

Effect of Nitrogen and Phosphorus fertilization on the growth and yield of Wheat (*Triticum aestivum* L.)

Comment [u1]: Which type of wheat? Bread wheat or Durum wheat?

Abstract

One of the most important cereal crops in the world, wheat (*Triticum aestivum* L.) provides a staple diet for a large proportion of the world's population. The use of chemical fertilizers in modern agriculture increases the risk to the environment in the quest for higher yields. On the other hand, applying urea and phosphorus presents a possible way to somewhat reduce this risk. To achieve this goal, a field trial was carried out as an experiment during the Rabi season of 2022-23 at the farm of R.M.P. (P.G.) College Gurukul-Narsan, Haridwar (U.K.) in order to address this objective. Sand loam soil with a pH of 7.5, electrical conductivity (EC) of 0.26 dSm⁻¹, organic carbon content of 0.60 percent, and available nutrients at levels of 217.0, 19.66, and 196.66 kg ha⁻¹ for nitrogen (N), phosphorus (P), and potassium (K), respectively, was used for the experiment. Uttar Pradesh. "Effect of Nitrogen and Phosphorus Fertilization on the Growth and Yield of Wheat (*Triticum aestivum* L.)" was the main topic of the study. The common dosage for the experimental design was 40 kg N + 80 kg P₂O₅ was administered to every treatment. The experiment was designed using a Randomized Block Design (RBD) with 12 treatments spread across three replications, along with a control group. Based on the results, it was found that the mixture of 40 kg/ha P₂O₅ and 50 kg/ha (N) significantly improved yield, growth, and other yield parameters. The data for treatment 5 showed the highest values for the following parameters: plant height (97.62 cm), number of tillers m⁻² (375.00), dry matter accumulation (16.53 g/plant), test weight (44.99 g/grains/ear (12.93), effective ear head per (m²) (282.66), and straw yield (47.59 quintals/ha).

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Keywords: wheat, nitrogen, phosphorus, RBD, growth, yield attributes, and yield

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Wheat (*Triticum aestivum* L.) is One of the most important cereal crops which provides a staple diet for a large proportion of the world's population. The field experiment was carried out during 2022/23 at the farm of R.M.P. (P.G.) College Gurukul-Narsan, Haridwar (U.K.) to identify optimum Nitrogen and phosphorus fertilizers rates. The factorial combinations of four Nitrogen rates (0, 50, 100 and 150 kg ha⁻¹) and three levels of phosphorus fertilizer rates (0, 40 and 80 kg ha⁻¹) were laid out in factorial arrangement of randomized complete block design (RCBD) with three replications.

The Statistical analysis of the data shows that parameters such as plant height (PH), Dry matter (DM), Productive tiller (PD), Number of grain (NG), Test weight (TW), Grain yield (GY) and Straw Yield (SY) shows significant and while the non significant result was recorded from----- parameters. Try to fill it your result data.

The highest PH (97.62 cm) was obtained from 50 kg N ha⁻¹ with 0 kg P₂O₅ ha⁻¹, the highest DM (16.53), PT (285.66), NG (12.93), TW (44.99), GY (40.75 q/ha), SY (47.59) was obtained from 50 kg N with 40 kg P₂O₅ ha⁻¹, while the lowest for all treatments was obtained from zero fertilizer application except for number of grain per plant. The overall treatments indicated that application of 50 kg N ha⁻¹ fertilizer combined with 40 kg P₂O₅ ha⁻¹ is optimum for production of wheat in the study area.

