

Proceedings of the 4th Annual Nitrogen: Minnesota's Grand Challenge & Compelling Opportunity Conference

4th Annual
NITROGEN:
MINNESOTA'S GRAND
CHALLENGE & COMPELLING
OPPORTUNITY CONFERENCE



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Minnesota River's Edge Conference Center,
St. Cloud, MN

 UNIVERSITY OF MINNESOTA | EXTENSION

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of our Supporters!*



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Nitrogen Source As A Best Management Decision

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www.smartnitrogen.com
www.nutrien.com

A Changing Nitrogen-Management Landscape

Des Moines Water Works lawsuit vs farmers in three counties

Midwest nutrient loss reduction strategies

Minnesota nitrogen fertilizer management rules give MDA authority to regulate nitrogen for ground-water quality

New California root-zone water quality rules

Meeting water quality targets

*Need to fundamentally change how we manage N
(in addition to other conservation practices).*

Two Basic Nitrogen Risks

Urea on the soil surface

Can be lost by **volatilization** as it converts to ammonium

Short-term risk

Losses within a few days after surface application

Nitrate in the soil

Can be lost by **leaching** and **denitrification** from excess water

Season-long risk

Losses any time during season with rainfall or irrigation events

Reducing Loss

Why control N loss?

Maximize nitrogen benefits – Minimize environmental impacts

Manage 4Rs – source, timing, rate, placement – to reduce risk.

Example 1: Split application to apply N closer to time of crop need

Example 2: Incorporate urea and UAN immediately

AND/OR

Alter the fertilizer to manage soil N form and timing

Example 1: Use controlled-release N to deliver N as needed

Example 2: Use nitrification inhibitor to slow conversion to nitrate

1967

First polymer-coated fertilizer introduced in US

1972

N-Serve introduced

Enhanced-Efficiency Fertilizers (EEF)

**A fertilizer that has been
modified in some way to**

**1) reduce nutrient losses
to the environment and**

**2) increase nutrient
availability for the crop.**

Why Enhanced-Efficiency Nitrogen Fertilizers?

Reduce nitrogen loss to the environment

Improve nutrient-use efficiency

Increase productivity and profitability

Simplify N management

Conservation program incentives/enhancements

**EEFs are now, and will be, a large part of
N management strategies.**

“Enhanced-Efficiency” Fertilizers

Many proven products; some new unproven products

Controlled Release Fertilizer

Wide variety of formulations

Different modes of action for different objectives

Select the EEF that BEST solves the grower's problem

Superior
STABILIZED N

ESN
SmartNitrogen

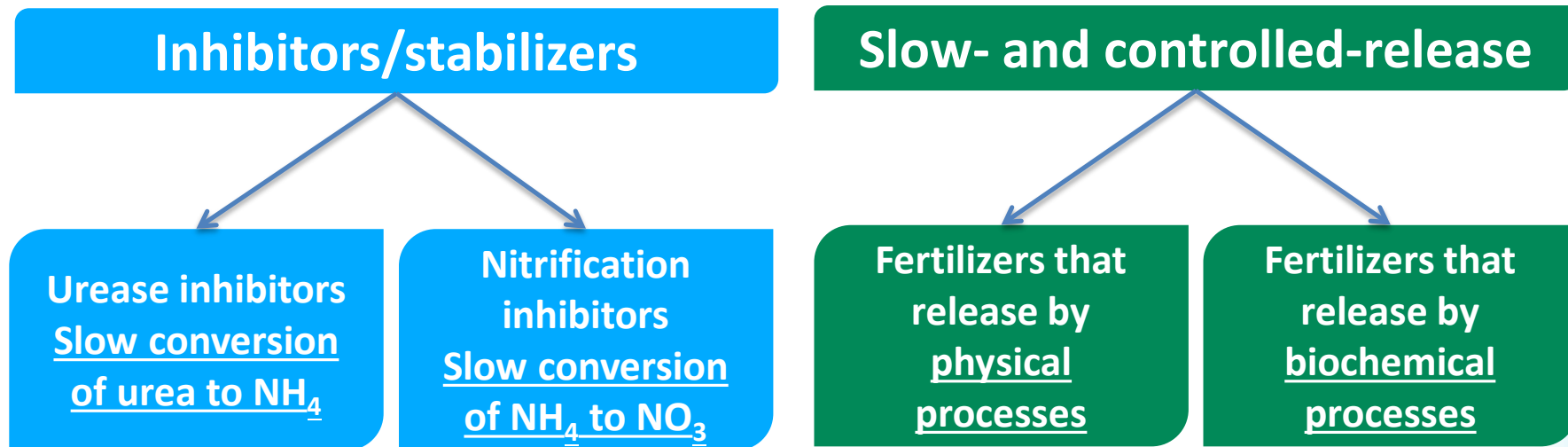
Common Misrepresentations

“They’re all the same; I’ll just use the cheapest.”

“I tried that, and ‘it didn’t work.’”

“It doesn’t really matter so much if I’m not using the right product; I just need to say I’m using an enhanced-efficiency fertilizer.”

Enhanced-Efficiency Nitrogen Fertilizers



Many products
Different modes of action
Different benefits

Inhibitors and Stabilizers

Chemicals added to fertilizers to slow N reactions

Urease inhibitors

Slow conversion of urea to NH_4

Control volatilization
for 7-14 days.

