Magnesium fertilization, broth quality and sugar production by cane varieties RB867515 and RB92579

Adubação com magnésio, qualidade do caldo e produção de açúcar pelas variedades de cana RB867515 e RB92579

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ABSTRACT
The nutritional status, juice quality and sugar production of sugarcane varieties RB867515 and RB92579 were evaluated in the cane-plant cycle, as a function of magnesium doses applied at the bottom of the planting furrow. The study, installed in soil with a Mg content equal to 0.61 cmolc dm\(^{-3}\), was conducted in an experimental design in randomized blocks with four replications. The study was a 2 x 5 factorial: two sugarcane varieties: RB867515 and RB92579, and five doses of magnesium: zero, 60, 120, 180 and 240 kg per hectare, using magnesium oxide as a source of Mg. commercial magnesium. The plots consisted of seven furrows of five meters in length with 1.0 meter spacing. All plots received phosphorus and potassium fertilization at a dose of 100 kg of phosphorus and 150 kg of potassium per hectare, with no nitrogen fertilization. In the maximum growth phase of sugarcane, the nutritional status of sugarcane was evaluated. About a year after planting, when the cane was mature, the cane plant was harvested to assess the quality of the juice and the sugar production of the varieties. There was no effect of magnesium fertilization on any of the analyzed variables. Regarding the nutrient content in leaf +3, nutritional deficiency was found only for potassium, copper and manganese. The RB92579 had an average productivity of industrializable stalks and sugars, respectively of 96.0 and 13.7 tons per hectare, surpassing the RB867515 by about 10%. The results of this study confirm reports by other researchers who mention that Mg contents of the order of 0.50 cmolc dm\(^{-3}\) are sufficient for adequate nutrition of sugarcane.

Keywords: cane-plant, mineral nutrition, production system.

RESUMO
Avaliou-se o estado nutricional, a qualidade do caldo e a produção de açúcar das variedades de cana-de-açúcar RB867515 e RB92579, no ciclo de cana-plant, em função de doses de magnésio aplicado no fundo do sulco de plantio. O estudo, instalado em solo com teor de Mg igual a 0,61 cmolc dm\(^{-3}\), foi conduzido em delineamento experimental em blocos casualizados com quatro repetições. O estudo foi um fatorial 2 x 5: duas variedades de cana-de-açúcar: RB867515 e RB92579 e, cinco doses de magnésio: zero, 60, 120, 180 e 240 kg por hectare, utilizando como fonte de Mg, o óxido de magnésio comercial. As parcelas foram constituídas de sete sulcos de cinco metros de comprimentos com 1,0 metro de espaçamento. Todas as parcelas receberam adubação fosfatada e potássica na dose de 100 kg de fósforo e 150 kg de potássio por hectare, não havendo adubação nitrogenada. Na fase de crescimento máximo da cana-de-açúcar foi avaliado o estado nutricional da cana-de-açúcar. Cerca de um ano após o plantio, quando a cana estava madura, foi colhida a cana-plant, para a avaliação da qualidade do caldo e a produção de
Açúcar das variedades. Não houve efeito da adubação com magnésio em nenhuma das variáveis analisadas. Em relação aos teores de nutrientes na folha +3 constatou-se deficiência nutricional apenas para o potássio, cobre e manganês. A RB92579 teve produtividade média de colmos industrializáveis e de açúcares, respectivamente de 96,0 e 13,7 toneladas por hectare, superando a RB867515 em cerca de 10%. Os resultados desse estudo confirmam relatos de outros pesquisadores que citam que teores de Mg da ordem de 0,50 cmol dm⁻³ são suficientes para uma adequada nutrição da cana-de-açúcar.

**Palavras-chave:** cana-planta, nutrição mineral, sistema de produção.

**1 INTRODUCTION**

Sugarcane is grown in all regions of Brazil and is therefore of great socio-economic and environmental importance for the country, since it employs a large number of people from different social classes (OLIVEIRA et al., 2007; RAPASSI et al., 2009; OLIVEIRA et al., 2018b) and contributes to the mitigation of greenhouse gases, due to the high rate of fixation of atmospheric CO₂ by photosynthesis, for a prolonged period of time (CALHEIROS et al., 2012; SILVA et al., 2017; OLIVEIRA et al. 2023).

