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Yield, quality and economics of fodder jowar varieties under different nitrogen management practices in North Coastal Andhra Pradesh

K Sai Prasanthi, S Tirumala Reddy, B Rajendra Kumar and V Srinivasa Rao
Department of Agronomy, Acharya N G Ranga Agricultural University,
Agricultural College, Naira , Andhra Pradesh, India

ABSTRACT

A field experiment was conducted during *kharif*, 2025 at the Agricultural College, Naira, Andhra Pradesh, to evaluate the performance of fodder jowar [*Sorghum bicolor* (L.) Moench] varieties under different nitrogen management practices with respect to yield, quality and economics. The experiment was laid out in a split plot design with three replications comprising three fodder jowar varieties, viz., CSH-24 MF, CSH-43 MF and Pant Chari-6 as main plot treatments and four nitrogen levels (0, 60, 80 and 100 kg N ha^{-1}) as sub plot treatments. Among the varieties, CSH-43 MF recorded significantly higher green fodder yield (48,490 kg ha^{-1}), dry fodder yield (12,695 kg ha^{-1}), gross returns (¹ 96,884 ha^{-1}), net returns (¹ 58,268 ha^{-1}) and benefit:cost ratio (2.51), whereas Pant Chari-6 recorded the lowest green fodder yield, dry fodder yield and economic returns. Varietal differences in crude protein content were non-significant; however, Pant Chari-6 recorded significantly higher crude fibre content (30.77%), while CSH-43 MF recorded lower crude fibre content (27.09%) and higher total ash content (8.36%). Application of 100 kg N ha^{-1} resulted in significantly higher green fodder yield (54,760 kg ha^{-1}), dry fodder yield (13,998 kg ha^{-1}), crude protein content (9.21%), total ash content (8.60%) and lower crude fibre content (26.02%), recording higher gross returns (¹ 107,930 ha^{-1}), net returns (¹ 69,537 ha^{-1}) and benefit:cost ratio (2.81). The treatment combination of CSH-43 MF supplied with 100 kg N ha{ ¹ was found superior for achieving higher fodder productivity, improved forage quality and greater profitability under the rainfed conditions of North Coastal Andhra Pradesh.

Key Words: *Fodder sorghum, Forage quality, Green fodder yield, Nitrogen management, Profitability and Rainfed conditions*

India possesses one of the largest livestock populations in the world with nearly 535.78 million animals as reported in the 20th Livestock Census (DAHD, 2019). Despite the significant contribution of livestock to the agricultural economy, the availability of quality feed and fodder remains inadequate to meet the increasing demand. At present, the country faces deficits of about 11.24 per cent green fodder, 23.4 per cent dry fodder and 28.9 per cent concentrate feed ingredients (IGFRI, 2022). Therefore, enhancing fodder productivity through improved crop and nutrient management practices has become essential for sustaining livestock production and improving farm profitability.

Fodder jowar [*Sorghum bicolor* (L.) Moench] is an important forage cereal crop belonging to the family Poaceae and is widely cultivated under tropical and semi-arid conditions owing to its rapid growth, drought tolerance and high biomass production potential. The crop is extensively utilized as green fodder, silage and hay and serves as an important source of livestock feed during periods of fodder scarcity (Iqbal *et al*., 2015). The productivity and nutritional quality of fodder jowar are largely influenced by varietal characteristics and nutrient management practices. Improved fodder sorghum varieties differ considerably in biomass production potential, nutrient-use efficiency and forage quality attributes (Kumar *et al*., 2019). In Andhra Pradesh, fodder scarcity continues to be a major challenge due to shrinking grazing lands, erratic rainfall and limited area under fodder cultivation (Chandhini *et al*., 2022). Therefore, identification of suitable high-yielding and nutrient-responsive fodder sorghum varieties is essential for improving fodder availability and sustaining livestock productivity.