NBPT

Agrotain
Nitrain/Nitrain Express
Limus
Arborite
Many others

Nitrification inhibitors

Slow conversion of NH_4 to NO_3

Control leaching,
denitrification for 4-8 weeks

Nitrapyrin

N-Serve
Instinct

DCD

Super U*
Agrotain Plus*
Guardian

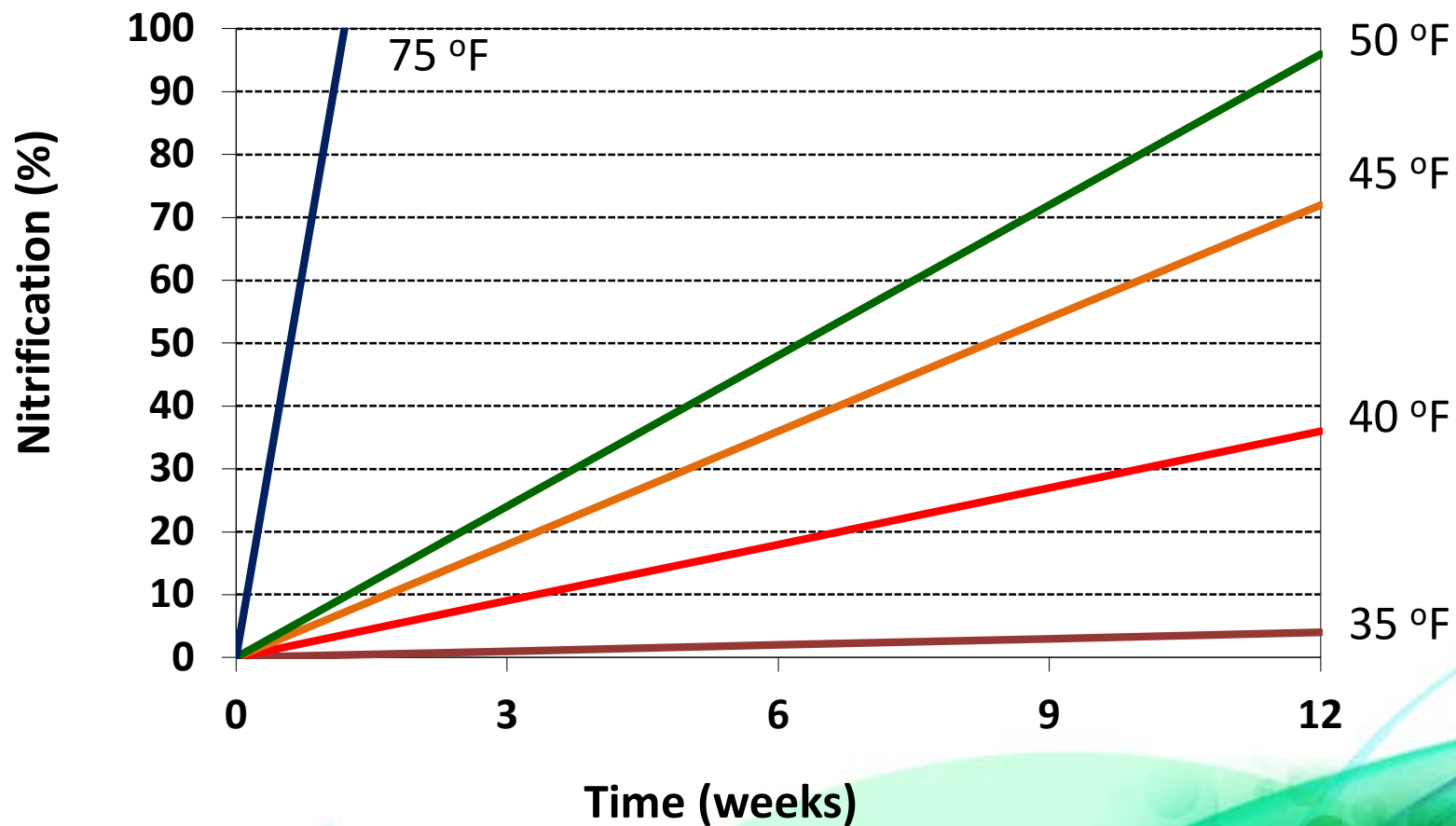
Other Active Ingredients**

Nutrisphere-N
Stay-N
N-Zone

*Contains both NBPT and DCD

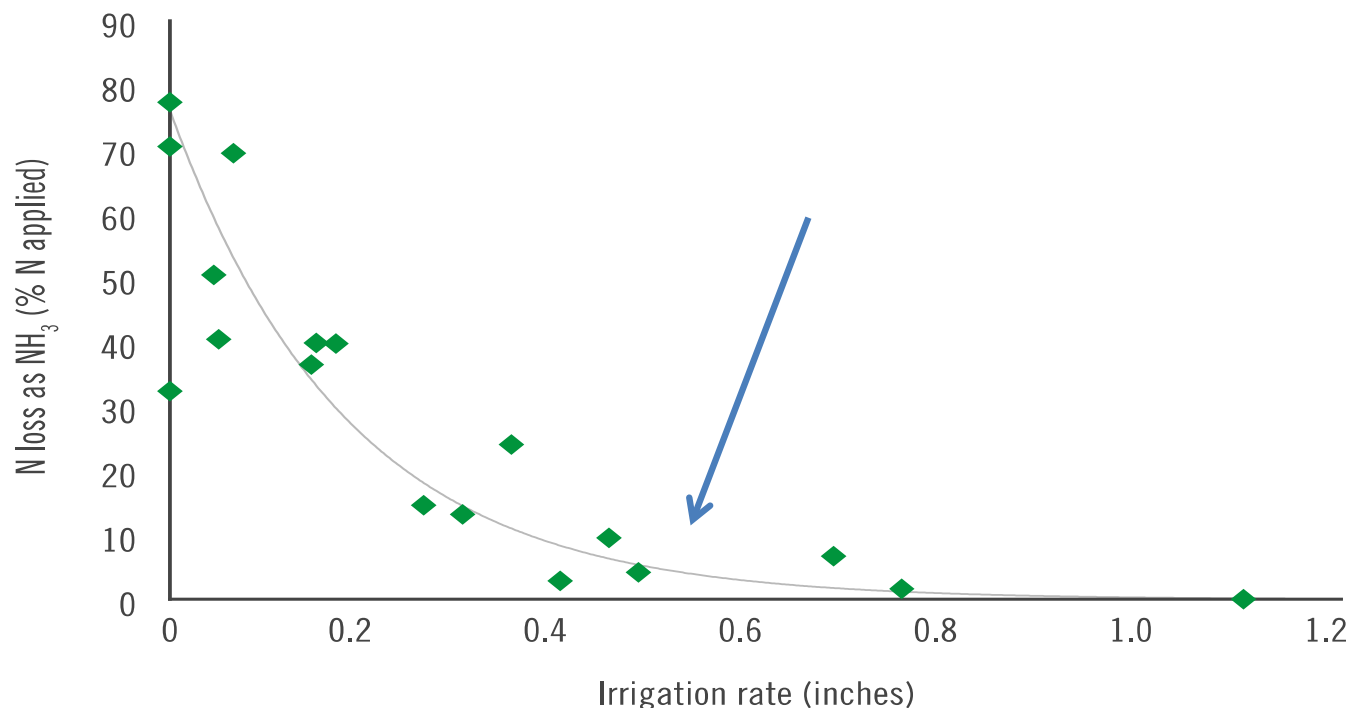
** Mode of action less certain or less-well documented

Soil Temperature and Nitrification Rates



How Much Rain to Incorporate Urea?

For this specific system, approximately 0.50-0.75 inches of water was needed to eliminate ammonia volatilization losses.

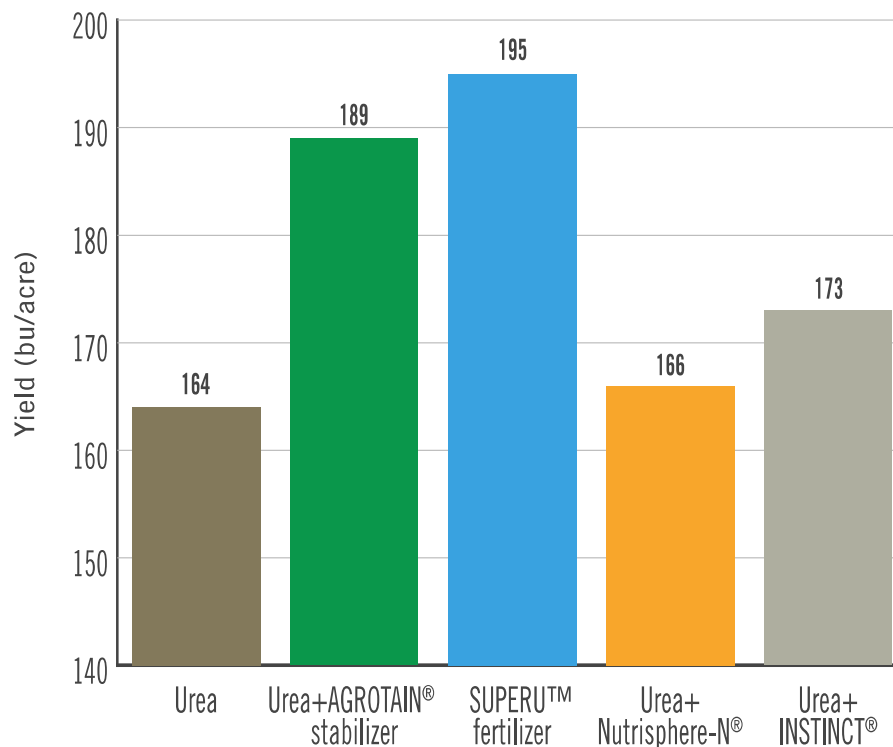


- Field study
- Average study temperature: 45° F
- Adkins fine sandy loam
- Nitrogen rate of 100 lbs N/acre
- Source: Horneck, 2010. Oregon State University.

The underlying data was provided by Oregon State University under a Research Trial Financial Support Agreement with Koch Agronomic Services, LLC and neither Oregon State University, nor the individual researchers referenced, endorse or recommend any product or service.

Corn Yield Benefit with AGROTAIN® and SUPERU™

- SUPERU™ fertilizer had a 31 bu/acre higher yield compared to untreated urea.
- The increased yield performance of urea treated with AGROTAIN® nitrogen stabilizer over untreated urea indicates ammonia volatilization was the major loss mechanism.
- The leading yield performance of SUPERU™ fertilizer indicates protection from denitrification was needed to maximize yield.

