Managing Corn Fertilizer Nitrogen with Stabilizer Products

Nutrient Management Webinar

March 9, 2012

Bob Kratochvil - Extension Agronomist

rkratoch@umd.edu

UNIVERSITY OF MARYLAND EXTENSION

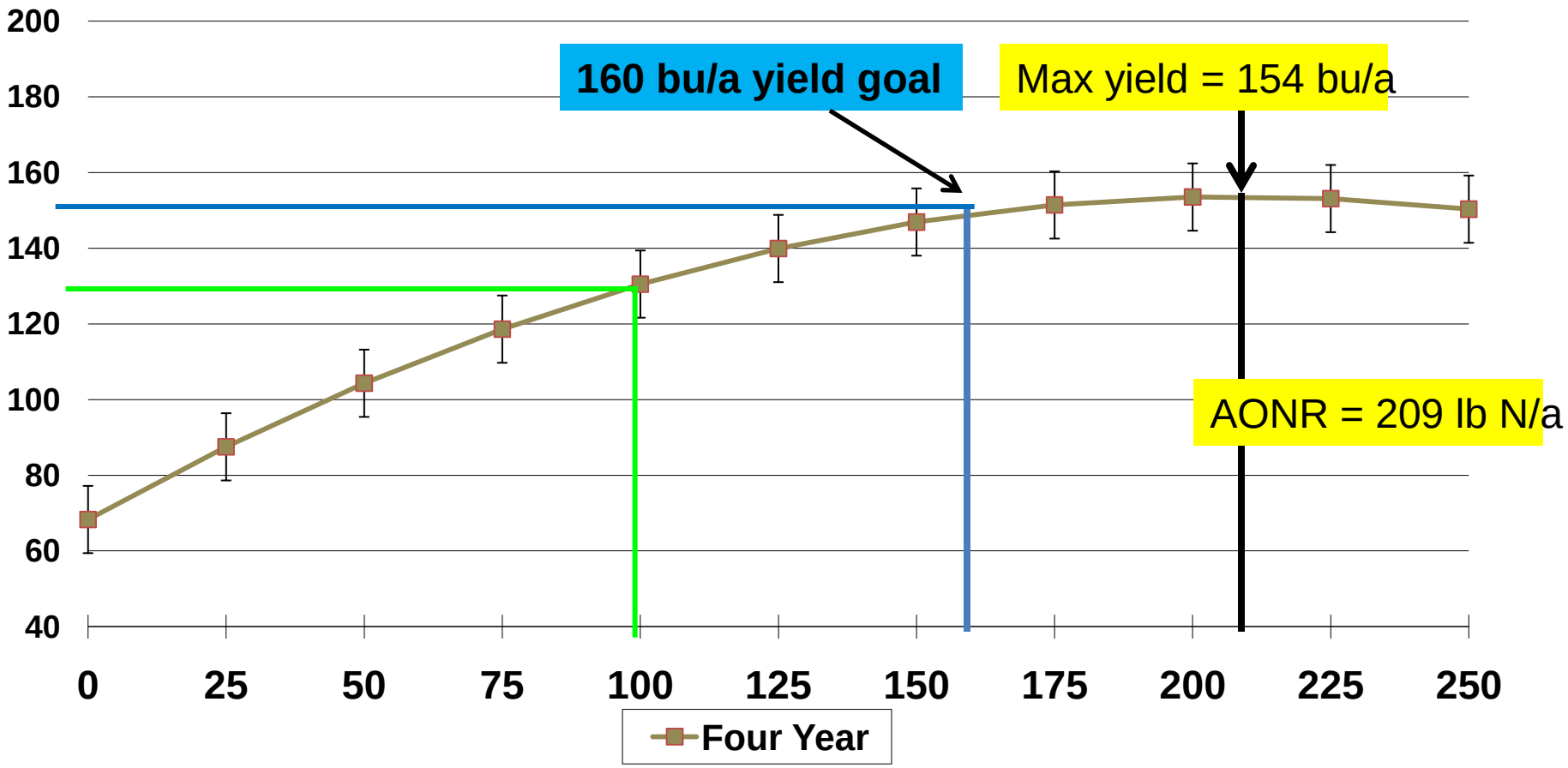
Solutions in your community

Why Should We Try To Improve Corn N Use?

- Corn is the major N consuming crop in region.
  - ~500,000 acres in MD annually
  - ~70-75 M lbs. N is applied to the crop.
- Corn is relatively inefficient at using N.
  - Corn N Use Efficiency is estimated at ~50% (Hoeft, 2004).
  - Considered a “leaky crop”.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

What is NUE?
Balance Between Crop N Uptake and N Loss

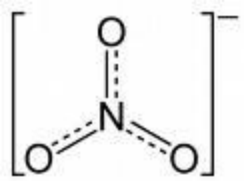


UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

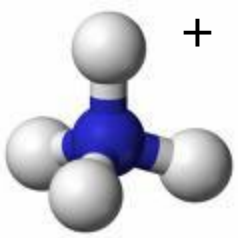
Why Should We Care?

