USE OF ROCK DUST AS SOIL CONDITIONER AND FERTILIZER IN SUGARCANE CROP

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Abstract

This study has evaluated the use of ground mica-schist rock dust in sugarcane crop for the production of biofuels. Four treatments were defined: fine mica schist sand, coarse mica schist sand, control absolute, and control with standard fertilization used by Raízen Company. The treatments were applied in a system of strip cropping with four replications. The results were obtained from measuring the Total Recoverable Sugar per hecter (TRS/ha), a standardazised method in Brazil that defines the price of the sugarcane based on, amog other factors, the prices of sugar and ethanol in the market. The TRS/ha functions like a currency for commercializing sugarcane. The results showed an increase in productivity and industrial quality for the treatments with mica schist when compared to the other treatments.

Keywords: Mica-schist rock, stonemeal, soil remineralization.

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Introduction

Sugarcane is historically an important activity for energy generation. It has a great capacity to develop many related sectors in the economy (Alves, 2009). It is the raw material for many products, especially ethanol and sugar, which are highlighted as having the highest participation in the consumption of this input: (Barbosa & Júnior 2012). In 1975, there was an expansion of the cultivated area for sugarcane, through the National Alcohol Program (PROÁLCOOL) in Brazil. This program brought economic benefits, but social losses (Sousa, 1987; Carvalho & Carrijo, 2007). It also led sugarcane crops to marginal agricultural areas with lower soil fertility and, consequently, higher consumption of fertilizers and soil correctives (Leite et al., 2008).

Recently the first option for agricultural expansion has been predominantly for areas previously occupied by pastures, and the second has been grain crop fields. The biofuel demand, supported by the government Growth Acceleration Program (PAC), stepped up the expansion of sugar-alcohol activities (Lima, 2010). The production of energy by biomass also fosters the implementation and maintenance of the activity. The substitution of pasture areas and grain crops by sugarcane crop may be one of the factors of expansion and opening of new agricultural frontiers in Brazil (Vieira Júnior et al., 2008).

The growth of the demand for sugarcane is foreseen in the government Decennial Plan for Electric Power, which expects an increase of approximately 90% in ethanol demand between 2010 and 2019, and of 3% per year in sugar demand (Barbosa & Júnior, 2012). Within the Brazilian socio-economic scenario, sugarcane production has played an important role due to foreign currency inflow, the expansion of new agricultural frontiers, and the intensive use of direct and indirect labor (Leite et al., 2008). The Brazilian state of Goiás emerges as one of the leaders in alcohol production due to several factors: its low prices of land compared to the Southeast region, the good quality of its soils, good weather conditions, land availability, workforce availability, fiscal incentives and most importantly, a strategic location and geographic characteristics of a flat topography, which facilitate the flow of production (Carvalho & Carrijo, 2007).

According to Theodoro et al. (2006), agriculture in general, and mining as well, are economic sectors that cause major environmental impacts. The mining activity, despite having one-off performance (only around the quarries), causes many transformations and generates a large amount of byproducts. Modern agriculture, depending on the type of crop and its management, can also causes huge transformations, because it requires extensive areas to become a profitable activity. However, it is necessary to harmonize the different economic interests with environmental preservation. This does not mean unfeasibility, but rather economic development with income generation and an increased appreciation for natural resources.

The use of fertilizers for biofuel production is criticized internationally, because 70% of the fertilizers for the Brazilian agriculture are imported. Therefore, stonemeal is a sustainable way to fertilize soils, replenishing nutrients that are used-up by certain crops. Stonemeal is a technology that uses crushed rocks in the soil, which is based on the pursuit of fertility balance, on conservation of natural resources and on sustainable production (Martins et al., 2007). There are several factors that support stonemeal as an important fertilization alternative in Brazilian agriculture, such as the necessity to search for low-cost products that may be used as sources of nutrients, the shortage of fertilizers that can be used by agro-ecological farmers (organic producers), and the increasing rate of fertilizer's imports (Leonardos et al., 1987; Theodoro et al., 2006; Martins et al., 2007). Accordingly, this study used by-products of mining quarries (rock dust – mica schist) in sugarcane crops in order to increase biofuel production.

