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REMEXCA

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Investigation note

Forage production of four cultivars of hybrid *Urochloa* in Güemez, Tamaulipas

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Abstract

The present study aimed to assess the effect of regrowth age on forage production in *Urochloa* cultivars (Cobra, Convert 330, Camello I, and Camello II) in Güemes, Tamaulipas. The experiment was conducted under rainfed conditions from September to November 2018. The variables evaluated were: plant height (PH; cm), yield (kg ha^{-1}) of dry matter of leaves (DMl), dry matter of stems (DMs), and intercepted radiation (IR; %). The statistical design was completely randomized, with three repetitions; Tukey's mean comparison test (p= 0.05) was applied. In general, the accumulation of dry matter increases depending on the age of regrowth. During the eighth week of regrowth, the highest yields were obtained, and the leaf yield was higher than the stem yield. The highest yields of DMl were obtained at the eighth week of regrowth (p# 0.05), regardless of cultivar, with yields of 1 625.3, 3 183.7, 3 032.7, and 4 227.7 kg ha^{-1} DM for Cobra, Convert 330, Camello I and Camello II, respectively. The eighth week is the optimal time to use the forage of the hybrids under the climatic conditions in which they were assessed.

Keywords:

age of regrowth, forage production, intercepted radiation, *Urochloa* hybrids.

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In ruminant production systems, the basis of livestock diet is forage through the use of pastures or meadows, by cutting and grazing, since it is a relatively low-cost feed in extensive production systems (Cuadrado *et al*., 2003; Zárate *et al*., 2012), with which daily weight gains between 0.4 and 0.5 kg are obtained in grazing cattle (Palma, 2014).

In this sense, to increase production in livestock systems, forage grasses with greater dry matter potential and nutritional value have been developed (Lascano, 2002); in this regard, when using cultivars of the genus *Urochloa*, between 0.7 (Suárez *et al*., 2014) and up to 1 000 kg d^{-1} $animal^{-1}$ (Cuadrado *et al*., 2003) can be obtained. In Mexico, there is a great diversity of improved forage grasses, mainly of the genera *Urochloa*, *Megathyrsus*, *Cenchrus,* and *Cynodon*, which can be used in animal production systems (Quero *et al*., 2007) to solve the problems observed with native forage species.

In this sense, it has been reported that with the most recent cultivars of *Urochloa* (Mulato II, Cobra, Cayman, among others), dry matter yields of 9 to 14 t ha^{-1} $year^{-1}$ could be obtained (Pizarro, 2013; Vendramini *et al*., 2014). However, the climatic conditions of Tamaulipas limit reaching the yields above; even so, these hybrids exceed the Buffel grass (*Pennisetum ciliare cv* H-17) by up to 13%, 9.4 *vs* 10.8 t ha^{-1} $year^{-1}$ in Güémez, Tamaulipas (Garay-Martínez *et al*., 2018).

In this regard, it is convenient to analyze that before introducing a forage material into any production system, it should be considered that the seed is certified to avoid the possible introduction of potential weeds (Pizarro, 2010). In addition, productive behavior and quality should be evaluated in a controlled manner to determine if it is an option for livestock in the region (Sosa *et al*., 2008). For this reason, the objective of this research was to assess the effect of the age of regrowth on forage production in cultivars of *Urochloa* (Cobra, Convert 330, Camello I, and Camello II) in Güemez, Tamaulipas.

The present study was carried out under rainfed conditions from September to November 2018 at the Engineer “Herminio García González” Zootechnical Post of the Faculty of Engineering and Sciences of the Autonomous University of Tamaulipas, located in the municipality of Güemes, Tamaulipas, Mexico. The geographical coordinates are 23° 56’ 26.5” north latitude and 99° 05’ 59.9” west longitude, at 193 masl (INEGI, 2015).

The place’s climate is of type BS1 (h’) hw (Vargas *et al*., 2007). The average annual temperature and rainfall are 24.1 °C and 940 mm, respectively. The temperature and precipitation during the 2018 assessment period are represented in Figure 1. The soil of the evaluation site is clayey in texture with a pH of 8.3, without salinity problems (SAR= 0.19), with organic matter and nitrogen contents of 4.2 and 0.25%, respectively (Table 1) (Garay-Martínez *et al*., 2018).

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Figure 1. Accumulated monthly precipitation and maximum and minimum monthly average temperature recorded throughout 2018. *Accumulated monthly precipitation, average of 59 years (1951-2010; SMN, 2020).

