

Effect of organic manure type and age at harvest on proximate composition and fibre fractions of *Brachiaria ruziziensis* (Congo grass)

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Abstract

Organic manure plays a significant role in improving soil fertility and soil structure, which enhances forage nutritive value. The study was conducted to determine the effects of organic manure type and harvesting age on the proximate composition and fibre fraction of *Brachiaria ruziziensis*. The experiment was laid out in a randomized complete block design (RCBD) in a 4 x 3 factorial arrangement, consisting of four organic manure treatments (no manure, poultry manure, cattle manure and pig manure) and 3 harvesting age (8, 12 and 16 weeks after planting). Forages samples were harvested at each harvesting age. The crude protein was significantly ($P < 0.05$) affected by manure ranging from 8.94% in control to 10.94% in pasture grown with poultry manure. While, ether extract, ash, crude fibre and all fibre fraction parameters were not significantly ($P > 0.05$) influenced by manure type. In contrast, age at harvest significantly affected all proximate parameters and fibre fraction parameters. Crude protein and ash content decreased with harvesting age progress while crude fibre increased as harvesting age progress. The interaction of manure type and harvesting age showed that forage established with poultry manure and harvested at 12 weeks after planting had the highest crude protein than the control. NDF content observed at different harvesting ages for the forage was within acceptable limits for ruminant nutrition, indicating that *Brachiaria ruziziensis* can provide adequate forage quality at the tested harvesting intervals.

Keywords: Organic manure, Age at Harvest, Proximate composition, fibre fraction

Effet du type de fumier organique et de l'âge à la récolte sur la composition proximale et les fractions fibreuses de *Brachiaria ruziziensis* (herbe du Congo)



Résumé

Le fumier organique joue un rôle important dans l'amélioration de la fertilité et de la structure du sol, ce qui améliore la valeur nutritive du fourrage. L'étude a été menée pour déterminer les effets du type de fumier organique et de l'âge de récolte sur la composition proximale et les fractions fibreuses de *Brachiaria ruziziensis*. L'expérience a été disposée selon un dispositif en blocs complets randomisés (DBCR) dans une disposition factorielle 4 x 3, comprenant quatre traitements de fumier organique (aucun fumier, fumier de volaille, fumier bovin et fumier porcin) et 3 âges de récolte (8, 12 et 16 semaines après la plantation). Des échantillons de fourrage ont été récoltés à chaque âge de récolte. La teneur en protéines brutes a été significativement ($P < 0,05$) affectée par le fumier, allant de 8,94 % dans le témoin à 10,94 % dans le pâturage cultivé avec du fumier de volaille. Alors que l'extrait étheré, les cendres, les fibres brutes et tous les paramètres des fractions fibreuses n'ont pas été significativement ($P > 0,05$) influencés par le type de fumier. En revanche, l'âge à la récolte a significativement affecté tous les paramètres proximaux et les paramètres des fractions fibreuses. La teneur en protéines brutes et en cendres a diminué avec

l'avancement de l'âge de récolte tandis que les fibres brutes ont augmenté avec l'avancement de l'âge de récolte. L'interaction du type de fumier et de l'âge de récolte a montré que le fourrage établi avec du fumier de volaille et récolté à 12 semaines après la plantation avait la teneur en protéines brutes la plus élevée par rapport au témoin. La teneur en NDF observée à différents âges de récolte pour le fourrage se situait dans des limites acceptables pour la nutrition des ruminants, indiquant que Brachiaria ruziziensis peut fournir une qualité de fourrage adéquate aux intervalles de récolte testés.

