Volume 58, January-December 2024, ISSN: 2079-3480

PASTURE SCIENCE AND OTHER CROPS

CUBAN JOURNAL OF AGRICULTURAL SCIENCE

Journal site: https://cjascience.com Cu-ID: https://cu-id.com/1996/v58e10

PRODUCTIVE PERFORMANCE, CHEMICAL CHARACTERIZATION AND ENERGY CONTRIBUTION OF *MEGATHYRSUS MAXIMUS* VC. TANZANIA

COMPORTAMIENTO PRODUCTIVO, CARACTERIZACIÓN QUÍMICA, DIGESTIBIDAD Y APORTE ENERGÉTICO DEL *MEGATHYRSUS MAXIMUS* VC. TANZANIA

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With the objective of evaluating the productive performance, chemical characterization, digestibility and energy contribution of *Megathyrsus maximus* vc. Tanzania at different regrowth ages, in both periods of the year, and under climatic condition of Granma province, a random block design with four replications was used. It was sampled in 25 m²plots, to which uniformity cut at 10 cm from the soil was applied, without irrigation and fertilization. It was determined the yield of total dry matter, leaves and stems; the length and width of leaves; leaf-stem proportion; the chemical composition (CP, NDF, ADF, ADL, CC, Si, P, Ca, ash and OM); energy contribution and digestibility. Analysis of variance of each studied variable was applied. The yields were higher at 75 days with 4.02 and 2.56 tDM/ha/cut in the rainy and dry season, respectively, the crude protein decreased with the age in both seasons and showed significant differences among all ages. The best values were showed at 30 regrowth days (9.44 and 10.11 % in the rainy and dry seasons, respectively), the fiber increase with the age with their higher values at 75 days with 68.04 and 67.45 % in the rainy and dry seasons, respectively, aspects that determine the quality with decrease of digestibility and energy contribution. The plant yield was affected by the seasons of the year, being higher in the rainy season. It is concluded that the evaluated cultivar has adequate morphological and productive performance under low rainfalls conditions, so is a viable option for animal feeding.

Key words: *quality, energy, digestibility, productivity, protein*

Con el objetivo de evaluar el comportamiento productivo, caracterización química, digestibidad y aporte energético del *Megathyrsus maximus* vc. Tanzania a diferentes edades de rebrote, en ambos períodos del año, y en las condiciones climáticas de la provincia Granma, se empleó un diseño en bloques al azar con cuatro replicas. Se muestreó en parcelas de 25 m², a la cual se aplicó un corte de uniformidad a 10 cm del suelo, sin riego, ni fertilización. Se determinó el rendimiento de materia seca total, de las hojas y los tallos; la longitud y el ancho de las hojas; la proporción hoja-tallo; la composición química (PB, FDN, FDA, LAD, CC, Si, P, Ca, ceniza y MO); el aporte de energía y la digestibilidad. Se aplicó análisis de varianza a cada variable estudiada. Los rendimientos fueron mayores a los 75 días con 4.02 y 2.56 tMS/ha/corte en el período lluvioso y poco lluvioso, respectivamente, la proteína bruta disminuyó con la edad en ambos períodos y mostró diferencias significativas entre todas las edades. Los mejores valores se mostraron a los 30 días de rebrote (9.44 y 10.11 % en los períodos lluvioso y poco lluvioso, respectivamente), la fibra aumentó con la edad con sus mayores valores a los 75 días con 68.04 y 67.45 % en los periodos lluvioso y poco lluvioso, respectivamente, aspectos que condicionaron la calidad con disminución de la digestibidad y aporte energético. El rendimiento de la planta se afectó por los períodos del año, siendo mayor en el período lluvioso. Se concluye que el cultivar evaluado presenta adecuado comportamiento morfológico y productivo en condiciones de escasas precipitaciones, por lo que constituye una opción viable para la alimentación animal.