Methodology

The study was conducted in Jataí-GO-Brazil, in a commercial farming area leased by Raízen Company, located at S 17o 48' 00, 75'' O 51o 45' 23.78'', at an altitude of 743 m. Extensive cattle raising with degraded pasture had previously occupied the area. The experiment was conducted in an area of 12 ha, in red oxisol formed from basalt of São Bento Group, Serra Geral Formation. The treatments used were the following: fine mica schist (FMX) (5 t/ha), mica schist sand (AMX) (5 t/ha), control absolute (control A) and control with standard fertilization used by Raízen company (control B) (600 kg/ha of NPK formula 10-25-25, 1900 kg/ha of gypsum and 5500 kg/ha of limestone recommended by soil analysis). The FMX had 80% of its total mass in a fraction smaller than 0.3 mm. The AMX had 25% of its total mass in a fraction smaller than 0.3 mm, and had a wide distribution of other particle sizes. The application of dust rock was in December of 2010 by hauling in the strip cropping system, with four replications, in an area without embedding and that was not previously plowed. The same procedure was applied to control treatments (A and B). The area remained fallow with natural growing of Brachiaria grass, which produced dry matter exceeding 12 t/ha. This dry matter was incorporated before planting sugarcane, which occurred in June of 2011. The sugarcane variety used was RB855453 with an early life cycle, in which 600 kg/ha of seedlings were distributed in soil grooves.

All the farming practices were conducted in a homogeneous way in the whole experiment area. Rescue irrigation applications were made twice, using a gun stile sprinkler, on July 08 and August 05 of 2011 with 30 mm and 40 mm respectively. Assessments in the area were conducted weekly in order to monitor crop development. The evaluations were carried out during harvest time, in July 2012. The productivity was calculated from the amount of tons per hectare multiplied by ATR (total recoverable sugar), resulting in the ATR/ha number.

Results and Discussion

During monitoring visits, visual differences were observed between FMX treatment and control B treatment especially regarding the maturation period. The treatment with rock dust showed an extended growth and culm filling period, given a two weeks delay in flowering. This contributed to the industrial productivity and quality of sugarcane. The damage caused by flowering is due to the energy (sugar) consumed by the respiration process, which uses sugar for the formation of panicles instead of storing sucrose inside the culms. This sucrose consumption causes water loss in the internodes of sugarcane plants. This phenomenon is known by “pith intensity of sugarcane”, which occurs vertically from the top to the base of the plants (Segato et al., 2006).

Figure 1. Treatment with mica-schist filler (right) and the control B treatment (left).

The results showed a greater increase for treatment FMX when compared to other treatments. The FMX had 13.409 ATR/ha, the control B of Raízen Company, had 13.155 ATR/ha, and treatment control A had 12.346 ATR/ha (Figure 2). These results show a different behavior if compared to the results obtained by Leite et al. (2008), who used calcium silicate, and did not observe any difference between treatments with rock dust or conventional fertilization for the ATR variable. This can be explained by the fact that calcium silicate rocks are rich in Si, Ca and Mg, while FMX shows also other nutrients noted in Table 1. These other nutrients are of great importance in fertilization and soil remineralization (Leonardos et al., 1987).

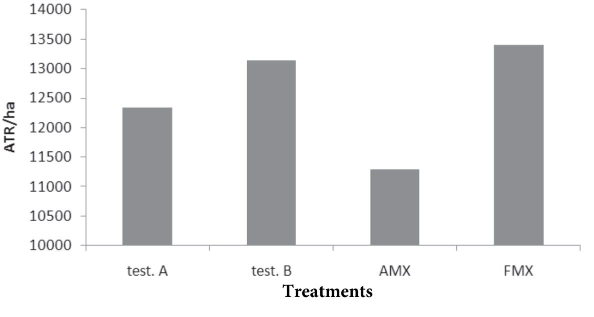

Figura 2. Sugarcane productivity (ATR/ha) under different treatments.

Table 1. Percentage chemical composition of the elements present in mica-schist.

Mica-Schist	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	P_2O_5	MnO	TiO_2	PF[8]	Total
Rock	57,8	17,4	8,6	1,8	4,6	2,3	3,4	0,2	0,05	0,9	2,9	100

8 – Structural volatiles in minerals (loss to fire)

The treatment with AMX showed lower value of ATR (11.293 ATR/ha) when compared with other treatments (Figure 2). These results may be related to the range of particle sizes, which decreases nutrient solubility if compared to the FMX treatment. However, it is expected that the AMX treatment will have also better production values in subsequent years due to residual effects.

Conclusions

The FMX treatment (fine mica shist application on sugarcane) provided an increment in production of ATR/ha. This represents an economic gain because additional production of ATR/ha means more profit for the sugarcane business.

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