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EFFECT OF FOLIAR NUTRIENT SUPPLEMENTATION AND NUTRIENT LEVELS ON GROWTH AND YIELD ATTRIBUTES OF MULTICUT FODDER SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH)

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SUMMARY

The present investigation entitled "Effect of Foliar Nutrient supplementation and Nutrient Levels on Growth and Yield of Multicut Fodder Sorghum (*Sorghum bicolor* (L.) Moench)" was conducted at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala from January to July 2025 to study the influence of foliar nutrient supplementation and nutrient levels on growth and yield attributes of multicut fodder sorghum. The field experiment was laid out in randomized complete block design with (3 x 3) + 1 treatment, replicated thrice. The treatment combinations included three levels of source of nutrients (S) (s_1 - DAP, s_2 – KNO_3, s_3 – 19:19:19) and three different nutrient levels (N) (n_1 - 50% RDN, n_2 - 75% RDN, n_3 – 100% RDN), compared against the control treatment (KAU POP 2024). The variety used for the study was CSH 24MF, released from GB Pant university of Agriculture and Technology. The results revealed that the treatment with DAP as foliar nutrient source along with 75% RDN proved its superiority by registering higher growth and yield attributes such as plant height, stem diameter, leaf area index, leaf: stem ratio, total green and dry fodder yield.

Key words: Multicut sorghum, foliar nutrient supplementation, recommended dose of nutrients and fodder yield

India, with a livestock population of 536 million (Anonymous, 2020), faces a significant deficit of green and dry fodder to the extent of 11.23 and 23.40 per cent, respectively (Roy *et al.*, 2019). In this context, drought-tolerant crops like sorghum play a crucial role in ensuring fodder security. Sorghum (*Sorghum bicolor* (L.) Moench) is a key cereal crop and is one of the most extensively cultivated forage crops in India, covering about 2.6 million hectares (Suneetha *et al.*, 2021). Owing to its climate resilience, sorghum is increasingly considered a suitable alternative in rainfed regions (Liaqat *et al.*, 2024). The summer season offers considerable potential for fodder sorghum cultivation, as it can provide forage during periods of acute scarcity (Kumar *et al.*, 2012). However, the absence of improved genotypes and inadequate management practices can result in yield losses (Rakshit *et al.*, 2014). Furthermore, the high nutrient removal by fodder crops necessitates sufficient nutrient supply through both inherent soil fertility and external inputs like fertilizers and manures (Satpal *et al.*, 2025).

Nowadays, soil-applied mineral fertilizers alone are often insufficient to meet crop nutrient demands due to losses such as fixation, leaching, volatilization, and uneven availability, which reduce nutrient use efficiency and increase production costs. Environmental constraints like soil moisture deficit, waterlogging, and salinity further limit nutrient uptake by plants (Deol *et al.*, 2018). Under such conditions, foliar nutrition, as a supplement to soil fertilization, has emerged as an effective strategy to enhance crop productivity (Alam *et al.*, 2010). Foliar feeding enables quick correction of deficiencies by rapid nutrient absorption and efficient utilization of readily soluble nutrients while minimizing soil-related losses (Sathishkumar *et al.*, 2020). Applied at critical growth stages, it improves growth attributes such as plant height, leaf number, tillering, and leaf area index, ultimately enhancing green and dry fodder yield and overall productivity in fodder crops (Lagad *et al.*, 2023). Water-soluble fertilizers like diammonium phosphate (DAP), potassium nitrate (KNO_3), and 19:19:19 are particularly effective for foliar application, supplying essential nutrients in readily available forms

(Patel and Patel, 1994; Yerawar, 2022). Thus, foliar nutrition presents a promising approach to improve the productivity and nutritional quality of fodder sorghum, supporting sustainable livestock production systems. Keeping the above facts in view, the present study has been planned to study the effect of foliar nutrient supplementation and nutrient levels on growth and yield attributes of multicut fodder sorghum.

MATERIALS AND METHODS

The field experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Kerala, India, during January to July 2025. The soil of the experimental site was sandy clay loam in texture, strongly acidic in reaction, with normal electrical conductivity, high phosphorus status, medium organic carbon and nitrogen, and low potassium content. Geographically, the site is located at 8°422 N latitude and 76°982 E longitude, at an altitude of 29 m above mean sea level. During the cropping period, a total rainfall of 138.1 mm was received, with a mean daily evaporation of 3.48 mm. The mean maximum temperature ranged from 29.8°C to 33.5°C, while relative humidity varied between 86.4 and 95.9 per cent.

The multicut fodder sorghum hybrid CSH 24MF, released from GB Pant University of Agriculture and Technology, Pantnagar, was used for the study. This variety is a tall-growing type with a duration of 120–150 days, characterized by low HCN content, high protein content, superior dry matter digestibility, and resistance to foliar diseases as reported by ICAR-IIMR.

The experiment was laid out in a randomized complete block design with ten treatments arranged as (3 × 3) + 1 and replicated thrice. The treatments consisted of two factor with source of nutrients (S) and nutrient levels (N), along with a control. The nutrient sources included s   : 1% DAP, s_1 : 1% KNO_3 and s_2 : 1% 19:19:19, while nutrient levels comprised n : 50% RDN, n, : 75% RDN, and nƒ : 100% RDN. The control treatment followed the Package of Practices recommendations of Kerala Agricultural University (KAU POP 2024).

