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Nutritive quality of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 under edaphoclimatic conditions of Zamorano, Honduras

Calidad nutritiva de *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 en condiciones edafoclimáticas de Zamorano, Honduras

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Livestock in Latin American and the Caribbean is developing based on naturalized meadows with low productions and nutritive contribution, hence the introduction of species with high productive potential and nutritive quality is necessary. Therefore, the effect of regrowth age on yield indicators, chemical composition and digestibility of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 was evaluated under the edaphoclimatic conditions of Zamorano, Honduras. The evaluation lasted a period of 193 days, between October 2020 and May 2021 (dry season). The average of rainfalls in the study months was 44.56 mm. A random block design was used, and the treatments (days of grass cut) were 30, 45, 60, 75 and 90 days. The best relation leaf/stem was finding at 75 days ($P<0.05$), also, at 90 days the highest growth (235.94 cm) was identified. Likewise, the higher content of dry matter and crude protein at 75 and 45 days (12.91 %) was quantified ($P<0.05$), respectively, which influence on the digestibility and in the metabolizable and net energy of lactation ($P<0.05$). The cut at 90 days provoked higher quantification of neutral detergent fiber (50.15 %), although the mineral content decreases with the cut age. It is concluded that this study takes part of the first report of chemical composition, digestibility and energy under the edaphoclimatic conditions of Honduras of *Cenchrus purpureus* Morrone cv. Cuba CT-115, where the characteristic performance of the species was maintained.

Keywords: *chemical composition, digestibility, morphology, yield*

La ganadería en América Latina y el Caribe se desarrolla sobre la base de praderas naturalizadas con bajas producciones y aporte nutritivo, de ahí que la introducción de especies con mayor potencial productivo y calidad nutritiva se hace necesaria. Por lo que, se evaluó el efecto de la edad de rebrote en los indicadores del rendimiento, composición química y digestibilidad del *Cenchrus purpureus* (Schumach.) Morrone vc. Cuba CT-115 en las condiciones edafoclimáticas de Zamorano, Honduras. La evaluación comprendió un período de 193 días, entre octubre de 2020 y mayo de 2021 (período seco). El promedio de precipitación en los meses de estudio fue de 44.56 mm. Se utilizó un diseño de bloques al azar y los tratamientos (días de corte de pasto) fueron 30, 45, 60, 75 y 90 días. La mejor relación hoja/tallo se encontró a los 75 días ($P<0.05$), además, a los 90 días se identificó ($P<0.05$) el mayor crecimiento (235.94 cm). Asimismo, el mayor contenido de materia seca y proteína cruda se cuantificó ($P<0.05$) a los días 75 y 45 días (12.91 %), respectivamente, lo que influyó en la digestibilidad y en la energía metabolizable y neta de lactancia ($P<0.05$). El corte a los 90 días provocó mayor cuantificación de fibra neutro detergente (50.15 %), aunque el contenido mineral disminuyó con la edad del corte. Se concluye que el presente estudio forma parte del primer reporte de la composición química, digestibilidad y energía en condiciones edafoclimáticas de Honduras del *Cenchrus purpureus* Morrone cv. Cuba CT-115, donde se mantuvo el comportamiento característico de la especie.

Palabras clave: *Composición química, digestibilidad, morfología, rendimiento*

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Introduction

The cattle beat and milk production at worldwide constitutes a great sector dynamic and in growing. This happens in environments where the common properties are in bad conditions: the vital support in low resources sectors, food and nutritional safety; natural resources and environment; as well as human and animal health. Therefore, this situation needs the decisions taking at different levels that favors to the sectors and, improvements in the rules to face problems and disadvantages with the purpose of increasing the development of livestock system (Ojeda Quintana *et al*. 2020).

The grasses and forages, due their abundance and fast growing, constitutes the main feeding source in tropical regions for cattle and it is necessary the production of these plants during all the seasons of the year (Ledea-Rodríguez *et al.* 2017). Likewise, to understand the grasses and forage growing is necessary to considered the transformations that occurs in the livestock ecosystems, which are influenced by the climatic change, soil management and bad agricultural practices that causes the soil degradation in the meadows, limiting the growing and persistence of forages species and other grasses (Ledea Rodríguez *et al.* 2017).