Keywords: Nitrogen, phosphorus, wheat and yield

Introduction

The most significant and extensively grown crop in the world is wheat (*Triticum aestivum* L.), one of the cereals. Wheat (*Triticum aestivum* L.) is one of the most widely grown and most consumed food crops all over the world (Semun, 2010). During 2022–2023, there were about 215 million hectares of wheat planted worldwide, yielding a production of 715.6 million tons (or 2665 tons of grain yield per hectare). Since wheat makes up 35% of staple foods and makes up 17% of the total, increasing its production is crucial for ensuring food security. Even though wheat is significant in Ethiopia, the country's yield is only 1.3 tons ha⁻¹, which is 24% less than both the average yield in Africa and the world [Wheat Crop Annual Report 2013, CGIAR Research Program]. Wheat Flour is used made from wheat for Pasta making, noodles, cakes, biscuits, cookies, and steamed and flat breads are among the food items (Chakravedi, 2006). According to Channabasavanna et al. (2001), fermentation produces beer and extra alcoholic beverages. According to the data, China produces 126.2 million metric tons of wheat, while India is the second largest producer at 95.9% million tons from an area of roughly 30.75 million hectares with productivity of 31.19 kg/ha.

Due to intensive cropping, the amount of nitrogen required per unit area has increased significantly. However, the sharp rise in fertilizer prices has created a significant barrier to the supply of all the fertilizers required for higher productivity. These chemical fertilizers are expensive and increase the cost of production, but they also present health risks and problems with soil microbial populations. The use of bio-fertilizers can be very beneficial in this circumstance. An essential role for microorganisms in chemical transformations. Because soils have an impact on the major nutrients that plants can access, such as nitrogen, phosphorus, potassium, and sulfur, applying fertilizer can be cut by 20–50% by using biofertilizers. To boost crop productivity, biofertilizers such as *Azospirillum*, *Azotobacter*, blue green algae, VAM, and phosphate solubilizing bacteria (PSB) can be employed (Singh et al., 1997).

It is undeniably economically feasible to use live, beneficial microorganisms in the form of biofertilizers as a self-generating source of nitrogen. Potential biofertilizers include non-symbiotic bacteria similar *Azospirillum* and *Azotobacter*. It has been discovered that *azotobacter* synthesizes compounds that promote plant growth, including cytokinins, gibberellins, auxins, and certain antibiotic metabolites (Doran, et al. 2019). *Azotobacter* thus plays a beneficial role in plant growth (Gene, Y; et al. 2000).

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One of the main structural components of a cell is nitrogen. While the primary cell wall contains approximately 5% nitrogen, the cytoplasm and particulate fractions of the cell organelles contain varying amounts of nitrogen, mostly in combination with carbon, hydrogen, oxygen, phosphorus, and sulfur. Because it is a necessary component of many different types of metabolically active compounds, including proteins, amino acids, nucleic acids, porphyrin, flavins, purines, pyrimidines, nucleotides, enzymes, and alkaloids, nitrogen plays a significant role in plant metabolism.

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Nitrogen and phosphorus are essential elements that play a vital role in the plant's metabolic activities. Macronutrient nitrogen occupies an important place in the plant metabolism system where it is an essential component of a protein associated with all vital processes in plants (Stewart *et al.*, 2005). In particular, nitrogen (N) and phosphorus (P) supply can play a vital role in plant development and optimal grain yield (Mussarat *et al.*, 2021). On the one hand, fertilization increases production costs, but on the other hand, the correct amount of fertilizer distributed at the right moment can enhance both wheat quality and quantity (Mandic *et al.*, 2015; Ferrari *et al.*, 2016). In plants, N is a key component of proteins, enzymes, and chlorophyll, thus affecting photosynthesis, substance synthesis and distribution, organ construction, and physiological processes (Maathuis, 2009). In soil, N is mainly related to the soil organic matter (OM), as it is a component of OM and is subjected to transformation via microorganism activity (Cotrufo *et al.*, 2013; Kallenbach *et al.*, 2013). Different nitrogen and phosphorus levels significantly affect the agronomic parameters like, plant height, grain spike, thousand grain weight and root biomass (Ahmed *et al.*, 2010). P is involved in cellular respiration and energy transfer via adenosine triphosphate (ATP) and participates in the formation of cellular membranes and physiologic processes such as cell division and development in the roots and the growing tip (Maathuis, 2009; Plaxton and Tran, 2011). Phosphorus in adequate amount is necessary for earlier maturity, rapid growth and improves the quality of vegetative growth (Khan *et al.*, 2014). Soils contain usually high pools of total P, but a small amount of readily available P. The P availability is mainly influenced by soil pH. Deficiency of phosphorus is responsible for small ears in maize due to crooked and missing rows as kernel twist (Masood *et al.*, 2011).

