_2). Application of 150 kg N ha^{-1} hastened 75 per cent spike emergence (87.36 days) and crop maturity (134.11 days) and yield attributing characters, viz., spike length (13.25 cm), number of spikelets spike⁻¹ (16.76), number of grains spike⁻¹ (62.12), grain weight spike⁻¹ (4.08 g) and 1000-grain weight (42.36 g), were recorded maximum under nitrogen @ 150 kg ha^{-1} , being at par with 225 kg N ha^{-1} . Among the varieties, variety DBW-303 recorded the maximum plants height, highest dry matter accumulation at harvest and superior yield attributes, followed by variety DBW-371, while variety HD-3298 remained the lowest for all the characters studied.

Keywords: Growth, Development, Nitrogen, Wheat, Varieties, Yield attributing characters

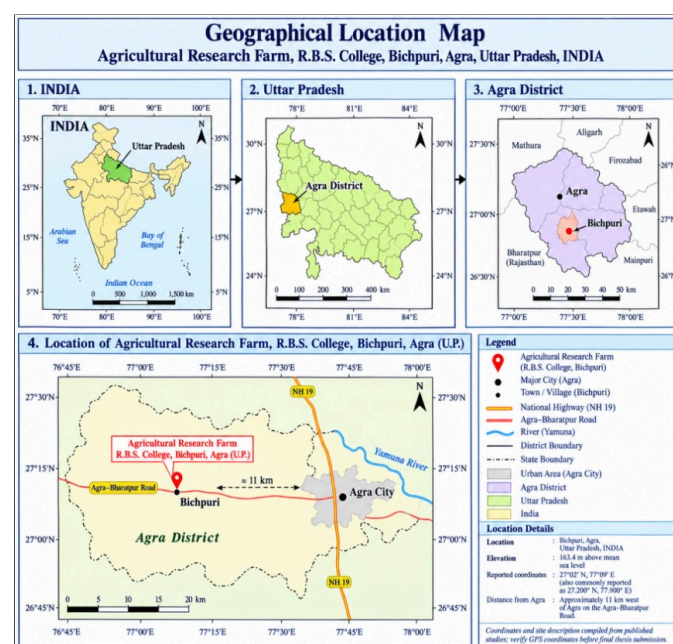
Introduction

Wheat (*Triticum aestivum* L.), known as the “King of cereals”, is the most important cereal crop of the world grown on the largest area, with an annual production of over 805 million tonnes at a productivity of 3.43 tonnes per hectare. (Vimal *et al.*, 2026) [1]. Wheat is the most important staple food crop of the world and the backbone of India’s food security. It is an important winter cereal contributing approximately 35 percent of the total food grain production in India. (Rajnish *et al.*, 2026) [2]. In general, wheat contains carbohydrate (70%), protein (12%), lipid (2%), vitamins and minerals (2% each) and crude fibre (Archana *et al.*, 2023) [3]. In 2024-25, the world area under wheat cultivation was 234.32 million hectares with a production of 805.85 million tonnes and an average productivity of 3.43 t ha^{-1} (USDA, 2025) [4]. India ranks second in wheat production after China, occupying about 19.45 per cent of the world wheat area and contributing nearly 14 per cent to global production, with an annual production of 117.95 million tonnes from 33.41 million hectares at a productivity of 3.507 t ha^{-1} during 2024-25 (Annual Report, 2024-25) [5].

Nitrogen plays a key role in wheat development and growth, and proper management strategies are necessary for sustainable wheat production in India. (Kumar *et al.*, 2025) [6]. One of the biggest obstacles to raising the commercial yield of crops is the current increase in fertilizer prices. Therefore, measures to reduce its losses and improve its economic utilization are required (Lokendra *et al.*, 2024) [7]. Fertilizer N management strategies need to be formulated to address the challenges of increasing agricultural productivity and improving sustainability. (Singh *et al.*, 2025) [8]. Varietal selection plays a role in determining yield potential. (Kumar *et al.*, 2025) [9]. The choice of right varieties of wheat helps to augment crop productivity by about 20-25 per cent. Thus, the value of stable and high yielding varieties has been universally recognized as an important factor for boosting crop production. (Verma *et al.*, 2025) [10]. Presently, development of new varieties for higher yields has reached a plateau and no further increase is achieved unless biotechnological interventions are made (Archana *et al.*, 2023) [3].

