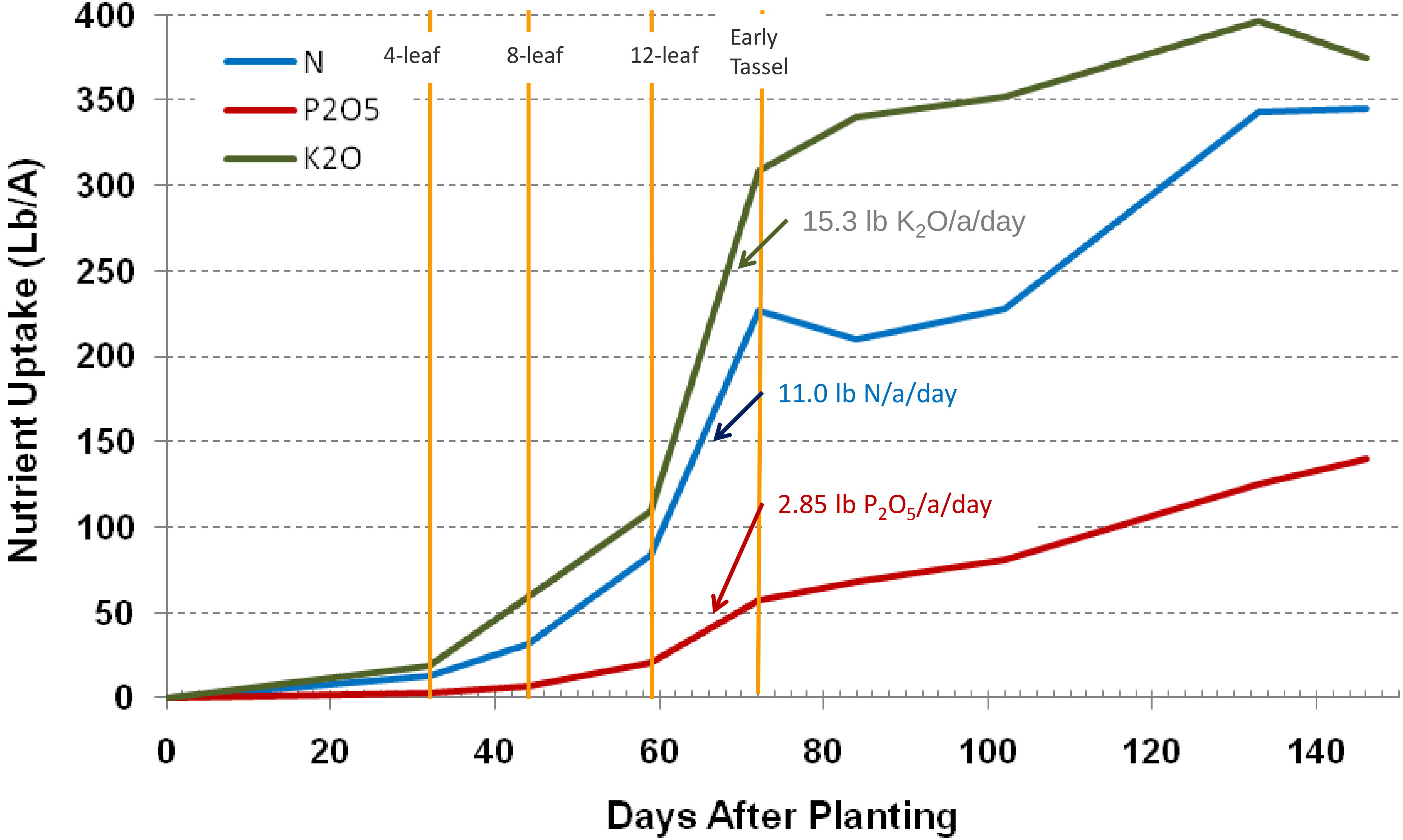
New Technologies: Products and Additives

Dale Leikam … pinch hitting for

Bryan Hopkins

Nutrient Uptake For High Yield Corn

(R. Flannery - 308 Bu/A)



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Higher Yields & High Population: Impact on Root Mass & Nutrient Uptake?

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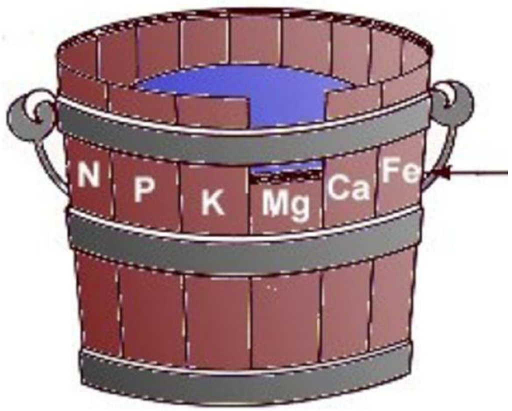
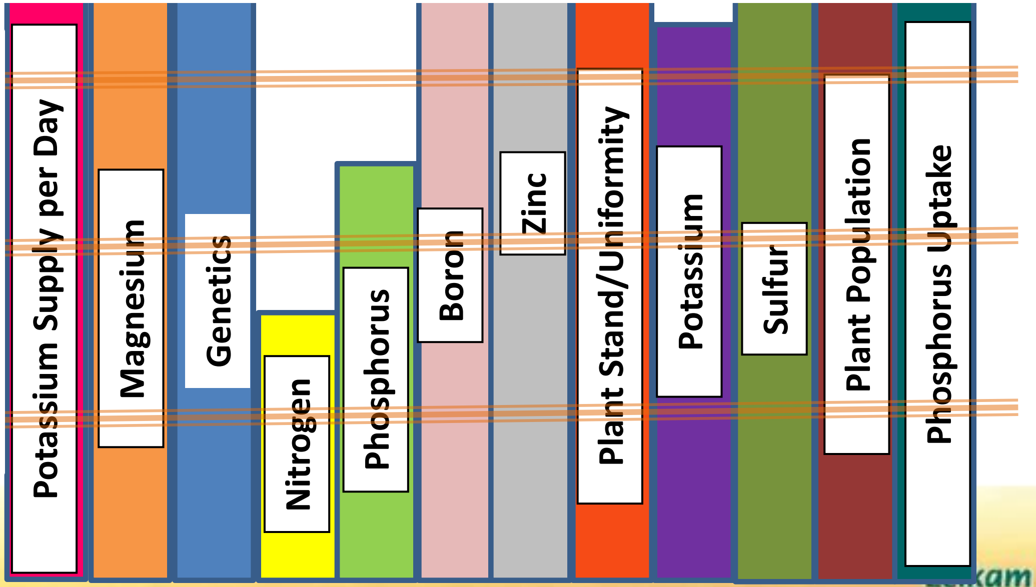


The wooden bucket represents the soil's nutrient supplying capacity

The Law of the Minimum

Law of The Minimum



Evaluation Of New Technologies

- **We Should Be Somewhat Skeptical**
  - Has The Company Invested In Product Research?
    - Research with Universities, Private Contractors and In-House Personnel
  - Does It Make Sense?
    - But Keep In Mind That New Ground Has Is Continually Being Broken
  - Is It Benefiting from Past Inputs/Management?
    - For Example, Nutrient Soil Tests That Have Been Previously Been Built

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Evaluation Of New Technologies

- **We Should Also Be Open Minded, Willing To Sometimes Change Our Ingrained Viewpoints and Progressive**
  - Everything Is New At Some Time
    - Internet, N-Serve, GPS, Fungicides
  - Things Are Not Necessarily The Same As Before
    - Yield Levels Are Much Higher
  - Companies Invest Huge Amounts Of Dollars In Research and Development
    - Research with Universities, Private Contractors and In-House Personnel

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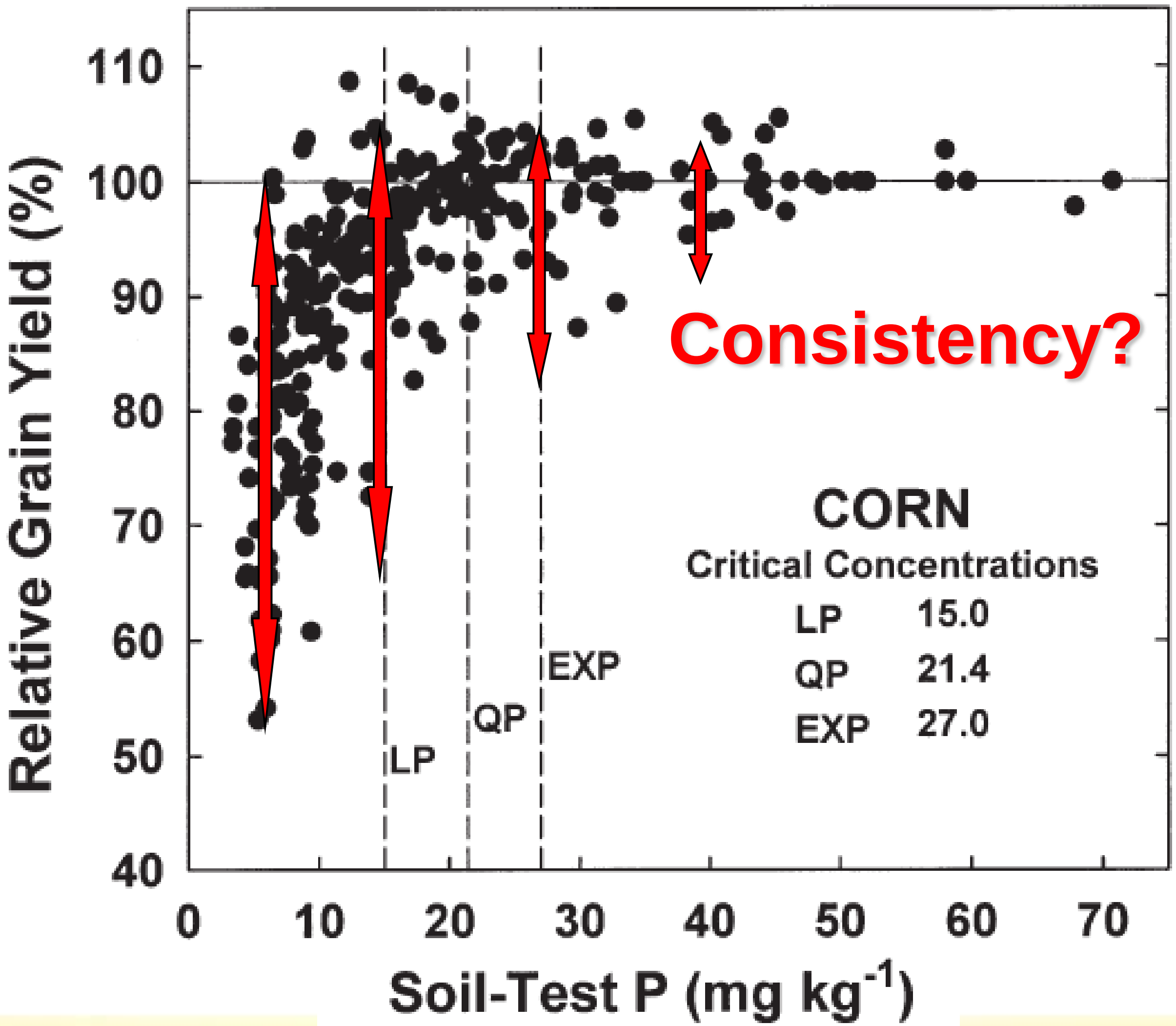
Relationship between Bray P and relative corn yield in three long-term Iowa studies over 30 years



Dodd and Mallarino, 2005

Consistency?

Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Pr

A Regional (Corn Belt) Approach to Nitrog

Single Price Ratio | Multiple Price R

Choose st

...ean

...g corn

☐ Include non-responsive sites

Set corn and nitrogen prices

Anhydrous Ammonia (82% N) 400 ($/Ton)

Nitrogen price 0.24 ($/lb N)

Corn price 3.00 ($/bu)

Calculate | Reset

Illinois Map | How to Use | More Info

Iowa
C/S Rotation
28% UAN @ $ 350/ton
Corn @ $ 4.00/bu

Corn Nitrogen Rate Calculator

Finding the Maximum Return To N and Most Profitable N Rate

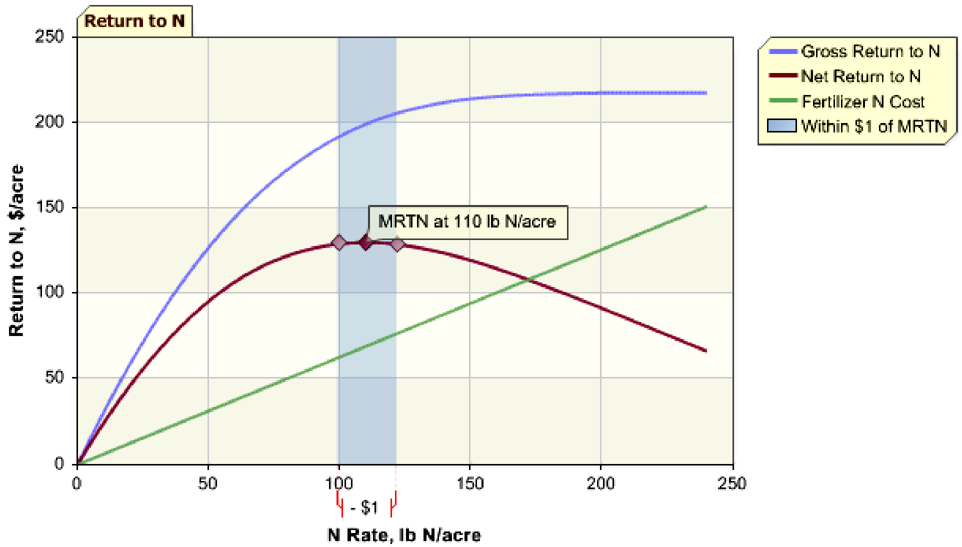
A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

State: Iowa
Number of sites: 188
Rotation: Corn Following Soybean
Non-Responsive Sites Included

Nitrogen Price ($/lb): 0.63
Corn Price ($/bu): 4.00
Price Ratio: 0.16

MRTN Rate (lb N/acre):	**110**
Profitable N Rate Range (lb N/acre):	99 - 122
Net Return to N at MRTN Rate ($/acre):	$130.02
Percent of Maximum Yield at MRTN Rate:	98%
UAN (28% N) at MRTN Rate (lb product/acre):	393
UAN (28% N) Cost at MRTN Rate ($/acre):	$69.30

Most profitable N rate is at the maximum return to N (MRTN).
Profitable N rate range provides economic return within $1/acre of the MRTN.



