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**GROWTH ANALYSIS OF GRASS MULATO II (HYBRID *Urochloa*) BY VARIETY OF CUTTING INTENSITY**

**Adelaido Rafael Rojas García<sup>1</sup>, María de los Ángeles Maldonado Peralta<sup>1\*</sup>, Paulino Sánchez Santillán<sup>1</sup>, Filiberto Magadan Olmedo<sup>1</sup>, Perpetuo Álvarez Vazquez<sup>2</sup>, Marco Antonio Rivas Jacobo<sup>3</sup>**

<sup>1</sup>Universidad Autónoma de Guerrero, Facultad de Medicina Veterinaria y Zootecnia No 2. Cuajinicuilapa, Guerrero, México

<sup>2</sup>Departamento de Recursos Naturales Renovables-UAAAN. Calzada Antonio Narro 1923, Buenavista, Saltillo, Coahuila. CP. 25315.

<sup>3</sup>Facultad de Agronomía y Veterinaria de la UASLP. Carretera San Luis-Matehuala km 14.5, Ejido Palmade la Cruz, Soledad de Graciano Sánchez, San Luis Potosí. CP. 78321

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**ABSTRACT**

The objective was to evaluate an analysis of growth of grass Mulato II (hybrid *Urochloa*) by varying the intensity and obtaining the optimal cutting moment in the dry and rainy season. The evaluated variables were: forage yield, morphological composition, plant density, plant height and intercepted relationship. The best dry matter yield was obtained at 56 days in rain, at an intensity of 15 cm, 1,820 kg DM ha<sup>-1</sup> and the lowest at 7 days of regrowth in the dry season, with intensity 10 cm and a yield of 200 kg DM ha<sup>-1</sup>. The highest plant density was in the dry season and lowest in rain with 9.5 and 8.5 plants m<sup>-2</sup>, respectively. 95% of intercepted radiation was obtained at 70 cm of plant height, in the rainy season, at 15 cm of cutting intensity and with 42 days of regrowth. The grass Mulato II should be cut between 35 and 42 days after the regrowth, at an intensity of 15 cm, since that is when the best structural characteristics and the highest intercepted radiation are found (95%).

**Keywords:** *Urochloa*, forage accumulation, cutting intensity.

**1. INTRODUCTION**

Forage production is important since they are the most economical and sustainable source in livestock units and a fundamental part of ruminant feeding (Pérez et al. 2002). The mismanagement and low nutritional value of forage grasses in tropical and subtropical regions represents a limitation in the productivity of grazing ruminants, due to the high content of cell walls and the low concentration of crude protein, these variables affect the digestibility and consumption (Lara et al. 2009).

Beltrán et al. (2005) mention that the impact of forage quality is determined by the quantity and type of tissue removed, remaining leaf area, cutting frequency and physiological state of the plants. Prairie management modifies the adaptation, productive potential, and persistence of forage species (Hernández et al. 2012; Rojas et al. 2016). Cut frequency and intensity are two

components of forage management strategies that determine yield and quality (Cruz et al. 2011; Rojas et al. 2018; Maldonado et al. 2019).

Several studies in tropical Mexico found in *Brachiaria* hybrid Mulato higher annual yield when increasing frequency and intensity of grazing 12,309 kg DM ha<sup>-1</sup>, independently of the time of year, however, decreased crude protein with 88g kg<sup>-1</sup>DM (Cruz et al. 2017a). In grass *Brachiaria humidicola* cv. Chetumal Cruz et al. (2017b) report the highest forage accumulation, grazing at a light intensity of 13-15 cm in height and a frequency of 28 days. Rojas et al. (2018) reported for the dry tropics in grass Cobra (hybrid *Urochloa*) the higher yield of dry matter at 56 days at an intensity of 15 cm 2,550 kg DM ha<sup>-1</sup> and the lower with the intensity at 10 cm reaching a yield of 2,250 kg DM ha<sup>-1</sup> (p=0.05).

In Mexico there are few research on yield accumulation and structural characteristics of grasses in the dry tropics. The objective of the present investigation was to evaluate an analysis of growth in Mulato II cv (*Brachiaria* now hybrid *Urochloa*) by varying the frequency and intensity and determine the optimal cutting time in the dry and rainy season.