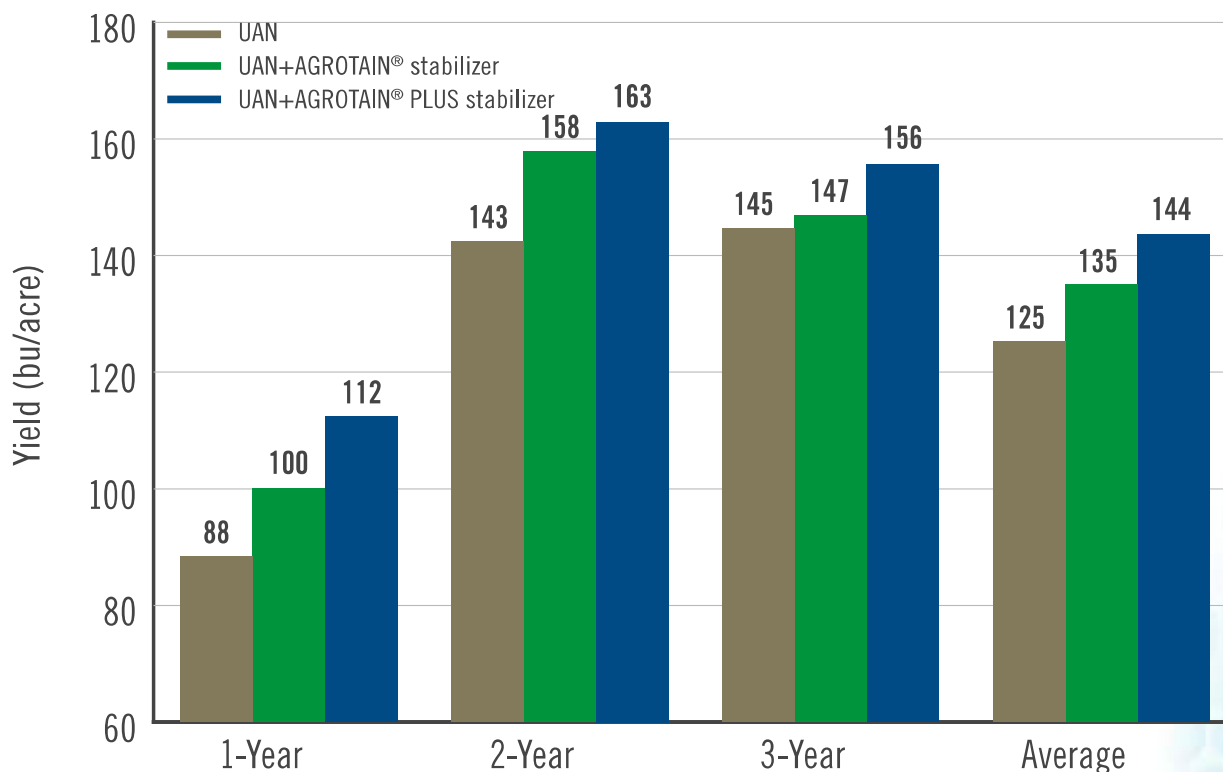


- Macon Ridge Research Station in Winnsboro, LA
- Average across three nitrogen rates (240, 270, and 300 lbs N/acre)
- Treatments broadcast applied at V4/5
- Furrow irrigation applied between 24–72 hours after application
- Source: Haggard et al., 2013. Louisiana State University.

The underlying data was provided by Louisiana State University under a Research Trial Financial Support Agreement with Koch Agronomic Services, LLC and neither Louisiana State University, nor the individual researchers referenced, endorse or recommend any product or service. NutriSphere-N® is a registered trademark of Specialty Fertilizer Products, LLC. INSTINCT® is a registered trademark of is a registered trademark of Dow AgroSciences LLC.

Corn Yield Benefit with AGROTAIN® PLUS

- On average, AGROTAIN®-treated UAN resulted in a higher yield compared to untreated UAN, indicating the value of a urease inhibitor to protect the nitrogen from ammonia volatilization leading to optimized yield potential.
- AGROTAIN® PLUS-treated UAN resulted in a higher yield compared to untreated UAN and AGROTAIN®-treated UAN. The study indicates a nitrification inhibitor to protect against nitrate leaching and denitrification was needed to gain the highest yield.



- Nitrogen rate of 120 lbs N/acre
- Treatments were broadcast at pre-plant

- Source: Ebelhar and Hart, 2009. University of Illinois.

The underlying data was provided by the University of Illinois under a Research Trial Financial Support Agreement with Koch Agronomic Services, LLC and neither the University of Illinois, nor the individual researchers referenced, endorse or recommend any product or service.

Slow- and Controlled-Release Fertilizers

Fertilizers that release N over a period of time

Release nitrogen by
physical processes

Release nitrogen by
chemical or biological processes

Control leaching, denitrification, and volatilization for a few weeks to many months depending on product longevity.

