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Study of Renewable Sugarcane Bagasse Biomass as Alternative Soil Fertilizer in the Banana Agricultural Production

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ABSTRACT

The Brazil is the highest producer of Sugarcane, after harvest, sugarcane is carried out to Sugar-Alcohol Plant for production of the sugar, ethanol and others subproducts. After ofthe extracting juice, nearly 30% of the residues from industrial (bagasse ash and vinasse). The sugarcane bagasse is consist of cellulose, and lignin contains hydroxyl - carboxylicgroups, which emerges for enhance plant nutrient supply and storage. Therefore, the application of the wastes sugarcane bagasse in the soil for agricultural planting would be an environmental alternative of low coust and eco friendly.

The Banana, is used a staple food and source of income in Latin America, Africa and Asia and in Brazil is characterized by small producers spread over the country regions are the Northeast and Southeast. The objective of this study were to evaluate the effect of the mixture composition from sandy soil from Alagoas at region Northeast of Brazil, with addiction of the sugarcane bagasse biomass for banana planting. The results prove the efficiency of the Sugarcane bagace were enrich this soil, causing the nutrient particles to interact with the soil particles and thus increasing the amount of nitrogen and potassium in that soil.

Keywords: *Biomass, Sugarcane Biomasse, Residue, Soil, Nutrient, Banana.*

INTRODUCTION

The Brazil is the highest producer of Sugarcane close to the India which dumps tonnes of Sugarcane Bagass per day. The Northeast of Brazil is the second largest sugarcane-producing region and is responsible for 8% of national production [1,2, 3].

After harvest, sugarcane is carried out to Sugar-Alcohol Plant for production of the sugar, ethanol and others subproducts. After extracting juice, one part of the available biomass (bagasse and straw) is burned in 65 bar pressure boilers on Sugar-Alcohol Plant in cogeneration plants and sugarcane bagasse raw fibrous pulp is used natural fertilizer [1,3].

Nearly 30% of the industrial residues from industrial (bagasse ash and vinasse) are which is used as landfill and which partially return to the sugarcane plantation, wich affect the biomass production costs and is fundamental evaluate of the environmental impacts [4, 5].

The sugarcane bagasse is a waste agricultural mainly consist of cellulose, and lignin contains hydroxyl - carboxylicgroups, and large quantities of the bagasse can be easily procured at a low cost. Among the renewable energy, ethanol and sugarcane bagasse represent 38.4% from brazilian energy supply [6, 7,8].

The biomass can also been used to produce biochar, which emerges as a green and sustainable material for soil amendment, chemical synthesis, wastewater treatment, and energy recovery [9]. The addition of the organic matter through organic residue application can been improve water holding capacity, cation exchange capacity (CEC), nutrient cycling, and soil structure, all of the which can enhance plant nutrient supply and storage [10, 11].

The sugarcane bagasse biomass deposited in the soil with the production of sugar cane protects it from events such as erosion and weathering, contributed to the improvement of the amount of organic matter in the soil, and brings positive reflections on the balance of nutrientes [12].

Therefore, the application of the wastes sugarcane bagasse in the soil for agricultural planting would be an environmental alternative for low the release of the greenhouse gases to the atmosphere from waste incineration and open field dumping sites, and the depletion of the non-renewable energy resources and therefone use brings positive reflections on the balance of the nutrientes [13].

The banana is a tropical plant species and one of the leading fruit crops globally and ranks economically as the fifth most important agricultural crop in world trade and It serves as a staple food and source of income in Latin America, Africa and Asia. The Banana production in Brazil is characterized by small producers spread over the country regions are the Northeast and Southeast. The optimum soil pH for banana growth ranges from 5.8 to 6.5 (in water) or 5.0 to 5.8 (in KCl extracts) and Low soil pH (< 5) is often associated with low contents of base cations and nutrients such as Ca2+ and Mg2+ or with high contents of aluminum and manganese [5, 13].

The objective of this study were to evaluate the effect of the doping composition from sandy soil from Alagoas at region Northeast of Brazil, with addiction of the sugarcane bagasse biomass for banana planting.

MATERIALS AND METHODS

The soil samples were collected from Cajueiro village, from interior of the Igreja Nova, Alagoas, northeastern Brazil and the sugarcane bagasse were industrial residue of the Usina Estivas from Rio grande do Norte, after heat treatment, grinding and screening [14], the methodology used is shown in Figure 1.