Palabras clave: *calidad, energía, digestibilidad, productividad, proteína*

Received: January 05, 2024
Accepted: April 06, 2024
Conflict of interest: There is not conflict of interest among the authors.
CRediT authorship contribution statement: W. Pincay-Ronquillo: **Conceptualization, Data curation, Investigation, Writing - original draft.** Tatiana Gavilánez-Buñay: **Conceptualization, Data curation, Investigation, Writing - original draft.** D.M. Verdecia: **Conceptualization, Data curation, Investigation, Writing - original draft.** E. Chacón-Marcheco: **Data curation, Investigation, Writing - original draft.** J.L. Ramírez-de la Ribera: **Conceptualization, Data curation, Investigation, Writing - original draft.** R.S. Herrera: **Conceptualization, Data curation, Investigation, Writing - original draft.**

Introduction

Currently there is environmental worsening due to the adverse socioeconomic impact that is in the agricultural sector, which is the result of the inadequate use of natural recourses. As well as the incorrect application of technologies so it is necessary to take strategies to mitigate and reverse the agricultural reality into a sustainable activity (Barragán-Hernández and Cajas-Girón 2019).

One of the main limiting factors for animal production in the tropics of Latin American and Cuba is the low availability and poor forages quality. Aspect that influence on the low livestock productivity, especially in areas of soils of natural low fertility, low drainage and with seasonal droughts (Patiño-Pardo *et al.* 2018).

Among these strategies it is the introduction of meadow species with high productive potential, adaptability to the changeable conditions of the environment and soil conditions, the *Megathyrsus maximus* specie is a grass with adequate response to the tropical conditions, although their real potential cannot be expressed by the edaphoclimatic conditions, mainly by the annual distribution of rains, and jointly with other factors of the environment and management, bring with it that these ones did not totally show their productive performance. These elements interact and have marked effect on the growth of species and varieties in the different months of the year, causing a lack of food mainly in the dry season (Herrera *et al.* 2020 and Cedeño-Aristega *et al.* 2021).

In the last years the advances reached in the field of production and animal nutrition needs the precise knowledge of yields and nutritional contribution of grasses and forages, which constitutes the higher source for animal feeding and more economic. For this, it is important to know the nutritive quality of the different grasses and forages, green or preserve, which take part of the ration and allow exteriorizing the high production potential of animals (Mojica-Rodríguez y Burbano-Erazo 2020).

Due to the above, researchers about yield performance, chemical composition, digestibility and energy contribution of *Megathyrsus maximus* vc. Tanzania under several edaphoclimatic conditions in different areas of Granma province is of great importance, especially by the expectations that has being creating by their productive potential and wide level of adaptation to the different climatic conditions and wide range of soils. Hence, the objective of this research was to evaluate the productive performance, chemical characterization, digestibility and energy contribution of *Megathyrsus maximus* vc. Tanzania to different regrowth ages in both seasons of the year, under the climatic conditions of Granma province.

Materials and Methods

Location of the experimental area, climate and soil. The research was developed in areas of the UEB "Pedro A. Borras Astorga" located in Yara municipality, in the Empresa Agroindustrial de Granos "Fernando Echenique", during the two season of the year: rainy season (July-September, 2020) and dry season (November, 2020-January, 2021).

The soil in the area was fluvisol (Hernández *et al.* 2015), with pH of 6.4. The content of P_2O_5, K_2O and total N was 2.6, 37.5 and 34 (mg/100g of soil, respectively) with 3.3 % of organic matter.

During the rainy season, the rainfalls were of 731.4 mm; the average, minimum and maximum temperature recorded values of 26.73, 22.31 and 34.92 ºC, respectively and the relative humidity was 80.78, 51.02 and 96.22 %, for the average, minimum and maximum, respectively. In the dry season, the rainfalls reached values of 270 mm; the temperature was 24.05, 18.29 and 31.58 ºC for the average, minimum and maximum, respectively and the minimum, average and maximum relative humidity with averages of 76.21, 44.16 and 97.03 %, values that correspond with the historical average for the region.

Treatment and experimental design. A random block design was used, the treatments consisted on the regrowth age (30, 45, 60 and 75 days) and four replications.

The experimental plots 25 m^2 (5x5 m) were sowing in February, 2020 with 50 cm between rows and 20 cm between plants. The plants had an establishment period until July, 2020, where the uniformity cut was made. From there, samplings at 30, 45, 60 and 75 regrowth days were made, eliminating 50 cm of border effect and all the material from the harvestable area at 10 cm above soil level. The yield of total dry matter, leaves and stems, length and width of leaves and leaf/ stem ratio were evaluated (Herrera 2006). Then two kilograms were taken for each of the treatments and replications for further analysis in the laboratory. No fertilization, irrigation and chemical treatment was used to eliminate weeds. At the beginning of the experiment the population of the varieties in the plots was 97 %.