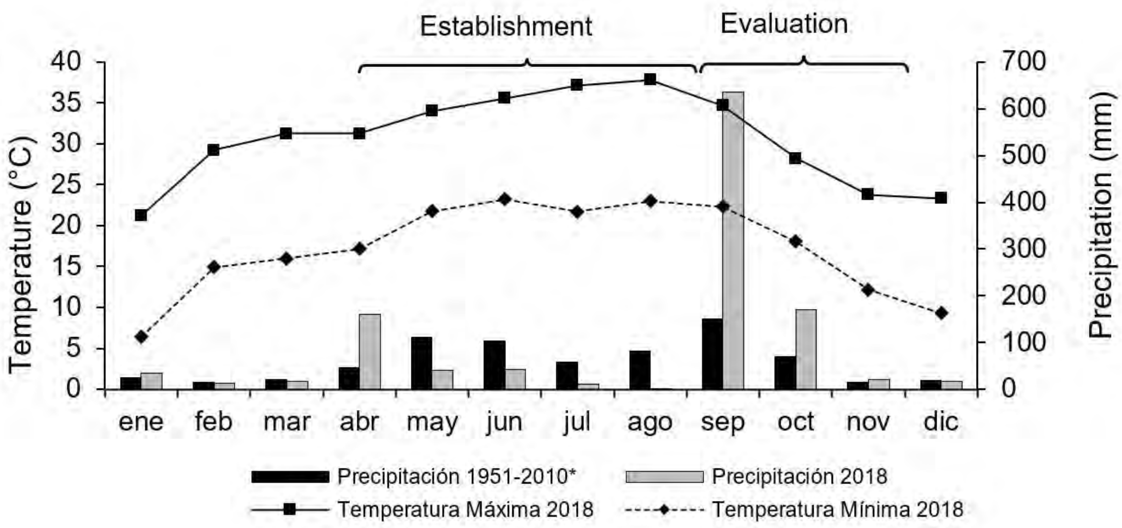

Table 1. Chemical and physical characteristics of the soil of the experimental site*.

pH	N_t	OM	Ca_t	P	K	Fe	Zn	Sand	Silt	Clay	SAR
		(%)			(mg kg^{-1})				(%)		
8.3	0.25	4.27	38.2	7.46	288.6	1.43	0.46	11.3	23.3	65.4	0.19

N_t= total nitrogen; OM= organic matter; Ca_t= total carbonates; P= phosphorus; K= potassium; Fe= iron; Zn= zinc; SAR= sodium adsorption ratio. *= laboratory of Agricultural Research and Diagnosis. Faculty of Engineering and Sciences, Autonomous University of Tamaulipas (Garay-Martínez *et al*., 2018).

The sowing was carried out in 2018 with a manual seeder to establish three plots of the grasses Cobra, Convert 330, Camello I, and Camello II (hybrid *Urochloa*). The area of the experimental plots was 9 m^2, consisting of ten furrows, of which four central furrows were selected, each corresponding to an age of regrowth (2, 4, 6, and 8 weeks), and 1 linear m was delimited in them, which formed the useful plot. The distance between plants and furrows was 10 and 30 cm, respectively.

During the establishment and evaluation of cultivars, no fertilization was carried out, and weed control was carried out manually. Before the evaluation, a uniformity cut was made at 15 cm height. The treatments used were regrowth ages (2, 4, 6, and 8 weeks of regrowth) for each cultivar and were distributed in a completely randomized design. The variables assessed were the yield of dry matter of leaves (DMl, kg) and stems (DMs, kg), plant height (cm), and intercepted radiation (%).

For plant height, two readings were made to obtain the average height in each age of regrowth within the useful plot, with a graduated wooden ruler, recording the height in centimeters from the soil surface to the most homogeneous point of the apex of the leaves.