The sugarcane produced in the large farms is mainly intended for the production of sugar and alcohol, but in the small and medium-sized farms, this crop is also used in animal feed, ruminants and monogastric, mainly when there is an increase in the price of corn, compared to the sale value of the animals (CALHEIROS et al., 2012; SILVA et al., 2018; OLIVEIRA et al. 2021). Another use of sugarcane in these small and medium-sized properties is in the manufacture of rapadura, brown sugar and cachaça. In different sugarcane producing regions, various technologies are employed to increase the efficiency of inputs, lower production costs and increase the productivity of land and labor, aiming to ensure the sustainability of the crop (RAPASSI et al., 2009; OLIVEIRA et al., 2011; RAIJ, 2011).

Sugar cane, because it produces a large quantity of mass, extracts and accumulates, consequently, a large quantity of nutrients from the soil. For a production of 120 tons of natural matter per hectare, about 100 t of industrialized stems, the accumulation of nutrients in the upper part of the plant is in the order of 150, 40, 180, 90, 50 and 40 kg of N, P, K, Ca, Mg and sulfur, respectively. In the case of micronutrients, iron, manganese, zinc, copper and boron, accumulations in the biomass of the upper part, also for a production of 120 t, are around 8.0; 3.0; 0.6; 0.4; and 0.3 kg, respectively. This is why the availability of nutrients in the soil should
be monitored, adopting agricultural practices that maintain or increase fertility (DEMATTÊ, 2005; OLIVEIRA et al, 2007; OLIVEIRA et al, 2018a).

The availability of the elements in the soil, and the consequent mineral nutrition of the plant, influence the metabolism of the sugarcane, reflecting the productivity of the crop. For magnesium there have been questions about the critical level of this element in the soil, and for some authors the sufficiency range would be between 0.40 to 0.50 cmolc dm\(^{-3}\) (DEMATTÊ, 2005; RAJJ, 2011; OLIVEIRA et al, 2017). Thus, in the present study, the nutritional status, the quality of the juice and the sugar production of the sugarcane varieties RB867515 and RB92579 were evaluated in the sugarcane-plant cycle, depending on the doses of magnesium applied at the bottom of the groove.

2 MATERIAL AND METHODS

The study was conducted in a Cohesive Yellow Argissolo Latosolic, medium to clay texture. This soil comes from the barrier group, whose sand fraction consists mainly of quartz and in the clay fraction kaolinite predominates, with low levels of iron oxide. The relief of the region is flat and smooth wavy, which is characteristic of the geomorphic unity of coastal trays (EMBRAPA, 2014). The soil in the study area had a Mg content equal to 0.61 cmolc dm\(^{-3}\) in the 0 to 20 cm layer (Table 1).

The study was a 2 x 5 factorial: two varieties of sugarcane: RB867515 and RB92579 and, five doses of magnesium: zero, 60, 120, 180 and 240 kg per hectare, using commercial magnesium oxide as the source of Mg. The experimental design was of casually shaped blocks with four repetitions. The varieties RB867515 and RB92579 were chosen because they are the most planted in the region, they are rustic and very productive (OLIVEIRA et al., 2018b; SILVA et al., 2018). The parcels were made up of seven grooves of five meters in length with 1.0 meters of spacing. Chemical fertilization at a dose of 100 and 150 kg ha\(^{-1}\) of P and K respectively was applied at the bottom of the planting groove. The planting density ranged from 15 to 18 buds per meter of groove, with an average 12 to 15 tons of seedlings per hectare being spent, following the system adopted in the region (OLIVEIRA et al., 2011; SILVA et al., 2017).
Table 1 - Analytical results of soil samples from the study area, in the layers 0 to 20 and 20 to 40 cm deep, collected one month before the implantation of the study.