Determination of chemical composition. The samples after collecting were dried in an air forced-draft oven at 65 °C, later were milled to 1mm particle size and stored in amber bottles until their analysis in the laboratory. The DM, CP, ash, OM, P and Ca were determined according to AOAC (2016); NDF, ADF, ADL, cellulose (Cel), hemicellulose (Hcel) and cellular content (CC) according to Goering and Van Soest (1970); the dry matter digestibility was quantified by Aumont *et al.* (1995) and the metabolizable energy and net lactation energy were established according to Cáceres and González (2000). All analyzes were performed in duplicate and by replication.

Statistical analysis and calculations. Analysis of variance was performed according to the experimental design and mean values were compared using Duncan (1955) multiple range test. For the normal distribution of the data the Kolmogorov-Smirnov (Massey 1951) test was used and for the variances the Bartlett (1937) test.

Results and Discussion

The yield during both season of the year (figure 1) had increases in accordance the plant maturity advance, with significant differences for $p<0.05$, among all the ages under study, with the highest results at 75 days of 4.02 and 2.56 tDM/ha/cut and increases of 2.35 and 1.54 tDM/ha/cut (58.46 and 40.62 %) for the rainy and dry season, respectively.

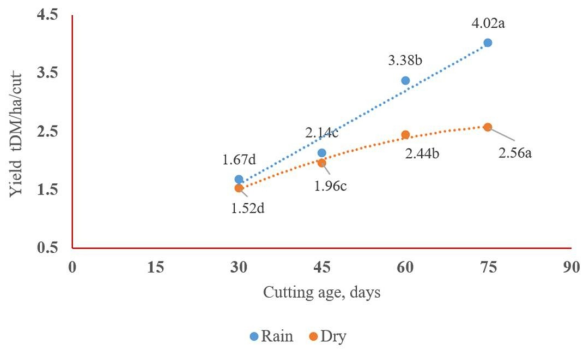

Figure 1. Yield (tDM/ha/cut) of *Megathyrsus maximus* cv. Tanzania in the two seasons of the year

The increases of the dry matter yield with the regrowth age in both seasons of the year are due, mainly, that the plant increases the photosynthetic activity and with it the synthesis of structural carbohydrates, so there is increase in the accumulation of dry matter in the supporting organs as stems, with their higher amount during the rainy season. These results coincide with those reported by Verdecia *et al.* (2015), for Valle del Cauto and Méndez-Martínez *et al.* (2019, 2020), for the cultivars Común, Tanzania, Mombasa and Tobiatá under the conditions of three regions of Ecuador, and find interaction variety- climatic zone. In addition, they stated that for the livestock in the tropic are difficult times, where the activity depends on the forage supply, while these ones in turn are in function of the soils and water, among other factors.

The farmers suffer this situation due to the forests degradation, later the forages and soils. This circle of economic, environmental and social degradation is a complex phenomenon at global scale recognized by the United Nations, named desertification. Process that is based on the reduction or loss of the biological or economical productivity of the earth bioproductive system that includes soil, vegetation, other biota components and ecological and hydrological processes, especially in the ecosystems from the dry areas, due to the way of using the earth and combination of resulting processes of the human activities and climatic factors (Maricelis *et al.* 2022).

On the other hand, Cedeño-Aristega *et al.* (2021) under the Ecuadorean subtropics when evaluating *Megathyrsus maximus* cultivar Tanzania and Mombasa with rainfalls of 2061 mm and the average temperature for the rainy an dry season is 24.5 and 25.0 °C, respectively and sandy soil, find yields of 4-6 tDM/ha, productions higher to those reported in this research. These differences are marked by environmental factors that most contrast in the grasses performance like: time, locality, year, fertilization and irrigation, as well as also the specific and general adaptability of the cultivars in favorable and unfavorable environments (Milera *et al.* 2017). Although about the cultivar under study it can be state that this grass is easily adapted to different climatic conditions, although when there is excess of rains it can be affected influencing on their productive yields. However, it has been a widespread and introduced grass in the tropical zone by their advantages. Also, it was reported that in early age is most use by the animal due to the high capacity of leaves production (Maricelis *et al.* 2022).