Among the essential plant nutrients, nitrogen plays a pivotal role in fodder sorghum production through its influence on chlorophyll formation, photosynthetic activity, protein synthesis and vegetative growth. Adequate nitrogen nutrition enhances dry matter accumulation, crude protein content and overall forage quality (Hanif, 2023; Ismaeil *et al*., 2024). Higher nitrogen availability also improves nutrient uptake and utilization, thereby increasing biomass production and fodder productivity. However, information on the performance of fodder jowar varieties under varying nitrogen levels under the rainfed conditions of North Coastal Andhra Pradesh is limited.

Hence, the present investigation was undertaken to evaluate the performance of fodder jowar varieties under different nitrogen management practices with respect to yield, forage quality and economics under the rainfed conditions of North Coastal Andhra Pradesh.

MATERIAL AND METHODS

The present investigation was conducted during *kharif*, 2025 at the PG Experimental block, College Farm, Agricultural College, Naira, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experimental site is situated at 18.386°N latitude and 83.945°E longitude with an altitude of 27 m above mean sea level in the North Coastal Agro-climatic Zone of Andhra Pradesh. The weekly meteorological observations recorded during the crop growth period (25 June–18 September 2025) are presented in Fig. 1. During this period, the mean maximum temperature ranged from 30.0 to 37.2°C, while the mean minimum temperature varied from 16.1 to 25.9°C, with respective averages of 33.7 and 19.4°C. A total rainfall of 482.1 mm was received in 29 rainy days, indicating favourable moisture availability for crop growth and development. The soil of the experimental field was sandy loam in texture, slightly acidic in reaction (pH 6.25), low in available nitrogen (249.6 kg ha^{-1}) and medium in available phosphorus (28.7 kg ha^{-1}) and potassium (284.2 kg ha^{-1}). The soil contained 0.54 per cent organic carbon with an electrical conductivity of 0.10 dS m^{-1}.

The experiment was laid out in a split plot design with three replications comprising three fodder jowar varieties *viz.,* V_1: CSH-24 MF, V_2 : CSH-43 MF and V_3 : Pant Chari-6 as main plot treatments and four nitrogen levels *viz.,* N_1: 0, N_2 : 60, N_3 : 80 and N_4: 100 kg N ha^{-1} as sub plot treatments. Thus, twelve treatment combinations were evaluated. The gross and net plot sizes were 6.0 m × 5.0 m and 5.4 m × 4.6 m, respectively. Nitrogen was applied through urea