The forages species as sugar cane and those from *Cenchrus* sp genus constitutes viable strategies as biomass banks for the season with lack of feed. The studies showed that with adequate managements is possible to obtain high yields with acceptable quality that contributes to the nutritional requirements of the bovine mass (Herrera 2022).

At present, the *Cenchrus* sp. species are widely distributed in the tropical regions and in several universities and Latin-American institutes are researching the different cultivars from this genus; especially those obtained through genetic improvements programs with different biotechnological methods (Sinche *et al*. 2021, Vander Pereira *et al.* 2021 and Lire Wachamo 2022). Specifically, *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 was release by Instituto de Ciencia Animal, Cuba, for the forage production and direct grazing. This forage has low height and acceptable yield and leaf/stems relation. Also, its use in ruminants stimulate the growing and milk production (Ojeda Quintana *et al*. 2020).

The tropical forages due to their intrinsic characteristics are of fast growing and maturing. However, their nutritive contribution is affected due to the plant maturity, which makes the cell wall content worse, rich in lignocellulosic structure, which can decrease the use of other nutrients of the ration. The mentioned transformations have a direct effect on the digestive physiology of ruminants; hence, it is needed to know the variability of the plant quality with the regrowth age in different productive systems. Thus, this study evaluated the effect of the regrowth age on the yield indicators, chemical composition, and digestibility of the *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 under the edaphoclimatic conditions of Zamorano, Honduras.

Materials and Methods

Experimental ecology. The study was developed in the experimental areas of the Escuela Agrícola Panamericana, Universidad de Zamorano, Honduras, located in the km 32 of Tegucigalpa roadway to Danlí (13°59´46" N and 87°0´ 42" W) at 780 m o.s.l. the experimental period was between October 2020 to May 2021 (dry season).

The climate is classifying as tropical of grassland (Holdridge 1987); the rainfall was 356.44 mm; the mean temperature was 19.5 °C and the relative humidity 67 %, in the study phase (1419 mm/year, 27.5 °C and 80 % as annual average of rainfalls, temperature and relative humidity, respectively). The soil in the area is Fluvisol (Soil Survey Staff 2014) and the chemical composition is shown in table 1.

Table 1. Chemical composition of the soil

pH (H_2O)	g/100g			mg/kg (to extract)				
	CO	OM	N total	P	K	Ca	Mg	Na
5.76	2.44	4.2	0.21	16	533	1526	186	ND

Treatment and experimental design. A random block design with five replications was used and the treatments consisted of the regrowth ages of 30, 45, 60, 75 and 90 days.

Procedure. An area of 841 m^2 (29 x 29 m) was used for the study, the plots measured 25 m^2 (5 x 5 m) with 1m space between them, the soil was prepared in a conventional way and the *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 was planting on May 2020 at 90 cm between furrows with a density of 13 kg of seed/plot, 180 days of age of the vegetative material, furrow deep of 20 cm, the whole stems placed on top were put on the bottom of the furrow, making to coincide the basal part with the apical one, which were cut into pieces with sharp machete guaranteeing cuttings with 6 buds approximately, later they were covered with a soil layer of 10 cm, irrigation and fertilization was not applied and there were made labors to control the weeds, all plots has a similar population (98 %).

The plants were established between May to October 2020, in this period the homogenization cut at 10 cm over the soil level was carried out. Later, for the sample taking, the border effect was considering (0.5 m for each side in the plot) and the central part was harvested every 15 days from 30 days of the initial cut at 20 cm over the soil level. As study variables were determined the biomass production, yield in total dry matter, length, width and number of leaves per plants and plant height (Herrera *et al*. 2017). Then the harvested material was homogenized and 2 kg per treatment and replication were taking according to experimental design for their sending to the laboratory.