Corn Nitrogen Rate Calculator

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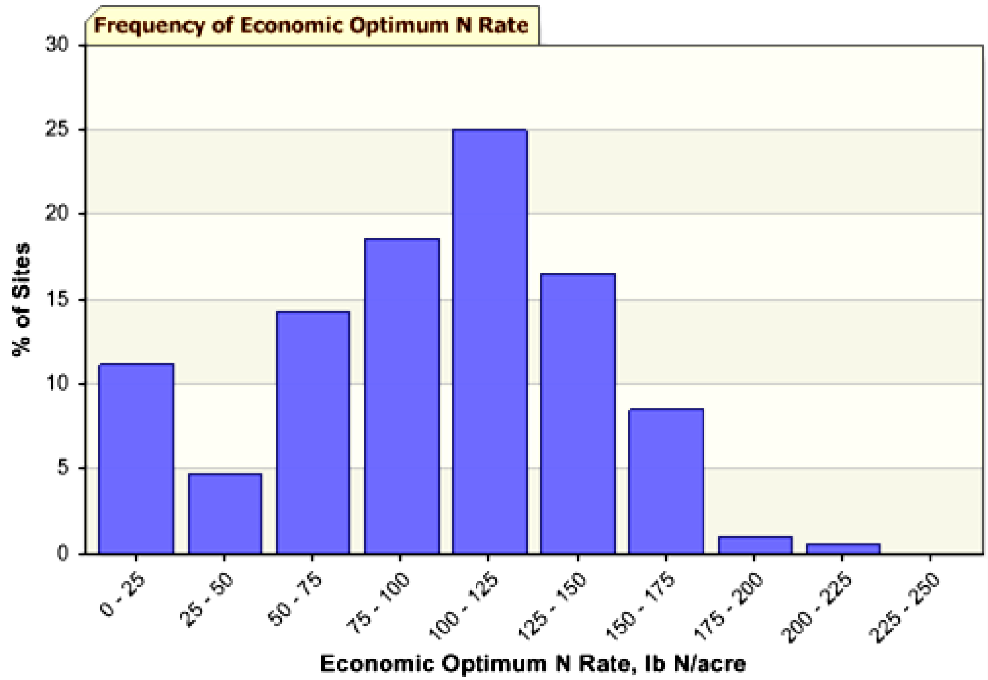
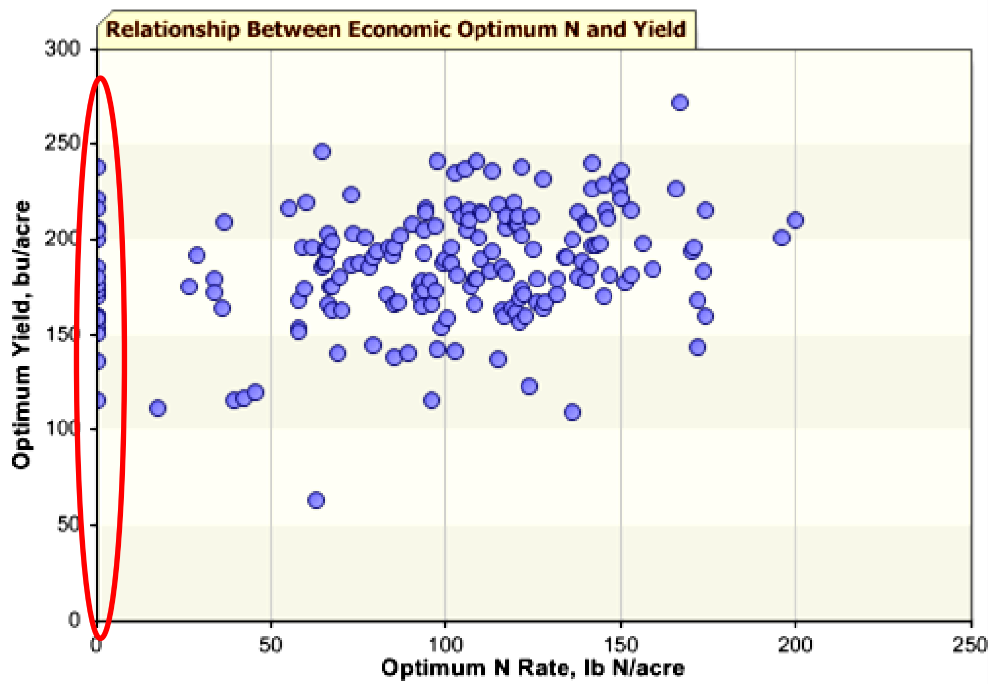
Consistency and/or Predictability?

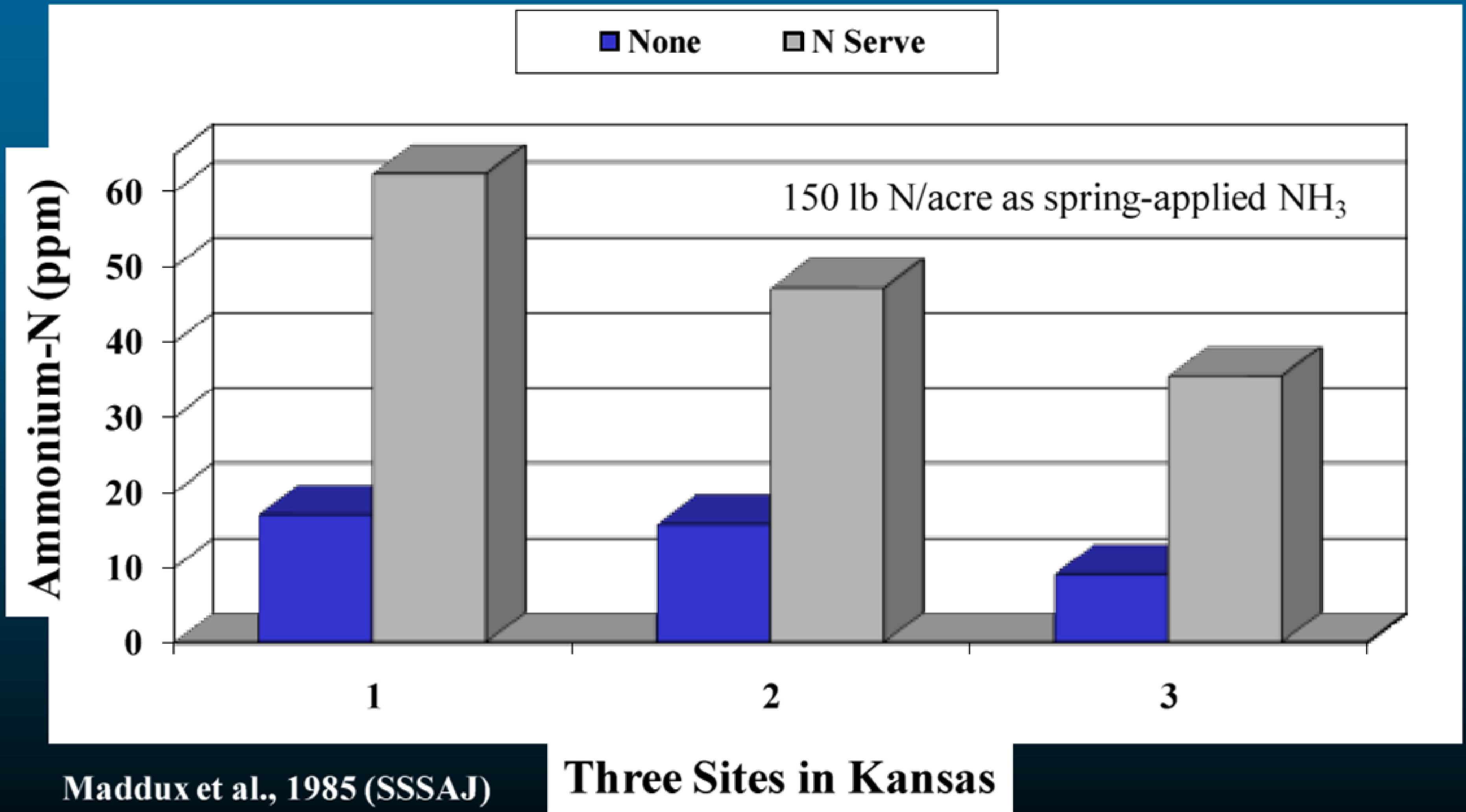




N-Serve, Instinct & DCD

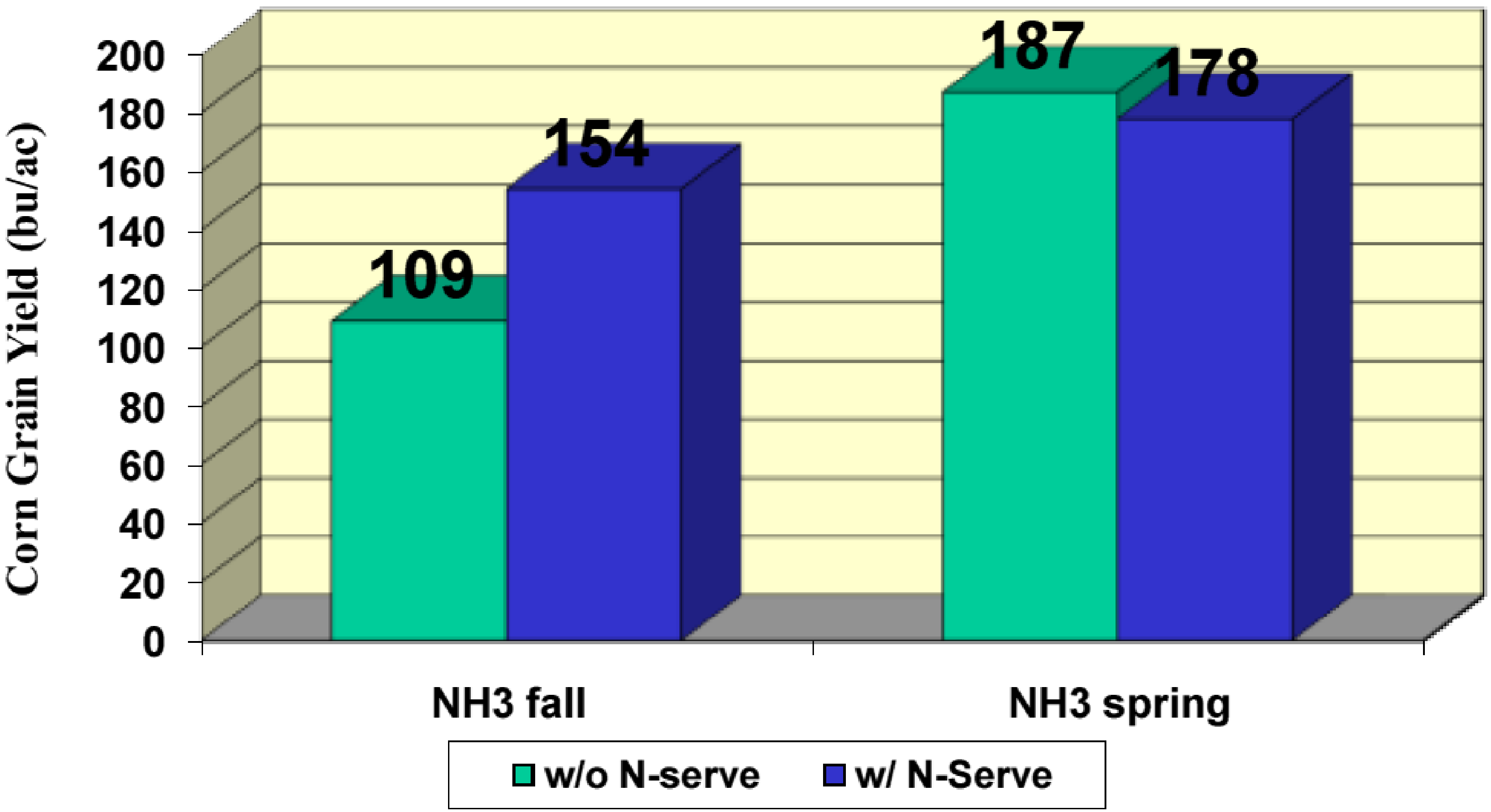
Nitrification Inhibitors

Effect of N Serve on Nitrification



Maddux et al., 1985 (SSSAJ)

Minnesota: N-Serve 1999



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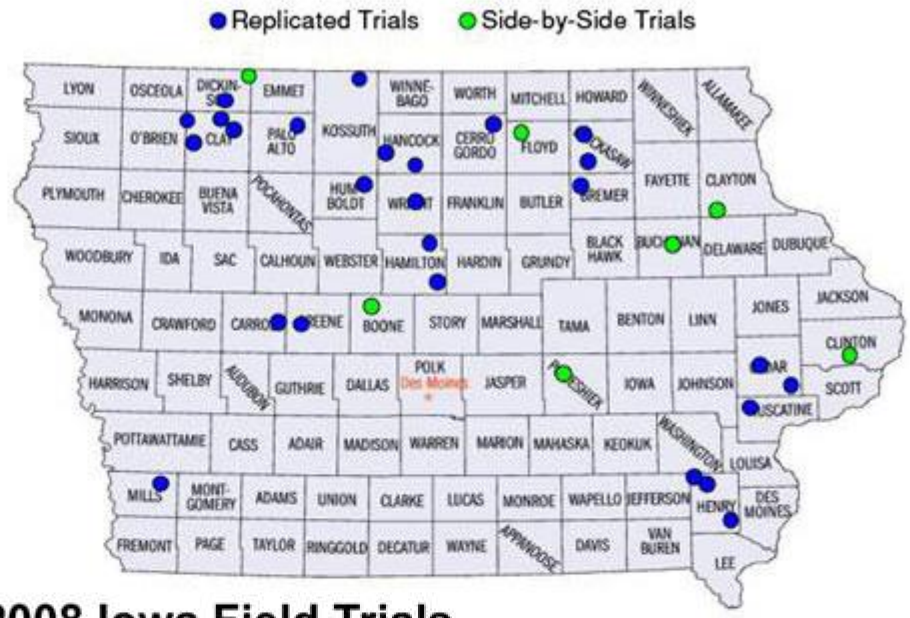
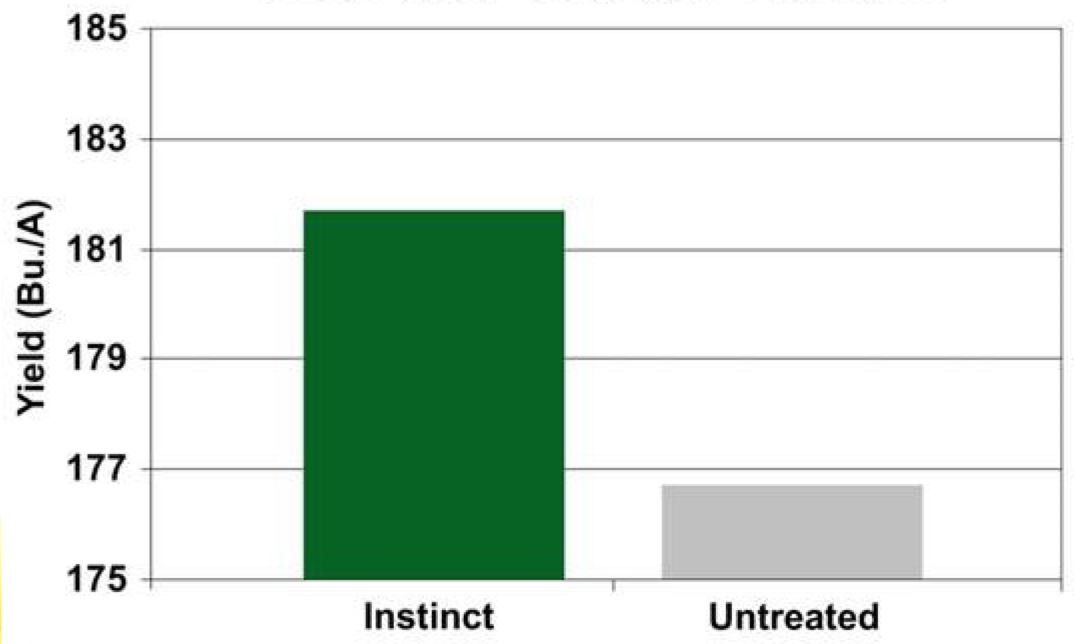
Instinct

Encapsulated *Nitrapyrin* UAN solution and liquid manure

2008 Iowa Trial Locations of Instinct™ Nitrogen Stabilizer



Yield Results of 2008 Iowa Field Trials for Instinct™ Nitrogen Stabilizer



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Urea-Formaldehyde and Triazone Products

- **Urea Containing Polymers**
  - Combinations of various urea-formaldehyde polymers such as methylene urea, methylene diurea, dimethylene triurea, triazone, etc.
  - The longer/more complex the polymer, the longer the residual (slower the release).
  - The higher the SRN content, the longer the residual soil availability.

