

Raw castor meal.

P ² O ⁵	SO ³	SiO ²	K ² O	CaO	MgO	Al ² O ³	Fe ² O ³	Cl
1.8	1.3	1.3	1.2	0.9	0.8	0.3	0.1	0.1

Carbonized (500°C, 2 h) castor meal.

P ² O ⁵	SO ³	SiO ²	K ² O	CaO	MgO	Al ² O ³	Fe ² O ³	Cl
4.1	0.2	2.4	4.8	4.8	0.3	0.3	0.6	0.3

By DRUV-Vis spectroscopy the raw material presents two mainly absorption bands at 220 and 280 nm, typical of electronic transitions into the organic materials ($\pi\rightarrow\pi^*$), and the carbonized material presents continuous absorption from 250 to 850 nm, typical of humic materials with high degree of conjugation. The electron paramagnetic resonance spectroscopy (EPR) study shows that the concentration of free radicals increase from the raw material (number of spin g-1 = 5.38×10^{16}) to the carbonized material (1.45×10^{19}). Thought this technique, the carbonized material shows performance of a humic-like material in correlation with the results of the DRUV-Vis study. The material was also used to prepare a potassium slow release fertilizer by mixing potassium sulfate with appropriate quantity of the raw material and promoting the carbonization. By tests of leaching with water, aqueous citric and HCl acids, 0.1 mol L⁻¹, the obtained product shows a capacity of K retention of 87.6 %. The retained K will slowly be released to the soil in more satisfactory way with the necessity of the plants. The carbonized material and the potassium slow release fertilizer are been characterized now by the technique of ¹³C Nuclear Magnetic Resonance (¹³C-NMR).

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C16: Agronomic effect of humic like substances produced from charcoal

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The agricultural use of products like organic fertilizers, soil ameliorates and physiological stimulator, based on humic substances, has grown rapidly in Brazil in the last two decades. The main sources of humic acids (HA) for commercial use are peat and sedimentary deposits like antracite and Leonardite, of which are not renewable resources. Laboratory experiments show that it is possible to produce satisfactory yields of humic-like substances from charcoal using acid treatment. The obtained humic material showed some characteristics that are similar to those extracted from pyrogenic carbon rich soils i.e. polycyclic aromatic nuclei containing peripheric carboxylic groups. These compounds are chemically stable and have a high cation exchange capacity. Although the process used is energy intensive and requires the use of chemicals, the application of this technology on an industrial scale could reduce the costs of production. In this research we evaluated the effect of foliar application of charcoal humic acid solutions on soybean yields. Foliar application rates of 150 L/ha of the HA solution and at a concentration of 300 mg/L (or 45 g of charcoal HA per hectare) was applied to the soybean plots 30 days after seeding. The results show an increase in soybean yield of 17% in relation with the Control, and which correspond to an increase of 600 kg of soybean per hectare. Considering these results, we suggest that the production of humic-like substances for agronomic use from biochar would be economical viable, and should need further investigation.

C17: Biochar decomposition under different water and temperature regimes

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The stability of biochar is an important property that is not only important in the framework of carbon sequestration but also for the sustainability of any soil improvements. Decomposition of plant litter and soil organic matter is known to be strongly influenced by temperature and moisture conditions in soil. Similar information is not available for biochar. Specifically, how the properties of biochar as a function of feedstock and production temperature affect its decomposition and change in oxidation, has not been reported up to now. This study investigates the interactions of feedstock type (corn crop residue and oak wood), production temperature (350°C and 600°C; produced with slow pyrolysis by BEST Energies), presence of microorganisms with either temperature in the environment (4, 10, 20, 30, 45 and 60°C at field capacity) or moisture conditions (anaerobic, aerobic, alternating anaerobic-aerobic at 30°C) on mineralization (mass loss over 1 year incubation; N=4) and change in properties (oxidation by elemental analysis; functional groups by FTIR; cation retention capacity by ion exchange). There was no significant difference between decomposition or oxidation under aerobic and alternating anaerobic-aerobic conditions. Carbon loss was significantly reduced, however, under anaerobic conditions. Some negative surface charge developed on biochars even under continuous anaerobic and submerged conditions. The greatest increase in cation exchange capacity was noted under aerobic conditions for corn biochar produced at 350°C. Over the one year incubation, carbon loss amounted to 12% for corn biochar and 9% for oak biochar. While biochar produced from corn residues at 600°C had a significantly lower carbon loss than when produced at 350°C, there was no significant difference when biochar was produced from oak wood. The sensitivity of oxidation (O/C ratio) to incubation temperature was lower with a lower mass loss. Carbon loss, however, appeared to increase with increasing incubation temperature irrespective of biochar type.

C18: Attenuation of char surface activity over time by natural substances in soil

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An important consideration in the use of biochar as a soil amendment in agriculture is its effect on the mobility and bioavailability of agriculturally important organic chemicals including applied pesticides, residues of incidental contaminants such as legacy pesticides or contaminants in manures or municipal sludges, and natural allelopathic chemicals. Depending on source material and conditions, newly-formed biochar typically has high surface area and microporosity, properties that render it strongly adsorptive. A decrease in the availability of agriculturally important chemicals due to biochar application may have positive or negative effects. Beneficial effects include reduction in pesticide leachability, reduction in bioavailability of incidental contaminants, and reduction in bioavailability of allelochemicals that reduce crop yield or quality. Deleterious effects include reduction in pesticide efficacy (i.e., requiring greater application levels) and reduction in activity of beneficial allelochemicals.