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Influence of Different Nitrogen and Phosphorus Fertilizer Rates on Growth and Yield Components of Sesame (*Sesamum indicum* L.)

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Abstract:
A field study was conducted to evaluate the effect of different nitrogen and phosphorus (NP) fertilizer rates on the growth and yield performance of sesame (Sesamum indicum L.). The experiment was laid out in a Randomized Complete Block Design (RCBD) with six treatments including a control (0, 30, 40, 50, 60, and 70 kg NP ha⁻¹). The results showed a significant and consistent increase in all growth and yield parameters with increasing NP levels. Plant height (104.35–181.94 cm), stem diameter (4.89–10.97 cm), capsules per plant (70.42–181.08), and seeds per capsule (19.12–44.63) increased progressively with higher fertilizer application. Similarly, seed weight per plant (21.46–51.58 g), seed index (2.69–4.26 g), and biological yield (3124.8–5225.4 kg ha⁻¹) also showed marked improvement across treatments. The maximum values for all studied traits were recorded at 70 kg NP ha⁻¹, while the minimum values were observed in the control treatment. Statistical analysis indicated highly significant differences among treatments ($P \leq 0.05$) for all parameters. The study concludes that balanced application of nitrogen and phosphorus at higher levels (especially 70 kg NP ha⁻¹) significantly enhances sesame growth and yield performance under field conditions.
Keywords: *Influence, NP, Levels, Sesame, Growth and Yield, Components*

Introduction

Sesame (*Sesamum indicum* L.) is among the oldest cultivated oilseed crops and is widely recognized for its economic and nutritional significance. The crop is highly valued for its premium-quality edible oil, protein-rich seeds, and various medicinal uses. Sesame seeds generally contain about 45–55% oil and 20–25% protein, contributing substantially to human nutrition and supporting agricultural economies, especially in Asian and African countries (Kumar et al., 2021). In Pakistan, sesame is primarily cultivated under rainfed and low-input farming systems, which commonly leads to reduced productivity because of poor soil fertility and insufficient nutrient management.

Among the essential nutrients required by plants, nitrogen (N), phosphorus (P), are key elements that significantly influence crop growth, yield, and quality (Kaleri (a) et al., 2026). Nitrogen is an essential component of chlorophyll and amino acids, playing a major role in promoting vegetative growth and enhancing photosynthetic activity. Phosphorus, on the other hand, is crucial for root development, energy transfer processes, flowering, and seed formation (Zhao et al., 2022). A deficiency of any of these macronutrients can markedly restrict sesame productivity, especially in soils with low fertility. Numerous studies have shown that balanced application of nitrogen and phosphorus fertilizers significantly enhances growth traits such as plant height, stem thickness, and branching, as well as yield components including the number of capsules per plant, seeds per capsule, and seed weight in sesame (Gebremichael et al., 2021; Rahman et al., 2023). Adequate nutrient availability promotes improved vegetative growth by increasing the photosynthetic surface area, which in turn enhances assimilate production and its translocation to reproductive structures. In addition, phosphorus and potassium are reported to be important in improving seed development and increasing oil accumulation in sesame seeds (Singh et al., 2024). In sesame, an adequate supply of nitrogen is essential for achieving optimum plant height, branch formation, and capsule number per plant. However, both insufficient and excessive nitrogen application can negatively affect growth, resulting in either stunted plants or excessive vegetative development that reduces seed formation. Phosphorus is equally important, as it is involved in energy transfer through ATP, nucleic acid synthesis, and the development of a strong root system. Adequate phosphorus nutrition enhances root growth, improves water and nutrient uptake, promotes early flowering, and contributes to better seed development and oil quality in sesame (Pandey et al., 2020). Therefore, optimizing the rates of nitrogen and phosphorus application is essential for improving sesame productivity. Although the importance of these nutrients is well recognized in agronomy, their interactive effects on the growth and yield performance of modern sesame varieties under the local edapho-climatic conditions of Tandojam still need further investigation. This study was therefore designed to assess the impact of different nitrogen and phosphorus levels on the growth, yield components, and final seed yield of sesame (Sesamum indicum L.), with the objective of providing evidence-based

recommendations to local farmers for better crop management and increased profitability.

Materials and Methods

The present study was conducted during 2026 at Kaleri Agriculture Farm, located near Latif Agriculture Farm, Sindh Agriculture University, Tandojam. The main objective was to evaluate the effect of different NP fertilizer levels on the growth and yield of sesame crop. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each experimental plot measured 5 × 6 m, covering an area of 30 m². The sesame variety used in the study was 'S-9'.

