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Article

Yield, leaf elongation and bromatological analysis of Camello grass in the rainy and dry seasons

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Abstract

Livestock farming largely depends on the supply of forage that allows animals to maintain production year-round. This research aimed to evaluate the effect of the cut day on the dry matter yield, structural characteristics, and bromatological analysis of Camello grass (hybrid *Urochloa*) during the rainy and dry seasons. The variables evaluated were dry matter yield, structural characteristics, and bromatological analysis. The treatments were cuts at 10, 20, 30, 40, 50 and 60 days during the rainy and dry seasons. The data were analyzed using a completely randomized block design. The highest dry matter (DM) yield was obtained at 50 days after cutting during the rainy season, at 2 905 kg ha^{-1}DM and the lowest at 10 days after cutting, at 34 kg ha^{-1}DM during the rainy season ($p< 0.05$). On the other hand, the highest crude protein (CP) content was observed during the rainy season, regardless of the day after cutting ($p< 0.05$). On the contrary, the results of neutral detergent fiber and acid detergent fiber tended to increase as the age of the plant advanced. The highest yield, highest leaf growth and acceptable bromatological quality in Camello grass are obtained 50 days after cutting.

Keywords:

forage, grass, production, tropics.

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Introduction

Tropical livestock farming largely relies on the supply of grasses that allow animals to maintain production throughout the year, and they are the most economical and sustainable source in livestock units, being a fundamental part of animal feed (Hernández *et al* ., 2012 ; Rojas *et al* ., 2017a).

In this sense, forage grasses constitute the backbone of animal feeding systems, thanks to their ability to produce biomass efficiently, adapt to varied agroclimatic conditions, and contribute to the production system's sustainability (Hernández-Canul *et al* ., 2024 ; Medrano-Escobar *et al* ., 2024 ; Rojas *et al* ., 2024).

The low nutritional value of forage grasses in tropical regions is mainly due to the plant's genetic characteristics (Torres *et al* ., 2020) and poor management of the pastures, which limits the production of grazing ruminants (Da Silva *et al* ., 2015 ; Rojas *et al* ., 2017b). These plants have a high content of cell walls and low concentration of crude protein; consequently, forage digestibility and voluntary consumption of animals are affected (Aguirre *et al* ., 2025).

Authors such as Rojas-García *et al* . (2018) , when evaluating the Cobra grass (hybrid *Urochloa* BR02/1794), obtained a yield of 1 200 kg ha^{-1}DM in leaf with 21% CP at 35 days of regrowth and at an intensity of 15 cm. In a study conducted by Maldonado-Peralta *et al* . (2024) , when evaluating different hybrid *Urochloa* grasses, they obtained the highest yield at 49 days after cutting in Mulato II and Convert 330 grasses, with 5 450 and 3 900 kg ha^{-1}DM, respectively, and for the Convert 431 grass, the highest value occurred on day 56, with 3 000 kg ha^{-1}DM.

Nevertheless, in Mexico, there is limited research on the management and hybrids of *Urochloa* under the conditions of the dry tropics; therefore, the objective of the present study was to evaluate the effect of the cut day on dry matter yield, stem dynamics, tissue replacement and bromatological analysis of Camello grass (hybrid *Urochloa*) during the rainy and dry seasons, to determine the optimal time for use. The hypothesis was that the best structural and quality characteristics will be obtained when Camello grass is harvested at 50 days of regrowth.

Materials and methods

The study was conducted from August 10, 2024, to August 10, 2025, in Iguala de la Independencia, in the northern region of the state of Guerrero, located at 18° 21' 55.5" north latitude and 99° 34' 35.3" west longitude, at 930 masl, with a warm subhumid climate (Aw; García, 2004). The soil had a sandy clay texture, a pH of 5, and was deficient in organic matter, with 1.5%.

The bromatological analyses were carried out from August to September 2025 at the experimental unit of the Pinotepa Technological Institute, located at kilometer 26 of the Pinotepa Nacional, Oaxaca-Acapulco, Guerrero highway, in the locality of San José Estancia Grande, Oaxaca, at 16° 21' 35.55" north latitude and 98° 14' 59.51" west longitude, at 60 masl (García, 2004).