## 2. MATERIALS AND METHODS

Location of the experimental area: The test was made from January to March and August to October 2017 at the experimental plots of the Facultad de Medicina Veterinaria No. 2 de la Universidad Autónoma de Guerrero, situated in Cuajinicuilapa, Guerrero, Mexico. Located at coordinates 16° 28' 28" north latitude and 98° 25' 11.27 " west longitude at 46 masl. The climate is classified Aw and called the dry tropic according to the Köppen-Geiger system classification (García, 2004). The soil with a sandy clay texture, pH 4.8 to 5.0, deficient in organic matter. The average annual temperature of the dry season, which comprises from January to March, was 26.9° C with a precipitation of 15 mm, however, in the rainy season from August to October, the highest precipitation was recorded with 699 mm (Table 1). Gravity irrigations up to field capacity for regrowth recovery were applied every eight days in the dry season and fertilization was not applied throughout the experimental period. Climatic data were obtained from the agro-meteorological station CONAGUA located 1000 m of the experimental plots.

**Table 1. Data maximum temperature, minimum, average (°C) and precipitation (mm) during the study period 2017.**

Month	Maximum	Minimum	Half	Precipitation	Irrigation
Dry season					
January	35	19	27	8	Yes
February	35.5	19.5	27.5	4	Yes
March	36.6	19.8	28.5	3	Yes
Rainy season					
August	33	17	25	250	Not

September	32.5	17.5	25.5	280	Not
October	34.6	17.8	26.5	169	Not

Plots management: The sowing of hybrid *Urochloa* cv Mulato II (CIAT 36087) was carried out on October 10, 2016 with a density of 8 kg ha<sup>-1</sup> of viable pure seed. The furrows were made with a separation of 50 cm and 5 cm between plants, agrochemicals were not applied throughout the experimental period. Three 10 x 10 m plots were sown as experimental units. Likewise, each experimental unit was divided into two areas of 5 x 10 m to evaluate two cutting intensities of 10 and 15 cm and these in turn into nine areas, in order to evaluate a growth analysis with nine ages of regrowth. The variables evaluated were: dry matter yield, morphology composition, plants m<sup>-2</sup>, height of plant, intercepted radiation in the dry season and rain. Before starting the growth analysis, a homogenization cut was made at a height of 10 and 15 cm depending on the cutting intensity.

**Variables evaluated**

**Yield of dry matter:** After the uniformization cut every seven days, two 50 x 50 cm squares were cut in each experimental plot at 10 and 15 cm depending on the cutting intensity, selected randomly; the harvested forage was washed, and deposited in a forced air oven at 55 °C until constant weight to estimate recording the weight of dry matter per hectare, for different ages cutting.

**Morphological composition:** Of the samples for dry matter yield, approximately 20% was taken to evaluate the morphological and botanical composition, separating the leaf, stem, dead material and spike components. Subsequently each component was deposited in labeled paper bags and deposited in a forced air stove at 55 °C until the samples obtained constant weight and the weight was recorded.

**Plant density:** A starting the experiment, a fixed box of 1m<sup>2</sup> randomly in each experimental plot, one day later each cut was counted the number of plants present and with it, the average was obtained from plants by frequency, intensity and season of year.

**Plant height:** The average height per plant was estimated, a day before the cutting, taking randomly 20 readings at each experimental plot. For it, a 100 cm graduated ruler was used and the height was taken into account in the morphological component with the highest height.

