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Yield, Quality and Nutrient uptake of Fodder Sorghum Influenced by Nitrogen Management and Foliar nutrition in Southern Laterites of Kerala

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ABSTRACT

An experiment was conducted to examine the effect of different concentrations of nano urea on yield, quality and nutrient uptake of fodder sorghum. The experiment was laid out in randomized block design with 13 treatments, replicated thrice. The treatments comprised of nitrogen management and foliar nutrition. The fertilizer recommendation followed was 60:40:20 kg NPK ha-1, along with the recommended dose of farm yard manure (10 t /ha). Foliar spray of nano urea and urea were applied each at 20 DAS and 40 DAS. Full P and K were applied as basal. The results revealed that, 100% RDN along with foliar spray of nano urea 0.4% (T_5) recorded higher green fodder yield, dry fodder yield, crude protein content, crude protein yield, nitrogen uptake, phosphorous uptake and potassium uptake and was statistically on par with 100% RDN along with foliar spray of nano urea 0.6% (T_6).

Key Words: Fodder sorghum Laterite, Nano urea, Nutrient uptake, Quality, Urea spray, Yield.

INTRODUCTION

The total livestock population in India has grown by 4.8 percent, reaching 536.76 million according to the 20th livestock census, compared to the 2012 census (FAHD, 2019). However, the country allocates only 4 percent of its cultivated land to fodder crops. The country faces a net shortfall of 35.6 per cent green fodder 10.5 per cent dry crop left overs and 44 per cent concentrate feed ingredients (Singh *et al*, 2022). The only way to bridge the large gap between supply and demand of fodder is to maximize the fodder production per unit area and unit time with in the existing farming system and by adopting improved agricultural practices.

Sorghum is a widely adopted cereal fodder crop, due to its ease of cultivation, high yield potential, rich nutritional value and quick regeneration. It is a drought- resistant, short-duration crop that can also tolerate some salt, making it well-suited for arid regions. These qualities make sorghum a promising solution for addressing feed shortages. Additionally, sorghum can provide suitable fodder and feed to meet the needs of the dairy industry. Foliar nutrition can enhance the plant's physiological processes, leading to improved yield potential. Foliar feeding is particularly effective for correcting nutrient deficiencies and maximizing nutrient efficiency. It is especially beneficial for early maturing, short duration crops, where the nutrients from soil applied fertilizers may not be fully accessible before the crop reaches maturity.

Nano fertilizers have been introduced as alternatives to traditional fertilizers and have proven to be both effective and efficient in enhancing plant nutrition, thereby boosting crop production and improving fodder quality (Kumar *et al*, 2021). Their application not only increases yields but also minimizes environmental risks. Unlike synthetic fertilizers, which release nutrients within 4-10 days, nano fertilizers provide a sustained release over 40–50 days. Moreover, they strengthen plants' resilience against both biotic and abiotic stresses (Mejias *et al*, 2021). Specifically, nano urea supplies nitrogen in sync with crop demand, improving nitrogen use efficiency by reducing leaching and emissions, while also promoting long-term integration by soil microorganisms (Kannoj *et al*, 2022). Foliar spray of nano urea provides a quick nutrient boost to plants, especially during periods of rapid growth, stress or deficiency. Hence foliar application of nano urea is a desirable way to increase the productivity of fodder sorghum.

In order to meet the increasing demand for supply of quality forage due to increasing pressure on agricultural land for food and cash crops, quality fodder production for sustainability on limited space and time could be achieved from ideal forage crops and

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Sr. No	Treatments		
T_1	75% RDN + nano urea (0.2%)	T_7	75% RDN + urea spray (2%)
T_2	75% RDN + nano urea (0.4%)	T_8	100% RDN + urea spray (2%)
T_3	75% RDN + nano urea (0.6%)	T_9	Nano urea (0.2%) alone
T_4	100% RDN + nano urea (0.2%)	T_{10}	Nano urea (0.4%) alone
T_5	100% RDN + nano urea (0.4%)	T_{11}	Nano urea (0.6%) alone
T_6	100% RDN + nano urea (0.6%)	T_{12}	KAU POP (60:40:20 NPK kg ha^{-1})
T_{13}	Control (without nitrogen)		

best management practices (Srivani *et al*, 2022). In this backdrop, the present investigation is proposed with an objective to study the effect of different concentrations of nano urea on yield and quality parameters of fodder sorghum.