A spacing of 30 cm × 15 cm was maintained. The recommended fertilizer dose of 60:40:20 kg NPK/ha (KAU POP 2024) was applied, with nitrogen given in three splits (basal, 25% at 20 DAS, and 25% at 40 DAS), while the entire phosphorus and potassium were applied as basal. Foliar application of 1% DAP, KNOƒ , and 19:19:19 was carried out at 20 DAS, 40 DAS, and 20 days after each of the first and second harvests. All other agronomic practices were followed uniformly as per KAU recommendations. The first harvest was taken at 63 DAS, followed by subsequent harvests at 45-day intervals, resulting in three harvests, and the mean values were computed. Nutrient uptake was estimated by multiplying the nutrient content by the dry fodder yield. The experimental data were analyzed statistically using analysis of variance (ANOVA) appropriate for a randomized complete block design (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Growth attributes

Data on plant height revealed that source of nutrient had a significant influence. DAP resulted in the tallest plants compared to KNO_3 and 19:19:19. The observed increase in plant height may be ascribed to the essential role of phosphorus in promoting cell elongation (Kavanova *et al.*, 2006), along with the high phosphorus content of DAP (46% P, O…). Plant height was significantly affected by different nutrient levels. The highest plant height was recorded with 75% RDN, which was superior to both 100% and 50% RDN treatments. The improved performance at the reduced fertilizer level may be attributed to the optimization of nitrogen availability, enabling efficient utilization for chlorophyll synthesis as well as meristematic cell division and expansion, while avoiding the osmotic stress associated with excess nitrogen (Shahjahan *et al.*, 2016). Among treatment combinations, the treatment s_1n_2 recorded the highest plant height. The increase in the above growth characters might be due to the combined influence of favorable environmental conditions and adequate nutrient levels in the soil. The same treatment combination, s_1n_2 showed a significant influence when compared with control (Table 1). These findings are comparable with Lagad *et al.* (2023) in forage sorghum

Data on leaf area index showed that source of nutrients had a significant influence. DAP showed a significant influence on leaf area index compared to KNO_3 and 19:19:19. This may be attributed to the capacity of DAP to supply nitrogen along with readily available phosphorus, thereby promoting root development, stimulating active meristematic cell division and elongation, and enhancing ATP-mediated energy transfer essential for various metabolic processes (Tang *et al.*, 2025). Among nutrient levels, 75% RDN was found on a par with 50% RDN. The increase in leaf length, leaf breadth, leaf area, and leaf area index may be attributed to the more efficient utilization of nutrients under moderate supply levels

TABLE 1
Effect of foliar nutrition and nutrient levels on plant height, Leaf area index and LS ratio of multicut fodder sorghum

Treatments	Plant height (cm)	Leaf area index	Leaf stem ratio
Source of nutrients (S) – 3			
s_1: 1% DAP	118.37 ± 7.13[a]	1.68 ± 0.31[a]	0.80 ± 0.04[a]
s_2: 1% KNO_3	112.6 ± 9.71[b]	1.43 ± 0.30[b]	0.77 ± 0.05[b]
s_3: 1% 19:19:19	109.67 ± 2.66[c]	1.39 ± 0.09[b]	0.74 ± 0.01[c]
SEm (±)	0.54	0.05	0.00
CD (0.05)	1.61	0.14	0.01
Nutrient levels (N) - 3			
n_1: 50% RDN	112.53 ± 2.28[b]	1.40 ± 0.11[ab]	0.76 ± 0.02[b]
n_2: 75% RDN	118.94 ± 8.54[a]	1.67 ± 0.33[a]	0.81 ± 0.04[a]
n_3: 100% RDN	109.16 ± 7.91[c]	1.43 ± 0.27[b]	0.74 ± 0.03[c]
SEm (±)	0.54	0.05	0.00
CD (0.05)	1.61	0.14	0.01
S x N interaction			
s_1n_1	110.23 ± 1.76[ef]	1.34 ± 0.20[cd]	0.78 ± 0.01[c]
s_1n_2	126.33 ± 1.85[a]	1.98 ± 0.07[a]	0.85 ± 0.01[a]
s_1n_3	118.53 ± 1.60[c]	1.72 ± 0.19[b]	0.78 ± 0.01[c]
s_2n_1	114.63 ± 0.40[d]	1.42 ± 0.06[c]	0.78 ± 0.01[c]
s_2n_2	122.57 ± 1.78[b]	1.73 ± 0.30[b]	0.82 ± 0.01[b]
s_2n_3	100.6 ± 1.57[g]	1.15 ± 0.12[d]	0.71 ± 0.01[e]
s_3n_1	112.73 ± 1.70[de]	1.43 ± 0.05[c]	0.74 ± 0.01[d]
s_3n_2	107.93 ± 1.21[f]	1.32 ± 0.11[cd]	0.75 ± 0.01[d]
s_3n_3	108.33 ± 1.60[f]	1.43 ± 0.07[c]	0.74 ± 0.01[d]
SEm (±)	0.93	0.08	0.01
CD (0.05)	2.79	0.24	0.02
Control	119.4	1.67	0.79
Treatment vs Control	S	S	S

compared to higher doses. Data revealed that the treatment combination s_1n_2 had a significant influence on leaf area index while compared to other treatment combinations (Table 1). This combination may have enhanced root water uptake and nutrient translocation through improved root–shoot signaling, thereby promoting rapid leaf expansion and canopy development (Harish *et al.*, 2022). These findings are in agreement with the results reported by Ray *et al.* (2020) in maize.