- N loss is a contributor to non-point source pollution of the Bay and its tributaries.
- Chesapeake Bay Executive Order
  - TMDL's and WIP's
- **Protect a major investment in corn production costs.**
  - Potential loss is ~ 30 - 35 million lbs N.
  - $$$ lost = $17.5 to $32 M

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community



Nitrogen Fertilizer Fate



Nitrification bacteria

Note: **Nitrogen Losses Are Driven by Hydrology**

Denitrification losses:

Waterlogged soils

Volatilization losses: urease

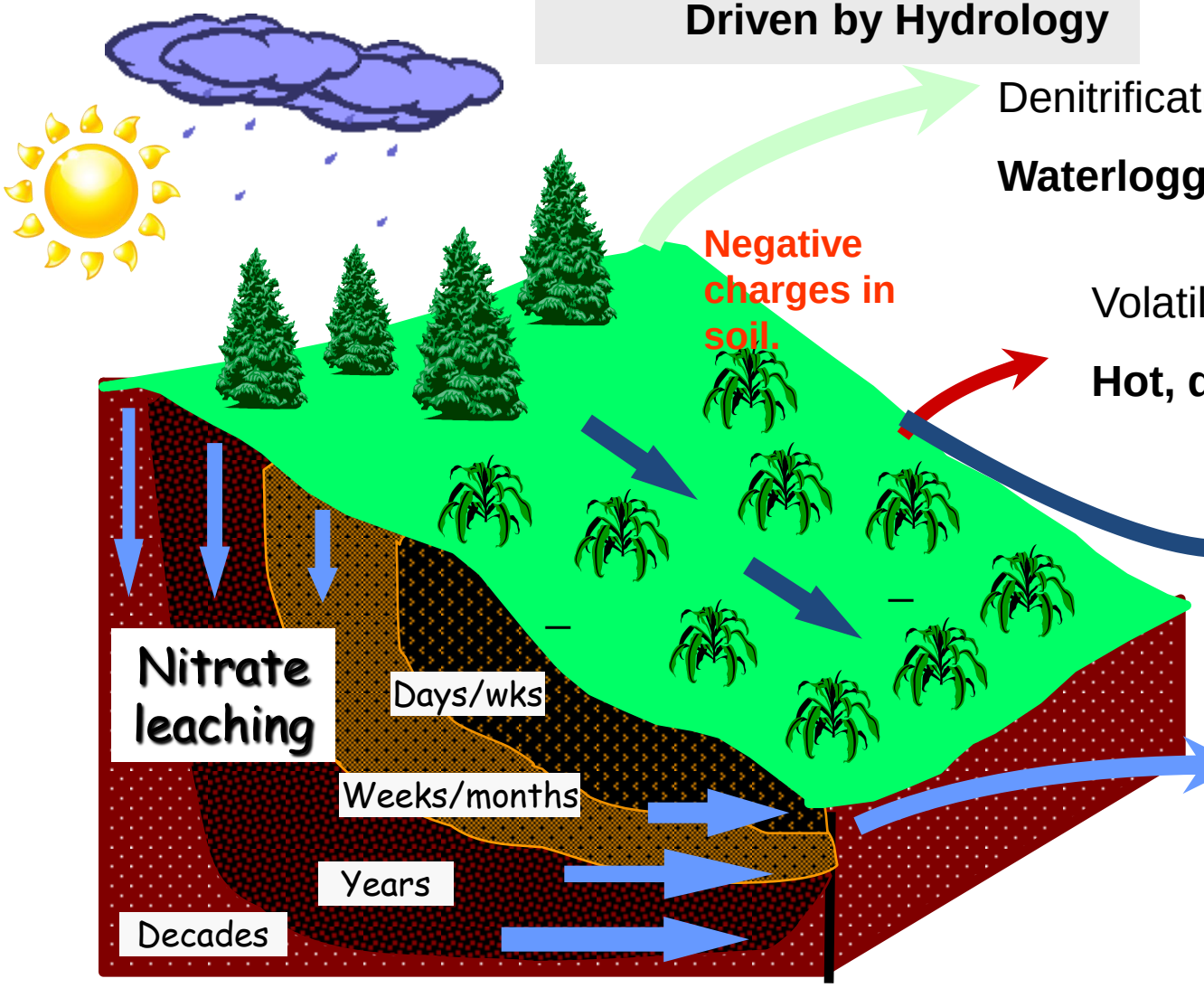
Hot, dry weather

Eroded N:

Slopes; heavy rain

Leaching losses:

Soil texture; rain amount



(J.J. Meisinger)

What Can Be Done to Minimize N Loss?