N-Sure, N-Pact, CoRoN, Nitamin, KQ-XRN, Gradual N, etc.

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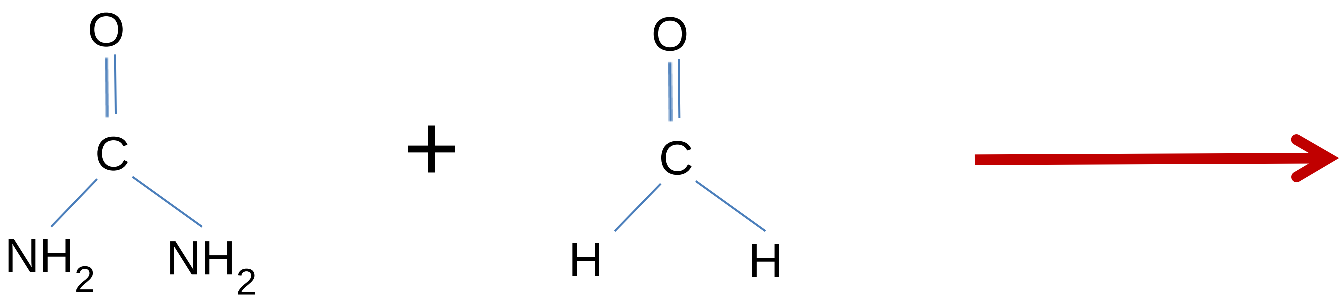
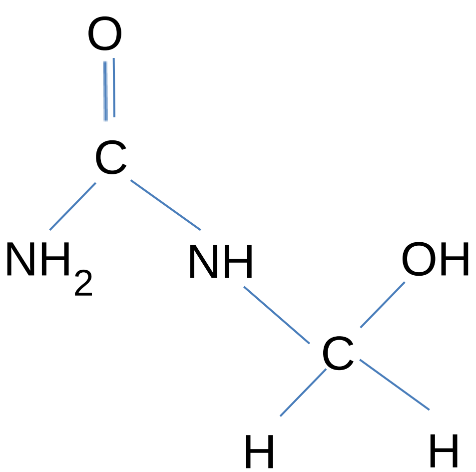
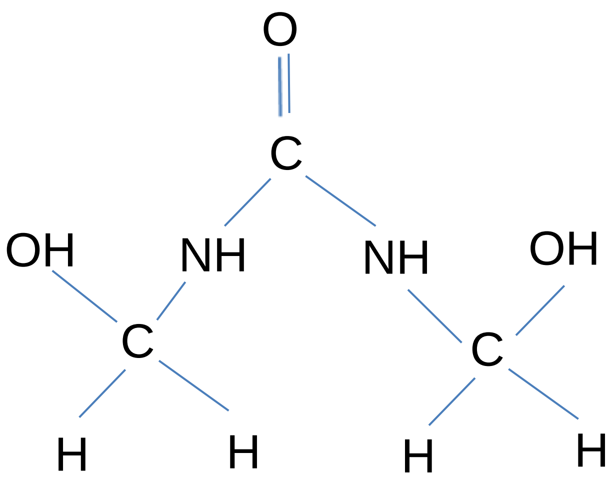
Urea Formaldehyde Condensate Products



Urea **Formaldehyde**

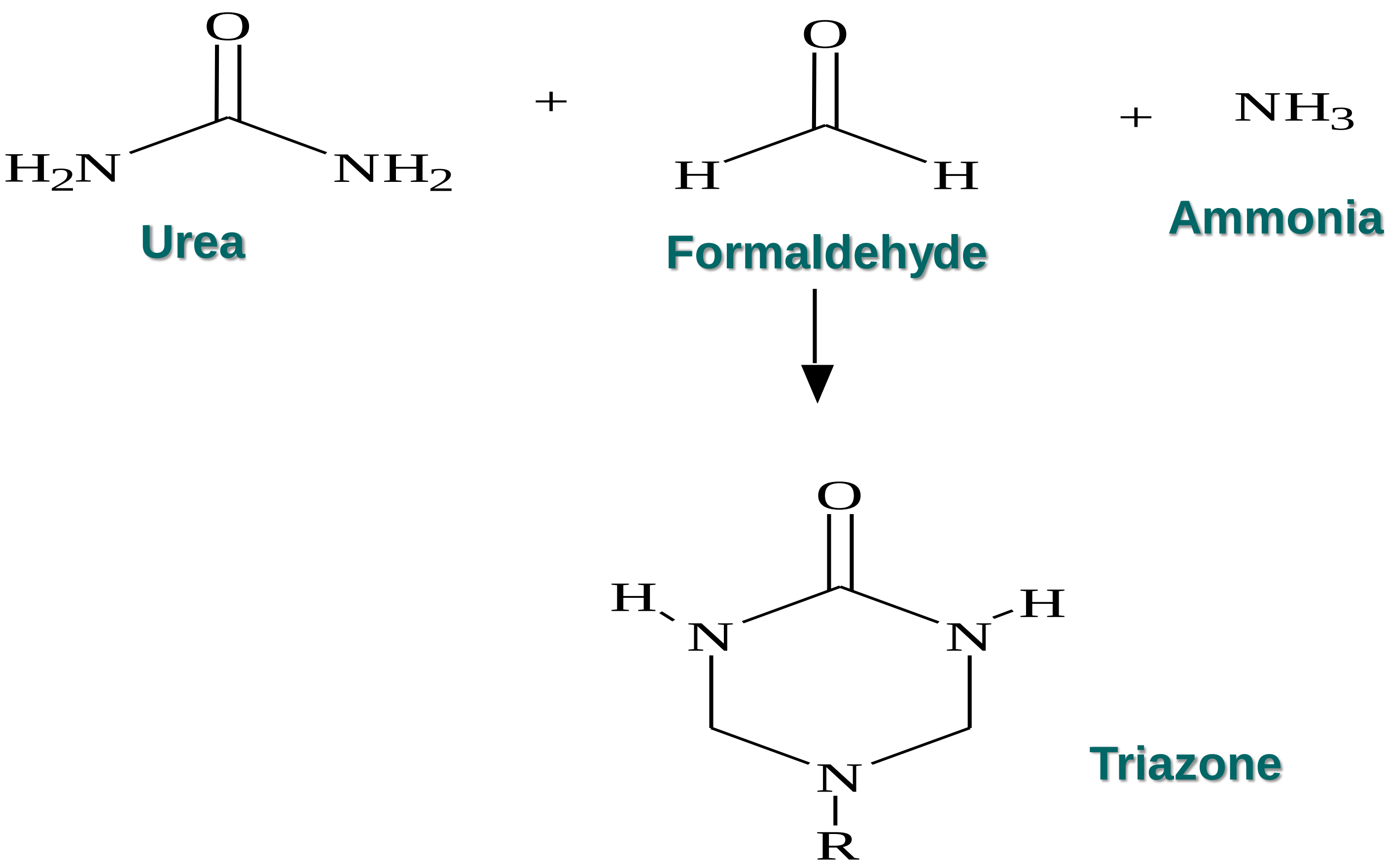


Monomethylene Urea (MMU)



Methylene Diurea (DMU)

Triazone Formation



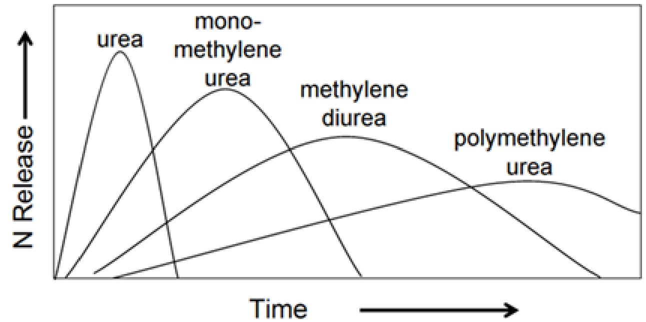
$$R = H,\ CH_2\ NHCONH_2$$

Triazone/Urea-Formaldehyde Characteristics

- **Slow-release N properties**
  - Requires soil microbial activity; temperature and moisture sensitive
  - After 24 days@72˚F only 41% had converted to ammonium (Kissel, 1988)
  - Soil at 78º F is four times as active as soil at 42º F
    (J. N. Booze-Daniels and R. E. Schmidt, Virginia Tech)
  - Commonly stated availability at 8-10 weeks, less at cool temperatures

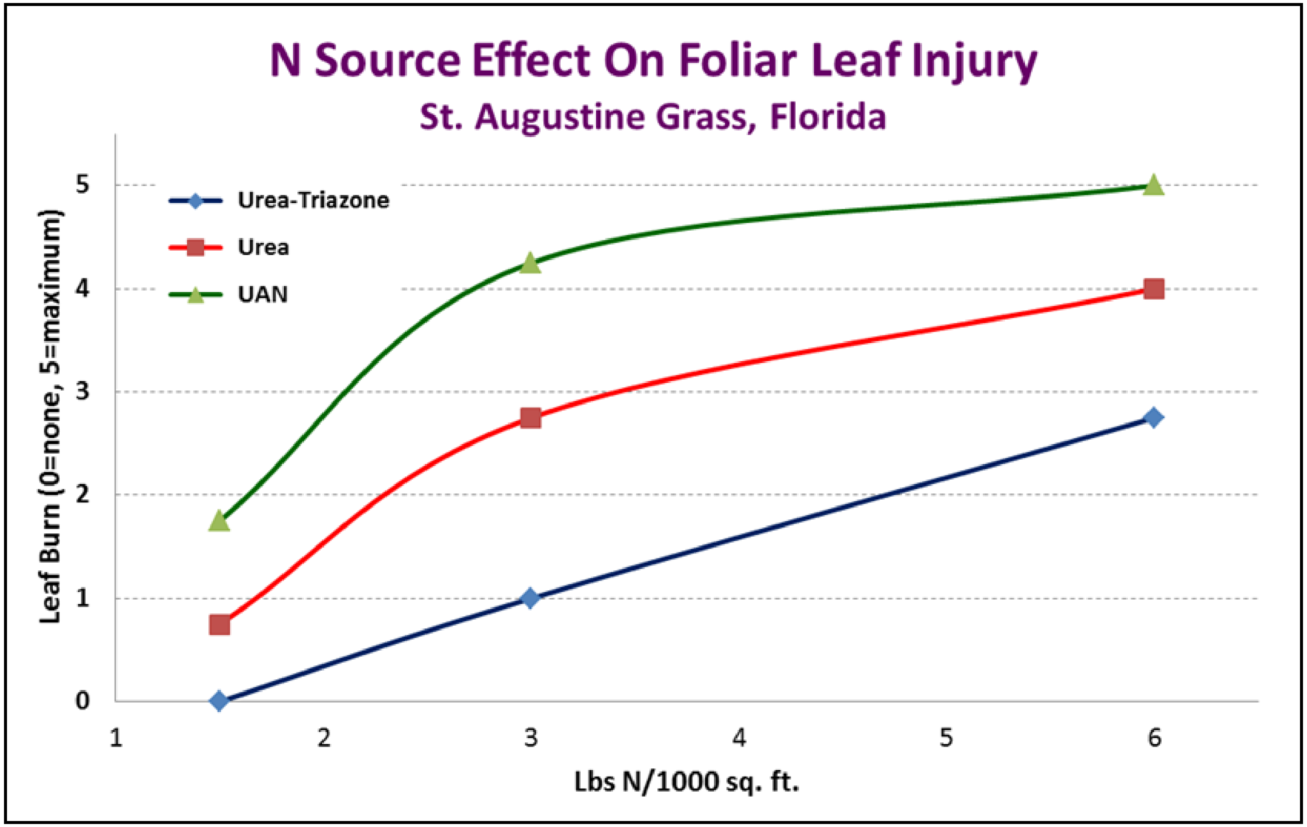
Low-Solubility Compounds (UF, MU)

- N release by microbial mineralization (soil temperature, moisture, pH, etc)
- Longer chains = slower release
- Typical release 8-12 weeks



Triazone/Urea-Formaldehyde Characteristics

- Less leaf burn potential than urea or other N sources



Triazone/Urea-Formaldehyde Characteristics

- Remains on leaf tissue in liquid phase longer than urea
  - Potential foliar absorption is greater than for urea alone

    (Clapp and Parham, Fertilizer Research, Vol. 28, 1991)

- Less initial potential for N volatilization than urea
  - Potentially important for unincorporated soil application

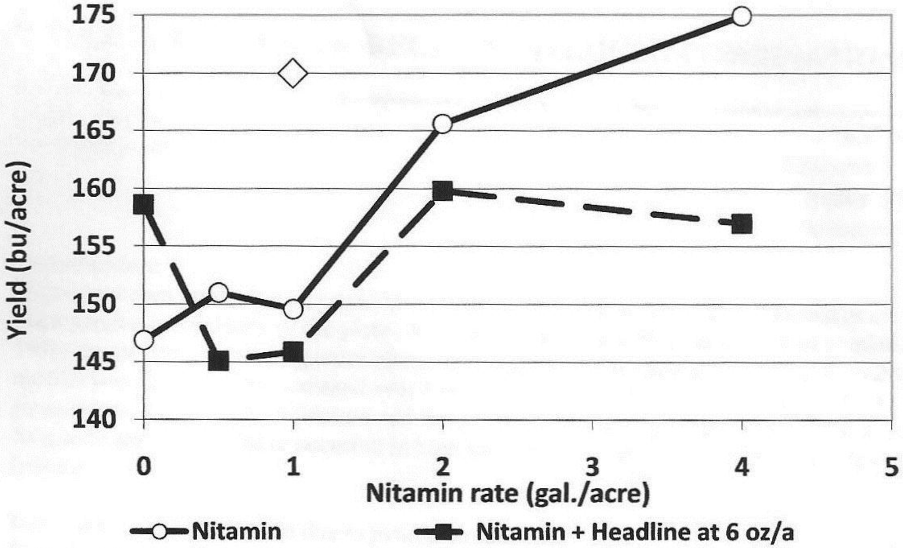


Figure 1. Grain yield response to Nitamin rates with and without Headline at 6 oz/acre or 3 oz/acre plus nonionic surfactant at 0.25% v/v in 2008. LSD ($P \leq 0.05$) was 18. Mixing order is the sequence listed in the legend.

