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Influence of biochar and plant growth on organic matter dynamics in a reclaimed mine residue

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This study aims at assessing the impact of biochar and marble waste amendment and the development of vegetation in acidic mine wastes on organic matter dynamics. For this purpose, a mine residue was collected in a tailing pond from the Sierra Minera of Cartagena-La Unión (SE Spain), and a greenhouse experiment was established for 120 days. Marble waste (MW) was added in a rate of 200 g kg-1 as a source of calcium carbonate to increase the pH from 3 to 7.5-8 (average pH in the native soils of the area). We added biochar as a source of organic carbon and nutrients, in two different rates, 50 g kg-1 (BC1) and 100 g kg-1 (BC2). To assess the influence of vegetation growth on the creation of a technosoil from mine residues and its impact on organic matter dynamics, the plant species Piptatherum miliaceum (PM) was planted in half the pots with the different amendments. Thus, five treatments were established: unamended and unplanted control (CT), BC1, BC2, BC1+PM and BC2+PM. Results showed that the different treatments had no significant effect on aggregates stability, microbial biomass carbon and the emission of N2O and CH4. So, it seems that longer periods are needed to increase the stability of aggregates and microbial populations, since even the combined use of biochar, marble waste and vegetation was not enough to increase these properties in 120 days. Nonetheless, it was positive that the addition of biochar and the release of root exudates did not trigger the emission of greenhouse gases. Organic carbon significantly increased with the addition of biochar, with values similar to the dose applied, indicating high stability and low mineralization of the amendment. The addition of amendments significantly increased arylesterase activity, while the growth of the plant was needed to significantly increase β-glucosidase activity. The soluble carbon significantly decreased in BC1 and BC2 with regards to CT, while no significant differences were observed among CT and treatments with plant. Arylestarase showed significant correlations with pH and organic carbon, while β-glucosidase was related to total and soluble organic carbon. Thus, the high recalcitrance of biochar increased the total organic carbon, but decreased soluble carbon, likely by adsorption, and was not able to activate microbial populations. A labile source of organic matter should be added together with the proposed amendments to promote the activation of microbial communities and likely the formation of stable aggregates, since root exudates were not enough for this purpose.
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