Determination of the bromatological composition. After collecting the plant samples, they were dried in a forced air oven at 65 °C, later were milled at 1 mm particle size and stored in amber bottles until their processing in the laboratory, to determined: dry matter, crude protein, ashes, organic matter (OM), P, K, Ca, Mg, Cu, Fe, Mn and Zn (AOAC 2016); neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), cellulose (Cel), hemicellulose (Hcel) and cellular content (CC) according to Goering and Van Soest (1970). Likewise, the digestibility of the dry matter and organic matter was determined (Aumont *et al*. 1995), also, the Cáceres and González (2000) criteria were taking into account to determine the metabolizable energy and net lactation energy. All determinations were performed in duplicate and by replication.

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

Results

The performance of the morphological indicators of the plant at different regrowth ages is shown in table 2. There were significant differences for all the studied indicators, with increases as the plant maturity advance, the highest values were reached at 90 days with a length of 128.81 and leaves width of 3.01cm, leaves per plant of 10.64 and height of 235.94 cm.

Figure 1 shown that, at 90 regrowth days *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 increased the production of green matter and dry matter up to 6.78 $t.ha^{-1}$ and 2.25 $t.ha^{-1}$, respectively.

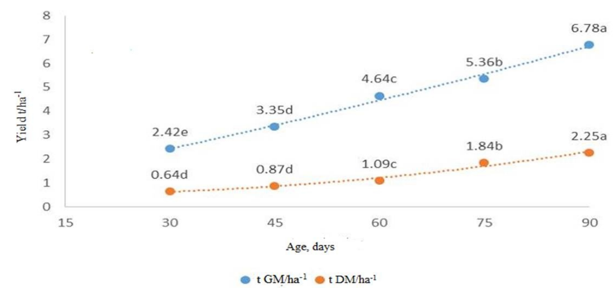

Figure 1. Yield of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115

For the performance of the cell wall composition (table3) the classic dynamic of tropical forage of grasses was maintained with increases of the dry matter (DM), structural carbohydrates (NDF, ADF, Cel, Hcel and lignin ADL) up to 90 days (36.40, 79.06, 50.15, 34.95, 50.15 and 4.45 %, respectively); while the cell content (CC) and crude protein (CP) decrease as the regrowth age increase with the highest values at 30 days (28.67 and 12.14 %, respectively).

The digestibilities and energies decreased (P<0.05) as the regrowth age increased and the lower values, for both indicators were obtained at 90 regrowth days (table 4).

The minerals content in *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 (table 5) was variable, the ash and K decreased with the age and the highest values (17.96 and 4.5 %, respectively) were reached at 30 regrowth days. However, the other macro elements were higher at 45 regrowth days for then decrease up to 90 days. The microelements Cu, Fe and Mn increased up to 45 days with 16.66, 89 and 144.67 $mg.kg^{-1}$, respectively, as higher values for then decrease (10.66, 48 and 109.34 $mg.kg^{-1}$) up to

Table 2. Morphological characterization of leaves of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115

Age, days	Leaves			Plant height, cm
	Length, cm	Width, cm	Number/plant	
30	71.41[e]	1.92[e]	6.44[e]	118.41[e]
45	88.89[d]	2.03[cd]	6.60[d]	153.40[d]
60	100.80[c]	2.05[c]	7.12[c]	186.19[c]
75	102.76[b]	2.89[b]	10.21[b]	216.43[b]
90	128.81[a]	3.01[a]	10.64[a]	235.94[a]
SE±	4.51	0.13	0.56	11.88
P	<0.0001	<0.0001	0.0015	<0.0001

[a,b,c,d] Means with different letters in column differ at P<0.05 (Duncan 1955)

Table 3. Performance of the cell wall of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115

	Cell wall, %							
Age, days	**DM**	**CP**	**NDF**	**ADF**	**ADL**	**Cell**	**Hcel**	**CC**
30	19.10^{d}	12.14^{a}	71.33^{e}	32.61^{e}	3.05^{e}	27.35^{e}	26.65^{e}	28.67^{a}
45	19.82^{d}	11.91^{a}	73.67^{d}	37.71^{d}	3.41^{d}	28.91^{d}	37.71^{d}	26.33^{b}
60	21.20^{c}	9.37^{b}	75.33^{c}	39.47^{c}	3.97^{c}	31.65^{c}	39.47^{c}	24.67^{c}
75	34.36^{b}	6.66^{c}	77.48^{b}	41.47^{b}	4.17^{b}	33.04^{b}	41.47^{b}	22.52^{d}
90	36.40^{a}	5.79^{d}	79.06^{a}	50.15^{a}	4.45^{a}	34.95^{a}	50.15^{a}	20.94^{e}
SE±	0.010	0.130	0.010	0.247	0.009	0.564	0.076	1.760
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