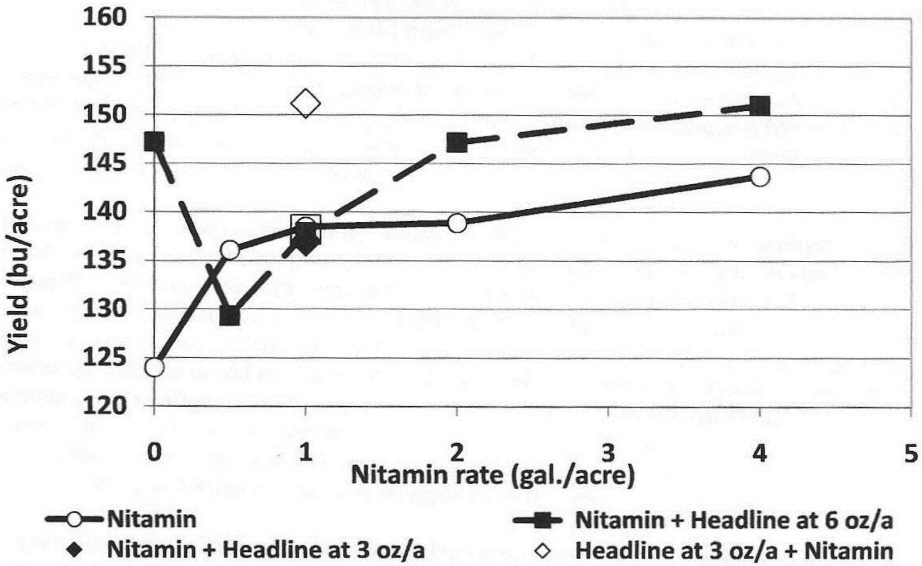


Figure 2. Grain yield response to Nitamin rates with and without Headline at 6 oz/acre or 3 oz/acre plus nonionic surfactant at 0.25% v/v in 2009. LSD ($P \leq 0.05$) was 14. Mixing order is the sequence listed in the legend.

K. Nelson, P. Motavalli and B. Burdick
University of Missouri

Triazone, Methylene Urea, Urea Formaldehyde, etc.

N-Sure®

N-Pact

nitamin

GRADUAL-N

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Effect Of CoRoN on Corn

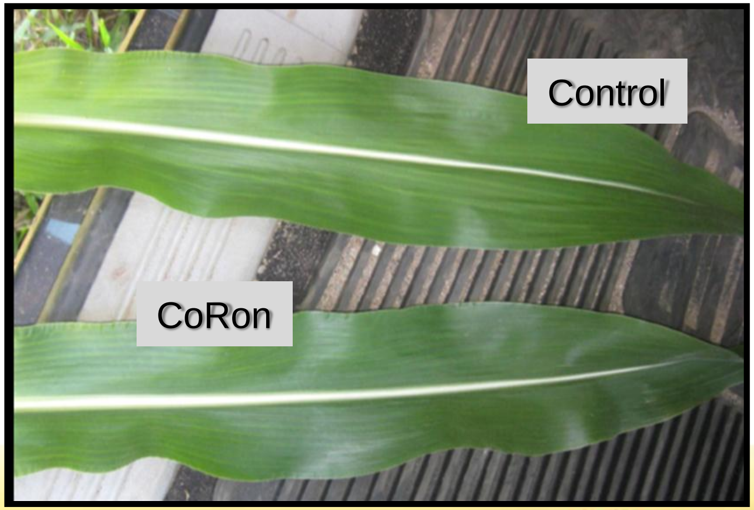
Kristi Thompson, University of Wisconsin-River Falls

Control

Treated with 28.17 liters CoRoN®

CoRon 25-0-0-0.5B @ V6 to V8 (~25% SRN)

Treated with 28.17 liters CoRoN® Control



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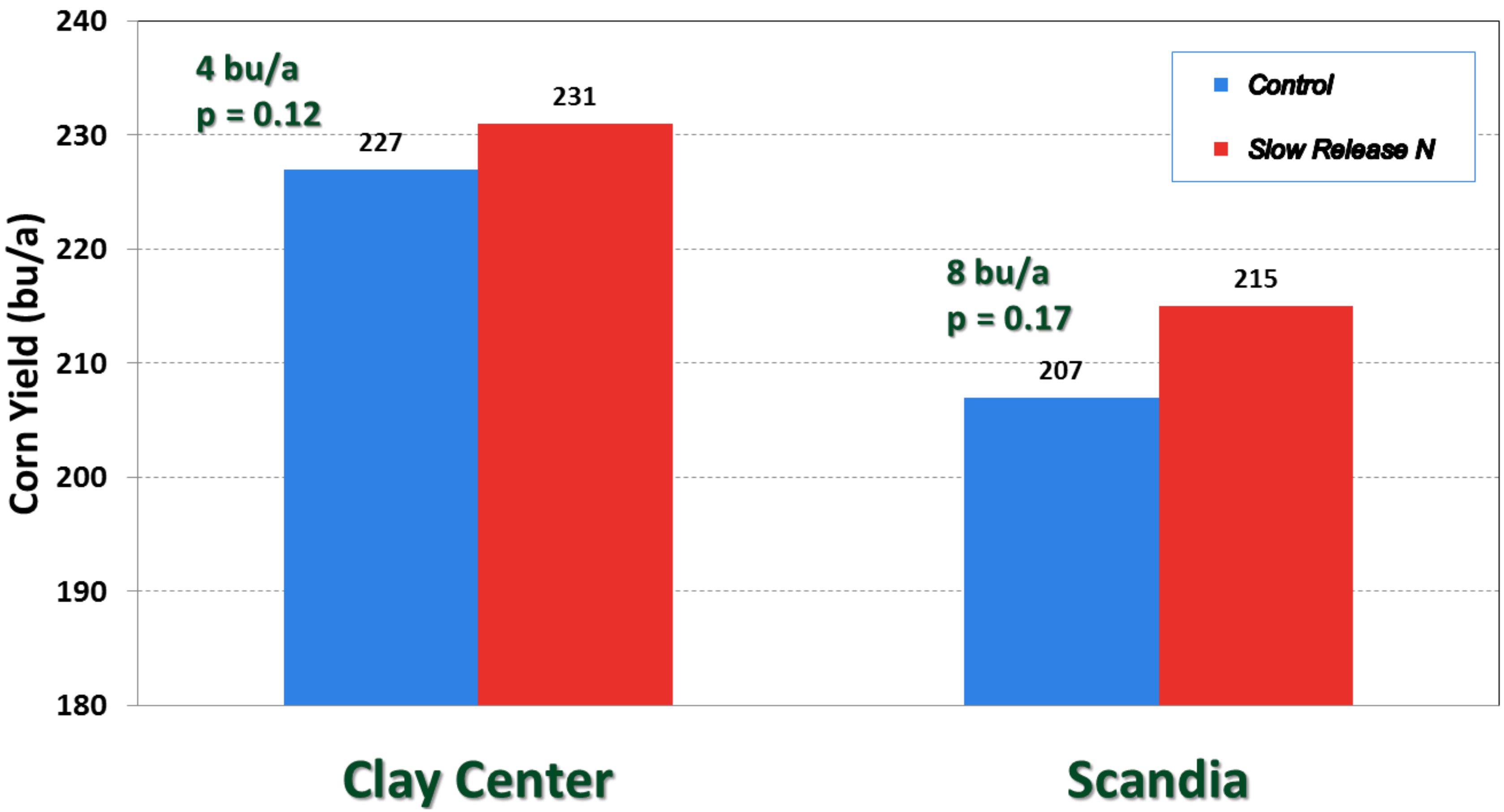
Foliar Urea-Triazone Application To Corn

Dorivar, KSU, 2010



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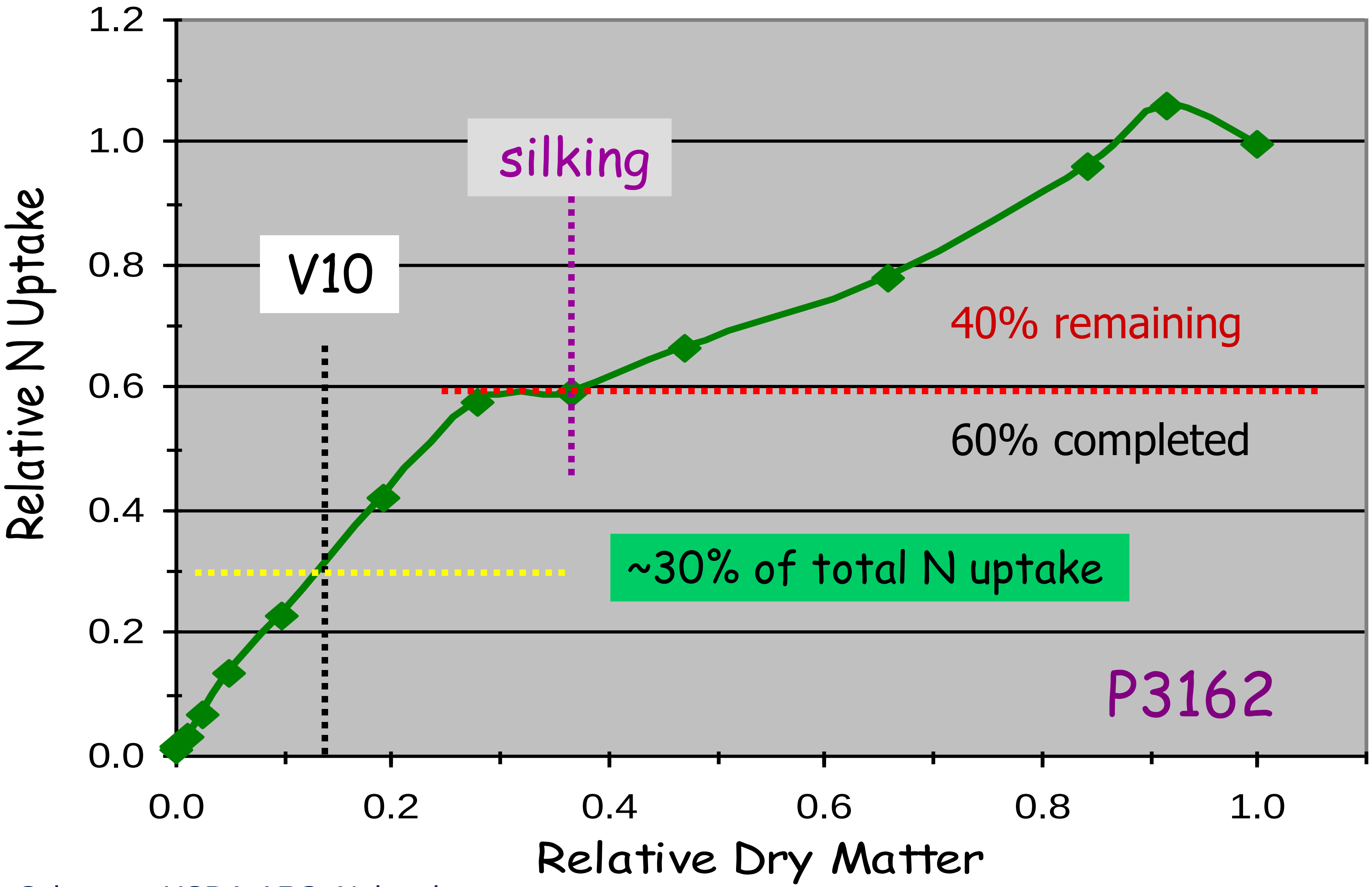
Relative Dry Matter vs. N Uptake



J. Schepers, USDA-ARS, Nebraska

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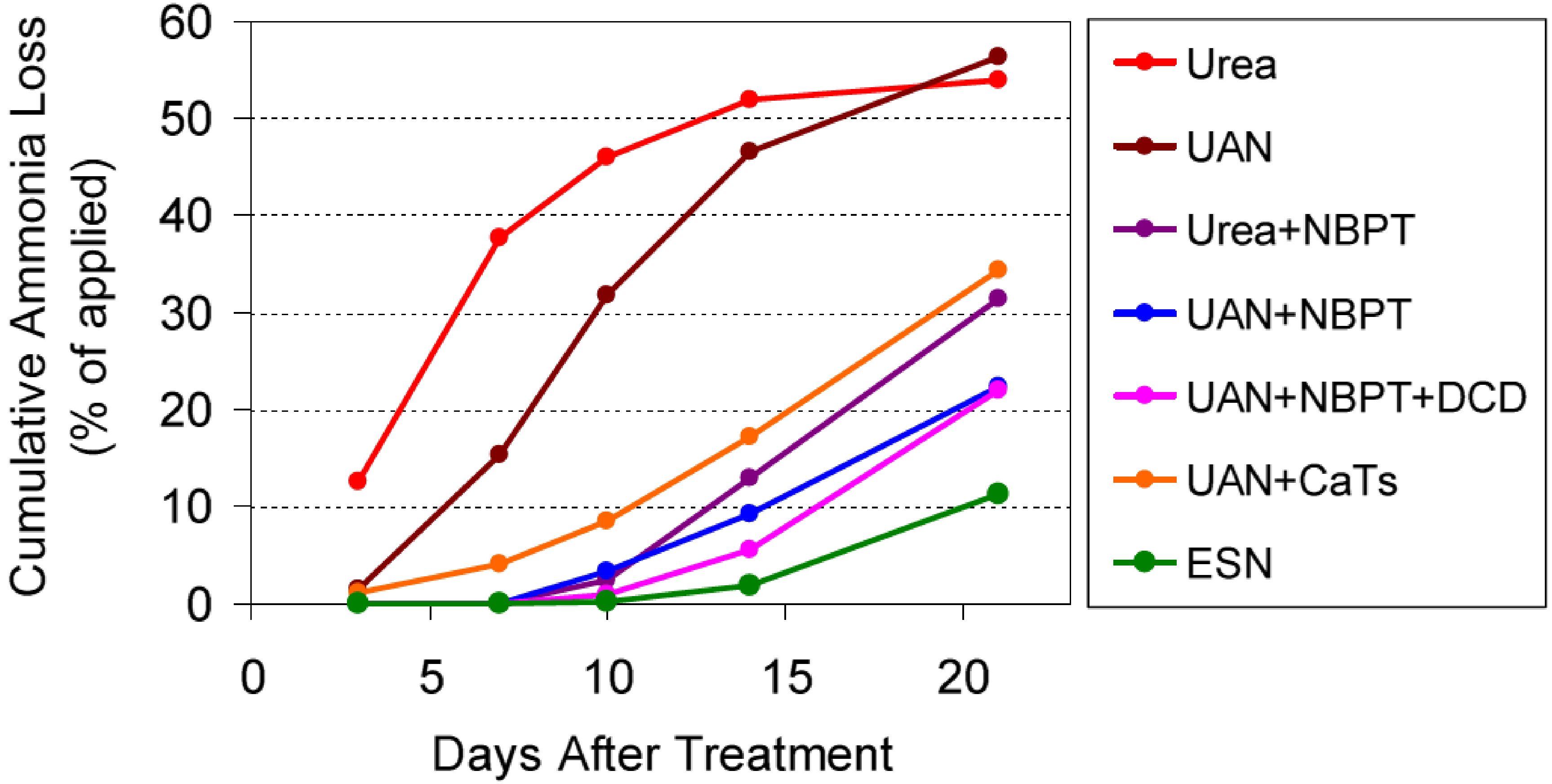
Agrotain (NBPT)

- Disrupts urease activity from 7 to 14 days and decreases potential volatilization loss.

