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Research Article
Influence of Seed Type on Forage Production of *Panicum maximum* Cultivars

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Abstract

Objective: The aim of this study was to evaluate the influence of seed type and sampling times in the agricultural year 2011/2012 on the production of Dry Mass (DM) of cultivars of *Panicum maximum*. **Methodology:** The experiment was carried out at the Universidade Estadual de Mato Grosso do Sul, Campus Aquidauana-MS. The statistical design was a randomized block in a split plot with four replications. The plots consisted of three cultivars of *Panicum maximum*: Tanzânia, Mombaça and Massai. The subplots comprised two seed treatments: Conventional seed with high purity and seed encrusted, who went through the process of chiseling, fungicide and subsequently received péleti containing macro and micronutrients. The first cut occurred on 22 October, 2011 the remaining forage cuts were 60 days of regrowth, which it was assessed the following parameters: Dry mass of leaves, culm and roots and leaf/culm ratio (L/C). **Results:** The seed coating did not affect the production of DM. Mombaça showed greater DM and leaf/culm ratio in relation to Tanzânia and Massai. **Conclusion:** In the region of Aquidauana-MS, *Panicum maximum* cultivars showed low forage production during the winter season, characterizing the summer as the best period of forage production for the three cultivars of this species.

Key words: Grass colonião, forage production, seed types, dry mass, leaf/culm ratio

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In the management of forage species one of the most important practice is to use good quality seeds[1]. In marketing, you may find two types: Conventional seeds and seed encrusted. The conventional seed is traditionally grown in pastures, formed by bare with no seed coating process[2,3]. Already the incrustation process is a species of seed coating with macro and micronutrients and fungicides, which increases by up to 5 times its size without changing its format, allowing better use by improving physical purity and facilitate sowing due to its increased size[4].

The successful use of pasturage depends not only on the use of seeds of good quality, but also the availability of nutrients or the choice of forage plant to be used[5], as well as the understanding of physiological mechanisms and their interaction with the environment, key point to support both growth and maintenance of the productive capacity of the pasture[6].

According to Oliveira *et al.*[7], approximately 80% of the areas under forage pastures in Brazil belong to the genera Brachiaria and Panicum. Plants of the genus Panicum are of African origin, belonging to the family Poaceae being described as a perennial crop, forming clumps, deep root system and with great potential for forage production[8].

One of the main cultivars of the species *Panicum maximum* are the Massai, Mombaça and Tanzânia[9]. Cultivating Massai has presented itself as an important option for diversification of pastures in the Cerrado showing tolerance to soil acidity and low fertility, in addition to its ability to produce more leaves in relation to stalk and providing a regrowth of up to 80% after cutting[10]. Cultivating Tanzânia has as main characteristics, high dry matter production potential and high nutritional value[11,12]. Cultivating Mombaça is considered high forage productivity and showing percentage of leaves especially in dry season[13].

In favorable weather conditions, the yields of dry mass of cultivating Mombaça are around 15-20 t ha year^{-1}. In plots under mechanical cuts, the Mombaça produced 130% more than the common colonião and 28% more than cultivating Tanzânia. During the dry period, where there is little incidence of rainfall, the forager produces about 12-15% of their annual income of forage[14].

Experiments performed with different forage grasses, including *Panicum maximum*, show that the reduction of the frequency of cuts leads to higher production, but cause drop in quality[15,16]. The intensity of these effects, however, depends on the characteristics of the species of the plant variety, the time of year and the soil and climate characteristics of the environment in question[17]. The aim of this study was to evaluate the influence of seed type of *P. maximum* cultivars in forage production, cutting at different times in the region of Aquidauana-MS.

MATERIALS AND METHODS

The experiment was conducted at the Universidade Estadual de Mato Grosso do Sul, Campus Aquidauana-MS, located in the Cerrado biome (Brazilian Savanna), comprising the geographical coordinates 20°27'S and 55°40'W with an average altitude of 170 m.

The soil of the area was classified as Alfissol distrophic, sandy loam texture with the following chemical features in the layer 0-0.20 m: pH (H_2O) = 6.2, Al exchangeable ($cmol_c$ dm^{-3}) = 0.0, Ca+Mg ($cmol_c$ dm^{-3}) = 4.3 1, P (mg dm^{-3}) = 41.3, K ($cmol_c$ dm^{-3}) = 0.2, organic matter (g dm^{-3}) = 19.74, V (%) = 45, m (%) = 0.0, sum of bases ($cmol_c$ dm^{-3}) = 2.3 and CEC ($cmol_c$ dm^{-3}) = 5.1. The climate of the region, according to the classification described by Köppen-Geiger is Aw (Tropical Savanna) with average annual rainfall of 1,200 mm and maximum and minimum temperatures of 19 and 32°C, respectively.

The experimental design used was the entirely randomized blocks in subdivided plots with four replicates. The plots consisted of three *Panicum maximum* cultivars: Tanzânia, Mombaça and Massai. The subplots included two seed treatments: Conventional seed with high physical purity and encrusted seeds, which passed through the process of mechanical scarification, treatment with fungicide and later pelleting, that consists of sticky material of macro and micronutrients.