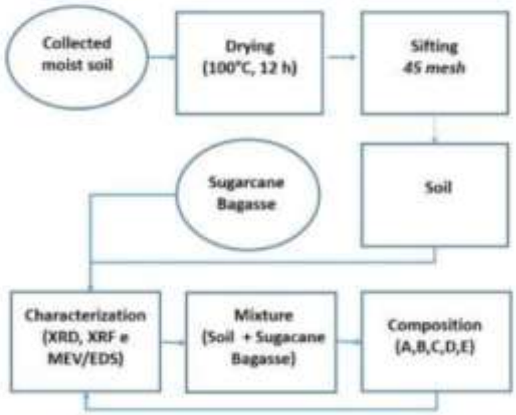

Figure1. *Flowsheet of the methodoy of obtained into the compositions of the sugarcane bagasse and soil.*

The Figure 1 shown the steps of collecting moist soil about 500g, then it was put to dry for 12 hours at a temperature of 100 ° C and after that the soil was sieved with a 45 mesh granulometry. The characterization of the soil and sugar cane bagasse were using x-ray diffraction (DRX) and x-ray fluorescence (FRX), and then the mixing steps between the soil (S) and the sugarcane bagasse (BG) were performed, as shown in the Table 1, were using a agate mortar and pestle that lasted 15 minutes for each sample and always performed in circular movements, finally it was possible to obtain the five samples, being A, B, C, D and E.

Table1. *Mixture composition used in the experiment*

Composition (1,0 g)	Sugarcane Bagace (BG)	Soil (S)
A	10%	90%
B	20%	80%
C	30%	70%
D	40%	60%
E	50%	50%

The analysis of the materials of both the soil (S) and the sugarcane bagasse (BG) and the samples carried out in this work were characterized by the analysis of: x-ray diffraction (XRD), x-ray fluorescence (FRX) and scanning electron microscopy (SEM) (FEG-SEM) with EDS. The fluorescence spectroscopy analyzes were carried out by X-ray dispersive energy with an EDX-720 / 800HS apparatus. The structure of the crystalline phases in the calcined powders were investigated by X-ray diffraction (XRD) using a shimadzu diffractometer with radiation cuka (λ = 1.5418Å).

For phase identification, measurements were performed in the range of 2θ ° between 10 ° to 90 ° and the step speed of 0.02 ° / min with a fixed time of 1 s. Finally, the samples were realized by spectroscopy (EDS) using a field-emission gun scanning electron microscopy (FEG-SEM; Carl Zeiss, model supra 35-VP, Germany) operated at 14 kv.

RESULTS AND DISCUSSION

The Table 2 shows the chemical composition of the soil and sugarcane bagasse obtained by X-ray fluorescence spectroscopy.

Table2. *XRF of soil and sugarcane bagasse.*

	Components	
Chemical Elements	Soil	Sugarcane biomasse
Si	37,53%	14,92%
Fe	37,35%	17,84%
Al	9,75%	1,26%
K	4,58%	34,17%
Ti	3,14%	0,92%
Zr	1,66%	
Nb	1,46%	
Ta	1,21%	
Ca	1,01%	17,66%
Mn	0,46%	1,40%
Mg	0,41%	
Rb	0,41%	
Sr	0,33%	
S	0,17%	2,22%
Zn	0,14%	1,10%
Y	0,13%	
Cr	0,09%	
Na		5,40%
Ni		1,70%
P	0,08%	1,36%

The analysis of Table 2 indicates that the most representative percentages in the soil sample were Si (37.53%), Fe (37.35%) and Al (9.75%). And these properties can been related to the unique sandy characteristic in this region, they are very low in calcium and phosphorus, it is basically composed of light minerals, of which quartz (SiO2) constitutes the dominant mineral [15].

Table 1 indicates that the most representative percentages in the sample of the sugarcane bagasse were the K (34.17%), Fe (17.84%), Si (14.92%) and Ca (17.66%) . These properties can been related to the soil from cultivation [14]. The Figure 2 showing X-ray diffractogram of the soil.