✓ **Primary use is on surface applied urea**

✓ **Combined with DCD (Agrotain Plus/Super U) slows nitrification when urea or UAN are incorporated into soil.**

N Source and Additive Effects On Laboratory Ammonia Volatilization



Source: Dr. W. Thornberry, Sturgis, KY; Dr. S. Ebelhar, Univ of Illinois

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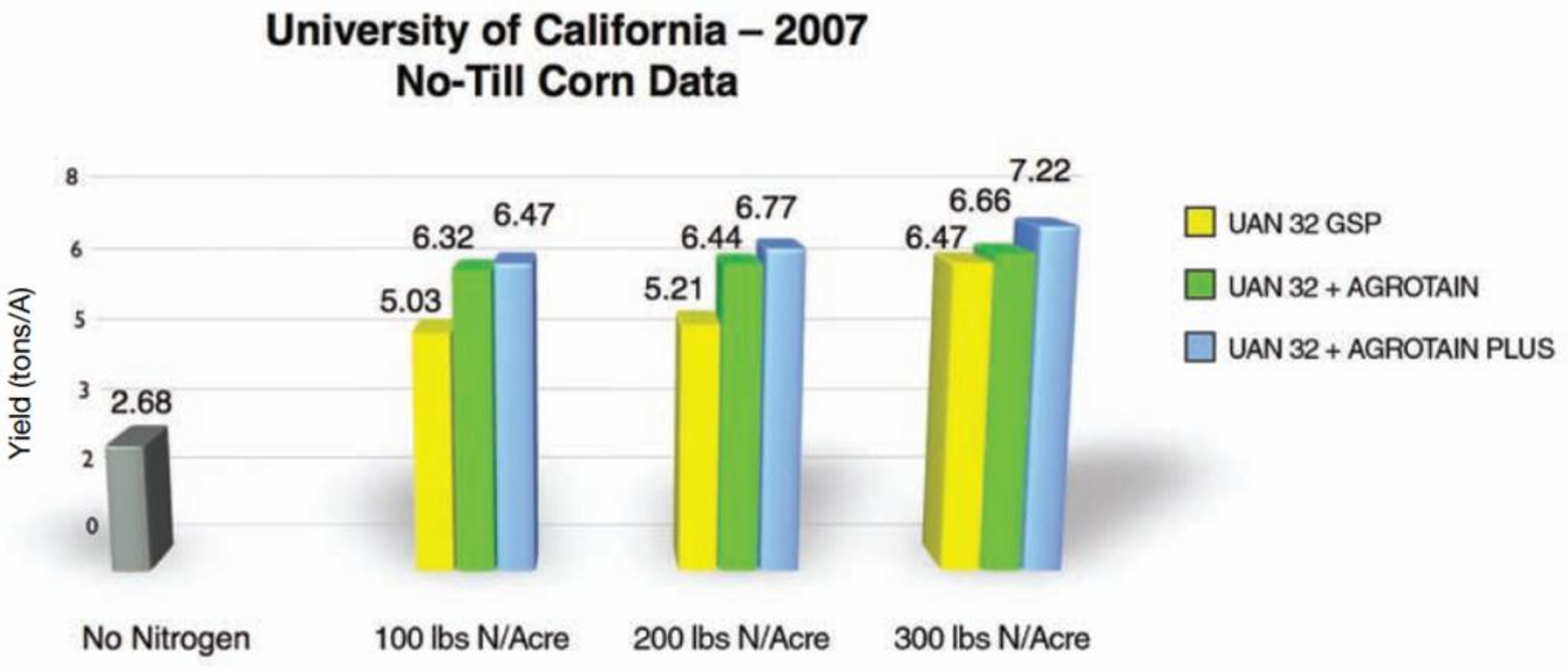
Utilization of AGROTAIN Treated Urea In A Corn Cropping System In Alabama

AUBURN UNIVERSITY (ALABAMA) - C. W. Wood, C. G. Cummings, R. Duffield

Treatment	N Rate (lb/acre)	
	100	**200**
	yield (bu/acre)	
AGROTAIN Urea	110.8	116.0
Urea	102.1	107.3
Ammonium Nitrate	98.8	99.0

Nitrogen and Agrotain Effects On No-Till Corn



Treatment
Soil: Yolo Clay Loam
pH: 7.0
UAN shallow incorporated followed by furrow irrigation.

1994 Nitrogen Source Study on No-till corn, Poplar Hill Research and Education Facility, University of Maryland

No-till corn into a small grain (wheat) double cropped soybean stubble.
All liquid materials were broadcast between rows when corn was 12" tall.

TREATMENTS	YIELD BU/A
Check P&K only	77.5
Urea (46-0-0)	150.5
Urea with AGROTAIN	176.5
30% UAN Solution Broadcast	166.9
30% UAN Solution Injected	173.9
UAN with AGROTAIN	182.3
UAN with AGROTAIN & DCD	173.7
UAN with 8-0-0-9 (ammonium sulfate)	185.4
SuperU	176.8

F. R. Mulford, Mryland

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UNIVERSITY OF ILLINOIS - B. Hoeft,
Evaluation Of AGROTAIN Nitrogen Stabilizer

Experiments were established at two Illinois locations to evaluate the effect of N rate and AGROTAIN on the N concentration of ear leaf corn samples collected at tasseling and on corn yield at maturity when applied with urea and UAN solutions. N treatments were 0, 80, 120, 160, and 200 lb/acre N. Due to an abnormally wet spring and summer, treatment applications were delayed in hopes of finding a rain-free period. Summary: Limited yield response associated with the surface applications and receipt of rain (1.65") within 5 days of applications did not allow the AGROTAIN an opportunity to express its effectiveness as a Nitrogen Stabilizer. Out of 8 NBPT comparison, it significantly increased yield at 2,120 lb/acre N (+14) and 200 lb/acre N (+20.5).

N Source	**120 lb/acre N**	**200 lb/acre N**
	yield (bu/acre)	
AGROTAIN Urea	120.9	131.4
Urea	106.8	110.9
Advantage	**+14.1**	**+20.5**

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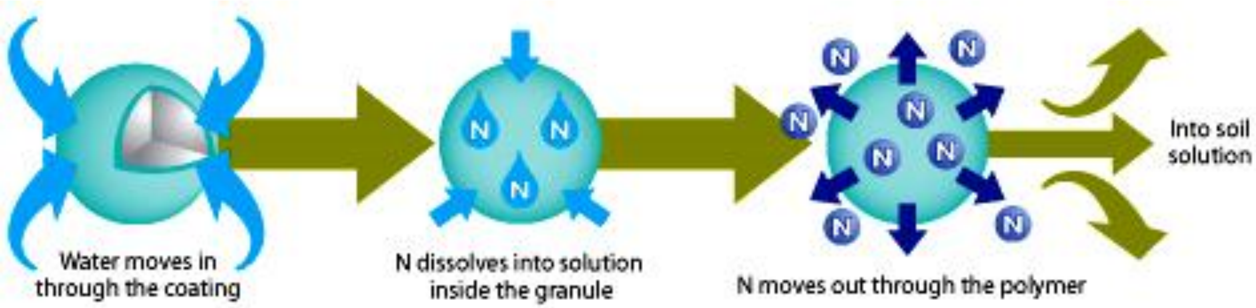
ESN

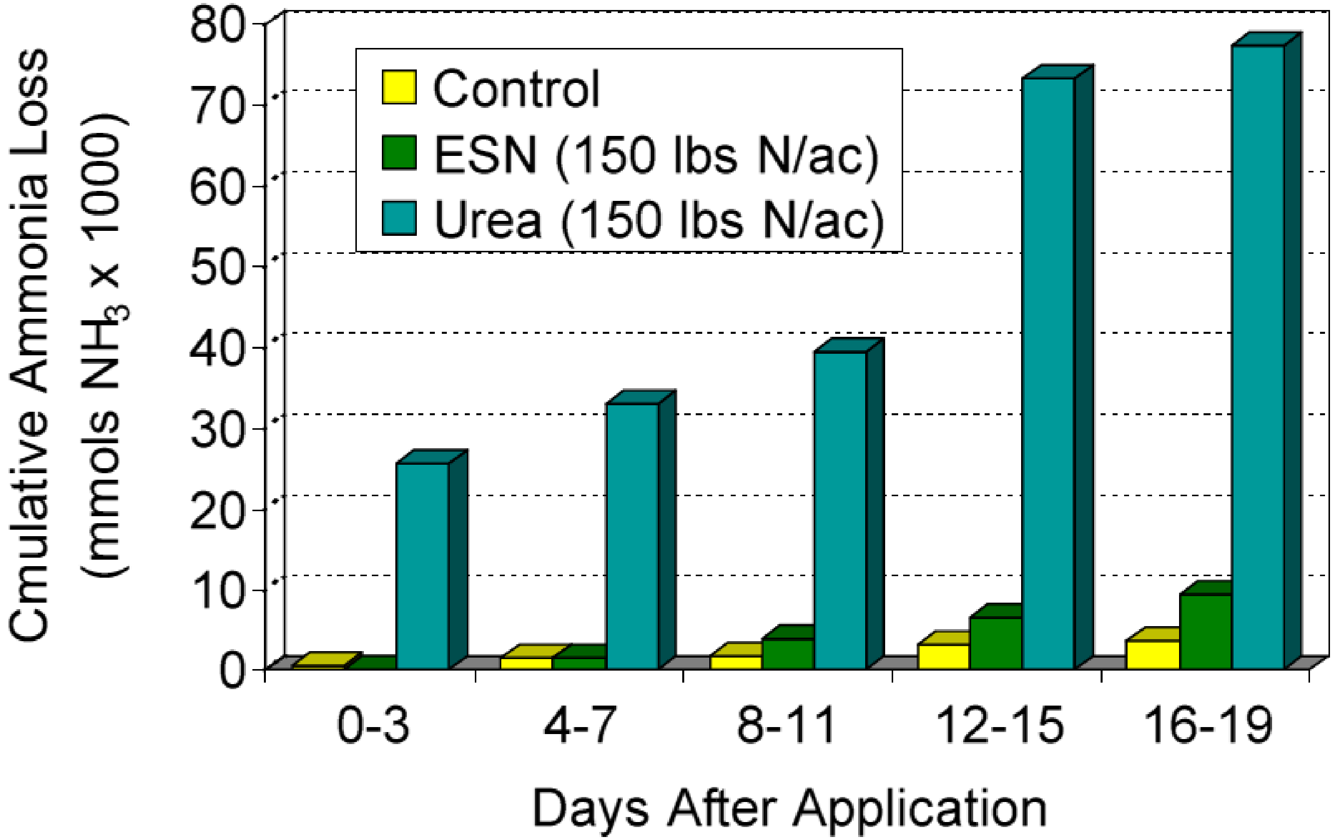
SmartNitrogen

Agrium

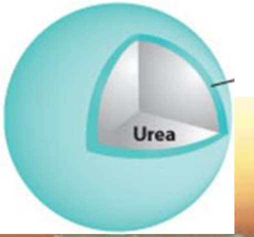
- **Polymer coatings applied to soluble fertilizer**
- **Release by diffusion through coating**
- **Release rate determined by**
  - **Polymer chemistry, thickness, coating process**
  - **<u>Temperature</u> and moisture**
- **Controlled release vs delayed release**



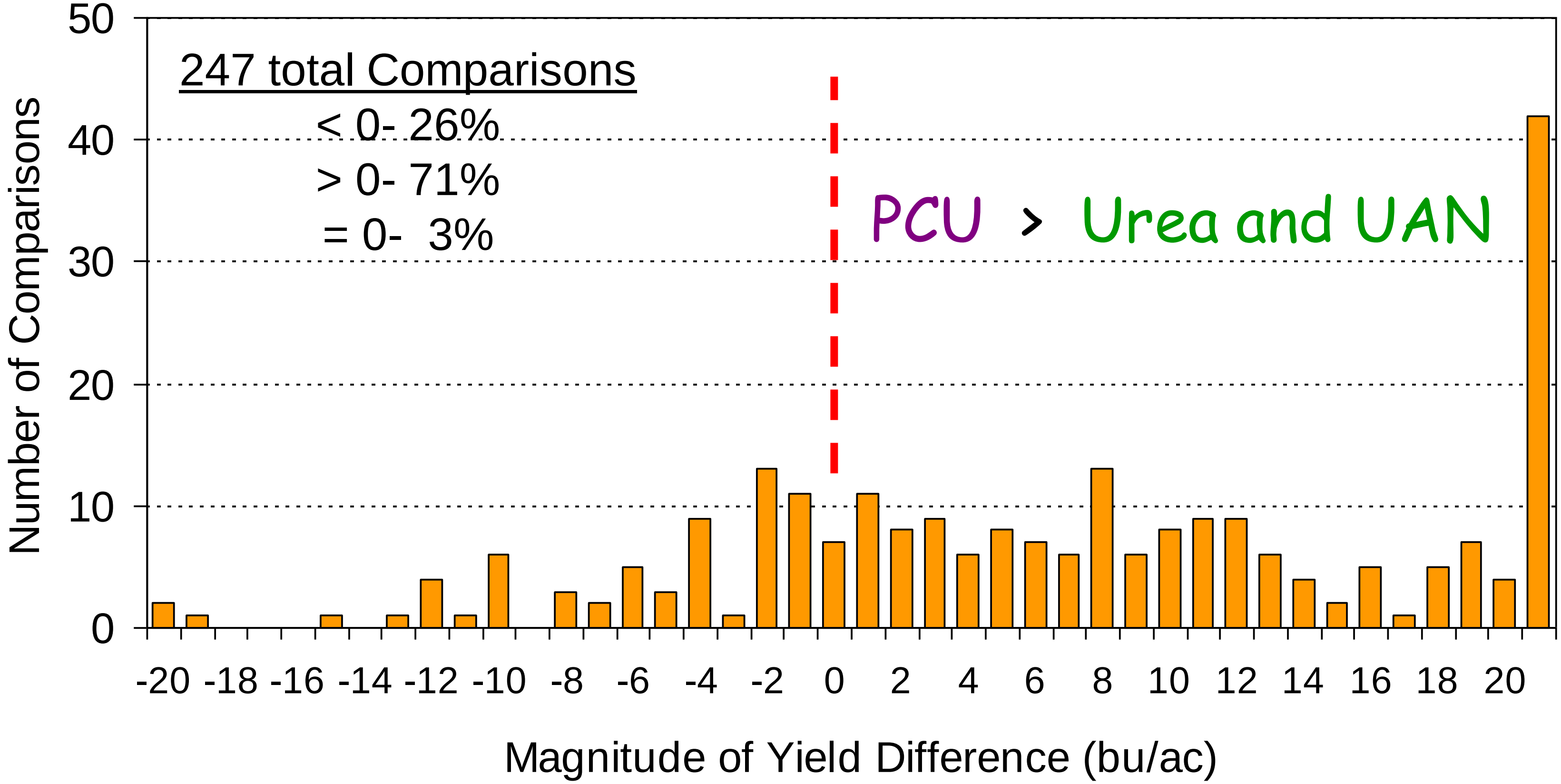
N Source and Ammonia Volatilization Washington, 2007



Field study; spring top-dress application on winter wheat
Source: R Koenig, Washington State Univ



Comparisons of pre-plant PCU with urea and UAN at equal N rates



Compilation of data from source-rate studies and trials in the US Corn Belt, 2000-2005
A. Blaylock, personal communication