^{a,b,c,d,e} Means with different letters in column differ at P<0.05

Table 4. Quality of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115

Age, days	**Digestibility, %**		**Energy, MJ.kgDM^{-1}**	
	DMD	**OMD**	**ME**	**NFE**
30	72.26^{a}	66.45^{a}	10.55^{a}	7.66^{a}
45	70.33^{b}	65.78^{a}	10.02^{ab}	6.55^{b}
60	69.45^{b}	63.45^{b}	9.36^{b}	5.84^{c}
75	67.78^{c}	61.09^{c}	8.44^{c}	5.67^{c}
90	65.56^{d}	59.66^{d}	8.24^{d}	4.56^{d}
SE±	1.04	1.34	0.678	0.543
P	<0.001	<0.001	<0.0001	<0.0001

^{a,b,c,d} Means with different letters in column differ at P<0.05

Table 5. Minerals content of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115

	Age, days						
Minerals	**30**	**45**	**60**	**75**	**90**	**SE±**	**P**
Ashes, %	17.66^{a}	17.36^{b}	16.9^{c}	12.30^{d}	11.20^{e}	0.561	0.002
P, %	0.24^{ab}	0.25^{a}	0.22^{c}	0.12^{d}	0.15^{e}	0.025	<0.001
K, %	4.5^{a}	2.99^{b}	2.95^{c}	2.03^{d}	1.74^{e}	0.05	<0.001
Ca, %	0.27^{de}	0.42^{a}	0.31^{b}	0.27^{d}	0.30^{c}	0.010	0.0009
Mg, %	0.09^{e}	0.11^{bc}	0.10^{d}	0.11^{b}	0.12^{a}	0.010	0.0009
Cu, mg.kg^{-1}	9.00^{c}	16.66^{a}	7.66^{d}	6.00^{e}	13.00^{b}	0.220	<0.0001
Fe, mg.kg^{-1}	59.00^{b}	89.00^{a}	42.66^{d}	41.00^{e}	57.00^{c}	1.89	<0.0001
Mn, mg.kg^{-1}	88.33^{c}	144.67^{a}	92.00^{b}	35.33^{e}	69.66^{d}	1.43	<0.0001
Zn, mg.kg^{-1}	29.33^{b}	23.00^{d}	26.00^{c}	10.00^{e}	54.00^{a}	1.84	<0.0001

^{a,b,c,d,e} Means with different letters in column differ at P<0.05

75 days and increased (7, 16 and 34.33 mg.kg^{-1}) up to 90 days, while Zn was high at 90 days with 54 mg.kg^{-1}.

Discussion

The morphological growing and developing is a process that is linked to the maturity the plant reaches when the cut periods are longer, hence the length, width, number of leaves and plant height has been increased with the regrowth days (table 2). These results coincide with Villanueva Avalos *et al*. (2022), who evaluated several cultivars of *Cenchrus* cultivars (Elefante, Uruguana, Taiwán, CT-169, Caña Africana, Maralfalfa, Mott, Roxo, King Grass violet, CT-115, Merkerón, Cameron, King Grass green and three ecotypes of Tamaulipas: Elefante Tamps). Also, these authors find that the cultivars obtained by biotechnologies techniques (CT-115 and CT-169) showed the best morphological characteristics, since the rest has high variability in the growing under the Mexican dry tropic.

Herrera (2022) informed heights from 65.63 to 79.58 cm for CT-115 in ferrallitic soils, this indicator is important to understand the growth of cultivars with different biochemical and physiological characteristics under several environmental conditions and agricultural works. Ojeda Quintana *et al.* (2020) found the best response of *Cenchrus purpureus* (Schumach.) Morrone cv. Cuba CT-115 under many rainfalls conditions, something that is not happen during the dry season, where the climate factors (rainfalls, temperatures, solar radiation, intensity and duration of light hours) limits the growing and other morphological indicators of grasses.