Experimental Treatments:

A graded dose of NP was applied, creating six distinct treatments:

T_1 = Control (No fertilizer)
T_2 = 30 kg NP ha^{-1}
T_3 = 40 kg NP ha^{-1}
T_4 = 50 kg NP ha^{-1}
T_5 = 60 kg NP ha^{-1}
T_6 = 70 kg NP ha^{-1}

Parameters Measured:

Growth, yield, and yield components were evaluated based on the following observations:
Plant height (cm)
Branches per plant
Capsules per plant
Seeds per capsule
Seed weight per plant (g)
1000-seed weight (g)
Biological yield (kg ha^{-1})

Statistical analysis

The collected data were analyzed using Statistix 8.1 software (Statistix, 2006). Treatment means were compared using the Least Significant Difference (LSD) test where appropriate.

Result

The results presented in Table 1 and Chart.1 indicate a significant positive response of sesame growth and yield components to increasing levels of nitrogen and phosphorus (NP) fertilizers. All studied parameters, including plant height, stem diameter, capsules

per plant, and seeds per capsule, showed a consistent and progressive increase from the control treatment to the highest NP level (70 kg ha^{-1}). Plant height increased markedly from 104.35 cm in the control to 181.94 cm at 70 kg NP ha^{-1}. Similarly, stem diameter improved from 4.89 cm to 10.97 cm across the same treatments, indicating enhanced vegetative growth with higher nutrient availability. The number of capsules per plant also showed a substantial increase, ranging from 70.42 in the control to 181.08 in the highest fertilizer treatment, reflecting improved reproductive development. In addition, seeds per capsule increased significantly from 19.12 in the control to 44.63 under 70 kg NP ha^{-1}, demonstrating better seed formation and filling under adequate nutrient supply. Statistical analysis confirmed that all differences among treatments were highly significant ($P \leq 0.05$), with low standard error and LSD values, indicating the reliability of the results. Overall, the findings clearly demonstrate that increasing NP fertilizer rates significantly enhances both vegetative growth and yield components of sesame, with the best performance recorded at 70 kg NP ha^{-1} under the given experimental conditions.

Table.1 Influence of Different Nitrogen and Phosphorus Fertilizer Rates on Growth and Yield Components of Sesame (*Sesamum indicum* L.)

Treatments	Plant height (cm)	Stem diameter (cm)	Capsules $plant^{-1}$	Seeds $capsule^{-1}$
T_1 = Control (No fertilizer)	104.35 F	4.89 F	70.42 F	19.12 F
T_2 = 30 kg NP ha^{-1}	119.28 E	5.38 E	92.15 E	24.36 E
T_3 = 40 kg NP ha^{-1}	134.76 D	6.71 D	114.83 D	29.41 D
T_4 = 50 kg NP ha^{-1}	149.87 C	8.07 C	136.72 C	34.18 C
T_5 = 60 kg NP ha^{-1}	164.52 B	9.58 B	159.34 B	39.47 B
T_6 = 70 kg NP ha^{-1}	181.94 A	10.97 A	181.08 A	44.63 A
.E. ±	2.41	0.08	0.38	0.37
LSD (0.05)	1.15	0.04	0.17	0.17
P-value	0.0000	0.0000	0.0000	0.0000

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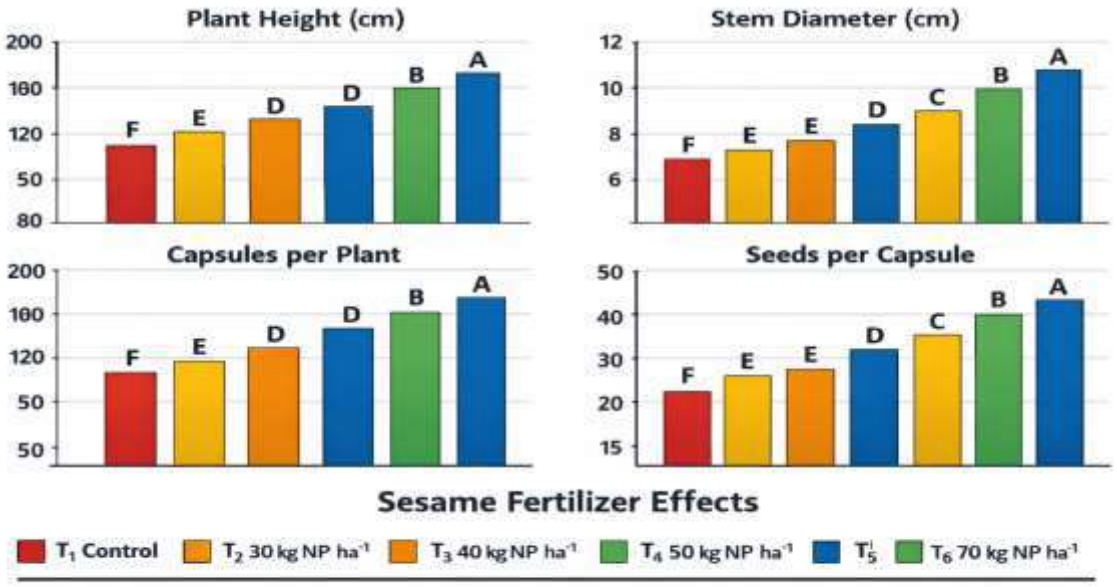
Note: Means followed by different letters within a column differ significantly at $P \leq 0.05$ according to the LSD test.