To measure the radiation intercepted by the plant, two readings were taken, one at the top of the canopy and one at the bottom, with a solar radiation meter (Spectrum® Light Sensor Reader 3415FX and Quantum Light 6 Sensor Bar 3668I6). The readings were made at each

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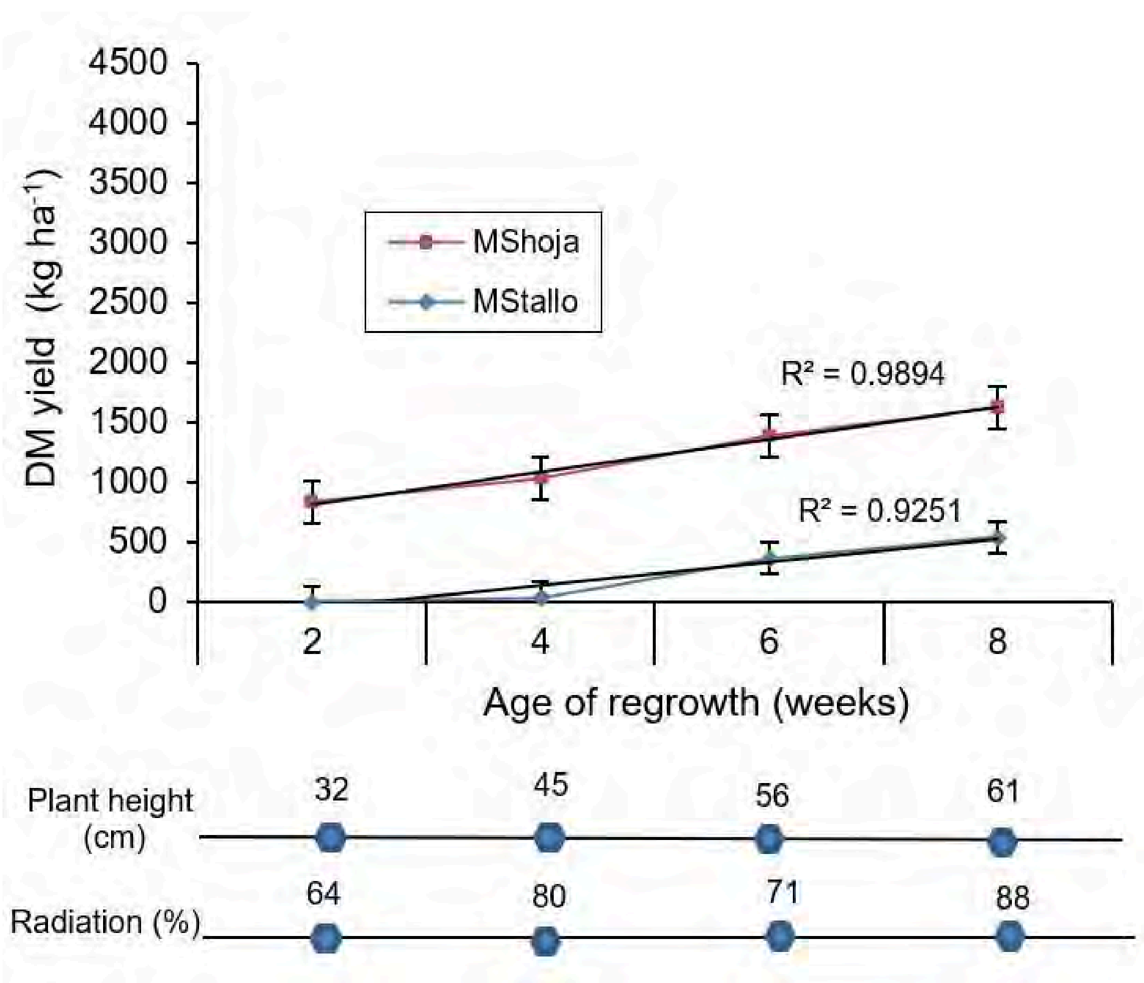
age of regrowth, always at 12:00 h, when the sun's rays were perpendicular to the canopy. Subsequently, the percentage of intercepted radiation was obtained by multiplying the value of the radiation obtained at the bottom of the canopy by one hundred and then dividing the result by the value of the radiation intercepted at the top.

The harvested forage was weighed, and a subsample of approximately 200 g was taken, which was separated into morphological components: leaf (leaf blade+ sheath) and stem. The subsamples were placed in a forced-air oven at 60 °C until constant weight was obtained. At the end of the drying period, the dry weight of each subsample was recorded, and the yield and accumulation of dry matter were estimated by morphological component for each age of regrowth.

The data of the evaluated variables were analyzed using the GLM procedure (SAS, 2003) based on a completely randomized design and regression and correlation analyses between measured variables. The treatment means were compared using Tukey's test, with a significance level of 5%. The yield of dry matter over time and its relationship with plant height and intercepted radiation in the Cobra cultivar is observed in Figure 2.