Pérez Ramos *et al.* (2021) informed 8.5 leaves per plant, 60 cm of plant height and 40 cm of leaves length in CT-115 up to 180 days, lower results to those reached in this study, these differences are due to phenological cycle of this species. In this sense, Arias *et al.* (2018, 2019) and Ledea *et al.* (2018a) when evaluating different *C. purpureus* cultivars tolerant to water stress observed that from 120 regrowth days the dimensions (length and width) of leaves are reduced in relation with the 90 days, and they attributed to the most lower distribution of the leaf area due to the incidence of low size leaves. Therefore, it is produce high biomass duration and the self-shading, apparently, did not influence on the interception of light, which increase the photosynthesis rate, with low accumulation of fresh biomass.

In this sense, Herrera (2022) explain that, during the growing, the grasses have a compensatory mechanism from the physiological point of view; however, despite the high availability of the total biomass (leaves and stems) with the growing the edible biomass decrease by the high amount of structural carbohydrates and lignin when the stem fraction increased. Therefore, the varieties and ecotypes of *C. purpureus* present advantages considering morphological, physiological, and productive characteristics, which gives them usefulness under adverse edaphoclimatic conditions (Sinche *et al.* 2021).

It is recommended before to introduce any variety or ecotype in a region to perform studies of morphological characterization in order to know the adaptability to those conditions. Hence, this study from the beginning constituted the first test of the CT-115 variety under the edaphoclimatic conditions of Honduras, for which the dry season was selected to evaluate the adaptability of this cultivar being proved in many regions. Also, will be of great importance for the Honduran beef and milk livestock to have a variety with abundant biomass accumulation, low size and can be use in grazing, although for that is still needed to deep and perform studies in the different seasons of the year, digestibility test, voluntary intake and animal performance.

The increase of yield in green biomass and dry matter (figure 1) is very link to the plant growing and developing, above all to the increase of the stems proportion. These results coincide with Arias *et al.* (2018) whose when evaluating the different *Cenchrus purpureus* cultivars notified for CT-115 the production of 5.78 $tGM.ha^{-1}$ and 1.5 $tDM.ha^{-1}$ up to 150 days, similar values reported Pérez Ramos *et al.* (2021) and Villanueva Avalos *et al.* (2022) with productions of 4-5 $tGM.ha^{-1}$ and 1.4-1.8 $tDM.ha^{-1}$ in regions of the dry tropic and dry seasons, respectively although Uvidia *et al.* (2015) find high biomass production in the Ecuadorean Amazonia with 80 $tGM.ha^{-1}$ in Maralfalfa variety, likewise, Retureta-González *et al.* (2019) reported a production of 15 $tDM.ha^{-1}$ of CT-115 under irrigation conditions, while, Reyes-Castro *et al.* (2018) informed production of 18 $tDM.ha^{-1}$ in dry seasons in Veracruz, México for the bioethanol production.

The difference in the regrowth age for grazing and forage production lies in that for bioethanol production is needed the high accumulation of structural carbohydrates (cellulose and hemicelluloses) and polyphenolic compounds (lignin) hence their optimum cut age be between ages of 100-120 days, while for the animal production this one range about the 60 days for grazing and 90 days when it is used as forage. The above reaffirms that for low rainfalls regions the results of this research are in the range of reported values, the differences find are due to the rains levels, irrigation use, cut age and productive purposes.

On the other hand, Herrera (2022) under rain conditions and in the west of Cuba reported a production of 12 $tDM.ha^{-1}$; this performance is due to the different edaphoclimatic conditions of each region. To highlight, that the studies which informed the highest yields reported precipitations from 700 to 4000 $mm.year^{-1}$ in comparison with rainfalls from 200 to 430 $mm.year^{-1}$, being conditions responsible of the marked differences find from the productive point of view among regions of the humid and dry tropic in Latin American and the Caribbean in terms of climatology. This response is due according to Ledea Rodríguez *et al.* (2017) to the compensation of the photosynthetic system to potentiate the growing; the water molecules contribute the necessary hydrogen to form the carbonate skeleton and produce the structural and non-structural carbohydrates (Herrera 2022), effect that favors high growing and developing, with high photosynthetic efficiency.

