



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(4): 402-405
Received: 11-01-2026
Accepted: 14-02-2026

Vishal SB
PG Scholar, Department of Animal
Nutrition, Veterinary College,
Hassan, Karnataka, India

Jaishankar N
Professor, Department of Animal
Nutrition, Veterinary College,
Bengaluru, Karnataka, India

Thirumalesh T
Professor and Head, Department
of Animal Nutrition, Veterinary
College, Shivamogga, Karnataka,
India

Guruprasad R
Associate Professor, Department of
Livestock Production
Management, Veterinary College,
Hassan, Karnataka, India

Vinuthan MK
Associate Professor, Department of
Veterinary Physiology and
Biochemistry, Veterinary College,
Hassan, Karnataka, India

Harish Shenoy
Associate Professor, KVK,
Mangalore, KVAFSU, Bidar,
Karnataka, India

Roopa TK
Assistant Professor, Department of
Livestock Farm Complex,
Veterinary College, Hassan,
Karnataka, India

Corresponding Author:
Vishal SB
PG Scholar, Department of Animal
Nutrition, Veterinary College,
Hassan, Karnataka, India

Evaluation of fodder yield, chemical composition and prediction of nutritive value of some non-leguminous fodder crops by SEDS

Vishal SB, Jaishankar N, Thirumalesh T, Guruprasad R, Vinuthan MK, Harish Shenoy and Roopa TK

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i4f.5384>

Abstract

The experiment was conducted to evaluate non leguminous annual fodder crops: Maize, Sorghum, Bajra and Ragi for their green fodder yield (GFY) and dry matter yield (DMY). The same were subjected for proximate, fibre fraction and energy values were calculated by summative equations of detergent system. There is a significant difference ($P < 0.01$) between the non-leguminous fodder crops for GFY and DMY. Significantly ($P < 0.01$) higher GFY (43.04 t/ha) and DMY (11.01 t/ha) was recorded in Maize. Ragi and Bajra had around 17 to 19 percent DM, whereas Maize and Sorghum had around 25 percent DM. The CP content was around 9 per cent whereas Sorghum and Bajra contained around 7 to 9 percent CP. EE level was significantly ($P < 0.01$) higher in Maize and NFE was also higher Maize. Highest CP yield, EE yield and NFE yield was noticed in Maize fodder crop. NDF content of Bajra was 67.36 per cent, which is significantly ($P < 0.01$) higher than other non-leguminous fodder crops whereas, the same fodder also had significantly ($P < 0.01$) higher ADF. The true digestible dry matter (TDDM), apparent digestible dry matter (ADDM), Metabolizable energy (ME) and total digestible nutrients (TDN) were higher in Sorghum, and lowest in Bajra. Based on agronomical parameters and chemical composition if more green fodder yield is required Maize can be recommended. As energy values and CP are comparable, based on Total digestible nutrients Sorghum can be recommended to include in the diets of ruminants to meet the requirements for growth and milk production.

Keywords: Maize, sorghum, bajra, ragi, non-leguminous fodder crops, green fodder yield

Introduction

An essential factor in managing dairy cattle and sheep production is the availability of quality fodder, which is influenced by soil type and crop growth stage (Yadav *et al.*, 2007) [22]. In India, predicted deficits in 2015 were 45.76 million tons of crude protein (CP) and 33.71 million tons of total digestible nutrients (TDN), with green and dry fodder deficits of 63.50% and 23.56%, respectively (IGFRI, 2013). Sugarcane trash exhibited nutritional composition comparable to common crop residues, with voluntary intake of urea ammoniated sugarcane trash at 2% of body weight, highlighting its potential to use as roughage source during scarcity (Jaishankar *et al.*, 2021) [12]. To compensate, dairy farmers often rely on costly concentrate feeds, increasing production expenses. Feeding diverse fodder types can reduce these costs. Non-leguminous fodders, typically taller with higher biomass than leguminous crops, require more fertilizer due to their inability to fix atmospheric nitrogen and contain 5–8% CP on average (Rao, 2004) [18]. Green forages, especially cereal crops like maize, sorghum, bajra, and ragi, remain the primary and most economical feed source, providing both protein and energy for humans and livestock, and enabling potential milk yield improvements up to 100% when of high quality. Studies on non-leguminous fodder varieties aim to evaluate green fodder yield, dry matter yield, proximate composition, and fiber fractions. Accurate assessment of energy density in these feeds is critical for optimal dairy cow productivity (Robinson *et al.*, 2007) [19]. The summative equations of the detergent system (SEDS) offer a widely accepted approach to predict the nutritive value of ruminant feeds based on chemical composition.