The experiment was conducted in 4 instalments of 9 m long and 4 wide, these were divided into 3 m for each cultivar and subdivided into a meter and a half into the type of seed. In preparing the experimental area, undergrowth was performed with the use of a single seeder, performing sowing manually throw at a rate of 10 kg ha^{-1} of seeds in the day 22 August, 2011.

From September, 2011 to August, 2012 were held 610 cm cutting height from the ground. The first cut occurred on 22 October, 2011 and the other cuts was with 60 days of regrowth. For each sampling were cut four plants in each sub-plot at ground level, being performed the separation of leaves and culms. After packed in perforated study bags were taken to the oven with air circulation and renewal to 149°F for

Table 1: Months, average temperature, Degree Days accumulation, average mositure and rainfall accumulated between the months of conducting the experiment

Harvest dates	Month/year	Average temperature (°C)	Accumulated degree days (DD)	Average moisture (%)	Rainfall accumulated (mm)
HD1	October/2011	26.65	1,419.80	56.75	228.40
HD2	December/2011	27.45	1,506.20	60.75	162.60
HD3	February/2012	28.83	1,654.70	61.50	237.80
HD4	April/2012	24.28	1,163.30	63.75	250.60
HD5	June/2012	21.15	825.80	63.00	222.40
HD6	August/2012	21.45	858.20	58.00	10.40

HD: Harvest dates and DD: Degree days

Table 2: Analysis of variance (ANOVA) for dry mass of leaves (DML), dry mass of culm (DMC), dry mass of roots (DMR) and leaf/culm ratio (L/C) in three cultivars of *Panicum maximum* with two kinds of seed coating in 6 different seasons and its interactions in Aquidauana-MS, Brazil, 2011/2012

S.V	DF	DML (g plant^{-1})	DMC (g plant^{-1})	DMR (g plant^{-1})	L/C
Block	3	983.00^{ns}	1,158.17^{ns}	2,141.17^{ns}	0.85^{ns}
C	2	3,957.24**	1,813.67**	5,770.91**	2.18**
Residue 1	6	219.92	335.28	555.20	0.66
S	1	19.97^{ns}	1.86^{ns}	21.83^{ns}	10.74^{ns}
C×S	5	1.11^{ns}	5.91^{ns}	7.02^{ns}	0.19^{ns}
Residue 2	6	126.91	170.53	297.44	0.74
HD	5	8,155.99**	2,697.52**	10,853.51**	3.02**
HD×C	10	367.83^{ns}	128.75^{ns}	496.58^{ns}	2.85^{ns}
S×HD	5	531.65^{ns}	70.55^{ns}	602.20^{ns}	7.49^{ns}
C×S×HD	10	100.65^{ns}	197.56^{ns}	298.11^{ns}	0.51^{ns}
Residue 3	93	233.07	162.40	395.47	1.44
CV% 1	-	22.34	21.04	15.89	18.11
CV% 2	-	12.11	16.07	13.44	17.01
CV% 3	-	19.01	14.11	13.96	14.59

**Significant by the F-test at 5 and 1% probability, ns: Not significant, DF: Degrees of freedom, S.V: Source of variation, C: Cultivars, S: Seed coating type, HD: Harvest dates and CV: Coefficient of variation

72 h, being subsequently evaluated the following assessments: Dry mass of leaves (DML), dry mass of culm (DMC), dry mass of roots (DMR) and leaf/culm ratio (L/C).

After collected, separated and weighed the samples were dried in an oven at a temperature of 149°F for 72 h and heavy again to obtain the dry mass. In Table 1 are showed the rainfall accumulated in each cut, average temperature and humidity during the interval between cuts. The values of dry mass production were related to the thermal time scale in units of thermal growth, enabling a broader interpretation of the phenomena found[18]. For this, it was used the set of equations proposed by Ometto[19], in which the thermal units are defined as Degree Days (DD) growth. In the equation to estimate the degree days is used the basal temperature of the plant. According to Garcez Neto *et al.*[6], the temperature for *Panicum maximum* is 56.84°F. The data were subjected to analysis of variance and averages compared by Tukey's test at 5 and 1% probability, using the statistical software SISVAR[20].

RESULTS AND DISCUSSION

Table 2 are presented the results obtained by analysis of variance to the DML, DMC and DMR, where there was significant results only for the Cultivars (C) and Harvest Dates (HD). There was no significance for DML, DMC, DMR and L/C in relation to the types of seed used. One would expect a better performance of the coated seeds regarding to common due to incorporation of macro and micronutrients and application of insecticides in these, what could have spurred a greater production of analyzed variables, which was not evidenced in the this study.

These results corroborate with Teodoro *et al.*[4], Torres *et al.*[21] and De Oliveira *et al.*[22] that when assessing the influence of seed coating in the development of *Brachiaria brizantha* did not obtain significant differences among common and coated seeds to production of dry mass of leaves and culms agreeing with this study. According to these authors, possibly the similarity among data collected in different treatments reflects the quality of the soil used in the forage growing, the latter possibly supplied the nutritional requirement of the grass in question.

