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Effect of nitrogen and potassium on yield and nutrient content of wheat (*Triticum aestivum L.*) crop

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Abstract

A pot experiment was conducted to study the effect of nitrogen and potassium on the yield and nutrient content of wheat crop. The experiment was laid out in a randomized block design with four levels of nitrogen (0, 20, 40 and 80 kg ha^{-1}) and four levels of potassium (0, 25, 50 and 100 kg ha^{-1}) with three replications. The results revealed that increasing doses of nitrogen up to 80 kg ha^{-1} and potassium up to 100 kg ha^{-1} significantly enhanced the grain and straw yield of wheat crop. The N, P and K contents were improved by the application of both nutrients. The addition of nitrogen and potassium had a beneficial effect on the uptake of N, P and K by the wheat crop.

Key words: Nitrogen, potassium, yield, nutrient content, wheat

Introduction

Wheat (Triticum aestivum L.) is the most important winter-season food crop in India, and improvements in its productivity have played a key role in making the country self-sufficient in food grains. The crop occupies an area of about 28.5 million hectares with a total production of 80.70 million tonnes and productivity of 2.83 tonnes ha^{-1}, contributing 12.43% of total world production. The major wheat-producing states in the country are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttarakhand, Himachal Pradesh and Jammu & Kashmir. These states contribute about 99.5% of the total wheat production in the country. Nitrogen is the most important plant nutrient required for crop production and is needed in the greatest quantities among fertilizer nutrients. Although N plays a vital role in the good growth and development of wheat, over-fertilization is often harmful as it results in lodging, increased susceptibility to insect pests and diseases, and thus reduced yield and quality. After N, potassium is absorbed in larger amounts than any other element and plays a leading role in increasing crop yield and improving product quality. Potassium is the third most important macronutrient after nitrogen and phosphorus. It has an important osmotic role, activates enzymes, and is involved in carbohydrate and protein synthesis, energy relations and assimilate translocation. Potassium supply is often considered a limiting factor due to its high accumulation in cereals.

Materials and Methods

The pot experiment was carried out at the agricultural experimental field (Department of Soil Science & Agricultural Chemistry), Nehru Mahavidyalaya, Lalitpur (U.P.) during 2023–24. Lalitpur district is part of the Bundelkhand plateau. The soil had EC 0.21 dSm^{-1}, pH 7.8, organic carbon 4.7 g kg^{-1}, and available N 80.5, P 6.0 and K 95.0 kg ha^{-1}. The experiment was laid out in a randomized block design with four levels of nitrogen (0, 20, 40 and 80 kg ha^{-1}) and four levels of potassium (0, 25,

50 and 100 kg ha^{-1}) with three replications. The recommended dose of P at 80 kg P_2O_5 ha^{-1} was applied as single superphosphate. Nitrogen and potassium were supplied through urea and muriate of potash (MOP) as per treatments. Wheat was sown on October 15, 2023 and irrigated at appropriate times based on soil and crop appearance. Weeds were removed periodically. The crop was harvested at maturity. Grain and straw samples were analysed for N content by the Kjeldahl method (Jackson, 1973). Grain and straw samples were digested in di-acid (HNO_3 :$HClO_4$) and the digest was analyzed for phosphorus by the Vanadomolybdo phosphoric acid yellow colour method, for K by flame photometer, and for Mn by atomic absorption spectrophotometer (Jackson, 1973). Nutrient uptake was calculated using yield data in conjunction with their respective contents.

Results and discussion

Yield studies

Nitrogen application had a significant effect on grain and straw yield of wheat crop. Higher doses of nitrogen significantly increased grain and straw yield. The percentage increases were 17.62%, 34.46% and 49.70% in grain yield and 13.24%, 15.11% and 34.36% in straw yield over control due to 20, 40 and 80 kg N ha^{-1}, respectively. Higher levels of potassium also increased grain and straw yield of wheat. The percentage increases were 15.55%, 29.75% and 41.07% in grain yield and 10.83%, 19.92% and 31.95% in straw yield due to 25, 50 and 100 kg K ha^{-1}, respectively. Similar results have been reported by Gupta et al. (2020), Deep Chandra et al. (2024) and Sahu et al. (2024).

