Fertilizer Outlook and Technology Conference-- Nov. 2005

Enhanced Efficiency Fertilizers

Technology and Commercial Product Overview

Tampa, FL

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Presentation Outline

- What are EEFs (Enhanced Efficiency Fertilizers)?-Bill Hall
- Why the Interest in EEFs ?-Bill Hall
- Benefits of EEFs- Bill Hall
- Some Statistics to Ponder-Bill Hall
- Terms and Definitions-Harvey Goertz
- Commercial Overview-Harvey Goertz
- Conclusions- Harvey Goertz

What Is An Enhanced Efficiency Fertilizer?

- **AAPFCO Policy Statement (official 1999)**
- **AAPFCO Term To Be Considered This February and Acted Upon in August 2006**
- **T-69 Enhanced Efficiency** is a term describing fertilizer product**s** with characteristics that minimize the potential of nutrient losses to the environment, as compared to a "reference soluble" product ***such as Urea/Ammonium Nitrate,***

Enhanced Efficiency Fertilizers

Why the Interest?

- **Economic Drivers Changing**
  - Cost Ratios Changing (raw materials higher versus overall cost of product)
- **National (US) Policy & Farm Bill Support**
  - BMPs Now Include EE Materials (e.g. NRCS 590 Std & EQUIP programs)
- **Environmental Perception & Reality**
  - Viewed As Possible Solution To Hypoxia & Reduced Loss To Environment
- **Regulatory - TMDL Implementation & Local Ordinances**
  - Required Actions e.g. implementing a BMP/mandatory use of EE Products
- **Technological Advancements**

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What Are The Benefits?

Two Benefit Categories

- Obvious (or traditional) Benefits
- Hidden (or secondary) Benefits

Can Be Further Sorted Into Additional Categories

- Environmental Benefits
- Production Benefits

Enhanced Efficiency Fertilizers

Obvious/Traditional Benefits Currently Touted

- Environmental
  - Less N to ground and surface water
  - Perceived as easy way to achieve nutrient reduction goals
- Production/Efficiency
  - More N utilized by the plant
  - Reduced potential for plant injury/crop damage
  - Save time/effort/money by reducing applications
  - Improved yields and/or fewer acres needed to farm

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Hidden/Secondary Benefits Yet To Be Realized

- Environmental
  - Reduce N into the air – reductions in NH3 & NOx
  - Reduce other emissions – fewer acres/fewer passes = less fuel
  - Less stress/more consistent growth/less disease = less pesticides
  - Reduce soil contamination such as metals, drug residues and imbalanced nutrient ratios versus manure/biosolids
  - Higher nutrient concentrations & application rates can reduce trips over field (compaction) and fuel consumption versus

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Hidden/Secondary Benefits Yet To Be Realized

- Production/Efficiency
  - Make it possible to match nutrient release with plant uptake
  - Make it possible to manage release based on changing environmental conditions (water, soil temperature…)
  - Make it possible to precisely blend nutrient release & ratio to local crops, soils, & growing conditions
  - Make it possible to utilize all nutrients optimally to obtain maximum efficiency
  - Make it possible to reduce stress & achieve more consistent

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Some Statistics To Ponder -

Estimated N (total nutrient metric tons)

- Total N World ~ 85 million tons
- Total N US ~ 12 million tons
- SR N (@ 25% N) World ~ 184 thousand tons or 0.25%
- SR N (@ 25% N) US ~ 129 thousand tons or 1.1%
- **There is plenty of room to grow!**

Enhanced Efficiency Fertilizers

Terms and Definitions

- Currently no global agreement on definitions characterizing EEF's
  - **But AAPFCO Term Will Likely Become Final In 2006**
- **Definitions to be used in this session**
  - **Enhanced Efficiency – Already Mentioned**
  - **Slow Release**
  - **Controlled Release**
  - **Inhibitors/Stabilizers**

Enhanced Efficiency Fertilizers

Terms and Definitions

Slow Release

- Functionality
  - Limit the availability of plant nutrients to the soil solution by reducing the solubility of the fertilizer
- Methods of Achieving
  - Reaction Products (eg: Methylene ureas, IBDU)
  - Absorbtion into a porous carrier (eg: Zeolites)
  - Occlusion (eg: matrix)
  - Particle Size and binders(eg: spike/briquettes)

Enhanced Efficiency Fertilizers

Terms and Definitions

Controlled Release (Coated Nutrients)

- Functionality
  - Limit the availability of plant nutrients to the soil solution by coating with water insoluble compound to meter nutrients at a controlled rate.
- Methods of Achieving
  - Impermeable Coatings with imperfections (eg: Sulfur Coated Urea)
  - Semi-Permeable Coatings (eg: Polymer Coated Urea)
  - Hybrid Coatings- Impermeable/Semi Permeable (eg: PSCU)

