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Quantification of biochar in arable land: a new approach with Rock-Eval® thermal analysis.

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Abstract:

Biochar, the solid residue of pyrolyzed organic material, is considered as a negative emission technology (Smith 2016). When applied on soils, biochar was shown to additionally improve plant yields and soil physical environment (Blanco-Canqui 2017; Kavitha et al. 2018; Zhang et al. 2021). Therefore, biochar has attracted lots of attentions in agricultural fields. However, biochar particles are highly mobile in soils (Chen et al. 2017), which raises questions about the fate of biochar over long-term scales. Quantifying biochar apprears as necessary to help monitoring its fate in soil. However, the technical methods allowing biochar quantification are still time consuming or imprecise. In our study, we propose a new approach to quantify biochar when mixed with agricultural soil, based on their thermal properties. We used six industrial biochars from plants and four cultivated soils mixed at five different biochar/soil ratios (from 0.05 % to 1 % (w/w)), that we analysed using the Rock-Eval® thermal method.

Our results showed that the CO_2 emissions during oxidation stage of the Rock-Eval® analysis (CO_2oxi) presented a peak between 430 and 630 °C, that increased along with biochar quantities in the mixtures. In this range of temperatures, the difference between CO_2oxi emissions from the mixture and from pure soil samples was well correlated with the carbon content from biochar in the mixture. Hence, we showed that the Rock-Eval® thermal method was a good tool to quantify biochar in cultivated soils, using the CO_2oxi emissions. However, this method requires data from pure soil samples. Further research would be needed to adapt this protocol to the cases when pure soil sampling is not possible and/or when biochar is mixed with non-cultivated soils.

References

Blanco-Canqui H (2017) Biochar and Soil Physical Properties. Soil Science Society of America Journal 81:687–711. https://doi.org/10.2136/sssaj2017.01.0017

Chen M, Wang D, Yang F, Xu X, Xu N, Cao X (2017) Transport and retention of biochar nanoparticles in a paddy soil under environmentally-relevant solution chemistry conditions. Environ Pollut 230:540–549. https://doi.org/10.1016/j.envpol.2017.06.101

Kavitha B, Reddy PVL, Kim B, Lee SS, Pandey SK, Kim K-H (2018) Benefits and limitations of biochar amendment in agricultural soils: A review. Journal of Environmental Management 227:146–154. https://doi.org/10.1016/j.jenvman.2018.08.082

Smith P (2016) Soil carbon sequestration and biochar as negative emission technologies. Global Change Biology 22:1315–1324. https://doi.org/10.1111/gcb.13178

Zhang Y, Wang J, Feng Y (2021) The effects of biochar addition on soil physicochemical properties: A review. CATENA 202:105284. https://doi.org/10.1016/j.catena.2021.105284