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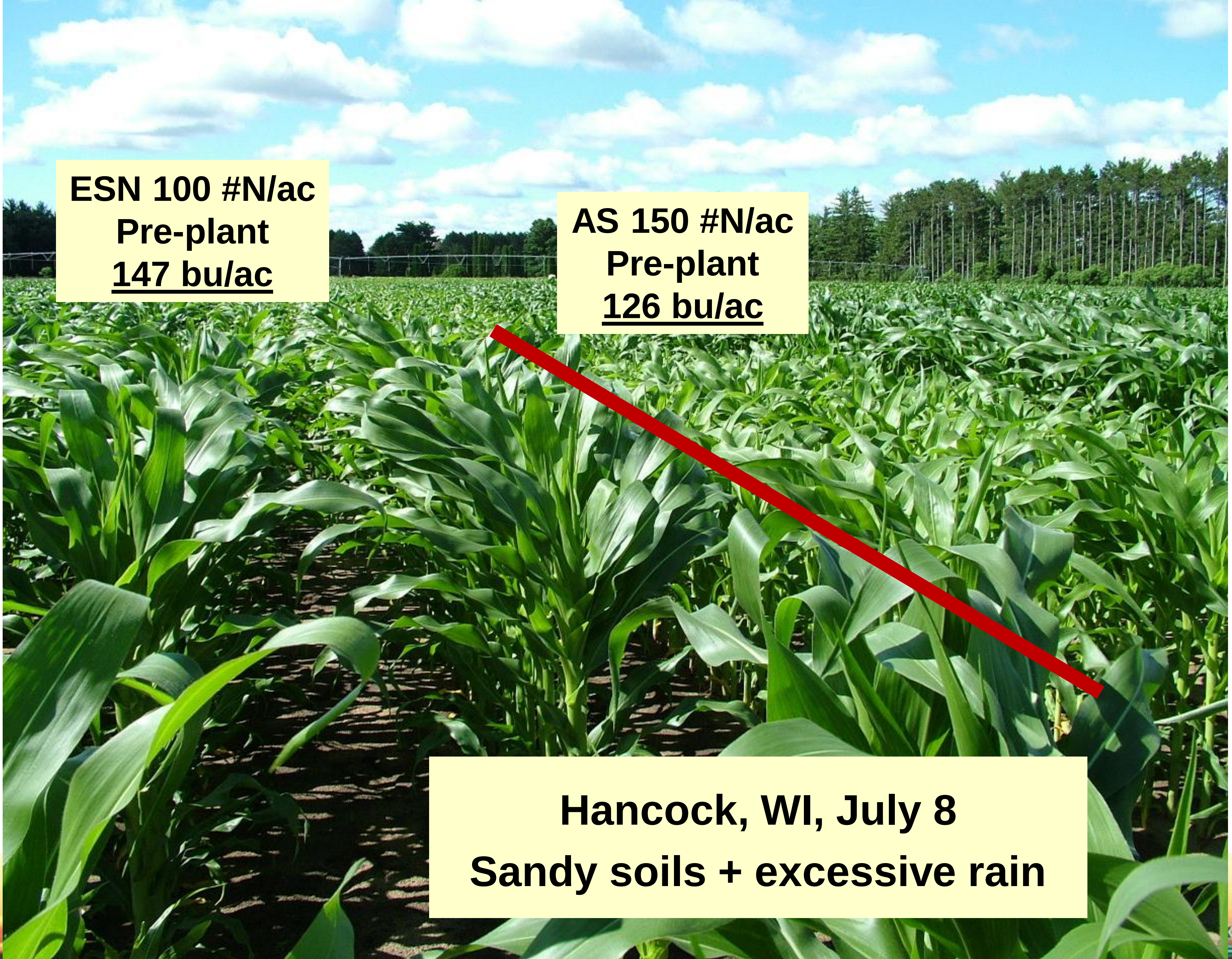
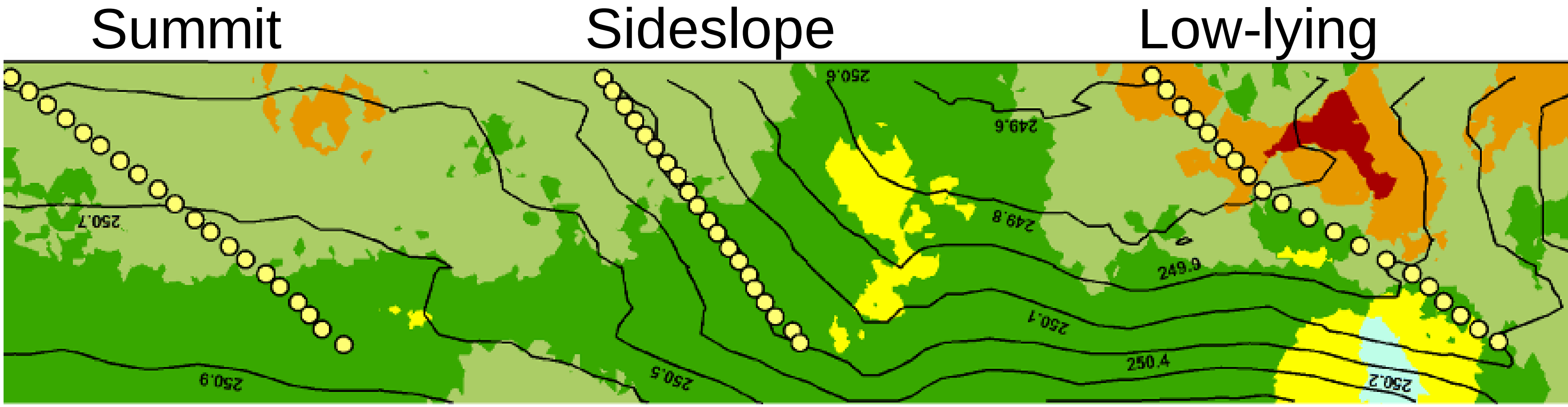
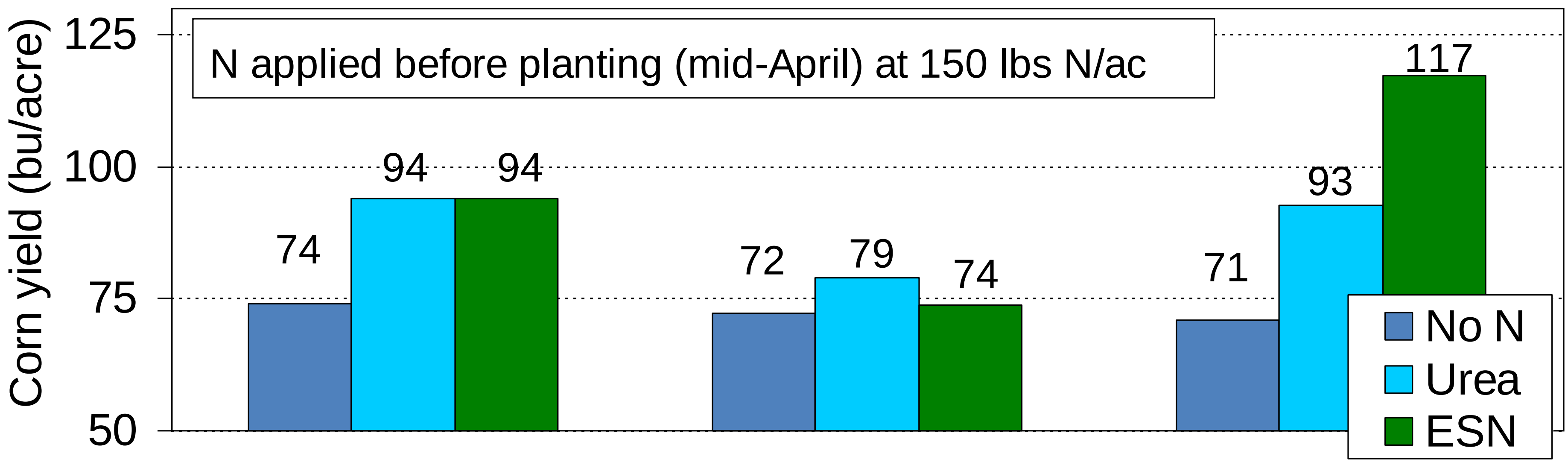

ESN 100 #N/ac
Pre-plant
147 bu/ac
AS 150 #N/ac
Pre-plant
126 bu/ac
Hancock, WI, July 8
Sandy soils + excessive rain

Variable-Source N Fertilization Greenley, MO, 2005

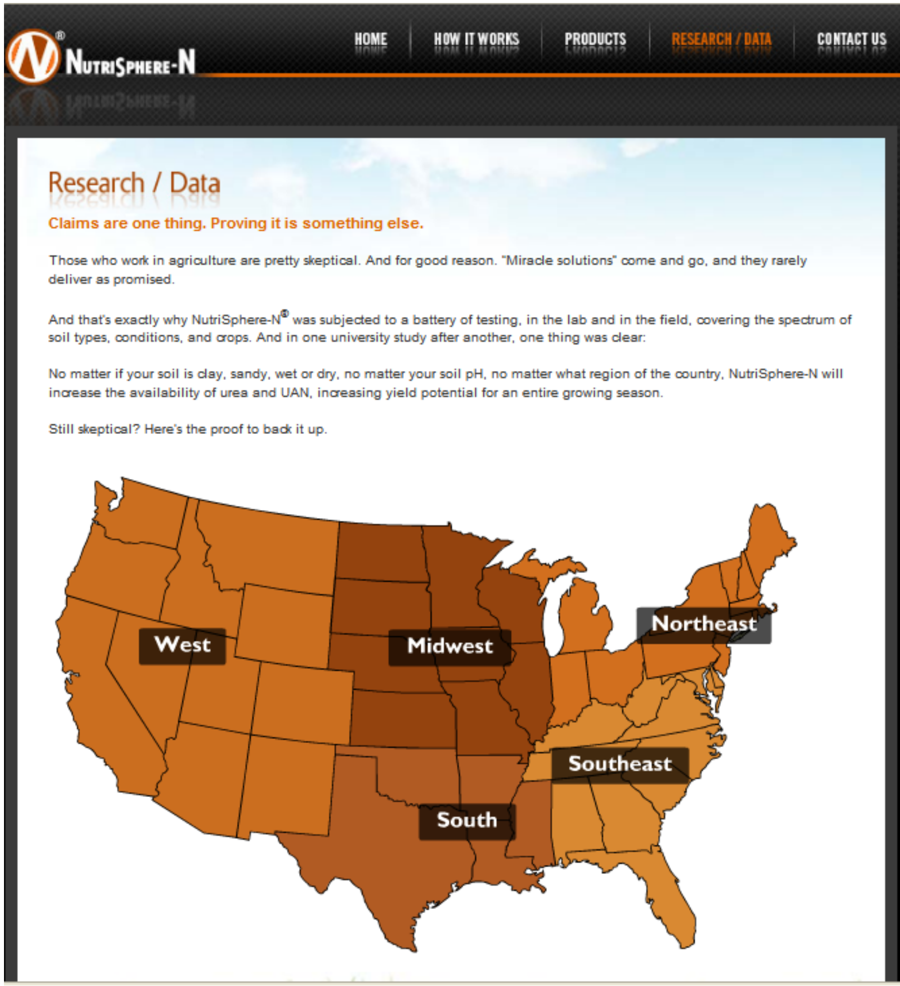




Source: Drs. P. Motavalli, K. Nelson, Missouri, 2005.

NutriSphere-N

- **Thought to complex multivalent cations removing them from biochemical processes.**
  - Combines with Ni to reduce urease activity.
  - Combines with Fe and Cu to reduce micro-organism metabolic activity delaying nitrification.



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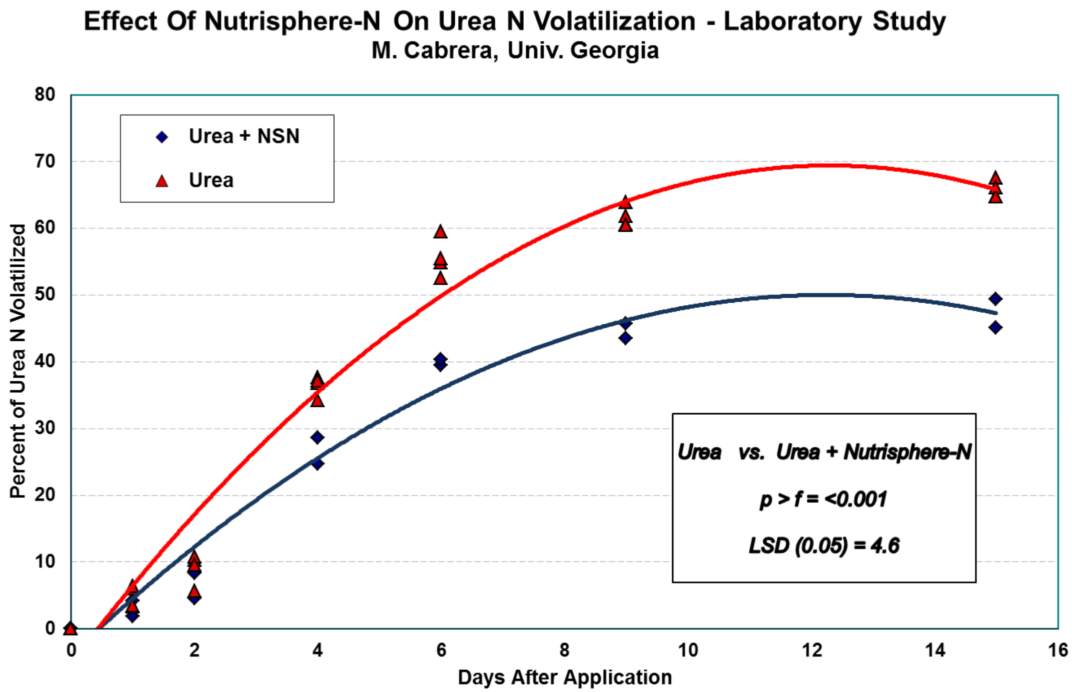
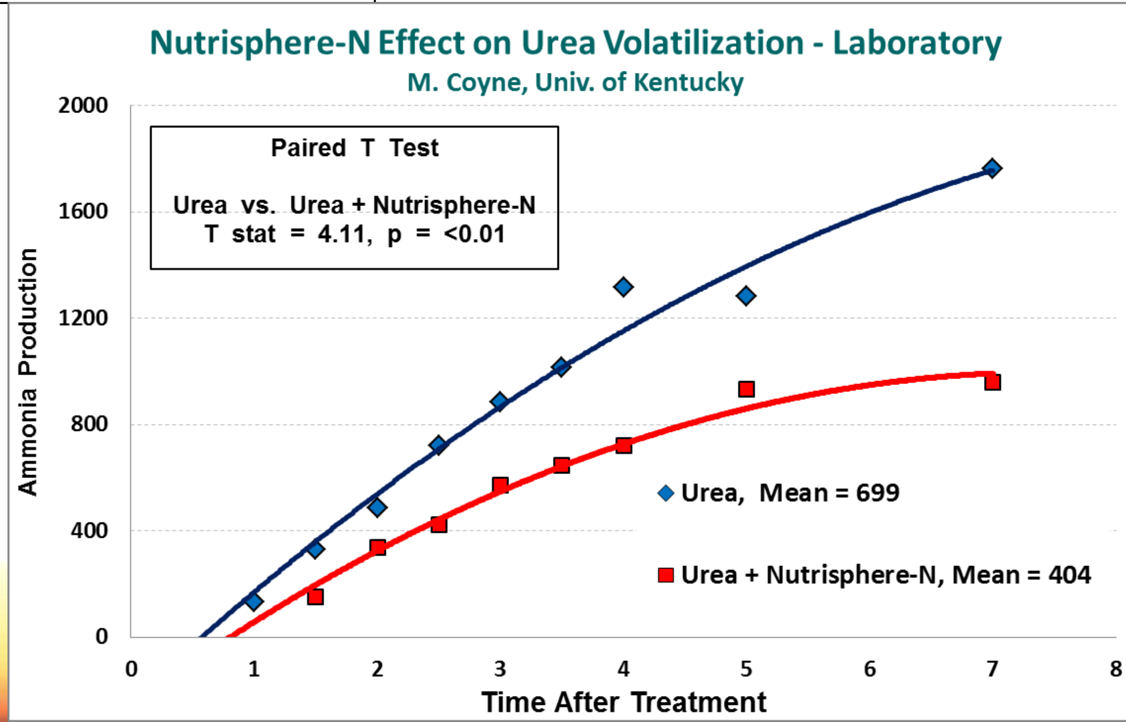
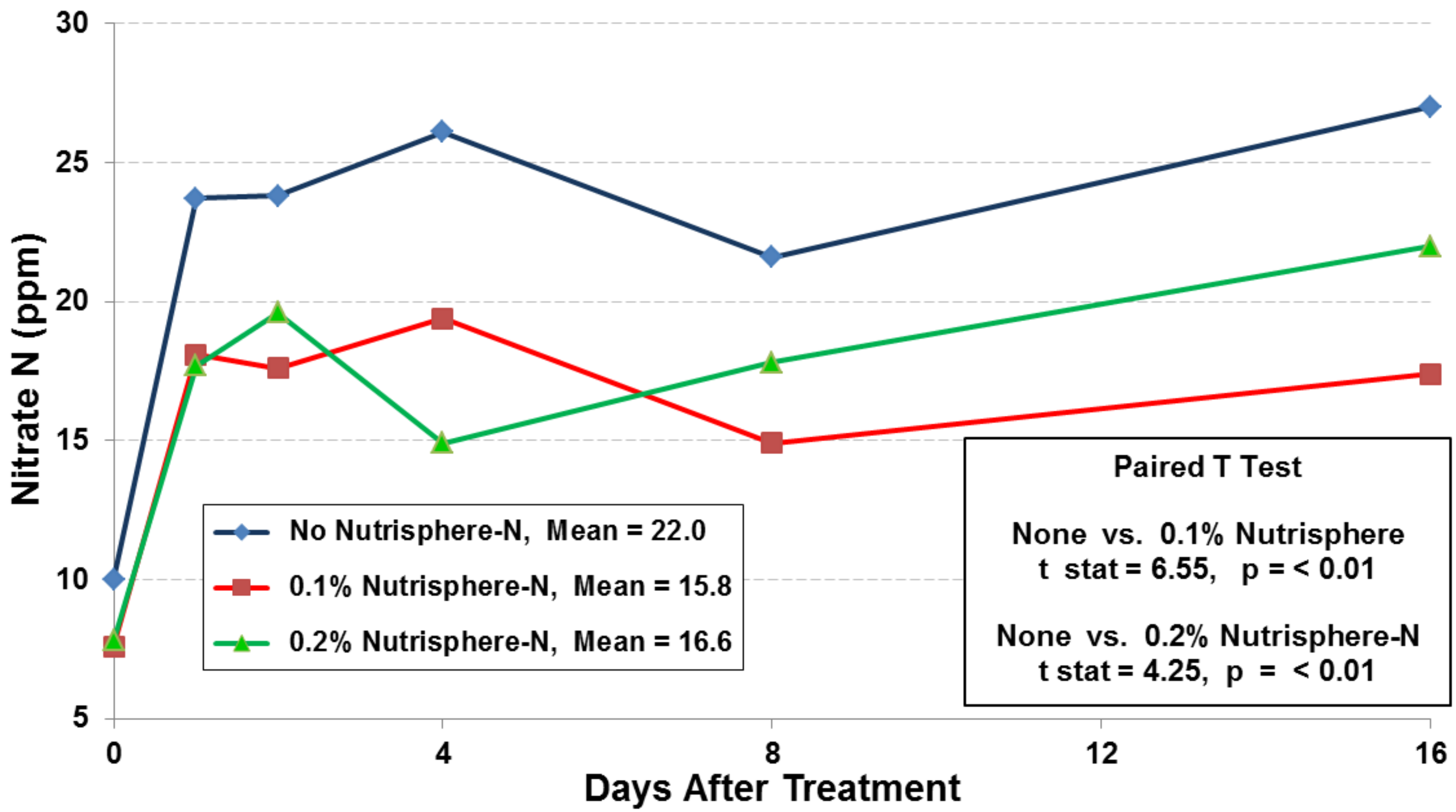

