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Yield and economics of fodder sorghum (*Sorghum bicolor* L.) as influenced by nutrient management practices

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Abstract

A field experiment was conducted during *Kharif* 2024 at the Experimental Farm of Agronomy Section, College of Agriculture, Latur to study the effect of nutrient management practices on the growth and yield of fodder sorghum (*Sorghum bicolor* L.). The soil was clayey in texture, moderately alkaline, low in available phosphorus, moderate in nitrogen and high in potassium. The experiment was laid out in a Randomized Block Design with eight treatments and replicated thrice. The treatments are T₁- control, T₂- 100% RDF, T₃- 100% RDF with Micronutrient Gr-II @ 0.5% spray, T₄-100% RDF with Urea spray @ 2%, T₅- 100% RDF with 2% DAP spray, T₆- 75% RDF with micronutrient grade II 0.5% spray, T₇- 75% RDF with 2% urea spray and T₈ - 75% RDF with 2% DAP spray. Full dose of P & K and half dose of N as basal & remaining half dose of N as top dressing at 30 DAS were applied. The results showed that application of 100% RDF with Urea spray @ 2% (T₃) recorded significantly higher yield attributes i.e., maximum green fodder yield (462 q ha⁻¹), leaf: stem ratio (0.39), gross monetary return (₹115526 ha⁻¹), net monetary return (₹64978 ha⁻¹) and B:C ratio (2.7) which was at par with 100% RDF with Micronutrient Gr-II @ 0.5% spray (T₃).

Keywords: Fodder sorghum, nutrient management, green fodder yield, economics

Introduction

India faces a significant shortage of animal feed, with deficits of 35.6% in green fodder, 10.5% in dry crop residues, and 44% in concentrate feed ingredients (Singh *et al.*, 2022) [15]. Although livestock contributes about 32% to agricultural output, it is constrained by 15% of the world's livestock being supported on just 2% of global land area (Dey & Kumar, 2017; Sarvade *et al.*, 2019) [6, 13]. Dry fodder demand (851.3 Mt) far exceeds supply (467.6 Mt), while green fodder supply (590.4 Mt) slightly exceeds demand (530.5 Mt) (Anonymous, 2013) [2]. Major *kharif* fodder crops include sorghum, bajra, and maize, while berseem and oat are key *rabi* crops. Sorghum (*Sorghum bicolor* L.), known as the "king of millets" and the "camel crop," is an important *kharif* fodder cereal due to its resilience to drought, salinity, and waterlogging. It is a fast-growing C4 plant with high biomass potential and decent nutritive value, containing 6.1-7.4% crude protein and 35.8-36.9% ADF Chaudhary *et al.*, (2018) [5]. However, improper and uneven fertilizer application in Indian conditions limits its yield and quality. Effective nutrient management, especially involving both macro (N, P, K) and micronutrients (Zn, Fe, B, Mn, Cu, Mo), is critical to improving fodder yield and quality. Nitrogen and phosphorus are among the most limiting nutrients in Indian soils, essential for plant growth, photosynthesis, and metabolic functions Guinn, (1984) [7] and Munir *et al.*, (2004) [10]. However, improper nutrient management often leads to reduced yield and forage quality. Sorghum is nutrient-intensive and particularly responsive to balanced application of macro- and micronutrients, especially nitrogen, phosphorus, potassium, and trace elements like Zn, Fe, and B Yadav *et al.*, (2010) [17] and Prajapati *et al.* (2023) [12]. Micronutrient deficiencies are increasingly common in intensively farmed Indian soils, affecting both yield and fodder quality. Moreover, method and timing of nutrient application especially foliar nutrition is increasingly seen as an efficient strategy to correct nutrient deficiencies quickly and minimize losses compared to soil application. This study explores the nutrient management practices to maximize yield in fodder sorghum.

Materials and Methods

The field investigation entitled “Effect of nutrient management practices on growth and yield of fodder sorghum (*Sorghum bicolor* L.) during *kharif* season.” was conducted during *kharif* 2024 at Experimental Farm, Department of Agronomy, College of Agriculture, Latur. The soil was clayey, moderately alkaline (pH 7.35), low in available phosphorus (9.65 kg ha^{-1}), moderate in nitrogen ($137.98 \text{ kg ha}^{-1}$) and high in potassium ($1045.60 \text{ kg ha}^{-1}$). The experiment was laid out in a Randomized Block Design with eight treatments and replicates thrice. The treatments are T₁- control, T₂- 100% RDF, T₃- 100% RDF with Micronutrient Gr-II @ 0.5% spray, T₄-100% RDF with Urea spray @ 2%, T₅- 100% RDF with 2% DAP spray, T₆- 75% RDF with micronutrient grade II 0.5% spray, T₇- 75% RDF with 2% urea spray and T₈ - 75% RDF with 2% DAP spray. Full dose of P & K and half dose of N as basal & remaining half dose of N as top dressing at 30 DAS were applied. The spacing between rows was maintained at 30 cm. The gross plot size was 5.4 meters by 4.5 meters, while the net plot size was 4.8 meters by 3.9 meters. The seed rate used was 40 kilograms per hectare. Sowing was done by dibbling method. The recommended cultural practices and plant protection measures were taken. Five plants were randomly selected and tagged from each net plot to record biometric observations at various growth stages. These same plants were later harvested individually for post-harvest analysis. The forage sorghum variety used for experimentation was CSV-40F. The data collected from various observations were organized into tables and analyzed using analysis of variance (ANOVA). The statistical technique of analysis of variance was employed to analyze the recorded data Panse and Sukhatme, (1967)^[11].