MATERIALS AND METHODS

A field experiment entitled nitrogen management and foliar nutrition for yield, quality and nutrient uptake of fodder sorghum was conducted in Instructional Farm attached to College of Agriculture, Vellayani during December 2023 to February 2024. The experimental field was geographically located at 8° 42, latitude and 76 °98 longitude, at an altitude of 24.13 m above the mean sea level. The field experiment was laid out in randomized block design with 13 treatments replicated thrice, as follows:

Both the nano urea and urea spray were applied at 20 DAS and 40 DAS. Nitrogen was applied in three splits – 50% as basal, 25% at 20 DAS and 25% at 40 DAS. Full P and K were applied as basal. The experimental soil was sandy clay loam in texture, moderately acidic with a pH of 5.63, low in organic carbon, medium in available nitrogen (413.95 kg /ha) and available potassium (278.38 kg/ ha) and high in available phosphorous (62.44 kg /ha). Single cut variety of fodder sorghum 'CNFS-1' was used in the experiment. Seeds were sown with a spacing of 30 X 15 cm. All other agronomic practices were followed uniformly in all the treatments as per the package of practices for Kerala Agricultural University, India (KAU POP). Five plants from each plot were tagged for observation. Harvesting of the crop was done at 50 per cent flowering stage in all the treatments. The harvested green fodder from each plot was weighed directly in the field (kg/ plot) and was expressed as quintals per hectare (q/ ha). At harvest, a 500 g representative sample of green fodder was randomly collected from each plot. These samples were first sun-dried and then oven-dried until a constant weight was achieved. Based on the dry weight of these samples, the green fodder yield was converted into dry fodder yield (q/ha). For estimating the quality, crude protein content and crude fibre content were analyzed. The crude fibre content was determined by using the weende method (A.O.A.C 1960) and was expressed as percentage on dry weight basis. The plant crude protein content was calculated by multiplying the percentage of nitrogen by the factor 6.25 (Simpson *et al*, 1965) and expressed as percentage on dry weight basis. To determine crude protein yield, the dry fodder yield is multiplied by the crude protein content and expressed as t/ha. At harvest, plant samples were analyzed for total N, P and K content. The samples were shade dried for two days to reduce moisture, then oven dried at 65$\pm$ 5 °C. After drying, the samples were ground into a fine powder, accurately weighed, subjected to acid digestion and used for determining N, P and K content. The N content in plant was assessed using the modified micro Kjeldahl method (Jackson, 1973). The P content in plant was estimated colorimetrically following wet digestion and color development using the vanadomolybdate phosphoric yellow color method, with the color intensity measured using a spectrophotometer (Jackson, 1973). The K content in plant was measured with a flame photometer (Jackson, 1973). The total N, P and K uptake was determined by multiplying the plant nitrogen, phosphorus and potassium content by the dry matter produced and the result was expressed in kg ha^{-1}.

RESULTS AND DISSCUSSION

Effect on yield parameters

The treatment (T5) produced higher green fodder yield (320 q /ha) which was statistically comparable with T6 (300 q/ha). The observed improvements can be attributed to the swift uptake and assimilation of nano-nutrients, which promoted enhanced growth traits such as greater plant height and expanded leaf area. The rise in yield appears to be associated with the prolonged retention of nanomaterials within plant tissues, resulting in higher productivity. In addition, the synergistic action of nano fertilizers boosted the

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Table 1. Effect of nitrogen management and foliar nutrition on yield attributes of fodder sorghum

Treatment	Green fodder yield (q /ha)	Dry fodder yield (q /ha)
T1	203.3	34.0
T2	219.5	41.4
T3	243.3	45.3
T4	231.7	44.0
T5	320.3	58.1
T6	300.0	55.1
T7	210.0	39.2
T8	230.0	42.2
T9	193.3	20.0
T10	195.0	30.8
T11	200.0	31.3
T12	223.3	42.1
T13	140.0	17.7
SEm (±)	20.89	03.8
CD (0.05)	60.55	11.10

RDN-Recommended dose of nitrogen

efficiency of conventional fertilizers, likely facilitating better nutrient absorption by plant cells. This, in turn, supported optimal development of plant organs and vital metabolic activities like photosynthesis, leading to increased production and translocation of photosynthates to economically important plant parts, thereby achieving superior yields. These findings are consistent with the reports of Bhoya *et al* (2013) in fodder sorghum.

Dry fodder yield was found to be greater under treatment T5 (58.1 q /ha) and was on par with T6 (51.1 q /ha). The increased dry matter yield can be attributed to enhanced crop growth and photosynthetic activity, which ensured a greater supply of carbohydrates. Improved partitioning of photosynthates and efficient nutrient accumulation further contributed to biomass production, ultimately resulting in higher dry fodder yield. The findings of Meena *et al* (2021) also confirmed the same observations.

