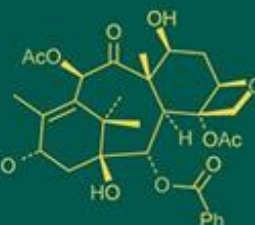
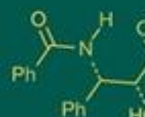
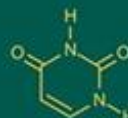
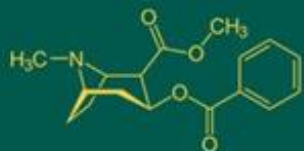


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Influence of nutrient management practices on growth, yield attributes, and productivity of wheat (*Triticum aestivum* L.)

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Abstract

A field experiment was conducted at Raja Balwant Singh College Research Farm, Bichpuri (Agra) during 2018-19 to evaluate the influence of different nutrient management practices on growth, yield attributes and productivity of wheat (*Triticum aestivum* L.). The experiment comprised eight treatments involving sole and combined application of recommended NPK fertilizers, farmyard manure (FYM), sulphur and zinc in a randomized block design. The results revealed that nutrient management practices significantly improved crop growth, yield attributes and yield over control. Among the treatments, T₈ (150 kg N + 90 kg P₂O₅ + 60 kg K₂O ha⁻¹) recorded significantly higher plant height (100.1 cm), tillers (90.7 m⁻¹), dry matter accumulation (64.0 g 25 cm⁻²), ear length (11.1 cm), grains ear⁻¹ (59.0), test weight (43.0 g), grain yield (55.57 q ha⁻¹) and straw yield (66.12 q ha⁻¹), which remained statistically at par with T₇. The enhancement in crop performance under integrated nutrient management was mainly attributed to balanced nutrient availability, improved soil environment and higher nutrient use efficiency. Thus, the study indicated that conjunctive use of inorganic fertilizers with FYM, sulphur and zinc proved more efficient and sustainable than sole fertilizer application for enhancing growth and productivity of wheat.

Keywords: Integrated nutrient management, wheat productivity, farmyard manure, sulphur, zinc, yield attributes

Introduction

Wheat (*Triticum aestivum* L.) is one of the most extensively cultivated cereal crops worldwide and serves as a major source of calories and dietary protein for a large proportion of the global population (Khalid & Hameed, 2023) ^[1]. Sustained productivity of wheat under intensive cultivation largely depends on efficient nutrient management practices, as continuous cropping without adequate nutrient replenishment often leads to soil fertility depletion and declining yield trends (Ladha *et al.*, 2020). Integrated Nutrient Management (INM), which combines inorganic fertilizers with organic amendments like farmyard manure (FYM) and other nutrient sources, has been widely investigated as a strategy for improving wheat performance. Field studies have shown that integrated application of nutrients significantly improves growth indices, nutrient uptake and yield compared to sole fertilizer application. For instance, combined use of recommended doses of fertilizers with FYM and vermicompost enhanced growth attributes and yields of wheat, indicating the benefits of integrating organic sources in nutrient supply. Similarly, balanced INM practices have been reported to increase plant height, effective tillers, grain weight and straw yield under different agro-climatic conditions, highlighting their positive influence on both quantitative and qualitative aspects of wheat production (Sharma & Tomar, 2025) ^[2]. Several experiments further emphasize that INM not only improves crop yield but also supports soil fertility and nutrient dynamics. Studies conducted under alluvial soil conditions demonstrated that conjoint application of NPK with FYM and organic manures increased soil nutrient availability and resulted in higher grain and straw yields than control or sole chemical fertilization (Jaiswal *et al.*, 2025) ^[3]. Improved vegetative growth under balanced nutrient supply positively influences yield attributing characters including spike length, number of grains per spike and test weight, ultimately leading to enhanced grain and straw yields (Verma *et al.*, 2025) ^[4]. Furthermore, integrated nutrient approaches contribute to higher nutrient use efficiency and long-term soil sustainability compared to sole chemical fertilization (Ladha *et al.*, 2020). Therefore, evaluating the influence of nutrient management practices on growth dynamics, yield components

and productivity of wheat is essential for developing sustainable and resourceefficient production strategies.