Materials and methods

The field experiment was conducted during the *Rabi* season of 2024-25 at the Agricultural Research Farm, R.B.S. College, Bichpuri, Agra, situated at 11 km west of Agra on the Agra-Bharatpur road (27°2' N latitude, 77°9' E longitude, 163.4 m above mean sea level) in the North-Western Semi-arid Zone of Uttar Pradesh. The soil of the experimental field was sandy loam in texture, low in available nitrogen (172.65 kg ha⁻¹), medium in available phosphorus (25.20 kg P₂O₅ ha⁻¹) and potassium (215.80 kg K₂O ha⁻¹), with a pH of 7.89 and organic carbon content of 0.37 per cent. The experiment comprised twelve treatment combinations consisting of four levels of nitrogen, viz., 0 (N₀), 75 (N₁), 150 (N₂) and 225 (N₃) kg N ha⁻¹, and three wheat varieties, viz., DBW-303 (V₁), DBW-371 (V₂) and HD-3298 (V₃), replicated thrice in a Factorial Randomized Block Design (FRBD). A uniform basal dose of 60 kg P₂O₅ ha⁻¹ and 40 kg K₂O ha⁻¹ was applied through DAP and MOP, respectively, along with one-third of the treatment dose of nitrogen through urea at sowing, while the remaining two-third nitrogen was top-dressed in two equal splits after the first and second irrigations.



Results and discussion

Growth characters of wheat at harvest

Nitrogen levels

Data presented in Table 1 reveal that number of shoots m⁻¹ row length increased progressively and significantly with each increment in nitrogen level, from 172.58 (N₀) to 182.83 application of N @ 225 kg ha⁻¹ (N₃). Similar improvement in tillering and crop stand with increasing nitrogen/nutrient levels has been reported by Singh *et al.*, (2024) [11], Kumar *et al.*, (2025a) [6], Gupta *et al.*, (2025a) [12] and Kumar *et al.*, (2025) [9]. Plant height increased significantly with nitrogen levels, being maximum under application of N @ 225 kg ha⁻¹ (N₃, 106.45 cm) and minimum under control (N₀, 89.76 cm), owing to nitrogen's role in promoting cell elongation and internodal growth. These results corroborate the findings of Archana *et al.*, (2023) [3], Singh *et al.*, (2025a) [8], who observed increasing plant height from 100 to 200 kg N ha⁻¹; Verma *et al.*, (2025) [10] and Nagar *et al.*, (2026) [13] and Vimal *et al.*, (2026) [1], Singh *et al.*, (2023) [14] and Singh *et al.*, (2024b, 2024c) and Rathor *et al.*, (2025) [15]. Dry matter accumulation increased markedly with nitrogen level, from 97.30 g (N₀) to 125.28 g application of N @ 225 kg ha⁻¹ (N₃), reflecting improved leaf area development and photosynthetic efficiency under adequate nitrogen nutrition. This finding is in agreement with Vimal *et al.*, (2026) [1] and Nagar *et al.*, (2026) [13], Gupta *et al.*, (2025b) [16], Kumar *et al.*, (2026) [17], Rathor *et al.*, (2025) [15] and Kumar *et al.*, (2025b) [18].

