Effect of cutting age on the productive indicators and nutritional quality of *Brachiaria hybrid* vc. Mulato I

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***Abstract* — with the objective of determining the productive components, chemical characterization, digestibility and energy contribution of the Brachiaria hybrid vc Mulato I at different ages of cuts in both periods of the year. For which a randomized block design with four repetitions was used. It was sampled in plots of 25 m^2, to which a uniformity cut was applied 10 cm from the ground, without irrigation or fertilization. The yield of total dry matter, leaves and stems was determined; the length and width of the leaves; the leaf-stem ratio, chemical composition (CP, NDF, ADF, ADL, CC, Si, P, Ca, ash and OM), energy contributions and digestibility. A double classification analysis of variance was applied to each variable studied and the means were compared according to Duncan. Crude protein decreased with age for both periods, showing significant differences between all ages. The best values were shown at 30 days of cutt (9.47 and 10.40 % in the rainy and dry periods respectively), the fiber increased with age with its best values at 75 days with (71.39 and 70.11 % in the rainy periods and little rain), aspects that conditioned the quality with a decrease in digestibility and energy intake. The yield of the plant was affected by the periods of the year, being higher in the rainy period. It is concluded that the increase in regrowth age directly influences the depression of nutritional quality and yield in both periods of the year.**

***Keywords:* chemical composition, energy, digestibility, protein, performance**

***Resumen* — Con el objetivo de determinar los componentes productivos, caracterización química, digestibilidad y aporte energético del Brachiaria híbrido vc Mulato I a diferentes edades de corte en ambas épocas del año. Para lo cual se utilizó un diseño de bloques al azar con cuatro repeticiones. Se muestreó en parcelas de 25 m^2, a las cuales se les aplicó un corte de uniformidad a 10 cm del suelo, sin riego ni fertilización. Se determinó el rendimiento de materia seca total, hojas y tallos; el largo y ancho de las hojas; la relación hoja-tallo, composición química (PB, FDN, FDA, LAD, CC, Si, P, Ca, cenizas y MO), aportes energéticos y digestibilidad. Se aplicó un análisis de varianza de clasificación doble a cada variable estudiada y se compararon las medias según Duncan. La proteína cruda disminuyó con la edad para ambos períodos, mostrando diferencias significativas entre todas las edades. Los mejores valores se presentaron a los 30 días de corte (9,47 y 10,40 % en los períodos lluvioso y poco lluvioso respectivamente), la fibra se incrementó con la edad con sus mejores valores a los 75 días con (71,39 y 70,11 % en los períodos lluvioso y poco lluvioso), aspectos que condicionaron la calidad con una disminución en la digestibilidad y el aporte energético. El rendimiento de la planta se vio afectado por los períodos del año, siendo mayor en el período lluvioso. Se concluye que el aumento de la edad de rebrote influye directamente en la disminución de la calidad nutricional en ambos períodos del año.**

***Palabras clave:* composición química, energía, digestibilidad, proteína, rendimiento**

I. INTRODUCTION

AMONG the resources and alternative sources available to producers for livestock feeding in Cuba and other developing countries, grasses and forages are fundamental. These resources account for approximately 70 % of the energy needs and 65 % of the protein requirements for cattle production. However, the productivity of these resources varies significantly across different ecosystems, influenced by factors such as soil and climatic conditions, animal load, irrigation availability, and the specific varieties of grasses used [1].

In tropical countries where grain and cereal production falls short of desired levels, developing livestock supplementation strategies using locally available resources is essential. This approach is a cornerstone of effective livestock programs and is crucial for achieving greater independence and competitiveness in the sector [2].

In Cuba, the production of milk, meat, and their derivatives must primarily rely on livestock management practices that optimize production while utilizing pastures and forages. This strategy is ground in the economics of these products, which do not compete with food needs for direct human consumption, and it leverages the potential of unsuitable, unproductive, or marginal lands for livestock grazing. Given the current economic challenges, the ongoing deterioration of the environment, and

1. The current investigation was carried out as a result of the financing project: Nutritional Evaluation of grasses for the Purpose of Feeding Ruminants. Financing: CITMA Funds.
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Manuscript Received: 20/03/2024
Revised: 25/05/2024
Accepted: 28/08/2024
DOI: https://doi.org/10.29019/enfoqueute.1043

the limited feasibility of continuing high-input livestock operations, relying on pastures and forages emerges as the most viable option for livestock feeding, maximizing their potential [3].