The DML, DMC, DMR and L/C are shown in Table 3, where the average values of these variables for the evaluated cultivars presented significant differences ($p>0.01$). The Mombaça excelled regarding to the others in all evaluated parameters. These values were similar to those found by

Table 3: Dry mass of leaves (DML), dry mass of culm (DMC) and dry mass of roots (DMR) and leaf/culm ratio (L/C) of three cultivars of *Panicum maximum* grown in Aquidauana-MS, Brazil, 2011/2012

Cultivars	DML (g plant^{-1})	DMC (g plant^{-1})	DMR (g plant^{-1})	L/C
Massai	[1]24.85^{c}	18.00^{c}	42.85^{c}	1.38^{c}
Mombaça	69.11^{a}	39.49^{a}	108.60^{a}	1.75^{a}
Tanzânia	45.18^{b}	29.37^{b}	74.55^{b}	1.54^{ab}

[1]Same lowercase letters on the lines do not differ by Tukey's test ($p<0.05$)

Table 4: Average dry mass of leaves (DML), dry mass of culms (DMC) and dry mass of dead material (DMDM) of three cultivars of *Panicum maximum* in six different harvest dates in 2011/2012, Aquidauana-MS, Brazi

Periods	DML (g plant^{-1})	DMC (g plant^{-1})	DMDM (g plant^{-1})	L/C
HD1	[1]46.96^{a}	26.42^{ab}	73.38^{a}	1.78^{b}
HD2	54.35^{a}	31.94^{a}	86.32^{a}	1.70^{b}
HD3	49.08^{a}	26.17^{ab}	71.25^{a}	1.87^{b}
HD4	22.28^{b}	10.32^{ef}	32.60^{b}	2.15^{a}
HD5	28.39^{b}	16.90^{cd}	45.29^{b}	1.68^{b}
HD6	7.10^{c}	3.15^{f}	10.25^{c}	2.25^{a}

[1]Same lowercase letters on the lines do not differ by Tukey's test at 5 and 1% probability, HD: Harvest dates

Kichel *et al.*[23], which evaluating the forage production intercropped with maize, verified that the grass higher-yielding in dry mass of forage was Mombaça, followed by Tanzânia and finally by the Massai, which have the lowest yield among all.

The difference among the cultivars for production of dry mass can be explained by morphological features of each. Mombaça grass, which was superior to the other has wider leaves and a larger size, whereas the Massai that showed the least yield, presents smaller leaves when compared to the other cultivars.

According to De Queiroz Filho *et al.*[24] the leaf/culm relationship is of great importance both for animal nutrition and for the management of fodder plants. High leaf/culm ratio means higher protein content, forage digestibility and consumption, able to meet the nutritional requirements of the animals. It has been considered a critical threshold for this ratio[25] of 1.0 with values less than this would fall in the quantity and quality of forage produced. In this experiment all cultivars showed superiority in relation to this value for this ratios. This results resemble those obtained by Brancio *et al.*[26] and De Oliveira *et al.*[22], which did not get differences among the cultivars Mombaça and Tanzânia, which were superior to Massai. In Table 4 are showed the average values for the variables DML, DMC, DMR and L/C, where statistical differences were obtained among the sampling periods evaluated.

For the production of DML, DMC and DMDM was not obtained differences among the periods HD1, HD2 and HD3 being the same superiors in relation to others. One can consider that these values were derived from rainfall, which occurred in a distributed way and the cumulative average temperature between the samples, where this was higher in relation to HD4, HD5 and HD6 periods (Table 1), providing a greater degree days accumulation in relation to the same times.

Already in HD4, HD5 and HD6 can be observed an intense rainfall, but the temperature was cooler (Table 1). With this fodder the development was affected and the cultivars showed lower production of DML, DMC and DMDM being possible to observe that the best time for cutting with high productivity of dry mass for the region of Aquidauana-MS is in the spring and summer seasons.

During the periods of cutting HD4 and HD5 despite the low production of dry mass, the leaf/culm ratio was superior. However, in all periods for assessing this ratio has remained above the critical value of 1.0 stipulated by Pinto *et al.*[25]. Similar results were obtained by Brancio *et al.*[26] and Torres *et al.*[21] that when assessing the effect of sampling in *P. maximum* cultivars observed that the formation of leaves and culms was greater during the rainy season, when the plant growth is intense, providing greater amount of aboveground dry matter.

However, Santos *et al.*[27] when evaluated the rate of dry mass accumulation of the Mombaça and Tanzânia in different periods of the year, verified that on November/December and January/February this parameter were higher than that on September/October. These results disagree with this experiment, in which there were no significant differences in relation to the same periods. Again, should be taken into consideration the weather and rainfall, reflecting about the adaptability of cultivars in relation to environmental and climatic conditions.

CONCLUSION

Mombaça showed the highest dry matter production and leaf/culm ratio in relation to Tanzânia and Massai cultivars.The seed coating did not influence on dry matter production. In the region of Aquidauana (Mato Grosso do Sul, Brazil), *Panicum maximum* cultivars showed low forage production in the winter period, featuring summer as the best period of forage production for the three cultivars of this species.

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