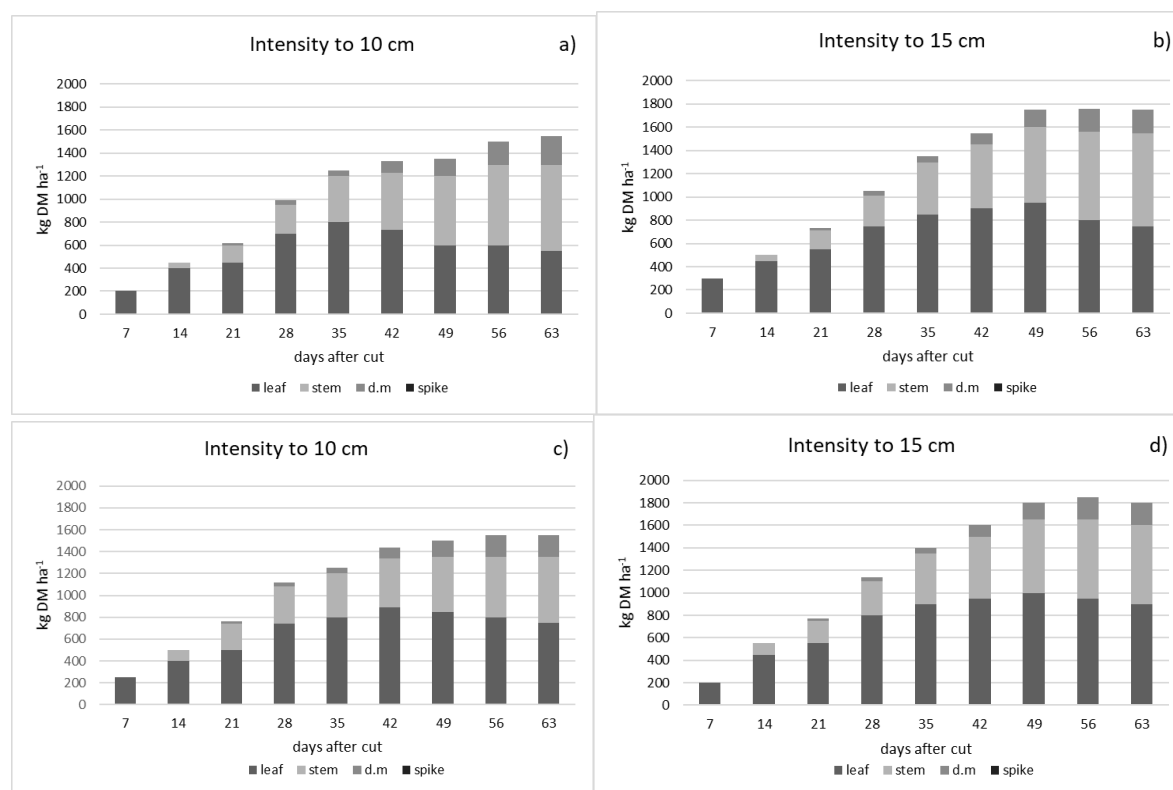
**Intercepted radiation:** One day before each cut, five repetition radiation readings were taken at random with the wooden meter method described by Rojas et al. (2016) in each experimental unit. The readings were made at approximately 1:00 p.m. The procedure consisted of placing the ruler on the ground surface (under the canopy), facing south-north, and immediately afterwards, the shaded centimeters were counted, which represented the percentage of intercepted radiation by the vegetal canopy.

**Statistical analysis:** The data was analyzed using a completely randomized block design with arrangement in divided plots and three replications, the procedure used was PROC GLM from SAS (2011), where the effects of frequency and height of cut were considered as fixed. The multiple comparison of measure of the treatments was carried out using the Tukey test ( $\alpha=0.05$ ).

### 3. RESULTS AND DISCUSSION

#### Yield and morphological composition

Growth analyzes of the grass Mulato II by varying the intensity of cut 10 and 15 cm during the dry and rain in Figure 1. Growth is observed as the age of regrowth increases until it reaches a maximum point and then decrease. The highest yield of dry matter was obtained at 56 days in the rainy season at an intensity of 15 cm with 1, 820 kg DM ha<sup>-1</sup> and the lower after 7 days of regrowth in the dry season with the intensity 10 cm with a yield of 200 kg DM ha<sup>-1</sup> ( $P \leq 0.05$ ).