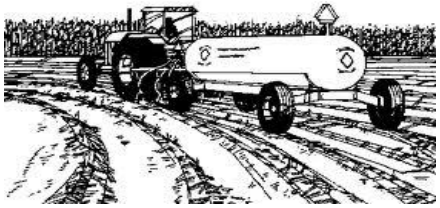
- Good management practices of nitrogen can improve its retention.
  1. Source of nitrogen.
  2. Application timing.
  3. Application method.
  4. Enhanced efficiency fertilizers and stabilizer products.

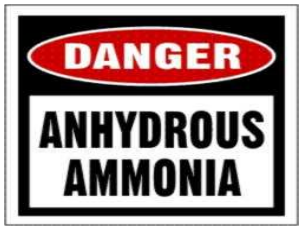
UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

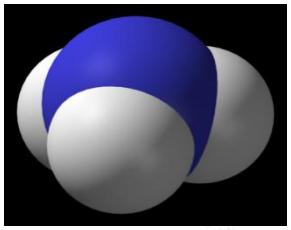
#1 - Nitrogen Fertilizer Sources
All Are Susceptible to Loss

- Anhydrous ammonia (NH_3) – 83% N

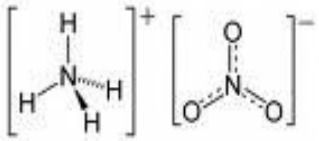
  -cheapest source; must be incorporated





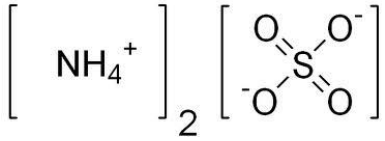


- Ammonium nitrate – 34% N



  – Little volatilization; susceptible to leaching

- Ammonium sulfate

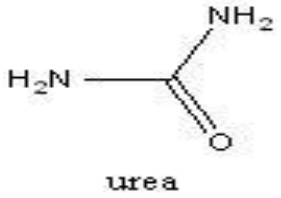


  – Little volatilization; acidic; source of S; costly

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

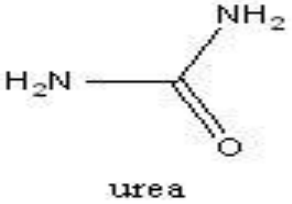
#1 - Nitrogen Fertilizer Sources All Are Susceptible to Loss

- Urea – 46% N



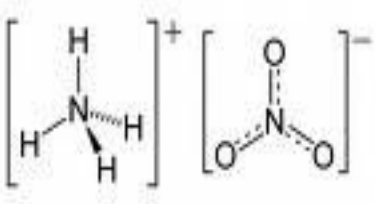
urea

  - $CO_2 + NH_3$
  - Susceptible to volatilization; converts to nitrate rapidly
- UAN – 30% Solution



