

Original Research Article

Effect of Nitrogen and Potassium Fertilization Strategies on Yield and Economics of Pearl Millet [*Pennisetum glaucum* (L.)]

Abstract

Pearl millet (*Pennisetum glaucum* L.) is a vital staple crop in arid and semi-arid regions due to its high resilience to drought and poor soil fertility, playing a crucial role in food and nutritional security for millions of people globally. Despite its adaptability and nutritional richness, productivity remains low under traditional farming practices owing to inadequate nutrient management, particularly nitrogen and potassium. The present study was undertaken during *kharif* 2023 at MJRP College of Agriculture & Research, Jaipur, to evaluate the impact of varying nitrogen and potassium fertilization strategies on the yield and economic performance of pearl millet. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments replicated thrice, including combinations of nitrogen (60, 80, 100 kg ha⁻¹) and potassium (20, 40 kg ha⁻¹) along with a soil test-based nutrient application. The results revealed a significant improvement in grain and straw yield, as well as harvest index, with increasing nitrogen and potassium levels. The treatment T7 (100 kg N ha⁻¹ + 30 kg P₂O₅ ha⁻¹ + 40 kg K₂O ha⁻¹) recorded the highest grain yield (3839 kg ha⁻¹), straw yield (5578 kg ha⁻¹), and net returns (50,707.80 ha⁻¹), while T4 (100 kg N + 30 kg P₂O₅ + 20 kg K₂O ha⁻¹) showed the maximum benefit: cost ratio (3.16), indicating economic viability. Soil test-based nutrient application (T8) also showed promising results, suggesting the potential of site-specific nutrient management in improving yield and profitability. These findings affirm the critical role of balanced fertilization in enhancing both productivity and economic sustainability in pearl millet cultivation under rainfed conditions. Adoption of appropriate nitrogen and potassium combinations can thus serve as a practical strategy to optimize resource use and ensure better returns, especially in semi-arid agro-ecosystems with low input access.

Keywords: Potassium Application, Yield Performance, Economic Analysis, Rainfed Agriculture, Nutrient Management Strategies

Introduction

Pearl millet (*Pennisetum glaucum* L.), also known as bajra, cattail millet, or bulrush millet, is the fifth most important cereal crop globally after rice, wheat, maize, and sorghum. It is a highly climate-resilient crop grown extensively in arid and semi-arid tropical regions of Africa and South Asia (Satyavathi, *et al.*, 2021). Characterized by its remarkable tolerance to drought, high temperatures, and low soil fertility, pearl millet has established itself as a staple food and fodder crop in regions where other cereals such as maize and sorghum cannot thrive due to insufficient rainfall, typically between 200 and 600 mm annually. Although precise statistics are sometimes elusive due to its classification along with other millets like finger millet and foxtail millet in global records, pearl millet accounts for nearly 50% of global millet production. Africa contributes about 60% of the total cultivation area, followed by Asia at 35%, while Europe and North America collectively contribute a mere 5%, primarily for forage rather than grain production. It supports food and nutritional security for more than 500 million people, particularly in resource-poor farming systems. Current estimates indicate that pearl millet is cultivated on approximately 29 million hectares worldwide, with global production exceeding 10 million tonnes annually.

The grain of pearl millet is highly nutritious and is rich in dietary fibre, iron, phosphorus, and essential amino acids. It contains 11–19% protein, 60–78% carbohydrates, and 3.0–4.6% fat, and offers higher levels of micronutrients than most other cereals, making it an important component in

Comment [P1]: Pur Rs

Comment [P2]: Put Rs

Comment [P3]: Put Rs

Comment [P4]: Clear, but you could shorten slightly for clarity:
"Pearl millet (*Pennisetum glaucum* L.), or bajra, ranks fifth among global cereal crops..."

Comment [P5]: Suggest:
"Although often grouped with other millets like finger and foxtail millet in records, pearl millet alone contributes..."

Comment [P6]: Could be linked more smoothly to the previous sentence. Add transition:
"As a result, it supports food and nutritional security for over 500 million people..."