Figure 2. Analysis of growth and its relationship with plant height and intercepted radiati on in the Cobra cultivar.



The regression model and the coefficient of determination were high, with R^2 values> 0.98 and 0.92 for leaf DM and stem DM, respectively. The yield of the morphological components

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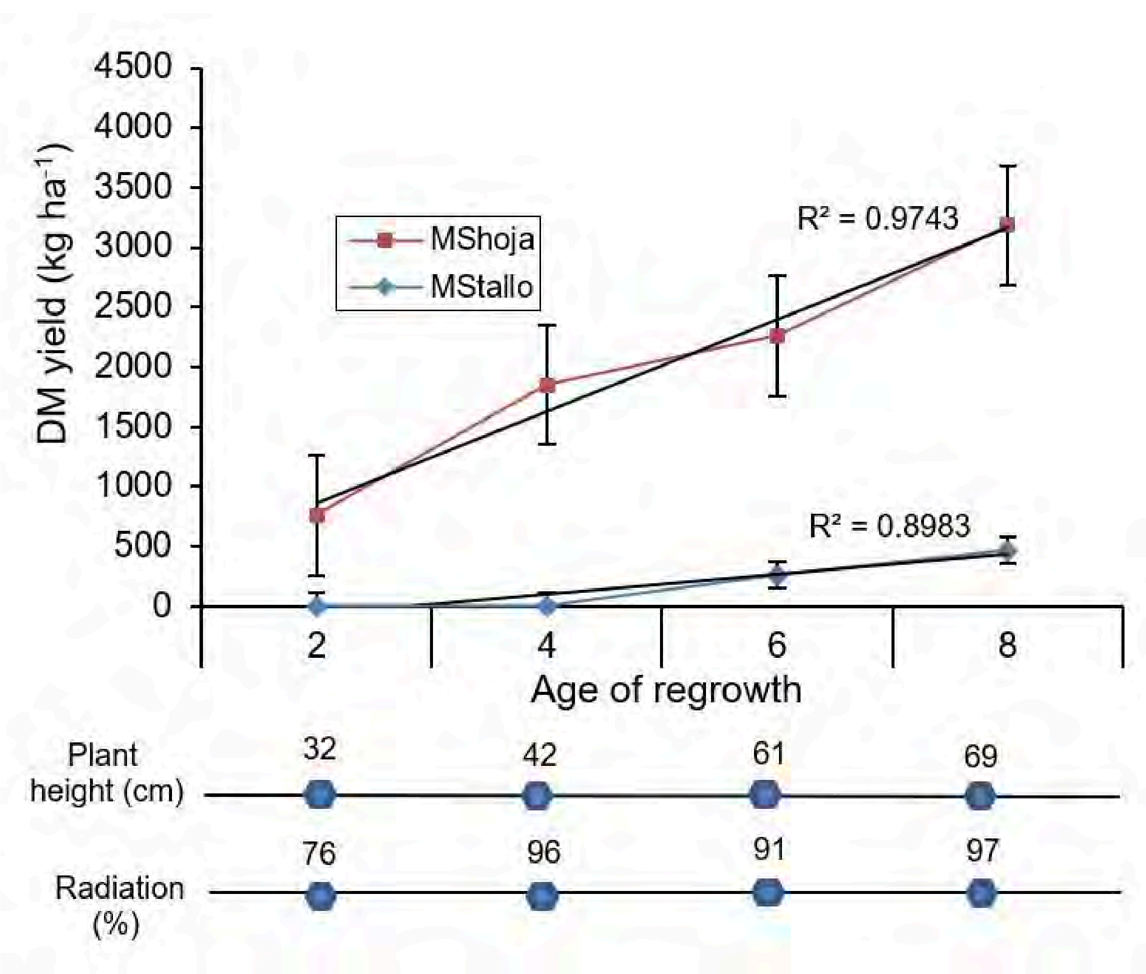
increased with the age of regrowth until reaching the maximum yield at the regrowth age of eight weeks (1 700 and 500 kg ha^{-1} DM for leaf and stem, respectively). The yields obtained in this research differ from those reported by Rojas-García *et al*. (2018), who, when harvesting the Cobra cultivar at a cutting intensity of 15 cm during the eighth week of regrowth, obtained leaf and stem yields of 1 000 and 1 300 kg ha^{-1} DM, respectively.