Mots-clés : Fumier organique, âge à la récolte, composition proximale, fraction fibreuse

Introduction

Grasses are the world's most prevalent plant. They supply the nutrients and energy required for animal growth and maintenance. Congo grass, also known as *Brachiaria ruziziensis*, is an important forage grass used in ruminant production because of its high biomass yield, palatability, and adaptability to a variety of settings (Cook *et al.*, 2025). *Brachiaria ruziziensis* is highly nutritious and easily digestible by animals. It has an aggressive growing behavior, which generates a dense ground cover capable of controlling weeds (Nafiatul *et al.*, 2018). There is need for sustainable livestock farming in other to meet up with human demand. Forages are regarded to be the most cost-effective primary nutritional component in ruminant diets (Oyewole and Aderinola, 2022). Continuous access to appropriate forage quantity and quality can help maximize livestock output. The main environmental factors limiting forage productivity in tropical region are water availability and nutrient deficiencies in soil (Lopez-Gutierrez *et al.*, 2004). However, the application of organic manure enriches the soil with nutrients, enhances soil structure and stimulates beneficial microbial activity, resulting in quality parameters of forages. Harvesting age is another critical determinant of forage quality the age at harvest has apparent effect on yield of forages, their nutritional quality and dry matter degradability (Oyewole and Aderinola, 2022). Hence, the combine effect of organic manure application and timely harvesting can help

improve forage quality and maximize yield which in turns ensure a sustainable livestock farming. This study was therefore designed to evaluate the effect of different organic fertilizer sources and age at harvest on proximate composition and fibre fraction of *Brachiaria ruziziensis* (Congo grass).

Materials and methods

Experimental site

The research was conducted at Pasture Unit of the Livestock Teaching and Research Farm, Joseph Sarwuan Tarka University Makurdi, Benue State, Nigeria. Makurdi lies within latitude 7.45°N and longitude 8.32°E within the southern guinea savanna agro-ecological zone of north central Nigeria. Makurdi falls within the tropical, sub-humid, wet and dry climate which has two distinct seasons (wet and dry season) with an average annual rainfall of 1290 mm and a daily temperature of 40°C maximum and a minimum of 22.5°C (Ekhuemelo *et al.*, 2019).

Soil Sample of the Experimental Site

Soil samples were collected from the experimental site at a depth of 0 – 20cm and analyzed for physical and chemical properties. The soil was analyzed for texture, particle size, soil pH, phosphorus, nitrogen and cations exchange capacity (CEC).

Experimental design

The experimental design used was randomized complete block design laid out in a 4 x 3 factorial arrangement. A total of 572m² of land was mapped out for the experiment. The layout was divided into three blocks and each block was

further partitioned into four plots; measuring 6 x 5m with 2m inter-plots and between blocks spacing as shown in figure 1. Each plot represented the four treatment groups viz T1 (No application of manure), T2 (application of cattle dung), T3 (application of poultry litter) and T4 (application of pig manure), and all treatments were replicated across the three blocks. The pasture was sampled at 8, 12 and 16 weeks after plant to determine the morphological parameters and dry matter yield.

Sampling and analysis

Sampling

At the three harvesting ages (8, 12 and 16WAP) a 1m² quadrat was demarcated on each plot and the fodder within was harvested with a sickle leaving a stubble height of 8cm and weighed with a weighing balance to estimate the fresh yield. 400g representative samples of fresh forage were collected and oven-dried at 65°C until a constant weight was attained. After drying, samples were ground to pass through a 2mm sieve using milling machine and taken to the laboratory for further chemical analysis.

Determination of proximate composition

The crude protein, ether extracts and total ash were determined according to AOAC (2005). Nitrogen free extract (NFE) was estimated from the equation $\%NFE = 100 - (\%moisture + \% crude fibre + \% crude protein + \% ether extract + \% ash)$. Neutral detergent fiber (NDF), acid

detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to the procedure of Van Soest, (1963), the cellulose and hemicelluloses content was calculated using the equation

$$\begin{aligned} \text{Hemicellulose (\%)} &= \text{Neutral Detergent Fiber (NDF)} \\ &- \text{Acid Detergent Fiber (ADF) and Cellulose (\%)} \\ &= \text{Acid Detergent Fiber (ADF)} \\ &- \text{Acid Detergent Lignin (ADL)}. \end{aligned}$$

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using SPSS version 20. Significant differences among treatment means were separated using Duncan multiple range test as contained in the statistical software at 5% probability level ($P < 0.05$).