Comment [P7]: Split into two sentences for readability. Suggest:
"It contains 11–19% protein, 60–78% carbohydrates, and 3.0–4.6% fat. Additionally, it offers higher levels of micronutrients..."

addressing hidden hunger and malnutrition in rural populations (Vidhya *et al.*, 2023). It has a low glycemic index and is gluten-free, which adds to its growing demand in health-conscious urban markets. Due to its short growing season and adaptability to diverse cropping systems, pearl millet is also favoured for crop rotation and intercropping practices in marginal ecosystems.

India is the largest producer of pearl millet, both in terms of area and production, contributing significantly to global output. It occupies nearly 9.3 million hectares with a production of 9.3 million tonnes and an average productivity of 1044 kg ha⁻¹ over the past five years (Tonapi *et al.*, 2024). The crop plays a critical role in Indian dryland agriculture, especially in states like Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Haryana, Karnataka, Madhya Pradesh, Tamil Nadu, and Andhra Pradesh. Among these, Rajasthan leads in acreage, cultivating pearl millet over approximately 67,000 hectares. The average productivity in Rajasthan is 1749 kg ha⁻¹, which is relatively low compared to Haryana (2040 kg ha⁻¹), Madhya Pradesh (1924 kg ha⁻¹), and Uttar Pradesh (1839 kg ha⁻¹), indicating considerable scope for yield improvement through agronomic interventions.

Despite its potential, the productivity of pearl millet remains sub-optimal due to limited input use, poor soil fertility, and reliance on traditional cultivation practices. Among the various production constraints, nutrient deficiency is one of the most limiting factors, especially the lack of adequate nitrogen and potassium supply. Nitrogen is a critical nutrient for vegetative growth, chlorophyll synthesis, and protein accumulation, whereas potassium enhances drought tolerance, grain filling, enzyme activation, and overall plant health (Ahmad *et al.*, 2018). The synergistic role of nitrogen and potassium is well documented in promoting both yield and grain quality in cereals. Imbalanced fertilization or over-dependence on nitrogen alone without adequate potassium often leads to poor nutrient use efficiency and susceptibility to environmental stress (Ryan *et al.*, 2009). Given the growing importance of pearl millet in food and nutritional security, particularly under climate-vulnerable farming systems, it becomes imperative to explore efficient nutrient management strategies that not only enhance grain and biomass productivity but also improve economic returns and sustainability. Scientific evaluation of nitrogen and potassium fertilization regimes under field conditions will help identify the most responsive combinations suited for rainfed agro-ecologies. This research addresses these gaps by assessing the impact of various nitrogen and potassium fertilizer levels on growth, yield, harvest index, and profitability of pearl millet, with the goal of recommending optimum nutrient doses for sustainable intensification in semi-arid zones.

Material and Methods

The field investigation was conducted during the *kharif* season of 2023 at MJRP College of Agriculture & Research, Jaipur. The experimental site is geographically positioned at 30°23' N latitude and 76°47' E longitude with an elevation of 264 meters above mean sea level. The area falls under the semi-arid subtropical climatic zone, characterized by hot summers, monsoonal rainfall, and moderate winters. During the crop growth period, the meteorological data recorded at the college observatory indicated weekly mean maximum temperatures ranging from 30.54 °C to 38.50 °C (average 34.40 °C) and minimum temperatures from 23.41 °C to 27.93 °C (average 25.30 °C). Relative humidity fluctuated between 63.43% and 91.43% (average 79.09%). The mean bright sunshine hours per day ranged from 0.61 to 7.56 hours with an average of 3.74 hours, while evaporation ranged between 3.19 to 10.79 mm day⁻¹ (average 5.93 mm day⁻¹). Total rainfall received during the cropping period amounted to 456 mm, with 280.5 mm falling across 6 rainy days. Initial soil analysis revealed that the experimental soil was sandy loam in texture, neutral in reaction (pH 7.35), with normal electrical conductivity (0.068 dS m⁻¹), medium organic carbon content (0.63%), low in available nitrogen (150.52 kg ha⁻¹), but high in available phosphorus (159.97 kg ha⁻¹) and potassium (422.01 kg ha⁻¹). The experimental layout was a randomized block design (RBD) comprising eight treatments with three replications. Treatments included: T1: Control (no fertilizers), T2: RDF with 60 kg N, 30 kg P₂O₅, and 20 kg K₂O ha⁻¹; T3 and T4: 80 and

Comment [P8]: Clarify the time frame. Add: "...an average productivity of 1044 kg ha⁻¹ over the past five years..."