It can be seen that the presence of stem occurs from week four; the same behavior was reported by Rojas-García *et al*. (2018) evaluated this cultivar. Plant height and intercepted radiation behaved similarly to the yield, they tended to increase as the age of regrowth advanced, since 61 cm in height and 88% of intercepted radiation were reached at 8 weeks of regrowth.

The regression model and the coefficient of determination were high, with R^2 values> 0.97 and 0.89 for leaf DM and stem DM, respectively. The trend in the variables evaluated in the Convert 330 cultivar was similar to that of the Cobra cultivar; the difference was that the yield of the leaf component was around 3 200 kg DM at eight weeks of regrowth. Regarding the stem component, it was very similar to Cobra (about 500 kg ha^{-1} DM). Plant height increased as the regrowth age increased until a height of 69 cm at the regrowth age of eight weeks.

The intercepted radiation was greater than 95% interception at weeks four and eight of regrowth, indicating that the optimal use time could be eight weeks because there is a higher percentage of leaf than stem (Figure 3).

Figure 3. Analysis of growth and its relationship with plant height and intercepted radiation in the Convert 330 cultivar.



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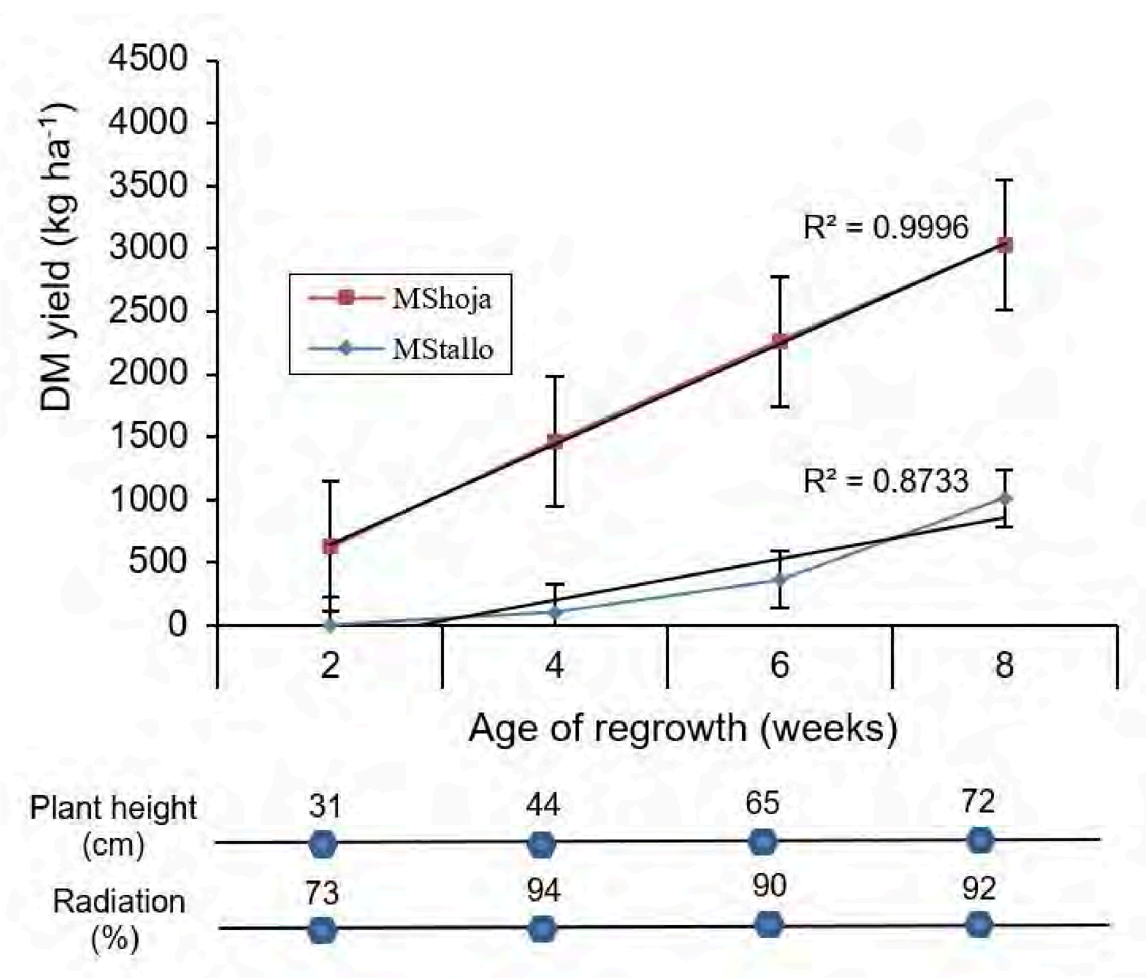
The regression model and the coefficient of determination were high, with R^2 values> 0.99 and 0.87 for leaf DM and stem DM, respectively. The trend in the variables evaluated in the Camello I cultivar was similar to the previous cultivars; nevertheless, the difference was that the yield of the leaf component was around 3 000 kg DM at eight weeks of regrowth and that the stem component reached 1 000 kg ha^{-1} DM, higher than the cultivars Cobra and Convert 330.