Materials and Methods

The study area is Hassan, which is located in the southern transition zone region at an elevation of 950 m above mean sea level with an average annual rainfall of about 1031 mm. The type of soil is been red sandy soils. The main crops cultivated being Coffee, Black pepper, Potato, Paddy and Sugarcane. Some non-leguminous *i.e* Maize (*Zea mays*), Sorghum (*Sorghum bicolor*), Bajra (*Pennisetum glaucum*) Ragi (*Eleusine coracana*) fodder crops were sown in the separate plots (5× 12 m²) on open furrows at 60 cm apart, At the time of sowing, a total amount of fertiliser including nitrogen and phosphorus in the form of urea and triple super phosphate was applied. All other standard agricultural practices were followed similarly to all the plots. The fodder crops were irrigated through sprinklers at 3-4 days interval depending on the rainfall. Fodders were harvested manually at right stage to utilise as green fodder. Based on sample harvests at one square meter in four distinct areas of the plot, the green fodder and dry matter yields were estimated. The fodder yield derived from the net plot area converted into ton ha⁻¹, the sampling was done as per quartering method (Campos-M and Campos-C, 2017)^[6].

Processing of samples for analysis

After harvesting, the fodder crops were sampled and dried at 60 °C in a forced air oven till constant weight and ground through 1 mm sieve using a Willey mill. Airtight containers were used to store the milled samples, till further analysis.

Chemical analysis

The Samples of different non leguminous fodders were analysed for proximate/chemical composition. The dry matter (DM), organic matter (OM), ether extract (EE), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE) and total ash contents of selected leguminous and non-leguminous annual fodder crops were analyzed (AOAC, 2016)^[1]. The techniques outlined by Van Soest *et al.* (1991)^[21] were used to determine the neutral detergent fiber (NDF) and acid detergent fiber (ADF).

The true digestible dry matter (TDDM), apparent digestible dry matter (ADDM), metabolisable energy (ME) and total digestible nutrients were calculated for fodder crops using summative equations (Goering and Van Soest, 1970; Van Soest, 1971)^[10, 20]. TDN was converted to ME by a factor of 0.15.

$$\text{TDDM} = (\text{NDS} \times 0.98) + (\text{NDF} \times ((147.3 - (78.9 \log_{10}((L + BS) \times 100 / \text{ADF}))) / 100)) - (\text{SS} \times 1.4)$$

$$\text{ADDM} = \text{TDDM} - (365.7 - 0.275 \text{TDDM})$$

$$\text{TDN} = \text{ADDM} - (\text{TA} - \text{TS}) + 1.25\text{EE} + 19$$

1 kg TDN = 15.1 MJ of ME or 18.45 MJ of DE, ME = 0.82 DE
Where, ME = Metabolisable energy (MJ kg⁻¹ DM), TDDM, ADDM, TDN, EE, NDS, NDF, BS, ADF, SS, TS and TA are true digestible dry matter, apparent digestible dry matter, total digestible nutrients, ether extract, neutral detergent solubles, neutral detergent fibre, biogenic silica, acid detergent fibre, sand silica, total silica and total ash respectively in g kg⁻¹ DM.

Results and Discussion

Forage yield

The green fodder yield (GFY) (t/ha), dry matter yield (DMY) (t/ha) and chemical composition of some non-leguminous annual fodders are presented in Table 1. GFY (t/ha) and DMY (t/ha) of Maize, Sorghum, Bajra and Ragi were 43.04 and 11.01; 33.91

and 8.39; 32.2 and 6.03; 11.18 and 1.89, respectively. There is a significant difference ($P < 0.01$) between the non-leguminous fodder crops for GFY and DMY. Significantly ($P < 0.01$) higher GFY was recorded in Maize (43.04 t/ha) and also higher DMY (11.01 t/ha) was observed. This difference in yield is obvious because, even though all four non leguminous annual fodders were of cereals, the proportion of stems and leaves was more in Maize followed by Sorghum, Bajra and ragi therefore accordingly green fodder yield and dry matter yield varied.