Comprehensive sesame fertilizer performance chart No.01



The results presented in Table 2 and Chart. 01 shows a significant improvement in yield-related traits of sesame with increasing nitrogen and phosphorus (NP) fertilizer application. All parameters, including seed weight per plant, seed index (1000-seed weight), and biological yield, exhibited a consistent increasing trend from the control to the highest fertilizer level (70 kg NP ha^{-1}). Seed weight per plant increased from 21.46 g in the control treatment to 51.58 g at 70 kg NP ha^{-1}, indicating a strong positive response of sesame to nutrient application. Similarly, the seed index improved gradually from 2.69 g to 4.26 g, reflecting better seed development and filling under adequate nutrient supply. Biological yield also showed a substantial increase, rising from 3124.8 kg ha^{-1} in the control to 5225.4 kg ha^{-1} at the highest NP level, demonstrating enhanced overall biomass production with improved fertilization. Statistical analysis confirmed that all differences among treatments were highly significant ($P \leq 0.05$), with low standard error and LSD values, indicating high reliability of the results. Overall, the findings clearly demonstrate that higher NP fertilizer rates, particularly 70 kg ha^{-1},

significantly enhance yield components and biological productivity of sesame under the given experimental conditions.

Table.2 Influence of Different Nitrogen and Phosphorus Fertilizer Rates on Growth and Yield Components of Sesame (*Sesamum indicum* L.)

Treatments	Seed weight plant^{-1} (g)	Seed index (1000-seed wt., g)	Biological yield (kg ha^{-1})
T_1 = Control (No fertilizer)	21.46 F	2.69 F	3124.8 F
T_2 = 30 kg NP ha^{-1}	27.58 E	3.01 E	3547.3 E
T_3 = 40 kg NP ha^{-1}	33.42 D	3.31 D	3965.7 D
T_4 = 50 kg NP ha^{-1}	39.38 C	3.65 C	4384.2 C
T_5 = 60 kg NP ha^{-1}	45.42 B	3.96 B	4803.6 B
T_6 = 70 kg NP ha^{-1}	51.58 A	4.26 A	5225.4 A
S.E. ±	0.34	0.07	0.59
LSD (0.05)	0.15	0.03	0.26
P-value	0.0000	0.0000	0.0000

Note: Means followed by different letters within a column are significantly different at $P \leq 0.05$ according to the LSD test.