Comment [P9]: Verify data — this acreage figure appears very low compared to national data. It might be 6.7 million ha instead of 67,000 ha. Please double-check.

Comment [P10]: Consider rewording to: "Despite its resilience and potential, pearl millet productivity remains sub-optimal due to limited input use..."

Comment [P11]: Good line but could follow better from the previous one if combined: "These nutrients work synergistically to enhance both yield and grain quality in cereals."

Comment [P12]: Slight refinement: "Field-based evaluation of nitrogen and potassium fertilization will help identify optimal combinations..."

Comment [P13]: • Coordinate verification needed. Jaipur is approximately at 26°55' N, 75°49' E — please double-check latitude and longitude. •

Comment [P14]: Scientifically correct, but you may clarify by adding: "...indicative of a humid monsoonal pattern during crop growth."

Comment [P15]: Unusual figure — over 280 mm in just 6 days implies very heavy rainfall. You might clarify this or cross-check the data source.

Comment [P16]: Correct, but consider streamlining: "...neutral pH (7.35) and normal EC (0.068 dS m⁻¹)..."

100 kg N ha⁻¹ respectively with constant P and K; T5–T7 varied in K application (40 kg K₂O ha⁻¹); and T8 was based on soil test values, with adjusted doses (78 kg N, 21 kg P₂O₅, and 14 kg K₂O ha⁻¹). Each plot measured 5.0 m × 4.5 m (22.5 m²).

The hybrid variety used was PHB-3, sown on June 17, 2023, using a seed rate of 4 kg ha⁻¹. Seeds were treated with carbendazim (2 g kg⁻¹) to mitigate disease incidence. Land preparation involved two ploughings, harrowing, and levelling. Furrows were created at 45 cm spacing using a tractor-mounted ridge. Nutrient sources included urea (46% N) applied in two splits: half at sowing and half at 30 days after transplanting (DAT), single super phosphate (16% P) applied at sowing, and muriate of potash (60% K) applied similarly. Hand weeding was carried out at 15 DAS. Initial irrigation was provided 3 days after sowing; thereafter, the crop relied on rainfall. Stem borer infestation was managed by spraying chlorpyrifos at 2.5 ml L⁻¹. Bird scaring was practiced from the 65th day until harvest.

Harvesting occurred on September 23, 2023, when the crop attained full maturity. Grains and straw were harvested separately, dried, cleaned, and weighed for yield estimation. Plant samples were taken at 30, 60 DAT, and harvest, separated into leaves, stems, and ear heads, and oven-dried at 60 °C for biochemical analysis using a Willey mill grinder. Pre-harvest biometric observations included plant height and dry matter production, measured from five randomly selected plants per plot. Post-harvest observations involved grain yield, straw yield, and harvest index calculated as the ratio of grain yield to total biological yield.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield kg/ha}}{\text{biological yield kg/ha}} * 100$$

Economic evaluation considered cost of cultivation based on treatment-wise inputs. Gross returns were computed using prevailing market prices of grain and straw, while net returns were calculated by subtracting cost of cultivation. Benefit-cost ratio was also derived. Data were statistically analysed using analysis of variance (ANOVA) for RBD as per Panse and Sukhatme (1978). F-tests at 5% probability determined significance, and critical difference (CD) values were calculated to compare treatment means.

