Soil Fertility Update

Ag Agent Update

April 7, 2010

by Clain Jones, Extension Soil Fertility Specialist and Kathrin Olson-Rutz, Research Associate
clainj@montana.edu; 994-6076
Recent and Current Projects

- Updated Nutrient Management Modules 7-12 (2009)
- Gardening Articles in Big Sky Small Acres and Zone 4 (Spring and Summer 2010)
- Soil Fertility Management on Organic Farms Extension Bulletin (~June 2010)
- Collaborating with NRCS on identifying practices that reduce nitrate leaching (for incentive payments)
- Overwinter nitrate-N differences (3rd year)
- Legume green manures in conventional systems (w/ Perry Miller)
- Urea volatilization (w/ Rick Engel)
Objectives

• Explain types of EEFs
• Describe how they work
• Show their benefits and limitations
Enhanced Efficiency Fertilizers (EEFs)

• Any fertilizer designed to:
  – Increase fertilizer availability
  – Decrease fertilizer losses

• 3 major methods of action
  – Stabilized - alter soil microbial or enzymatic reactions
  – Slow release - have additives which require chemical or biological decomposition to release nutrients
  – Controlled release - a semipermeable coating, usually a polymer, regulates release
Partial list of available stabilized EEFs

- Stabilized
  - Nutrisphere-N® (NSN)
  - Agrotain®
  - Avail®
  - NSource®
  - NServe®
  - Instinct®
  - SuperU®
  - Nitamin Nfusion®
Partial list of available controlled and slow release EEFs

- **Controlled Release**
  - ESN®
  - Polyon®
  - PolyS®
  - Duration®

- **Slow Release**
  - NSure®
  - Nitroform®
  - Nutralene®
Under what growing conditions should EEFs work better?

- High potential volatilization loss
  - coarse soils
  - moist surface
  - warm temps
  - long time between application and incorporation

- High potential leaching
  - coarse soils
  - high moisture content/irrigation/rainfall
NBPT (Agrotain) uses

- Can minimize urea volatilization for up to 14 days
- ‘Buys’ time for rainfall, irrigation or mechanical incorporation to protect urea
- Warm weather top-dressing
- Cool weather broadcast

Next 4 slides are from two sampling campaigns of Rick Engel’s and my project on urea volatilization in the Golden Triangle
Campaign #2 – low NH$_3$ losses observed

- October 9, 2008 application, air-temp. 45 °F, dry soil surface
- no rain for 24 days and then Nov. 2-5 field site received 0.98”ppt.

1 wk post-fertilization prills not dissolved
Campaign #2 - Kaercher farm

- Mean Air Temp ~ 42 F
- Mean Soil Temp ~ 41 F

Graph: Percentage of applied N lost over weeks post-fertilization.
- Urea (3.1%)
- Urea + NBPT (1.4%)
Fertilizer applied on Mar 26, 2009
light snow on soil surface and air temp = 21 F

soil surface with fertilizer prills beginning to dissolve
Campaign #5 - Kaercher farm

Percentage of applied N lost

- urea (39.9%)
- urea + NBPT (18.1%)

Weeks post-fertilization

Conclusion: High losses observed even though temperatures were cold!

Precipitation
- no rain 0-2 wks
- 1.54” 2-8 wks

Mean temperature
- Soil = 38 °F
- Air = 39 °F
## Summary (% N loss)