Appropriate and balanced fertilization on wheat is not only cause's yield enhancement but also has good impact on phosphorus uptake by these crop plants (Rehman *et al.*, 2006). Better

matching of N and P fertilizers at rates suitable to the local climate and soil type can increase the productivity of wheat (Soofizada *et al.*, 2023). Determining the appropriate NP fertilizer combinations rate is hence necessary for maximizing wheat economic yields. Therefore, the objective of this study is to determine the optimum N and P combination rates for the study area.

Materials and Methods

At the farm of R.M.P. (P.G.) College Gurukul Narsan, Haridwar (U.K.), a field trial was held during the Rabi season of 2022-2023 to determine the impact of various fertilization treatments. Observations were made on the growth and development of the ear and grain characters, yield, harvest index of wheat, and population at the appropriate stages. The pH of the sandy loam soil at the experimental site was 7.5. The experimental field's soil had a low organic carbon content and reacted slightly alkaline. Both the available Phosphorus and Potash are medium. A randomised randomized block design comprising twelve treatments and three replications was used to set up the experiment. T1 Control plot, T2 0 Kg/ha (N) + 40 Kg/ha P₂O₅, and T3 0 Kg/ha (N) + 80 Kg/ha P₂O₅ were the treatments. T4 50 kg/ha (N) plus 0 kg/ha P₂O₅, T5 50 kg/ha (N) plus 40 kg/ha P₂O₅, T6 50 kg/ha (N) + 80 kg/ha P₂O₅, T7 100 kg/ha (N) + 0 kg/ha P₂O₅, T8 100 kg/ha (N) + 40 kg/ha P₂O₅, T9 100 kg/ha (N) + 80 kg/ha P₂O₅, T10 150 kg/ha (N) + 0 kg/ha P₂O₅, T11 150 kg/ha (N) + 40 kg/ha P₂O₅, T12 150 kg/ha (N) + 80 kg/ha P₂O₅. On December 12, 2022, wheat seeds (W.H. 291) were planted with a row spacing of 22.5 cm. A dosage of 40 kg N and 80 kg P₂O₅ fertilizer At the time of sowing, a full dose of phosphorus and potash and a half dose of nitrogen were drilled. The remaining half of the nitrogen dose was top-dressed in two equal portions, one following the initial irrigation and the other at the onset of the panicle.

This chapter includes tables that show the experimental results for mother shoots, shoot density at the maximum tillering stage, ear density at harvest, production of various fertilization populations at different stages, and the economics of various nitrogen and phosphorus fertilization treatments. When deemed necessary, bar diagrams have also been used to illustrate the main findings. The appendices contain the analysis of variance results.

Experimental treatments and design

The experimental design were a Randomized Complete Block Design (RCBD) with three replications with the plot size of ---m x ----m and 20cm spacing between rows used. The treatments combinations of Nitrogen and phosphorus fertilizers are. (T1) Control or no fertilizer, (T2) 0 Kg N ha⁻¹ + 40 Kg P₂O₅ ha⁻¹, (T3) 0 Kg N ha⁻¹ + 80 Kg P₂O₅ ha⁻¹, (T4) 50 kg N ha⁻¹ + 0 kg P₂O₅ ha⁻¹, (T5) 50 kg N ha⁻¹ + 40 kg P₂O₅ ha⁻¹, (T6) 50 kg N ha⁻¹ + 80 kg P₂O₅ ha⁻¹, (T7) 100