**Figure 1.** Total dry matter accumulation, and morphological composition of Mulato II grass (hybrid *Urochloa*) by varying the frequency (days) and cutting intensity (cm) in the dry and rainy season; m.m. = dead material; a and b = dry; c and d = rain

The highest proportion of leaf was reported 35 days in intensity at 15 cm in the rainy season where it was increasing until it reached the maximum point with 1000 kg DM ha<sup>-1</sup> (Figure 1;  $P \leq 0.05$ ), and later begin to decline as the leaves in the lower layers were disappearing as indicated by Calzada et al. (2014), Rojas et al. (2018) and Maldonado et al. (2019) in tropical grasses. They report higher senescence at higher cutting frequency because they are below the light compensation point until the leaves continuously die.

Velasco et al. (2001), Rueda et al. (2016) and Wilson et al. (2017) report similar behavior in growth analysis of different grasses where the highest yield is obtained in the sixth week of regrowth, tending to decrease. The higher yield reported with an intensity of

15 cm could be due to the fact that there is a larger remaining leaf area which causes the biomass to recover more easily (Cruz et al. 2017a; Rojas et al. 2018), maintains higher reserves of carbohydrates, increases the persistence of the prairie and prevents soil erosion (Rojas et al. 2016). Rojas et al. (2018) when evaluating Cobra grass (hybrid *Urochloa*) obtained the highest dry matter yield at 56 days at an intensity of 15 cm with 2550 kg DM ha<sup>-1</sup>, related to this investigation.

Independently of the frequency, intensity and time of the year the number of stem was in increasing as passed the evaluation time until the last week of evaluation at day 63 with 710 kg DM ha<sup>-1</sup> (P ≤ 0.05). The contribution of spike and dead material was minimal and was found in a higher proportion from day 42 with an average of 221 kg DM ha<sup>-1</sup>. Rojas et al. (2016) and Maldonado et al. (2019) found that the distribution of the components in the yield is influenced by the time of the year, planting density, associations and monoculture. On the other hand, different authors (Juskiw et al. 2000) mention that in the advanced stages the weight of the stem and spike increases, decreasing the leaf, which is explained physiologically by increasing the weight of the spike by filling grains, due in part translocation of nutrients from the leaves resulting in senescence and death of this component.

**Plant density**

Plant density m<sup>-2</sup> of the grass Mulato II by varying the frequency and intensity of cut in the dry and rainy season it is observed in Table 2. The highest plant density was reported in the intensity of 15 cm with an average 10 plants m<sup>-2</sup> and lowest with an intensity of 10 cm in the rainy season with 8 plants m<sup>-2</sup> (P=0.05). In the time that the investigation lasted, was lost 1 floor m<sup>-2</sup> in two intensities. This is due as time passing they go losing vigor and death of plants for the management given, since to higher intensity higher loss of plants (Rojas et al. 2016).

**Table 2. Density of plants (m<sup>-2</sup>) of grass Mulato II (hybrid *Urochloa*) when varying the frequency (days) the height (cm) of cut in the dry and rainy season.**

Intensity (cm)	Cutting frequency (days)								
	Dry season								
	7	14	21	28	35	42	49	56	63
10	10a	10 a	10a	9b	9b	9b	9b	9b	9b
15	10a	10 a	10a	10 a	9b	9b	9b	9b	9b
	Rainy season								
10	9a	9a	9a	9 a	8b	8b	8b	8b	8b

15	9a	9a	9a	9a	8b	8b	8b	8b	8b
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abc = Averages with the same lowercase literal in the same row, are not different (P= 0.05).

The highest intensity of Mulato II grass plants with an intensity of 15 cm coincides with the highest contribution of forage yield at both times of the year (Table2; Figure 1). Sevilla et al. (2001) mention that, the death of plants is higher when there is higher grazing intensity, reaching the density of plants to be maintained in a certain time; noting that the minimum density required to not affect its growth is 30 plants per m<sup>2</sup>, below which, prairie markedly decreases the production of forage. In this investigation we have by below this number of plants may be due to the species, type of growth and adaptation to the pedo-agronomical surrounding medium.

These changes in plant density are reflected in the crop of dry matter yield and are attributed to the height of cut (Figure 1) by its direct influence on photosynthesis (McKenzie et al. 1999) by having little remaining leaf area at the intensity of 10 cm. In this regard, Chapman and Lemaire (1993) mention that the prairies respond differently to the management that is practiced, affecting their persistence and yield by effect of intensity and interval of harvest. In this particular investigation the Mulato II grass was benefited by the management provided with the intensity at 15 cm.