Days to 75% spike emergence and days to maturity: Nitrogen levels significantly influenced phenology, with application of nitrogen @ 150 kg ha⁻¹ recorded the earliest 75% spike emergence (87.36 days) and maturity (134.11 days), while control took the longest (92.11 and 142.36 days). Application of N @ 225 kg ha⁻¹ (N₃) matured slightly later than application of N @ 150 kg ha⁻¹, indicating that a threshold nitrogen level promotes efficient reproductive transition, whereas further increase prolongs vegetative growth marginally. Comparable delay in flowering and maturity under higher/combined nutrient regimes has been reported by Sharma *et al.*, (2025) [19], Kumar *et al.*, (2025a) [6] and Gupta *et al.*, (2025a) [12], Rajnesh *et al.*, (2026) [2] and Summan *et al.*, (2025) [18].

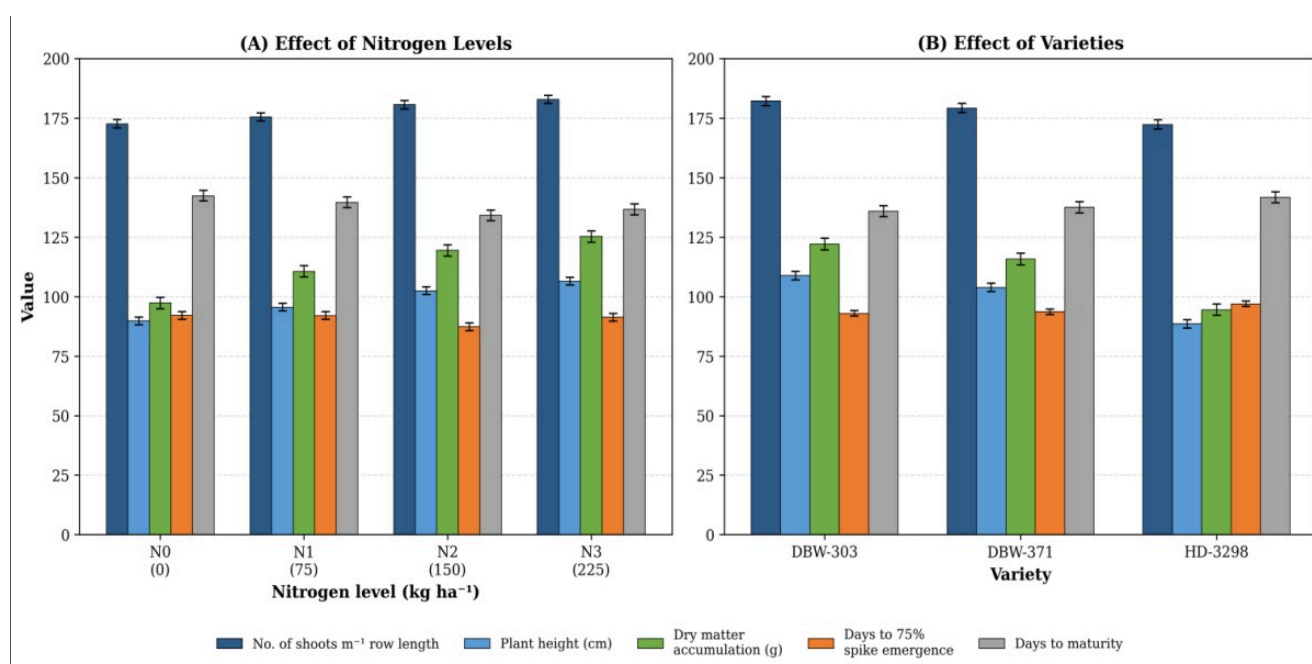


Figure 1. Growth and development characters of wheat at harvest stage as influenced by nitrogen levels and varieties.