Polymer-coated

ESN

Polyon

Duration

Sulfur-coated

urea

Poly-S

XCU

Methylene urea
Urea formaldehyde

Urea triazone

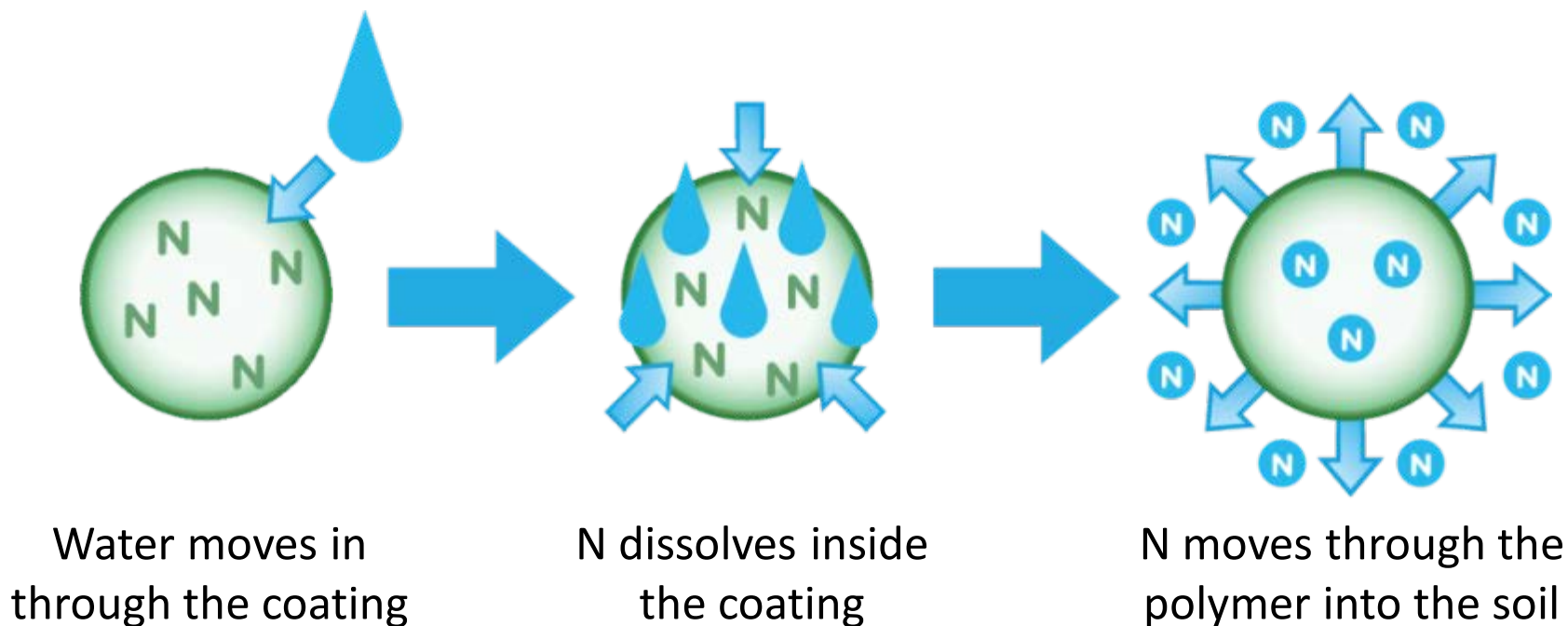
Coron

Nitamin/Nfusion

NPact

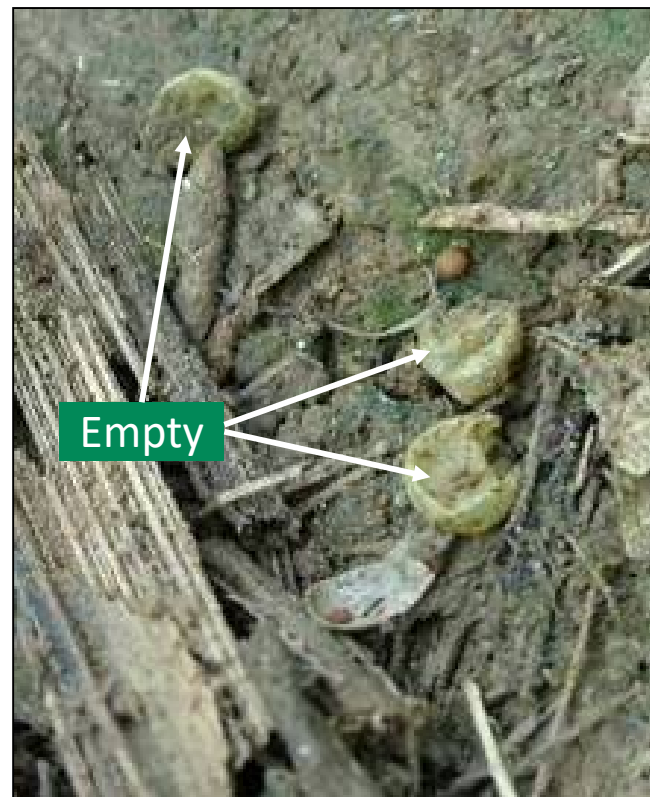
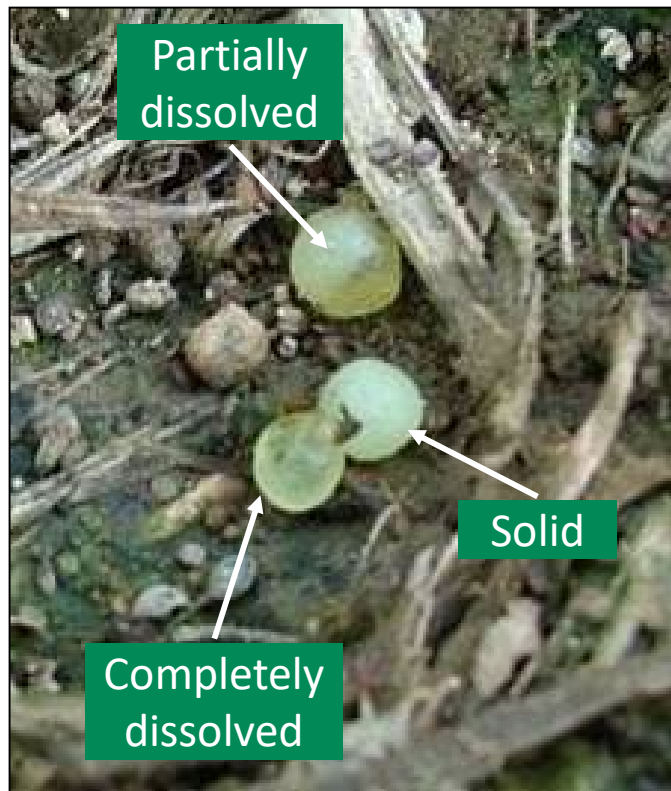
Trisert

ESN is Controlled Release



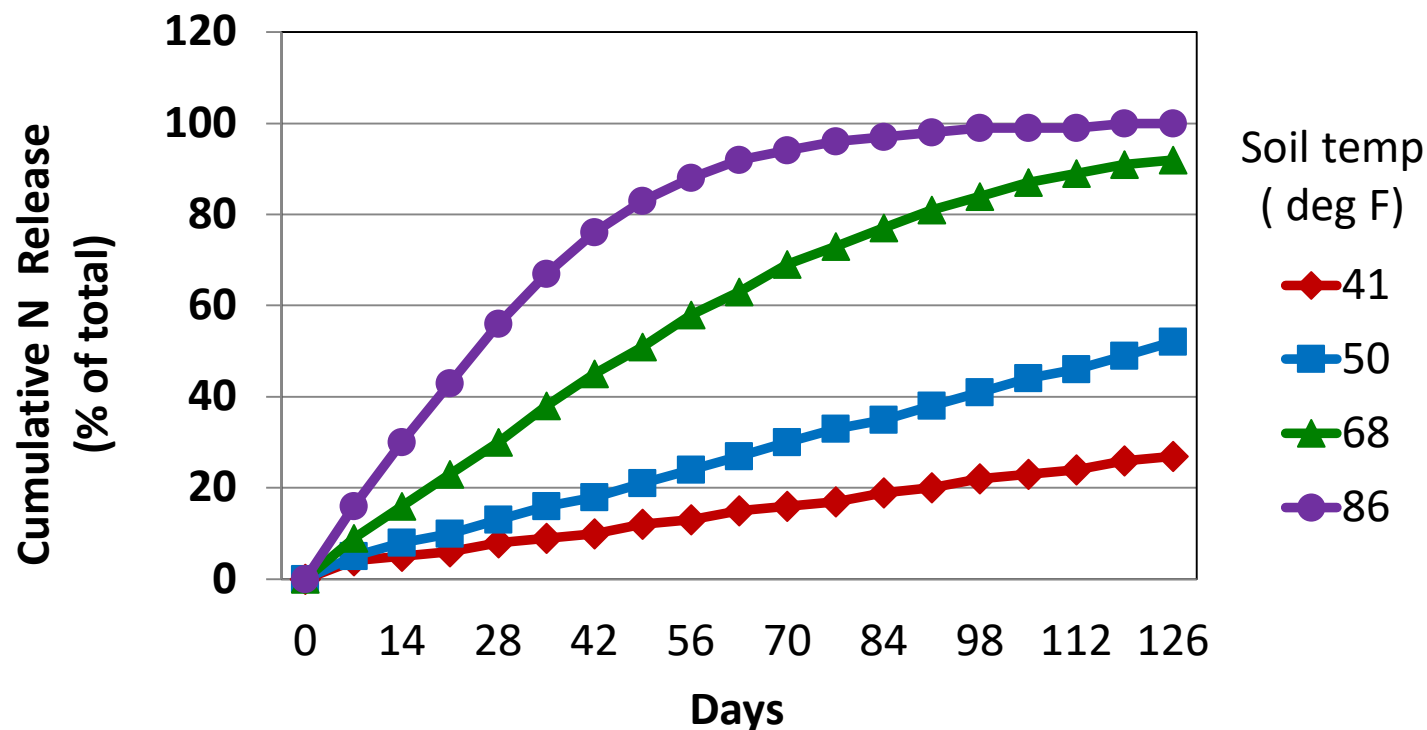
Coating protects the nitrogen, increases N-use efficiency, protects the environment

ESN is Protection You Can See



See your N protection is working

ESN Release Is Controlled By Soil Temperature



Disclaimer:

1. This is a predicted release based on typical release data reported for the product and is not specific to any particular batch or lot. Agrium does not represent or warrant the accuracy of this data for any particular batch or lot.
2. Predicted release shown is based on product as it leaves the plant, and does not represent product that has been blended and transferred as it is applied to the soil.
3. Release in water can be significantly different from release in soil medium.
4. This data is for informational purpose only and should not be interpreted as a recommendation. Weather patterns and soil conditions vary from location to location, and these variations will affect the performance of the product.