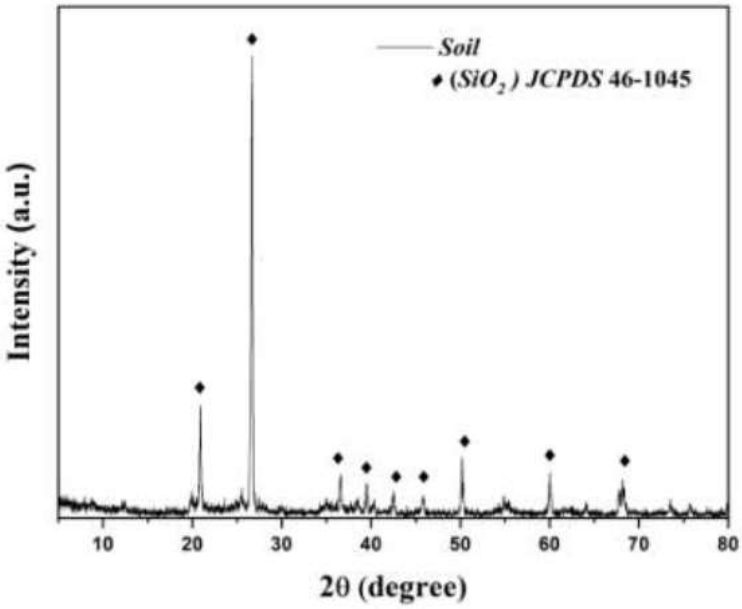

Figure2. *X-ray diffractogram of the soil.*

The Figure 2 shown the peaks of the diffractograms in which we have identified the corresponding quartz phase (SiO2). the card JCPDS 46-1045 were identified using the X'pert program [16]. The Figure 3 shows the x-ray diffractogram of the sugarcane bagasse.

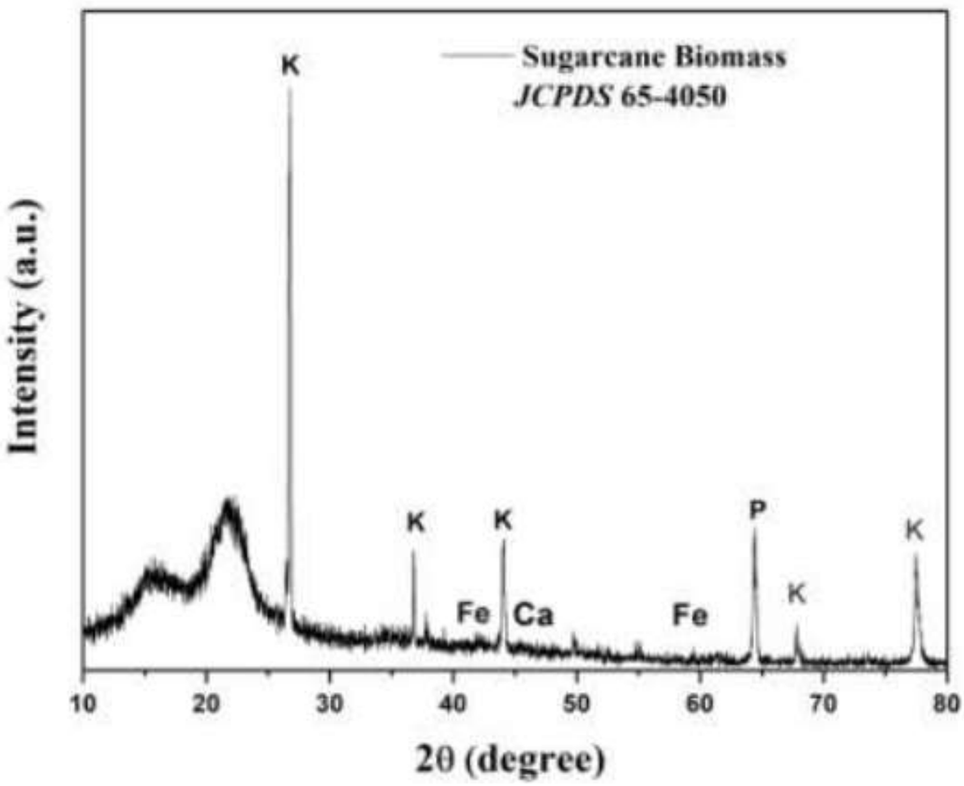

Figure3. *X-ray diffractogram of the sugarcane bagasse.*

The Figure 3, the crystalline phase was identified, showing the potassium phase represented in the card JCPDS 65-4050, these peaks have shown in the chart left of the Peak with the main Peak, we also have the presence of peaks relevant to the elements that have higher percentages in the chemical composition as shown in the table 3 of the FRX, we have the Fe in 42.22 and 61.37 with the JCPDS card 85-1410, for the Ca in 47. 65 with the JCPDS card 89-4052, the P in 42.09 and 64.45, shifted to the left with the card JCPDS 76 -1967.