The average annual temperature during the study period was 26.9 °C. Rainfall was 1 075 mm during the rainy season (August to December 2024) and 51 mm during the dry season (January to July) (Figure 1), for a total annual rainfall of 1 126 mm. During the dry season, gravity irrigation was applied to field capacity every tres days.

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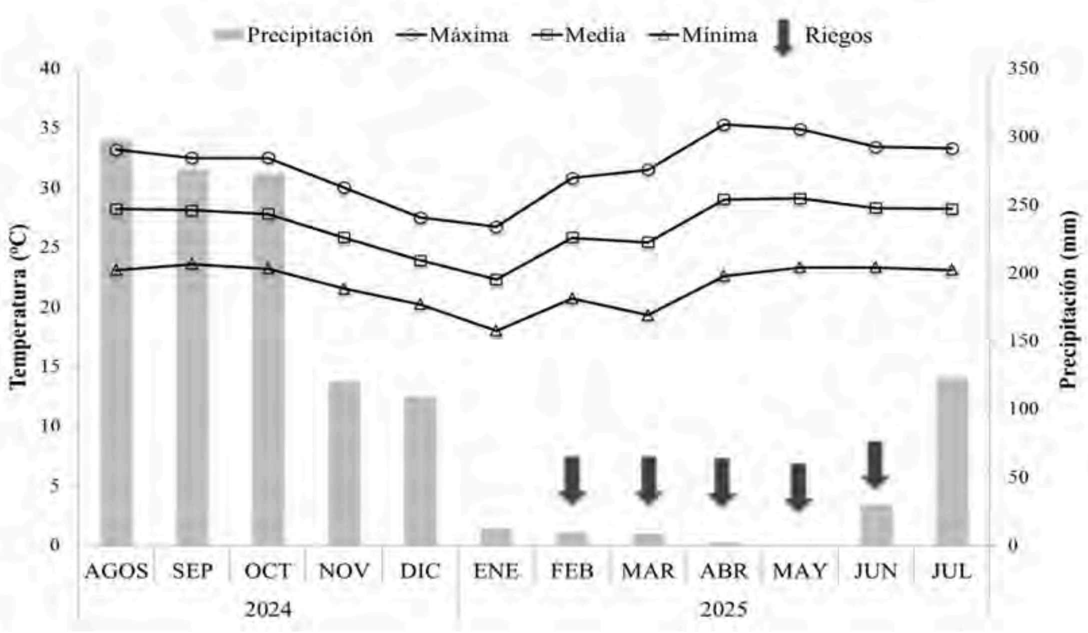
Figure 1. Minimum, average and maximum temperatures, accumulated precipitation and irrigation over the research period.



Climatic data were obtained from the Conagua agrometeorological station, located 1 000 m from the experimental site (Conagua, 2025). During the dry season, sprinkler irrigation was applied every eight days, for a total of 24 irrigations, with a net irrigation sheet of 748 mm, given that the annual accumulated rainfall was 1 874 mm.

The hybrid *Urochloa* grass Camello was sown on August 10, 2024, at a density of 8 kg ha^{-1}of viable pure seed. The plants were then allowed to grow for 60 days before the uniformization cut. Six experimental plots, each measuring 5 × 5 m, were established. Given the 10% slope of the uneven terrain, the design was a randomized complete block design with three replications.

The factor evaluated was the number of days of pasture growth, with cuts at 10, 20, 30, 40, 50 and 60 days after planting (DAS). At each age, the following variables were measured: dry matter yield (DMT; kg ha^{-1}), tissue replacement, leaf:stem ratio, weight per stem, CP, NDF and ADF.

Two applications of chemical fertilizer were made: one during the rainy season and the other during the dry season, at the time of the uniformization cut. The fertilizer contained 18N-8P-8K and its commercial name was sugarcane mixture. It was applied in a localized manner at a rate of 10 g plant^{-1}, providing a total of 400 kg ha^{-1}for the two applications.