For the dry matter yield of leaves and stems (figure 2), there was a similar performance to the total yield, with significant differences for $p<0.05$ as the plant maturity advanced with increases up to 60 days for the leaves in the rainy season with 2.40 tDM/ha/cut, for later decrease up to 75 days in 0.15 tDM/ha/cut; while for the leaves in the dry season and stems in both seasons, increased up to 75 days with the highest values (1.70 and 0.86 tDM/ha/cut, respectively).

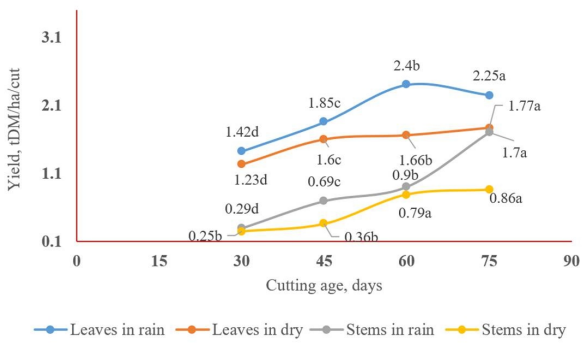

Figure 2. Yields (tDM/ha/cut) of leaves and stems of *Megathyrsus maximus* cv. Tanzania in both seasonal periods

During the study periods the increase of the stems with the age and decrease of leaves for the rainy season from the 60 days is link to that during this stage there is stem

growing and increase in the senescence of leaves, influenced by the climate conditions that interact and has marked effect on the growing and developing of species and varieties of grasses in the different months of the year, causing a seasonal unbalance in the yields, that cause high amounts during the rainy season (May- October) and low during the dry season (November- April). To this situation is added that, the soils destined to grasses cultivation, most of them are of low fertility and bad, that jointly to the climate, negative effects on the productivity and persistence of forages (Herrera 2022).

These aspects has been taking into account for the introduction of improvement species with adaptability to the different livestock systems, with higher potentialities from the productive point of view and nutritional quality, as the case of the variety under study (Tanzania). Hence that, Herrera *et al*. (2018) showed that the plant species exits, they reproduce and live in certain edaphoclimatic contexts, which can be consider as tolerance to those conditions. In the case of this study it can be verify, where the distribution of rains make important influence on the yield of this *Megathyrsus maximus* variety.

This performance is due, according to Avellaneda-Cáceres *et al*. (2019), that the growing and productivity of grasses is influence by the climatic conditions mainly by the annual distribution of rains, that join to other environment factors and of management (fertilization, irrigation and cut frequency), had an effect on the grasses and forage did not totally reached their productive potential, which is showed in different zones in the tropics, in Ecuador in the Interandean regions, Amazonia and the coast as showed Uvidia *et al.* (2015), Méndez-Martinez *et al.* (2020) and Derichs *et al.* (2021); De Lucena-Costa *et al*. (2018) in Boa Vista, Brasil and Verdecia *et al.* (2015) in Valle del Cauto, Cuba.

On the other hand, Fortes *et al.* (2016) under the west of Cuba conditions and low rainfalls (53 mm) and average temperatures of 27 °C, reported 5.45 and 1.87 tDM/ha in leaves and stems, respectively in Mombasa variety and Oyedeji *et al.* (2016) in Nigeria showed yields under monoculture conditions of Común variety of 0.53, 0.40 and 0.65, 0.52 tDM/ha, for the dry matter yield of leaves and stems, in the rainy and dry season, respectively with rainfalls of 200-300 mm, as well as, averages temperatures of 33-34 ºC. Therefore, Sánchez-Hernández *et al.* (2019) and Tapia-Coronado *et al.* (2023), when applying chemical fertilization and humid climate of Oaxaca Mexico and the humid and dry Caribbean of Colombia duplicate the reported productions under Cuba conditions, showing the manage effect and the excellent response to the fertilization of these species.

The length and width of leaves was increased as the regrowth age advance in the two season of the year, with significant differences for $p<0.05$, showing the highest values at 75days (81.75 and 2.88 cm for the rainy season and 57.00 and 2.33 cm for the dry season), with increase in its value in 47.18 and 37.5 % and 53.07 and 44.21 %, respectively. The number of leaves decreased and the stems increased with the plant age, for both seasons and the best results were at 30 days (80.92 and 19.08 % and 84.87 and 15.13 %, respectively), when decreasing the leaves in 37.72 and 31.31 %; the stems increased with 44.86 and 56.52 % in the rainy and dry season, respectively (table 1).

