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Progressing from Terra Preta de Índios to the Whole World

Soil microbial respiration and nitrogen mineralization in a biochar-amended soil from Quebec, Canada

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Introduction

The impact of biochar on soil microbial communities is poorly understood. Although biochar is not an important substrate for microbial metabolism or growth, there is evidence that biochar-amended soils support greater overall cell biomass, respiration and nitrogen cycling processes. This may be due to physical protection of microorganisms within biochar pores or retention of substrates essential for microbial growth on biochar surfaces. The objective of this study was to evaluate the response of soil microbial communities under controlled conditions in a biochar-amended soil from Quebec, Canada. The experiment was a completely randomized design with two soil types (surface soil, subsurface soil) and one biochar amendment. Soil of the St. Bernard series (pH 6.0) was cultivated for corn production in the previous two years. The surface soil (5-30 cm) was a sandy-loam with 11.6 g organic C kg^{-1}, while the subsurface soil (> 40 cm) was a sandy clay loam with about 4.0 g organic C kg^{-1}. Wood based biochar made through pyrolysis (Pyrovac) was added at rates of 0, 10, 20 and 30 g biochar kg^{-1} soil, which was equivalent to field application rates of 20, 40 and 60 tonnes ha^{-1}. Experimental units were 90 cm^3 plastic cups containing 75g soil mixed with biochar, moistened to 50% water-filled pore space, placed in covered 1 L Mason jars and incubated at 25°C. Soil respiration was measured weekly and mineral nitrogen (NH_4-N and NO_3-N) concentrations were evaluated after 0, 1, 2, 4, 8, 12, 16 and 20 weeks of incubation following protocol described at Whalen *et al*.[1].

Results and Discussions

Soil respiration and N mineralization were greater in topsoil than subsoil, regardless of biochar amendment. After 8 weeks of incubation, there was significantly more soil respiration in soils amended with 40 tons and 60 tons of biochar than without biochar (Figure 1 and 2).

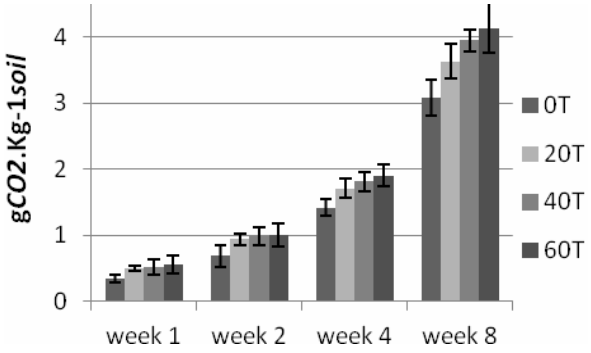

Figure 1. Respiration (gCO_2. Kg^{-1} soil) detected in the topsoil treated with different amounts of biochar.

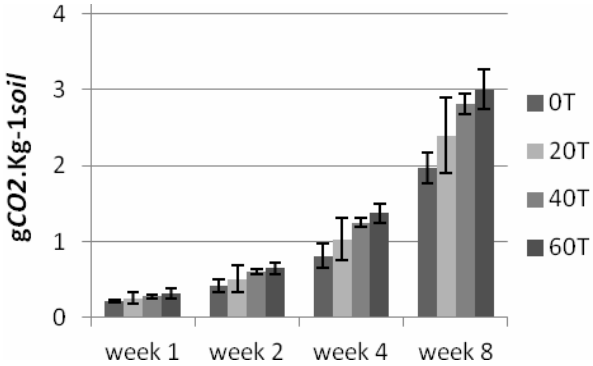

Figure 2. Respiration (gCO_2. Kg^{-1} soil) detected in the subsoil treated with different amounts of biochar.

The nitrogen mineralization was not affected by biochar amendment in both types of soils (Figure 3 and 4).

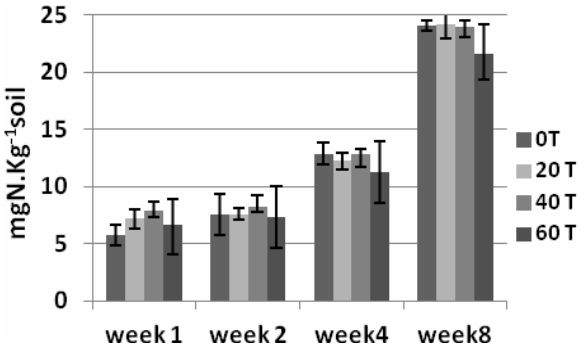

Figure 3. Nitrogen mineralization (mgN.Kg^{-1}soil) in topsoil treated with different amounts of biochar.

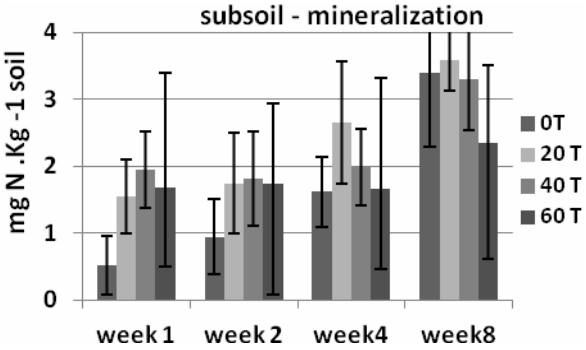

Figure 4. Nitrogen mineralization (mgN.Kg^{-1}soil) in subsoil treated with different amounts of biochar.

Conclusions

These results suggest that biochar provides a favorable habitat for microbial communities involved in decomposition while maintaining nitrogen forms required for crops. The incubation will be continued for another 12 weeks to verify the trends observed. Field trials are underway with corn, soybean and switchgrass to evaluate nitrogen availability to crops grown in temperate agroecosystems of Quebec, Canada.

Acknowledgements

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[1] Whalen J. K.; Bottomley P J.; Myrolda 2000 *Soil Biology & Biochemistry 32*, 1345-1352.