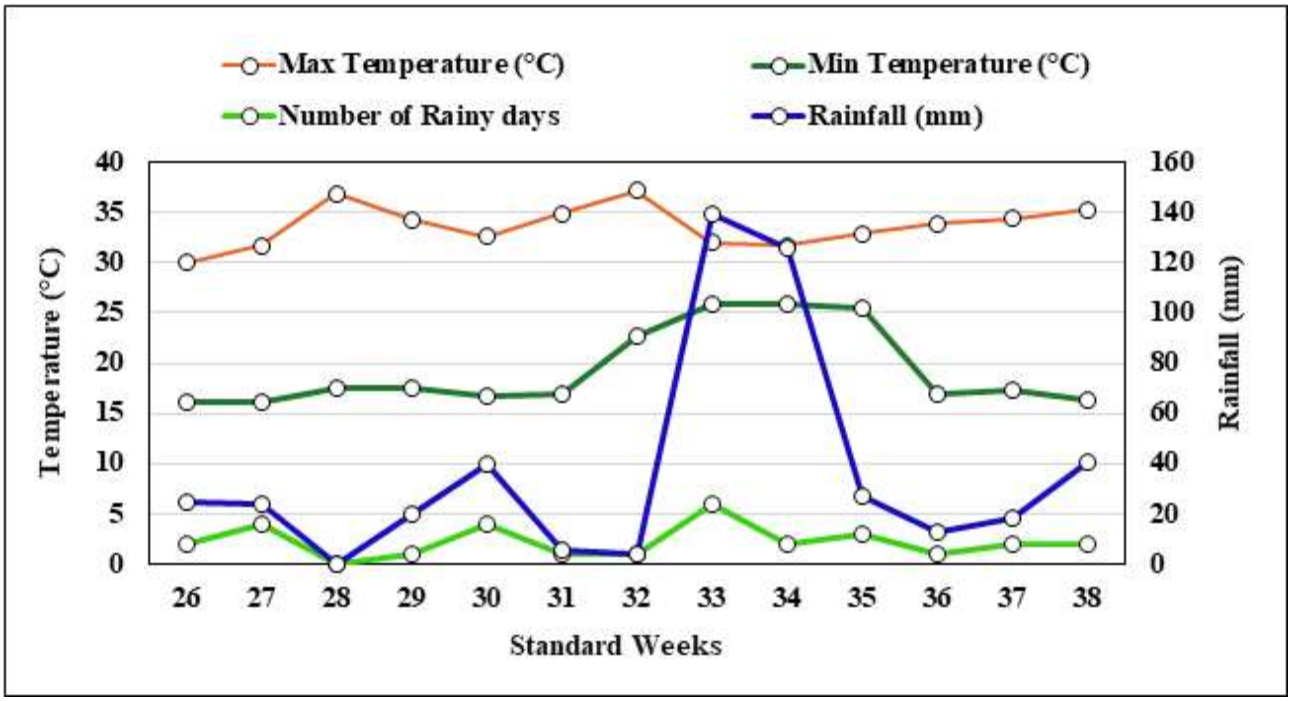


Fig. 1. Weekly meteorological observations recorded during the crop growth period of fodder jowar (25 June–18 September 2025)

according to the treatment schedule, while phosphorus and potassium were applied uniformly at 40 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} through single super phosphate and muriate of potash, respectively. Half of the nitrogen along with the full dose of phosphorus and potassium was applied basally and the remaining nitrogen was top dressed at 30 DAS.

The crop was sown on 10 July 2025 using a seed rate of 25 kg ha^{-1} at a spacing of 30 cm × 10 cm. Recommended agronomic and plant protection practices were followed uniformly for all the treatments. The crop was harvested at 50 per cent flowering stage. The experimental data were subjected to analysis of variance appropriate to a split plot design as described by Panse and Sukhatme (1985). The significance of treatment differences was tested by F-test at 5 per cent level of probability and critical differences were worked out wherever the treatment effects were found significant.

RESULTS AND DISCUSSION

Yield Parameters

Green fodder yield

Green fodder yield was significantly influenced by varieties, nitrogen levels and their interaction effect (Table 1). Among the varieties, CSH-43 MF recorded significantly higher green fodder yield (48,490 kg ha^{-1}), followed by CSH-24 MF (43,245 kg ha^{-1}), whereas Pant Chari-6 recorded significantly lower green fodder yield (36,564 kg ha^{-1}). The superior performance of CSH-43 MF may be attributed to its higher biomass production potential, efficient utilization of available resources and greater dry matter accumulation, which collectively contributed to enhanced fodder productivity.

Application of different nitrogen levels significantly influenced green fodder yield. The highest green fodder yield (54,760 kg ha^{-1}) was recorded with the application of 100 kg N ha^{-1}, followed by 80 kg N ha^{-1} (49,480 kg ha^{-1}) and 60 kg N ha^{-1} (44,530 kg ha^{-1}) and all the nitrogen levels differed significantly from each other. The lowest green fodder yield of (22,295 kg ha^{-1}) was recorded with control treatment. Increased nitrogen availability enhanced chlorophyll formation, photosynthetic activity, nutrient uptake and dry matter production, resulting in vigorous crop growth and greater biomass accumulation.

The interaction effect between varieties and nitrogen levels was significant and among the treatment combinations, CSH-43 MF supplied with 100 kg N ha^{-1} (V_2× N_4) recorded the highest fodder productivity, whereas Pant Chari-6 with control treatment (V_3 × N_1) recorded significantly lowest yield. The results indicated that the yield potential of fodder jowar could be effectively realized through the cultivation of superior varieties coupled with optimum nitrogen nutrition. Similar findings were reported by Yadav *et al*. (2019), Satpal *et al*. (2020), Shekara *et al*. (2021), Nanda *et al*. (2024) and Reddy *et al*. (2025).