Comment [u8]: Site Description

These studies were conducted at ----- from December to----- February of 2022/23 years under rain fed conditions or under irrigation conditions. Not stated try to write it

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kg N ha⁻¹ + 0 kg P₂O₅ ha⁻¹, (T8) 100 kg N ha⁻¹ + 40 kg P₂O₅ ha⁻¹, (T9) 100 kg N ha⁻¹ + 80 kg P₂O₅ ha⁻¹, (T10) 150 kg N ha⁻¹ + 0 kg P₂O₅ ha⁻¹, (T11) 150 kg N ha⁻¹ + 40 kg P₂O₅ ha⁻¹, (T12) 150 kg N ha⁻¹ + 80 kg P₂O₅ ha⁻¹. The wheat variety of (W.H.291) were used.

Experimental procedure

All full doses of phosphorus fertilizer applied at time of sowing and nitrogen fertilizer applied in split application of half at time of sowing and half N top-dressed at time of panicle imitation. All agronomic management applied uniformly for all plots.

Soil Sampling and Analysis

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Data Collection

Descriptions of each data you have taken for example listed below try to use your own

Phenological data

Days to 50% heading: number of days from sowing up to the date when the tips of the panicles first emerged from the main shoot, on 50% of the plant in a plot.

Days to 90% maturity: number of days from the date of sowing up to the date when 90% of the crop stands in a plot changed to light yellow color.

Growth data

Plant height (cm): It was measured at maturity, from five random plant samples of the harvestable rows, from the ground level to the tip of the spike.

Tillers number (m⁻²): To determine the capacity of tillering per 1 m², 10 × 20 cm area was demarcated and the number of plants existed in that area was counted. Then recounting was done after at flowering on demarked area; because maximum tillers produced during vegetative phase and senescence occurs at maturity. Finally the difference between the first and second count was converted into 1m².

Panicle length (cm): length of the panicle was measured by selecting six plants randomly and measuring from the node (the first panicle branch started) to the tip of the panicle.

Yield and yield components

Total above ground biomass (kg): was measured after sun-drying for two days.

Straw yield (kg): was measured by subtracting grain yield per plot from the total above ground biomass.

Grain yield (kg ha⁻¹): yield from every plot.

3. Results and Discussion

3.1 Effect on Growth Parameters

3.1.1. Plant height (cm)

As the growth progressed, a discernible increase in plant height was noted, as shown in (Table 1). In terms of statistical significance, treatment T5 (50 kg/ha (N) + 40 kg/ha P₂O₅) yielded the highest plant height (97.62 cm), followed by treatment T8 (100 kg/ha (N) + 40 kg/ha P₂O₅) and treatment T7 (100 kg/ha (N) + 0 kg/ha P₂O₅).

Obtaining 75% of the suggested rate of NPK in addition to a higher plant height than other fertility treatments is the maximum that can be achieved. Because it is a crucial component of proteins, amino acids, and proto plants, nitrogen had a direct impact on plant growth and development by improving photosynthesis. When combined with a sufficient amount of N₂, the crop generated biomass. Many researchers have previously reported on the positive effects of NPK fertilizer on wheat growth (Gene, Y; R.D. et al., 2000). A similar study found that NPK inoculation significantly increased wheat plant height, ear length, and grain yield (Morsy, M.A. and Moussa, A.M. (1998).

The analysis of variance or statistical analysis indicated that plant height was significantly ($P < 0.01$ or 0.05 use your own significance level) affected by NP fertilizer combination (Table 1). The tallest plant (97.62 cm) was recorded from the treatments combination of 50 kg N ha⁻¹ with 40 kg P₂O₅ha⁻¹ followed by treatment 100 kg N ha⁻¹ with 40 kg P₂O₅ha⁻¹ and the shortest plant height (63.42cm) was obtained from control. This might be due to Nitrogen is a crucial component of proteins, amino acids, and proto plants, nitrogen had a direct impact on plant growth and development by improving photosynthesis. The combination of phosphorus fertilizer with a sufficient amount of Nitrogen generated high amount of biomass and the plant height may increase. (Genc *et al.*, 2000) reported that the positive effects of NPK fertilizer on wheat growth. A similar study found that NPK inoculation significantly increased wheat plant height, ear length, and grain yield (Morsy and Moussa, 1998).