One of the primary limiting factors for animal production in the tropical regions of Latin America is the limited availability and poor quality of forage. Consequently, grasslands are predominantly composed of naturalized species. This inadequate nutritional level significantly contributes to the low productivity of tropical livestock, particularly in areas characterized by low natural soil fertility and seasonal droughts. To address this challenge, it is essential to introduce adapted species with high potential for improved forage quality and availability [4].

In this context, Silva-Cardoso, et al. [5], reported that the introduction of grasses and forages is one of the oldest methods of genetic improvement in crops. Today, this approach enables countries lacking adequate infrastructure for genetic enhancement to incorporate more productive varieties into their commercial varietal structures. However, it is essential to identify species with the highest potential for success in the specific environments where the crops are intends to be introduce, necessitating prior research.

Therefore, the objective of this work was to determine the effect of cutting age on the productive components, chemical characterization, digestibility and energy contribution of the *Brachiaria hybrid* vc Mulato I under current climatic conditions.

II. METHODS

A. Research area, climate, and soil

The experiment was conducts in areas belonging to the Teaching-Productive Department of the University of Granma, located in the southeastern region of Cuba's Granma Province, approximately 17.5 km from the city of Bayamo. The study spanned a two-year period from 2020 to 2021 and considered two distinct seasons: the rainy season (May to October) and the dry season (November to April).

The soil in the study area was classifies as a calcic haptustept [6], with a pH of 6.4. The levels of phosphorus pentoxide (P_2O_5), potassium oxide (K_2O), and total nitrogen (N) were 2.6, 37.5, and 34 mg.100g^{-1} of soil, respectively, with an organic matter content of 3.4 %.

During the rainy season, precipitation reached 712.8 mm. The average, minimum, and maximum temperatures recorded were 27.33 °C, 22.67 °C, and 35.44 °C, respectively, with relative humidity values of 80.04 %, 50.86 %, and 94.33 % for the average, minimum, and maximum, respectively. In the drier period, rainfall totaled 265 mm, with average, minimum, and maximum temperatures of 25.12 °C, 19.38 °C, and 32.65 °C, respectively. The relative humidity ranged from an average minimum of 44.03 % to an average maximum of 95.31 %.

B. Treatment and experimental design

The experiment employed a randomized block design, with treatments consisting of four different cutting ages (30, 45, 60, and 75 days) and four replications.

C. Experiment management

The experimental plots measured 25 m^2 (5x5 m) and were planted in February 2020, with a spacing of 50 cm between rows and 20 cm between plants. The plants underwent an establishment period until July 2020, when a uniformity cut was performs. Thereafter, sampling was conducts at 30, 45, 60, and 75 days after cutting, with a 50 cm edge effect eliminated. All harvestable material was cutting 10 cm above ground level. The following parameters were evaluated: total dry matter yield, leaf and stem yields, leaf length and width, and leaf-to-stem ratio [7]. For each treatment and replicate, two kilograms of samples were collects for subsequent laboratory analysis. No fertilization, irrigation, or chemical weed control measures were applies. At the start of the experiment, the plant population in the plots was 97 %.

D. Determination of chemical composition, digestibility and energy

After collection, the samples were dried in a forced-air circulation oven at 65 °C, ground to a particle size of 1 mm, and stored in amber bottles until laboratory analysis. The following parameters were determines: dry matter (DM), crude protein (CP), ash, organic matter (OM), phosphorus (P), and calcium (Ca) according to AOAC [8]; neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), cellulose (Cel), hemicellulose (Hcel), and cell contents (CC) according to Goering and Van Soest, [9]; Dry matter digestibility was quantify using Aumont, et al. [10] and metabolizable and net lactation energy were established according toCáceres and González, [11]. All analyzes were performs in duplicate and by replication.