Dry fodder yield

Dry fodder yield was significantly influenced by varieties, nitrogen levels and their interaction effect (Table 2). Among the varieties, CSH-43 MF recorded significantly higher dry fodder yield (12,695 kg ha^{-1}),

Table 1. Green fodder yield (kg ha^{-1}) of fodder jowar as influenced by varieties and nitrogen levels

Main Plots: Varieties	Sub Plots: Nitrogen levels				
	N_1: Control (0 kg N ha^{-1})	N_2: 60 kg N ha^{-1}	N_3: 80 kg N ha^{-1}	N_4: 100 kg N ha^{-1}	MEAN
V_1: CSH-24 MF	22173	45050	51542	54215	43245
V_2: CSH-43 MF	22952	47803	55302	67903	48490
V_3: Pant Chari-6	21761	40736	41595	42162	36564
MEAN	22295	44530	49480	54760	
	S. Em (±)	CD (*p=0.05*)	CV (%)		
Main plots	1298.1	5095	10.5		
Sub plots	1461	4340	10.2		
Varieties X Nitrogen levels					
(M at S)	2941.1	9467	-		
(S at M)	2530.5	7518	-		

Table 2. Dry fodder yield (kg ha^{-1}) of fodder jowar as influenced by varieties and nitrogen levels

Main Plots: Varieties	Sub Plots: Nitrogen levels				
	N_1: Control (0 kg N ha^{-1})	N_2: 60 kg N ha^{-1}	N_3: 80 kg N ha^{-1}	N_4: 100 kg N ha^{-1}	MEAN
V_1: CSH-24 MF	5718	12325	12775	13144	10990
V_2: CSH-43 MF	6868	12537	13960	17415	12695
V_3: Pant Chari-6	4469	9386	10690	11435	8995
MEAN	5685	11416	12475	13998	
	S. Em (±)	CD (*p=0.05*)	CV (%)		
Main plots	308.2	1210	9.8		
Sub plots	345.8	1027	9.5		
Varieties X Nitrogen levels					
(M at S)	696.7	2243	-		
(S at M)	598.9	1779	-		

followed by CSH-24 MF (10,990 kg ha^{-1}), whereas Pant Chari-6 recorded significantly lower dry fodder yield (8,995 kg ha^{-1}). The higher dry fodder yield recorded by CSH-43 MF might be attributed to its superior growth performance, greater dry matter accumulation and efficient conversion of photosynthates into economic biomass.

Application of nitrogen significantly enhanced dry fodder yield. The highest dry fodder yield (13,998 kg ha^{-1}) was recorded with the application of 100 kg N ha^{-1}, followed by 80 kg N ha^{-1} (12,475 kg ha^{-1}) and 60 kg N ha^{-1} (11,416 kg ha^{-1}), whereas the lowest dry fodder yield (5,685 kg ha^{-1}) was recorded under the control treatment. All nitrogen levels differed significantly from each other. Increased nitrogen availability might have promoted vegetative growth, photosynthetic efficiency and dry matter accumulation, resulting in higher dry fodder production.

The interaction effect between varieties and nitrogen levels was significant. Among the treatment combinations, CSH-43 MF supplied with 100 kg N ha^{-1} ($V_2 \times N_4$) recorded the highest dry fodder yield, whereas Pant Chari-6 under the control treatment ($V_3 \times N_1$) recorded the lowest dry fodder yield. These findings indicated that the combined effect of a high-yielding variety and adequate nitrogen supply played a crucial role in maximizing dry fodder production. Similar findings were reported by Yadav *et al*. (2019), Satpal *et al*. (2020), Shekara *et al*. (2021), Nanda *et al*. (2024) and Reddy *et al*. (2025).