Effect of varieties

Among the three varieties, DBW-303 (V_1) recorded the maximum number of shoots m^{-1} row length (182.16), which was significantly superior to varieties DBW-371 (V_2 , 179.19) and HD-3298 (V_3 , 172.31). Similar varietal differences in tillering and crop stand have been reported by Rajnesh *et al.*, (2026) [2], Kumar *et al.*, (2025b) [18] and Summan *et al.*, (2025) [18]. Plant height also varied significantly among varieties, with variety DBW-303 (V_1) recording the tallest plants (108.83 cm) at harvest, followed by variety DBW-371 (V_2 , 103.87 cm), while variety HD-3298 (V_3) remained the shortest (88.54 cm). Comparable varietal differences in plant height have been reported by Verma *et al.*, (2025) [10], Singh *et al.*, (2025a) [8], Kumar *et al.*, (2025b) [18] and Rajnesh *et al.*, (2026) [2]. Dry matter accumulation followed a similar results, being maximum in variety DBW-303 (V_1 , 122.11 g), followed by variety DBW-371 (V_2 , 115.76 g) and minimum in variety HD-3298 (V_3 , 94.51 g). These results are supported by Verma *et al.*, (2025) [10], Singh *et al.*, (2025a) [8], Summan *et al.*, (2025) [18] and Kumar *et al.*, (2025b). Phenology (days to 75% spike emergence and days to maturity): variety DBW-303 (V_1) attained 75% spike emergence earliest (92.95 days) and matured earliest (135.83 days), whereas variety HD-3298 (V_3) required significantly more time for both spike emergence (96.95 days) and maturity (141.74 days), with variety DBW-371 (V_2) being intermediate (93.61 and 137.49 days, respectively). Similar varietal differences in days to maturity have been documented by Singh *et al.*, (2023) [14], Singh *et al.*, (2025a) [8], Sharma *et al.*, (2025) [19] and Rajnesh *et al.*, (2026) [2] in wheat, and by Summan *et al.*, (2025) [18].

Yield attributing characters

Effect of nitrogen

The data presented in Table 2 reveal that all the yield-attributing characters of wheat, viz. spikelets $spike^{-1}$, grains $spike^{-1}$, spike length, grains weight $spike^{-1}$ and 1000-grain weight, were significantly influenced by different nitrogen levels. A progressive increase in these characters was recorded up to application of nitrogen @ 150 kg ha^{-1} (N_2), with maximum of spikelets $spike^{-1}$ (16.76), grains $spike^{-1}$ (62.12), spike length (13.25 cm), grains weight $spike^{-1}$ (4.08 g) and 1000-grain weight (42.36 g), beyond which a decline was observed at application of nitrogen @ 225 kg $N ha^{-1}$ (N_3). The lowest for all attributes were recorded under the control (N_0), confirming the fundamental role of nitrogen in promoting cell division, chlorophyll synthesis, tillering and translocation of photosynthates towards the developing spike (Archana *et al.*, 2023) [3]. This progressive improvement in yield attributes up to an optimum nitrogen level is well corroborated across the wheat literature from this research group. Lokendra *et al.*, (2024) [7] and Singh *et al.*, (2025) [8] reported that the nitrogen level of 150 kg $N ha^{-1}$. Similarly, Kumar *et al.*, (2025) [6], Nagar *et al.*, (2026) [13], Vimal *et al.*, (2026) [1], Gupta *et al.*, (2025a) [12] working with precision nitrogen management. The decline in yield attributes at 225 kg $N ha^{-1}$ in the present study, however, contrasts with reports where attributes increased continuously up to the highest nitrogen dose tested, largely because those studies did not extend testing beyond 150–200 kg $N ha^{-1}$ (Singh *et al.*, (2023) [14], Singh *et al.*, (2024a) [11]; Singh *et al.*, (2024b) [20], Kumar *et al.*, (2025) [6], Rathor *et al.*, (2025) [15], Gupta *et al.*, (2025b) [16] Nagar *et al.*, (2026) [13] and Vimal *et al.*, (2026) [1].

Table 1. Growth and development characters of wheat at harvest stage as influenced by nitrogen levels and varieties.

