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Progressing from Terra Preta de Índios to the Whole World

Biochar properties and environmental behavior

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Introduction

Biochar properties vary significantly with the type of feedstock used under different production conditions [1]. It is less clear what effect those differences have on environmental behavior of biochars, such as persistence in soil, nutrient retention, water retention, or nitrous oxide emissions from soil. In a series of experiments, we tested the effects of both the pyrolysis temperature and feedstock type on a range of effects including plant growth and nutrient uptake. We attempted to characterize the biochars using spectroscopic techniques as well as by less expensive and more rapid tests to predict environmental behavior.

Results and Discussions

Between 300°C and 600°C, environmental behavior largely improved with greater charring temperature. Stability against microbial mineralization generally increased at higher temperature, even though this increase was more pronounced for the more labile biochars made from maize stalks than those made from oak wood. Nitrous oxide emissions were larger than the unamended control for high-N containing feedstocks such as poultry manure, pyrolysed at 300°C. However, increasing the pyrolysis temperature to 600°C decreased N availability in the biochar, and nitrous oxide emissions almost completely disappeared. Similar effects of pyrolysis temperature on N leaching were observed with the same set of biochars. The ability of soil to retain plant available soil water more than doubled with 7% added maize biochar pyrolysed at 600°C, but hardly increased when maize stalks were charred at 300°C. Biochar produced from food waste significant decreased maize growth in a greenhouse experiment when pyrolysed at 300°C. This negative effect largely disappeared when food waste was pyrolysed at 600°C. Detrimental effects of biochars were largely a result of Na contents, and apparent only at high application rates of 2-7% (Figure 1).

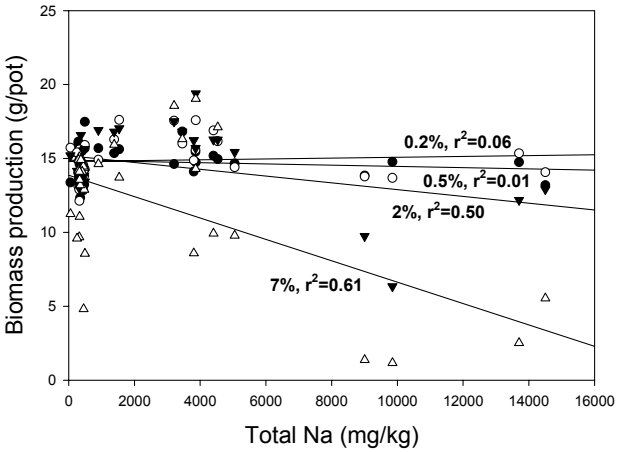

Figure 1. Relationship between total Na and biomass production in a greenhouse experiment after additions of biochars with greatly varying properties to a loamy soil from Upstate New York.

Conclusions

These results indicate that environmental behavior of biochars may be significantly influenced by production conditions, even in situations where feedstock properties can not be varied.

[1]Lehmann, J. 2007. Frontiers in Ecol. Env. 5: 381-387.