E: Statistical analysis

An analysis of variance was performed according to the experimental design and the mean values were compared using Duncan's Multiple Range and Multiple F Tests, [12] after verifying the normality of the data with the Kolmogorov-Smirnov test [13] and the homogeneity of the variance with the Bartlett test [14].

III. RESULTS

The dry matter yield of the Brachiaria hybrid variety Mulato I increases with cutting age, demonstrating significant differences at $p < 0.05$. The highest yields were observes at 75 days, measuring 6.84 t DM ha^{-1} cut during the rainy season and 3.69 t.DM.ha^{-1}.cut^{-1} during the less rainy season. Conversely, the lowest yields were recorders at 30 days, with values of 1.69 t.DM.ha^{-1}.cut^{-1} in the rainy season and 1.51 t.DM ha^{-1}.cut^{-1} in the less rainy season (Fig. 1)

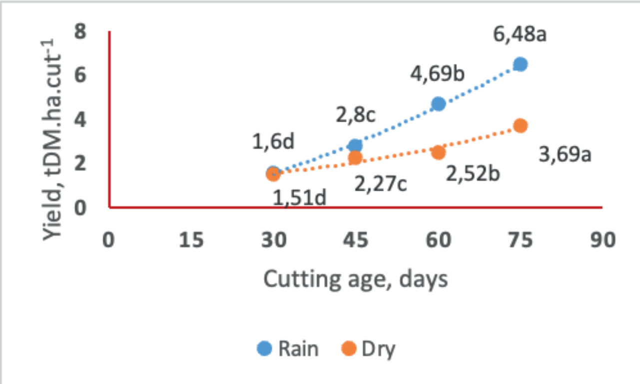

Fig. 1. Performance of the *Brachiaria hybrid* vc Mulato I in the two seasons of the year

As shown in figures 2 and 3, the dry matter yield of both leaves and stems increases with cutting age, exhibiting significant differences at $p < 0.05$ during both periods of the year. The highest yields were recorders at 75 days, with values of 3.1 $t.DM.ha^{-1}.cut^{-1}$ for leaves and 1.92 $t.DM.ha^{-1}.cut^{-1}$ for stems, during the rainy season 3.7 $t.DM.ha^{-1}.cut^{-1}$ for leaves and 1.17 $t.DM.ha^{-1}.cut^{-1}$ for stems during the dry season.

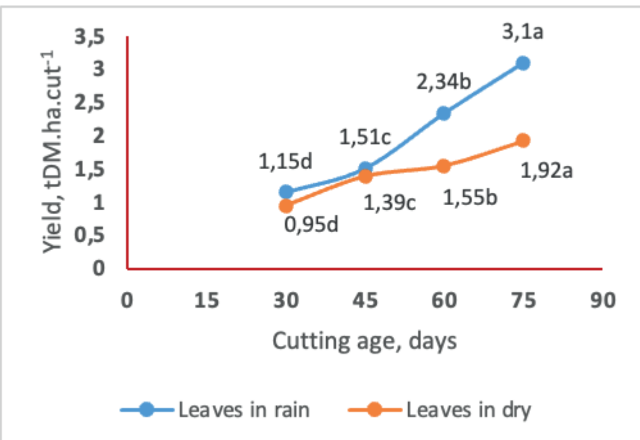

Fig. 2. Yield of leaves of the *Brachiaria hybrid* vc Mulato I during the two seasons of the year

As shown in Table 1, both the length and width of the leaves increase with the age of regrowth, with significant differences observed between some cutting ages. The highest values were recorders at 75 days, measuring 47.80 cm in length and 2.68 cm in width during the rainy season, and 29.00 cm in length and 1.90 cm in width during the dry season.

The leaf-stem proportion decreased with the age of the grass, showing significant differences for $p < 0.05$ (Table 1), among all ages in the study. The proportion of leaves decrease with age, with the highest values observed at 30 days and the lowest at 75 days. During this period, the decrease was 36.59 % in the rainy season and 28.67 % in the dry season. In contrast, the proportion of stems increased, showing rises of 36.32% in the rainy season and 26.3 % in the dry season.

