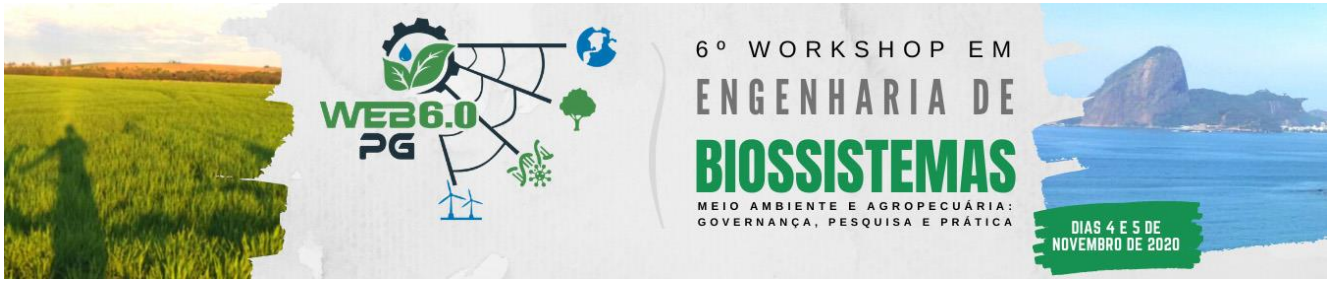

CHARACTERIZATION OF ELEPHANT GRASS (PENNISETUM PURPUREUM SCHUM. - BRS CAPIAÇU) AS AN ALTERNATIVE SOURCE OF ENERGY CULTIVATED IN THE RAIN PERIOD IN MACACU-RJ WATERFALLS

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Abstract
Diversifying the energy matrix, minimizing the use of oil sources, combating extreme weather events, are important strategies to mitigate environmental impacts. In this way, elephant grass (*Pennisetum purpureum Schum*. - BRS Capiaçu) is considered a prominent source of renewable energy containing high biomass productivity. Thus, the study was conducted to characterize the potential of the cultivar BRS Capiaçu, a recent genotype of elephant grass from Embrapa Gado de leite, in the production of energy biomass in the rainy season, grown in the city of Cachoeiras de Macacu. The treatments consist of four different experimental units, treatments 1, 2, 3 and 4, with four repetitions and cut performed at 180 days, in the month of November. The experiment was designed in a completely randomized design (DIC) with four samples and four replications, thus totaling 16 experimental units. The variables analyzed were dry matter (DM), mineral material or ash (MM), average plant height (AP), average number of leaves (EN), stem diameter (DC), number of tillers (NP), leaf production (PF), calorific value (PC), acid detergent insoluble fiber (FDA), nitrogen and lignin. Statistical procedures were performed with the R program and the means were compared using the Tukey test ($p < 0.05$). In Productivity, the grass reached 21,713 kg / MS / ha in 180 days of harvest. The calorific value reached (17.91 MJ kg^{-1}). The cut-off period in the rainy season accumulated a higher proportion of ash in the constitution of the plant, making heat transfer difficult.

Keywords: Biomass, forage, clean energy.

Presentation: https://youtu.be/3xKzOZwyIHA

INTRODUCTION

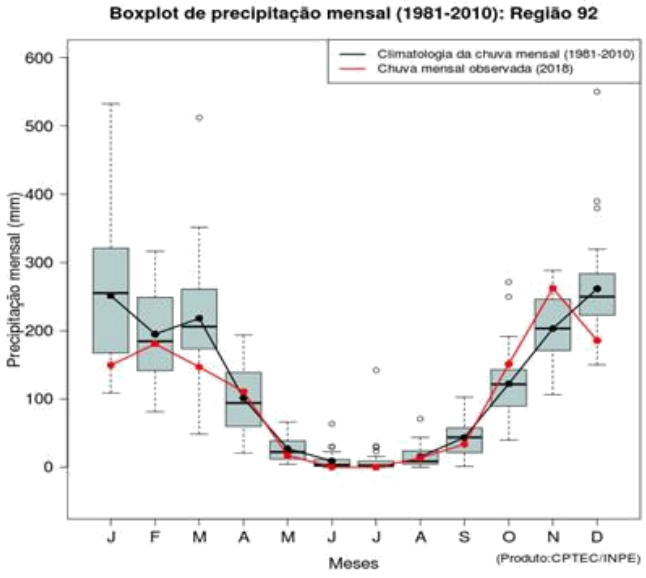
Rapidly combating climate change, extreme climatic events worldwide, such as fires, floods, are directly related to global warming, caused by human activities, a challenge of this century, according to the Parties to the United Nations Framework Convention on Climate Change. Climate (COP-25, 2019).