Result and Discussion

Yield and yield attributes

Yield attributing character of fodder sorghum viz. leaf: stem

ratio and green fodder yield were influenced significantly by various treatments (Table 1). Highest leaf: stem ratio (0.39) and green fodder yield (462 q ha^{-1}) were recorded with the application of 100% RDF with urea spray @ 2% at 30 DAS (T₄) which was at par with the application of 100% RDF + micronutrient grade II 0.5% (T₃) and found significantly superior over rest of the treatments. This increase in yield can be attributed to significant improvements in various growth parameters and it might be due to enhanced availability of nitrogen likely stimulated key physiological processes including cell division, cell elongation, and the synthesis of nucleotides and coenzymes, which in turn promoted meristematic activity and expanded the leaf surface area. This led to greater photosynthetic efficiency and accumulation of food reserves, ultimately contributing to higher biomass production. Similar positive effects of nitrogen application via foliar sprays alongside basal fertilization were reported by Singh *et al.* (2012)^[14], Bhoya *et al.* (2013)^[3], and Bocharé (2015)^[4].

Economics

Gross Monetary Returns, Net Monetary Returns and B:C ratio of fodder sorghum were influenced significantly due to various treatments. application of 100% RDF with urea spray @ 2% at 30 DAS (T₄) recorded significantly GMR ($\text{₹}115526 \text{ ha}^{-1}$), NMR ($\text{₹}64978 \text{ ha}^{-1}$) and B:C ratio (2.7) which was at par with the application of 100% RDF + micronutrient grade II 0.5% (T₃) and found significantly superior over rest of the treatments. The superior performance of treatment T₄ in terms of net monetary return was mainly due to its highest green forage yield and relatively lower cost of cultivation. These findings are similar with earlier studies conducted by Amina *et al.* (2012)^[1], Kumawat *et al.* (2016)^[8], and Mohammad (2021)^[9].

Table 1: Yield attributes and economics of fodder sorghum influenced by different treatments.

Treatments	Leaf: stem ratio	Green fodder yield (q ha ⁻¹)	GMR ₹ ha ⁻¹	NMR ₹ ha ⁻¹	B:C Ratio
T ₁ - Control	0.12	222	55478	13880	1.4
T ₂ - 100% RDF	0.26	323	80649	33619	1.9
T ₃ - 100% RDF + micronutrient grade II 0.5%	0.36	418	104408	53427	2.3
T ₄ - 100% RDF + 2% urea	0.39	462	115526	64978	2.7
T ₅ - 100% RDF + 2% DAP	0.30	375	93791	45312	2.2
T ₆ - 75% RDF + micronutrient grade II 0.5%	0.23	268	66936	20433	1.5
T ₇ - 75% RDF + 2% urea	0.25	296	74071	28399	1.7
T ₈ - 75% RDF + 2% DAP	0.22	257	64220	19428	1.5
SE(m)	0.02	19	4356	4352	
C.D.at 5%	0.05	58	13045	13045	
General Mean	0.27	328	81885	34935	1.90

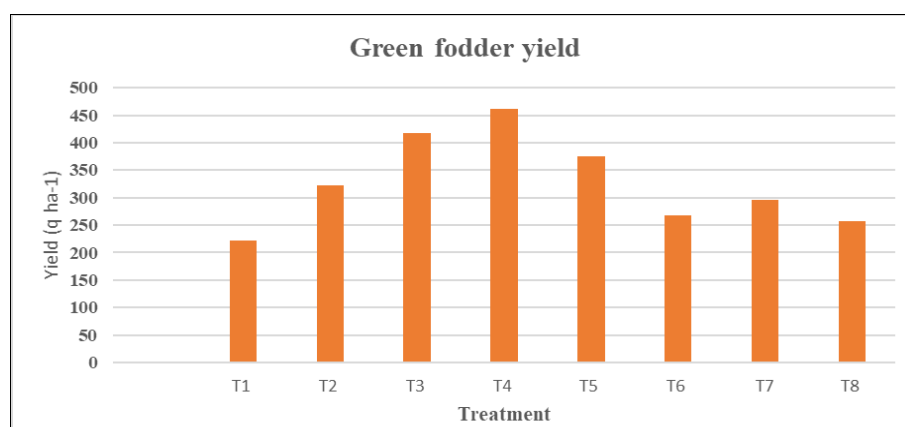


Fig 1: Green fodder yield influenced by different treatments

Conclusion

It can be concluded that, application of 100% RDF (80:40:40 NPK kg ha⁻¹) with urea spray @ 2% at 30 DAS was found beneficial for getting higher leaf: stem ratio, total green fodder yield, GMR, NMR and B:C ratio of fodder sorghum which was closely followed by application of 100% RDF + micronutrient grade II 0.5%.

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