The decrease of cell content and increase of the cell wall components (table 3) is exclusive of these forage species, since the stems proportion, leaves biomass, dry matter and plant maturity directly influence on the proportion of the cell wall components (Ledea *et al.* 2021). Besides of these intrinsic factors of each species, those considered as abiotics (temperature, rains and light intensity, among others) also contributes to the variability and growing of the cell wall, which modify their components and dimensions (Arias *et al.* 2019). Moreover, during the plant growing is made worse the deposition of structural carbohydrates as the cellulose that participate in the defense secondary mechanisms to achieve stress tolerance (Ledea *et al.* 2018a). In this sense, Chupin *et al*. (2020) reported that the nutrients content in the soil (mainly N, P and K) and fertilization promote the growing and developing of forages and therefore NDF and ADF deposition.

In accordance with the concentration and independent distribution of carbohydrates, Habte *et al.* (2020) showed that for immature plants the cellulose contents and non-cellulosic compounds fluctuate between 25 and 60 %; while in the matures has 38 % of cellulose, 43 % of no-structural polysaccharides and 17 % of lignin. The obtained results (table 3) in this research show that considering the content of cellulose (34.95 %) and lignin (4.45 %), these plants are catalogue as immature. According to Sosnowski *et al.* (2017) notified that there is a high variability among species and varieties from a same genus as response to the environmental conditions of each region in terms of the deposition of supporting tissue in the stems, cellulose, hemicelluloses, lignin and silica in the cell wall of leaves.

The growing and the morphological development of meadow species provides increase of the productivity, but the increases of structural carbohydrates and polyphenols with the plant maturity directly influence on their quality (table4) hence the nutritive contribution is affected. Similar results reported Ledea *et al.* (2018b) who showed that the morphological and structural components of forages and the agronomical performance directly influence on the proportion of leaves and stems, digestibility and energy contribution. In this sense, De Dios León *et al.* (2022) reported that the morphological component favors the degradability of the fractions of DM and OM, according to the type and distribution of the cells that determines the percentage of the digestible, little digestible and totally indigestible.

The decrease of the DMD and OMD with the increase in cut age is due, possibly, to the higher proportion of stems and lower of leaf at 90 days, this performance was described by González Blanco *et al*. (2018), Ledea *et al*. (2021) and de Dios León *et al*. (2022), who observed high DM concentration and consequently NDF and ADF, with the forage maturity (90 days of regrowth age) due to the high proportion of stems that increase the lignocelluloses structure, which directly affects their digestibility, contribution of forage energy and use efficiency in the production systems in the tropic.

The digestibility percentages and energy values obtained in this study are in the range reported in the international literature for the different grasses forages. Álvarez Perdomo *et al*. (2017), Méndez Martínez *et al*. (2020), Reyes Pérez *et al.* (2020) and Herrera (2022) when evaluating varieties of *Brachiaria*, *Megathyrsus* and *Cenchrus* did not reported differences in digestibility and energy with values higher than 47 % and 6 MJ.kgDM^{-1}, respectively and informed that the main effect is due to the high increase of the cellular components of the plant according to the species and variety as the forage maturity advance.

Table 5 shown that the minerals concentration decreased with the growing of the CT-115 grass, at 30 cutting days was observed the higher content of total ashes (17.66 %) and at 45 days, the most evaluated minerals showed the highest concentration, with emphasis in Mn, Fe, Zn, this effect was reported by Santiago *et al.* (2016), who found a reduction of the mineral content with the grasses age. In this sense, Muñoz González *et al*. (2014), notified that during the rainy season the grasses change the mineral content of their leaves due to the metabolic rate increase the due to the growing and yield in aerial biomass. Fortes *et al.* (2019) reported a concentration of Ca, P and Mg of 0.55-0.70 %, 0.21-0.27 % and 0.29-0.37 %, respectively at 45 days of cut age in CT-115.