The Table 3 shows the chemical composition obtained from the mixture process between the soil and sugarcane bagasse (BG /S) obtained by X-ray fluorescence spectroscopy.

Table3. *XRF of Chemical composition of soil and sugarcane bagasse*

	Compositions				
Chemical Elements	A	B	C	D	E
Si	33,33%	34,21%	29,71%	32,50%	30,20%
Fe	42,50%	40,76%	46,53%	43,50%	46,80%
Al	11,53%	11,85%	10,20%	11,34%	9,70%
K	5,17%	5,03%	6,16%	5,37%	5,53%
Ti		2,92%	3,58%	3,15%	3,22%
Zr	2,70%	3,03%	1,80%	2,12%	2,63%
Ca	1,05%		1,32%	1,13%	1,23%
Mn	0,57%		0,70%	0,60%	0,66%

Were obtained by the mixing process, using the agate mortar in which mixture with 10, 20, 30, 40 and 50% of sugarcane bagasse and soil were performed, these results were obtained through X-ray fluorescence, as shown in Table 4.

From these results obtained demonstrate the increase in the percentage of the elements as iron, silica and aluminum in all percentages from 10% to 50% carried out in the mixture and highlighting the composition 3 (30% BG / 70%

S) that would have the same percentage when comparing composition 5 (50% BG / 50% S) performed with mixture of 10, 20, 30, 40 and 50% of bagasse in soil. In Figure 4, the peaks of the diffractograms of the studied soil were maintained, in which we have identified the corresponding quartz (SiO2) phase in the card JCPDS 46-1045 (16), we were identified that the mixture was inserted in its structure.

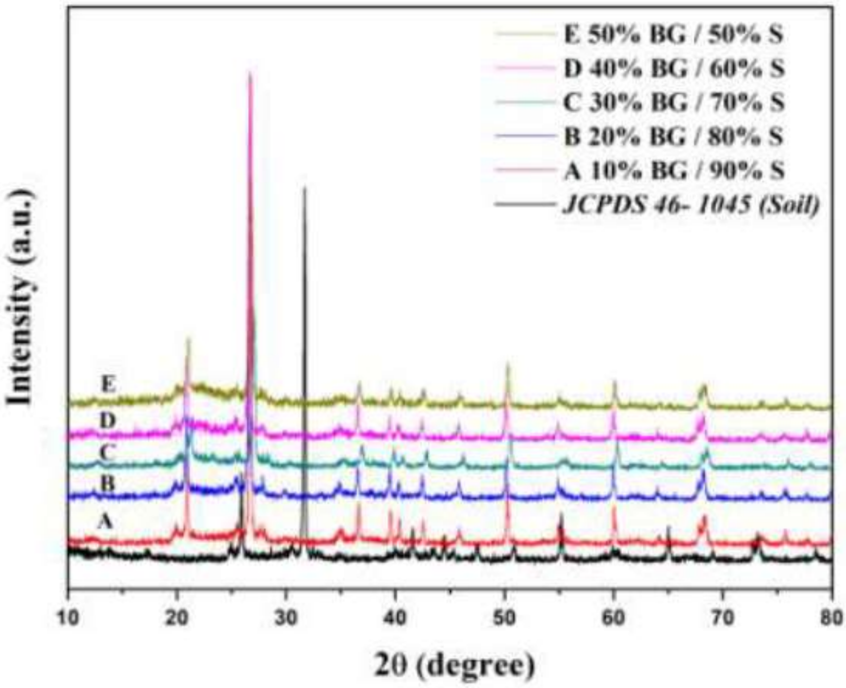

Figure4. *X-ray diffractogram of composition of soil and sugarcane bagasse*

The micrographs obtained by scanning electron microscopy (SEM) were performed to confirm the patterns already studied and discussed in the previous characterizations and shown in Figure 5 (a-e).