Results and Discussion

Soil Physical and Chemical Properties of the Experimental Site

Table 1 shows the physical and chemical properties of the experimental plot. The soil has a sandy loam textural class composed of a high percentage of sand (68.80%), with smaller proportions of clay (18.20%) and silt (13.00%), it is slightly acidic with a pH of 6.63. The soil has a high base saturation of 88.57%, the cation exchange capacity (CEC) is 8.75 Cmol/kg. The dominant exchangeable cations were Ca (3.50 cmol kg⁻¹), Mg (3.30 cmol kg⁻¹), Na (0.40 cmol kg⁻¹), and K (0.33 cmol kg⁻¹).

Table 1: Soil Physical and Chemical Properties of the Experimental Site

Mechanical properties	Value
Sand	68.50
Clay	18.20
Silt	13.00
Textural class	Sandy Loam
Chemical properties	
pH	6.63
Organic carbon (%)	1.88

Effect of organic manure type and age at harvest on proximate composition and fibre fractions of Brachiaria ruziziensis (Congo grass)

Organic matter (%)	3.25
Total Nitrogen (%)	0.52
Available phosphorous (mg/l)	6.10
Base saturation (%)	88.57
Exchangeable cation (Cmol)	0.33
Potassium	
Sodium	0.40
Magnesium	3.30
Calcium	3.50
Exchangeable base (Cmol/kg)	7.75
Exchangeable Acid (Cmol/kg)	1.00
¹ C.E.C (Cmol/kg)	8.75

¹C.E.C: Cation Exchange Capacity

Table 2: Effect of Manure Type on Proximate Composition and Fibre Fractions of *Brachiaria ruziziensis*

PARAMETERS	T ₁	T ₂	T ₃	T ₄	SEM
Proximate					
Crude protein	8.94 ^b	10.94 ^a	9.54 ^{ab}	10.09 ^{ab}	0.27
Ether extract	1.90	2.07	2.06	2.33	0.09
Ash	9.69	10.99	9.89	9.20	0.49
Crude fibre	30.74	30.27	30.15	29.36	0.54
Nitrogen-free extract	48.72	45.72	48.35	49.01	0.55
Fibre Fractions					
NDF	37.67	37.27	37.66	37.53	0.74
ADF	34.28	34.50	34.51	33.23	0.53
ADL	5.78	5.67	6.06	5.49	0.39
Cellulose	28.50	28.82	28.50	27.73	0.43
Hemicellulose	3.38	2.78	3.57	4.30	0.58

^{a,b} Means with different superscript along the row are significantly ($p < 0.05$) different, T₁: Control (no manure application), T₂: Poultry manure, T₃: Cattle dung, T₄: Pig manure, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin

Table 2 represents the effect of manure types on proximate composition and fibre fraction of *Brachiaria ruziziensis*. Crude protein varied significantly ($p < 0.05$) across treatments. The CP content was higher in forage established with poultry manure (10.94%) than control (8.94%) but comparable with pig manure (10.09%) and cattle manure (9.54%). The high CP content observed in forage established with organic manure application as compared to control can be attributed to the improved nitrogen content in the soil. The application of organic manures has been shown to improve the nutritive quality of forages, particularly by increasing the crude protein (CP) content, this can be attributed to the ability of organic manure in enhancing soil fertility and plant nutrient uptake.

The ash content ranged from 9.2% in treatment with pig manure to 10.9% in treatment with poultry manure. The non-significant effect observed in ash content with different manure type can be attributed to the ability of *Brachiaria*

ruziziensis to thrive well on a wide range of soil irrespective of the fertility status. No significant differences were observed in Ether extract, with values ranging from 1.90% in control to 2.33% in treatment with pig manure. Crude fibre ranged from 29.36% in treatment with pig manure to 30.74% (control). Similarly, NFE was comparable across treatments ranging between 45.72% in treatment with poultry manure to 49.01% in treatment with pig manure. The non-significant effect of manure type on ether extract, ash, crude fibre, nitrogen-free extract, and fibre fractions is consistent with previous findings by Ewetola *et al.* (2020) and Onwih *et al.* (2021), who reported no significant influence of fertilizer types on ether extract, ash, and non-fibre carbohydrates in *Panicum maximum*, *Andropogon tectorum*, and *Pennisetum pedicellatum* established under different manure treatments.