The increase of the length and width of leaves with the plant age in both seasons of the year, are due to the physiological response of the plants, increase of the intensity of the photosynthetic activity, which can be affected during the dry season due to the decrease of rains causing a humidity deficit in the soil and influencing on the assimilation of CO_2 and consequently affecting the productive response of the grass (Patiño-Prado *et al*. 2018).

On the other hand, the decrease of leaves ratio and increase of stems during the study period, is due that during the first regrowth weeks appears lower number of tillers and need of the plant of create the necessary substances for their development make possible the higher amount of

Table 1. Lenght and width of leaves and leaf and stem ratio of *Megathyrsus maximus* cv. Tanzania in the two seasons of the year.

Age, days	Leaves, cm				Leaf and Stem, %			
	Rainy season		Dry season		Rainy		Dry	
	Length	Width	Length	Width	Leaves	Stems	Leaves	Stems
30	43.18^{a}	1.80^{a}	26.75^{a}	1.30^{a}	80.92^{a}	19.08^{a}	84.87^{a}	15.13^{a}
45	57.48^{ab}	2.15^{b}	37.25^{b}	1.55^{b}	67.84^{b}	32.15^{b}	81.63^{b}	18.37^{b}
60	71.78^{b}	2.56^{c}	47.00^{c}	1.90^{c}	59.00^{c}	32.50^{c}	68.40^{c}	26.60^{c}
75	81.75^{c}	2.88^{d}	57.00^{d}	2.33^{d}	50.40^{d}	34.60^{d}	58.30^{d}	34.80^{d}
SE±	4.17	0.11	2.92	0.10	2.91	1.58	2.79	1.97
P	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

^{abcd} Uncommon letters in row differ to $p<0.05$ according to Duncan (1955)

leaves and low stems ratio (Herrera 2022). However, their decrease is associated according to Reyes-Pérez *et al*. (2019) and Méndez-Martínez *et al*. (2019, 2020), to the increase of the stems length and their thickness, as well as the aging. The seasonal growing of the morphological components of the plant has direct relation with the edaphoclimatic and management conditions to which the forage is passes through. The amount of leaves and stems, as well as their growing responds to the genotype-environment interaction, result in the increase or decrease of grasses yields. The knowing of this effect, allows to know the availability and, in consequence, to adopt management strategies of the grass (Velasco *et al*. 2018 and Schnellmann *et al.* 2019).

With the science development it has been showed that not only the climatic factors influence on the morphological development of the, in this sense in Méndez-Martínez *et al*. (2020) studies when evaluating the effect of the climatic zone on the growth, number of leaves and stems find higher values in the area of considerable rainfalls, 245.6 mm, and 25.8 °C of temperatures while, Fortes *et al.* (2016), Cedeño-Aristega *et al.* (2021) and Lucero-Pita *et al.* (2023) under west of Cuba and Ecuadorean subtropics conditions reported leaves and stems ratio of 75.5 and 24.5 %. Therefore, other factors as soils characteristics, fertilization, water availability sowing time and management plays important role in the plant systems production. The grasses are a clearly example of the above mentioned (Herrera 2022).

The importance of knowing the amount of leaves the specie can has compared with the stem is of vital importance, since the nutritive value of the plant is concentrate in a higher leaves production. In turn, this one is of high palatability for the ruminant. The reality is that the leaves percentage is a relative indicator and any variation of the luminosity intensity that favors or reduce their total weight, did not has to affect the relation if it equally influence on the leaves and stems as it is observed on the obtained results in this study (Pérez-Luna *et al.* 2023).

The chemical composition during the rainy season (table 2) showed significant differences for $p<0.05$, with increases of the cell wall components and minerals at 75 days compared with 30 days in 6.67, 4.12, 3.95, 2.70, 0.08 and 3.12 % for NDF, ADF, ADL, Si, Ca and ash, respectively while for CP, CC and OM there was decreases in their concentration in 4.80, 6.22 and 3.12 % in the same order; the phosphorous did not show a defined performance increasing their percentages up to 45 days for later decreased. For the dry season (table 3) and the same ages previous compared a similar pattern for CP, CC, P and OM was maintained and they decreased in 4.38, 3.22, 0.06 and 3.60 %, as well as increases of 2.80, 7.39, 2.55, 3.70, 0.12 and 3.60 %, respectively for NDF, ADF, ADL, Si, Ca and ashes.