Missouri Variable-Source Study

Side-dress in addition to pre-plant
(double rate – 300 lbs N/acre)

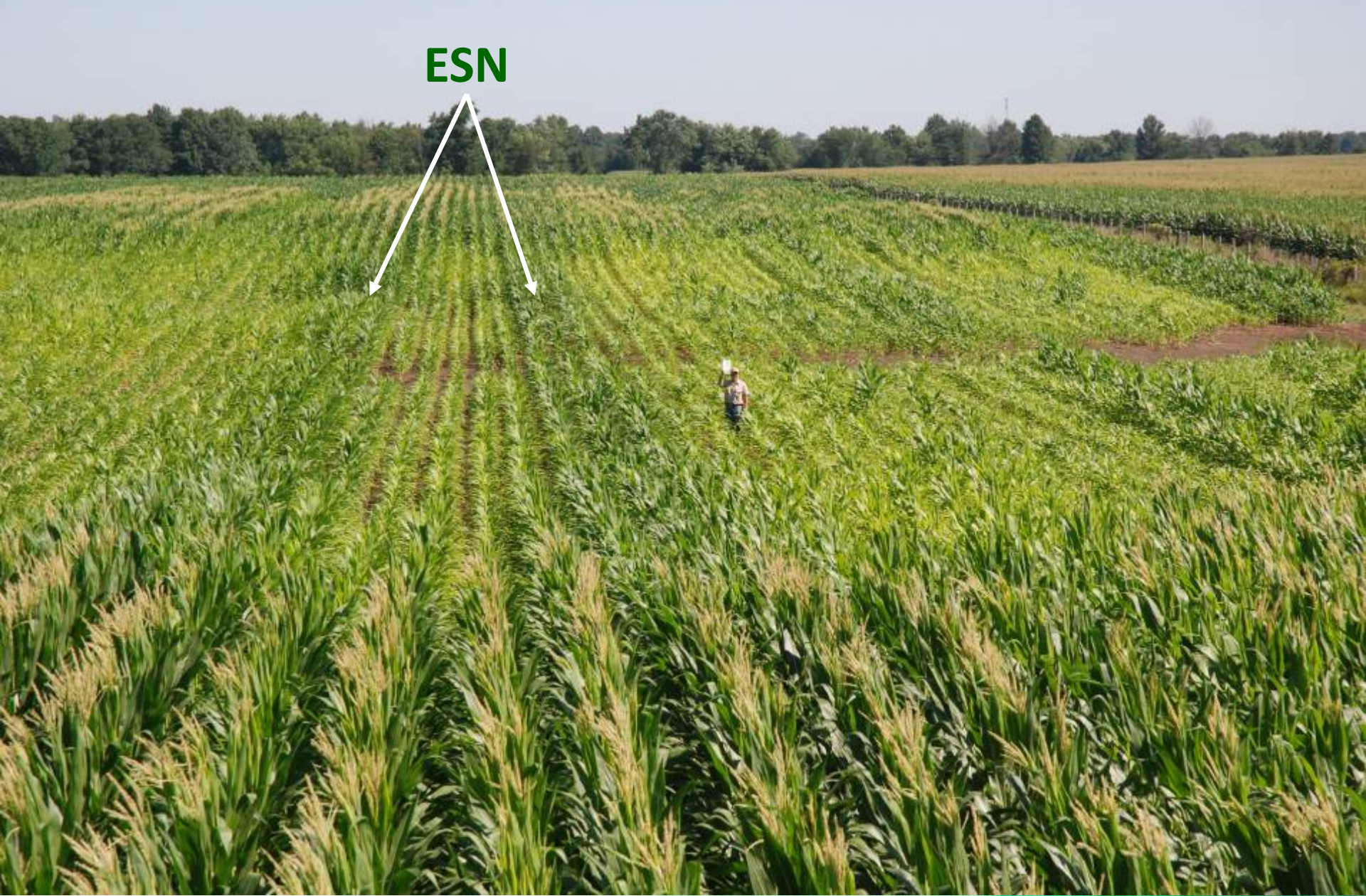


ESN

Urea

Greenley Research Center
Novelty, MO, June 2008

ESN



Greater Benefit With Greater Potential for N Loss

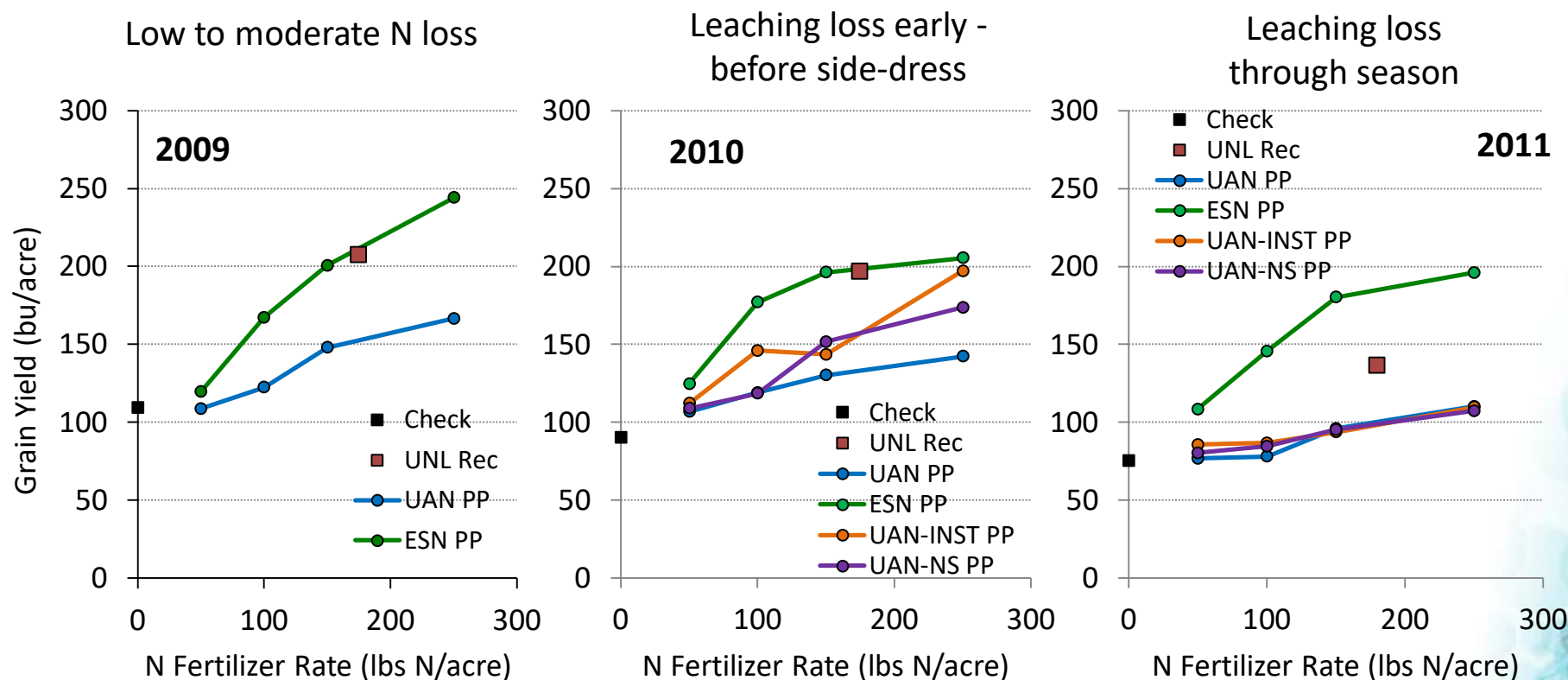
← Greater Benefit Lesser Benefit →

	Greater Precipitation or Irrigated		Lower Precipitation	
	Lower Organic Matter	Higher Organic Matter	Lower Organic Matter	Higher Organic Matter
Poorly Drained	15 – 20 bushels	8 – 10 bushels	0 – 5 bushels	0 – 5 bushels
Moderately Well Drained	15 – 20 bushels	8 – 10 bushels	0 – 5 bushels	0 – 5 bushels
Well Drained	15 – 20 bushels	8 – 10 bushels	5 – 15 bushels	0 – 5 bushels

Greater benefit with greater potential for N loss

- Expectations are based on >80% of N coming in the form of ESN
- Greater precipitation = > 6 – 8 inches of combined rainfall in May and June (the majority of the corn belt)
- Higher organic matter represents > 3 - 4%