However, contrary results were reported by Yakubu *et al.* (2024), who observed significant

improvement in CP, DM, ash, and NFE of *Brachiaria ruziziensis* when *Centrosema pubescens* was applied as green manure. Similarly, Sobande *et al.* (2024) reported that fertilizer application at the rate of 240 kg N/ha significantly increased the CP (by 40%) and ash content (11.42%) of *Brachiaria ruziziensis*, while the highest CF (16.45%) was observed at a lower rate of 120 kg N/ha. These contrasting results suggest that although manure type may not always have a statistically significant effect on pasture composition, the rate of nutrient application may play a more decisive role in enhancing forage nutritional quality under specific agro-ecological conditions.

All analyzed fibre fraction parameters were not significantly ($P>0.05$) affected by manure type. Neutral detergent fibre ranged from 37.27% to 37.67%, Acid detergent fibre ranged from 33.22 to 34.51%, Acid detergent lignin 5.49% to 6.06%, while cellulose and hemicelluloses contents ranged from 27.73% to 28.82% and 2.78% to 4.30%, respectively. The non-significant

difference observed in fiber fraction parameters (Neutral Detergent Fibre, Acid Detergent Fibre and Acid Detergent Lignin) among manure treatments suggests that organic manure influenced forage yield and nutritive value mainly through improved nutrient supply and plant vigour, rather than by altering cell wall composition. The synthesis of structural carbohydrates (cellulose, hemicellulose, and lignin) that constitute NDF and ADF is primarily determined by the plant's growth stage and morphological development. Therefore, while organic manure improves soil fertility and promotes vegetative growth, it does not significantly modify the biochemical pathways responsible for fibre formation. These findings are consistent with previous reports indicating that nutrient amendments produced only minor or inconsistent changes in cell-wall constituents of *Brachiaria ruziziensis*, whereas species and maturity/regrowth age had strong, consistent effects on NDF, ADF, cellulose and hemicellulose (Do Valle *et al.*, 1988; Santos *et al.*, 2014).

Table 3: Effect of Age at Harvest on Proximate Composition and Fibre Fractions of *Brachiaria ruziziensis*

Parameters	8WAP	12WAP	16WAP	SEM
Proximate				
Crude protein	11.48 ^a	10.17 ^b	7.99 ^c	0.161
Ether extract	2.68 ^a	1.76 ^b	1.84 ^b	0.052
Ash	13.21 ^a	9.47 ^b	7.15 ^c	0.234
Crude fibre	26.75 ^b	31.29 ^a	32.36 ^a	0.329
Nitrogen free extract	45.88 ^b	47.32 ^b	50.66 ^a	0.476
Fibre Fractions				
NDF	34.16 ^c	36.85 ^b	41.58 ^a	0.50
ADF	31.45 ^b	34.93 ^a	36.01 ^a	0.41
ADL	4.10 ^b	4.99 ^b	8.16 ^a	0.24
Cellulose	27.35 ^b	29.93 ^a	27.89 ^b	0.39
Hemicellulose	3.12 ^b	2.52 ^b	5.89 ^a	0.42

^{a,b,c} Means with different superscript along the row are significantly ($p<0.05$) different, WAP: Week after planting, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin, SEM: Standard error of mean

The proximate composition and fibre fraction of *Brachiaria ruziziensis* harvested at different age is presented in Table 3. Crude protein (CP) declined significantly ($P < 0.05$) with increasing pasture age, recording 11.48%, 10.17%, and 7.99% at 8, 12, and 16 WAP, respectively. This could be attributed to accumulation in dry matter content and fibrous nature of the grass with maturity. On the other hand, crude fibre content was lower ($p < 0.05$) at 8 WAP (26.75%) compared to 12 and 16 WAP (31.29 and 32.36%, respectively). The increase in crude fibre content with advancing age independent of manure type reflects progressive lignifications in maturing grasses. These observations are consistent with the findings of Dandara *et al.* (2024), who reported decline in CP content of forage from 10.89% at 8 WAP to 7.68% at 12 WAP, while CF increased from 29.34% to 36.24% within the same period.