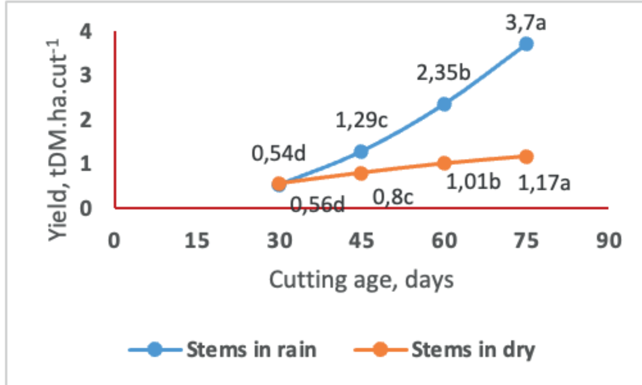

Fig. 3. Yield of stems of the *Brachiaria hybrid* vc Mulato I during the two seasons of the year

TABLE I
LENGTH AND WIDTH OF THE LEAVES AND LEAF-TO-STEM RATIO OF THE *BRACHIARIA HYBRID* VC MULATO IN THE TWO SEASONS OF THE YEAR

	Length and width of the leaves, cm				Leaf-to-stem ratio, %			
	Rain		Dry		Rain		Dry	
Age, days	Length	width	Length	width	Leaves	Stems	Leaves	Stems
30	20.60^{a}	1.55^{a}	13.00^{a}	0.90^{a}	68.13^{a}	31.87^{a}	70.52^{a}	29.48^{a}
45	25.90^{a}	1.78^{a}	15.83^{b}	1.23^{b}	53.71^{b}	46.29^{b}	61.20^{b}	38.80^{b}
60	32.90^{b}	1.93^{a}	20.00^{c}	1.55^{c}	49.07^{c}	48.31^{c}	60.03^{c}	37.00^{c}
75	47.80^{c}	2.68^{b}	29.00^{d}	1.90^{d}	43.20^{d}	50.05^{d}	50.30^{d}	40.00^{d}
SE±	3.009	0.122	1.570	0.096	2.379	1.859	1.889	1.064
P	0.02	0.03	0.01	0.001	0.001	0.001	0.001	0.001

^{abcd} Values with different letters differ at P<0.05 [12]

As shown in Table 3, during the rainy season, the chemical composition of the grass exhibits the following changes, cell wall components increase with cutting age, with values at 75 days exceeding those at other ages for NDF (71.39 %), ADF (33.29 %), ADL (3.23 %), and silica (5.32 %). Crude protein (CP) and cell contents (CC) decrease with age, with the highest values recorded at 30 days (9.47 % and 36.28 %, respectively). Minerals, ash, and organic matter show fluctuations in their behavior across cutting ages.

During the dry season (Table 3), a similar trend was observe, albeit with different numerical values. The highest values were recorders at 30 days, with crude protein (CP) at 10.40 %, cell contents (CC) at 35.38 %, and organic matter (OM) at 88.84 %. These components decrease with age. In contrast, the structural components NDF, ADF, ADL, silica (Si), calcium (Ca), and ash increase with maturity, reaching their highest percentages at 75 days, with values of 70.11 %, 30.15 %, 3.43 %, 8.09 %, 0.45 %, and 13.04 %, respectively.

TABLE II
CHEMICAL COMPOSITION OF *BRACHIARIA HYBRID* VC. MULATO I RAINY SEASON

Age, days	Chemical composition, %									
	CP	**NDF**	**ADF**	**ADL**	**CC**	**Si**	**Ca**	**P**	**Ash**	**OM**
30	9.47[a]	63.72[d]	26.99[c]	0.99[d]	36.28[a]	3.66[d]	0.53[b]	0.015[a]	12.65[c]	87.35[a]
45	8.34[b]	67.29[c]	31.13[b]	1.47[c]	32.71[b]	3.99[c]	0.62[a]	0.014[a]	16.29[a]	83.71[b]
60	7.32[c]	69.10[b]	32.00[a]	2.08[b]	30.90[c]	4.65[b]	0.42[c]	0.012[ab]	11.62[d]	87.38[a]
75	6.39[d]	71.39[a]	33.29[a]	3.23[a]	28.61[d]	5.32[a]	0.53[b]	0.017[b]	13.76[b]	86.24[a]
SE±	0.345	0.794	1.635	0.776	0.884	0.332	0.005	0.001	0.543	1.523
P	0.0001	0.0001	0.001	0.0001	0.0001	0.0001	0.01	0.001	0.0001	0.01