Sampling was conducted during the rainy season on October 10 and during the dry season on March 30, 2025. Ten days before starting the evaluation cuts, a homogenization cut was made at a residual height of 15 cm.

Variables evaluated

Dry matter yield

During each sampling period, after the uniformization cut, two 50 × 50 cm squares were harvested from each experimental plot at 10-day intervals until 60 days of regrowth, leaving a residual area of 15 cm. The harvested forage was washed and then dried in a forced-air oven at 55 °C until a constant weight was reached and the weight was recorded. This value subsequently served as a basis for estimating the dry matter yield per hectare (Rojas *et al* ., 2019).

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Tissue replacement

Total growth, net growth and leaf senescence were evaluated in a 2 m long transect, where five stems of each plant were randomly selected and identified with wire rings of different colors. On the selected stems, the length of the leaf blade was measured from the base of the ligule to the apex in green leaves or to the base of the chlorotic tissue in senescent leaves (Rojas *et al* ., 2024).

Leaf:stem ratio

To estimate the leaf:stem ratio, two 50 × 50 cm quadrants were taken per experimental plot every 10 days, leaving a residual height of 15 cm. The collected material was manually separated into leaves and stems, then dried in a forced-air oven at 55 °C until a constant weight was obtained. The leaf:stem ratio was calculated as the quotient of the leaf dry weight and the stem dry weight.

Weight per stem

To determine the weight per stem, 10 stems from each plot were randomly selected every 10 days until day 60. They were cut at ground level, then dried in a forced-air oven at 55 °C until a constant weight was reached, and their weight was recorded. The reported value was the average of the 10 harvested stems. The average weight per stem was calculated by dividing the total weight by the number of stems harvested.

Bromatological analysis

The dry samples used to determine dry matter yield were also used to determine CP content using the method described by the AOAC (2005) . NDF and ADF were determined using the method of Van Soest *et al* . (1991) . All laboratory analyses were performed in triplicate.

Statistical analysis

The data collected were analyzed using a completely randomized block design with split-split plots, with three replications. The procedure used for the analysis was the PROC GLM of SAS (2011) , in which the effects of cut frequency and season of the year were treated as fixed effects, and a linear regression analysis was used for the dry matter yield variable. Multiple comparisons of treatment means were performed using Tukey’s test (α= 0.05).

Results and discussion

Dry matter yield

The dry matter yield of Camello grass is shown in Figure 2 , with differences among cut days and seasons of the year ($p< 0.05$). The highest yield was obtained at 50 days during the rainy season, at 2 905 kg ha^{-1}DM, while the lowest value occurred at 10 days after cutting, at 234 kg ha^{-1}DM ($p< 0.05$). Notably, the yield was low until day 30, increased from day 40 to day 50 and then decreased ($p< 0.05$).

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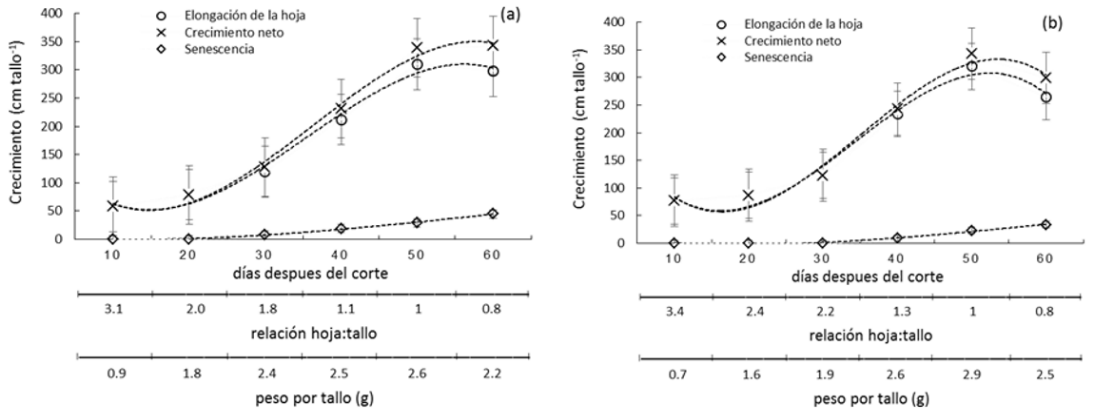
Figure 2. Dry matter yield (kg DM ha^{-1}) of Camello grass (hybrid *Urochloa*) in different cut periods. a)= rainy season; b)= dry season; I= standard error.