<table>
<thead>
<tr>
<th>Layer</th>
<th>pH</th>
<th>P —mg/dm$^{-3}$—</th>
<th>K</th>
<th>Ca —cmole/dm$^{-3}$—</th>
<th>Mg —cmole/dm$^{-3}$—</th>
<th>Al$^{3+}$</th>
<th>H+Al$^{3+}$</th>
<th>SB</th>
<th>CTC(t)</th>
<th>CTC(T)</th>
<th>V</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 20 cm</td>
<td>5.5</td>
<td>12</td>
<td>69</td>
<td>2.3</td>
<td>0.61</td>
<td>0.0</td>
<td>3.51</td>
<td>3.09</td>
<td>6.60</td>
<td>46.79</td>
<td>0.0</td>
<td>3.51</td>
</tr>
<tr>
<td>20 to 40 cm</td>
<td>4.7</td>
<td>10</td>
<td>32</td>
<td>1.6</td>
<td>0.35</td>
<td>0.3</td>
<td>3.47</td>
<td>2.03</td>
<td>2.35</td>
<td>5.36</td>
<td>13.61</td>
<td>36.93</td>
</tr>
</tbody>
</table>

pH in H$_2$O (ratio 1:2.5). P and K: Mehlich extractor. Ca, Mg and Al: KCl extractor. H+Al: Calcium Acetate extractor.

Source: Authors, 2023.

In the region, it is usual to apply insecticide on the newly cut toletes, to control the termites, which undermine the toletes, killing the sugarcane cuttings. The insecticide Fipronil (Regent 800 WG), in a dose of 250 grams of the commercial product per hectare, was applied with a costal sprayer and afterwards the seedlings (toletes) were covered with earth, in thickness that varied from 5 to 8 cm. After planting, a herbicide (Tebutiron) was applied to control weeds. The choice of herbicide was based on the history of the area and the occurrence of weeds in previous years. During the course of the crop cycle, biological pest control was carried out, and, for the sugarcane borer, mini predators were used, called *Cotesia flavipes* (wasps), which are produced in laboratories and released in the morning at strategic points of the sugarcane industry.

In June of the year following the planting (maximum growth phase of the sugarcane), the collection of the leaves + 3 (Figures 2 to 5) was carried out, to evaluate the nutritional status of the plants, following methods described by Malavolta et al. (1997), Oliveira et al. (2007), Raij (2011) and Oliveira et al. (2018b). Leaf limbus was analyzed for N, P, K, Ca, Mg, S, B, Cu, Fe, Mn and Zn. Nitrogen levels were obtained by the Kjeldahl method, phosphorus and boron by spectrophotometry, potassium by flame photometry. Calcium, magnesium, copper, manganese, zinc, iron were determined by atomic absorption spectrophotometry and sulfur by turbidimetry (MALAVOLTA et al., 1997).
At the beginning of December of the year following the planting, the moment at which the sugarcane was ripe, the harvesting was carried out and the production of industrialized stems and the quality of the broth were evaluated. Similar to the collection of leaf +3, the sampling was carried out in the three central grooves of the parcel. The sugarcane was cut close to the ground, heavy, shaved and stripped, thus obtaining the industrializable stems. 10 industrializable turnips per plot were selected for the industrial quality analysis. The industrializable stems were passed in forage pickers, homogenized and a 500 g sub-sample was pressed to 250 kgf cm$^{-2}$, for one minute (FERNANDES, 2000). The resulting broth determined the levels of soluble solids (‘Brix’), apparent sucrose (‘POL’), purity of broth (‘Purity’), apparent sucrose content in the stems (‘PCC’) and Total Recoverable Sugars (‘ATR’) following methods described by FERNANDES (2000) and OLIVEIRA et al. (2014).

The average levels of nutrients in leaf +3, the productivity of industrialized stems, the levels of soluble solids, apparent sucrose, the purity of the broth, the levels of apparent sucrose in the stems and the total of recoverable sugars, depending on the fertilization with magnesium oxide, were submitted to the analysis of variance at 5% probability (FERREIRA, 2007).
3 RESULTS AND DISCUSSION

Initially, the results of the nutritional status of the plants will be presented, and afterwards the results of the production of industrialized stems, sugar production, the quality of the stock of RB867515 and RB92579, depending on the fertilization with magnesium oxide.