3.1.2. Number of total tillers: No. of tillers (m⁻²)

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At harvest, the highest number of tillers treated with T5 (50 kg/ha (N) + 40 kg/ha P₂O₅) was 285.66. At harvest, a similar trend in the number of tillers was also observed with all the respective treatments; the maximum number of tillers was obtained with T5 (50 kg/ha (N) + 40 kg/ha P₂O₅). The minimum number of tillers was recorded with control treatment 221.00 and 215.66. For each treatment, a percentage increase in the number of tillers was observed. The number of tillers at all growth stages was substantially impacted by the levels of zinc and phosphorus. (Sekhawat and Swami, S., 2019).

The analysis of variance indicated that number of total tiller produced was highly significant or significant use you own ($P < 0.01$ or 0.05) affected by the combined N and P fertilizers (Table 1). The highest number of tillers (285.66) counted at tillering stage was recorded from treatment combinations of 50 kg N ha⁻¹ with 40 kg P₂O₅ha⁻¹ while the minimum number of tillers (149) was recorded with control treatment. For each treatment, a percentage increase in the number of tillers was observed. The number of tillers at all growth stages was substantially impacted by the levels of zinc and phosphorus (Sekhawat and Swami, 2019).

Table 1. Effect of nitrogen and P₂O₅ fertilization on the growth of wheat.

No. of treatments	Plant Height (cm)	Dry matter accumulation (g plant ⁻¹)	No. of total tillers	No. of effective tiller
T ₁ (N ₀ P ₀)	63.42	7.82	149.00	
T ₂ (N ₀ P ₁)	87.65	13.66	246.00	
T ₃ (N ₀ P ₂)	86.48	13.75	246.00	
T ₄ (N ₁ P ₀)	83.53	13.50	251.66	
T ₅ (N ₁ P ₁)	97.62	16.53	285.66	
T ₆ (N ₁ P ₂)	91.14	13.82	215.00	
T ₇ (N ₂ P ₀)	95.80	15.44	222.36	
T ₈ (N ₂ P ₁)	96.75	15.22	255.66	
T ₉ (N ₂ P ₂)	89.48	14.00	236.33	
T ₁₀ (N ₃ P ₀)	95.75	15.00	246.00	
T ₁₁ (N ₃ P ₁)	93.39	14.77	261.00	
T ₁₂ (N ₃ P ₂)	90.30	13.71	237.33	

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<u>Sem +</u>	<u>0.83</u>	<u>0.32</u>	<u>0.28</u>	
<u>CD (P = 2.25%)</u>	<u>0.26</u>	<u>0.92</u>	<u>0.56</u>	

3.1.3 Dry matter accumulation (g/plant^{-1})

The weight of the plant's dry matter increased in tandem with the crop's growth, as shown in Table 1. Treatment T5 (50 kg/ha (N) + 40 kg/ha P₂O₅) showed a notable and maximum dry matter accumulation (16.53 g/plant). However, treatment T7 yielded results that were statistically similar to those of treatment T8. Jana *et al.* (2002), P.K. Numerous workers have reported that N₂ fertilizers have a positive effect on wheat's dry matter. Wheat received N₂ and P₂O₅ fertilization to a dry weight that was comparable to wheat that received 100% fertilization. Mahmoud (1991) reported that urea, without inoculation, improved plant height, shoot dry weight, and grain yield development more significantly in terms of N₂ uptake.

