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Growth and yield 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 T_1- control, T_2- 100% RDF, T_3- 100% RDF with Micronutrient Gr-II @ 0.5% spray, T_4-100% RDF with Urea spray @ 2%, T_5- 100% RDF with 2% DAP spray, T_6- 75% RDF with micronutrient grade II 0.5% spray, T_7- 75% RDF with 2% urea spray and T_8 - 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% (T_3) recorded significantly higher growth attributes *i.e.*, plant height (243.27 cm) plant^{-1}, number of functional leaves plant^{-1} (14.10), leaf area plant^{-1} (71.00 dm^2), stem girth plant^{-1} (8.37 cm), fresh weight per plant (1.187 kg) and yield attributes *i.e.*, maximum green fodder yield (462 q ha^{-1}), leaf: stem ratio (0.39) which was at par with 100% RDF with Micronutrient Gr-II @ 0.5% spray (T3).

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

Introduction
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**)** **[1].** 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 and Munir *et al*., 2004) [2, 3]. 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; Prajapati *et al*., 2023) [4, 5]. 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 kg ha^{-1}) and high in potassium (1045.60 kg ha^{-1}). The experiment was laid out

in a Randomized Block Design with eight treatments and replicates thrice. The treatments are T_1- control, T_2- 100% RDF, T_3- 100% RDF with Micronutrient Gr-II @ 0.5% spray, T_4- 100% RDF with Urea spray @ 2%, T_5- 100% RDF with 2% DAP spray, T_6- 75% RDF with micronutrient grade II 0.5% spray, T_7- 75% RDF with 2% urea spray and T_8 - 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) [6].

Results and Discussion

Growth attributes

A perusal of data (Table 1) revealed that the growth attributing characters of fodder sorghum *viz*., plant height, number of functional leaves plant$^{-1,}$ leaf area plant^{-1}, stem girth and fresh weight plant^{-1} were influenced significantly by various treatments. Application of 100% RDF with urea spray @ 2% at 30 DAS (T_4) recorded highest plant height, number of functional leaves plant$^{-1,}$ leaf area plant^{-1}, stem girth and fresh weight plant^{-1} which was at par with the application of 100% RDF + micronutrient grade II 0.5% (T_3) and found significantly superior over rest of the treatments. It might be due to foliar application of urea which increases availability of nutrients and uptake of nitrogen by crop which resulted in more vegetative growth and increase in protoplasmic constituents and increase in the process of cell division, expansion and differentiation, which results in luxuriant growth of the crop. The similar findings was also demonstrated by Tiwana *et al*. (2003) [7], Singh *et al*. (2012) [8], Bochare (2015) [9], Somashekar *et al*. (2015) [10] and Prajapati *et al*. (2023) [4].

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 (T_4) which was at par with the application of 100% RDF + micronutrient grade II 0.5% (T_3) 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 is 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) [8], Bhoya *et al.* (2013) [11], and Bochare (2015) [9].

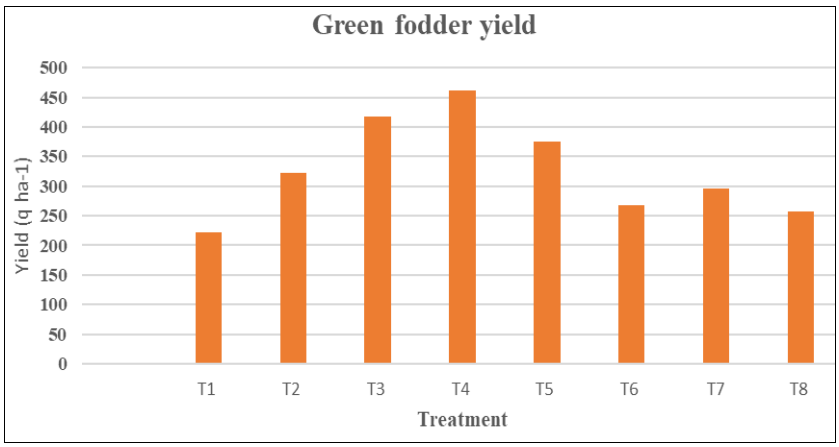

Fig 1: Green fodder yield influenced by different treatments

Table 1: Growth attributes and yield attributes influenced by different treatments at harvest

Treatments	Plant height (cm)	No. of functional leaves plant^{-1}	Leaf area plant^{-1} (dm^{-2})	Stem girth (cm)	Fresh weight plant^{-1} (kg)	Leaf: stem ratio	Green fodder yield (q ha^{-1})
T_1 - Control	93.17	6.70	27.99	4.08	0.15	0.12	222
T_2 - 100% RDF	191.90	12.06	43.69	7.12	0.77	0.26	323
T_3 - 100% RDF + micronutrient grade II 0.5%	221.20	13.12	61.73	7.80	1.09	0.36	418
T_4 - 100% RDF + 2% urea	243.27	14.10	71.00	8.37	1.19	0.39	462
T_5 - 100% RDF + 2% DAP	200.18	12.42	48.47	6.87	0.94	0.30	375
T_6 - 75% RDF + micronutrient grade II 0.5%	156.52	11.20	38.50	6.42	0.63	0.23	268
T_7 - 75% RDF + 2% urea	175.20	11.77	40.30	6.49	0.66	0.25	296
T_8 - 75% RDF + 2% DAP	131.10	10.13	30.62	5.08	0.54	0.22	257
SE(m)	7.925	0.57	2.61	0.36	0.35	0.02	19
C.D.at 5%	23.76	1.71	7.83	1.08	0.11	0.05	58
General Mean	176.57	11.44	45.29	7.40	8.06	0.27	328

Conclusion

It can be concluded that, application of 100% RDF (80:40:40 kg ha^{-1}) with urea spray @ 2% at 30 DAS was found beneficial for getting higher plant height, number of functional leaves, leaf area, stem girth, fresh plant weight, leaf: stem ratio, and total green fodder yield of fodder sorghum which was closely followed by application of 100% RDF + micronutrient grade II 0.5%.

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