urea

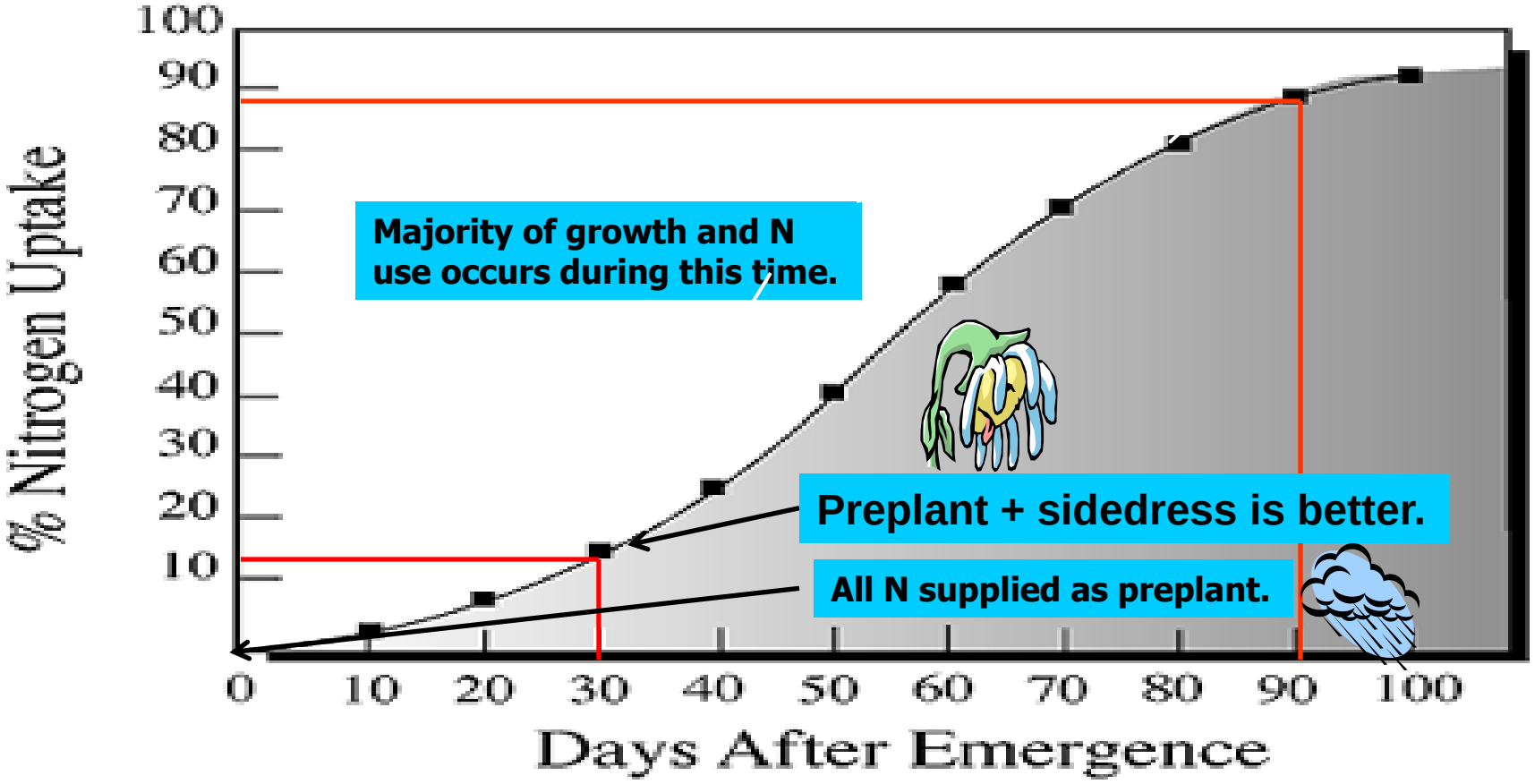
+



+ Water

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

2 - Application Timing



UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

#3 - Application Methods
Some are better than others!

UM recommends injection

Surface applied or "dribbled"

Granular spinner spreader

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

4
Enhanced Efficiency Fertilizers
Nitrogen Stabilizer Products

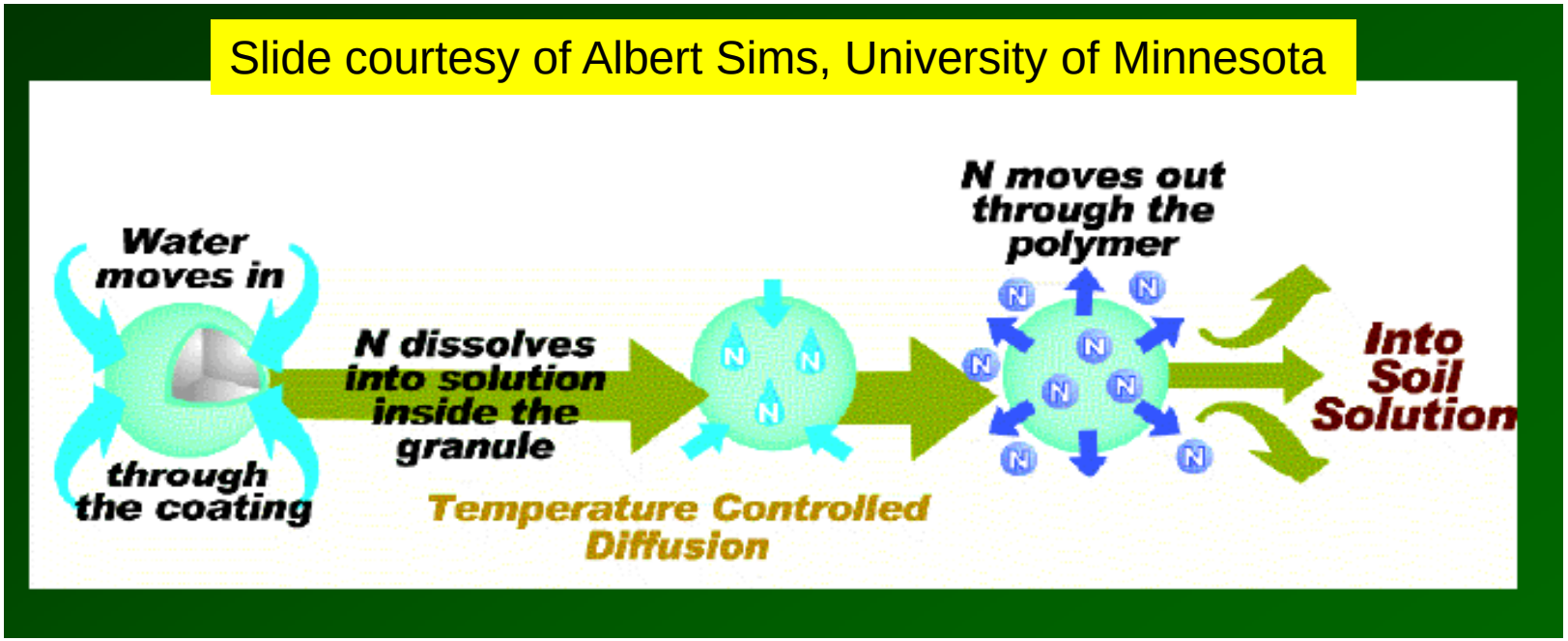
1. A source of nitrogen that when applied to fields is less susceptible to N loss for varying periods of time.
2. Additives used in combination with fertilizer sources of nitrogen to temporarily reduce ammonia and nitrate loss.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