Quality Parameters

The quality parameters of fodder jowar were significantly influenced by varieties and nitrogen levels, except crude protein content, for which varietal differences were non-significant (Table 3). Crude protein content increased significantly with increasing nitrogen levels and the highest value (9.21%) was recorded with the application of 100 kg N ha^{-1} followed by 80 kg N ha^{-1}, 60 kg N ha^{-1}, and all nitrogen levels differed significantly from each other. The lowest crude protein content (6.58%) was recorded with the control treatment. The increase in crude protein content under higher nitrogen levels may be attributed to greater nitrogen uptake and its incorporation into amino acids and proteins, thereby improving the nutritional quality of the fodder.

Crude fibre content differed significantly among the varieties. Pant Chari-6 recorded significantly higher crude fibre content (30.77%) than CSH-24 MF and CSH-43 MF, and the latter two varieties remained statistically comparable. Increasing nitrogen levels reduced crude fibre content, with the lowest value being recorded under 100 kg N ha^{-1} and higher values recorded under the control treatment, which was however comparable with 60 kg N ha^{-1} and 80 kg N ha^{-1}. The reduction in fibre concentration under higher nitrogen availability may be attributed to increased synthesis of cellular proteins and reduced accumulation of structural carbohydrates.

Total ash content was significantly influenced by both varieties and nitrogen levels. CSH-43 MF and CSH-24 MF recorded higher ash content and

Table 3. Crude protein (%), crude fibre content (%) and ash content (%) of fodder jowar as influenced by varieties and nitrogen levels

Treatments		Crude protein (%)	Crude fibre (%)	Total ash (%)
Varieties (V)				
V_1: CSH-24 MF		7.86	27.31	8.29
V_2: CSH-43 MF		8.18	27.09	8.36
V_3: Pant Chari-6		7.52	30.77	7.16
S.Em (±)		0.195	0.756	0.194
CD (*p=0.05*)		NS	2.97	0.76
CV (%)		8.6	9.2	8.5
Nitrogen levels (kg ha^{-1}) (N)				
N_1: Control (0 kg N ha^{-1})		6.58	29.58	7.5
N_2: 60 kg N ha^{-1}		7.35	29.18	7.75
N_3: 80 kg N ha^{-1}		8.26	28.79	7.9
N_4:100 kg N ha^{-1}		9.21	26.02	8.6
S.Em (±)		0.218	0.843	0.206
CD (*p=0.05*)		0.65	2.51	0.61
CV (%)		8.3	8.9	7.8
Varieties X Nitrogen levels				
(M at S)	**S.Em (±)**	0.439	1.702	0.422
	CD (*p=0.05*)	NS	NS	NS
(S at M)	**S.Em (±)**	0.377	1.461	0.357
	CD (*p=0.05*)	NS	NS	NS

remained statistically comparable, whereas Pant Chari-6 recorded significantly lower values. Total ash content increased progressively with increasing nitrogen levels and reached a maximum value of 8.60 per cent under 100 kg N ha^{-1}, which was significantly superior to the rest of the nitrogen levels. This was followed by 80 kg N ha^{-1} (7.90%) and 60 kg N ha^{-1} (7.75%). The lowest ash content of 7.50 per cent was recorded under the control treatment. Enhanced mineral uptake and efficient translocation of nutrients under higher nitrogen availability might have contributed to the increased ash content.

The interaction effect between varieties and nitrogen levels was non-significant for crude protein, crude fibre and total ash content, indicating a consistent response of the varieties to nitrogen application with respect to fodder quality. Overall, higher nitrogen nutrition improved forage quality by enhancing crude protein and mineral content while reducing crude fibre concentration. Similar findings were reported by Singh *et al*. (2017), Yadav *et al*. (2019), Bellamkonda *et al*. (2021), Shah *et al*. (2022), Banik *et al*. (2023) and Nisar *et al*. (2024).

