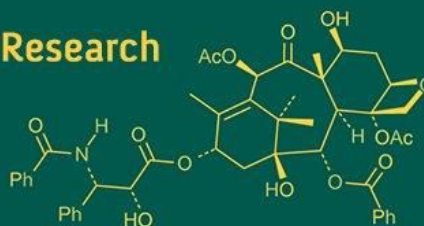


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Effect of different NPK levels on Growth, yield and nutrient uptake of brown top millet (*Urochloa ramosa* L.) under rainfed conditions of Coimbatore

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Abstract

Brown top millet is a hardy and climate-resilient millet with high nutritional value and good adaptability to dryland ecosystems. However, scientific information on suitable nutrient management to improve its productivity under rainfed conditions is limited. In this context, the present study was undertaken to identify suitable nutrient recommendation for enhancing growth and yield. The field experiment was conducted during the late *Rabi* season of 2025-26 at the Instructional Farm of Karunya Institute of Technology and Sciences, Coimbatore. The experiment was structured in a Randomized Block Design (RBD) with thirteen treatments replicated thrice. The treatments consisted different levels of N:P₂O₅:K₂O fertilizers namely T₁- 40:20:0 kg/ha, T₂- 20:10:10 kg/ha, T₃- 20:10:20 kg/ha, T₄- 20:20:10 kg/ha, T₅- 20:20:20 kg/ha, T₆- 40:20:10 kg/ha, T₇- 40:20:20 kg/ha, T₈- 40:30:10 kg/ha, T₉- 40:30:20 kg/ha, T₁₀- 60:20:10 kg/ha, T₁₁- 60:20:20 kg/ha, T₁₂- 60:30:10 kg/ha and T₁₃-60:30:20 kg/ha. The results revealed that application of 60:30:20 kg N:P₂O₅:K₂O/ha recorded higher plant height (118.27 cm), Dry matter production (6436 kg/ha), Grain yield (1185 kg/ha), straw yield (2488.5 kg/ha), Nutrient uptake (52.07, 16.81, 58.69 kg/ha of N, P₂O₅, K₂O respectively) and Net returns (₹8,945.20). The study concludes that balanced fertilization, especially at 60:30:20 kg N:P₂O₅:K₂O/ha, plays a crucial role in enhancing productivity, nutrient uptake, and economic returns of brown top millet under rainfed conditions, making it a suitable recommendation for sustainable cultivation in semi-arid regions.

Keywords: Brown top millet, IIMR AK 2, NPK levels, Nutrient recommendation, Rainfed conditions, Nutrient uptake

Introduction

Millet has made their comeback as crops of global importance in the view of climate change, nutritional insecurity and sustainable agricultural systems. They are suited to grow in marginal soils and rainfed environments, capable to withstand high temperature, low fertility and moisture stress and so they are considered as climate-resilient crops. With an annual yield of about 30 million tons, millets are produced on 30-32 million hectares worldwide, improving food security in Asia and Africa (FAO, 2023) [3].

Brown top millet (*Urochloa ramosa* L.), commonly known as Dixie signal grass, belongs to the family *Poaceae* is one of the small millets. The crop is vernacularly called 'Kula samai' in Tamil, 'Korale' in Kannada and 'Andu korra' in Telugu. The plant can be grown as a contingency crop under rainfed conditions because it completes its life cycle within 75 to 90 days (Pavankumar *et al.*, 2021). [8] The distribution of brown top millet in India includes the states of Karnataka, Andhra Pradesh, Telangana, Tamil Nadu and Chhattisgarh and extends to certain regions in Africa and Southeast Asia (Singh *et al.*, 2022) [11].

Brown top millet has high dietary fibre content (12.43 g/100 g). It also contains minerals such as calcium (26.24 mg/100 g), iron (6.98 mg/100 g), zinc 2.88 mg/100 g), copper (1.43 mg/100 g), manganese (0.88 mg/100 g) and protein content (13.37 g/100 g) (Harichandana *et al.*, 2023) [5]. The crop contains antioxidants and bioactive compounds which make it suitable for people who have gluten intolerance and metabolic disorders like hyperglycaemia. It also controls blood sugar levels, enhances cardiac health, reduces constipation, aids digestion and promotes bone health.

Nitrogen, phosphorus and potassium are the essential macronutrients which regulates plant growth, development and yield. Nitrogen (N) effects biomass development and chlorophyll production; Phosphorus (P_2O_5) promotes root growth and reproductive development and Potassium (K_2O) controls enzyme activity and stress resistance (Thakur *et al.*, 2019) ^[13]. Under rainfed agro-ecological conditions prevailing in Coimbatore region, lack of region-specific fertilizer recommendation often limits crop performance; hence the present study was undertaken to evaluate the effect of NPK levels on growth, yield and nutrient uptake of brown top millet.