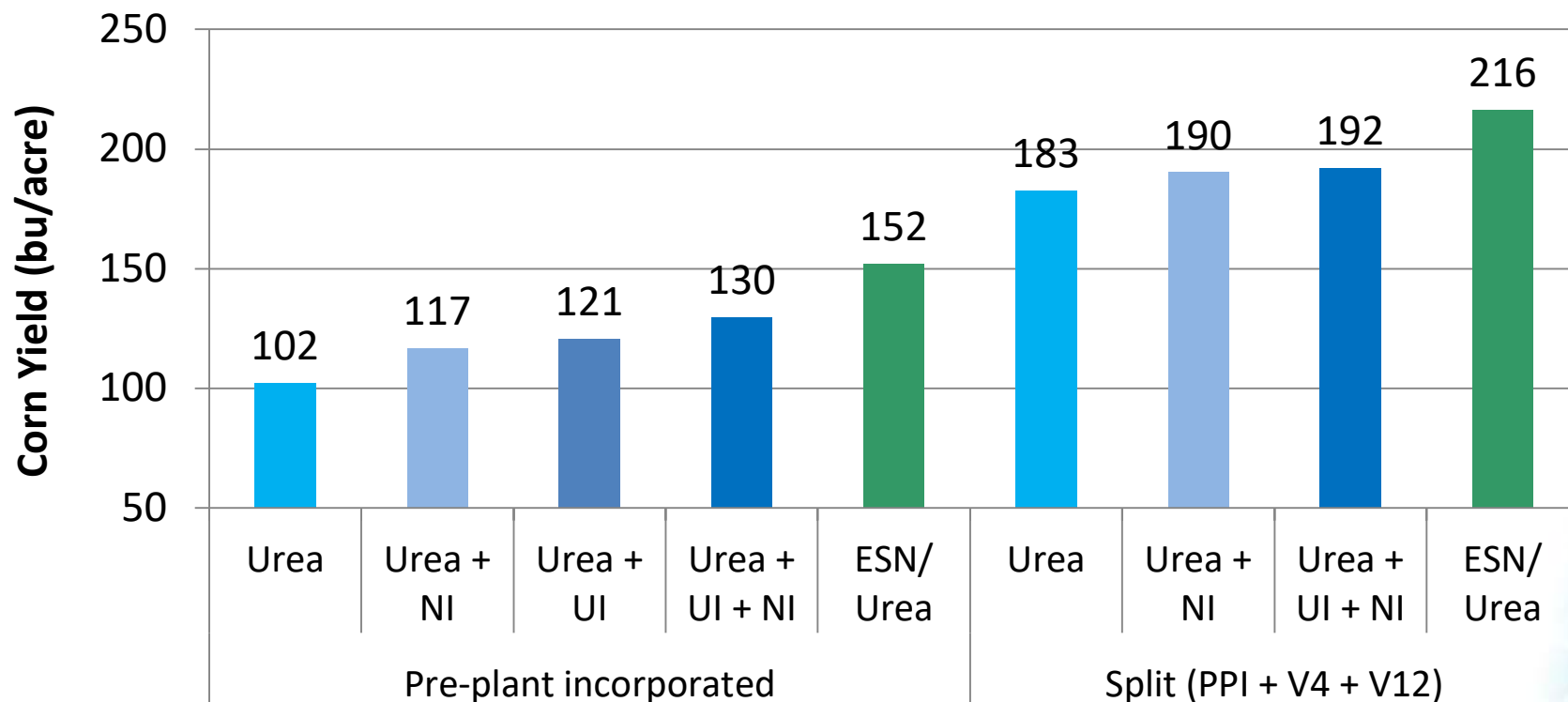
Nitrogen Source Comparison in Irrigated Corn



ESN maintains consistent N performance even under nitrogen leaching conditions when UAN fails. ESN produces yields similar to or greater than recommended BMPs with less N and fewer applications.

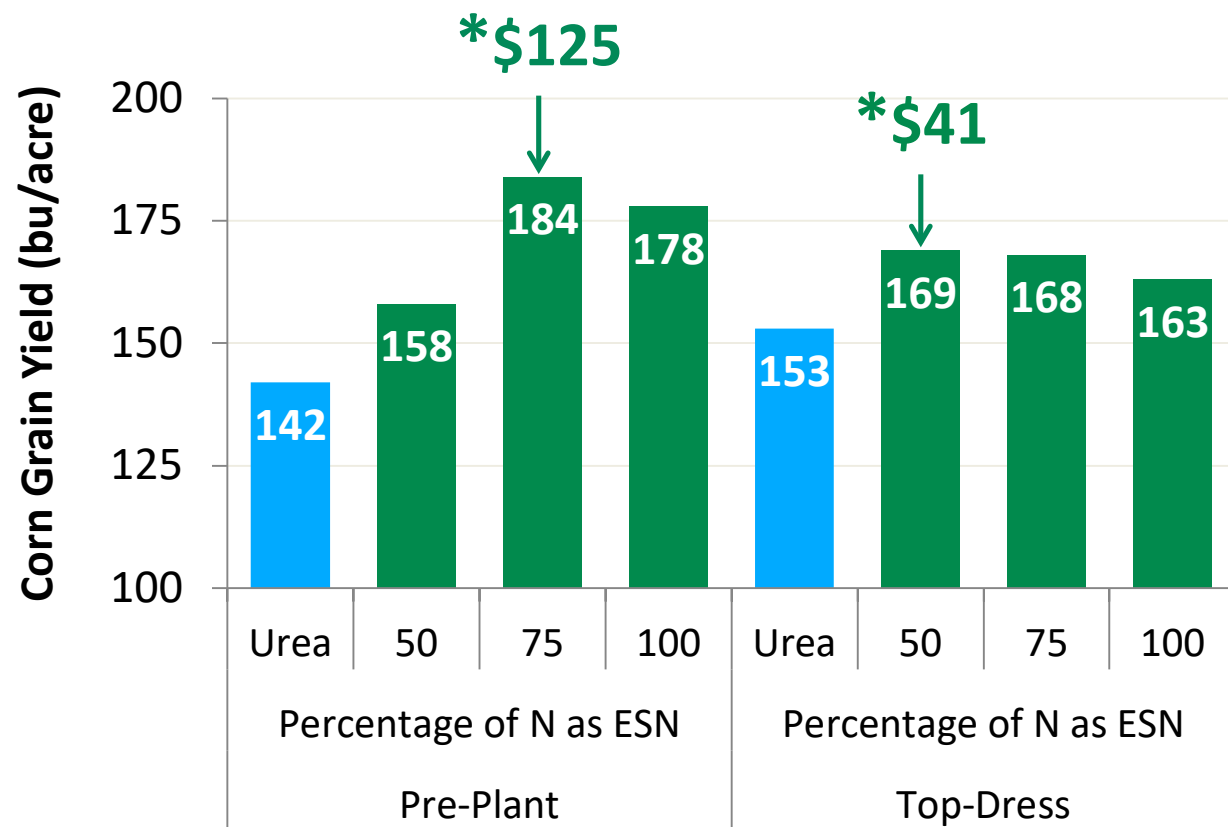
2016 Iowa Irrigated Corn Study

Sandy Soils in Eastern Iowa



ESN advantage over urea:
50 bu/acre for pre-plant
33 bu/acre for split application