Average green fodder and dry matter (t / ha) yield observed in the present study for Maize, Bajra and Ragi are comparable with the yield (t/ha) reported in the earlier studies (Aslam *et al.*, 2011; Meena *et al.*, 2012; Backiyalakshmi *et al.*, 2021)^[3, 17, 5]. However average green fodder and dry matter (t / ha) obtained in the current study for Sorghum are lower than the yield (53.98 and 14.59; 45.50 and 9.11) reported in the earlier studies by Ayub *et al.* (2002)^[4], Ashiqet *al.* (2007)^[2] respectively which might be attributed to variations in soil types and fertilizer treatments.

Among non-leguminous annual fodder crops Ragi and Bajra had around 17 to 19 percent DM, whereas Maize and Sorghum had around 25 percent DM. Variation in DM content was due to variation in stage of harvest where Bajra and Ragi were harvested on 60th and 100th days after sowing respectively, Maize and Sorghum harvested on 75th and 65th days after sowing respectively. The CP content was around 9 per cent whereas Sorghum and Bajra contained around 7 to 9 percent CP. EE level was significantly ($P < 0.01$) higher in Maize and NFE was also higher Maize. The CP yield, EE yield and NFE yield was significantly ($P < 0.01$) different between the non-leguminous annual fodder crops where highest CP yield, EE yield and NFE yield was noticed in Maize fodder crop which was due to higher nutrient level and also higher dry matter yield when compared to other non-leguminous annual fodders

Chemical composition (as percent DM basis) of Maize, Sorghum and Bajra fodder *i.e* DM, OM, CP, EE, TA and NFE obtained in the present study are comparable to values of chemical composition of respective fodder reported in the earlier studies (Ayub *et al.*, 2002; Chaudhary *et al.*, 2016; Kumar *et al.*, 2023)^[4, 7, 15]. Comparatively higher CP, EE and TA obtained in the present study for Ragi, might be due to harvesting of fodder at vegetative stage (Madibela *et al.*, 2004)^[16].

Fibre fraction: Nonleguminous annual fodder crops

NDF content of Bajra was 67.36 per cent, which is significantly ($P < 0.01$) higher than other non-leguminous fodder crops whereas, the same fodder also had significantly ($P < 0.01$) higher ADF. NDF yield and ADF yield were significantly ($P < 0.01$) higher in Maize followed by Sorghum, Bajra and Ragi and this variation in fodders might be due to the difference in varieties and stage of harvest. NDF, ADF and ADL (as per cent DM basis) assessed in the present study for Maize, Sorghum, Bajra and Ragi are in agreement with the findings of earlier studies conducted by Chaudhary *et al.* (2011)^[8], Colombo *et al.* (2007)^[9], Kumar *et al.* (2023)^[15] and Madibela *et al.* (2004)^[16] respectively.

Predicted digestibility and energy values

The true digestible dry matter (TDDM), apparent digestible dry matter (ADDM), Metabolizable energy (ME) and total digestible nutrients (TDN) were higher in Sorghum, and lowest in Bajra. Predicted ME values of Maize, Sorghum, Bajra and Ragi by SEDS were lower than the ME values reported in the earlier studies (Khanum *et al.*, 2007, Kumar *et al.*, 2015 and Keba *et al.* 2022)^[14, 13].