The chemical composition (tables 2 and 3) decreased with the plant maturity. Méndez-Martínez *et al.* (2019) when evaluating the cultivars Tanzania, Tobiatá and Común under Guayas, Ecuador conditions find for the Comun variety significant increases of the cell wall (50 %). Fernandes *et al.* (2016) and Cedeño-Aristega *et al.* (2021) reported for *Megathyrsus maximus* cv. Tanzania and Mombasa values of the fibrous components (NDF, ADF, ADL) of 75, 36 and 6.12 %, respectively with the increase of the regrowth age, and they associated to the increase of the supporting tissue (stems) ratio. On the other hand, Antonio *et al.* (2018) and Derichs *et al.* (2021) in Tanzania and Mombasa find concentrations of CP (7.12-17.1 %), NDF (64.35-73.6 %), ADF (34.2-52.33 %), Lignin (5.2-13.18 %), Ash (8.1-12.93 %) and OM (85.6- 88.4 %), which were influenced by the increase of the physiological age of the plant and the values of the structural components of the cell wall. The previous show that, when increasing the grasses age, there is significant increase of ADF, NDF and ADL due to the higher synthesis of structural carbohydrates, which reduce the grass quality.

Méndez-Martínez *et al.* (2020) find that for the variation of the chemical composition there was only interaction variety- zone for CP and the cell wall components (NDF, ADF, ADL, CEL and HCEL) there were not differences, which agree with those stated by Schnellmann *et al.* (2019), Lucero-Pita *et al.* (2023) and Tapia-Coronado *et al.* (2023), who showed that when the nutritive value of forages is

Table 2. Chemical composition of d *Megathyrsus maximus* cv. Tanzania in the rainy season

Age, days	Chemical composition, %									
	CP	NDF	ADF	ADL	CC	Si	Ca	P	Ashes	OM
30	9.44^{a}	68.04^{d}	31.65^{b}	1.22^{d}	31.89^{a}	4.63^{d}	0.46^{b}	0.16^{a}	9.98^{d}	90.02^{a}
45	7.94^{b}	69.95^{c}	31.96^{b}	3.45^{c}	30.15^{b}	5.88^{c}	0.50^{ab}	0.17^{a}	10.80^{c}	89.20^{b}
60	6.55^{c}	72.12^{b}	35.47^{a}	4.12^{b}	27.96^{c}	6.95^{b}	0.52^{ab}	0.15^{ab}	12.20^{b}	87.80^{c}
75	4.64^{d}	74.71^{a}	35.77^{a}	5.17^{a}	25.67d	7.33^{a}	0.54^{a}	0.14^{b}	13.10^{a}	86.90^{d}
SE±	0.29	0.58	1.78	0.66	0.78	0.45	0.007	0.003	0.31	0.87
P	0.0001	0.0001	0.01	0.0001	0.0001	0.0001	0.01	0.001	0.0001	0.0001

^{abcd} Uncommon different letters differ to $p<0.05$ according to Duncan (1955)

Table 3. Chemical composition of *Megathyrsus maximus* cv. Tanzania in the dry season

Age, days	Chemical composition, %									
	CP	NDF	ADF	ADL	CC	Si	Ca	P	Ashes	OM
30	10.11[a]	67.45[c]	28.27[c]	1.11[d]	32.53[a]	4.96[d]	0.66[c]	0.26[a]	10.90[d]	89.10[a]
45	8.67[b]	68.24[b]	29.45[b]	1.89[c]	31.18[a]	5.89[c]	0.69[bc]	0.25[ab]	11.60[c]	88.40[b]
60	7.24[c]	69.33[a]	34.02[a]	2.04[b]	30.62[c]	7.37[b]	0.71[b]	0.23[b]	12.30[b]	87.70[c]
75	5.73[d]	70.25[a]	35.66[a]	3.66[a]	29.31[d]	8.66[a]	0.78[a]	0.20[c]	14.50[a]	85.50[d]
SE±	0.56	1.34	0.78	0.006	0.23	0.34	0.002	0.004	0.27	1.02
P	0.0001	0.001	0.001	0.0001	0.0001	0.0001	0.02	0.002	0.0001	0.0001

[abcd] Uncommon different letters differ to p<0.05 according to Duncan (1955)

analyzed, the variability is minimum between cultivars and varieties from a same genus, but it quality is affected by the fluctuations of rains and temperatures , performance showed in this study where despite of maintain a same tendency in both seasonal periods, there were obtained different numerical values. Hence, the use of improvement grasses with high adaptability to the different conditions in the livestock systems and similar chemical composition, are elements that should be considered when selecting the varieties for their use in the livestock production systems.