Effect on quality parameters

The treatment T5 recorded higher crude protein content and was 24.00 per cent higher compared to T12. This could be attributed to sufficient nitrogen fertilization, which promoted better metabolism and resulted in higher protein content in plant tissue. Additionally, nitrogen plays a key role in the amino acid composition of protein, thereby improving the nutritional quality of fodder maize (Kashyap *et al*, 2023). Similar findings are also reported by Kumari *et al* (2014) and Rajesh *et al* (2022) in fodder oat. Higher crude protein yield was observed with T5 and was found on par with T6. The rise in crude protein yield is directly linked to a higher accumulation of dry matter and protein in plants, which in turn boosted crude protein yield in fodder sorghum. Application of 100 per cent RDN along with 2 per cent urea spray recorded higher crude protein yield followed by T6 (100 per cent RDN + nano urea 0.4 per cent) in maize (Kumar *et al*, 2024). This is supported by the findings of Almodares *et al* (2009) in sweet sorghum, Shekara *et al* (2015) in baby corn and Meena *et al* (2021) in fodder maize.

Plant Analysis

Data on plant analysis revealed that T5 resulted in higher N content and was statistically comparable with T6. The application of RDF along with foliar spray of nano urea might have increased the nitrogen concentration in soil solution resulting in better extraction by roots and translocation with in the plant system. This process reduces nitrogen losses through leaching and emissions, while also promoting its sustained incorporation by soil microorganisms (Kannoj *et al*, 2022). These findings align with the research of Gupta *et al* (2022) in wheat. The variations in P and K content due to nitrogen management and foliar nutrition were not significant.

Nutrient uptake is the product of the amount of dry matter and the concentration of nutrient present in the tissue. The treatment, (T5) 100 per cent RDN + 0.4 per cent nano urea recorded higher NPK uptake and it was found to be on par with T6.

The total nitrogen uptake in forage sorghum increased linearly with higher rates of the RDN combined with foliar sprays of nano urea. This approach boosts nutrient concentration in the soil solution, improving root nutrient uptake and better translocation within the plant. The enhanced nutrient uptake can be attributed to nano fertilizers, which have larger surface area and smaller particle size, lesser than pore size of plant roots and leaves. This allows better penetration into plant from the applied surface, thereby improving uptake of nutrient and nutrient use efficiency of the nano fertilizer. A similar pattern was observed by Bochare (2015) in fodder maize and Sheoran *et al* (2018) in fodder pearl millet and Rani *et al* (2019) in sorghum.

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Table 2. Effect of nitrogen management and foliar nutrition on quality attributes of fodder sorghum

Treatment	Crude protein content (%)	Crude fibre content (%)	Crude protein yield (t/ ha)
T1	7.67	24.83	0.30
T2	7.73	24.80	0.31
T3	7.96	26.37	0.32
T4	8.39	25.54	0.36
T5	9.92	26.87	0.50
T6	9.59	26.68	0.43
T7	7.59	25.01	0.30
T8	8.41	26.38	0.41
T9	7.42	23.69	0.16
T10	7.46	24.16	0.23
T11	7.48	24.73	0.25
T12	8.00	25.76	0.33
T13	7.35	23.32	0.14
SEm (±)	0.52	2.03	0.04
CD (0.05)	1.517	NS	0.110

NS- Not significant
RDN-Recommended dose of nitrogen

Table 3. Effect of nitrogen management and foliar nutrition on nutrient content of fodder sorghum

Treatment	N content (%)	P content (%)	K content (%)
T1	1.23	0.23	1.03
T2	1.24	0.25	1.04
T3	1.28	0.27	1.05
T4	1.34	0.28	1.06
T5	1.59	0.31	1.09
T6	1.53	0.30	1.08
T7	1.21	0.24	1.03
T8	1.34	0.29	1.07
T9	1.18	0.28	1.01
T10	1.19	0.21	1.02
T11	1.20	0.21	1.03
T12	1.27	0.22	1.06
T13	1.17	0.20	1.00
SEm (±)	0.09	0.03	0.11
CD (0.05)	0.259	NS	NS

NS- Not significant
RDN-Recommended dose of nitrogen

Table 4. Effect of nitrogen management and foliar nutrition on nutrient uptake of fodder sorghum