Treatments		No. of shoots m^{-1} row length	Plant height (cm)	Dry matter accumula- tion (g)	Days to 75% spike emergence	Days to maturity
Nitrogen levels (kg ha^{-1})						
0 kg ha^{-1}	N_0	172.58	89.76	97.30	92.11	142.36
75 kg ha^{-1}	N_1	175.46	95.54	110.55	92.05	139.58
150 kg ha^{-1}	N_2	180.67	102.45	119.39	87.36	134.11
225 kg ha^{-1}	N_3	182.83	106.45	125.28	91.32	136.65
SEm $\pm$		1.75	1.62	2.38	1.61	2.24
CD at 5%		5.26	4.78	6.08	4.76	5.42
Varieties						
DBW-303	V_1	182.16	108.83	122.11	92.95	135.83
DBW-371	V_2	179.19	103.87	115.76	93.61	137.49
HD-3298	V_3	172.31	88.54	94.51	96.95	141.74
SEm $\pm$		1.90	1.76	2.44	1.11	2.32
CD at 5%		5.78	5.35	7.32	2.87	4.87

Table 2. Yield attributing characters of wheat as influenced by nitrogen levels and varieties

Treatments		No. of Spikelets $spike^{-1}$	No. of Grains $spike^{-1}$	Spike length (cm)	Grains weight $spike^{-1}$ (g)	1000-grain weight (g)
Nitrogen levels (kg ha^{-1})						
0 kg ha^{-1}	N_0	9.54	38.69	8.10	1.62	36.12
75 kg ha^{-1}	N_1	10.89	43.65	9.89	2.21	38.53
150 kg ha^{-1}	N_2	16.76	62.12	13.25	4.08	42.36
225 kg ha^{-1}	N_3	15.57	58.76	12.87	3.67	40.24
SEm $\pm$		0.86	2.43	0.28	0.15	0.85
CD at 5%		2.67	5.78	0.97	0.48	2.32
Varieties						
DBW-303	V_1	17.65	62.15	13.04	3.98	42.09
DBW-371	V_2	14.93	55.03	12.01	3.46	40.69

(continued on next page)

HD-3298	V ₃	12.65	43.54	10.34	1.94	38.78
	SEm ±	1.31	2.12	0.43	0.24	0.78
	CD at 5%	3.79	5.67	1.35	0.65	2.11