Ash content followed a similar trend to CP, with higher values at 8 WAP (13.21%) compared to 12 and 16 WAP (9.47% and 7.15%, respectively; $P < 0.05$). The decline in ash content as harvesting age advancing can be attributed to physiological and structural changes that occur during plant growth and development. One of the major factors responsible for the decline in ash content is the dilution effect. The decline in ash with advancing age is likely due to physiological and structural changes during growth, particularly the dilution effect, where mineral accumulation does not keep pace with structural biomass accumulation (McDonald *et al.*, 2010). This report is supported by Xu *et al.*, 2024 who observed that older forages tend to accumulate more structural tissues with lower mineral density, thereby reducing ash concentrations over time. Yalew *et al.* (2020) also reported that there was a decrease in total ash content of the natural pasture in late maturity. On the other hand, Onwih *et al.* (2020) reported an increase in ash

content with plant maturity in *Andropogon gayanus*, contrasting with the present study.

The nitrogen free extract increased ($P < 0.05$) after 12 WAP reaching 47.32% and 50.66% at 12 and 16 WAP, respectively, likely due to accumulation of soluble carbohydrates as CP and ash content decline. Ether extract was higher ($p < 0.05$) at 8 WAP (2.68%) and decreased with age to 1.76% and 1.84% at 12 and 16 WAP, respectively, consistent with Idowu *et al.* (2020), who reported higher EE content in *Panicum maximum* at earlier harvest stages.

All fibre fraction parameters increased ($p < 0.05$) with increase in the age of the *Brachiaria* grass. Neutral detergent fibre (NDF) increased with the advancing age of the grass from 34.16% at 8 WAP to 36.85% and 41.58% at 12 and 16 WAP, respectively. NDF is known to be inversely related to forage digestibility with higher NDF values are associated with longer rumen retention time and reduced voluntary feed intake. The progressive increase in NDF with harvesting age is an indicator of reduced digestibility at later growth stages. Acid detergent fibre was lowest at 8 WAP (31.45%) but similar at 12 and 16 WAP (34.93% and 36.01%, respectively). Acid detergent lignin was higher at 16 WAP (8.16%) but comparable at 8 and 12 WAP (4.10 and 4.99%, respectively). Since ADF comprises cellulose and lignin, its increase with age negatively affects digestibility and palatability. These results suggest that forage harvested at earlier stages will support better intake and digestibility. Cellulose content did not show a consistent trend with age, a higher ($p < 0.05$) value was observed at 12 WAP (29.93%) compared to 27.35% and 27.89% at 8 WAP and 16 WAP respectively. Hemicelluloses content was higher ($p < 0.05$) at 16 WAP (5.89%) but comparable at 8 and 12 WAP (3.12% and 2.52%, respectively).

Table 4: Interactions Effect of Manure Type and Age at Harvest on Proximate Composition and Fibre Fractions of *Brachiaria ruziziensis*

