PANEL: Making a resource into the right source

Moderator:
Tom Bruulsema, International Plant Nutrition Institute

Panelists:
Karl Wyant, Helena Chemical Company
Galen Mooso, J.R. Simplot Company
Chris Peot, DC Water
Making a resource into the right source

Tom Bruulsema, IPNI
• 4R phosphorus & legacy phosphorus

Karl Wyant, Helena Chemical Company
• Agri-retail delivery of mineral and organic sources
• What drives grower choices?

Galen Mooso, J.R. Simplot Company
• Manufacturing, wholesale and distribution

Chris Peot, DC Water
• Wastewater treatment, sustainable end use, P availability in biosolids
4R Phosphorus for Sustainable Crop Nutrition

**Actions (adoption metrics)**

**Key Outcomes (impact metrics)**

1. Farmland productivity
2. Soil health
3. Nutrient use efficiency
4. Water quality
Legacy Phosphorus
Distribution of soil test P levels, %

- Soil test P reflects the legacy of past P management.
- Soil test P determines the right rate and source.

http://soiltest.ipni.net
Phosphate Use in Agriculture

• **Liquid** – ortho vs. polyphosphate

• **Dry** – DAP, MAP, SSP, TSP

• Conventional vs. Organic

• Custom Blends

• Flexibility is key!
Grower and Market Logistics Drives Fertilizer Choice

• **Crop type** – annual vs. permanent vs. semi-permanent
• **Planning** – soil testing and crop removal rates
• **Application equipment** – *broadcast*, *band*, *injection*
• **Liquid Application** – Fertigate or dryland application
• **Local practices and retailer inventory**
Variable Rate Fertilizer

• VR technology and digitization of the farm
• Connect field variability → prescription → application technology

• Case study – Cotton – AZ/CA

• 4Rs (right source, rate, time, place)
Information Management

Data Layers

- Soil Data
- Yield Data
- Fertility Recommendation
- Consistent Field Boundaries
- Soil Test Points
- Satellite and Aerial Imagery
Variable Rate Rx Results

• 12.5% US$ savings over conventional P application
• 150 gallons of fertilizer saved
• ~460 lbs. P2O5 saved
Challenges for Recycled Products

• Recycled P is already used in agriculture – manures and composts
• Analysis is not consistent
• Manures and composts carry *E. coli* and salinity risks
• Struvite needs to match $/lbs. P found in marketplace
• Struvite needs to fit existing delivery and application equipment
Galen Mooso Ph.D., CPAg, CCA

Agronomy Manager
JR Simplot Company
Boise, Idaho
Simplot Phosphate Mining and Manufacturing

Bringing Earth’s Resources to Life
Process Overview

Phosphate Rock (Ore) Mined & Milled

Wet Process Reacted (Liquified)

Dihydrate

Hemihydrate

Thermal Process Reduced (Vaporized)

Elemental Phosphorus (P4)

PPA

Round Up

Potassium Hydroxide (KOH)

Food

Industrial

Ag

PPA

Solvent Membrane

Potassium Phosphates (PPA)

Evaporation

SPA MGA

Granulation

MAP DAP TSP
dical (Replacing) SSP

NPK

Foliars Starters Others

NH3 Supply Urea
Biosolids and Nutrient Recovery: Finding the Right Balance

Sustainable Phosphorus Alliance, May 19th, 2017
Agriculture
WWTP and P

- WWTP’s keep P out of sensitive waters
- 9.1M tons of biosolids generated annually in the US
- P levels in biosolids (1 – 6%)
- 350,000 tons of P, half of which is landfilled
- Biosolids benefits
  - Slow release nutrients
  - Carbon footprint reduction
  - Crop drought resistance
WWTPs prime directive – keep nutrients out of sensitive receiving waters

- P removed with chemical, biological, and physical processes
- Issues related to each
  - Chemical - P gets bound in biosolids creating a nutrient imbalance
  - Biological - P can get re-released in digestion process
  - Struvite removal – difficult to meet stringent effluent standards economically
DC Water Blue Plains example

- The DC Water Blue Plains WWTP (290 MGD) uses iron salts (ferric chloride) for P removal. P is bound in the biosolids.
- P reduced from 9 million pounds in 1985 to 3 million pounds in 2009, a 67% reduction.
- Chesapeake Bay’s overall phosphorus pollution that is attributed to wastewater dropped from 35 percent in 1985 to 17 percent in 2009.
- DC Water Blue Plains WWTP: P discharge limit of 0.18 mg/l.
- Blue Plains Biosolids: P = 6.4% dry weight basis.
- Iron content 7.5%, WEP 4% of total P.
State Regulations

• Many states treat all P equally, assuming all is available and extractable

• PA and MD allow use of WEP to determine a site specific P index

• WI – recognizes P in biosolids is often bound by metal salts addition

  • In addition, the department is following new research assessing the relative environmentally available phosphorus between biosolids, manure, and commercial fertilizer. Early indications show that the water extractable phosphorus in most biosolids is much less than that found in manure or commercial fertilizer. Further the iron, aluminum, and oxides that are commonly found in biosolids serve to form strong and long-lasting bonds with the phosphorus. To aid in this research and to gather more relevant information, all municipal biosolids and industrial sludge producers are requested to begin testing for water extractable phosphorus (WEP) in addition to the total phosphorus testing already required in permits. The recommended test method as developed by researchers at Penn State University is attached.
Comparison of WEP for TSP, Manures, and Typical Biosolids

Error bars indicate one standard deviation.

Mean values followed by same letter are not statistically different at the 95% confidence level.
Water Extractable P versus total Al+Fe

\[ y = 1.808x^{-0.9657} \]
\[ R^2 = 0.5716 \]
Summary

• Considerable quantities of P in US generated biosolids
• Half ends up in landfills
• Much of the other half is bound in the land applied biosolids
• Discharge permit limits and economics drive decisions at WWTPs
• Current low P permit limits favor economical solutions to keeping P out of sensitive waterways
• Need an innovative and economical solution to P recovery at plants with low discharge limits