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Impacts of lake sediment reuse on plant growth and soil properties in the field

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Abstract

Lake sediments are in many cases known to be rich in nutrients, organic carbon, and clay minerals. These compounds originate from eroded agricultural soils acting as primary sediment source. European countries produce about 200 million m^3 y^{-1} of sediment removed from waterbodies which provides the potential of recycling nutrients from sediments in crop production. There are just a handful studies available exploring the potential of recycling the nutrients from sediments and none have been conducted under field conditions. Therefore, there is a need to develop efficient ways to reuse sediments on agricultural lands to preserve phosphorus and other nutrients and respond to crop demands.

The aim of this research was to investigate the effects of different ways of sediments applications to soil on grass growth, soil, and environment. The study was conducted in the shore of a 1-ha heavily eutrophicated lake from which sediments were excavated. Four different sediment application methods were tested in a RCBD design with four replicates. The treatments were pure topsoil, a mixture of soil and biochar on top of the sediment, a mixture of biochar with top 20 cm of sediment, and a 75–100 cm layer of sediment directly on topsoil. In June 2017, mixture of red fescue, Kentucky bluegrass, ryegrass, and white clover was sown to all plots with meat bone meal organic fertilizer. The leaf area index, the relative leaf chlorophyll values, aboveground biomass, soil moisture content, total carbon and nitrogen, GHG emissions, and the soil penetration were measured in all plots in August 2017.

The analysis of representative samples of sediments revealed that the sediments were not contaminated by heavy metals, PAHs, and PCBs. The moisture content was significantly higher in sediment plots (33±5%) than soil (19±1%). Relative leaf chlorophyll value and leaf area index were significantly 1.3 and 1.7 times greater in sediment plots than in the soil plots, respectively. Moreover, the treatments containing biochar had the highest C:N ratio. Sediment phosphorus (P) content was high, providing sufficient available P to agricultural lands. The final presentation will include data on yields of 2018, GHG emissions, and the mechanical soil resistance in different treatments.

Our results emphasizes the importance of preventing the transport of nutrients to water bodies and considering the assessment of sediment nutrient contents and pollutants in the disposal of removed sediments.

Keywords: Biochar, Eutrophication, Phosphorus, Recycling nutrients, Sediment removal