How Available is Phosphorus from Sewage Sludge Incinerator Ash?

Persephone Ma[+], Carl Rosen, Daniel Kaiser
Department of Soil, Water, and Climate,
University of Minnesota, Saint Paul, MN, USA
[+]phma@umn.edu

Introduction

We are assessing whether untreated sewage sludge incinerator ash (Ash) can be a safe and effective agricultural fertilizer.

The Metropolitan Wastewater Treatment Plant (MWTP) in Saint Paul, Minnesota, USA serves 1.8 million people by incinerating 272 dry Mg of sewage sludge, generating an average of 5 MW of power and **34.5 Mg of ash (11% P_{tot}, 5.7% P_{cit}) a day.**

Trace metals are present in the ash, but loading rates are below regulatory limits when applied to meet agricultural P requirements.

Our objective was to determine the effects of Ash compared to other P sources by observing crop biomass and yield results and metals and other elemental concentrations in soil and plant tissue.

Methods

Design & Methods:

- 3-year (2017-2019) field study of corn and soybean

	2017	2018	2019
Field 1	Corn	Soy	Corn
Field 2	Corn	Corn	Soy

- Waukegan silt loam on 1.4 ha site in Rosemount, MN, USA
- Low-medium initial available-P (7-12 Bray-P), 6.6 pH, 3.4% OM
- Randomized complete block, replicated 4 times per field
- P sources only applied to plots planted with corn
- Agronomic N and K needs met evenly in all plots

Treatments (4x5 factorial):

4 P Sources:

1. **TSP** - Triple superphosphate (0-44-0 N-P_2O_5-K_2O)
2. **Ash** - MWTP sewage sludge incineration ash (0-13-2)
3. **BS** - Exceptional-Quality biosolids (0.5-7.6-0)
4. **Str** - Commercial struvite (0-27-0)

5 P Rates: 0, 45, 90, 135, 180 kg citrate-soluble P_2O_5/ha

End of Season Results

Figure 1. Yield, 2019

Rate p<0.001, Rate^2 p<0.05, Source and Rate x Source NS

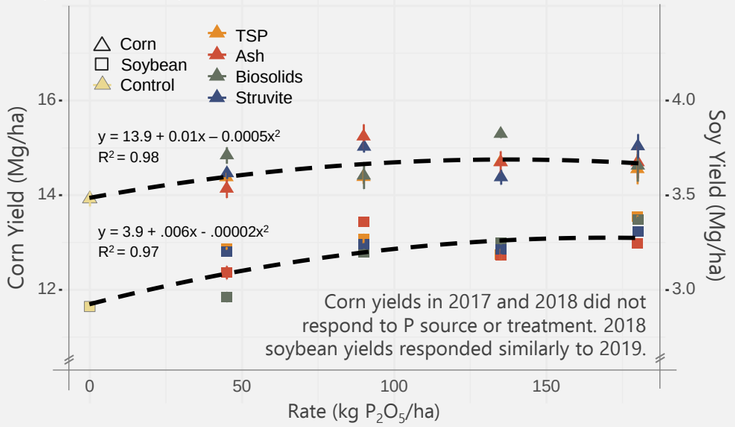


Figure 2. P Uptake, 2018 (see Fig. 1 for legend)

Rate p<0.001, Rate2 p<0.01 (corn only), Source and Rate x Source NS

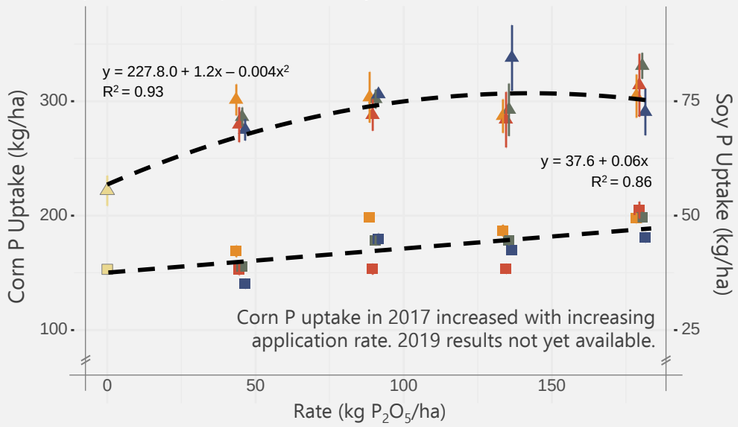


Figure 3. Soil Bray-P, 2019

Rate p<0.001, Source and Rate x Source NS

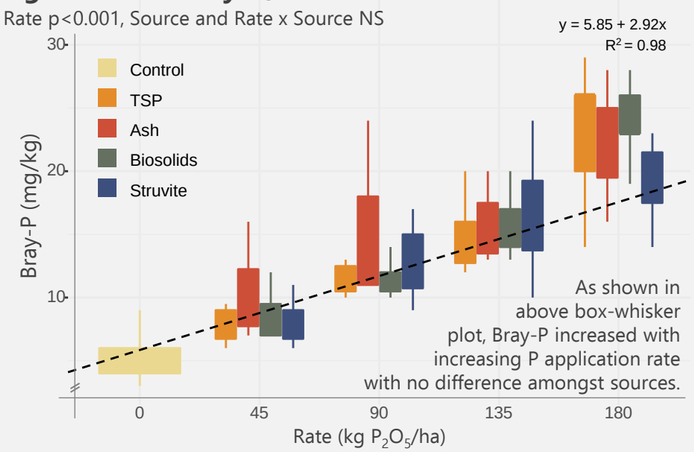
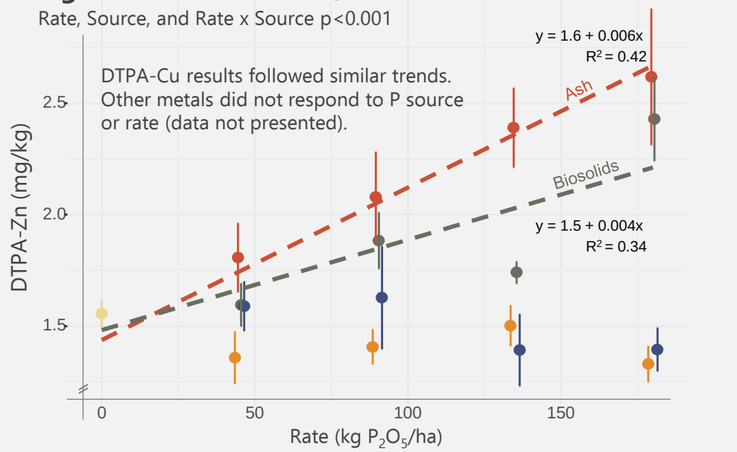


Figure 4. Soil DTPA-Zn, 2019

Rate, Source, and Rate x Source p<0.001



Conclusions & Future Work

1) Evidence suggests that ash can be a viable P fertilizer and an additional source of micronutrients like zinc and copper.
2) Future work includes continued analysis of 2019 field season results, additional P characterization and availability analysis, and metagenomics analysis of microbial diversity and abundance.

EGU | Sharing Geosciences Online | April-May 2020