[abcd] Values with different letters differ at P<0.05 [12]

TABLE III
CHEMICAL COMPOSITION OF *BRACHIARIA HYBRID* VC. MULATO I DRY SEASON

Age, days	Chemical composition, %									
	CP	**NDF**	**ADF**	**ADL**	**CC**	**Si**	**Ca**	**P**	**Ash**	**OM**
30	10.40[a]	61.62[d]	26.07[b]	0.99[d]	38.38[a]	4.33[d]	0.28[c]	0.014[c]	11.16[d]	88.84[a]
45	9.83[b]	65.15[c]	27.26[b]	1.11[c]	34.85[b]	4.66[c]	0.38[b]	0.017[a]	12.97[c]	87.03[b]
60	7.17[c]	67.58[b]	29.32[a]	2.08[b]	32.42[c]	5.99[b]	0.41[b]	0.016[ab]	13.32[b]	86.68[c]
75	6.33[d]	70.11[a]	30.15[a]	3.43[a]	29.89[d]	8.09[a]	0.45[a]	0.015[bc]	13.54[a]	86.46[c]
SE±	0.432	0.612	1.543	0.711	0.664	0.321	0.003	0.005	0.212	1.432
P	0.0001	0.0001	0.01	0.0001	0.0001	0.0001	0.01	0.01	0.0001	0.001

[abcd] Values with different letters differ at P<0.05 [12]

Tables 4 and 5 show that during both the rainy and dry seasons, the energy contribution and digestibility indicators of the forage decreased with increasing cutting age. During the rainy season, dry matter digestibility (DMD), organic matter digestibility (OMD), metabolizable energy (ME), net lactation energy (NLE), and net energy for fattening (NEF) decrease by 10.68 %, 11.03 %, 1.66 $MJ.kg^{-1}$ DM, 1.12 $MJ.kg^{-1}$ DM, and 0.82 $MJ.kg^{-1}$ DM. Although the trend was similar during the dry season, the magnitude of the decreases was lower, with DMD, OMD, ME, NLE, and NEF declining by 3.98 %, 2.75 %, 1.09 $MJ.kg^{-1}$ DM, 0.68 $MJ.kg^{-1}$ DM, and 0.36 $MJ.kg^{-1}$ DM, respectively.

TABLE IV
QUALITY OF *BRACHIARIA HYBRID* VC. MULATO I RAINY SEASON

Age, days	%		$MJ.kg^{-1}$ DM		
	DMD	**OMD**	**ME**	**NLE**	NEF
30	58.25[a]	60.06[a]	8.78[a]	4.96[a]	4.47[a]
45	55,93[b]	57.29[a]	8.04[ab]	4.56[ab]	4.25[a]
60	54.12[c]	55.97[b]	7.86[b]	4.19[b]	4.06[b]
75	47.57[d]	49.03[c]	7.12[c]	3.84[c]	3.65[c]
SE±	1.022	0.841	0.023	0.033	0.032
P	0.0001	0.001	0.001	0.001	0.001

[abcd] Values with different letters differ at P<0.05 [12]

TABLE V
QUALITY OF *BRACHIARIA HYBRID* VC. MULATO I DRY SEASON

Age, days	%		$MJ.kg^{-1}$ DM		
	DMD	**OMD**	**ME**	**NLE**	**NEF**
30	57.42[a]	58.05[a]	8.45[a]	4.93[a]	4.42[a]
45	56.86[b]	56.76[b]	7.86[b]	4.48[ab]	4.13[a]
60	51.12[c]	53.68[b]	7.04[c]	4.05[b]	3.99[b]
75	53.44[d]	55.30[d]	7.36[d]	4.25[c]	4.06[c]
SE±	1.734	1.964	0.044	0.036	0.041
P	0.0001	0.0001	0.0001	0.001	0.001