Result and Discussion

Yield

The results on yield components of pearl millet as influenced by varying nitrogen and potassium fertilization strategies are presented in (Table 1). The data revealed significant differences among treatments with respect to grain yield, straw yield, and harvest index, clearly indicating that both nitrogen and potassium play a crucial role in enhancing the productivity of pearl millet. The grain yield ranged from 1390 kg ha⁻¹ in the unfertilized control (T1) to 3839 kg ha⁻¹ in the treatment receiving 100 kg N ha⁻¹ + 30 kg P₂O₅ ha⁻¹ + 40 kg K₂O ha⁻¹ (T7). This marked increase in grain yield with higher nitrogen and potassium application can be attributed to enhanced vegetative growth, improved nutrient uptake, and increased source-sink efficiency. Nitrogen is well known for its role in stimulating tillering, leaf area development, and photosynthetic efficiency, while potassium enhances grain filling and translocation of assimilates (Singh et al., 2010). The RDF treatment (T2) yielded 2861 kg ha⁻¹, but yield improved further with increasing nitrogen rates in T3 (3501 kg ha⁻¹) and T4 (3798 kg ha⁻¹), showing a linear response up to 100 kg N ha⁻¹. This trend is in line with earlier findings by Jadhav, et al. (2011), who reported that higher nitrogen levels significantly improved yield attributes in pearl millet. Potassium also played a positive role, as observed by comparing T2 and T5 (same N but higher K in T5), where an increase in grain yield from 2861 to 2965 kg ha⁻¹ was

Comment [P17]: • it's unclear how T5–T7 differ if all apply 40 kg K₂O. You should clarify specific N or other variable differences.

Comment [P18]: millet is typically direct-seeded, not transplanted. Use "30 days after sowing (DAS)" instead of DAT.

Comment [P19]: how was bird scaring done? Manual, visual deterrents, etc.?

Comment [P20]: Correct, but you could clarify the mesh size (e.g., 0.5 mm) for reproducibility.

Comment [P21]: Fix minor formatting: Harvest index (%) = (Grain yield / Biological yield) × 100

Comment [P22]: The benefit-cost ratio (B:C) was calculated by dividing net returns by cost of cultivation."

Comment [P23]: The results on yield components of pearl millet under varying nitrogen and potassium fertilization strategies are presented in Table 1."

Comment [P24]: Consider replacing "play a crucial role" with more technical phrasing: "...both nitrogen and potassium significantly influenced productivity parameters in pearl millet."

Comment [P25]: Valid, but you may consider citing a supporting study for source-sink relationship claims.

Comment [P26]: Linear response" may be overstated unless regression analysis was done. You may write: "...showing an increasing trend up to 100 kg N ha⁻¹."

recorded. This implies that potassium supplementation beyond the recommended dose is beneficial under conditions of high soil K availability. However, beyond a threshold, the yield response tends to plateau, as seen in T6 and T8, where no significant yield difference was observed despite varying nutrient combinations. Straw yield followed a similar pattern to grain yield, increasing progressively from 2815 kg ha⁻¹ in control (T1) to a maximum of 5578 kg ha⁻¹ in T7. The higher biomass accumulation under N and K-rich treatments can be ascribed to improved plant growth and prolonged photosynthetic activity, which leads to higher total dry matter production. This supports the findings of Yadav et al. (2011), who emphasized the importance of balanced nutrient supply for maximizing biomass in coarse cereals. Harvest index (HI), an important parameter indicating the efficiency of converting biomass into economic yield, ranged from 33.05% in T1 to 41.00% in T4, and slightly declined to 40.77% in T7. This marginal reduction despite higher yields could be due to proportional increase in straw biomass with increasing nutrient availability. Among the treatments, T4 recorded the highest harvest index (41.00%), suggesting a more efficient partitioning of dry matter towards grain under optimal nitrogen application. This result is corroborated by the work of Singh et al. (2010), who observed that moderate to high N application improved the HI by favouring grain development over vegetative growth.