Treatment	N uptake (kg /ha)	P uptake (kg /ha)	K uptake (kg /ha)
T1	62.14	29.72	153.67
T2	66.84	30.59	159.67
T3	68.19	30.77	168.33
T4	73.94	31.98	167.67
T5	88.93	41.00	191.67
T6	84.28	38.06	183.67
T7	66.20	29.18	154.00
T8	70.45	32.16	172.00
T9	55.37	24.46	136.67
T10	56.52	26.96	142.00
T11	59.11	27.14	149.33
T12	66.52	30.35	166.67
T13	45.60	21.00	118.33
SEm (±)	5.83	2.89	11.46
CD (0.05)	17.019	8.439	33.437

RDN-Recommended dose of nitrogen

The increased phosphorus uptake in fodder sorghum can be attributed to the increased application of urea as a nitrogen source. During nitrification, urea generates hydrogen ions along with nitrate ions, which can influence phosphorus availability. Since phosphorus is vital for root development, it would help to create a robust root system, enhancing the absorption of other micronutrients from the soil. These findings align with the research of sannagoudar *et al* (2017) in fodder pearl millet and Upsana *et al* (2022) in sweet corn.

Higher K uptake observed in T5 might be due to the foliar application of nano urea may enhance nitrogen uptake due to its larger surface area and increased permeability, allowing nitrogen to interact synergistically with most mineral nutrients, which also improved the absorption of potassium. A similar pattern was observed by Al-Juthery *et al* (2018) in wheat, Khan *et al* (2019) in oat, Rani *et al* (2019) in sorghum and Kannoj *et al* (2022) in black wheat.

CONCLUSION

Based on the study it can be concluded that nitrogen management along with foliar application of nitrogen-based formulations improved the fodder yield, quality and nutrient uptake in fodder sorghum. There was an increased yield of green fodder (39.26 % when nano urea (0.4%) was supplemented with RDF compared to urea spray (2%). Hence application of 100 per cent recommended dose of nitrogen combined with foliar application of nano urea 0.4 % at 20 DAS and 40 DAS can be recommended for cultivating fodder sorghum in Kerala during the *rabi* season.

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REFERNCES

Al-Juthery H W, Habeeb K H, Altaee, F J K, AL-Taey D K and Al-Tawaha A R M (2018). Effect of foliar application of different sources of nano-fertilizers on growth and yield of wheat. *Biosci Res* **15**(4): 3988-3997.

Almodares A, Jafarinia M and Hadi M R (2009). The effect of nitrogen fertilizer on chemical composition in corn and sweet sorghum. *Am Eurasian J Agric Environ Sci* **2**: 889- 899.

AOAC. Association of Official Agricultural Chemists (1960). *Official and Tentative methods of Analysis*. 13th edition. Association of Official Analytical Chemists, Washington D.C. 226p.

Arun Kumar M R, Fathima P S, Yogananda S B and Sowmyalatha B S (2024). Comparative evaluation of nano urea and urea foliar sprays on nutrient uptake and soil fertility in fodder maize (*Zea mays* L.) Production. *J Sci Res Rep* **30**(5): 939-946.

Bhoya M, Chaudhari PP, Raval CH and Bhati PK (2013). Effect of nitrogen and zinc on yield and quality of fodder sorghum (*Sorghum bicolor* L. Moench) varieties. Forage Res **39**(1):24-26.

Bochare A D (2015). *Effect of nutrient management on green forage yield of maize (cv. African tall),* Ph.D. (Ag) thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri.

FAHD [Ministry of Fisheries, Animal Husbandry And dairying]. 2019. 20th Livestock census-2019: All India Report [online]. Available: https://ruralindiaonline.org/en/libra ry/reso urce/20th-livestockcensus- 2019-all-india-report. [18 May 2023].

Gupta S P, Mohapatra S, Mishra J, Yadav S K, Verma S, Singh S and Singh B V (2022). Effect of nano nutrient on growth attributes, yield, Zn content and uptake in wheat (*Triticum aestivum* L.). *Int J Environ Clim Chang* **12**(11): 2028-2036.

Jackson M L (1973). *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi, 498p.

Kannoj J, Jain D, Tomar M, Patidar R and Choudhary R (2022). Effect of nano urea vs conventional urea on the nutrient content, uptake and economics of black wheat (*Triticum aestivum* L.) along with biofertilizers. *Biol Forum Int J* **14** (2a): 499-504.

Kashyap S, Kumar R, Ram H, Kumar A, Basak N, Sheoran P, Bhatacharjee S, Biswal B, Ali G, Kumar B and Bhakuni K (2023). Quantitative and qualitative response of fodder maize to use of bulk and nano fertilizers in north western plains of India. *Agron* **13**(7):1889.