Enhanced Efficiency Fertilizers

Terms and Definitions

Inhibitors/Stabilizers

- Functionality
  - Affect the rate plant nitrogen uptake by affecting the rate of conversion to the ammoniacal and nitrate forms
- Methods of Achieving
  - Urease Inhibitors (eg: nBTPT)
  - Nitrification Inhibitors (eg: DCD)

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Urea-Formaldehyde Reaction Products **(Granular)**
  - MDU/DMTU/Methylene Ureas/Ureaform
- Manufacturers

North America	Europe/Middle East	Asia
Scotts Miracle Gro* Hercules Inc. Nu-Gro Corporation Lebanon Seaboard*	Aglukon GmbH* Agra Dunger GmbH Kemira GrowHow Sadepan SpA Scotts Miracle Gro*	Mitsui Toatsu Inc Sumitomo Chemical Co Ltd

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Urea-Formaldehyde Reaction Products (**Liquids/Suspensions**)
  - Methylol Ureas, Methylol urea ethers, MDU/DMTU
- Manufacturers

North America	Europe/Middle East	Asia
Borden Chemical Inc. Georgia Pacific Corp. Helena Chemical Moral Companies Growth Products		

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Urea-Formaldehyde-Ammonia Reaction Products
  - Triazone
- Manufacturers

North America	Europe/Middle East	Asia
Tessenderlo Kerley Inc.		

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Urea-Isobutyraldehyde Reaction Products
  - Isobutylidene diurea (IBDU)
- Manufacturers

North America	Europe/Middle East	Asia
Nu-Gro Corporation	BASF	Mitsubishi Chemical

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Urea-Acetaldehyde Reaction Products
  - Crotonylinine Diurea (CDU)
- Manufacturers

North America	Europe/Middle East	Asia
		Chisso Corporation

Enhanced Efficiency Fertilizers

Commercial Overview

Slow Release

- Other Urea Reaction Products
  - Oxamide
- Manufacturers

North America	Europe/Middle East	Asia
		Ube Industries, Ltd.

Enhanced Efficiency Fertilizers

Commercial Overview

Controlled Release (Coated)

- Impermeable Coatings with Imperfections
  - Sulfur Coated Urea (sulfur coated nutrients)
  - Metal Phosphate Coated Fertilizer
- Manufacturers

North America	Europe/Middle East	Asia
Nu-Gro Corporation		Mitsui Toatsu Nissan Chemical Ind. Zhengzhou Luxuriance Fertilizer

Enhanced Efficiency Fertilizers

Commercial Overview

Controlled Release (Coated)

- Semi-Permeable (polymer) coatings
  - Polymer Coated Urea (polymer coated nutrients)
- Manufacturers

North America	Europe/Middle East	Asia
Agrium Scotts Miracle Gro Pursell Technologies	Haifa Chemicals, Ltd Scotts Miracle Gro Aglukon GmbH BASF-AG	Asahi Chemical Ltd Chisso Corporation Central Glass Co, Ltd Co-op Chemical Co Katakura Chikkarin Mitsubishi Chemical Sumitomo Chemical

Enhanced Efficiency Fertilizers

Commercial Overview

Controlled Release (Coated)

- Hybrid Coatings- Impermeable/Semi Permeable
  - Polymer Sulfur Coated Urea (PSCU)
  - Polymer Sulfur Coated Fertilizer (PSCF)
- Manufacturers

North America	Europe/Middle East	Asia
Pursell Technologies Scotts Miracle Gro Turf Care Supply (Lesco)		

Enhanced Efficiency Fertilizers

Commercial Overview

Inhibitors/Stabilizers

- Urease Inhibitors
  - nBTPT
  - Thiosulfates

North America	Europe/Middle East	Asia
Agrotain Int'l Tessenderlo Kerley		

Enhanced Efficiency Fertilizers

Commercial Overview

Inhibitors/Stabilizers

- Nitrification Inhibitors
  - DCD
  - Nitrapyrin
  - DMPP
  - Ammonium Thiosulfate
- Manufacturers

North America	Europe/Middle East	Asia
Dow Chemical Agrotain Int'l Tessenderlo Kerley	BASF	Showa Deno

Enhanced Efficiency Fertilizers

Conclusions

- Benefits of EEF's are well documented
- Many Types and "Flavors" of EEF's
  - More on the way
- Used primarily in Specialty Markets
  - Return on Investment (Economics)
- Larger Issues Loom which may drive broader use of EEF's in the future