ESN = Environmentally Safe Nitrogen

- Produced by Agrium Inc.
  - Urea coated with synthetic polymer.
  - Water diffuses through coating, dissolves urea pellet and liquid N diffuses out of coating.

Slide courtesy of Albert Sims, University of Minnesota



UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

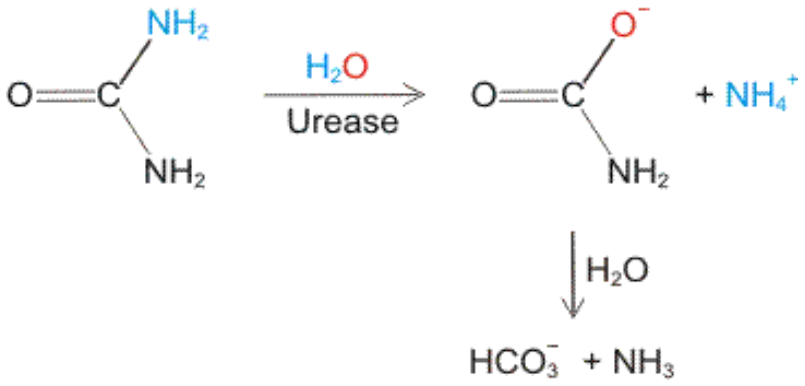
Nitrogen Stabilizer Products
Two Forms

- Volatilization inhibitors
  - Impede the action of urease.
  - Urease = naturally occurring soil enzyme that converts ammonium to ammonia.
- Nitrification inhibitors
  - Impede soil microbes from converting ammonium to nitrate.
  - Bactericides.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Agrotain®

- Volatilization inhibitor
  - N-(n-butyl) thiophosphoric triamide (“NBPT”)
    - $C_4H_{14}N_3PS$
    - Urease inhibitor
  - inhibits the urease enzyme that catalyzes the hydrolysis of urea.



UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

N-Serve® or Nitrapyrin

- Nitrification inhibitor
  - Bactericide that impedes nitrification bacteria.
  - Used with anhydrous ammonia.
  - N-Serve subject to volatilization if not injected.
- Instinct developed for use with UAN for surface application.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Agrotain Plus®

- Nitrification inhibitor
  - Dicyandiamide : $C_2H_4N_4$ = **DCD**
  - Inhibits the first stage of nitrification, the oxidation of ammonium NH_4^+ to nitrite NO_2^-, by rendering the bacteria ineffective
- Volatilization inhibitor
  - NBPT
- Provides dual protection

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

NutriSphere-N®

- Maleic itaconic polymer; calcium salt.
- Mode of action remains proprietary.
- Promoted as a season long nitrogen management tool.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Half Time - Questions

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

UM Research
Nitrogen Stabilizer Products

Patrick Watkins – Grad Student

- Do the N stabilizer products work?
  - Do they all function as advertised?
- Do surface UAN applications function like injected UAN if a volatilization inhibitor is used?
- Can N rates be reduced if an inhibitor is included with sidedress UAN?

Procedures – 4 Years

- UAN is nitrogen source.
- 20% of N applied prior to planting.
- Sidedress treatments

Total N Rates = 160, 120, and 80 lb/acre.
Control = no N provided
Surface application with products.
Injection w/o products (check).
Surface w/o any products.