The plant height increased as the regrowth age increased, until reaching a height of 72 cm at the regrowth age of eight weeks. The maximum intercepted radiation (94%) was reached at week four of regrowth, when the meadow was 44 cm high, which would indicate that, despite not having reached 95% (as happened in Convert 330), it could be the optimal moment of use (Figure 4).

Figure 4. Analysis of growth and its relationship with plant height and intercepted radiati on in the Camello I cultivar.



The regression model and the coefficient of determination were high, with R^2 values> 0.96 and 0.83 for leaf DM and stem DM, respectively. The trend in the variables evaluated in the Camello II cultivar was similar to the previous cultivars; however, a marked difference was observed in terms of the yield of the leaf component since it was 4 250 kg DM at eight weeks of regrowth and, in turn, the stem component reached 1 750 kg ha^{-1} DM, superior to the cultivars Cobra, Convert 330 and Camello I (Figure 5).

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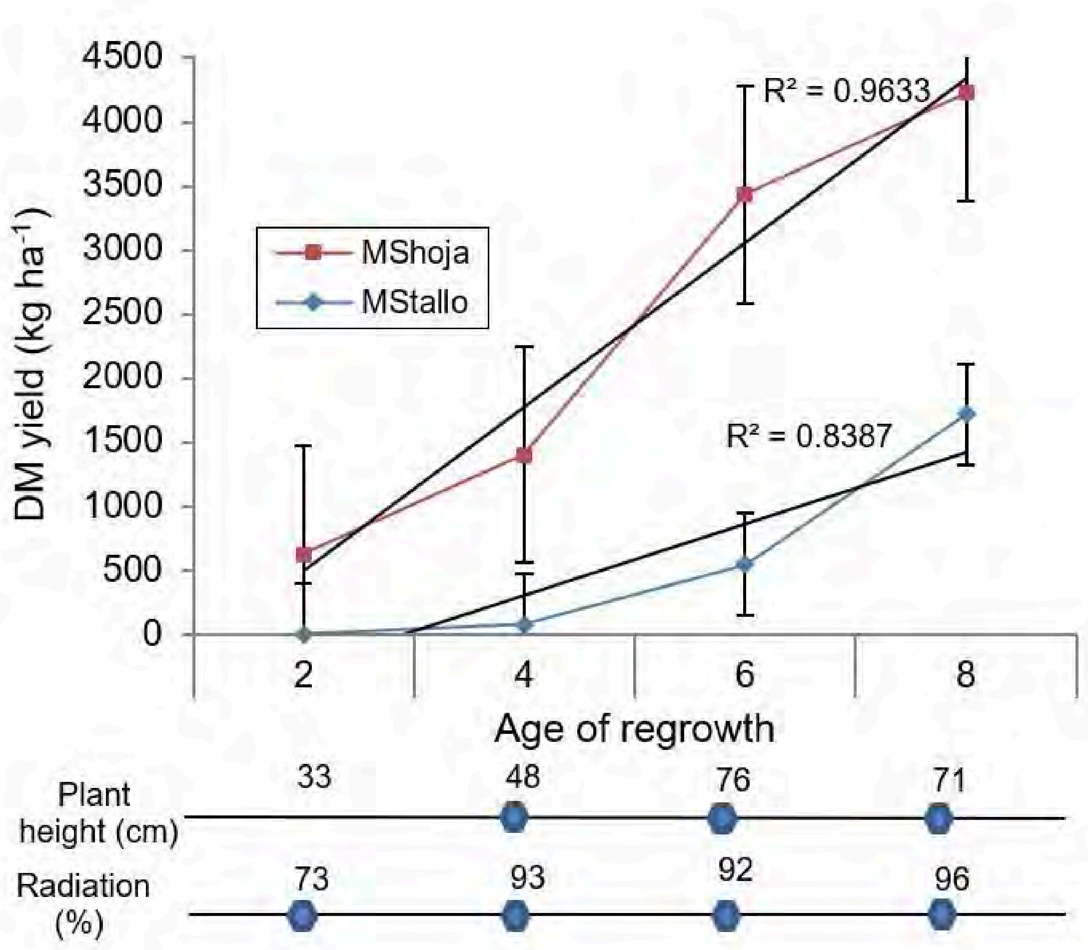
Figure 5. Analysis of growth and its relationship with plant height and intercepted radiation in the Camello II cultivar.