The use of plant biomass as an alternative to fossil fuel provides less greenhouse gas emissions. In this sense, the use of elephant grass (Pennisetum purpureum Schum. - BRS Capiaçu), in the production of biomass as an energy source is justified by its high productivity, excellent adaptation to edaphoclimatic conditions, still providing less demand for inputs in relation to the crops destined for this purpose, such as corn and sugar cane. The BRS Capiaçu elephant grass, launched by Embrapa Gado de Leite, is currently being cultivated in Brazil and in the semi-arid region (Embrapa Gado de Leite. 2016. 6 p.). However, as it is a new forage on the market, there are gaps as to the knowledge of the correct cutting frequency or height (MONÇÃO et al., 2019 ab). Therefore, as it is an extremely important topic, the study was conducted with the objective of using elephant grass BRS Capiaçu in the characterization and production of this grass during the rainy season as biomass for an alternative source of energy, grown in the city of Cachoeiras de Macacu RJ.

MATERIALS AND METHODS

The experiment was conducted at Fazenda Escola de Cachoeiras de Macacu, belonging to the Universidade Federal Fluminense, located in the city of Cachoeiras de Macacu, State of Rio de Janeiro. The geographical coordinates of the place are: latitude 22º 27 '45" S, longitude 42º 39' 11" W and altitude of 57m (IBGE, 2019). The climate of the region, according to the Köppen classification, was identified as the Af, tropical type with rainy summers and dry winters (AZEVEDO et al., 2018). A high Precipitation rate was observed in the month of November (graph 1), during the experiment period.

Graph 1: Monthly and seasonal evolution of rainfall, 2018.



Source: INPE, 2019.

BRS Capiaçu seedlings were planted in May 2018, with spacing between furrows of 0.9 m and depth of 30 cm. The experimental area was demarcated in plots of 20 m 2 each (5 m x 4 m), randomly distributed in treatments 1, 2, 3 and 4, in a completely randomized design, with four samples and four replications, thus totaling 16 experimental units. The grass was cut at 180 days, in the month of November. The variables analyzed were dry matter (DM), mineral material or ash (MM), average plant height (AP), average number of leaves (EN), stem diameter (DC), number of tillers (NP) , leaf production (PF), heating power (PC), acid detergent insoluble fiber (FDA), nitrogen and lignin. In each sample, the production of leaves was analyzed, using a digital hand scale. The assessment of inter-nodes (EN) was performed manually, identifying the number of inter-nodes existing in the length of the stalk. The stem diameter (DC) was measured using a digital caliper. The plant height measurement (AP) was performed with the aid of a measuring tape. The number of tillers (NP) measured by manual counting of each plant. Then, the samples went through the drying process separately and crushed individually and were subjected to analysis in the animal nutrition laboratory of the UFF veterinary faculty, to measure ash, dry matter and calorific value. The results presented refer to the 180-day cut of the plant.

RESULTS AND DISCUSSION

The morphological and productive characteristics of the cultivar BRS Capiaçu in the four treatments were modified according to the age of the plant. In the cut performed at 180 days, between the four treatments, the plant height (AP) averaged 3.2 cm, while the average number of plants (EN) reached 16 per plant. The stem diameter (DC) reached an average of 16 mm per plant, the number of tillers (NP) reached a total of 27 units per m 2, and the leaf production (PF) reached an average of 2,700 Kg / ha-1. The increase in dry matter production was increasing, reaching 21,713 kg / DM / ha at 180 days of harvest (table 1). These high values in the variables are similar to those found by Pereira et al (2016), for BRS Capiaçu, which confirms high photosynthetic rates found in C4 metabolism plants, as they are more efficient in the use of atmospheric CO2, according to Na et al (2016). The number of tillers greater than 12 plants per square meter confirms the adequate formation and

maintenance of the weeding, as well as the adequate soil cover. According to a study carried out by researcher Paulino Andrade (Embrapa dairy cattle, 2020), the MS production of BRS Capiaçu is 57% cheaper than that of corn. Estimated value of the average dry matter cost of BRS Capiaçu silage is R $ 130, 85 / ton, corn, R $ 304.46 / ton and sugar cane, R $ 226.91 / ton.