Dual purpose

Dow AgroSciences
Instinct™
Nitrogen Stabilizer
™Trademark of Dow AgroSciences LLC

Nitrification inhibitor

Volatilization inhibitor

Dual purpose

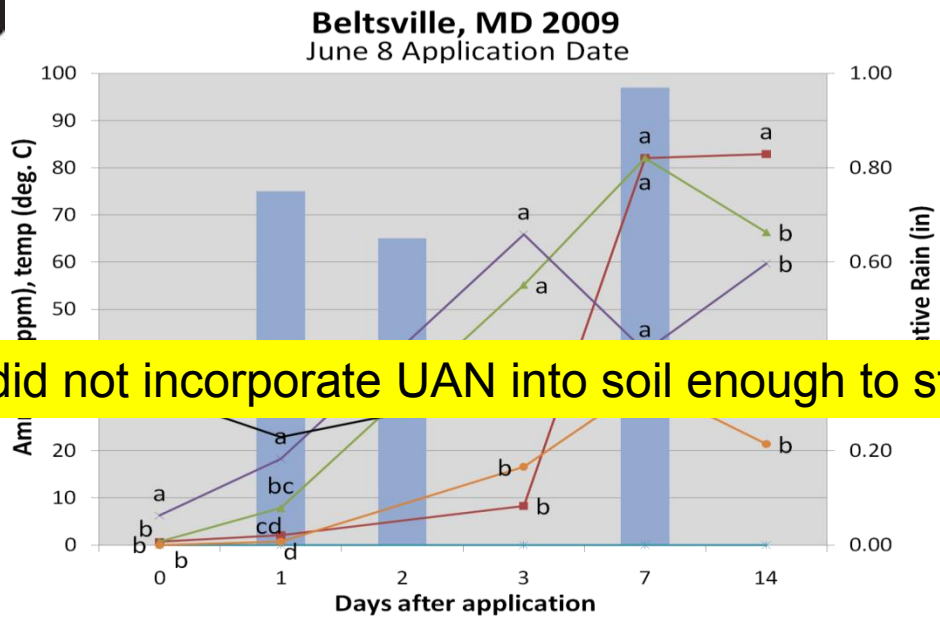
UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Volatilization Inhibitor Performance
How Did We Test for This?

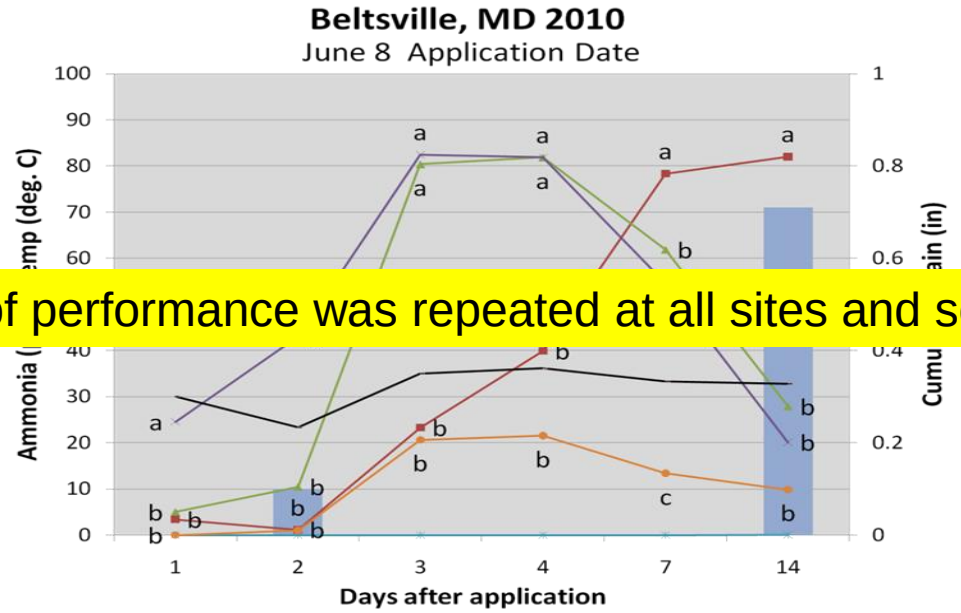
- Compared products surface applied with injected and surface UAN.
- 1 L passive collection chambers, moved after each sampling
- Used Drager gas detection tubes to measure ammonia collected in chambers during the two weeks following sidedress.
  - Measuring range 0.25 ppm - 100 ppm

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

What Did We Find?



1.4” rain did not incorporate UAN into soil enough to stop loss.



Pattern of performance was repeated at all sites and soil types.

