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How Available is Phosphorus from Sewage Sludge Incinerator Ash?

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The Twin Cities (Minneapolis and Saint Paul) of Minnesota (MN) in the United States incinerate sewage sludge for energy. Every day at the Metropolitan Wastewater Treatment Plant, 650 million liters of wastewater are converted to an average of 5 MW of power and 32 MT of ash (SSA). This ash is currently landfilled at a cost to taxpayers but contains 13% phosphorus (P), a limited natural resource required for all living things. While some have reported that the P in this ash is unavailable for plant uptake, a previous greenhouse study of Twin Cities ash demonstrated that this SSA, as is, could be a safe and available source of P for corn and lettuce. To follow up, we conducted three years of corn and soybean field studies from 2016-2019 in Rosemount, MN comparing various rates (0 to 180 kg P₂O₅/ha) of untreated SSA to equivalent rates (based on citrate soluble P) of triple superphosphate, a conventional P-only fertilizer, and two other residual products - Class A EQ (exceptional quality) biosolids and commercially available struvite. Our objectives were to describe and compare responses from SSA and other P sources to assess the feasibility of SSA as an alternative agricultural fertilizer. Response variables included harvest yield and plant and soil concentrations of P and other metals of concern.

Our results indicated that SSA as a soil amendment provided comparable amounts of P as the other P sources. Final 2019 harvest yields in plots amended with SSA or any P source were significantly higher than control plots that had no P applied. In 2017 and 2018, P uptake increased with increasing application rate, regardless of P source. Similar trends were found within Bray-P and Olsen-P soil tests, which assess available soil P, and within buried ion exchange resin soil probes. Except for copper (Cu) and zinc (Zn), no metal of concern was found to have increased significantly in either plant material or the soil. Soil concentrations of Cu and Zn, but not plant concentrations, increased significantly with increasing rate in plots amended with biosolids and SSA but below levels dangerous to the environment or human health. Taken together, we believe untreated SSA has the potential to be a safe and viable source of P and an additional option for returning a valuable natural resource to our food system.