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Forage potential of sugarcane cultivars in the Caparaó "Capixaba" region

Abstract – The objective of this work was to evaluate the quantitative characteristics of stems and forage production of sugarcane cultivars for use as dairy cattle feed in the Caparaó "Capixaba" region, located in the state of Espírito Santo, Brazil. The RB867515, RB835486, RB855536, SP801842, and Palito cultivars were evaluated under field conditions. RB867515 stood out for the highest values of stem productivity (269.09±45.90 Mg ha^{-1}) and juice (339.92±52.90 L Mg^{-1}), also showing the highest total soluble solids (°Brix) values, being, therefore, the cultivar with the greatest forage potential for the region.

Index terms: *Saccharum officinarum*, animal feed, grass, seasonality.

Potencial forrageiro de cultivares de cana-de-açúcar na região do Caparaó capixaba

Resumo – O objetivo deste trabalho foi avaliar as características quantitativas de colmos e a produção de forragem de cultivares de cana-de-açúcar para uso como alimento de gado leiteiro na região do Caparaó capixaba, localizada no estado do Espírito Santo, Brasil. Avaliaram-se as cultivares RB867515, RB835486, RB855536, SP801842 e Palito, em condições de campo. RB867515 destacou-se quanto aos maiores valores de produtividade de colmo (269,09±45,90 Mg ha^{-1}) e caldo (339,92±52,90 L Mg^{-1}), tendo apresentado, também, os maiores valores de sólidos solúveis totais (°Brix), sendo, portanto, a cultivar com maior potencial forrageiro para a região.

Termos para indexação: *Saccharum officinarum*, alimentação animal, gramínea, sazonalidade.

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Brazil was the largest world producer of sugarcane during the 2021/2022 crop year, with 585.17 million megagrams harvest, which produced about 35.05 million megagrams of sugar and 26.78 million liters of ethanol, according to Conab (2022). In addition to the commercial use of sugar, ethanol, and electricity in the power, sugarcane plants are widely used in dairy farming for animal feed.

The Caparaó "Capixaba" region has 11 municipalities in the south of the Espírito Santo state, Brazil (Brasil, 2015). Most of the land is distributed in small properties destined to family farming. In addition to growing arabica coffee, the dairy farming has been one of the main activities in these properties because it provides monthly income throughout the year for producers. The region has contributed 14% of the total milk production in the state (IBGE, 2020).

Every year, in the dry season, the Caparaó capixaba cattle ranchers suffer from the lack of food for the herd (Vervloet, 2016). To meet this demand, they have used sugarcane as a supplement, since it is a semi-perennial grass that has several advantages over other forages such as ease of planting, lower production cost in comparison to silage and hay, as well as good acceptance by animals (Guimarães et al., 2016).

The genotype predominantly used in the region is called 'Palito' by the producers themselves. Its origin is unknown, but it has been cultivated for generations without any agronomic evaluation with scientific rigor. Thus, there is no information on the productive potential of this genotype. As to an alternative for the adequacy of animal feeding in the dry period of the year, a comparative study of agronomic characteristics is necessary for a subsequent selection of sugarcane cultivars with high productive potential, in order to meet the demand of dairy production in Caparaó "Capixaba" for sugarcane cultivars with better agronomic performance.

The objective of this work was to evaluate the quantitative characteristics of stems and forage production of sugarcane cultivars for use as dairy cattle feed in the Caparaó "Capixaba" region, located in the state of Espírito Santo, Brazil.

The work was carried out in the experimental area of the Centro de Ciências Agrárias e Engenharias of the Universidade Federal do Espírito Santo – (CCAE-UFES - Center for Agricultural Sciences and Engineering of the Universidade Federal do Espírito Santo), in the Campus of Alegre county (20º42'52"S, 41º27'24"W, at 254 m altitude), in the state of Espírito Santo, Brazil. The climate of the region, according to the Köppen-Geiger's classification, is Cwa, characterized by dry winters and rainy summers, with average annual precipitation of 1,200 mm and annual average temperature about 27°C (Inmet, 2022).

The experiment was performed in field conditions, using a randomized complete block design. The treatments were the five sugarcane cultivars: RB867515, RB835486, RB855536, SP801842, and the regional sugarcane Palito, with ten replicates per treatment. The propagules came from the collection of CCAE-UFES.

The planting was carried out in the first week of March 2019, in a 1,000 m^2 area, subdivided into five-row plots with 6.0 m length, at 1.5 m spacing between lines. Each line represented one of the cultivars. The stems were chopped into two or three buds, then deposited in the furrows and covered with a layer of earth from 5.0 to 8.0 cm depth. Sugarcane fertilization was carried out in the initial period of plant sproutings, with the application of 12 L m^{-1} cattle manure in the planting lines.

The agronomic parameters to evaluate the quantitative characteristics of the cultivar stems were: number of stems per hectare, by counting them; diameter (cm), measured with a caliper; length (m); and the number of nodes per meter, measured from the base of the plant to the upper end, with a tape. The agronomic parameters to evaluate the forage production of the sugarcane cultivars were: stem yield (%); productivity of stem (Mg ha^{-1}); and juice (L Mg^{-1}); and total soluble solids (°Brix). The stem cuttings took place 18 months after planting, between the last week of August and September 1, 2020. Ten samples of whole plants were taken per cultivar.