3.1 PLANT NUTRITIONAL STATUS

There was no effect of fertilizer with MgO or fertilizer interaction with MgO and variety on the leaf contents of any of the nutrients analyzed. The results obtained in this study confirm the observations of Oliveira (1993), Demattê (2005), Raij (2011) and OLIVEIRA et al. (2018a) citing soil magnesium values ranging from 0.40 to 0.50 cmolc dm$^{-3}$ as the critical level of magnesium in soil.

Varietal effect was observed for the foliar levels of nitrogen, phosphorus, magnesium, sulfur, manganese and zinc (Table 2). The coefficients of variation for leaf contents varied widely ranging from only 3.78% (nitrogen) to 38.34% (copper). In variability studies conducted in cane fields that are visually very uniform in terms of vegetative development, in Anadia, agreste Alagoano, Oliveira et al (2011) and Oliveira et al. (2018b) observed that the highest coefficients of variations in leaf contents were for calcium (44.11%), followed by manganese (23.51%), copper (23.00%) and iron (22.90).

This variability in the plant must be reflecting the variability of these elements in the soil. Concatenating the quotations of Oliveira et al. (2007) with de Oliveira et al. (2018b) it can be seen that in the studies conducted by these authors the copper levels were very low in all samples analyzed, and this had a high coefficient of variation, even though the difference between the highest and lowest observed value of only 0.30 mg dm$^{-3}$ of soil. Zanão Júnior et al. (2007) in his research on spatial variability of soil fertility in a cultivated and homogeneously managed area, he found the high variability of copper and manganese contents in 80 soil samples collected in 373 hectares and, like the present study by Oliveira et al. (2018c). Thus, the low Cu and Mn levels in the soil have contributed to the high coefficients of variation observed in the leaf levels of these micronutrients.

Plants are able to compensate for small variations in nutrient acquisition by storing nutrients in the vacuole (MALAVOLTA et al., 1997; NOVAIS & SMITH, 1999; RAII, 2011),
but the results obtained show that there was a large variation of these nutrients in the soil or differences between nutrients regarding homeostasis.

Table 2 - Mean squares of the variance analysis for the nutrient contents in leaf limbo +3 (Nutritional status) of RB867515 and RB92579, in the sugarcane-plant cycle, as a function of fertilization with magnesium oxide.

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety (V)</td>
<td>119.71***</td>
<td>0.1444***</td>
<td>1.1560ns</td>
<td>0.0490 ns</td>
<td>10.712***</td>
<td>2.6010***</td>
</tr>
<tr>
<td>MgO(D) dose</td>
<td>1.27ns</td>
<td>0.0175 ns</td>
<td>0.8860 ns</td>
<td>0.2068 ns</td>
<td>0.6002 ns</td>
<td>0.0103 ns</td>
</tr>
<tr>
<td>D x V</td>
<td>0.056ns</td>
<td>0065 ns</td>
<td>1.1060 ns</td>
<td>0.0808 ns</td>
<td>0.1128 ns</td>
<td>0.0503 ns</td>
</tr>
<tr>
<td>Nutrient content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>867515 RB</td>
<td>18.38a</td>
<td>1.61 to</td>
<td>8.56a</td>
<td>3.29a</td>
<td>2.47a</td>
<td>2.03 to</td>
</tr>
<tr>
<td>RB92579</td>
<td>21.84 b</td>
<td>1.73 b</td>
<td>8.90 to</td>
<td>3.36a</td>
<td>1.43 b</td>
<td>1.52 b</td>
</tr>
<tr>
<td>Overall Average</td>
<td>20.11</td>
<td>1.67</td>
<td>8.73</td>
<td>3.32</td>
<td>1.95</td>
<td>1.78</td>
</tr>
<tr>
<td>C. V.(%)</td>
<td>3.78</td>
<td>13.54</td>
<td>8.41</td>
<td>8.67</td>
<td>10.3</td>
<td>9.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>B</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety (V)</td>
<td>0.8702 ns</td>
<td>5.625ns</td>
<td>140.62 ns</td>
<td>864.90 ***</td>
<td>429.02 ***</td>
</tr>
<tr>
<td>MgO(D) dose</td>
<td>10.948 ns</td>
<td>3.891 ns</td>
<td>14.537ns</td>
<td>66.537ns</td>
<td>23.75 ns</td>
</tr>
<tr>
<td>D x V</td>
<td>7.3115 ns</td>
<td>3.287ns</td>
<td>177.31 ns</td>
<td>103.96 ns</td>
<td>49.15 ns</td>
</tr>
<tr>
<td>Nutrient content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>867515 RB</td>
<td>11.29a</td>
<td>4.95 to</td>
<td>41.45a</td>
<td>33.10 to</td>
<td>39.40 to</td>
</tr>
<tr>
<td>RB92579</td>
<td>11.58a</td>
<td>4.20a</td>
<td>45.20 to</td>
<td>23.82b</td>
<td>32.50 b</td>
</tr>
<tr>
<td>Overall Average</td>
<td>11.43</td>
<td>4.57</td>
<td>43.32</td>
<td>28.45</td>
<td>36.12</td>
</tr>
<tr>
<td>C. V.(%)</td>
<td>24.51</td>
<td>38.34</td>
<td>19.77</td>
<td>33.33</td>
<td>13.88</td>
</tr>
</tbody>
</table>