Materials and Methods

A field experiment was conducted in the Instructional farm of Karunya Institute of Technology and Sciences, Coimbatore during the late *Rabi* season of 2025-26. The farm is geographically located in the Western agro-climatic zone of Tamil Nadu with 10.93 °N latitude and 76.75 °E longitude at an elevation of 427 m above mean sea level. Composite soil samples were taken from 0-15 cm depth, and standard method analysis was performed prior to sowing. The soil contains clay loam texture, with medium organic carbon (0.65%), medium available nitrogen (252 kg/ha), high available phosphorus (44.2 kg/ha) and high available potassium (280 kg/ha).

The experiment comprised thirteen treatments arranged in a Randomized Block Design (RBD) with three replications. The treatments consisted different combinations of N: P_2O_5 : K_2O levels (kg/ha) T₁- 40:20:0, T₂- 20:10:10, T₃- 20:10:20, T₄- 20:20:10, T₅- 20:20:20, T₆- 40:20:10, T₇- 40:20:20, T₈- 40:30:10, T₉- 40:30:20, T₁₀- 60:20:10, T₁₁- 60:20:20, T₁₂- 60:30:10 and T₁₃- 60:30:20. Brown top millet (*Urochloa ramosa* L.) variety IIMR AK-2 was sown at 30×10 cm spacing using a seed rate of 3 kg/ha, with a gross plot size of 5.4 m×4.0 m and net plot size of 3.5 m×3.2 m. Nitrogen (Neem coated Urea) was applied in two equal splits, 50% basal and the remaining 50% top-dressed at 30 days after sowing. Basal doses of Phosphorus (Single super phosphate) and Potassium (Muriate of potash) were applied during the time of sowing. Before sowing, a tank mix solution containing chlorpyrifos (0.05%) was sprayed to control termite infestation. The experimental data were statistically analyzed using the analysis of variance (ANOVA) (Gomez and Gomez, 1984), ^[4] and significance was tested at 5% level of probability.

Results and Discussion

Effect of various nutrient levels on Growth and Yield of Brown top Millet

Plant height of brown top millet was significantly influenced by different fertilizer levels (Table 1). Among the treatments, application of 60:30:20 kg N: P_2O_5 : K_2O /ha recorded the higher plant height (118.27 cm), followed by the treatment with the application of 60:30:10 kg N: P_2O_5 : K_2O /ha (T₁₂) (115.90 cm). The lower plant height (86.62 cm) was observed in the treatment with the application of 20:10:10 kg N: P_2O_5 : K_2O /ha. The increase in plant height under higher fertilizer levels may be attributed to the balanced supply of essential nutrients, which improved nutrient availability and enhanced vegetative growth. These are consistent with the findings of Thakur *et al.*, (2019) ^[13].

The dry matter production of brown top millet showed a significant response to different nutrient level treatments according to the results shown in Table 1. The treatment with application of 60:30:20 kg N: P_2O_5 : K_2O /ha produced higher dry matter of 6436 kg/ha followed with the application of 60:30:10 kg N: P_2O_5 : K_2O /ha which produced dry matter of 6341 kg/ha. The treatment 20:10:20 kg N: P_2O_5 : K_2O /ha produced the least amount of dry matter which resulted in dry matter production of 4795 kg/ha. The increased fertilizer application led to higher dry matter growth where it resulted in better nutrient access for plants to produce more biomass (Pavankumar *et al.*, 2021) ^[8].

Grain yield of brown top millet was substantially influenced by different nutritional levels (Table 1). The higher grain yield of 1185 kg/ha was recorded with the application of 60:30:20 kg N: P_2O_5 : K_2O /ha, followed by the treatment with the application of 60:30:10 kg N: P_2O_5 : K_2O /ha (1156.91 kg/ha). The lower grain yields were recorded in 20:10:10 kg N: P_2O_5 : K_2O /ha (723.22 kg/ha). Improved nutrient availability could have boosted crop development and enabled effective assimilate partitioning which may be the cause of the higher grain production under higher fertilizer levels. Additionally, Siddiqui *et al.*, (2020) ^[10] reported that balanced nutrient administration increased grain yield of brown top millet.

Straw yield of brown top millet differed significantly among the nutrient treatments (Table 1). The higher straw yield of 2488.50 kg/ha was recorded in the treatment with the application of 60:30:20 kg N: P_2O_5 : K_2O /ha, which was on par with 60:30:10 kg N: P_2O_5 : K_2O /ha (2429.45 kg/ha). The lower straw yield was recorded in the treatment with the application of 20:10:10 kg N: P_2O_5 : K_2O /ha (1569.3 kg/ha). Increased straw yield under higher fertilizer levels reflects greater vegetative growth and biomass accumulation under adequate nutrient supply (Anitha *et al.*, 2020) ^[2].

