The effect of biochar on corn, soybean and switchgrass on high and low fertility soil in Southern Quebec, Canada

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Addition of biochar to tropical soils has resulted in increased nutrient availability and soil organic matter leading to increased crop yields [1]. However, little research has been conducted on the impact of biochar soil amendments in temperate climates. The aim of this 2-year field experiment is to investigate the effects of biochar on the growth of three crops (switchgrass, corn and soybean) grown on two contrasting soil types (a high quality loamy soil and a low fertility sandy soil) in Southern Quebec, Canada. Biochar was added in the spring prior to secondary tillage and seeding at rates of 0, 20 and 40 t ha^{-1} and was incorporated into the soil through secondary tillage. Time to seedling emergence, time to flowering, leaf area index and accumulated biomass were recorded at the mid-vegetative stage, at flowering and halfway through seed-filling. In the case of soybean the nodulation process was observed through indicators such as the number and weight of nodules. At harvest total crop residue (stems and leaves), seed number, 100-seed weight, seeds per reproductive structure (cob or pod) and seed yield were all measured. Detailed results will be presented on the effects of biochar soil amendment on the three crops. This research will provide insight into the effects of biochar soil amendment in a temperate climate and investigate its prospects to be used commercially in Southern Quebec.

Effect of Biochar on wheat yield, soil respiration and nitrous oxide fluxes

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The idea that agricultural soils have great potentials for storing Carbon and sequester atmospheric CO_2 is attracting increasing interest in the scientific community and society. Agricultural intensification occurred over the last 50 years in developed countries led to a substantial depletion of Carbon stored in the organic fraction of agricultural soils and soils which are depleted in organic Carbon represents a potential large sink for atmospheric C-sequestration. The pyrolisis conversion of agricultural residues into biochar and its incorporation in agricultural soil, avoids CO_2 emissions providing a safe long-term soil carbon sequestration. Furthermore, biochar application to soil seems to increase nutrient stocks in the rooting zone, to reduce nutrient leaching and to improve crop yields. This paper reports the results of an experiment of biochar application in Central-Italy on a durum wheat (Triticum durum L.) crop. The present study was carried out. A randomized block experiment with three treatments and four replicates was made, involving a C (control), B3 (30 t biochar ha^{-1}) and B6 (60 t biochar ha^{-1}). Each experimental plot had an area of 25 m^2. The addition of large amounts of biochar caused detectable changes in the optical properties of the soil surface.

Based on results from two subsequent years of biochar application, an increase crop yield and dry matter production was observed. The time lag between sowing and plant emergence was significantly reduced in the treated plots. The increased soil temperature, the improved soil water retention, the increased CEC are some of the soil modifications induced by biochar which might have stimulated plant growth. CO_2 and N_2O fluxes were also measured during and between fertilization events. Preliminary data seems to indicate that biochar application slightly increases soil CO_2 emissions and partially reduced N_2O production.

Influence of different types of biochars on the water retention of two soils (an Alfisol and an Andisol)

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The use of biochar as a means to ameliorate the physical properties of soils and, particularly, the soil water retention capacity, has emerged after identifying its unique characteristics (e.g., high porosity). The objective of this study was to investigate to what extent the addition of biochars produced from different feedstocks and at different temperatures affects the water retention curve of two soils. Four biochar types – produced from corn stover (CS) and Miscanthus spp. (MS) pyrolysed at 25 °C min^{-1} to 350 and 550 °C (MS350, MS550, CS350, CS550) – were incorporated into two distinct soils, an Alfisol and an Andisol, at the following application rates: 0, 2.5, 5.0, and 10.0 t ha^{-1}. Soils were previously dried and sieved through 2 mm. Moisture contents of the mixtures at different matric potentials (-15, -1, -0.3, -0.1, -0.08, -0.06, -0.04, and -0.02 bar) are being measured to represent the soil water retention curve. The results obtained at -0.1 bar indicate that, compared to the controls – which had a soil water content of 0.50 and 0.70 (wt/wt) for the Alfisol and the Andisol, respectively – all the biochar-amended soils increased the amount of water retained, as expected. When adding 2.5, 5 and 10 t ha^{-1} of MS350 biochar to the Alfisol, the moisture content increased 4-12 % the original value. This range changed to 2-10, 4-8, and 2-6 % when the MS550, CS350 and CS550 biochars were added to the same soil. The addition of 2.5, 5 and 10 t ha^{-1} of MS350 biochar to the Andisol increased the soil moisture 3-9 % of the original value. This range changed to 1-6, 3-7, and 3-6 % with the addition of MS550, CS350 and CS550 biochars, respectively. A greater water retention was generally observed in the 350-biochars compared to the 550-biochars, but this was only significant ($P<0.05$) for the MS biochar added to the Alfisol. No significant differences ($P<0.05$) in water retention were observed between the MS a nd CS biochars, except for the biochars produced at 350 °C and applied to the Alfisol. Application rate also showed a significant effect ($P<0.05$) on soil water retention for both biochar types in either soils, this effect being more evidenced at the highest application rate. The results obtained to date suggest that the addition of biochar to soils can have a positive effect on the water availability of these two soils.