Materials and Methods

The present field experiment was conducted Raja Balwant Singh Collage Research Farm, Bichpuri (Agra) during 2018 - 19 to study the influence of nutrient management practices on growth, yield attributes and productivity of wheat (*Triticum aestivum* L.). The experiment was laid out in a Randomized Block Design (RBD) with eight treatments and three replications. The treatments included T₁ (Control), T₂ (10 t FYM ha⁻¹), T₃ (120 kg N + 60 kg P₂O₅ + 40 kg K₂O ha⁻¹), T₄ (120 kg N + 60 kg P₂O₅ + 40 kg K₂O ha⁻¹ + 10 t FYM ha⁻¹), T₅ (120 kg N + 60 kg P₂O₅ + 40 kg K₂O ha⁻¹ + 20 kg S ha⁻¹), T₆ (120 kg N + 60 kg P₂O₅ + 40 kg K₂O ha⁻¹ + 5 kg Zn ha⁻¹), T₇ (120 kg N + 60 kg P₂O₅ + 40 kg K₂O ha⁻¹ + 20 kg S + 5 kg Zn + 10 t FYM ha⁻¹) and T₈ (150 kg N + 90 kg P₂O₅ + 60 kg K₂O ha⁻¹).

Wheat crop was grown under standard agronomic practices. Full dose of phosphorus and potassium along with one-third nitrogen was applied at sowing, while remaining nitrogen was top-dressed in two equal splits at tillering and booting stages. FYM was incorporated uniformly in respective treatments before sowing. Sulphur and zinc were applied as per treatment details at basal stage. Observations on growth parameters such as plant height, number of tillers and dry matter accumulation were recorded at physiological maturity.

Yield attributes including ear length, grains per ear and test weight were measured from randomly selected plants. Grain and straw yields were recorded from each plot and converted into q ha⁻¹. For statistical analysis using the F-test as per the procedure given by Gomez and Gomez (1984) [5]. Critical difference values at P=0.05 were used to determine the significance of differences between treatment means.

Result and Discussion

Growth studies

Growth parameters of rice were significantly affected by nutrient management treatments (Table 1). The lowest plant height (78.8 cm), tillers (69.8 m⁻¹) and dry matter accumulation (54.0 g 25 cm⁻²) were recorded under control, whereas all fertilized treatments showed marked improvement. Application of recommended NPK alone enhanced growth substantially; however, its integration with FYM, sulphur and zinc produced superior results. Treatment T₈ (150 kg N + 90 kg P₂O₅ + 60 kg K₂O ha⁻¹) recorded significantly higher plant height (100.0 cm), tillers (90.7 m⁻¹) and dry matter accumulation (64.0 g 25 cm⁻²), which remained statistically at par with T₇. Integrated nutrient management significantly improved plant height, tillering and biomass production in wheat due to balanced nutrient supply and improved soil fertility status (Singh, 2019) [6]. Similar beneficial effects of integrated nutrient application on wheat growth were also reported by Kumar et al. (2023) [7].

Table 1: Effect of nutrient management practices on growth parameters of wheat.

S. No.	Treatment	Plant height (cm)	Tillers (m ⁻¹)	Dry matter accumulation/ 25 cm ² (g)
T ₁	Control	78.8	69.8	54.0
T ₂	10 t FYM ha ⁻¹	83.6	74.0	56.5
T ₃	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹	92.5	85.8	62.5
T ₄	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 10 t FYM ha ⁻¹	99.5	90.2	63.2
T ₅	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S ha ⁻¹	98.7	89.5	62.1
T ₆	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 5 kg Zn ha ⁻¹	97.2	88.0	61.3
T ₇	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S + 5 kg Zn + 10 t FYM ha ⁻¹	100.0	90.5	63.8
T ₈	150 kg N + 90 kg P ₂ O ₅ + 60 kg K ₂ O ha ⁻¹	100.1	90.7	64.0
	SEm	1.37	0.64	0.71
	CD (P=0.05)	4.02	1.88	2.09