Economics

The economic analysis of different nutrient management treatments in pearl millet is presented in Table 2. The results indicate substantial variation in gross returns, net returns, and benefit: cost (B:C) ratio across treatments, reflecting the influence of nitrogen and potassium fertilization on the profitability of pearl millet cultivation. The control plot (T1), which received no fertilizers, recorded the lowest gross returns (25,055 ha⁻¹), net returns (12,315 ha⁻¹), and a B:C ratio of 0.97, indicating uneconomical cultivation under nutrient-deficient conditions. In contrast, all fertilized treatments significantly improved economic returns. The highest gross return of 67,002 ha⁻¹ was obtained with the application of 100 kg N ha⁻¹ + 30 kg P₂O₅ ha⁻¹ + 40 kg K₂O ha⁻¹ (T7), followed closely by T4 (66,233 ha⁻¹). These increases can be directly attributed to enhanced grain and straw yields under higher nutrient availability, as seen in the previous yield data. This aligns with the findings of Yadav et al. (2011), who reported that nutrient-enriched treatments in pearl millet significantly improved profitability due to higher biomass production and marketable yield. Net returns, which account for input costs, showed similar trends. T7 and T4 registered the highest net returns of 50,707.80 ha⁻¹ and 50,335.46 ha⁻¹, respectively. Despite higher input costs in T7 due to increased potassium application, the additional return from higher yield compensated effectively, maintaining profitability. This supports the observations of Yadav et al. (2011), who emphasized that a balanced fertilization approach can yield optimal economic gains in coarse cereals, especially under semi-arid conditions where nutrient responsiveness is high.

The benefit: cost ratio further reinforces the economic superiority of nutrient-optimized treatments. The B:C ratio increased from 2.29 in T2 (RDF) to a peak of 3.16 in T4, indicating that even moderate increases in nitrogen levels can enhance the efficiency of investment in inputs. Although T7 achieved the highest gross returns, its B:C ratio was slightly lower (3.11) than T4, due to higher input costs associated with additional potassium. Interestingly, the soil test-based treatment (T8) also performed well economically (₹43,853.86 net returns, B:C ratio of 2.91), suggesting that site-specific nutrient application strategies can optimize both agronomic performance and economic output. This concurs with the conclusions of Singh et al., (2010), who advocated for integrated soil test-based fertilization in millet systems to balance input use with returns. These findings clearly demonstrate that applying 100 kg N ha⁻¹ along with balanced doses of P and K maximizes economic returns from pearl millet, with the treatment T4 (100:30:20 N:P₂O₅:K₂O kg ha⁻¹) offering the best benefit-cost ratio among all treatments. Adoption of such fertilizer regimes, tailored to crop demand and site conditions, can substantially improve farm profitability in rainfed pearl millet systems.

Comment [P27]: Contradiction — if soil K is already high, extra K may not be needed. Reword to:

“...suggesting that potassium supplementation beyond the recommended dose can further enhance yield, even in K-rich soils.”

Comment [P28]: Clear statement, but consider quantifying “threshold” if possible, or referencing prior literature.

Comment [P29]: The term “slightly declined” should be statistically validated. If not significant, use:

“...was marginally lower at 40.77% in T7, though the difference was not statistically significant.”

Comment [P30]: 1. Accurate, but for better clarity:

“...indicating more efficient assimilate partitioning toward grain production under optimal nitrogen supply.”

Comment [P31]: Remove parentheses around Table 2 and revise to:

“The economic analysis of different nutrient management treatments in pearl millet is presented in Table 2.”

Comment [P32]: • The term “uneconomical” is subjective — consider a more academic tone:

“...B:C ratio of 0.97, suggesting poor economic viability under nutrient-deficient conditions.”

Comment [P33]: Valid, but you might cite Table 1 here for cross-reference:

“...as seen in the previous yield data (Table 1).”

Comment [P34]: Consider making this more concise and analytical:

“Although input costs were higher in T7 due to increased potassium, the yield gains offset expenses, maintaining profitability.”

Comment [P35]: Revise to:

“...the soil test-based treatment (T8) also performed well economically (₹43,853.86 net returns, B:C ratio of 2.91)...”

Comment [P36]: Well-stated, but for precision, rephrase slightly:

“The results demonstrate that 100 kg N ha⁻¹ combined with balanced P and K doses maximizes economic returns...”

Comment [P37]: This is a strong conclusion but consider citing agronomic literature or local relevance for reinforcement.