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3.2. Yield Attributes and Yields

3.2.1 Number of effective tiller per (cm^{-2})

In treatment 50 kg N ha⁻¹ with 40 kg P₂O₅ ha⁻¹ T5 (50 kg/ha (N) + 40 kg/ha P₂O₅), a notable and highest counts the highest (285.66) of effective per spike. ear head per (cm^{-2}) (285.66) was observed (Table 2). However, the treatment administered to T11, T8, T4, and T12 showed statistically similar outcomes to treatment T2; was reported by Al-Juthery *et al.* (2018).

3.2.2 Number of grains per ear head spike

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Significantly more grains per ear head (12.93) were found in the treatment ear head, which showed statistically comparable outcomes to treatment T5 (50 kg/ha (N) + 40 kg/ha P₂O₅). However, the treatment was much better than the other treatments and on par with T8 and T1. The phosphorus application rate showed a positive quadratic relationship with wheat grain. Our results are consistent with those published by Ojha et al. (2023). According to Morsy, M.A. and Moussa, A.M. (1998), market-driven NPK inoculation enhanced wheat grain yield, ear length, and plant height. According to Singh, Mahendra, and Yadav B.L. (2004), the application of 150 and 180 kg N ha⁻¹ was equivalent in terms of greatly boosting growth yield parameters, including grain yield.

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The result revealed that NP fertilizer showed significant effect with respect to the number of grains per spike. The highest number of grains (12.93) per spike was recorded from treatments 50 kg N ha⁻¹ with 40 kg P₂O₅ ha⁻¹ while the minimum (7.60) were recorded from treatment 50 kg N ha⁻¹ with 0 kg P₂O₅ ha⁻¹. This may be due to the phosphorus application rate showed a positive quadratic relationship with wheat grain. The results are consistent with Ojha et al. (2023). Similarly, (Singh et al., 2004) reported that application of 150 and 180 kg N ha⁻¹ was equivalent in terms of greatly boosting growth yield parameters, including grain yield.

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3.2.3 Test weight (g)

The findings show that treatment T5 (50 kg/ha (N) + 40 kg/ha P₂O₅) saw the highest test weight (44.99). However, therapy T9 However, in comparison to the other treatments, T9 and T1 treatment is on par. Several workers had noted similar outcomes (Singh Yadav 2018).

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The findings show that treatment 50 kg N ha⁻¹ with 40 kg P₂O₅ ha⁻¹ showed the highest test weight (44.99) and the lowest was recorded from no fertilizer. Similar, outcomes was reported by (Singh, 2018).

Table 2 Effect of nitrogen and P₂O₅ fertilization on the growth & yield of wheat.

<u>Sr. No.</u>	<u>No. of Treatments</u>	<u>Number of grains per ear head/grain per spike</u>	<u>Test weight (g)</u>	<u>spike length (cm)</u>	<u>Grain yield q/ha</u>	<u>Straw yield q/ha</u>

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1	T₁ (N₀P₀)	11.05	29.54	3.57	25.19	30.21
2	T₂ (N₀P₁)	9.20	42.87	9.33	37.30	44.75
3	T₃ (N₀P₂)	8.93	43.38	9.66	37.15	45.02
4	T₄ (N₁P₀)	7.60	42.11	9.44	36.62	44.06
5	T₅ (N₁P₁)	12.93	44.99	10.22	40.75	47.59
6	T₆ (N₁P₂)	10.67	43.45	9.33	37.99	44.12
7	T₇ (N₂P₀)	11.00	44.25	10.32	39.96	47.02
8	T₈ (N₂P₁)	11.50	44.36	10.11	40.11	44.27
9	T₉ (N₂P₂)	10.67	43.64	9.33	37.64	44.27
10	T₁₀ (N₃P₀)	10.98	43.64	9.55	39.29	47.00
11	T₁₁ (N₃P₁)	10.93	43.86	9.33	38.47	44.60
12	T₁₂ (N₃P₂)	9.55	42.05	9.05	32.41	42.56
Sem +		1.78	0.21	0.79	0.20	0.94
CV (0.05 %)		5.21	0.61	2.32	0.59	2.75

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3.2.4 Spike length (cm)

Results show that treatment T5(50 kg/ha (N) + 40 kg/ha P₂O₅) showed the maximum Spike length (10.22 cm). However, in comparison to the other treatments, T3 and T10 treatment is on par. The same study found that NPK inoculation significantly raised wheat plant height, ear length, and grain yield. In 1998, Morsy, M.A. and Moussa, A.M.