In this regard, the leaf is the component that contributes the most to yield (Cruz *et al*., 2011) and has the greatest nutritional value because it has a higher content of crude protein, compared to the stem, and greater digestibility (Garay *et al*., 2020; Rojas-García *et al*., 2018). In this regard, Pereira *et al*. (2012) argued that fertilization with nitrogen and phosphorus immediately after cutting induces an increase in the number and expansion of leaves and protein content (Gándara *et al*., 2017).

Plant height increased as the regrowth age increased, until reaching a height of 76 cm at the regrowth age of six weeks; nevertheless, it subsequently showed a tendency to decrease. The maximum intercepted radiation (96%) was reached at week eight of regrowth, when the meadow reached 71 cm in height, which would indicate that this value could be closely related to the maximum accumulation of the components of yield (leaf and stem) and, therefore, could be the optimal moment of use, which would indicate that this cultivar has slower growth, therefore, it accumulates more dry matter (Figure 5).

The variation in plant height between hybrids is due to the growth habit they present, which is modified by environmental and management conditions (González *et al*., 2020). In this sense, it has been reported that the Cobra hybrid presents an erect growth habit (Hare *et al*., 2015), while in the hybrids Camello I and Camello II, a more erect growth was observed in Camello II,

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therefore, the incidence of wind exerted a greater effect on this cultivar, causing the lodging of the plant at eight weeks of regrowth.

The increase in total dry matter yield as the age of regrowth increases is a behavior that has been documented in different studies (Garay-Martínez *et al*., 2018; Rojas-García *et al*., 2018), as a consequence of the active growth of grasses (Castro *et al*., 2013). When evaluating the hybrids Cayman, Mulato II, and Cobra, Vendramini *et al*. (2014) obtained higher dry matter yield as the age of regrowth increased from three to six weeks, with the cultivars Cayman and Mulato II obtaining the highest yields.

In addition, when assessing the same cultivars under different climatic conditions and cutting intervals of 30, 45, 60, and 90 days, Hare *et al*. (2013) obtained increases in total dry matter by increasing the cutting interval, with the Mulato II cultivar obtaining the highest yields at 30 and 45 days, while at 60 and 90 days, it was surpassed by the cultivars Cobra and Cayman, respectively. On the other hand, *Urochloa* cultivars generate higher rates of leaf elongation (Dias-Filho and Carvalho, 2000); however, leaf elongation rates vary depending on the time of year due to the different climatic conditions that occur, mainly temperature and precipitation (Martínez *et al*., 2020).

In this sense, Bernal *et al*. (2016) mentioned that the hybrids Cayman and Mulato II produce more leaves, which has been corroborated by Garay-Martínez *et al*. (2018), who, when evaluating the cultivars Cayman, Mulato II, Cobra, Insurgente and Buffel H-17, reported greater accumulation of leaves in the cultivars Cayman and Mulato II at four and six weeks of regrowth; nevertheless, when the age increased to eight weeks, leaf accumulation decreased, increasing the accumulation of stem and dead matter; a behavior similar to that observed in the present research.

The differences in the accumulation of stem dry matter can be attributed to the variations between the rates of stem elongation presented by the cultivars, which vary between cultivars and times of the year (Paciullo *et al*., 2011), as well as to the increase in the period of use, which induces the elongation of the stems (Filho *et al*., 2020).

Conclusions

In general, the accumulation of dry matter increases depending on the age of regrowth. During the eighth week of regrowth, the highest yields were obtained, and the leaf yield was higher than the stem yield, so it could be the optimal time to use the forage of the hybrids under the climatic conditions in which they were evaluated.

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