Data on leaf stem ratio showed that nutrient source DAP had significant influence over KNO_3 and 19:19:19. This may be attributed to the phosphorus supplied through DAP, which promotes leaf development over stem thickening due to its dual role in regulating meristematic cell division and vascular tissue differentiation (Tang *et al.*, 2025). Among the nutrient levels, 75% RDN recorded the highest leaf:stem ratio. The greater mean leaf:stem ratio at 75% RDN, along with its decline at 100% RDN, indicates a critical threshold in nitrogen metabolism, where excess nitrogen shifts growth from leaf-dominant development toward increased stem growth (Sun *et al.*, 2024). Among interactions, s_1n_2 recorded the highest leaf stem ratio over other treatment combinations (Table 1). The improvement over the control suggests a synergistic interaction between phosphorus and nitrogen, wherein both nutrients acted together to enhance leaf development while limiting excessive stem thickening (Mori *et al.*, 2019).

Yield attributes

The results showed that yield attributes like total green fodder yield and total dry fodder yield were significantly influenced by source of nutrients. Foliar application of DAP was found to be on par with KNO_3. This may be attributed to the efficient absorption, translocation, and assimilation of nitrogen and phosphorus facilitated through foliar application of DAP. These findings are in agreement with those reported by Lagad *et al.* (2023) in forage sorghum and Mishra *et al.* (2024) in rice. The results showed that yield attributes like green fodder yield and dry fodder yield were significantly influenced by different levels of nutrients. The superior performance of 75% RDN over 100% RDN in yield attributes may be attributed to the combined influence of the initial soil nutrient status and rainfall-driven nutrient dynamics. Among the treatment combinations, s_1n_2 recorded the highest total green fodder yield and total dry fodder yield over other treatments. This may be attributed to increased plant height, leaf area index, and leaf:stem ratio, along with the synergistic interaction between optimal soil nitrogen supply and efficient foliar

TABLE 2
Effect of foliar nutrition and nutrient levels on total green fodder yield and total dry fodder yield of multicut fodder sorghum

Treatments	Total green fodder yield	Total dry fodder yield
Source of nutrients (S) - 3		
s_1: 1% DAP	18.47 ± 4.08[a]	3.20 ± 0.71[a]
s_2: 1% KNO_3	16.91 ± 2.83[a]	2.93 ± 0.49[a]
s_3: 1% 19:19:19	14.12 ± 2.58[b]	2.45 ± 0.45[b]
SEm (±)	0.57	0.10
CD (0.05)	1.72	0.3
Nutrient levels (N) - 3		
n_1: 50% RDN	13.47 ± 2.35[c]	2.34 ± 0.41[c]
n_2: 75% RDN	19.18 ± 3.55[a]	3.32 ± 0.62[a]
n_3: 100% RDN	16.85 ± 2.38[b]	2.92 ± 0.41[b]
SEm (±)	0.57	0.3
CD (0.05)	1.72	0.10
S x N interaction		
s_1n_1	13.52 ± 0.53[de]	2.34 ± 0.09[de]
s_1n_2	22.85 ± 0.36[a]	3.96 ± 0.06[a]
s_1n_3	19.04 ± 0.49[bc]	3.30 ± 0.09[bc]
s_2n_1	14.58 ± 0.75[de]	2.53 ± 0.13[de]
s_2n_2	19.78 ± 1.16[b]	3.42 ± 0.20[b]
s_2n_3	16.36 ± 3.03[cd]	2.84 ± 0.53[cd]
s_3n_1	12.32 ± 4.17[e]	2.13 ± 0.72[e]
s_3n_2	14.90 ± 0.80[de]	2.58 ± 0.14[de]
s_3n_3	15.14 ± 1.13[de]	2.62 ± 0.20[de]
SEm (±)	0.99	0.17
CD (0.05)	2.97	0.52
Control	18.62	3.53
Treatment vs Control	S	S

phosphorus delivery, which enhanced nutrient use efficiency without causing nutrient imbalances (Table 2). These findings are in agreement with those reported by Lagad *et al.* (2023) in fodder sorghum and Singh *et al.* (2024) in wheat.

CONCLUSION

Based on the study, it can be concluded that basal application of farm yard manure at the rate of 5 t/ha, in combination with soil application of 75% RDN supplemented with foliar spray of 1% DAP at 20 DAS, 40 DAS, and 20 days after the first and second cut, resulted in improved growth and yield attributes of multicut fodder sorghum.

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