Results show that the longest spikes (10.22 cm) was recorded at the combined application of both 50 kg N ha⁻¹ and 40 kg P₂O₅ ha⁻¹ fertilizers, whereas the shortest spikes (3.57 cm) was

recorded under no fertilizer application (Table 2). The same study by Morsy and Moussa (1998) found that NPK inoculation significantly raised wheat plant height, ear length, and grain yield.

3.2.5 Grain yield (kg ha⁻¹)

Treatment T5 (50 kg/ha (N) + 40 kg/ha P₂O₅) showed a significant and elevated grain yield (40.75 quintals/ha). Treatment at par T11 and T6, however, was noticeably better than rest treatments. Grain yield was found to be significantly impacted by nitrogen. There are reports that state that urea's synergistic effect increases the effectiveness of conventional fertilizers, causing plant cells to absorb nutrients optimally, which in turn promotes optimal growth and metabolic processes like photosynthesis. Higher photosynthesis accumulation and translocation to the plant's economic parts follow, which in turn lead to a higher yield that is attributed to stronger sources (leaves) and sinks (economic parts) Ojha et al. 2023. According to Singh, Mahendra, and Yadav B.L. (2004), the application of 150 and 180 kg N ha⁻¹ was equivalent in terms of greatly boosting growth yield parameters, including grain yield. The same study found that NPK inoculation significantly raised wheat plant height, ear length, and grain yield. In 1998, Moussa, A.M. and Morsy, M.A.

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The result regarding grain yield showed that grain yield was found to be significantly impacted by combination of N and P fertilizer application. The highest grain yield (40.75qha⁻¹) was obtained from 50 kg N ha⁻¹ and 40 kg P₂O₅ ha⁻¹ fertilizer rates. While the lowest (25.19 qha⁻¹) grain yields were recorded from zero fertilizer applications (Table 2). This may be due to urea's synergistic effect increases the effectiveness of causing plant cells to absorb optimal nutrients, which in turn promotes optimal growth and metabolic processes like photosynthesis. Higher photosynthesis accumulation and translocation to the plant's economic parts follow, which in turn lead to a higher yield that is attributed to stronger sources or leaves and sinks or economic parts (Ojha et al., 2023). According to Singh et al., 2004, the application of 150 and 180 kg N ha⁻¹ was equivalent in terms of greatly boosting growth yield parameters, including grain yield. The same study by (Moussa and Morsy, 1998) found that NPK inoculation significantly raised wheat plant height, ear length, and grain yield.

3.2.6 Straw yield (q ha⁻¹)

The findings showed that treatment T7 had a higher straw yield (47.59 quintals/ha). However, therapy at level T11 and T2. On the other hand, treatment T1 had the lowest straw yield. Similar findings were

reported by Swami, S. and Sekhawat (2019); according to Vasudeva and Anathanarayana, R. (2001), the maximum straw yield was recorded with 150% NPK.

The findings showed that the highest straw yield of 47.59 q ha⁻¹ was obtained at 50 kg N ha⁻¹ and 40 kg P₂O₅ ha⁻¹ fertilizer rates whereas the lowest straw yields of 30.21 q ha⁻¹ was from the control (Table 2). The result is consistent with that of (Nasser and El-Gizawy, 2009) who reported increased straw yield of wheat with increase in NP fertilizers rates up to 90/45 kg ha⁻¹. Similar findings were reported by (Swami and Sekhawat, 2019); (Vasudeva and Anathanarayana, 2001) reported the maximum straw yield was recorded with 150% NPK.

