Phosphate biochar: a new horizon in organomineral fertilization[1]

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Resumo — Phosphorus (P) is a crucial macronutrient necessary for fertilizing crops in tropical soils, where it is estimated that up to 90% of applied soluble phosphorus rapidly becomes insoluble due to phosphate fixation reactions. However, Amazonian Dark Earth (ADE) soils are an exceptional case. These soils, despite being highly weathered, maintain remarkable fertility, primarily because of their rich organic pyrogenic carbon content. The genesis of ADE soil is believed to occur through a melanization process, influenced by both natural and human activities. Although the production of enriched biochars is promising, it incurs higher operational and energy costs compared to traditional biochar methods, mainly due to the additional required steps of drying and torrefaction. Thus, exploring new methods and organomineral mixtures for enriched biochar production is crucial. Our study introduces a method for creating phosphate biochar by pyrolyzing biomass with mineral materials, eliminating the need for doping and subsequent drying or torrefaction. We examined eight treatments to produce P-enriched organomineral composts, resulting in eight distinct phosphate biochars from organomineral mixtures. Four biochars were produced by pyrolyzing biomass (either rice husks or coffee husks) with soil samples of sandy or clay textures and integrating triple superphosphate during pyrolysis. The other four were generated by adding triple superphosphate after pyrolysis, using the same biomass and soil combinations. This approach allowed us to assess the impact of phosphate addition timing on the biochars' efficacy in improving soil fertility. During the thermal decomposition of biomass, organic molecules in liquid and gas phases reacted with mineral fractions to form organomineral compounds, potentially enhancing carbon retention in biochars due to the presence of minerals during pyrolysis. The total phosphorus content remained consistent across all biochar treatments, as phosphorus does not vaporize at the low pyrolysis temperature of 350°C. The variations in available phosphorus, labile phosphorus, calcium-bound phosphorus, and occluded phosphorus levels in biochars phosphated before pyrolysis could be due to an increase in phosphate crystallinity. Our findings indicate that for tropical soils, it is preferable to mix triple superphosphate with biochar after pyrolysis, achieving higher available phosphorus levels and reducing the more recalcitrant phosphorus fractions.

Termos para indexação: phosphorus, pyrolysis, carbon sequestration, fertilizers, tropical soils.