Table 1: Forage yield, Chemical composition, composition yield, fibre fraction and Fibre fraction yield (t/ha) of some non-leguminous annual fodders

Fodder crop		Maize	Sorghum	Bajra	Ragi	SEM	P value
Fodder yield (t/ha)	GFY (t/ha)	43.04 ^d	33.91 ^c	32.2 ^b	11.18 ^a	0.191	<0.01
	DMY (t/ha)	11.01 ^d	8.39 ^c	6.03 ^b	1.89 ^a	0.044	<0.01
Composition (%)	DM	25.59 ^c	24.74 ^c	18.72 ^b	16.91 ^a	0.359	<0.01
	OM	91.50 ^c	91.61 ^c	88.21 ^{ab}	87.09 ^a	0.358	<0.01
	ASH	8.50 ^a	8.39 ^a	11.79 ^b	12.91 ^b	0.358	<0.01
	EE	3.67 ^d	1.03 ^a	1.71 ^b	2.02 ^c	0.075	<0.01
	CP	9.51 ^c	7.12 ^a	8.58 ^b	9.14 ^{bc}	0.226	<0.01
	NFE	28.18 ^b	27.52 ^b	23.85 ^a	23.59 ^a	0.552	<0.01
Composition yield (t/ha)	CP	28.18 ^b	27.52 ^b	23.85 ^a	23.59 ^a	0.552	<0.01
	EE	0.41 ^d	0.08 ^b	0.10 ^{bc}	0.04 ^a	0.008	<0.01
	NFE	3.10 ^d	2.31 ^c	1.44 ^b	0.45 ^a	0.037	<0.01
Fibre fraction (%)	NDF	62.13 ^{ab}	60.6 ^a	67.36 ^d	66.82 ^c	0.771	<0.01
	ADF	38.46 ^b	39.21 ^{bc}	42.91 ^d	34.62 ^a	0.438	<0.01
	ADL	4.9 ^c	3.37 ^a	5.05 ^d	3.69 ^b	0.05	<0.01
Fibre fraction yield (t/ha)	NDF yield	6.84 ^d	5.08 ^c	4.06 ^b	1.26 ^a	0.088	<0.01
	ADF yield	4.24 ^d	3.29 ^c	2.59 ^b	0.65 ^a	0.043	<0.01

Means with distinct superscripts ^{a, b, c, d} within a column, exhibit significant differences at ($P < 0.01$). GFY = Green fodder yield; DMY = Dry matter yield

Table 2: Chemical composition, predicted digestibility and energy values of some non leguminous annual fodder crops by SEDS

Fodder crop	Maize	Sorghum	Bajra	Ragi
SS (%)	2.76	3.26	3.26	3.76
BS (%)	2.6	2.32	2.37	1.61
TDDM(%)	61.53	67.77	60.86	63.21
ADDM(%)	41.88	49.83	41.02	44.02
TDN(%)	45.22	50.21	30.9	40.9
ME (MJ/kg DM)	6.83	7.33	5.81	6.88

Summary and conclusion

Among the non-leguminous annual fodder crops evaluated in the experiment, maize recorded the highest yield, with a green fodder yield (GFY) of 43.04 t/ha and a dry matter yield (DMY) of 11.01 t/ha. It also exhibited superior nutritional composition, with higher dry matter (DM), crude protein (CP), and ether extract (EE) contents compared to the other fodders. Consequently, maize produced the highest crude protein yield (28.18), making it highly suitable for enhancing animal productivity. The overall performance of the fodders, in terms of yield and nutrient contribution, followed the order: maize > sorghum > bajra > ragi. Except for bajra, the predicted digestibility and energy values estimated using SEDS were comparable among the non-leguminous fodder crops studied. Based on agronomic performance and chemical composition, maize can be recommended where the primary objective is to maximize green fodder yield. However, considering that energy values and crude protein contents were broadly comparable, sorghum demonstrated relatively better total digestible nutrient (TDN) value. Therefore, sorghum can be effectively recommended for inclusion in ruminant diets to meet the nutritional requirements for growth and milk production.