The increase in yield with regrowth age can be explained by leaf expansion (Hernández *et al* ., 1997 ; Aniano-Aguirre *et al* ., 2022), stem thickening, and greater photosynthetic efficiency of the plant in advanced developmental stages (Lucio-Ruiz *et al* ., 2023), as observed in this research from 30 day after cutting.

Similarly, in the study by Rojas *et al* . (2024) on Mulato II grass, the dry matter yield was higher for cuts during the rainy season and when the remaining height after harvest was 15 cm. The study reported the highest yields at 49 days of regrowth during the rainy season, at 1 800 kg DM ha^{-1}and at 63 days in the dry season, at 1 560 kg DM ha^{-1}.

For its part, the study by Rojas-García *et al* . (2018) , when evaluating the hybrid *Urochloa* grass ‘Cobra’, reported similar overall behavior and outcomes: growth increased with regrowth age, peaked and then decreased. The highest dry matter yield was obtained at 56 days at 2 550 kg ha^{-1}DM, and the lowest at 8 days of cutting, at 250 kg ha^{-1}DM ($p< 0.05$).

Leaf growth, leaf:stem ratio, and weight per stem

Figure 3 shows the leaf growth, leaf:stem ratio, and weight per stem of Camello grass as the day of cut and the season of the year vary. Regarding leaf elongation, it was higher on average during the rainy season and lower during the dry season; both reached the highest elongation value on day 50 after cutting, at 290 and 280 cm stem^{-1}, respectively ($p< 0.05$). Net growth followed a similar pattern, with the highest values on day 50, at 340 and 319 cm stem^{-1}for the rainy and dry seasons, respectively ($p< 0.05$).

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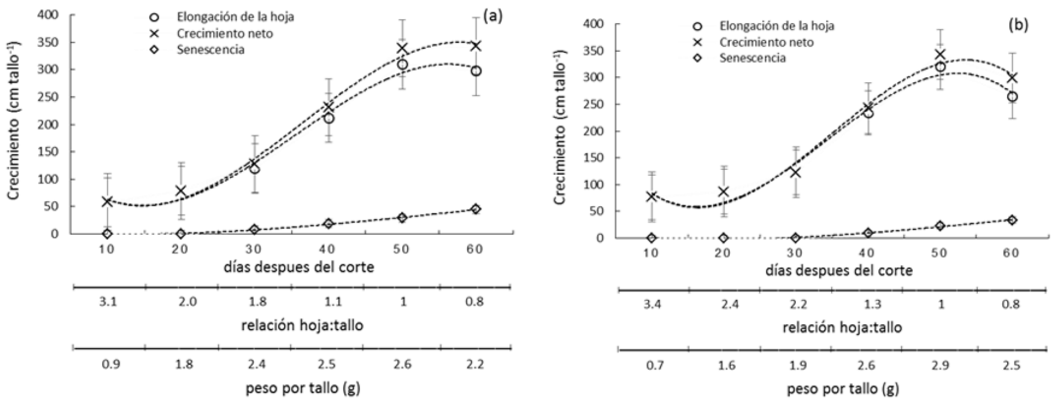
Figure 3. Tissue replacement (cm stem^{-1}), leaf:stem ratio, and weight per stem (g) of Camello (hybrid *Urochloa*) as the days of cut progressed. a)= rainy season; b)= dry season; I= standard error.



During the rainy season, senescence began at 30 days after the homogenization cut; for the dry season, it began at 40 days after, with no differences between them, with an average of 32 cm stem^{-1}. The leaf:stem ratio was slightly higher during the dry season, with an average of 1.9, and lower during the rainy season, with 1.8 ($p< 0.05$).