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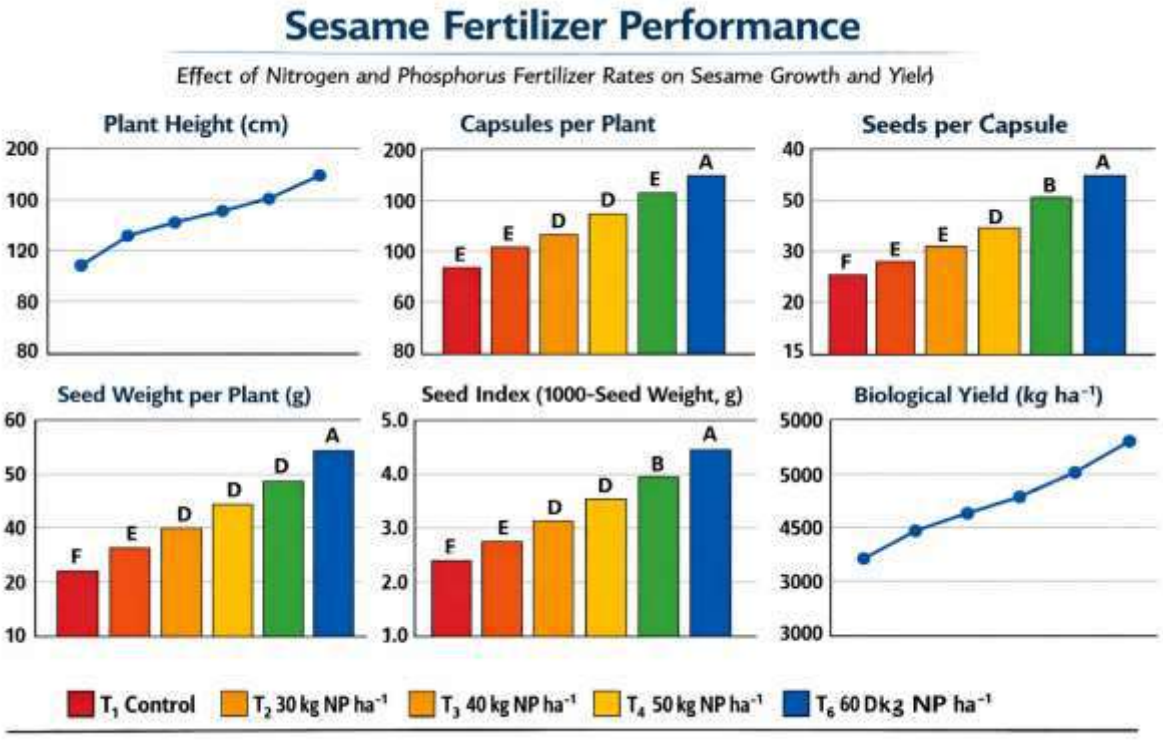
Comprehensive sesame fertilizer performance chart No.02



Discussion

The results of the present study clearly demonstrate that the application of nitrogen and phosphorus (NP) fertilizers had a significant positive effect on the growth and yield performance of sesame (*Sesamum indicum* L.). All growth parameters, including plant height, stem diameter, capsules per plant, and seeds per capsule, showed a consistent and progressive increase with increasing NP levels from 30 to 70 kg ha^{-1} compared to the control treatment Kebede et al., 2022):(Rehmani et al., 2025). The maximum plant height (181.94 cm), stem diameter (10.97 cm), capsules per plant (181.08), and seeds per capsule (44.63) were recorded at the highest NP level (70 kg ha^{-1}), indicating that adequate nutrient supply strongly enhances vegetative growth and reproductive potential. In contrast, the control treatment consistently produced the lowest values, confirming that sesame growth is highly dependent on external nutrient input under low-fertility conditions Kashani et al., 2015). Similarly, yield-related traits such as seed weight per plant, seed index (1000-seed weight), and biological yield were significantly improved

with increasing NP application (Perveen et al., 2021). The highest seed weight per plant (51.58 g), seed index (4.26 g), and biological yield (5225.4 kg ha^{-1}) were also observed at 70 kg NP ha^{-1}, while minimum values were recorded in the control plots (Shireen et al., 2018). This improvement may be attributed to the enhanced availability of nitrogen and phosphorus, which play a crucial role in photosynthesis, energy transfer, root development, and seed formation (Kaleri (b) et al., 2026) (Ihsanullah et al., 2023). The statistical analysis confirmed highly significant differences among treatments ($P \leq 0.05$) for all studied parameters, indicating that the response of sesame to NP fertilization is both strong and reliable. The progressive increase in yield components with increasing fertilizer levels suggests that balanced NP nutrition improves assimilate production and its partitioning towards reproductive organs, ultimately enhancing seed yield and biomass production. Overall, the findings suggest that application of NP fertilizer at higher levels, particularly 70 kg ha^{-1}, is most effective in improving the growth and yield performance of sesame under the agro-ecological conditions of the study area.

Conclusion

The present field study was conducted to assess the effect of different nitrogen and phosphorus (NP) fertilizer rates on the growth and yield performance of sesame (*Sesamum indicum* L.) using a Randomized Complete Block Design (RCBD) with six treatments (0, 30, 40, 50, 60, and 70 kg NP ha^{-1}). The findings revealed a clear and consistent improvement in all growth and yield attributes with increasing NP application levels. All studied parameters, including plant height (104.35–181.94 cm), stem diameter (4.89–10.97 cm), capsules per plant (70.42–181.08), and seeds per capsule (19.12–44.63), showed progressive enhancement with higher fertilizer rates. Likewise, seed weight per plant (21.46–51.58 g), seed index (2.69–4.26 g), and biological yield (3124.8–5225.4 kg ha^{-1}) also increased substantially across treatments. The highest values for all traits were obtained at the maximum NP level of 70 kg ha^{-1}, whereas the control treatment consistently recorded the lowest performance. Statistical

analysis confirmed highly significant differences among treatments ($P \leq 0.05$) for all measured variables. It is therefore concluded that the application of nitrogen and phosphorus, particularly at 70 kg ha^{-1}, is most effective in enhancing sesame growth and yield under the agro-ecological conditions of the study area.