Yield attributing characters

Yield attributes were significantly influenced by different nutrient management treatments (Table 2). The minimum ear length (7.0 cm), number of grains ear⁻¹ (47.0) and test weight (38.34 g) were recorded under control, while all nutrient-applied treatments showed appreciable improvement. Integrated application of recommended NPK along with FYM, sulphur and zinc proved superior over sole fertilizer use. Treatment T₈ (150 kg N + 90 kg P₂O₅ + 60 kg K₂O ha⁻¹) recorded significantly higher ear length (11.1 cm), grains ear⁻¹ (59.0)

and test weight (43.0 g), which remained statistically at par with T₇. The enhancement in yield contributing characters under integrated nutrient management may be attributed to balanced nutrient availability, improved assimilate translocation and better grain filling due to favourable soil conditions created by FYM and micronutrient supplementation. Similarly, improvement in panicle/spike length, grains per ear and test weight under combined use of inorganic fertilizers and organic sources has also been reported in cereal crops (Paramesh et al., 2020 and Kumar et al., 2023) [8].

Table 2: Effect of nutrient management practices on yield attributing characteristics of wheat.

S.No.	Treatment	Ear length (cm)	No. of grain/ear	Test weight (g)
T ₁	Control	7.0	47.0	38.34
T ₂	10 t FYM ha ⁻¹	8.0	49.6	39.20
T ₃	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹	9.0	55.8	41.05
T ₄	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 10 t FYM ha ⁻¹	10.6	57.8	42.10
T ₅	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S ha ⁻¹	10.0	56.0	40.65
T ₆	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 5 kg Zn ha ⁻¹	9.6	55.4	39.45

T ₇	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S + 5 kg Zn + 10 t FYM ha ⁻¹	11.0	58.5	42.80
T ₈	150 kg N + 90 kg P ₂ O ₅ + 60 kg K ₂ O ha ⁻¹	11.1	59.0	43.00
	SEm	0.08	0.76	0.67
	CD (P=0.05)	0.23	2.29	1.96

Yield studies

Grain and straw yield of wheat differed significantly due to various nutrient management treatments (Table 3 and Fig. 2). The lowest grain yield (31.17qha⁻¹) and straw yield (40.52 q ha⁻¹) were recorded under control, whereas progressive improvement was observed with application of organic and inorganic nutrient sources. Among the treatments, T₈ (150 kg N + 90 kg P₂O₅+60 kg K₂Oha⁻¹) produced significantly higher grain yield (55.57 q ha⁻¹) and straw yield (66.12qha⁻¹), which

remained statistically comparable with T₇. Higher yield under integrated nutrient management may be attributed to balanced nutrient supply, improved soil fertility and greater translocation of photosynthates towards sink development. Conjunctive use of FYM with sulphur and zinc possibly enhanced nutrient use efficiency and sustained crop growth, resulting in increased economic and biological yield. Similar beneficial effects of integrated nutrient application on wheat yield have also been reported by Singh (2019)^[6] and Prakash *et al.* (2024)^[9].

Table 3: Effect of nutrient management practices on grain and straw yield of wheat.

S.No.	Treatment	Grain Yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)
T ₁	Control	31.17	40.52
T ₂	10 t FYM ha ⁻¹	35.95	47.04
T ₃	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹	44.55	54.87
T ₄	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 10 t FYM ha ⁻¹	50.85	61.05
T ₅	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S ha ⁻¹	48.08	59.49
T ₆	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 5 kg Zn ha ⁻¹	47.11	57.80
T ₇	120 kg N + 60 kg P ₂ O ₅ + 40 kg K ₂ O ha ⁻¹ + 20 kg S + 5 kg Zn + 10 t FYM ha ⁻¹	54.10	64.25
T ₈	150 kg N + 90 kg P ₂ O ₅ + 60 kg K ₂ O ha ⁻¹	55.57	66.12
	SEm	1.24	1.17
	CD (P=0.05)	3.64	3.44

Conclusion

The study clearly demonstrated that nutrient management practices significantly influenced growth, yield attributes and productivity of wheat. Integrated application of inorganic fertilizers along with farmyard manure, sulphur and zinc proved more effective than sole application of fertilizers or organic manure. The treatment T₈ (150kgN+90kgP₂O₅+60 kg K₂O ha⁻¹) recorded the highest values for growth parameters, yield attributes, grain yield and straw yield, and remained statistically at par with T₇. This indicates that balanced and integrated nutrient supply improves nutrient use efficiency, enhances crop performance and sustains higher productivity. Therefore, integrated nutrient management can be recommended as a more efficient and sustainable approach for improving wheat productivity under field conditions.

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