ECONOMICS

Economic analysis revealed that gross returns, net returns and benefit:cost ratio of fodder jowar were significantly influenced by varieties and nitrogen levels and their interaction effect was also found to be significant (Table 4). Among the varieties, CSH-43 MF recorded the highest gross returns (₹ 96,884 ha^{-1}), net returns (₹ 58,268 ha^{-1}) and benefit:cost ratio (2.51), followed by CSH-24 MF which recorded gross returns (₹ 86,043 ha^{-1}), net returns (₹ 47,427 ha^{-1}) and benefit:cost ratio (2.23). The lowest gross returns of ₹ 72,701 ha^{-1}, net returns of ₹ 35,085 ha^{-1} and benefit:cost ratio of 1.93 were registered with Pant Chari-6. The superior economic performance of CSH-43 MF was primarily due to its higher fodder productivity, which resulted in greater returns and profitability.

Increasing nitrogen levels significantly improved the economic returns. The highest gross returns (₹ 107,930 ha^{-1}), net returns (₹ 69,537 ha^{-1}) and benefit:cost ratio (2.81) were recorded with the application of 100 kg N ha^{-1} followed by 80 kg N ha^{-1} and 60 kg N ha^{-1}. The lowest gross returns of ₹ 44,591

Table 4. Economics of fodder jowar influenced by varieties and nitrogen levels

Treatments		Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	Benefit:cost ratio
Varieties (V)				
V_1: CSH-24 MF		86043	47427	2.23
V_2: CSH-43 MF		96884	58268	2.51
V_3: Pant Chari-6		72701	35085	1.93
S.Em (±)		2507	2507	0.065
CD (*p=0.05*)		9842	9842	0.25
CV (%)		10.2	11.2	10.1
Nitrogen levels (kg ha^{-1}) (N)				
N_1: Control (0 kg N ha^{-1})		44591	6474	1.17
N_2: 60 kg N ha^{-1}		89558	51275	2.34
N_3: 80 kg N ha^{-1}		98759	60421	2.57
N_4:100 kg N ha^{-1}		107930	69537	2.81
S.Em (±)		2790	2790	0.072
CD (*p=0.05*)		8289	8289	0.21
CV (%)		9.8	10.5	9.7
Varieties X Nitrogen levels				
(M at S)	**S.Em (±)**	5633	5633	0.145
	CD (*p=0.05*)	18156	18156	0.47
(S at M)	**S.Em (±)**	4832	4832	0.125
	CD (*p=0.05*)	14356	14356	0.37

ha^{-1}, net returns of ¹ 6,474 ha^{-1} and benefit:cost ratio of 1.17 were registered with the control treatment. The increase in profitability under higher nitrogen levels could be attributed to substantial gains in fodder yield that outweighed the additional cost incurred on nitrogen fertilizer, thereby improving overall economic efficiency.

The interaction effect between varieties and nitrogen levels was significant for gross returns, net returns and benefit:cost ratio. The combination of CSH-43 MF with 100 kg N ha^{-1} ($V_2 \times N_4$) generated the highest gross returns, net returns and benefit:cost ratio, whereas Pant Chari-6 with the control treatment ($V_3 \times N_1$) recorded the lowest economic returns. These findings underscore the importance of integrating a high-yielding genotype with optimum nitrogen nutrition for maximizing fodder productivity and economic returns. Similar observations were reported by Satpal *et al*. (2023), Nanda *et al*. (2024) and Reddy *et al*. (2025).

CONCLUSION

The present investigation revealed that, among the fodder jowar varieties tested, CSH-43 MF proved superior in terms of fodder yield, forage quality and economic returns. Application of nitrogen at 100 kg N ha^{-1} significantly enhanced fodder productivity, quality and profitability under the rainfed conditions of North Coastal Andhra Pradesh.

LITERATURE CITED

Banik R, Kumar N, Nanda G, Mansingh B and Kalita P 2023. Performance of different varieties under various nitrogen levels in terms of yield and quality of fodder maize. *Forage Research.* 49(2): 239-245.

Bellamkonda M, Madaraju S, Kola S, Tummanepally S and Ravipati S 2021. Response of forage pearl millet genotypes to different nitrogen levels. *The Pharma Innovation Journal*. 10(12): 1514–1517.

Chandhini K, Raju S S, Vani N and Lavanya Kumari P 2022. Assessment of feed and fodder availability and requirement in Andhra Pradesh. *Andhra Pradesh Journal of Agricultural Sciences.* 8(2): 110-116.