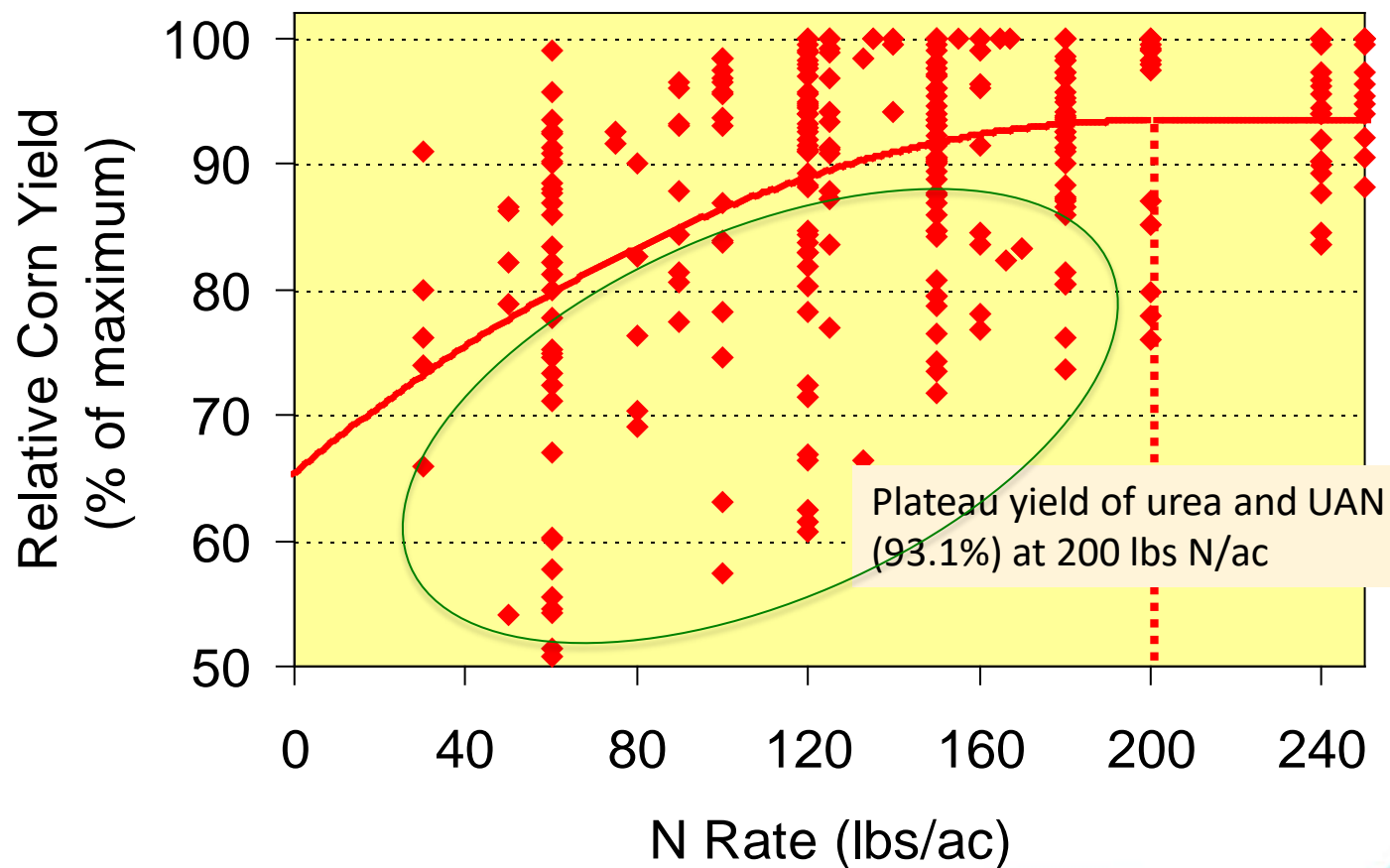
Greater Yields – Pre-Plant or Side-Dress



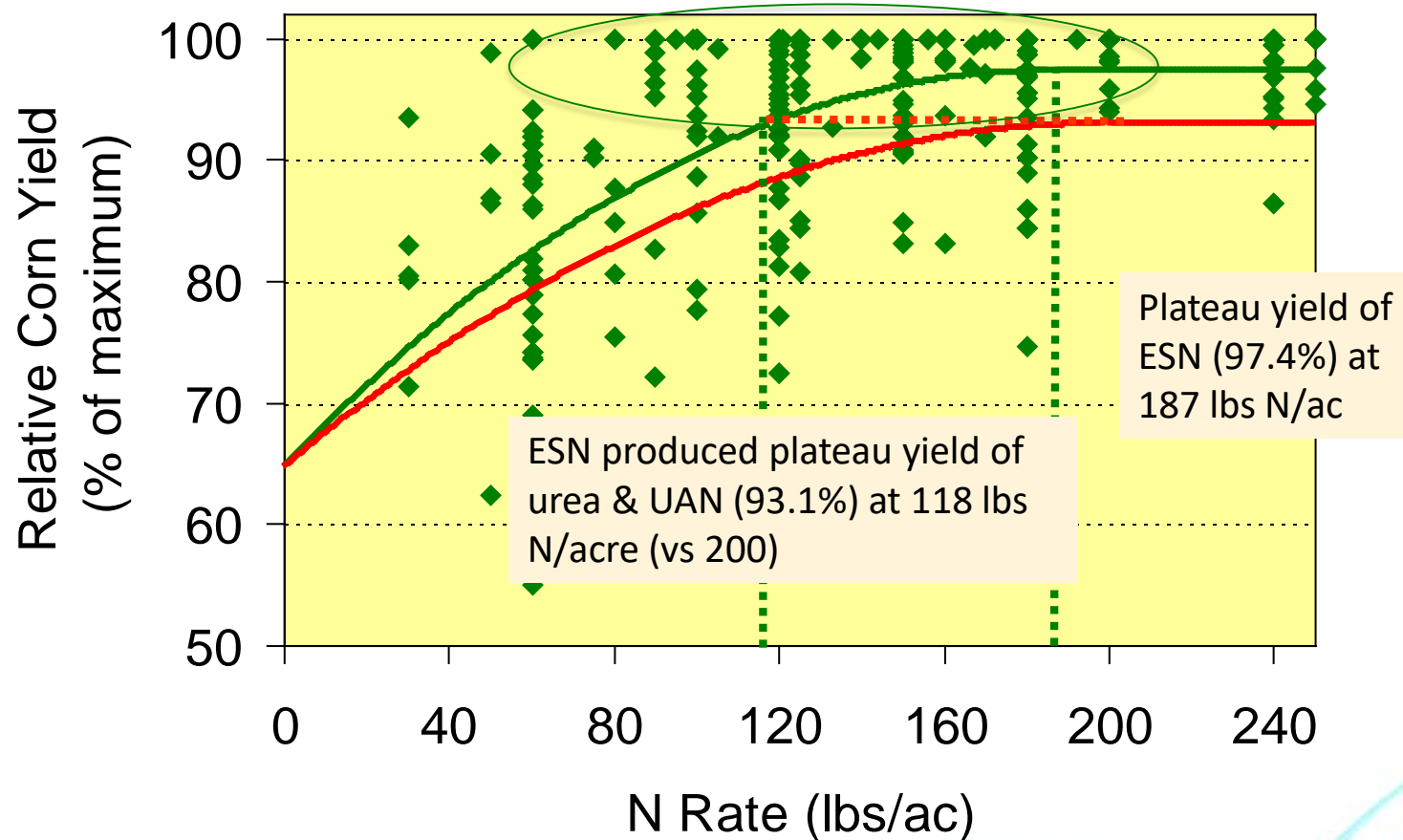
***Increase in Net Return Over Urea for Most Profitable ESN Treatment (\$/acre)**

Maximum benefit with higher percentages of ESN.