References

1. AOAC. Official methods of analysis. 20th ed. Association of Official Analytical Chemists; 2016.
2. Ashiq H, Sartaj K, Sultani MI, Dost M. Locational variation in green fodder yield, dry matter yield and forage quality of sorghum. Pakistan Journal of Agricultural Research. 2007;20(1-2):25-29.
3. Aslam M, Iqbal A, Zamir MI, Mubeen M, Amin M. Effect of different nitrogen levels and seed rates on yield and quality of maize fodder. Crop and Environment. 2011;2(2):47-51.
4. Ayub M, Nadeem MA, Tanveer A, Husnain A. Effect of different levels of nitrogen and harvesting times on growth, yield and quality of sorghum fodder. Asian Journal of Plant Sciences. 2002;1(4):304-307.
5. Backiyalakshmi C, Babu C, Naresh Reddy D, Padmakumar V, Prasad KVS, Azevedo VCR, *et al.* Assessing forage potential of global collection of finger millet (*Eleusine coracana* (L.) Gaertn.) germplasm conserved at the ICRISAT genebank. Agronomy Journal. 2021;11(9):1706-1726.
6. Campos-M M, Campos-C R. Applications of quartering method in soils and foods. International Journal of Engineering Research and Applications. 2017;7(1):35-39.
7. Chaudhary DP, Kumar A, Kumar R, Singode A, Mukri G, Sah RP, *et al.* Evaluation of normal and specialty corn for fodder yield and quality traits. Range Management and Agroforestry. 2016;37(1):79-83.
8. Chaudhary DP, Kumar A, Mandhanian SS, Srivastava P, Kumar RS. Maize as fodder: an alternative approach. New Delhi: Directorate of Maize Research, Pusa Campus; 2012. p. 1-32.
9. Colombo D, Crovetto GM, Colombini S, Galassi G, Rapetti L. Nutritive value of different hybrids of sorghum forage determined *in vitro*. Italian Journal of Animal Science. 2007;6(Suppl 1):289-291.
10. Goering HK, Van Soest PJ. Forage fiber analyses (apparatus, reagents, procedures and some applications). Agricultural Handbook No. 379. Washington DC: USDA-ARS; 1970.
11. Indian Grassland and Fodder Research Institute. Jhansi: IGFRI; 2013.
12. Jaishankar N, Ramachandra B, Thirumalesh T. Effect of urea ammoniated sugarcane trash based diets on growth potentiality of Nari Suwarna × Kenguri F1 lambs. Pharma Innovation Journal. 2021;10(11):138-142.
13. Keba W, Tolemaria T, Mohammed A. Straw dry matter yield and quality of finger millet intercropped with selected vetch species at different seeding ratios in western Oromia, Ethiopia. Heliyon. 2022;8(8).
14. Khanum SA, Yaqoob T, Sadaf S, Hussain M, Jabbar MA, Hussain HN, *et al.* Nutritional evaluation of various feedstuffs for livestock production using *in vitro* gas

- method. Pakistan Veterinary Journal. 2007;27(3):129-133.
15. Kumar R, Ram H, Kumar R, Meena RK, Meena BL, Kumar D. Proximate composition and fibre fraction of pearl millet fodder as influenced by different nutrient management practices. Indian Journal of Animal Research. 2023;57(3):334-339.
 16. Madibela OR, Modiakgotla E. Chemical composition and *in vitro* dry matter digestibility of indigenous finger millet (*Eleusine coracana*) in Botswana. Livestock Research for Rural Development. 2004;16(4).
 17. Meena SN, Jain KK, Prasad D, Ram A. Effect of nitrogen on growth, yield and quality of fodder pearl millet (*Pennisetum glaucum*) cultivars under irrigated condition of north-western Rajasthan. Annals of Agricultural Research. 2012;33(3):183-188.
 18. Rao S. Fodder production and grassland management. 1st ed. Delhi: Academe Publishers; 2004.
 19. Robinson PH. A new look at energy discounts: using published studies to calculate discounted net energy values for dairy cows fed ad libitum. Canadian Journal of Animal Science. 2007;87(1):57-70.
 20. Van Soest PJ. Estimation of nutritive value from laboratory analysis. Proceedings of Cornell Nutrition Conference for Feed Manufacturers. 1971:106-117.
 21. Van Soest PJ, Robertson JB, Lewis BA. Methods of dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science. 1991;74:3583-3597.
 22. Yadav RK, Singh SP, Lal D, Kumar A. Fodder production and soil health with conjunctive use of saline and good quality water in ustipsamments of a semi-arid region. Land Degradation and Development. 2007;18(2):153-161.