Nutrients composition

Nitrogen content

The data in Table 1 indicate that N application had a significant effect on nitrogen content in grain and straw of wheat crop. Higher doses of N significantly increased N content by 10.53%, 17.54% and 25.00% in grain and 10.91%, 20.00% and 41.82% in straw over control, respectively. Potassium application also had a significant effect on N content in grain and straw. It caused significant increases of 7.69%, 12.39% and 20.94% in grain and 3.28%, 8.20% and 13.11% in straw due to 25, 50 and 100 kg K ha^{-1}, respectively. Higher doses of K (25, 50 and 100 kg ha^{-1}) were significantly superior to control in enhancing N content in grain and straw of wheat. Similar results have been reported by Munna et al. (2012) and Sahu et al. (2025).

Table 1: Effect of nitrogen and potassium on grain and straw yield (gram/pot) and nitrogen content (%) of wheat crop

Treatments	Grain yield	Straw yield	N content (%) in grain	N content (%) in straw
Nitrogen (kg ha^{-1})				
N_0	5.05	7.48	2.28	0.55
N_1	5.94	8.47	2.52	0.61
N_2	6.79	8.61	2.68	0.66
N_3	7.56	10.05	2.85	0.78
SEm±	0.06	0.15	0.06	0.04
CD @ 5%	0.13	0.32	0.12	008
Potassium (kg ha^{-1})				
K_0	5.21	7.48	2.34	0.61
K_1	6.02	8.29	2.52	0.63
K_2	6.76	8.97	2.63	0.66
K_3	7.35	9.87	2.83	0.69
SEm±	0.06	0.15	0.06	0.04
CD @ 5%	0.13	0.32	0.12	0.08

Phosphorus content

As shown in Table 2, application of N increased P content by 7.14%, 14.29% and 17.86% in grain and 0%, 8.33% and 16.67% in straw over control. Higher levels (20, 40 and 80 kg N ha^{-1}) registered significant increases in P content in grain, while effects in straw were variable. The maximum P concentration in wheat was recorded at 80 kg N ha^{-1}. Potassium application caused increases in P content by 10.71%, 14.29% and 17.86% in grain and 4%, 12% and 16% in straw due to 25, 50 and 100 kg K ha^{-1}, respectively. Higher doses of K were significantly superior to control in enhancing P content in wheat (particularly in grain). Similar results have been reported by Munna et al. (2012) and Sahu et al. (2025).

Potassium content

The data in Table 2 indicate that N application had a significant effect on potassium content in grain and straw of wheat crop. Higher doses of N increased K content by 5.41%, 9.46% and 10.81% in grain and 4.64%, 6.19% and 6.19% in straw over control. Potassium application significantly affected its own content in grain and straw. The percentage increases were 2.63%, 5.26% and 6.58% in grain and 4.26%, 12.77% and 13.30% in straw due to 25, 50 and 100 kg ha^{-1}, respectively. Higher doses of potassium were significantly superior to control in enhancing K content in grain and straw of wheat. Similar results have been reported by Munna et al. (2012) and Sahu et al. (2025).

Conclusion

Increasing levels of nitrogen up to 80 kg ha^{-1} and potassium up to 100 kg ha^{-1} significantly improved grain and straw yields as well as N, P and K contents in wheat. Application of both nutrients showed positive interactions in enhancing nutrient concentrations and overall crop performance.

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Table 2: Effect of nitrogen and potassium on phosphorus and potassium content (%) of wheat crop

Treatments	P content (%) in grain	P content (%) in straw	K content (%) in grain	K content (%) in straw
Nitrogen (kg ha^{-1})				
N_0	0.28	0.24	0.74	1.94
N_1	0.30	0.24	0.78	2.03
N_2	0.32	0.26	0.81	2.06
N_3	0.33	0.28	0.82	2.06
SEm±	0.002	0.01	0.012	0.015
CD @ 5%	0.004	0.02	0.026	0.075
Potassium (kg ha^{-1})				
K_0	0.28	0.25	0.76	1.88
K_1	0.31	0.26	0.78	1.96
K_2	0.32	0.28	0.80	2.12
K_3	0.33	0.29	0.81	2.13
SEm±	0.002	0.01	0.012	0.015
CD @ 5%	0.004	0.02	0.026	0.075

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