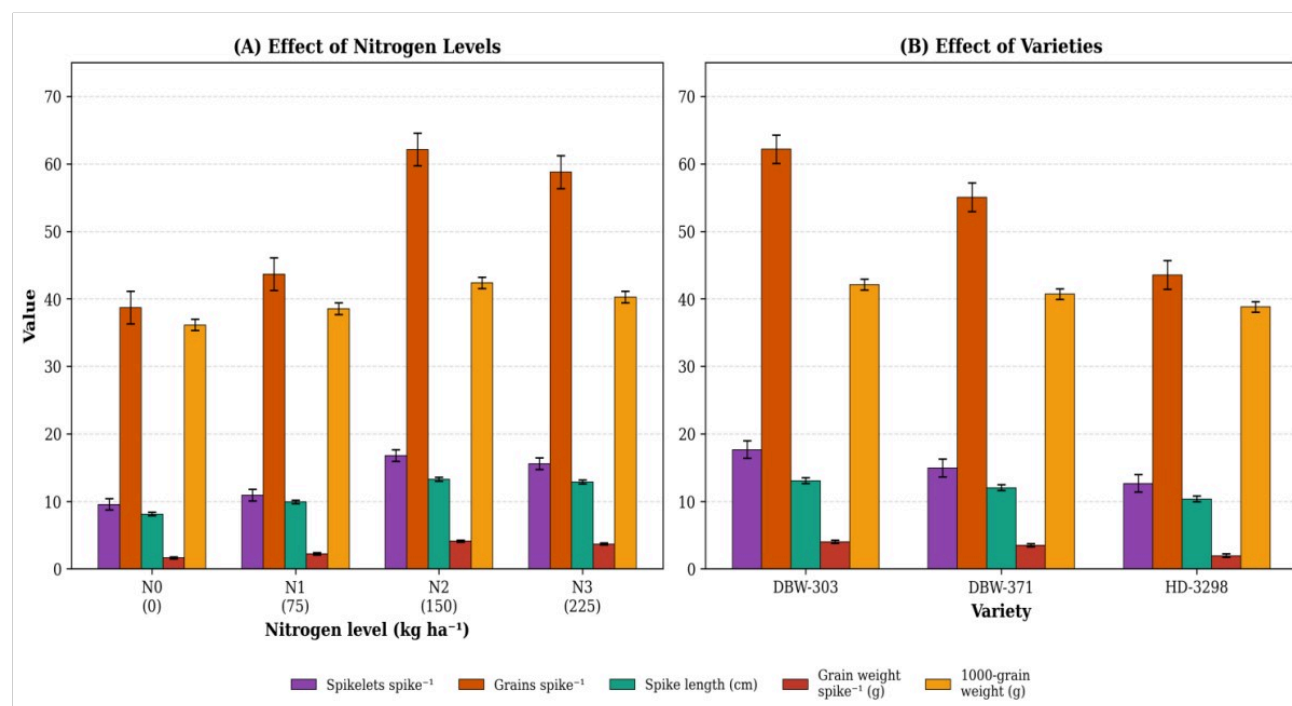


Figure 2. Yield attributing characters of wheat as influenced by nitrogen levels and varieties

Effect of varieties

Among the varieties, DBW-303 (V₁) recorded significantly superior yield-attributing characters, viz. spikelets spike⁻¹ (17.65), grains spike⁻¹ (62.15), spike length (13.04 cm), grains weight spike⁻¹ (3.98 g) and 1000-grain weight (42.09 g), over DBW-371 (V₂) and HD-3298 (V₃), the latter recording the lowest values for all characters studied. This superiority of a specific high-yielding genotype over others is a consistent finding across wheat varietal studies conducted at this research station. Verma *et al.*, (2025) [10], Singh *et al.*, (2025) [8] and Singh *et al.*, (2026) [21], reported that variety DBW-187 significantly outperformed HD-2967 and RAJ-3765 in number of spikes m⁻², spike length, grains spike⁻¹ and test weight across all potassium levels tested while Rajnesh *et al.*, (2026) [2], evaluating seven new wheat varieties under late and very late sowing, observed that JKW-261 and PBW-921 consistently produced the maximum earheads m⁻², spike length, grains spike⁻¹, grain weight spike⁻¹ and 1000-grain weight, remaining statistically at par with each other but significantly superior to other genotypes such as HD-3495. These findings collectively confirm that varietal differences in contributing traits are governed substantially by Singh *et al.*, (2022) [22], Singh *et al.*, (2023) [14], Singh *et al.*, (2024b) [20], Kumar *et al.*, (2025) [6] Summan *et al.*, (2025) [18], Sharma *et al.*, (2025a) and Kumar *et al.*, (2026), Verma *et al.*, (2025) [10] and Gupta *et al.*, (2025a) [12].

Conclusion

The results indicated that application of nitrogen @ 150 kg ha⁻¹ with variety of wheat DBW-303 was the most suitable combination for obtaining better growth, early development and superior yield attributing characters of wheat under irrigated, timely sown conditions of North Western Uttar Pradesh.

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How to cite this article: Chaubey P, Uma, Chaudhary S, Singh M, Singh M, Singh V. Impact of nitrogen levels and varieties on growth, development and yield attributing characters of wheat (*Triticum aestivum* L.) under timely sown conditions in western Uttar Pradesh. *International Journal of Agriculture and Food Science*. 2026;8(10):174-178. doi: <https://www.doi.org/10.33545/2664844X.2026.v8.i10c.2016>