Conclusion

In conclusion, it can be said that treatment T5(50 kg/ha (N) + 40 kg/ha P₂O₅) is the best fertilizer treatment in terms of growth, yield, nutrient uptake, and fertilizer productivity. This is based on the results mentioned above. Applying 50, 100, or 150 kg of nitrogen has a positive impact on wheat's growth parameters, yield, and yield attributes. Apply 0, 40, and 80 kg P₂O₅ along with treatment (T5) and 50, 100, and 150 kg nitrogen to improve soil health and productivity. It's crucial to remember that these findings are based on a single season, and more research may be required to provide more assurance. The study's findings showed that adding urea to conventional NPK nutrient supply had a generally positive impact on the growth and yield characteristics of wheat grown under irrigation.

As conclusions, the Phosphorus either Nitrogen fertilizer alone or high quantity does not increase the yield of wheat. The fertilizer rates of 50 kg N ha⁻¹ with 40 kg P₂O₅ ha⁻¹ are significantly increased wheat growth and yields. However, as one-season and one-location experiment, the experiment has to be repeated over locations and seasons together for further recommendations.

Table no. 1. Effect of nitrogen, P₂O₅ fertilization on the growth of wheat.

No. of Treatment	Plant Height (cm)	Dry matter accumulation (gm plant ⁻¹) At harvesting stage	No. of tillers (m ²) At harvesting stage
T ₁ (N ₀ P ₀)	63.42	7.82	149.00
T ₂ (N ₀ P ₁)	87.65	13.66	246.00
T ₃ (N ₀ P ₂)	86.48	13.75	246.00

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T ₄ -(N ₁ P ₀)	83.53	13.50	251.66
T ₅ -(N ₁ P ₁)	97.62	16.53	285.66
T ₆ -(N ₁ P ₂)	91.14	13.82	215.00
T ₇ -(N ₂ P ₀)	95.80	15.44	222.36
T ₈ -(N ₂ P ₁)	96.75	15.22	255.66
T ₉ -(N ₂ P ₂)	89.48	14.00	236.33
T ₁₀ -(N ₃ P ₀)	95.75	15.00	246.00
T ₁₁ -(N ₃ P ₁)	93.39	14.77	261.00
T ₁₂ -(N ₃ P ₂)	90.30	13.71	237.33
Sem ±	0.83	0.32	0.28
CD (P = 2.25%)	0.26	0.92	0.56

Table no. 2 Effect of nitrogen, P₂O₅ fertilization on the growth & yield of wheat.

Sr. No.	No. of Treatment	Number of grains per ear head	Test weight (g)	Length of ear (cm)	Grain yield q/ha	Straw yield q/ha
1—	T ₁ -(N ₀ P ₀)	11.05	29.54	3.57	25.19	30.21
2—	T ₂ -(N ₀ P ₁)	9.20	42.87	9.33	37.30	44.75
3—	T ₃ -(N ₀ P ₂)	8.93	43.38	9.66	37.15	45.02
4—	T ₄ -(N ₁ P ₀)	7.60	42.11	9.44	36.62	44.06

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5.—	$T_5-(N_1P_1)$	12.93	44.99	10.22	40.75	47.59
6.—	$T_6-(N_1P_2)$	10.67	43.45	9.33	37.99	44.12
7.—	$T_7-(N_2P_0)$	11.00	44.25	10.32	39.96	47.02
8.—	$T_8-(N_2P_1)$	11.50	44.36	10.11	40.11	44.27
9.—	$T_9-(N_2P_2)$	10.67	43.64	9.33	37.64	44.27
10.—	$T_{10}-(N_3P_0)$	10.98	43.64	9.55	39.29	47.00
11.—	$T_{11}-(N_3P_1)$	10.93	43.86	9.33	38.47	44.60
12.—	$T_{12}-(N_3P_2)$	9.55	42.05	9.05	32.41	42.56
Sem \pm		1.78	0.21	0.79	0.20	0.94
CV(0.05%)		5.21	0.61	2.32	0.59	2.75

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