KAU [Kerala Agricultural University]. 2016. *Package of Practices Recommendation*: *Crops* 2016. (15th Ed.). Kerala Agricultural University, Kerala, Thrissur, 393p.

Khan T A, Nadeem F, Chen L, Wang X, Zeng Z and Hu Y (2019). Enhancing naked oat (*Avena nuda* L.) productivity with minimal indirect nitrogen loss and maximum nitrogen use efficiency through integrated use of different nitrogen sources. *PloS one*, **14**(3), p.e0213808.

Kumari A, Kumar P, Ahmad E, Singh M, Kumar R, Yadav R K, Datt C and Chinchmalatpure A (2014). Fodder yield and quality of oats fodder (*Avena sativa*) as influenced by salinity of irrigation water and applied nitrogen levels. *Indian J Anim Nutr* **31**(3): 266-271.

Kumar N, Satpal, Kumar S, Kharor N, Phogat, D S and Jindal Y (2021) Genotypic response of berseem (*Trifolium Alexandrinum* L.) to different phosphorus levels. Forage Res. **47** (3): 329-333.

Mejias J H, Salazar F, Perez Amaro L, Hube S, Rodriguez M and Alfaro M (2021) Nanofertilizers: A cutting-edge approach to increase nitrogen use efficiency in grasslands. frontiers in environmental science **9**: 635114.

Mahmud K, Ahmad I and Ayub M (2003). Effect of nitrogen and phosphorus on the fodder yield and quality of two sorghum cultivars (*Sorghum bicolor* L.) *Int J Agric Biol* **5**(1): 61-63.

Meena S, Shweta, Kumar S, Kumar R, Tokas J, Neelam and Devi U (2021). Response of spring planted fodder maize to nitrogen and phosphorus levels. *Forage Res* **46**(4):363-367.

www.IndianJournals.com
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Downloaded From IP - 216.73.216.57 on dated 15-Nov-2026

Rajesh, Kumar R, Ram H, Meena R K, Kumar M, Verma A K, Kumar S, Makrana G, Kumar D and Jat P L (2022). Effect of nano nitrogen application on yield, nutrient uptake and profitability in fodder oat (*Avena sativa* L.) under north western Haryana condition. *Range Manag. Agrofor* **43**(2): 340-344.

Rani B, Zalawadia N M, Buha D and Rushang K (2019). Effect of different levels of chemical and nano nitrogenous fertilizers on content and uptake of N, P, K by sorghum crop cv. *Gundari J Pharmacogn Phytochem* **8**(5): 454-458.

Samui S, Sagar L, Sankar T, Manohar A, Adhikary R, Maitra S and Praharaj S (2022). Growth and productivity of rabi maize as influenced by foliar application of urea and nano-urea. *Crop Res* **57**(3): 136-140.

Sannagoudar M S, Lalitha B S and Kumar G P (2017). Effect of varieties, cutting and nitrogen management on green fodder yield, nutrient uptake, available soil nutrient status and economics of dual- purpose pearl millet (*Pennisetum glaucum* L.). *Int J Curr Microbiol App Sci* **6**(12): 214-226.

Shekara B G, Lohithaswa H C, Chikkarugi N M and Manasa N (2015). Fodder production potential of maize grown for baby corn and green cob in different cropping systems. *Forage Res* **41**(2): 92-94.

Sheoran R S, Tiwana U S, Yadav N S and Joshi U N (2018). Evaluation of promising forage pearl millet (*Pennisetum glaucum*) varieties for fodder and seed production with different nitrogen levels under varying environments. *Forage Res* **33**(4): 206-211.

Simpson J E, Adair C R, Kohler G O, Dowson E H, Dobald H A, Kester E B and Klickn J J (1965). *Quality Evaluation Studies of Foreign and Domestic Rices* Tech Bulletin No 1331, USDA, 186p.

Singh D N, Bohra J S, Tyagi V, Singh T, Banjara T R and Gupta G (2022). A review of India's fodder production status and opportunities. Grass *Forage Sci* **77**(1): 1-10.

Srivani M, Satish P, Hussain S A and Shailaja K (2022). Response of fodder maize (*Zea mays* L.) to urea and nano urea on growth, yield and economics. *Biol Forum* **14**(3): 766-769.

Upasana J, Deshmukh S P, Khadadiya M B, Rathva R S and Mori M B (2022). Effect of different levels and split application of nitrogen with and without foliar spray of urea on nutrient uptake and economics of sweet corn. *Pharma Innov J* **11**(2): 1170-1174.

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