



Impact of land-use and long-term (>150 years) charcoal accumulation on microbial activity, biomass and community structure in temperate soils (Belgium).

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In the last decade, biochar has been increasingly investigated as a soil amendment for long-term soil carbon sequestration while improving soil fertility. On the short term, biochar application to soil generally increases soil respiration as well as microbial biomass and activity and affects significantly the microbial community structure. However, such effects are relatively short-term and tend to vanish over time. In our study, we investigated the long-term impact of charcoal accumulation and land-use on soil biota in temperate haplic Luvisols developed in the loess belt of Wallonia (Belgium). Charcoal-enriched soils were collected in the topsoil of pre-industrial (>150 years old) charcoal kilns in forest (4 sites) and cropland (5 sites). The topsoil of the adjacent charcoal-unaffected soils was sampled in a comparable way. Soils were characterized (pH, total, organic and inorganic C, total N, exchangeable Ca, Mg, K, Na, cation exchange capacity and available P) and natural soil organic matter (SOM) and black carbon (BC) contents were determined by differential scanning calorimetry. After rewetting at pF 2.5, soils were incubated during 140 days at 20 °C. At 70 days of incubation, 10 g of each soil were freeze dried in order to measure total microbial biomass and community structure by PLFA analysis. The PLFA dataset was analyzed by principal component analysis (PCA) while soil parameters were used as supplementary variables. For both agricultural and forest soils, the respiration rate is highly related to the total microbial biomass ($R^2=0.90$). Both soil respiration and microbial biomass greatly depend on the SOM content, which indicates that the BC pool is relatively inert microbiologically. Land-use explains most of the variance in the PLFA dataset, largely governing the first principal component of the ACP. In forest soils, we observe a larger proportion of gram + bacteria, actinomycetes and an increased bacteria:fungi ratio compared to cropland, where gram - bacteria, arbuscular mycorrhizal fungi and 18:2 and 18:3 fungi are more present. BC is quite well represented ($R=-0.765$) by the third principal component of the PCA, representing 12.2 % of the total variance. It has limited impact on the community structure, particularly in cropland. However, in forest BC is negatively correlated ($R=-0.785$) with 18:1 fungi. The more pronounced effect of BC on community structure under forest could result from modified trophic conditions at kiln site (e.g. higher pH, lower available P content, ...) while cultivation practices attenuated such differences over time in cropland. In conclusion, our survey tends to confirm that the influence of BC on the soil microbiological parameters is governed by indirect effects on trophic conditions. On the other hand, land-use affects dramatically soil microbial community structure.