**Plant height**

Table 3 shows the height of the Mulato II grass by varying the frequency and intensity of cut in dry and rainy season. Independently of the cutting intensity and time of year, the height increased as the evaluation period passed (P = 0.05). The highest plant height was 77 cm, reported with a frequency of 49 days in the rainy season and with a residual area height of 15 cm (P = 0.05). While the lowest height was reported in the intensity of 10 cm with 13 cm height at seven days of regrowth (P = 0.05).

**Table 3. Height (cm) of Mulato II grass (hybrid Urochloa) when varying the frequency (days) and height (cm) of cut in the dry and rainy season.**

Intensity (cm)	Cutting frequency (days)								
	Dry season								
7	14	21	28	35	42	49	56	63	
10	13c	14c	16c	32b	39b	5 3b	6 9a	60a	62a
15	17c	20c	25b	38b	45b	66 <sup>a</sup>	7 5a	72a	73a
	Rainy season								

10	13c	15c	18b	30b	41 b	60 <sup>a</sup>	70a	66 a	68a
15	17c	20c	24c	35b	45b	70ab	77a	74 a	75a

abc = Averages with the same lowercase literal in the same row, are not different (p = 0.05).

Changes in seasonal values obtained in plant height were closely related to annual yield; As height increases, yield increases (Figure 1). Similar results in tropical grasses were obtained by Maldonado et al. (2019) reported an increase in height coupled with a higher yield of dry matter and intercepted radiation up to a certain point to start declining. On the other hand, Velasco et al. (2005) and Castro et al. (2013) observed statistical differences between stations and frequencies, registering the highest height in summer and the lowest in winter.

Intercepted radiation

Table 4 shows the intercepted radiation of the grass Mulato II by varying the frequency and intensity of cut in the dry and rainy season. As the cutting frequency increases, the intercepted radiation increases. The highest radiation was reported in the frequency of 63 days and with a height of 15 cm with 99 % of radiation intercepted; however, it should be noted that in that week the quality of the stem and dead material increases, decreasing the quality (Figure 1). Where it is recommended to harvest the forage is when it reaches 95% of intercepted radiation and in this case it was in the rainy season 56 days after cutting with a cutting intensity of 15 cm.

**Table 4. Intercepted radiation (%) of Mulato II grass (hybrid *Urochloa*) by varying the cutting frequency (days) and height (cm) in the dry and rainy season.**

Intensity (cm)	Cutting frequency (days)								
	Dry season								
	7	14	21	28	35	42	49	56	63
10	15d	18d	22c	35c	55b	77b	88a	85a	80a
15	20d	25d	30c	35c	60b	92b	93a	94a	97a
	Rainy season								
10	17d	30d	35c	56c	70b	90b	92 a	92 a	91a
15	21d	32d	36c	60c	81b	95b	97a	97a	99a

abc = Averages with the same lowercase literal in the same row, are not different ( $p = 0.05$ ).

In this regard, Da Silva and Nascimento (2007), Da Silva and Hernández-Garay (2010) and Maldonado et al. (2019) mention that forage should be harvested when it reaches 95% of intercepted radiation since the largest number of green leaves is found; these results are achieved when the plant density is competitive (Mattera et al. 2013; Rojas et al. 2016). The preceding percentages reveal that the ability of the species to interpret solar radiation depends on the number of plants, frequency, intensity and the environmental conditions to which they were exposed during their growth prior to each harvest (Federick et al. 1999; Horrocks and Vallentine, 1999; Da Silva and Hernández-Garay, 2010).

#### 4. CONCLUSION

As the re-growth increased, the dry matter yield increased until day 63, however, where the largest amount of leaf is found was on day 35. The height of the plant and intercepted radiation was increasing as the regrowth of the plant increased. However, the plant density was decreasing with the evaluation time.

Mulatto grass II should be cut 35 to 42 days after regrowth and at an intensity of 15 cm, since it is when the best structural characteristics and 95 % of intercepted radiation are found. It is recommended to continue expanding research on this tropical grass with more evaluation time and broaden the decision landscape.

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