Department of Animal Husbandry and Dairying (DAHD) 2019. *20th Livestock Census-2019: All India Report.* Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi.

Hanif M N 2023. Factors affecting nitrogen use efficiency (NUE): Meta analysis. *Türkiye Tarýmsal Araþtýrmalar Dergisi.* 10(2): 231-242.

Indian Grassland and Fodder Research Institute (IGFRI) 2022. *Deficit of Feeds and Fodder Resources in India*. ICAR-Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh.

Iqbal M A, Ahmad B, Shah M H and Ali K 2015. A study on forage sorghum [*Sorghum bicolor* (L.) Moench] production in perspectives of white revolution in Punjab, Pakistan: Issues and future option. *American-Eurasian Journal of Agricultural and Environmental Sciences.* 15: 640-647.

Ismaeil F M, Ahmed S E E, Jabereldar A A, Mohammed Ahmed E E B and Mohammed M H B 2024. Effect of different nitrogen levels on yield and quality of forage sorghum (*Sorghum bicolor* L. Moench cv. Abusabien). *Asian Journal of Advances in Agricultural Research.* 24(7): 28-38.

Kumar S, Tokas J, Bhardwaj K K, Devi S, Kumari P, Arya S, Neelam and Kumar S 2019. Evaluation of forage sorghum genotypes for production, productivity and quality at different fertilizer levels. *Forage Research*. 45 (1): 64-68.

Nanda G, Agrawal R K and Nilanjaya 2024. Nitrogen fertilization strategies for forage maize genotypes: Agronomic performance, nitrogen use efficiency and economic assessment and determination of economical N fertilizer rate. *Environment and Ecology.* 42(2A): 639-644.

Nisar S, Rashid Z, Ahmad T, Kumar R, Nissa S U, Faheem J, Angrez A, Sabina N, Shabeena M, Tanveer A, Amal S, Rakshanda A, Bhat R and Dar Z A 2024. Productivity of fodder maize (*Zea mays* L.) SFM-1 under varied sowing dates and nitrogen levels. *International Journal of Bio-resource and Stress Management.* 15(1): 1-12.

Panse V G and Sukhatme P V 1985. *Statistical Methods for Agricultural Workers.* ICAR, New Delhi.

Reddy M S, Kharor N, Satpal Nagar S, Kumari P, Sharma B L, Panchta R, Chugh V, Kumar V and Singh D P 2025. Evaluating the impact of fertilizer treatments on growth performance of single-cut forage sorghum varieties. *Forage Research.* 50(4): 400-406.

Satpal Gangaiah B, Kumar N, Devi S, Kharor N, Bhardwaj K K, Phogat D S and Neelam 2020. Performance of single-cut forage sorghum cultivars at different fertilizer levels. *Forage Research.* 46(2): 202-207.

Satpal Kumar S, Satyajeet Kumar N, Kharor N, Jindal Y, Sharma B L and Mandal N K 2023. Agronomic evaluation of fodder maize genotypes at varied nitrogen levels. Forage Research. 49(1): 86–90.

Sha K A, Balodariya K K, Patel N N and Salunkhe S 2022. Effect of varieties, FYM and nitrogen levels on growth, yield and quality of summer fodder pearl millet (*Pennisetum glaucum* L.) under South Gujarat condition. *Forage Research.* 48(1): 104-110.

Shekara B G, Mahadevu P, Chikkarugi N M and Manasa N 2021. Performance of fodder pearl millet genotypes to different levels of nitrogen. *Forage Research.* 47(2): 193-196.

Singh K P, Chaplot P C, Choudhary G L, Jani P P, Kumar R and Sumeriya H K 2017. Effect of fertility levels on quality of single-cut forage sorghum genotypes. *Forage Research.* 42(4): 279-281.

Yadav K, Verma A, Yadav M K, Choudhary M and Choudhary K M 2019. Effect of fertilizer levels on fodder productivity and quality of multi-cut sorghum genotypes. *International Journal of Bio-resource and Stress Management.* 10(2): 119-123.

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