ns, ***. ** and *: non-significant and, significant at 0.1, 1.0 and 5.0%, respectively, by the F-test at 5.0%.
Source: Authors, 2023.

Some researchers have reported that in their studies generally the greatest variability of nutrients in the soil is phosphorus, which diffuses at very small rates in the soil (NOVAIS & SMITH, 1999; DEMATTÊ, 2005; OLIVEIRA et al., 2007). In the studies of Oliveira et al. (2011) in Anadia, observed that the highest coefficients of variation of nutrients in the soil were for phosphorus, copper and manganese, all with values greater than 90%. The coefficients of
variation for the calcium and magnesium levels in the soil, extracted with 1.0 molc/L KCl solution, were in the order of 40%.

A trend of greater spatial variability in the levels of phosphorus in the soil was also found in the studies carried out by Salviano et al. (1998) in severely eroded area of the municipality of Piracicaba - SP and under cultivation of *Crotalaria juncea*. These authors found that the coefficients of variation of the levels of phosphorus, magnesium and potassium were, respectively, 75, 54 and 52%, in the same order as those reported by Machado et al. (2007) in works conducted in Uberlândia, MG, in a Red to Moderate Latossolo, clay texture, with sampling points 50 meters apart from each other. Coefficients of variation in the order of 50% in the levels of phosphorus in the soil were also reported by Carvalho et al. (2003), in studies conducted in soil Argissolo Vermelho-Amarelo eutrofico in the municipality of Vitória Brasil, SP.

Figure 5 shows the mean values of macro and micronutrients in the middle third of RB867515 and RB92579, compared to the values in the national literature, considered as minimum and maximum (MALAVOLTA et al.,1997; OLIVEIRA et al.,2007; RAIJ, 2011).

![Figure 5 - Average macro and micronutrient values in the middle third of the RB867515 and RB92579, compared to the values in the national literature, considered as minimum and maximum.](image)

Source: Authors, 2023.

From the analysis of Figure 5 it can be observed that for both RB867515 and RB92579 the levels of phosphorus in the leaf +3 limb were very close to the minimum, which is 1.5 g kg\(^{-1}\) of dry matter of leaf limbus (MALAVOLTA et al.,1997; OLIVEIRA et al.,2007; RAIJ, 2011). In a study conducted at the Triunfo Plant, with RB867515 in the first resprouting cycle, in soil with a high P content (mean values of a 30 mg dm\(^{-3}\) phosphorus, extracted with Melhich), Oliveira et
al. (2011) found foliar levels of P below 1.6 g kg$^{-1}$, characterizing Malavolta et al. (1997) inadequate supply of that element. However, the productivity of RB867515 was 166 t of stems per hectare. In view of this fact and other observations of sugarcane plantations of high productivity and with P levels in the leaf of less than 2.0 g kg$^{-1}$, Oliveira et al. (2011) asked whether the benchmarks of Malavolta et al. (1997) would be suitable for the assessment of the nutritional status of the Alagoas sugarcane plantations.