<table>
<thead>
<tr>
<th>Campaign</th>
<th>Cooperator</th>
<th>Fertilization date</th>
<th>Urea</th>
<th>NBPT - urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kaercher</td>
<td>Apr 3, 2008</td>
<td>8.4</td>
<td>4.4</td>
</tr>
<tr>
<td>2</td>
<td>Kaercher</td>
<td>Oct 8, 2008</td>
<td>3.1</td>
<td>1.4</td>
</tr>
<tr>
<td>3</td>
<td>Peterson</td>
<td>Nov 14, 2008</td>
<td>31.5</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>Peterson</td>
<td>Mar 25, 2009</td>
<td>35.6</td>
<td>18.0</td>
</tr>
<tr>
<td>5</td>
<td>Kaercher</td>
<td>Mar 26, 2009</td>
<td>39.9</td>
<td>18.1</td>
</tr>
<tr>
<td>6</td>
<td>McCormick</td>
<td>Oct 6, 2009</td>
<td>10.7</td>
<td>3.3</td>
</tr>
<tr>
<td>7</td>
<td>Kaercher</td>
<td>Oct 13, 2009</td>
<td>10.4</td>
<td>4.8</td>
</tr>
<tr>
<td>8</td>
<td>Peterson</td>
<td>Oct 19, 2009</td>
<td>15.7</td>
<td>3.4</td>
</tr>
</tbody>
</table>

*Average:* 19.4, *NBPT - urea:* 7.2
Take home messages on volatilization

• Urea volatilized even from cool soils (surface temperature is important factor, not air temp)
• Applying urea to wet soils w/ no chance of precipitation resulted in highest loss rates
• Difference between Agrotain and urea treatment was about a 12% loss – Agrotain ‘premium’ is about 15%, but highly dependent on urea cost
• Several studies by G. Jackson in the 1990s showed little difference in yields between ammonium nitrate (low volatilization) and urea.
• I’ll need to revise EB0173 (Management of Urea Fertilizer to Minimize Volatilization).
Questions on Urea Volatilization?
Nutrient availability from ideal slow release fertilizer

![Graph showing nutrient availability and plant uptake over days after emergence. The graph compares theoretical nutrient release to actual plant uptake for optimal yield.](image-url)
Timing of nutrient uptake by crops

- Corn
- Sugar Beet
- Wheat
Timing of ESN® nutrient release

- **Corn**
- **Sugar Beet**
- **Wheat**

Approx % N released by typical ESN seed placed in mid May

Options for wheat?
Effects of over-winter moisture conditions on effectiveness of PCU (i.e. ESN)

Yield Change with Spring-banded PCU over Conventional Urea (%)

-4 -2 0 2 4 6 8 10 12 14 16

Barley
Canola
Wheat

Grant & Dowbenko 2008 spring banded PCU Saskatchewan

Low Moisture
High Moisture

WHY?
Seed placing EEFs

• Can apply ~ 2 – 4x as much slow release product as urea directly with small grain seeds
• Saves on field passes – fuel, labor, soil disturbance
Effect of N source applied with the seed on dryland spring wheat yield

![Graph showing the effect of different N sources on dryland spring wheat yield.

- Urea
- Urease inhibitor
- Polymer-coated

Data from Saskatchewan Malhi et al. 2003]
Phosphorus EEF

• Types
  Polymer coated
  Avail® which reduces the rate of P mineral formation

• Limited regional research
  Research in MT, ND, and SK has shown no benefit of Avail
  Some barley yield increases observed in AB
Potential limitations of Avail®

- Mechanism may have difficulty in highly calcareous soils
- Existing soil properties may outweigh product ability

Ex: 100 lb MAP with Avail® contains < 0.25 lb of organic acids – the active ingredient

Organic acids occur naturally in soil, and are elevated in the root zone
Products other than ESN, Agrotain, and Avail

- Little to no regional research
- Express caution with growers until research data set grows
Conclusions

• Enhanced efficiency fertilizers (EEFs) will not always increase yields and nutrient recovery.
• Improved EEFs and blending with conventional fertilizer may provide a good match between crop uptake and fertilizer availability.
• More EEF can be placed with the seed than conventional fertilizer
• EEFs can reduce losses to the environment, especially in wet soils.
Additional info in:

*Enhanced Efficiency Fertilizers* (EB0188)

http://landresources.montana.edu/soilfertility

Go to Fertilizer Information
Questions?

Threshing in the 1920s