[abcd] Values with different letters differ at P<0.05 [12]

If we consider the potential productive improvements that can be achieve using this species in livestock systems in tropical regions, employing it in monoculture or silvopastoral systems could yield significant benefits. The expected investment for implementing these practices ranges from $844 to $1110, depending on production volumes and nutrient contributions. If the species is, utilize at an average age of 60 days, production rates could increase by 15-30 %, resulting in outputs of 3329 to 3,764 liters per cow per day. Consequently, income could fluctuate between $6742.51 and $7623.73. These benefits are particularly relevant for small and medium-sized producers, who account for more than 60 % of the region's livestock. The improvements could also translate into enhanced public services, such as health, education, housing, roads, and communication. To ensure the sustainability of these results, it is essential to design innovative seed production and marketing schemes that provide the livestock sector with an adequate supply in terms of volume, quality, and price

IV. DISCUSSION

Globally, livestock farming is one of the primary sources of greenhouse gas emissions, contributing to temperature increases of 1-6 ºC in tropical regions. This rise in temperature is expect to enhance evaporation per unit area, leading to alterations in the natural water balance of plants, including grassland species [15]. These effects can be particularly detrimental in areas dominated by dry land farming, where rising temperatures may be accompanies by either decrease or excessive precipitation, directly influencing the productive response of forage species [16].

In a study evaluating two cutting heights (0.4 and 0.5 m) and four levels of nitrogen fertilization (0, 50, 100, and 150 $kg.ha^{-1}$) in *Brachiaria hybrid* variety Mulato II, Marques, et al. [17] reported positive responses in biomass production and dry matter yield, with values of 6.61 $t.ha^{-1}$ and 1.14 $t.ha^{-1}$, respectively, under average temperatures of 23.2 ºC and total precipitation of 1,759.9 mm. Similarly, Faria, et al. [16] under comparable conditions with *B. decumbens* and *B. ruziziensis*, reported yields of 1.12 $t.ha^{-1}$ and 1.6 $t.ha^{-1}$, respectively. These responses highlight that nitrogen fertilization has an immediate and significant impact on the structural characteristics of forage, thereby enhancing productivity.

While, Ramírez, et al. [18] evaluate *Brachiaria decumbens* variety Basilisk in the Cauto Valley, eastern Cuba, during the rainy season (average temperature of 24.3 ºC and 130 mm of rain) and the dry season (27.2 ºC and 759 mm of rain). They report dry matter yields of 6.06 $t.ha^{-1}$ and 1.83 $t.ha^{-1}$, respectively, noting a 43 % decrease in the number of leaves between the two periods. This variation was associate with the influence of climatic factors on productive and morphological indicators (Fig. 1 and 2). It is important to note that the differences in leaf and stem content throughout the year serve as indicators for establishing yield composition. A higher proportion of leaves suggests an increase likelihood of enhancing the photosynthetic process, greater potential for growth substance production, and improved reserve accumulation for regrowth.

Cruz-López, et al. [19] and Tamele, et al. [20] studies the interaction between plant height and climatic season, reporting a negative linear relationship between the two factors. During the summer (350 mm rainfall, 23 °C) and winter (30 mm, 18 °C), leaf appearance increased with plant height. However, leaf and stem growth was negatively affects in winter, as evidence by R^2 values of -0.88 and -0.84, respectively. In contrast, summer saw increases in plant height for both leaves and stems, with R^2 values of 0.94 and 0.92. Brachiaria grass pastures are characterize by higher stem and leaf elongation rates and lower leaf emergence rates, particularly in the upper strata. Grasses exhibit significant variability in their tolerance to water deficit stress. In some cases, they undergo adaptations or escape mechanisms to mitigate the negative effects of stress. Brachiaria species are known for producing numerous decumbent stems that generate tillers under optimal moisture conditions, leading to increased leaf and stem production during summer [21].

