Nitrogen Stabilizers

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N Cycle

• Losses
  – Volatilization
  – Leaching
  – Denitrification
  – Runoff
Sources

• Urea
  – Volatilization, Leaching, Denitrification, Runoff

• Urea-ammonium nitrate
  (50% urea, 25% ammonium, 25% nitrate)
  – Volatilization, Leaching, Denitrification
Stabilizers

• Goals
  – Reduce volatilization
  – Reduce leaching
  – Reduce runoff
  – Reduce denitrification

• What are the mechanisms that these reductions are accomplished?
Urease Inhibitors

• N-(n-butyl) thiophosphoric triamide (NBPT)
  – Works by inhibiting or stopping the breakdown of urea, the chemical provides the ability to block the active site of the urease enzyme. This prevents the hydrolysis of urea.
  – \((\text{NH}_2)_2\text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 2(\text{NH}_3)\)
Urease Inhibitors

- **N-(n-butyl) thiophosphoric triamide (NBPT)**
  - Works by inhibiting or stopping the breakdown of urea, the chemical provides the ability to block the active site of the **urease** enzyme. This prevents the hydrolysis of urea.

  \[
  (\text{NH}_2)_2\text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 2(\text{NH}_3)
  \]
Urease Inhibitors

• NBPTs
  – Agrotain Ultra
  – Arborite
  – N-FIXX

• 40% maleic-itaconic co-polymer
  – Nutrisphere
  – UPGRADE

• Ca-Aminoethylpiperazine & Ca-Heteropolysaccharides
  – NSTAY
  – NZONE
Nitrification Inhibitors

- 2-chloro-6-(trichloromethyl)-pyridine
  - Nitrapyrin
- Dicyandiamide
  - DCD

Nitrification inhibitors help eliminate/reduce the nitrosomonas bacteria from turning ammonium-N into nitrate-N
Nitrification Inhibitors

DCD
- Agrotain Plus (+NBPT)
- Super U (+NBPT)
- Slow N
- Guardian

Nitrapyrin
- Instinct
Slow Release

• Exhibit a controlled release / slow release

Blaylock, 2010
Slow Release

- Sulfur-coated urea
- Polymer-coated urea
  - CoteN®
  - ESN®
Other Inhibitors

• Urea-Formaldehyde/Methylene Urea
  – CoRoN®
Current Trials

• 2 Sites
  – Macon Ridge Research Station
  – Northeast Research Station

• 1 year
  – 2013
Current Trials

6 N sources
- Urea
- SuperU
- Instinct
- Agrotain Ultra
- Agrotain 20
- Nutrisphere

3 N rates
- NERS
  - 240
  - 270
  - 300
- MRRS
  - 210
  - 240
  - 270
Northeast Research Station

Corn grain yields (bu/ac)

- None
- NBPT
- NBPT
- NBPT+DCD
- Maliec
- Nitrapyrin

Enhanced Efficiency N Products

- Urea
- Agrotain Ultra
- Agrotain 20%
- Super U
- Nutrisphere
- Instinct

Yield Comparison:
- 240
- 270
- 300
Macon Ridge Research Station

Enhanced Efficiency N Product

Corn grain yield (bu/ac)

None          NBPT        NBPT          NBPT+DCD    Maliec        Nitrapyrin

Urea          Agrotain Ultra  Agrotain 20%  Super U       Nutrisphere   Instinct

Enhanced Efficiency N Product

210           240          270
Enhanced Efficiency Nitrogen Products

Urea
Agrotain Ultra
Agrotain 20%
Super U
Nutrisphere
Instinct

None
NBPT
NBPT+DCD
Maliec
Nitrapyrin

Corn NUE (%)
MRRS - NUE

Enhanced Efficiency Nitrogen Products

- Urea
- Agrotain Ultra
- Agrotain 20%
- Super U
- Nutrisphere
- Instinct
- None
- NBPT
- NBPT + DCD
- Maliec
- Nitrapyrin

Corn NUE (%)
Results

• N rate was the most influential factor at St. Joseph
  – Residue
• Inhibitors were important at the Macon Ridge location
  – SuperU provided the ability to drop to 210 lbs N/acre and out yield 270 lbs N/acre as Urea.
Results

• The mode of action was important depending on the location
  – MRRS yielded better when a type of urease inhibitor was used
  – NERS
    • SuperU and Instinct
      – Showed some importance of a nitrification inhibitor
Results

• Nitrification Inhibitors
  – High moisture
    • Rain or irrigation
• Urease Inhibitors
  – Exposure to the surface/air
    • Urea on surface or dry soil
• Polymer Coated Urea
  – Physically controlled release
    • Dependent on temperature and moisture
  • Not beneficial as the only N source - Deficiencies