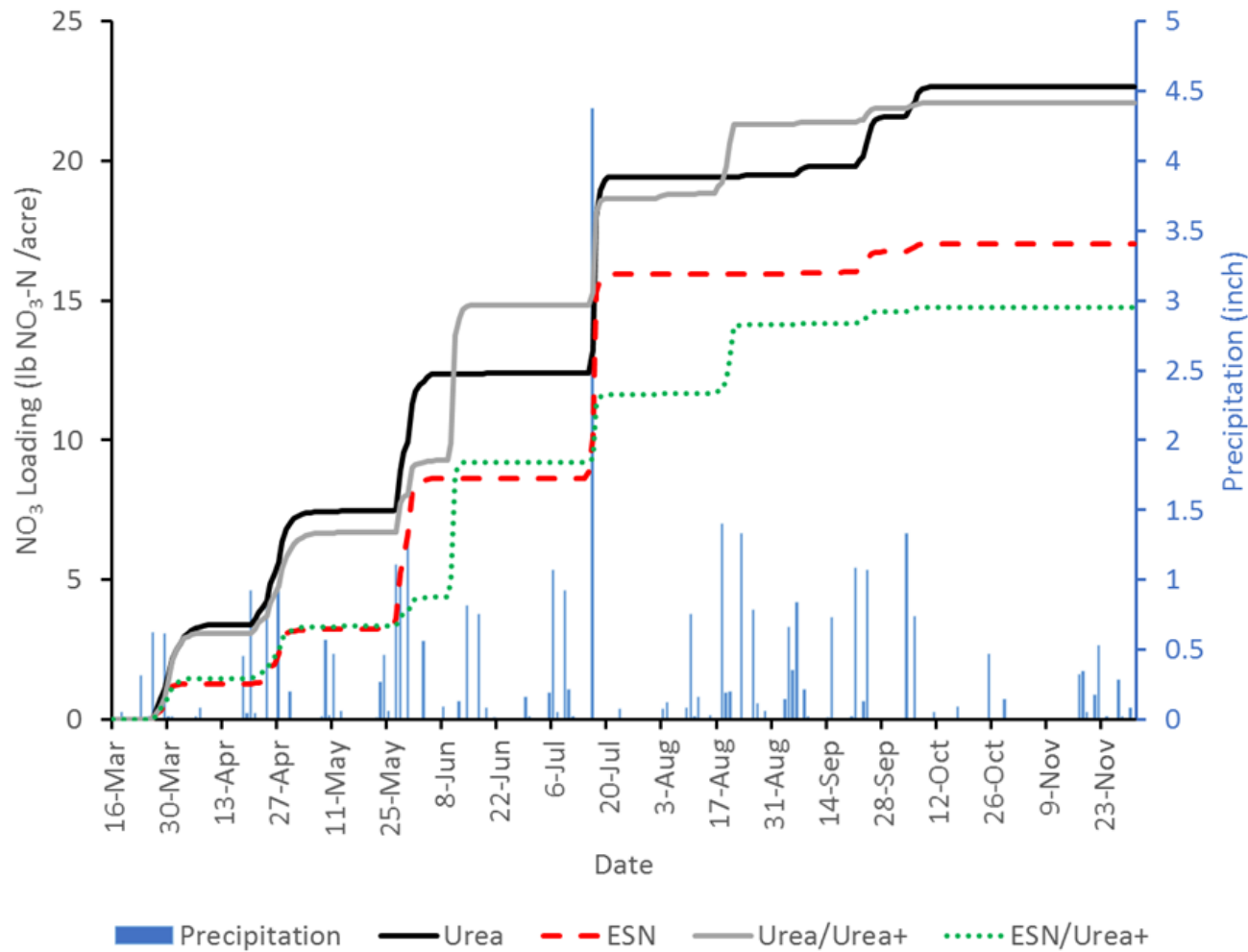
Corn Response to Urea and UAN



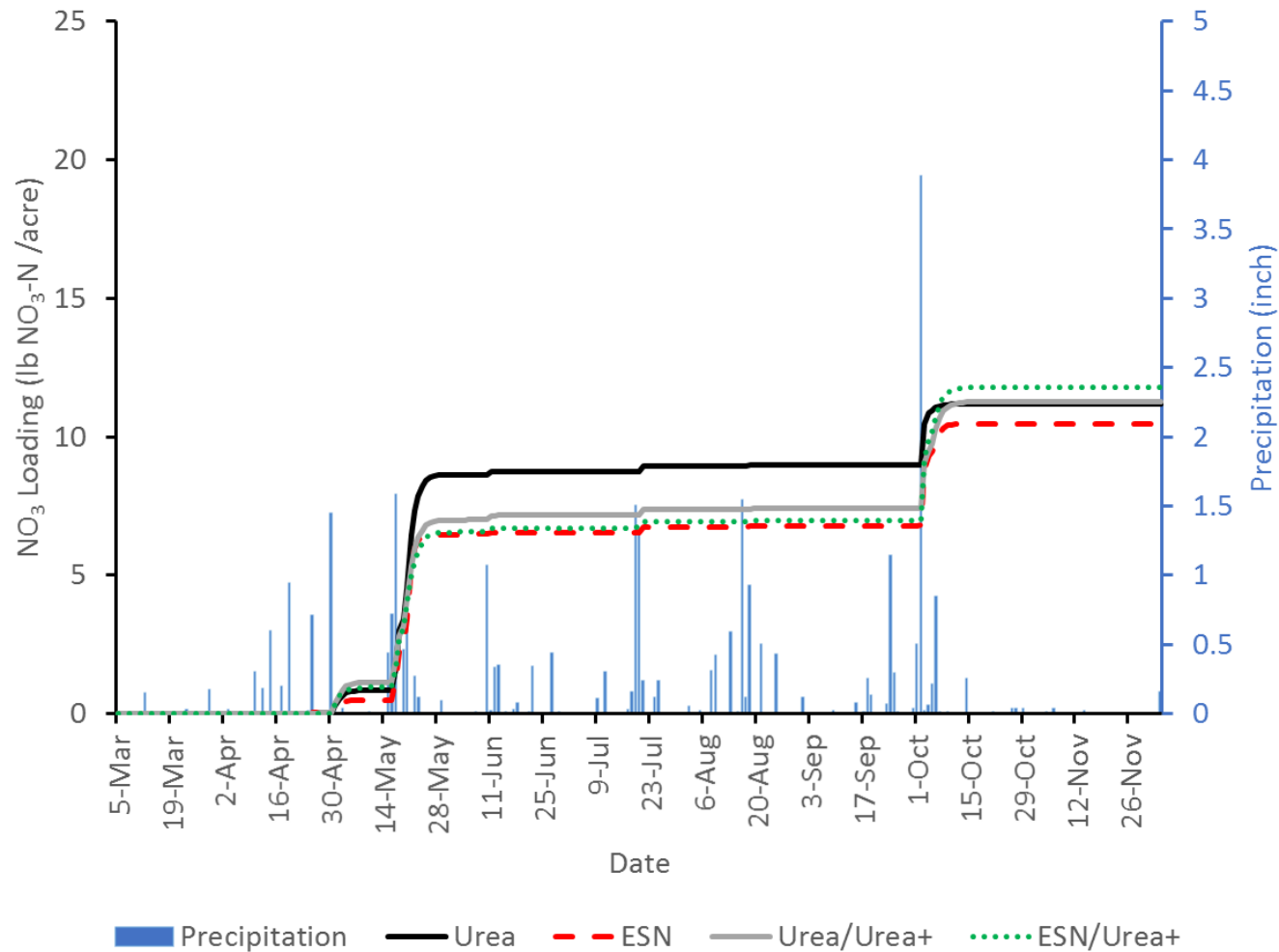
Corn Response to ESN



Lamberton N Source/Leaching Study - 2016



Lamberton N Source/Leaching Study - 2017



Biostimulants, “Biologicals”, “Microbials”

Many new products - The frontier in crop inputs

- Organic materials derived from biological processes
- May or may not include live organisms

Modes of action poorly understood

- Ingredients often “proprietary”, or unidentified, or too numerous to name
- Independent, third-party validation often lacking
- Broad, poorly substantiated claims
- Marketing has outpaced the science
- Can mode of action be matched to specific loss mechanism?

Biostimulants, “Biologicals”, “Microbials”

Largely unregulated

NOT accepted by AAPFCO as enhanced efficiency fertilizer

- Key criteria of AAPFCO EEF definition – improved nutrient availability and reduced nutrient losses – currently not well substantiated

NOT currently qualified for NRCS conservation incentives

- Much interest by agencies and NGOs in doing so
- Currently insufficient reliable science to support it

Future acceptance possible

- Rapidly advancing market sector
- Acceptance likely to follow science advancements

Reducing Nitrogen Losses With EEF's

Results require matching mode of action to N-loss mechanism

Reduce exposure of susceptible N forms to loss mechanisms

- Nitrate leaching
- N₂O and other gas emissions
- Ammonia volatilization

Increase N-use efficiency

- Greater yields and profits
- Reduced environmental impact

Demonstrated benefits leading to greater acceptance of proven technologies