Changes in morphological composition are influences by edaphic and climatic conditions, which can either enhance or inhibit the growth of leaves and stems, as well as alter their proportions. These aspects are evident in the results presents in Table 1. Ortega-Aguirre, et al. [22] and Cruz-Hernández, et al. [23] found that leaf emergence increases when temperatures range from 20 to 32.5 °C but decreases when temperatures exceed 35 °C. During the dry season, changes in growth may have been inhibit by low temperatures, while water stress further limited growth. This suggests that plant age plays a crucial role in determining the distribution of dry matter among morphological components.

The proportion of leaves in harvest forage decreases as the interval between harvests increases, primarily due to enhance stem growth when environmental conditions are favorable for plant development, such as during the rainy season. Therefore, the management of defoliation in a pasture significantly influences growth rate, production, botanical composition, quality, and persistence [24]. This indicates that it is essential to consider not only forage yield but also the leaf-to-stem ratio, which can help explain the behavior of the morphological indicators studied here

The observed variations in crude protein (CP) and cell contents (CC) were 1.08 % and 2.16 %, respectively, while the components of the cell wall NDF, ADF, ADL, cellulose, and hemicellulose were 1.82 %, 2.03 %, 0.87 %, 1.15 %, and 0.33 %, respectively (Tables 2 and 4). The lower concentrations in areas with higher rainfall can be attribute to the dilution effect of nutrients present in grasses in regions with abundant precipitation. This phenomenon has been reported by Martín, et al. [3]; Ramírez, et al. [18]; Santos-Cruvinel, et al. [25] and De Abreu-Faria, et al. [26] in cultivars such as *B. decumbens* (Basilisk), *B. brizantha* (Marandu, Piata, Xaraes), and the hybrid CIAT BRO2/1752 (Cayman), demonstrating variability between rainy and dry periods.

Faria, et al. [16] and Marques, et al. [17] reported a directly proportional relationship for crude protein (CP) and an inverse linear relationship for neutral detergent fiber (NDF) and acid detergent fiber (ADF) with nitrogen fertilization. They observe increases of 2 % in protein values (ranging from 12 % to 14 %) and reductions of 20 percentage points for NDF and 6 percentage points for ADF in Mulato II, *B. decumbens*, and B. *brizantha*. In other study, De Almeida-Moreira, et al. [27] evaluated 26 Brachiaria varieties under mesothermal climate conditions and red-yellowish soil, finding that *B. ruziziensis* clones performed best, with CP, NDF, ADF, and acid detergent lignin (ADL) values ranging from 13.5 % to 16.49 %, 50 % to 60 %, 21 % to 30 %, and 3.9 % to 4.06 %, respectively. The *B. ruziziensis* clones exhibit higher percentages of CP and lower percentages of cell wall components compare to the decumbens variety used as a control. This indicates that the improve clones have higher nitrogenous component values and lower structural carbohydrates and phenolic compounds, suggesting a greater leaf-to-stem ratio. The observe differences can guide new crosses in breeding programs aimed at complementing agronomic indicators for the development of superior genotypes.

Regarding ash, mineral, and organic matter content, the highest mineral and ash results were recorder during periods of low rainfall. Ramirez, et al. [28] and De Lucena-Costa, et al. [29] investigated the relationship between climatic factors and mineral content in *B. hybrid* variety Mulato I and *B. brizantha* variety Piatá, reporting high correlations (R^2 > 0.77) between rainfall and average temperatures during both rainy and dry periods for calcium and phosphorus content. Additionally, multiple linear regression equations were established with coefficients greater than R^2 0.81, showing better fits for age, total rainfall, and solar radiation. It was evident that the variability of these mineral elements is primarily due to their higher abundance in the young and growing parts of the plant, particularly in the shoots, young leaves, and root tips. The observe variation in minerals with increasing age is related to the dilution effect caused by vegetative development and water accumulation during the rainy season.