Indices (%)	8WAP				12WAP				16WAP			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
Crude protein	9.73 ^{cd}	12.88 ^a	11.24 ^b	12.05 ^{ab}	9.29 ^{de}	11.35 ^b	9.78 ^{cd}	10.24 ^c	7.8000 ^{fg}	8.58 ^{ef}	7.61 ^g	7.99 ^{fg}
Ether extract	2.42 ^{bc}	2.53 ^b	2.57 ^b	3.21 ^a	1.63 ^d	1.96 ^{cd}	1.67 ^d	1.75 ^d	1.65 ^d	1.73 ^d	1.94 ^d	2.04 ^{cd}
Ash	13.91 ^{ab}	14.59 ^a	12.41 ^{abc}	11.94 ^{bcd}	8.22 ^{fg}	10.77 ^{cde}	10.00 ^{def}	8.87 ^{efg}	6.94 ^g	7.61 ^g	7.27 ^g	6.79 ^g
Crude fibre	26.61 ^d	28.04 ^{bcd}	27.17 ^{cd}	25.20 ^d	31.58 ^{ab}	32.03 ^a	30.54 ^{abc}	31.00 ^{ab}	34.04 ^a	30.76 ^{abc}	32.75 ^a	31.87 ^a
NFE	47.33 ^c	41.97 ^c	46.62 ^{bc}	47.59 ^{ab}	49.27 ^a	43.88 ^{bc}	48.01 ^{ab}	48.13 ^{ab}	49.57 ^a	51.32 ^a	50.43 ^a	51.31 ^a
Fibre Fractions												
NDF	34.41 ^{cd}	32.42 ^d	35.14 ^{bcd}	34.67 ^{cd}	37.11 ^{abcd}	37.16 ^{abcd}	35.54 ^{bcd}	37.58 ^{abcd}	41.48 ^{ab}	42.23 ^a	42.29 ^a	40.34 ^{abc}
ADF	31.27 ^d	32.44 ^{cd}	30.53 ^d	32.44 ^{bcd}	36.01 ^{ab}	36.29 ^{ab}	33.62 ^{bcd}	33.78 ^{bcd}	35.57 ^{abc}	35.65 ^{abc}	39.37 ^a	33.46 ^{bcd}
ADL	3.89 ^b	4.27 ^b	4.333 ^b	3.89 ^b	4.69 ^b	4.86 ^b	5.90 ^{ab}	4.53 ^b	8.75 ^a	7.88 ^a	7.96 ^a	8.053 ^a
Cellulose	27.37 ^{bc}	27.28 ^{bc}	26.20 ^{bc}	28.55 ^{abc}	31.32 ^a	31.43 ^a	27.73 ^{bc}	29.25 ^{ab}	26.82 ^{bc}	27.77 ^{bc}	31.56 ^a	25.40 ^c
Hemicellulose	3.14	0.87	4.61	2.23	1.11	0.88	1.91	3.80	5.91	6.58	4.20	6.88

^{a,b,c} Means with different superscript along the row are significantly ($p < 0.05$) different, T₁: Control, T₂: Poultry manure, T₃: Cattle dung, T₄: Pig manure, WAP: Weeks after planting, NFE: Nitrogen free extract, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin, SEM: Standard error of mean.

The interaction between the fertilizer type and harvesting age on the proximate composition and fibre fraction of *Brachiaria ruziziensis* is presented in Table 4. At 8 WAP crude protein (CP) was highest ($P < 0.05$) in forage established with poultry manure (12.88%) and comparable to pig manure (12.05%). At 12 WAP, CP in poultry manure treatments (11.35%) was significantly higher than other treatments. This observation can be attributed to the rich nitrogen content of poultry manure, which enhances the synthesis of chlorophyll and promotes vigorous vegetative growth and increase protein accumulation in plants (Amanullah *et al.*, 2010). These findings are consistent with previous reports indicating that poultry manure generally improves soil nitrogen and subsequently forage CP (Adekiya *et al.*, 2017). The lowest CP was observed in cattle manure at 16 WAP (7.61%), was similar to control and pig manure (7.80% and 7.99%, respectively).

Ether Extract was highest in pig manure at 8 WAP (3.21%) but decreased ($P < 0.05$) and comparable across the manure types at 12 and 16 WAP. EE content, reflecting lipid fractions, was not truly affected with manure type but reduced with increase in harvesting age, the interaction indicates higher EE content in forages established with pig manure and harvested at 8 WAP but as harvesting age increased the EE content became comparable with grasses grown with other manure types.

Ash content was found to be highest in poultry manure at 8 WAP (14.59%), similar to control and cattle manure (13.91% and 12.41%, respectively). At 12 WAP, poultry manure retained higher ash content (10.77%) than the control (8.22%), while at 16 WAP ash content was lower and similar across treatments. Ash content in forage represents the total mineral (inorganic) matter present after complete combustion of the organic components. It is an important indicator of the mineral nutritional

value and quality of the forage for ruminant animals. The major factors that impact forage mineral composition include fertilizer application, stage of growth, and environmental conditions (Mirzaei, 2012). The current study observed that both harvesting age and poultry manure application at 12 WAP significantly ($p < 0.05$) enhanced ash content compared to unfertilized control.