Effect of various nutrient levels on Net returns and Benefit-Cost ratio of Brown top Millet

Net returns and benefit-cost ratio of brown top millet were also influenced by nutrient levels (Table 1). The higher net return (₹8,945.20) was obtained with the application of 60:30:10 kg N: P_2O_5 : K_2O /ha, which remained statistically comparable with 60:20:20 kg N: P_2O_5 : K_2O /ha (₹8,606.50). The minimum net returns (₹1,639.12) were observed in 20:10:20 kg N: P_2O_5 : K_2O /ha. The higher benefit-cost ratio (1.35) was recorded with 60:30:10 kg N: P_2O_5 : K_2O /ha and 60:20:10 kg N: P_2O_5 : K_2O /ha, whereas the lower B:C ratio (1.08) was noted under 20:10:20 kg N: P_2O_5 : K_2O /ha. According to Triveni *et al.*, (2023) ^[14], there exist a connection between increased fertilizer use and improved crop productivity, which resulted in higher profitability and greater economic returns for farmers.

Effect of various nutrient levels on Nutrient uptake of Brown top Millet

Uptake of nitrogen, phosphorus and potassium by brown top millet differed significantly by nutrient dosage (Table 1). The maximum nutrient uptake was obtained in the treatment with the application of 60:30:20 kg N: P_2O_5 : K_2O /ha (52.07 kg/ha N, 16.81 kg/ha P_2O_5 , 58.69 kg/ha K_2O). The minimum nutrient uptake was observed in the treatment with the application of 40:20:0 kg N: P_2O_5 : K_2O /ha (24.34 kg/ha N, 6.77 kg/ha P_2O_5 , 26.86 kg/ha K_2O). Higher nutrient absorption at higher fertilizer doses reflects

improved biomass production and increased nutrient availability, enabling greater nutrient accumulation. Similar

results were also observed by Suganya *et al.*, (2022)^[12].

Table 1: Effect of varied nutrient levels on plant height (cm), Dry matter production (kg/ha), Grain yield (kg/ha), Straw yield (kg/ha), Net returns (₹), Benefit-cost ratio and Nutrient uptake (%) in Brown top millet

Treatments	Plant height (cm)	Dry matter production (kg/ha)	Grain Yield (kg/ha)	Straw Yield (kg/ha)	Net returns (₹)	B:C Ratio	Nutrient Uptake (%)		
							N	P ₂ O ₅	K ₂ O
T ₁ : 40:20:0 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	97.53	5685	891.27	1899.66	5,887.98	1.28	24.34	6.77	26.86
T ₂ : 20:10:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	86.62	5139	723.22	1569.33	2,377.42	1.12	26.15	7.17	29.15
T ₃ : 20:10:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	88.60	4794	755.84	1671.18	1,639.12	1.08	28.88	7.97	32.0
T ₄ : 20:20:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	93.84	5182	829.73	1735.44	3,112.72	1.14	30.61	8.81	34.69
T ₅ : 20:20:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	94.60	5516	888.23	1837.29	3,174.52	1.14	33.11	9.4	36.66
T ₆ : 40:20:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	98.73	5638	931.71	1956.57	5,397.48	1.24	36.80	10.74	41.22
T ₇ : 40:20:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	101.62	5665	981.30	2060.73	5,192.28	1.21	38.72	11.38	42.96
T ₈ : 40:30:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	107.11	5968	1021.62	2145.36	5,656.98	1.23	41.78	12.51	46.53
T ₉ : 40:30:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	106.53	6066	1086.41	2281.44	5,907.78	1.22	43.03	12.98	47.94
T ₁₀ : 60:20:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	105.67	5981	1051.24	2207.52	8,211.70	1.35	43.0	12.85	47.86
T ₁₁ : 60:20:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	109.38	6218	1120.82	2353.68	8,066.50	1.34	46.20	14.13	51.32
T ₁₂ : 60:30:10 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	115.90	6341	1156.91	2429.45	8,945.20	1.35	48.74	15.04	54.29
T ₁₃ : 60:30:20 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹	118.27	6436	1185.0	2488.50	8,095.00	1.29	52.07	16.81	58.69
SE (d)	4.71	213.40	45.98	68.75	308.21	0.06	1.99	0.60	2.22
CD (p = 0.05)	9.72	440.52	94.90	141.90	636.11	0.13	4.10	1.23	4.58

Conclusion

The results of the current study indicated that balanced fertilization had a significant influence on the growth, yield and nutrient dynamics of brown top millet. Among the treatments evaluated, application of 60:30:20 kg N:P₂O₅:K₂O/ha produced comparatively higher grain yield, straw yield with greater nutrient uptake. Brown top millet is generally cultivated with limited nutrient management and farmers are less aware about its fertilizer requirement, thus identifying an optimum dose is important. Based on the results, the application of 60:30:20 kg N:P₂O₅:K₂O/ha will be suitable for improving productivity of brown top millet under rainfed conditions of Coimbatore.

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Competing Interest

Authors declare that there are no conflicting interests associated with this manuscript.

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