**Poultry Litter Ash as a Phosphorus Source for Corn**

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**ABSTRACT**

As the expanding world population places pressure on the poultry industry to meet consumption demands, heightened poultry litter (PL) production increases volumes of land application. Repeated PL applications within localized distances of poultry operations creates nutrient concentrated areas posing a threat to ecosystems. Poultry litter ash (PLA), a co-product from manure-to-energy systems, is a promising solution addressing: transportation logistics, repurposing PL nutrients, and offers dual purpose as a fertilizer and an energy source. The overarching project goal is to prove or disprove PLA as a comparable fertilizer. Thermo-conversion systems alter PLA nutrient solubility; therefore, the first objective is to determine solubility fractions of four PLA (Fluidized Bed Bulk, Combustion Mix, Fluidized Bed Fly, and Ash Coated Urea) and P fertilizers (poultry litter and triple super phosphate). Phosphorus sources were extracted sequentially using deionized water, NaHCO$_3$, NaOH, HCl, and finally acid digested with HNO$_3$ followed by analysis via ICP-AES. Water extraction represented soluble P (Ps%) whereas NaHCO$_3$ signified labile inorganic P (Pi). Phosphorus extracted by NaOH and HCl is categorized as non-labile inorganic or bound P (Pb%). The second objective is to compare nutrient availability of phosphorus (P) of PLA with industry standard P fertilizers and subsequent effect on corn yield. Experimental design included 13 fertilizer treatments arranged as a two-factor randomized complete block design with source and rates as factors. Overall, nutrient solubility and plant availability is paramount for evaluating PLA derived co-products as grain fertilizers.

**MATERIALS AND METHODS**

**Sequential Solubility Extractions**

- Poultry litter ashes and P fertilizer sources were sequentially extracted (Dou et al., 2000; Codling, 2006).
- Sequential extractants included:
  - 30 mL Deionized H$_2$O
  - 30 mL 0.5M NaHCO$_3$
  - 30 mL 0.1 M NaOH
  - 30 mL 1 M HCl
- Followed by Acid Digestion using EPA 3050B
- Extractions analyzed via ICP-AES for P concentrations.
- Mean separation completed using Fisher’s Protected LSD at 10% significance level.

**Results and Discussion**

- **Sequential Solubility**
  - Largest inorganic phosphorus fraction in PLA was found in the bound (Pb) portions.
  - Amount of inorganic P from PLA (greatest to least): HCl (Bound) > NaOH (Bound) > H$_2$O (Soluble) > NaHCO$_3$ (Labile).
  - Overall FB Bulk (0.95%), FB Fly (1.54%), and C. Mix (0.49%) water solubility was significantly less than TSP (74.51%) and PL (33.38%). (LSD$_{0.05}$=6.23%)
  - Ash coated urea, coated with FB Fly ash, had a significantly higher water soluble P percentage of 9.10% than other ash products due to smaller ash particle size needed for coating process. (LSD$_{0.05}$=6.23%)

**Field Study**

- Study was initiated in April 2017 in Essex County, Virginia.
- Poultry litter ash results in phosphorus (P) concentrations were similar following rates of 0.02% (Bound) and decreased PLA solubility is identified as a potential constraint to phosphorus availability.

**OBJECTIVES**

- To prove or disprove PLA as a comparable P fertilizer.
- Determine P solubility fractions from PLA and co-products compared to industry standard triple super phosphate and PL.
- Compare effects of PLA and P industry standard fertilizers on corn productivity.

**ASH PRODUCTS**

- Ash Coated Urea
- FB Bulk
- FB Fly
- C. Mix

**REFERENCES**


**CONCLUSIONS**

- Overall, poultry litter ash solubility (Ps%) is significantly less than industry standard P sources and presents an obstacle for utilizing PLA as comparable P fertilizer source.
- FB Bulk ash and PL resulted in statistically similar corn ear leaf concentrations and corn yield as PL.

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