The ratio of the number of nodes to the stem length (m) was calculated to obtain the number of nodes per meter. The fresh stem mass, with or without tops, was determined using a digital scale. Using these data, the stem yield (%) and productivity (Mg ha^{-1}) were estimated. The juice volume (mL) was determined by means of an electric mill and a volumetric vessel. Using these data, juice (L Mg^{-1}) was estimated. The The total soluble solids (°Brix) was determined with the aid of a portable refractometer.

The results were subjected to the analysis of variance, and Tukey's test was applied at 5% probability to compare the means. The free R software (ExDes.pt package) (R Core Team, 2019) was used to perform the analysis.

For the quantitative characteristics of stems (Table 1), 'Palito' showed the highest number of stems per hectare (14,600.01±14.17) and the shortest stem length (3.54±0.25 m); 'RB867515' had the largest diameter (3.62±0.32 cm) and length (5.63±0.40 m), and the lowest number of nodes per meter (5.56±1.26). The number of nodes per meter (7.56±0.76) of Palito was higher only than that of 'RB867515', being lower than those of all other cultivars.

The variables number of stem per hectare, diameter and length of stem are directly correlated to the production of biomass (Morais et al., 2017). Based on these parameters, 'RB867515' and 'Palito' are estimated as the most stem productive. The number of

nodes per meter is directly related to the amount of fiber in sugarcane, so that the more nodes per meter of stem, more fibrous and, consequently, more difficult digestion will be in the animal's rumen (Teixeira, 2016). Therefore, RB867515 is the most digestible cultivar, followed by Palito.

As to forage production (Table 2), 'RB867515' showed the highest stem yield (80.84±4.98%), stem productivity (269.09±45.90 Mg ha^{-1}), and juice (339.92±52.90 L Mg^{-1}). 'Palito' had the second highest stem productivity (212.58±36.30 Mg ha^{-1}), but the lowest juice productivity (211.44±32.90 L Mg^{-1}). The total soluble solids was statistically equal for 'RB867515', 'RB835486', and 'SP801842', which were superior to those of 'RB855536' and 'Palito'. These last two cultivars were statistically equal.

The desirable cultivar for a good forage potential should have at least 80% of its aerial part composed by the stem (Cruz et al., 2014). RB867515 was the only cultivar that met this requirement. The highest number of stem hectare of 'Palito' may have contributed to the second highest stem productivity. However, it was not sufficient to increase the juice productivity. Then, it is possible to infer that Palito can even produce more fibers, but with less broth than the other cultivars. Probably, the largest diameter, length, and yield of 'RB867515' stems influenced more intensely the higher productivity of stem and juice because these characteristics allow of the best use of the rainy periods for the production of biomass (Nascimento et al., 2019).

The total soluble solids is directly related to the sugar content in the juice for animal feed. The suitable values should be in the range 18–25 °Brix (Silva et al., 2017). Therefore, all studied cultivars showed adequate total soluble solids values. However, the highest values for this parameter were those of the RB867515, RB835486, and SP801842, while the lowest values were of the RB855536 and Palito commercial cultivars.

Therefore, RB867515 is a promising alternative to be used as forage in the Caparaó "Capixaba" region because it shows agronomic characteristics that provide food in a greater quantity, with more sweetness

Table 1. Quantitative characteristics of stems of the sugarcane (*Saccharum officinarum*) cultivars[(1)].

Cultivar	Number of stems per hectare	Diameter (cm)	Length (m)	Number of nodes per meter
RB867515	82,000.04±7.96b	3.62±0.32a	5.63±0.40a	5.56±1.26c
RB835486	84,000.04±8.15b	3.02±0.27b	4.24±0.30b	8.00±1.01a
RB855536	86,000.04±8.35b	2.95±0.26b	4.53±0.32b	7.97±1.01a
SP801842	92,000.05±8.93b	3.10±0.27b	4.28±0.30b	8.18±1.04a
Palito	14,600.01±14.17a	3.20±0.28b	3.54±0.25c	7.56±0.76b
$F_{(Calculated)}$	81.00	8.60	57.44	12.14
P_{value}	<0.01	<0.01	<0.01	<0.01

[(1)]Means followed by equal letters in the columns do not differ, by Tukey's test, at 5% probability.

Table 2. Forage production of the sugarcane (*Saccharum officinarum*) cultivars[(1)].

Cultivar	Stem yield (%)	Stem (Mg ha^{-1})	Juice (L Mg^{-1})	Total soluble solids (°Brix)
RB867515	80.84±4.98a	269.09±45.90a	339.92±52.90a	21.05±0.87a
RB835486	71.84±4.43b	169.83±29.00c	265.40±41.30b	21.90±0.91a
RB855536	74.39±4.50b	158.25±27.02c	247.27±38.40b	19.70±0.82b
SP801842	71.01±4.38b	157.12±26.83c	280.20±43.60b	20.85±0.87a
Palito	71.28±4.39b	212.58±36.30b	211.44±32.90c	19.51±0.81b
$F_{(Calculated)}$	8.16	21.09	12.77	13.34
$p\text{-}_{value}$	<0.01	<0.01	<0.01	<0.01

[(1)]Means followed by equal letters in the columns do not differ, by Tukey's test, at 5% probability.

and energy supply to the herd than the other cultivars, especially in the dry season.

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