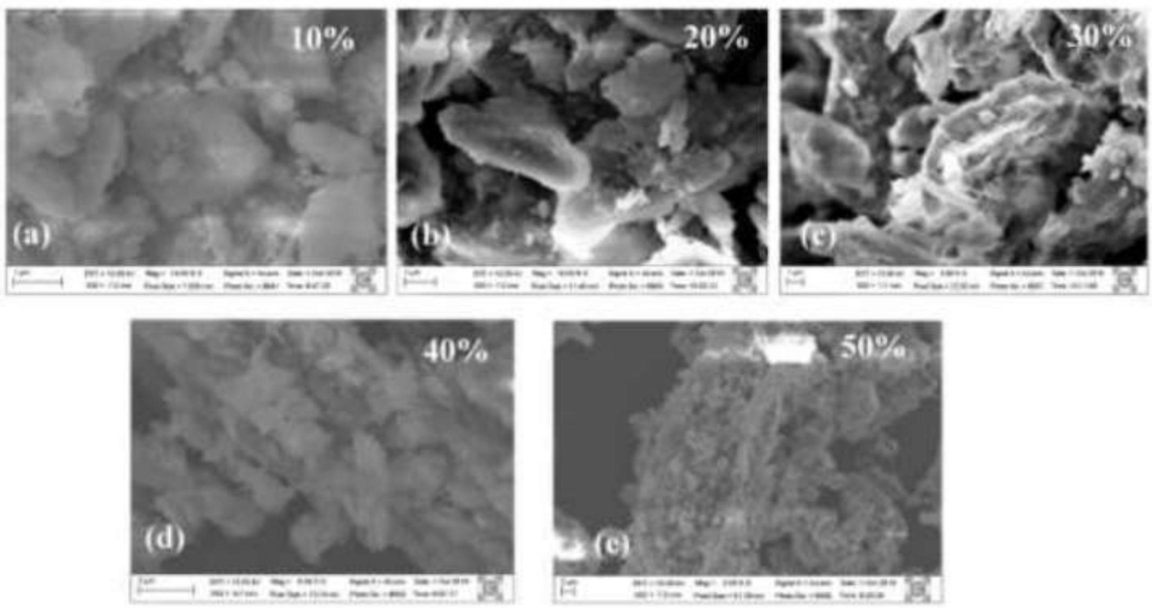

Figure5. *MEV. (a)10% (b)20% (c)30% (d)40% (e)50%.*

The micrographs shown in Figure 6 of composition 3 (30% BG / 70% S) in the letters (a-e) have regular and agglomerated structures. The mapping shown in Figure 6 below shows the elements of mixture present in the structure, such as potassium, iron, calcium and phosphorus. Anteriorly, we had only the sandy soil who now were changed, now we have a rich soil of nutrients particularly rich in nitrogen and potassium.

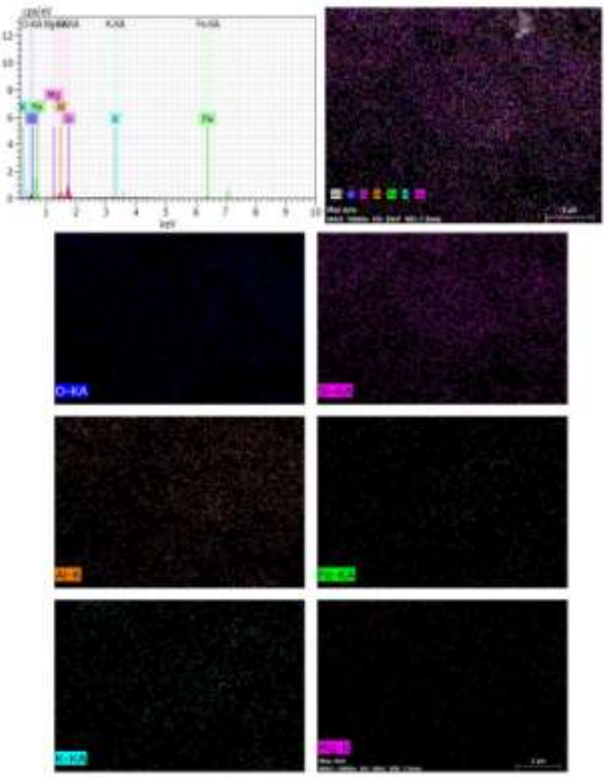

Figure6. *EDS. Composition of soil and sugarcane bagasse*

CONCLUSION

It this work was possible from the studies of the soil and sugarcane bagasse to prove the efficiency that by making a fertilizer using the sugarcane bagasse in the existing soil for planting the banana tree, which were presents the characteristic of being poor in nutrients such as nitrogen and potassium with the sugarcane bagasse. The Sugarcane bagace will enrich this soil, causing the nutrient particles in the sugarcane bagace berry to interact with the soil particles and thus increasing the amount of nitrogen and potassium in that soil.

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