Rain — Agrotain Plus — Nutrisphere N — UAN Surface Applied — Check — Injected — Temp Deg C

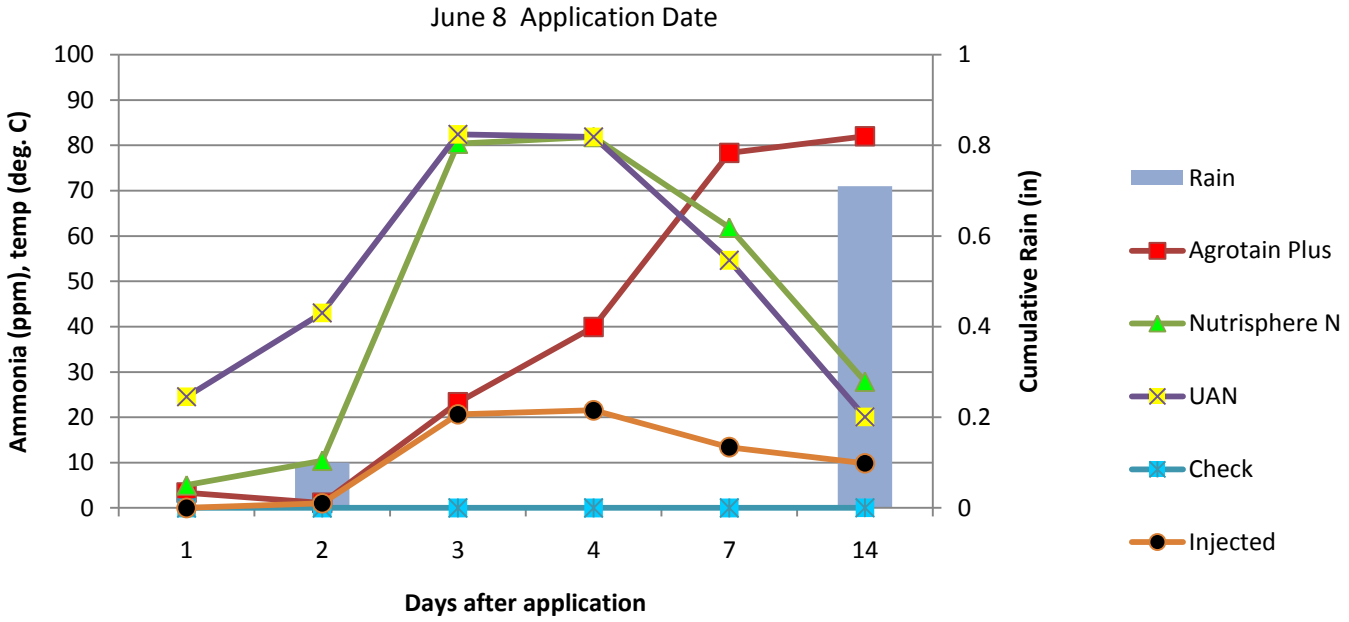
Verifying Urea Conversion Volatilization Loss Measurement

- Collected soil samples at the same time as the chamber measurements of ammonia.
- Soil samples were stored frozen even while they were prepared for analysis.

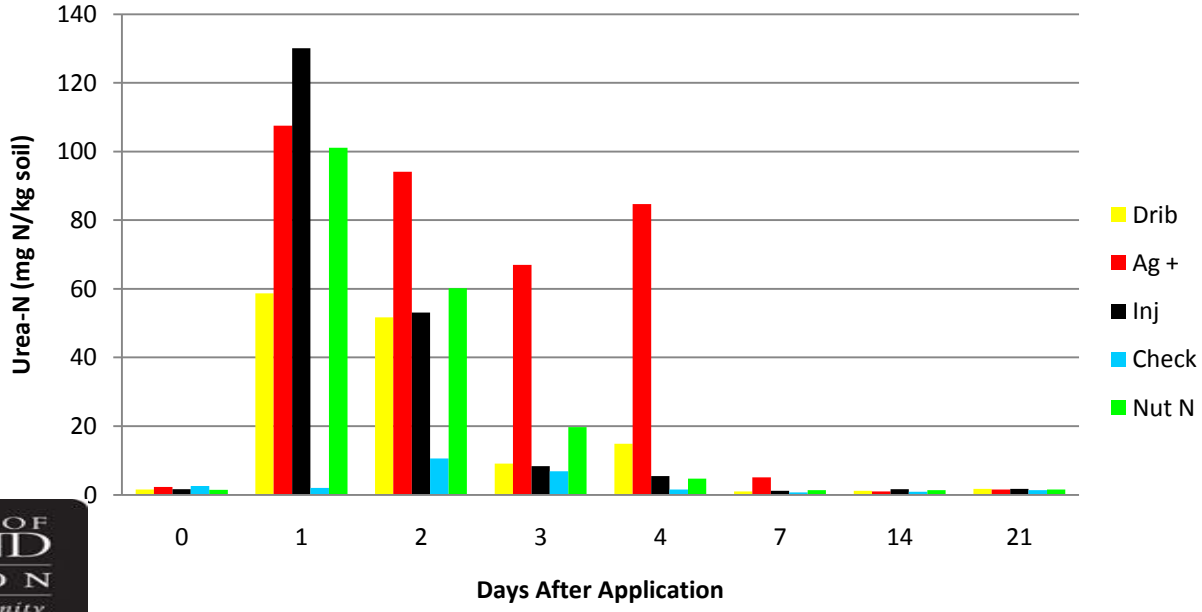
UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community