The rainfalls can cause stress in the different crops if it is in deficit as in excess. The water abundance causes anoxia in the roots, affecting their aerobic respiration, absorption of minerals and water, if this situation is extended in non tolerant species, causes decrease of the assimilation and translocation of the carbon, causing metabolic changes which activate the anaerobic respiration, which involve low energy efficiency and bioproductivity in the plant, While, the water stress by lack of water decrease the concentration of the cell wall in the leaves and stems of the grasses, although in a changeable way in their structural components (cellulose, hemicelluloses) and polyphenols (lignin), due to the need of the plant of having high carbohydrates values in soluble ways during the osmotic fits (Álvarez 2019).

The above is showed in Montenegro *et al*. (2018) results in Común variety, when reporting 8.61, 73.70 and 33.91 % for CP, NDF and ADF, respectively with rainfalls of 500 mm and temperatures of 32 ºC. Mojica-Rodríguez *et al*. (2017) and Montalvão *et al.* (2018), reported contents of CP, NDF, ADF, ADL, HCEL and CEL of 10.2, 70.8, 46.6, 5.8, 24.2 and 40.7 %, respectively when evaluating the effect of the regrowth age on the quality of Mombasa and Tanzania cultivars, and the differences in relation with this research can be attributed to the prevailing climatic conditions, to the fertilization effect, of the nutrients dilution by the rains, higher stem growing, experimental and management conditions among other factors.

The low values of minerals and organic matter find in this study (tables 2 and 3) can be attributable to the effect of the low rainfalls during the study period (731.4 mm in the rainy season and 270 mm in the dry season) which allow the minerals fluctuated and during the period of higher lack of rainfalls caused their dilution effect on the water concentration in the forage and their values did not higher during the dry season (De Barros *et al*. 2017). While, Méndez-Martínez *et al.* (2018) and Montalvão *et al.* (2018) reported similar results with ash percentages (9-14) and OM (85-90) for this species and concluded that the variability of these indicators depends of the own characteristics of each species and effect of the edaphoclimatic conditions.

The differences between climatic seasons are attributable according to Pereira *et al.* (2017), Méndez-Martínez *et al.* (2020) and Lucero-Pita *et al.* (2023) to the effect of the climate factors, specifically of rains and temperatures that favors higher growing and development of the plant (maturity). It is know that the minerals are the most in the young parts and in growing, especially in the shoots, young leaves and top roots and their decrease during the rains is related with the dilution caused by the plant development.

Regarding the quality indicators (tables 4 and 5) in both seasonal periods a decrease of these ones occurs, in the rainy season the DMD, OMD, ME, NLE and ENE were reduced in 7.65, 8.10 percentage units, 1.46, 0.88 and 1.17 MJ/kg DM, respectively while in the dry season were of 19.88, 19.17 percentage units, 3.09, 2.28 and 2.54 MJ/kg DM, respectively. These results coincide with those reported by Méndez-Martínez *et al.* (2019, 2020) in Común, Tanzania and Tobiatá varieties and argued that this performance is due to the anatomic characteristics of each variety and climatic variations, since these cultivars has higher proportion of available leaves for animal intake, there is not many differences as to their growing in the different season s of the year which make them promising for livestock feeding.

The decrease of the quality by the increase in the forages maturity, with decrease of DMD, OMD, ME and NLE was reported by Montalvão *et al.* (2018) and Tapia-Coronado *et al.* (2023) and they obtained similar results in the relation between the fraction fibrous and nitrogen, explaining that as the regrowth age increase there is a decrease of leaves percentage and stems increase, and so low levels of CP and g high of the cell wall components that affects the

Table 4. Quality of *Megathyrsus maximus* cv. Mombasa in the rainy season

Age, days	%		MJ/kgDM		
	DMD	OMD	ME	NLE	ENE
30	47.12[a]	48.66[a]	6.98[a]	3.82[a]	3.32[a]
45	45.33[b]	47.59[a]	6.56[ab]	3.64[ab]	3.08[a]
60	43.22[c]	44.37[b]	6.32[b]	3.37[b]	2.71[b]
75	39.47[d]	40.56[c]	5.62[c]	2.94[c]	2.15[c]
SE±	1.03	0.96	0.03	0.04	0.04
P	0.0001	0.001	0.001	0.001	0.001