In contrast, the highest leaf:stem ratio was obtained at the cut on day 10, with values of 3.4 and 3.1 for the dry and rainy seasons, respectively, and the lowest on day 60, with an average of 0.8 ($p< 0.05$). As for the weight per stem, it varied with the season of the year, tending to increase to 2.8 g until day 50 and then decrease to 2.4 g by day 60 ($p< 0.05$).

Rojas *et al* . (2024) , when evaluating Mulato II grass, found that the highest net growth was obtained at 49 days and behaved as follows: 15 cm-rainy seasons >15 cm-dry season >10 cm-rainy season >10 cm-dry season, with 340, 290, 270 and 240 cm stem^{-1}, respectively ($p< 0.05$). In this same study, they reported the highest leaf:stem ratio for regrowth ages between 7 and 21 days, with an average of 6.1 ($p< 0.05$), and an average stem weight of 2.9 g, which increased with regrowth age up to 49 days after harvest.

The higher temperatures and precipitation during the rainy season result in a higher rate of tissue replacement (Cruz *et al* ., 2017a), greater weight per stem, and active growth of pastures, primarily due to the availability of moisture (Cámara-Acosta *et al* ., 2022 ; Garay-Martínez *et al* ., 2022).

Bromatological analysis

The contents of CP, NDF and ADF in the whole Camello grass plant, as the cut days and season of the year progressed, are observed in Table 1 . Regarding CP, it tended to decrease as regrowth age increased, in both seasons of the year ($p< 0.05$). On the other hand, the highest CP content was obtained during the rainy season, regardless of the day after the cut ($p< 0.05$).

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Table 1. Effect of cutting age of Camello grass (hybrid *Urochloa*) on the contents of crude protein, neutral detergent fiber, and acid detergent fiber (%) during the rainy and dry seasons.

Season	Days of cut					
	10	20	30	40	50	60
	Crude protein (%)					
Rainy	20.2aA	19.5abA	18.4bA	16.8cA	14.7dA	12.6eA
Dry	19.3aAB	18.4abB	17.3cB	15.7dB	14.5eAB	12.2fAB
	Neutral detergent fiber (%)					
Rainy	63.6fAB	64.1eA	65.4dA	66.4cA	68.4bA	70.7aA
Dry	62.2fB	63.6eB	64.2dB	65.7cB	66.6bB	68.1aB
	Acid detergent fiber (%)					
Rainy	23.5fAB	28.6dAB	27.4eB	32.4cB	33.1bB	36.2aB
Dry	24.3fA	29.4dA	28.6eA	34.6cA	36.2bA	37.1aA

abc= means with the same lowercase letter in the same row are not different (Tukey, α= 0.05); ABC= means with the same uppercase letter in the same column are not different (Tukey, α= 0.05).

In contrast, NDF and ADF tended to increase as the days of regrowth progressed. NDF exhibited slightly higher values during the dry season than during the rainy season. Conversely, ADF values were slightly higher in the rainy season than in the dry season, regardless of the cut days.

For their part, in *Urochloa* grasses, Maldonado-Peralta *et al* . (2024) reported that the Convert 330 and Mulato II grasses obtained the highest CP value in the whole plant, with 16% crude protein and the Convert 431 grass obtained the lowest value, with 15% crude protein ($p< 0.05$). Previous research (Cruz *et al* ., 2017b ; Godína-Rodríguez *et al* ., 2025) found that protein contents in tropical cultivars are affected by the redistribution of nitrogen towards morphological structures, causing a constant decrease over time.

Similarly, in growth curves in Mulato II grass (*Urochloa*), Rojas *et al* . (2024) reported behavior similar to that of the present research in the contents of NDF and ADF, which tended to increase as the regrowth age advanced, with slightly higher values of NDF being observed during the dry season than during the rainy season.

Conclusions

The best yield, leaf growth, weight per stem and leaf:stem, combined with an acceptable crude protein, neutral detergent fiber and acid detergent fiber in Camello grass, both during the rainy and dry seasons, are obtained when the regrowth is 50 days old; however, between seasons, the one with better yield and quality characteristics was the rainy season.

It is recommended to continue evaluating this grass over a longer evaluation period to broaden the range of decisions in the dry tropics of Mexico.

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