Crude fibre (CF) increased significantly as the age of the grasses is advancing, it was higher ($P < 0.05$) and similar at 12 and 16 WAP regardless of manure application, while the lowest value at 8 WAP was comparable across treatments. The increase in crude fibre content with increasing age and not manure type can be explained by increased lignifications of the cell wall in maturing grasses. Younger plants, characterized by high metabolic activity and more leafy tissue, contain higher soluble cell contents and lower fibre fractions, whereas structural material deposition increases as plants mature to support stems and reproductive structures.

The nitrogen-free extract (NFE) content of grass harvested at 16 WAP was significantly higher ($P < 0.05$) and comparable across treatments, recording 49.57%, 51.32%, 50.43%, and 51.31% for control, poultry manure, cattle manure, and pig manure, respectively. At 12 WAP, NFE values were similar among grasses from control, cattle manure, and pig manure treatments (49.27%, 48.01%, and 48.13%, respectively), comparable to pig manure at 8 WAP (47.59%). The lowest NFE values were noted in grass grown with poultry manure at 12 WAP (43.88%) and in control, poultry, and cattle manure at 8 WAP (47.33%, 46.62%, and 41.97%, respectively). Nitrogen-free extract (NFE), which represents non-fibre carbohydrates, primarily soluble sugars, showed similar values across treatments at 16 WAP, suggesting that forage maturity had a stronger influence on carbohydrate partitioning than manure type. This

finding is consistent with the observations of Ewetola *et al.* (2020), but contrasts with Yakubu *et al.* (2024), who reported significant improvements in crude protein (CP), dry matter (DM), ash, and NFE of *Brachiaria ruziziensis* when *Centrosema pubescens* was applied as green manure.

Neutral detergent fibre (NDF) values ranged from 32.42% in forage established with poultry manure at 8 WAP to 42.29% in forage established with cattle manure at 16 WAP. According to Van Soest (1994), ruminants require forages with NDF below 60% to support adequate dry matter intake, while values above this threshold may restrict intake. Therefore, the NDF levels observed in this study indicate that *Brachiaria ruziziensis* harvested at any of the three ages falls within acceptable limits for ruminant nutrition.

Acid detergent fibre was higher ($P < 0.05$) and comparable in cattle manure, poultry manure and control at 16 WAP (39.37%, 35.65% and 35.57% respectively) and control and pig manure at 12WAP (36.01% and 36.29%). The least ($P < 0.05$) ADF was observed across treatments at 8WAP. The highest cellulose content was observed in cattle manure (31.56%) at 16WAP which is comparable to pig manure at 8 and 12WAP (28.5467 and 29.2533% respectively), control and poultry manure at 12WAP (31.32 and 31.43%). No significant difference ($P > 0.05$) was observed in hemicelluloses content across the treatments and harvesting age

Conclusion

Brachiaria ruziziensis is a widely cultivated forage grass valued for its adaptability to diverse environmental conditions and its potential to provide high-quality forage for livestock production systems. Agronomic practices, including organic manure application and appropriate harvest timing, can further enhance its nutritive quality. This study evaluated the effects of organic manure application, harvesting age, and their interaction on the forage quality of

Brachiaria ruziziensis. The results showed that harvesting at 8 WAP with organic manure particularly poultry manure significantly increased crude protein (CP) content in the sampled forage. In contrast, manure application had no significant effect on ether extract (EE), ash, crude fibre (CF), nitrogen-free extract (NFE), or fibre fractions. Additionally, the combination of poultry manure and harvesting at 12 WAP produced higher CP than other manure treatments.

Recommendation

To achieve higher crude protein (CP) content needed in supporting production beyond maintenance in ruminant animals, it is recommended to harvest *Brachiaria ruziziensis* at 8 WAP. Alternatively, if harvesting at 12 WAP, the application of poultry manure is advised to enhance CP levels in the forage.

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Date received: 6th February, 2026

Date accepted: 17th April, 2026