Table:1 Effect of Nitrogen and Potassium Fertilization Strategies on Yield of Pearl Millet

Treatment	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest Index (%)
T ₁ : Control (no fertilizers).	1390	2815	33.05
T ₂ : 60 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹ (RDF)	2861	4815	37.27
T ₃ : 80 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹	3501	5275	39.89
T ₄ : 100 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹	3798	5465	41.00
T ₅ : 60 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	2965	4785	38.26
T ₆ : 80 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	3379	5185	39.45
T ₇ : 100 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	3839	5578	40.77
T ₈ : Application of N, P ₂ O ₅ and K ₂ O based on Soil Test Values.	3360	5145	39.51
SEm±	44.596	50.325	0.147
CD (P = 0.05)	136.578	154.124	0.449

Table:2 Economics as influenced by nutrient management practices on Yield of Pearl Millet

Treatment	Gross returns (ha ⁻¹)	Net returns (ha ⁻¹)	Benefit: Cost ratio
T ₁ : Control (no fertilizers).	25055	12315.00	0.97
T ₂ : 60 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹ (RDF)	50591	35197.81	2.29
T ₃ : 80 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹	61291	45645.64	2.92

T ₄ : 100 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 20 kg K ₂ O ha ⁻¹	66233	50335.46	3.16
T ₅ : 60 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	52225	36435.15	2.31
T ₆ : 80 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	59249	43206.98	2.69
T ₇ : 100 kg N ha ⁻¹ + 30 kg P ₂ O ₅ ha ⁻¹ + 40 kg K ₂ O ha ⁻¹	67002	50707.80	3.11
T ₈ : Application of N, P ₂ O ₅ and K ₂ O based on Soil Test Values.	58905	43853.86	2.91
SEm±	763.405	704.136	0.041
CD (P = 0.05)	2337.985	2156.470	0.125

Conclusion

Integrated nitrogen and potassium fertilization significantly influenced the yield and economic returns of pearl millet. Among all the treatments, application of 100 kg N ha⁻¹ along with 30 kg P₂O₅ and 20 or 40 kg K₂O ha⁻¹ resulted in maximum grain and straw yield, as well as the highest gross and net returns, with a superior benefit: cost ratio. These results underscore the importance of optimized nitrogen levels and balanced potassium application for enhancing nutrient uptake, physiological efficiency, and resource use, particularly under semi-arid conditions. The soil test-based nutrient application also showed promising economic returns, validating its use for site-specific nutrient management. Thus, judicious and balanced application of nitrogen and potassium not only enhances crop productivity but also ensures better profitability, making it a sustainable and economically viable practice for pearl millet cultivation in rainfed agro-ecosystems.

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- Panse, V.G. and Sukhatme, P.V. (1978). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India, 381 pp.

Comment [P38]: Generally fine, but consider specifying that the influence was **positive** for clarity: "Integrated nitrogen and potassium fertilization had a significant positive impact on the yield and economic returns of pearl millet."

Comment [P39]: Slight ambiguity: Are both K₂O rates equally effective? Clarify which treatment was **superior** or **more economical**.

Suggested revision:

"...application of 100 kg N ha⁻¹ along with 30 kg P₂O₅ and either 20 or 40 kg K₂O ha⁻¹ significantly improved grain and straw yield. Among these, the 20 kg K₂O treatment (T₄) recorded the highest benefit: cost ratio."

Comment [P40]: Consider rewording for consistency with scientific writing style: "...with the most favorable benefit-cost ratio."

Comment [P41]: Slightly vague — consider specifying "resource use efficiency" for clarity: "...enhancing nutrient uptake, physiological efficiency, and resource use efficiency..."

Comment [P42]: Strong sentence, but you could strengthen it by connecting more explicitly to **rainfed systems**:

"Thus, judicious and balanced application of nitrogen and potassium enhances crop productivity and ensures better profitability, especially under rainfed conditions."

Satyavathi, C. T., Ambawat, S., Khandelwal, V., & Srivastava, R. K. (2021). Pearl millet: a climate-resilient nutriceal for mitigating hidden hunger and provide nutritional security. *Frontiers in Plant Science*, 12, 659938.

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Ryan, J., Ibricki, H., Sommer, R., & McNeill, A. (2009). Nitrogen in rainfed and irrigated cropping systems in the Mediterranean region. *Advances in Agronomy*, 104, 53-136.

Comment [P43]: Please arrange the references alphabetically by the first author's surname (A to Z) as per the *Journal of Scientific Research and Reports* guidelines. Also, ensure the referencing style is consistent with the Vancouver format required by the journal (i.e., numbered references in-text corresponding to a numbered reference list, without using the author-date style).