For nitrogen, the RB867515 also had values very close to the sufficiency limit: 18.0 g kg$^{-1}$ of dry matter of foliar limbus. However, the greatest deficiency for macronutrients was observed for potassium, as both RB867515 and RB92579 had leaf contents of less than 10 g kg$^{-1}$ of dry matter of leaf limbus. In studies conducted in the northeast of Minas Gerais -south of Bahia, Oliveira et al. (2014) compared the nutrient contents of the +3 leaves of three varieties and found that RB867515 and RB92579 almost reached the level of sufficiency for N, while for potassium RB867515 showed a small deficiency. On the other hand, SP791011 had adequate foliar levels for N, P, K, Ca and Mg.

For micronutrients, foliar concentrations of B and Cu were very close to or below the minimum, which are, respectively, 10 and 6 mg kg$^{-1}$, according to Brazilian authors (MALAVOLTA et al., 1997; OLIVEIRA et al., 2007; RAIJ, 2011). For boron there was no varietal effect and the mean value was 11.0 mg kg$^{-1}$ respectively. The varietal effect for the foliar concentration of Mn was significant at 1.0%, with RB92579 having a mean concentration of 23.8 mg kg$^{-1}$, while for RB867515 this content was 33.1 mg kg$^{-1}$. Thus, in this pedo-climatic environment RB92579 had about 70% of the Mn leaf concentration of RB867515. However, copper was the biggest nutritional limitation, since the average value of the leaf contents of this nutrient, in the two varieties of sugarcane, 4.50 mg kg$^{-1}$, was 75% of the minimum value. The finding of a great deficiency of copper reinforces the results obtained in other studies carried out at the Center of Agrarian Sciences of the Federal University of Alagoas (CECA- UFAL) and in the northeast of Minas Gerais, south of Bahia, by Oliveira et al. (2014), in which it was observed that the copper and manganese foliar contents were in lower concentration than the minimum value quoted by Malavolta et al. (1997) and Oliveira et al. (2007).
3.2 QUALITY OF SUGAR JUICE AND SUGAR PRODUCTION

Magnesium oxide fertilizer did not influence any of the six variables related to the quality of the broth and the production of sugar. Similar to the above for foliar levels, the results obtained reinforce the statements of Demattê (2005) and Raij (2011), for which the critical level of magnesium in the soil ranges from 0.40 to 0.50 cmolc dm$^{-3}$. Weber et al. (1997) conducted studies in two distilleries in the north of the state of Espírito Santo, on soils with magnesium contents of 0.40 and 0.70 cmolc dm$^{-3}$. The authors carried out magnesium fertilization at a dose of 25 kg per hectare, using magnesium sulfate. No effect of magnesium fertilization on nutritional status, quality of broth or on RB7254 production was observed.

The exchangeable magnesium content of 0.50 cmolc dm$^{-3}$ was also sufficient to adequately nourish the corn, as reported by Oliveira et al. (2017). These authors evaluated the production of forage by maize hybrid BM 3066 as a function of magnesium doses. The treatments were four doses of Mg: 30; 60; 90 and 120 kg per hectare, plus one treatment witness. In the 0 to 20 and 20 to 40 cm layers the magnesium levels were 0.50 and 0.22 cmolc dm$^{-3}$. The production of fodder and the levels of crude protein, phosphorus, potassium, calcium, magnesium and sulfur in this biomass were also not influenced by fertilization with magnesium oxide. The productivity of the aerial biomass of BM 3066 PRO2 was 59.5 t of natural matter per hectare, with an average dry matter content of 33.2%. The crop was very uniform and the coefficient of variation for the productivity of aerial biomass was 8.61%.

There was a significant variety effect for all six variables related to the quality of the juice and sugar production (Table 3). The coefficient of variation for the variables related to the quality of the broth: fiber, purity of the broth, apparent sucrose in the broth, production of sugars per ton of industrialized stems was lower than 5.0%, indicating low dispersion of the values, resulting in significant difference for variables such as the purity of the broth, even though the percentage difference between the varieties was only 1.87%.