References

Gebremichael, B., Desta, K., & Tadesse, T. (2021). Growth and yield response of sesame (Sesamum indicum L.) to nitrogen and phosphorus fertilization. Heliyon, 7, e07198.

Ihsanullah, Manzoor, D.,Magsi, M. A.,Sheikh, Z. A., Kaleri, A. A., Awan, H, M., Kumar, V., Baloch, N., Kaleri, K, M., Ali, Azmat., Rajput, A, A., Kaleri, A, I., &Chachar, M, A.(2023). Growth and yield response of sesame to different nitrogen levels. *Journal of Arable Crops and Marketing, 05*(01), 27-33.

Kaleri, A.A., (b) Dahar, M.A., Mirbahar, S.H., Chachar, A.A., Ahmed, M., Kaleri, G.M., Arsal, M., Majeedano, A.Q., Khanzada, B. and Jokhio, N.A. (2026) 'Influence of NPK fertilizer rates on growth and yield performance of sesame (SesamumindicumL.)', Planta Animalia, 5(1),pp. 53–57.

Kaleri, A. A., (a) Khanzada, B., Banbhan, G. M., Arain, A., Ahmed, J., Zakria, M. I., Jamali, A. R., & Kaleri, G. S. (2026). Response of Sesame Growth and Productivity to Varying Nitrogen Rates and Planting Geometry. Jammu Kashmir Journal of Agriculture, 6(1), 211–215.

Kashani, S.; Buriro, M.; Nadeem, A.; Ahmed, N.; Saeed, Z.; Mohammad, F.; Ahmed, S. Response of various sesame varieties under the influence of nitrogen and phosphorus doses. Amer. J. Plant. Sci. 2015, 6, 405–412.

Kebede, W., Taye, G. and Tana, T. (2022) 'Optimizing nitrogen and phosphorus fertilizer rates for maximizing sesame (Sesamum indicum L.) yield in the humid tropics', Journal of Plant Nutrition, 45(8), pp. 1156–1170.

Kumar, R., Verma, A., & Singh, P. (2020). Role of nitrogen and phosphorus in oilseed crop productivity. International Journal of Plant Production, 14, 523–534.

Pandey, A. (2020) 'A comprehensive review on the role of phosphorus in crop production and its management strategies',International Journal of Agronomy, 2020, Article ID 8587509.

Perveen, S., Ahmad, S., Skalicky, M., Hussain, I., Habibur-Rahman, M., Ghaffar, A. and El Sabagh, A. (2021) 'Assessing the potential of polymer-coated urea and sulphur fertilization on growth, physiology, yield, oil contents and nitrogen use efficiency of sesame crop under arid environment', Agronomy, 11(2), 269.

Rahman, M. A., Islam, M. S., & Hossain, M. M. (2023). Effect of macronutrients on yield and quality of sesame. Journal of Crop Science and Biotechnology, 26, 321–330

Rehmani, U., Ahmed, Z., Hamzeh, M., Majeedano, A.Q., Ijaz, N., Hussain, Z., Shah, M.A., Hyder, T., Ullah, I. and Soomro, A.R. (2025) 'Growth and yield of sesame (Sesamum indicumL.) as affected by nitrogen and phosphorus atPeshawar, Pakistan', Global Research Journal of Natural Science and Technology, 3(1), pp. 72–89.

Shireen, F., Nawaz, M.A., Chen, C., Zhang, Q., Zheng, Z., Sohail, H. and Bie, Z. (2018) 'Nitrogen: functions and approaches to enhance its availability in plants for sustainable agriculture', International Journal of Molecular Sciences, 19(7),1856.

Singh, D., Patel, R., & Meena, S. (2024). Role of phosphorus and potassium in improving reproductive efficiency of sesame. Field Crops Research, 301, 108972.

Zhao, Y., Li, X., & Chen, H. (2022). Physiological responses of oilseed crops to nitrogen, phosphorus, and potassium fertilization. Plants, 11, 2846.

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