Also, Valenciaga *et al*. (2009) found that the regrowth age had few influence on the Ca concentration in CT-115. However, other studies showed that concentrations higher than 0.30 % of Ca (dry base) in this plant promotes the harden action of the cell wall (Herrera 2022). Likewise, Domínguez *et al.* (2012) reported that concentrations higher than 0.2 % in P (dry base) at tissue level are considered adequate values for the nutrition of ruminants animals. Considering, the variations of the content of this mineral (table 5) is recommended the use of phosphoric fertilization to the soil for replacing the possible deficiency in the plant (Fortes *et al*. 2019).

The Mg concentration find in CT-115 (0.09-0.12 %) was lower to those reported by Valenciaga *et al*. (2009) and Herrera (2022), apparently the concentration of this mineral (Mg) in the soil of this study (186 mg.kg^{-1}) influenced on this results, the authors showed concentrations higher than 260 mg.kg^{-1} of Mg in the soil. Although there is contradictions in the requirements of this mineral (Mg) in the ruminant animals, it is knowing that it take part in the photosynthesis activity, hydrogen transport and participate in the production of organic fatty acids (Da Costa Leite *et al.* 2019).

There are contradictions on the necessities of the micro minerals in ruminants due to that many multifactorial elements can alter the absorption and use, in general way, the traces minerals participate in the protein synthesis, vitamins metabolism, in the formation of the connecting tissue and in the immunity functions (Spears *et al.* 2022). Therefore, to know the micro mineral composition contributes with the formation of nutritious nucleus appropriate to the study zones and the animal's needs.

The content of micronutrients in the forage is affected by many factors; one of the most important is the geographical location. In temperate climate has been find contents of Fe, Zn and Cu in meadows of *Lolium perenne*, which were insufficient to cover the dairy cattle requirements; while the

Na concentrations were higher to the normal level. In turn, in an area of semidesert, the Fe was finding in the forages in sufficient amounts to satisfy the requirements of bovines from meat breed in grazing. However, the forages were few deficient in Na, Zn and Cu. In the tropical zone is frequent to find lack of P in meadows of common Buffel grazing by growing meat bovines, which is why the authors recommend to complementing during the year, in turn the Cu and Mn should only be complemented during the dry season (Guerrero *et al*. 2020).

Cabrera Torres *et al.* (2009) when evaluating the content of microelements in different zones from Quintana Roo, México notified abundance of Fe and Mn in the forages sampled in the three areas and coincide with high content of these minerals in the respective soils. In turn, the content of Zn and Cu in the soil (middle levels) was contrary to those find in the forages in which low contents are reported. When analyzing the effect of the type of forage, Fe concentrations higher than critical levels of 50 mg.kg-1 were found, the amount of Mn was low of 40 mg.kg^{-1} in five of the collected forages (*B. brizantha, C. nlemfuensis, C. purpureus, M. maximus* and *B. humidicola*). As for Zn and Cu, it was found that all the average values were down of the critical level (30 and 10 mg.kg^{-1}, respectively). The low values of Zn and Cu are linked to the metabolic functions of these ones in the plant, the way they are in the soil (inaccessible for the plant) and their relationship with the Fe and negative interaction of Fe and acid pH on the absorption of Cu and Zn (Villalobos and González 2018).

Conclusions

This study is part of the first report on the chemical composition, digestibility, and energy of *Cenchrus purpureus* Morrone cv. Cuba CT-115 under the edaphoclimatic conditions of Honduras, where the characteristic behavior of the species was observed with an increase in yield, morphological components, and cell wall with increasing age of regrowth; while, the concentration of proteins, minerals, cellular content, digestibility, and energy contribution decreased with the maturity of the plant. Thus, the adaptability of this cultivar to different ecosystems is reaffirmed. Thereby, it is recommended to carry out other investigations under different edaphoclimatic conditions in Honduras to elucidate adaptability and its influence on growth and nutritional quality according to cutting age.

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Nutritive quality of Cenchrus purpureus (Schumach.) Morrone cv. Cuba CT-115 under edaphoclimatic conditions of Zamorano, Honduras

Calidad nutritiva de Cenchrus purpureus (Schumach.) Morrone cv. Cuba CT-115 en condiciones edafoclimáticas de Zamorano, Honduras

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