The concentrations of soluble solids, apparent sucrose in broth and purity were close to those cited by Fernandes (2000); Oliveira et al (2011). In the studies conducted by Oliveira et al. (2011) in Boca da Mata, the fiber of the stems of RB867515 was on average 12.2% and, with apparent sucrose content in the broth and purity, respectively, 16.5 and 82.5%. Thus, it can be inferred that the varieties were mature and the broth had good sugar content.
For the climatic conditions of Alagoas, where the availability of water in the soil does not coincide with the maximum solar radiation, the production of industrialized stems can be considered from medium to high, since the value obtained was around 90 t per hectare. Oliveira et al. (2014), citing studies conducted in Iturama - Triangulo Mineiro and, in the west of São Paulo (RAPASSI et al., 2009), report values ranging from 90 to 100 t per hectare. Oliveira et al. (2021) reports work carried out in Viçosa-MG, in soils with low P content and medium saturation by bases, in which they found that RB867515 stood out, among six varieties, by sugar production, reaching productivity of 16.6 tons per hectare.

Table 3 - Mean squares of the analysis of variance for the production of industrialized stems (TCH), fiber of the stems (Fiber), purity of the broth (Purity), apparent sucrose in the broth (apparent sucrose), production of sugars per ton of industrialized stems (ATR) and production of sugars per hectare, of the RB867515 and RB92579, in the sugarcane-plant cycle, as a function of fertilization with magnesium oxide.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>TCH</th>
<th>Fiber</th>
<th>Purity</th>
<th>Sucrose</th>
<th>RTA</th>
<th>Production Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety (V)</td>
<td>663.16**</td>
<td>4.97***</td>
<td>24.96**</td>
<td>6.37**</td>
<td>524.17***</td>
<td>32 098***</td>
</tr>
<tr>
<td>MgO dose (D)</td>
<td>95.24 ns</td>
<td>0.418ns</td>
<td>0.920ns</td>
<td>0.461 ns</td>
<td>39.30 ns</td>
<td>3,107 ns</td>
</tr>
<tr>
<td>D x V</td>
<td>18.02 ns</td>
<td>0.466ns</td>
<td>1.09ns</td>
<td>0.710ns</td>
<td>62.90 ns</td>
<td>624 ns</td>
</tr>
<tr>
<td>Unit</td>
<td>t ha⁻¹</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>kg t⁻¹</td>
<td>kg t⁻¹</td>
</tr>
<tr>
<td>867515 RB</td>
<td>87.9 to</td>
<td>14.27 to</td>
<td>84.48 to</td>
<td>13.81 to</td>
<td>136.1 to</td>
<td>11,970 to</td>
</tr>
<tr>
<td>RB92579</td>
<td>96.0 b</td>
<td>13.56 b</td>
<td>86.06 b</td>
<td>14.61 b</td>
<td>143.4 b</td>
<td>13,761 b</td>
</tr>
<tr>
<td>Overall Average</td>
<td>91.97</td>
<td>13.92</td>
<td>85.27</td>
<td>14.21</td>
<td>139.7</td>
<td>12,865</td>
</tr>
<tr>
<td>C. V.(%)</td>
<td>10.74</td>
<td>4.</td>
<td>1.67</td>
<td>4.9</td>
<td>4.49</td>
<td>11.25</td>
</tr>
</tbody>
</table>

ns, ***, ** and *: non-significant and, significant at 0.1, 1.0 and 5.0%, respectively, by the F-test. Source: Authors, 2023.

4 CONCLUSION

There was no effect of fertilizing with magnesium on the nutritional state of the plants, and a nutritional deficiency was found only in potassium, copper and manganese. There was varietal effect for the foliar levels of nitrogen, phosphorus, magnesium, sulfur, manganese and...
zinc. RB867515 had higher foliar content for the Mg, S, Mn and Zn nutrients, for the others cited above the foliar levels of RB92579 were higher than those of RB867515.

Fertilization with magnesium oxide also had no influence on the productivity of the crop. There was a difference between the varieties as to the production of industrialized stems and sugars: the RB92579 surpassed the RB867515 by about 10%.

The Mg levels of the order of 0.50 cmolc dm$^{-3}$ were sufficient for adequate sugar cane nutrition.
REFERENCES


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