On the other hand, Jiménez, et al. [30] reported data for *B. humidicola* in warm and humid climate conditions, with average temperatures of 26 °C, rainfall of 2,123 mm, and humic acrisol soil. They found values of 16.38 %, 0.015 %, 0.44 %, and 88.04 % for ash, calcium, phosphorus, and organic matter, respectively. Avelar-Magalhães, et al. [31] studied B. brizantha variety Marandú in a humid tropical climate characterized by laptosolic soil, an average temperature of 28 °C, and rainfall of 1,300 mm, reporting values of 16.46 %, 0.02 %, 0.52 %, and 88.21 % for ash, calcium, phosphorus, and organic matter, respectively. Similarly, Mutimura, et al. [32] evaluated *B. brizantha* variety Piatá in a semi-arid climate with average temperatures of 29 °C and rainfall of 600 mm, finding ash, calcium, phosphorus, and organic matter contents of 16.56 %, 0.025 %, 0.60 %, and 88.41 %, respectively. These results align with those reported by Ramírez, et al. [28].

Considering the variability observe in quality results (Tables 4 and 5), these findings are consistent with those of Tamele, et al. [20] who investigated the interaction between cutting height and climatic zone. They noted greater development of leaves and stems in areas with higher solar radiation intensity, precipitation, and average temperatures, concluding that the variability of these elements influences the structural characteristics of forages. It is important to emphasize that the proportions of leaves and stems serve as indicators of forage quality; a higher proportion of leaves indicates greater nutrient content, palatability, and digestibility, as animals tend to consume more leaves than stems.

The digestibility values fall within the range reports in the literature; however, it is noteworthy that the effects of variety play a significant role in the variability of these indicators. De Almeida-Moreira, et al. [27] evaluated several Brachiaria varieties (B. ruziziensis, B. brizantha variety Marandú, and B. decumbens variety Basilisk as a control) with a cutting frequency of every 27 days and a cutting height of 10 cm. They found significant differences in dry matter digestibility (DMD), with the best results (66.69 %) for *B. ruziziensis*. Factors identified as responsible for the variability in digestibility of tropical grasses include climate, plant maturity, soil type, fertilization level and type, growing season, and variability in fiber-nitrogen fractions. Changes in these factors can affect the plant's morphological structure (the proportion of leaves and stems), along with the intrinsic characteristics of each species (genetic improvement) and their adaptability to edaphoclimatic conditions, which may explain the lack of differences found between climatic zones.

The differences observed in the digestibility of matter and organic matter may be linked to the growth and development achieved. This process induces changes in the cell wall structure, particularly in the primary wall, which reduces the intercellular space where nutrients, such as proteins, are located. This reduction is influence by the relative proportions of each chemical component and their individual digestibility. Additionally, the increase in structural components, such as silica and monomeric lignin, also plays a significant role in this process [31]

Jiménez et al. [30] in their study conduct in The Sabana of Huimanguillo, Tabasco, Mexico, found that *Brachiaria humidicola* exhibit the highest in situ dry matter digestibility (ISDMD) values during the winter (dry) season, with percentages exceeding 50 %. The authors suggest that the seasonal differences can be attribute to variations in climatic factors, such as ambient temperature and precipitation, which significantly affect the growth and structure of the grass. On the other hand, Mutimura, et al. [32] reported that B. brizantha cv. Piatá contributed 8.19 MJ of energy and 8.1 kg of milk per day. They concluded that forages with high digestibility and an appropriate fiber-to-nitrogen ratio enhance milk consumption and production. The energy contributions from forages are influences by the plant's maturity, which leads to chemical and biochemical changes in its components, including a decrease in soluble carbohydrates, digestible proteins, and overall dry matter digestibility. Furthermore, it is important to note that the energy value of forages is closely link to the digestibility of organic matter, which is inherently relate to the plant's composition [33].

V. CONCLUSIONS AND RECOMMENDATIONS

The yield of total dry matter, leaves, and stems increased with the age of regrowth, reaching the highest values at 75 days. During this period, the yield increase by 75.29 % and 59.08 % in the rainy and dry seasons, respectively. This finding suggests that *Brachiaria hybrid* Mulato I can serve as a viable option for animal feed during the dry season.

Despite exhibiting similar growth patterns in both climatic seasons, *Brachiaria hybrid* Mulato I showed lower performance during the dry season in terms of leaf growth, cell wall components, digestibility, and energy contribution. However, these results confirm the adaptability and potential of this forage species in ecosystems with limited rainfall.

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