T° SENTRY
POWER
- 0 16
°C
ALARM
DELAY
Adjust
Adjust
HIGH ALARM
Display
LOW ALARM
Display
Hampshire Controls Corp
Model 125

Ammonia Loss Beltsville MD, 2010



Urea Concentration Beltsville MD, 2010



UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Measuring Performance of Nitrification Inhibitors

- Pre-plant and post harvest soil samples collected to 2’ depth.
  - Measure amount of ammonium-N and nitrate-N in soil and make comparisons among treatments.
  - **If a product slows conversion of ammonium to nitrate, is there a conservation effect that will result in higher soil concentrations of the two in the fall?**

- Spad (chlorophyll meter) readings.
  - Plant measurements during the season.
  - **Can be an indicator of nitrogen depletion in the plant.**

Measuring Performance of Nitrification Inhibitors

- This soil data and Spad meter readings are still being analyzed.
- Patrick Watkins, grad student, is working on this and it will be part of his thesis.
- Stay-tuned for the results.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Corn Yield & Stabilizers
What Are We Looking For?

1. Did stabilizer products @ 25% reduced N rate produce comparable yield to UAN injected?
   - Indicates both a cost saving and an environmental benefit can be attained.
2. Did stabilizer products @ same N rate produce comparable yield to UAN injected?
   - Indicates that surface application of stabilized UAN can be considered a comparable practice to injection of UAN.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Corn Performance & Stabilizers Yield - 2008

- Injected UAN maximized yield @ 160 lb N/a rate @ 2 locations
  - All stabilizer products at 120 lb N/acre rate produced the same as UAN Injected @ 160 lb N/acre.
  - Indicated products supported a **reduction in nitrogen rate**.
  - **Cost savings and environmental benefit.**

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Corn Performance & Stabilizers Yield - 2009

- Beltsville – drought produced very low yield.
- Poplar Hill yield maximized at 160 lb N/acre
  - None of the products @ 120 lb N/acre had comparable yield to UAN injected at 160 lb N/acre. (**no rate reduction**)
  - 3-4 products @ 160 lb N/acre had comparable yield to UAN injected @ 160 lb N/acre. (**Surface app. = injected**)
  - Agrotain, Instinct, and Nutrisphere-N
- Clarksville yield maximized at 80 lb N/acre.
  - Instinct @ 80 lb N exceeded UAN injected at 80 lb N/a.
  - 3 products @ 80 lb N = yield to UAN injected @ 80 lb.
  - **Surface application = injected**

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Corn Performance & Stabilizers Yield - 2010

- Beltsville – injected yield maxed @ 120 lb N
  - Instinct @ 80 lb N had yield comparable to UAN injected @ 120 lb N. (**N rate reduction**)
  - Agrotain & Instinct @ 120 lb N had comparable yield to UAN injected @ 120 lb N.
  - **Surface application = injection**
- Poplar Hill – injected maxed yield at 120 lb N/a
  - None of the products @ either 80 or 120 lb N/a had yield comparable to UAN injected @ 120 lb N/a.
  - **No rate reduction or surface application benefit.**
- Clarksville = no N rate response observed.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Corn Performance & Stabilizers Yield - 2011

- Response was similar across 3 locations.
- Yield for injected UAN maxed @ 160 lb N/a
  - **No rate reduction benefit.**
  - **Surface application for only Agrotain Plus = Injected.**
  - **Other products provided no benefit.**

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Do the N stabilizer products function as advertised?

- Volatilization inhibition
  - Agrotain/Agrotain Plus have shown protection for ~ 1 week when mixed with UAN and surface applied at sidedress.
  - Nutrisphere-N mixed with UAN and surface applied has lost ammonia the same as UAN surface applied with no inhibitor. It does not provide volatilization protection.
- Nitrification inhibition
  - Assessments have not been completed.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

When Surface Applied Can These Products Used with UAN Substitute for UAN Injected?

- Surface application of UAN with a proven stabilizer product at corn sidedress can be an accepted best management practice.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

What Effect Do These Products Have on Corn Yield?

- None of these products at a 25% reduced N rate have consistently produced a comparable yield to UAN injected.
- Only one product at one site-year provided yield improvement.
- **DO NOT EXPECT YIELD ENHANCEMENT.**
- **DO EXPECT NITROGEN MANAGEMENT WHEN USING PROVEN PRODUCTS.**

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community


Maryland Grain Producers
UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community
Maryland Crop Improvement Assn.
Thank You!!
QUESTIONS
MSB
MARYLAND SOYBEAN BOARD
Making Your Checkoff Pay Off.
MARYLAND CENTER FOR AGRO-ECOLOGY, INC.
Supporting viable farms and forests