Effect Of Nutrisphere-N On Urea N Volatilization - Laboratory Study
M. Cabrera, Univ. Georgia
Urea + NSN
Urea
Urea vs. Urea + Nutrisphere-N
p > f = <0.001
LSD (0.05) = 4.6
Percent of Urea N Volatilized
Days After Application
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16


Nutrisphere-N Effect on Urea Volatilization - Laboratory
M. Coyne, Univ. of Kentucky
Paired T Test
Urea vs. Urea + Nutrisphere-N
T stat = 4.11, p = <0.01
Urea, Mean = 699
Urea + Nutrisphere-N, Mean = 404
Ammonia Production
Time After Treatment
0
400
800
1200
1600
2000
0
1
2
3
4
5
6
7
8

Effect Of Nutrisphere-N On Nitrification

M. Coyne, Univ. of Kentucky



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Nutrisphere-N Potato Research Study

Bryan Hopkins, Univ. of Idaho, 2006

N Treatment vs. Recommended N Rate	Total Yield	Marketable Yield
- - % of recommended - -	*- - - cwt/a*	*- - -*
100% At Emergence	341	281
100% with NSN At Emergence	394	318
85% with NSN At Emergence	405	313
100% Split	376	276

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Effect Of Nitrogen and Nutrisphere-N On Malting Barley

Treatments Urea lbs./A at Pre-plant (PP) and Joint timings	Protein %	Yield Bu./A
100 Urea PP	11.7	113
100 Urea PP + NutriSphere-N	11.7	132
100 Urea (80% PP, 20% Joint)	11.9	123
100 Urea (80% PP, 20% Joint) + NutriSphere-N	11.4	140
130 Urea PP	12.4	134

Jeff Stark, Univ. Idaho, Aberdeen Research Center, 2009

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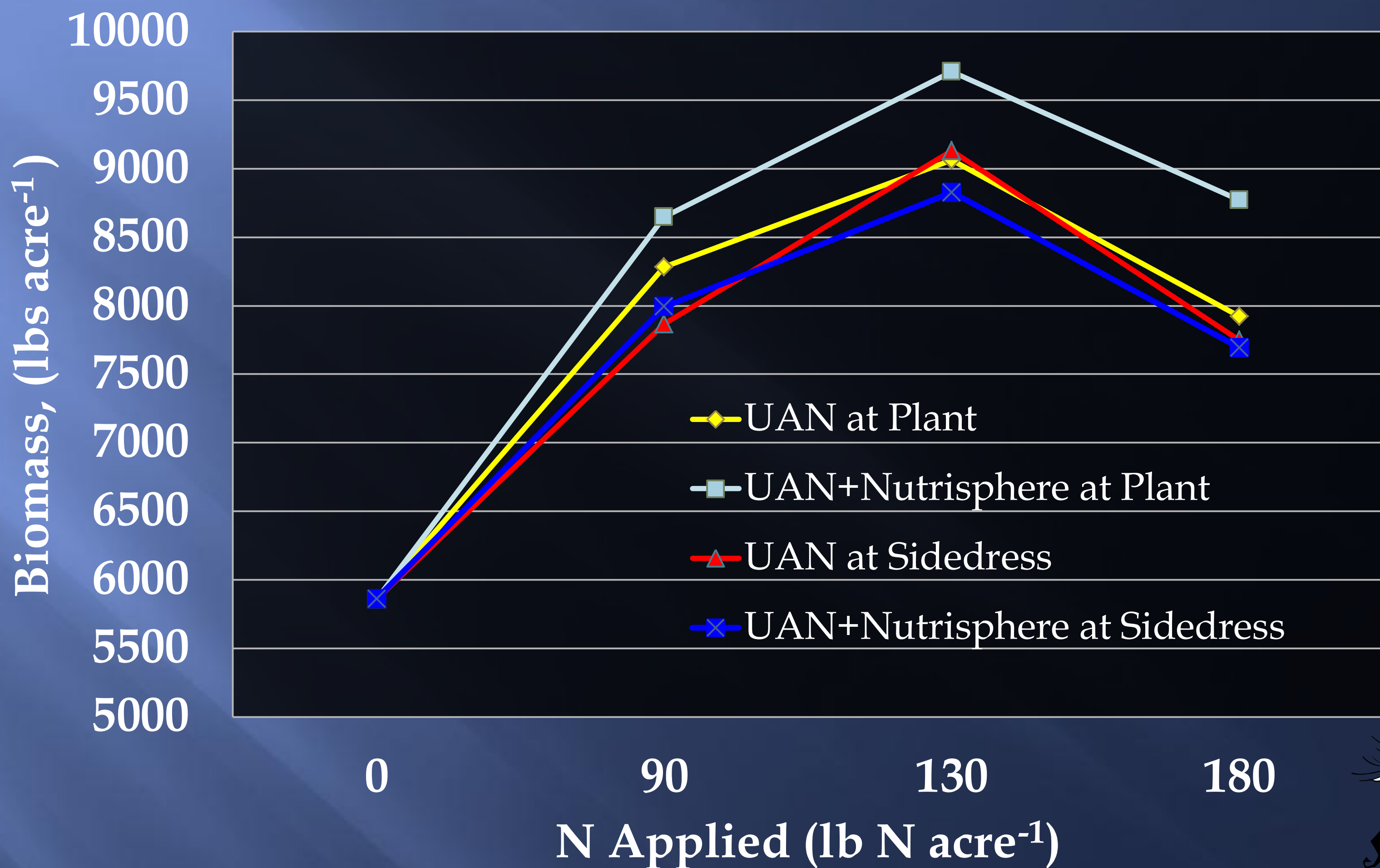
Biomass R1: Pamlico County - 2009



N Source and Nutrisphere Effects On Corn Yield

S. Ebelhar and C. Hart, Univ. of Illinois, 2009

	Nutrisphere	Corn Yield
Check	*No*	*133*
Urea	*No*	*191*
Urea	*Yes*	*198*
UAN	*No*	*193*
UAN	*Yes*	*200*
Amm. Sulfate	*No*	*228*
Amm. Sulfate	*Yes*	*238*
Amm. Sulfate-Nitrate	*No*	*227*
Amm. Sulfate-Nitrate	*Yes*	*237*
	p > f	*< 0.01*

Without Nutrisphere	*210*
With Nutrisphere	*218*
p > f	*< 0.05*

Urea	*194*
UAN	*196*
Amm. Sulfate	*233*
Amm. Sulfate-Nitrate	*232*
p > f	*<0.01*

"…. The addition of Nutrisphere-N to the N sources increased yields by 8.5 bu/a on average across N rates and sources. The addition of Nutrisphere-N to AS and ASN gave both an agronomic and economic response."

S.A. Ebelhar & C.D. Hart

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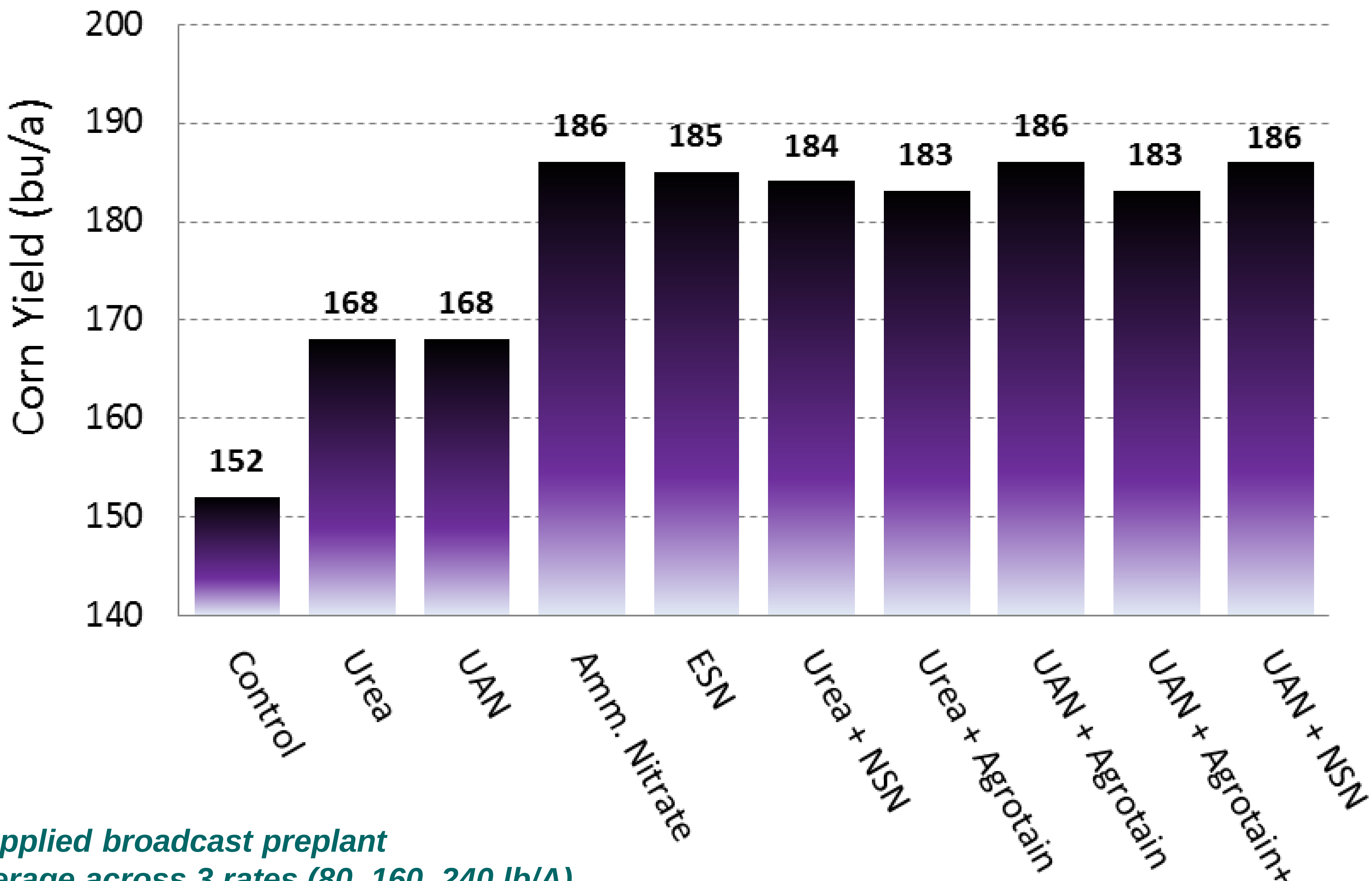
Nitrogen Treatment Effect On Corn Yield

Gordon, 2010 KSU Fertilizer Report, 3 yr. average



N applied broadcast preplant

Average across 3 rates (80, 160, 240 lb/A)

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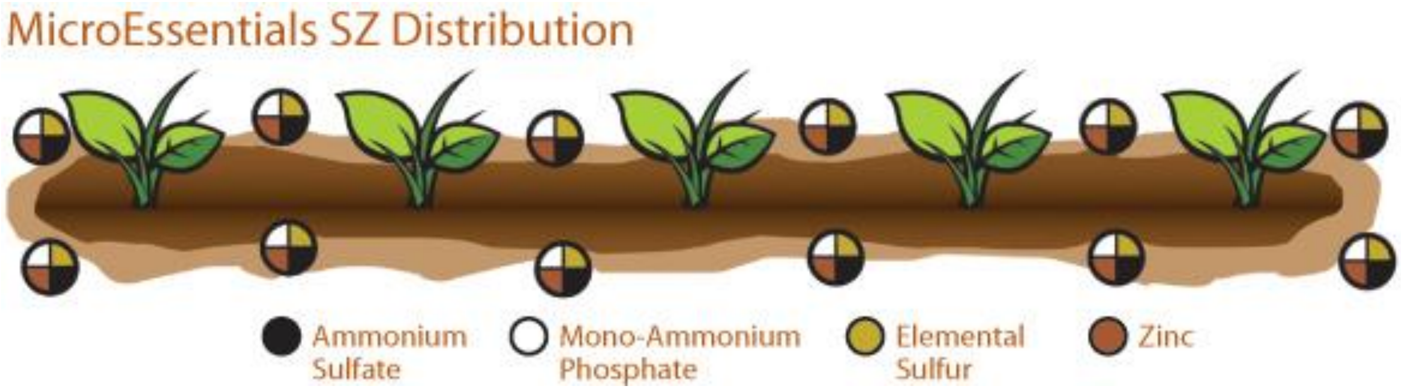
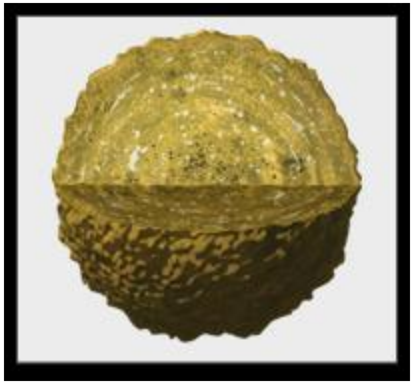




MicroEssentials granules, containing N, P, S and Zn (SZ), eliminate component segregation to ensure uniform distribution of nutrients.