Table 1: Capiaçu morphological and productive characteristics at 180 days of cutting.

CUT 180 DAYS					
TREATMENTS	1	2	3	4	Average
HEIGHT (CM)	3,19	3,12	3,16	3,39	3,2
STEM (N°)	16	16	16	18	16,5
STEM DIAMETER (N°)	17,85	13,03	15	18	16,0
PROFILES (N°)	29	27,5	22	31	27
P. LEAF / STALK	2,72	2,71	2,6	2,8	2,7
PRODUCTION (kg/DM/ha)	21,6	20,85	22,65	21,8	21,7

Source: Prepared by the authors, 2020.

The DM contents at 180 days were similar to those observed at 90 days of cutting by MONÇÃO et al. (2019 ab). In the Monção study the purpose was to evaluate the nutritional part of the grass. However, the values found in the grass evaluated in the period of rains grown in Cachoeiras de Macacu, for the 180-day cut, were similar to those found by Monção at 90 days, that is, high concentrations of minerals and nitrogen were found which is not desired for the plant to be used as an input energetic. At this point, it is important to highlight that the chemical composition of elephant grass for energy purposes has different objectives from those used in animal feed. These differences are striking, since in their use as forage, low levels of FDA and lignin are recommended, as well as high concentrations of minerals and nitrogen to meet the nutritional demand of the animals. For this reason, elephant grass managed as a forage plant requires shorter cutting intervals, approximately 70 to 90 days (PEREIRA et al., 2016). On the other hand, when this grass is directed to energy biomass, greater cutting intervals are necessary to optimize combustion efficiency (RENGSIRIKUL et al., 2011). Thus, the same BRS Capiaçu elephant grass can meet specific usage objectives, as long as the cutting interval is different for each situation. However, the climatic conditions of precipitation raise the humidity of the plants, even with advanced maturities. The concentration of DM is affected not only by the age of the plant, but is influenced by the rate of new leaf emission that is related to the rainy season environment (Pereira et al., 2000). The excessive humidity of the biomass makes it difficult to transport and store the material, in addition to impairing the combustion efficiency (LEWANDOWSKI & KICHERER, 1997).

Plants with greater maturity reduce mineral concentrations, especially potassium, due to increased senescence, translocation of nutrients and removal of soluble compounds by leaching (BAKKER et al., 2005). In addition, plants with a larger cut interval have a higher proportion of stalk, a structure that contains less mineral concentration than leaves and, consequently, dilutes the ash concentration in the grass as a whole (NA et al., 2016). However, in the present study, this trend did not occur, in the 180-day cut, where a high ash content was found (6.94%). At this cutting age, the precipitation that occurred in November stimulated the process of mineralization in the soil and mineral absorption by plants, as well as the renewal of tissues that have a higher concentration of minerals. The contents of acid detergent insoluble fiber (FDA), varied in different treatments, with an average of (46.21% FDA). In the period evaluated, the concentration of lignin obtained low concentration (14.75%), similar to those found by Monção 2019 for 90 days of cut. The low presence of lignin decreases the calorific value because of the concentration of oxygen in its composition (OBERNBERGER et al., 2006). The nitrogen content fluctuated between the cutting age variables with an average of 0.58%. However, the nitrogen increase at 180 days is associated with the beginning of the precipitation verified from October, which triggered the aerial and basal regrowth of the tillers favoring the nitrogen concentration in the cells.

Table 2: Percentage of dry matter, ash, PC, FDA, Nitrogen and Lignin.

Percentage of MS, MM, FDA, PC and Nitrogen of BRS Capiaçu	
DRY MATTER (MS)	24,24%
MINERAL MATERIAL OR ASH (MM)	6,94%
HEATING POWER (PC)	17,91 MJ kg^{-1}
DETERGENT INSOLUBLE FIBER (FDA)	46,21%
NITROGEN	0,58%
LIGNIN	14,75%

Source: Prepared by the authors, 2020.

CONSIDERATIONS

Due to the tissue renewal of grass that occurred in November, there was an increase in the percentage of ash in the biomass, affecting the heat transfer of the plant and decreasing the calorific value. Therefore, the rainy season is not suitable for harvesting BRS Capiaçu to be used as an energy alternative in the region of Cachoeiras de Macacu-RJ.

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