[abcd] Uncommon different letters differ to p<0.05 according to Duncan (1955)

Table 5. Quality of *Megathyrsus maximus* cv. Mombasa in the dry season

Age, days	%		MJ/kgDM		
	DMD	OMD	ME	NLE	ENE
30	56.46[a]	57.05[a]	8.45[a]	4.93[a]	4.42[a]
45	53.56[b]	54.72[b]	7.86[b]	4.48[ab]	4.13[a]
60	45.77[c]	47.66[b]	6.74[c]	3.66[b]	3.09[b]
75	36.58[d]	37.88[d]	5.36[d]	2.65[c]	1.88[c]
SE±	1.73	1.96	0.04	0.04	0.04
P	0.0001	0.001	0.001	0.001	0.001

[a,b c d] Uncommon different letters differ to p<0.05 according to Duncan (1955)

organic matter degradation and energy contribution due to the lower efficiency of rumen microorganisms. In Fernandes *et al.* (2014, 2016) studies notified for Tanzania variety digestibility of the dry matter and crude protein of 63.66 to 58.04 % and 54.1 a 56.31 %, respectively, with decrease influenced by the fibrous fraction increase and foliage decrease and consequent the biomass quality.

The variability of the digestibility and energy contribution due to the climate effect, was showed by Valles-de la Mora *et al.* (2016) and Méndez-Martínez *et al.* (2020), who when evaluating the effect of the seasonal nature in the quality of *Megathyrsus maximus* cv. Tanzania, Común and Tobiatá in three moments of the year (March-June, 200 mm and 30 ºC; August-November, 400 mm 32 ºC and January -April, 80 mm and 28 ºC) and two regions (Guayas 117.2 mm and 23.87 °C; Empalme 245.6 mm and 25.80 °C) find the best results in the interval January- April of low rainfalls and higher average temperature with digestibility of 73.8 % and a difference of 14.1 percentage units with respect to the period of higher rains and the best energy contribution was for the one of higher rainfalls, while for the climatic zones there were not differences for the regions with differences of 0.89 % and 0.69 MJ/kg DM.

When using fibrolite enzymes in *Megathyrsus maximus* cv. Mombasa, Antonio *et al.* (2018) notified increases in the digestibility of DM, NDF, ADF, ADL, hemicelluloses and cellulose of 1.7, 3.1, 4.7, 2.1, 2.3 and 4.6 %, respectively explaining that the cellulose and hemicelluloses are fermented by the rumen microorganisms with relative easily. Therefore, as the lignin content increases, this one is joined to the carbohydrates which were not available for the rumen microorganisms and digestive enzymes, so the fermentation degree decreased, which can be zero, depending on the lignifications intensity. Each type of lignocelluloses complex has a maximum fermentation degree by the microorganisms, and this one can be alter when treatments of the material are performed. The increase in the degradation of the fibrous fraction when the enzymes are used in the foods confirms that the lignin is a degradation limiting factor.

Ortega-Aguirre *et al.* (2015) and Avellaneda-Cáceres *et al*. (2019) when studing five *Megathyrsus maximus* varieties (Común, Tanzania, Enano, Mombaza and Tobiatá), did not find significant differences in the digestibility and reported DMD above 47% and considered that the causes of this performance is the constitutive similarity of the different cellular components of the plant in function of the variety. It is of highlight that the digestibility and energy contribution values of this study are in the range of those reported in the international literature. On this matter, several researchers has been reported that the link of grasses from *Megathyrsus* genus is ideal to intensify the livestock systems, due to their high yields and nutritional quality for the development of sustainable systems, been in monoculture or in associations in silvopastoral systems (Barragán-Hernández y Cajas-Girón 2019 and Contreras-Santos *et al*. 2021).

Conclusions

It is concluded that the evaluated cultivar during the dry season has good performance for the morphological components and yield, so it constitutes a viable option for the livestock production systems during the low food availability. Despite there were similar performance in both climatic seasons and lower management during the dry season for the growing of leaves and cell wall components has high digestibility and energy contribution so their adaptability and potentialities in low rainfall ecosystems is confirmed.

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