Soybean Yield Results

Four-Year Fertility Study
21 locations
Locations: IA, IL, IN, MN, SD, NE, ND, WI, ON, MB

Treatment	Yield --- bu/acre ---	ME SZ Advantage --- bu/acre ---
MicroEssentials SZ	53.7	
MAP	48.7	+ 5.0
DAP	48.2	+ 5.5

Note: Nutrient rates equalized across plots for each year.
P_2O_5 rate: 40 lbs/acre
All differences are significant at the O.1 level

Corn Yield Results

One Year Fertility Study
19 locations
Locations: IA, IL, IN, MN, SD, MO, NE, WI, ON, MB

Treatment	Yield --- bu/acre ---	ME SZ Advantage --- bu/acre ---
MicroEssentials SZ	155.9	
DAP + ZnSO4 (Zn @ 1.8 #/a)	149.2	+ 6.7
DAP + ZnSO4 (Zn @ 5 #/a)	153.2	+ 2.7
DAP (Check)	150.6	+ 5.3

Note: Nutrient rates equalized across plots for each year.
Zn @ 1.8 #/a equals zinc rate in MESZ
Zn @ 5 #/a represents farmer rate
P_2O_5 rate: 70 lbs/acre

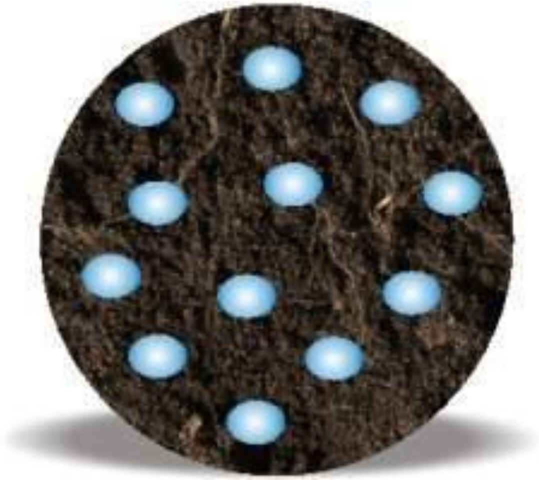
MicroEssentials SZ for complete soil coverage

Typical Zinc Blend

Zinc as granules in **bulk blend** through **broadcast** application (**5 lbs/A Zn**).

0.66 granules/sq ft

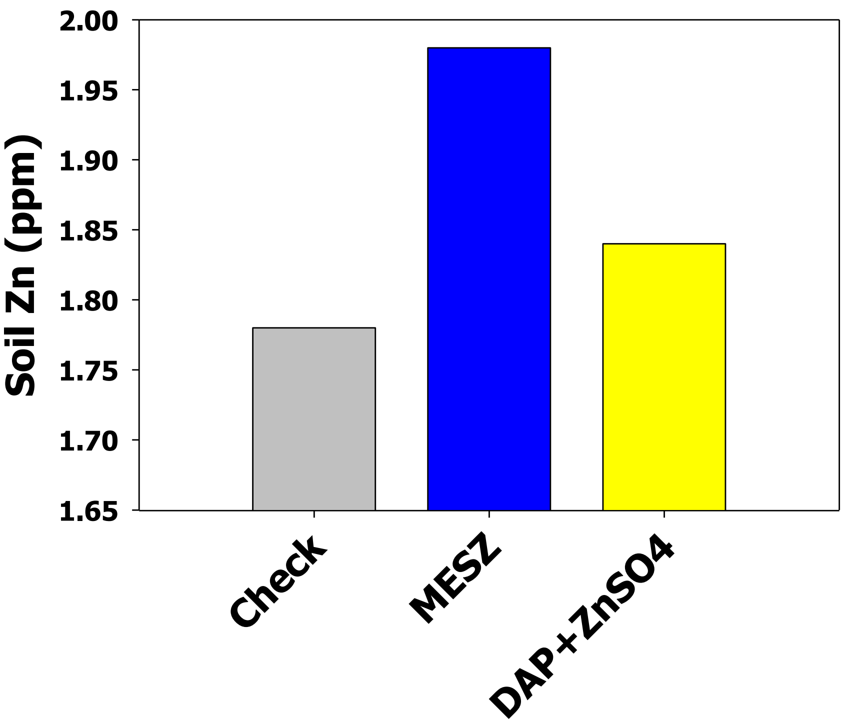
MicroEssentials SZ

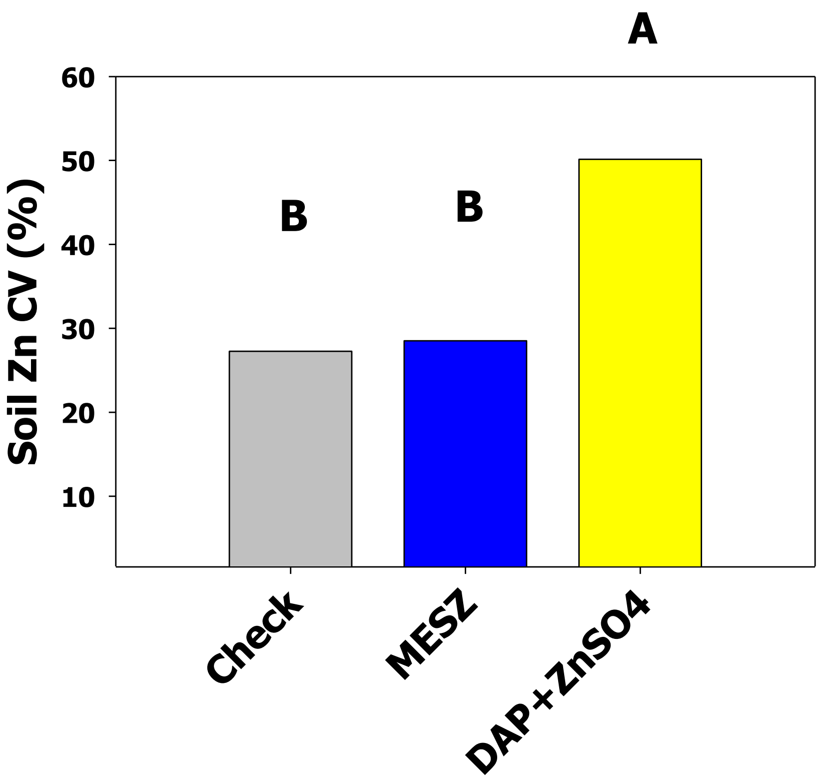


Zinc incorporated in phosphate fertilizer (65 lbs/A P_2O_5 and **1.6 lbs/A Zn**).

8.0 granules/sq ft

Soil Zn:
MESZ improves Zn distribution

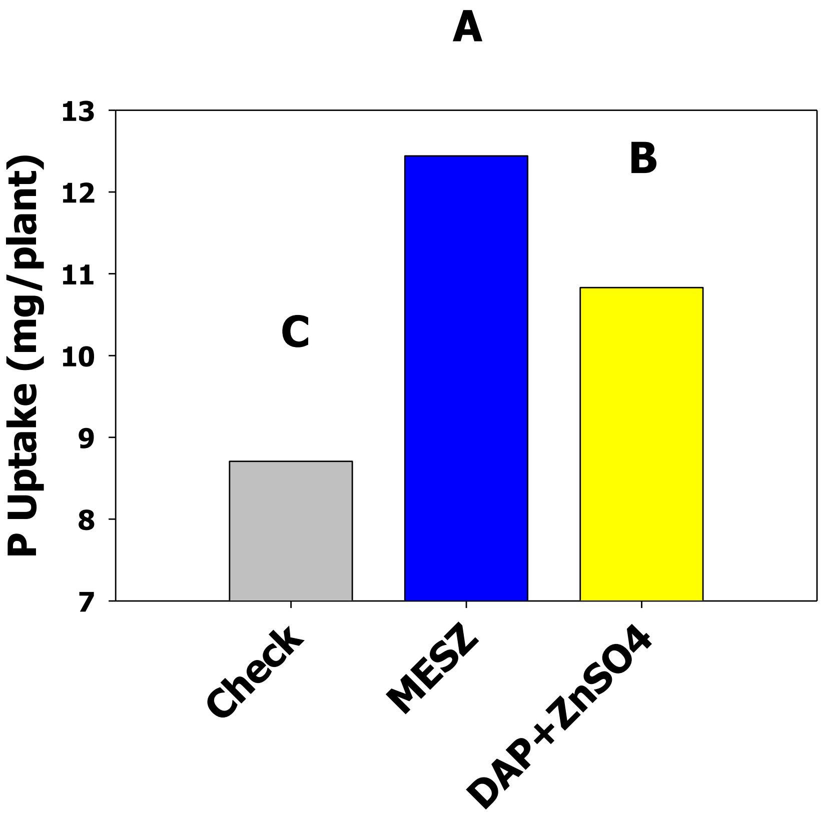


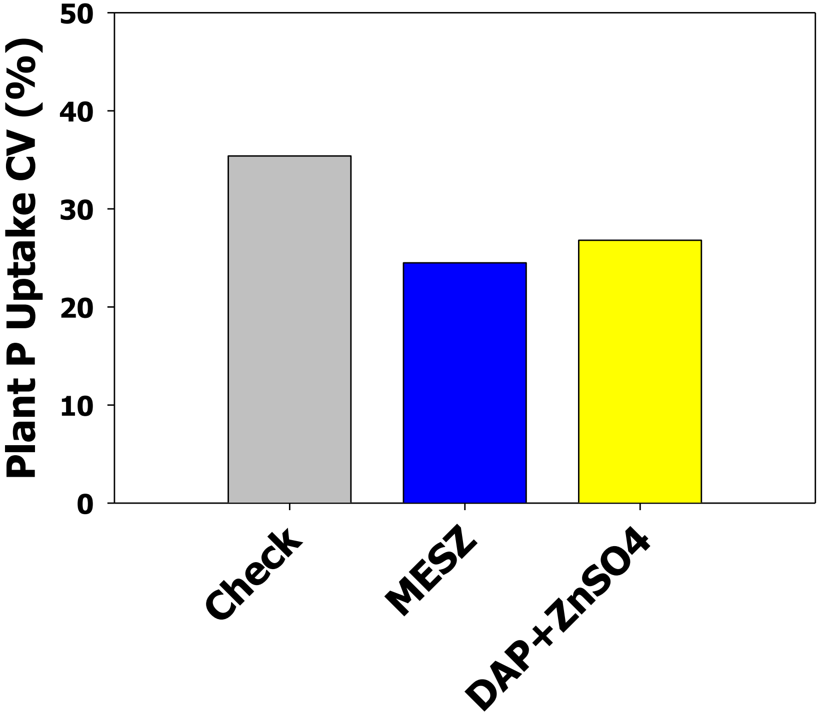


There was no difference between MESZ and the blend on soil available Zn.
MESZ resulted in a significantly more uniform Zn distribution compared to the blend, even at 1/5 of the Zn rate.

Letters indicate significant differences ($p<0.1$)

Plant P Uptake

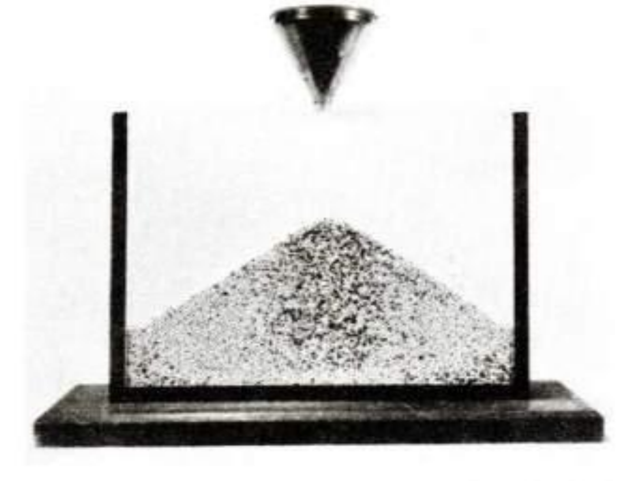


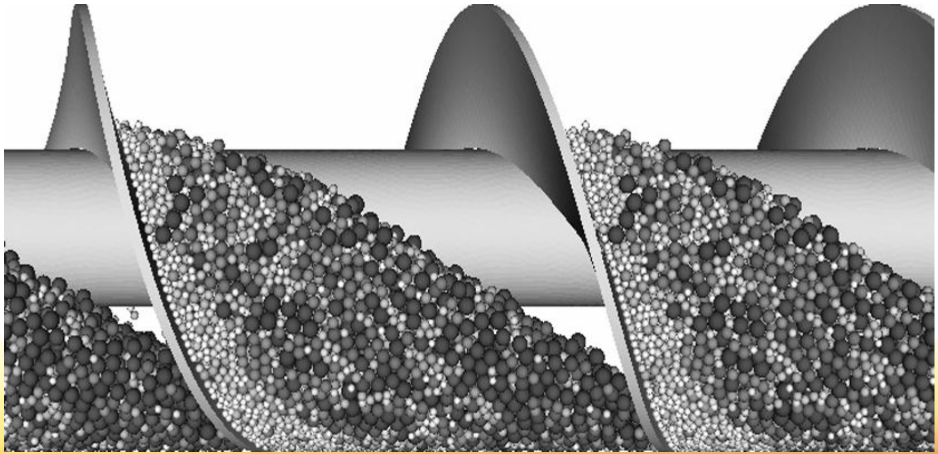


P fertilizer application increased P uptake.

MESZ increased P uptake by 17% compared to the blend.

Letters indicate significant differences ($p<0.1$)





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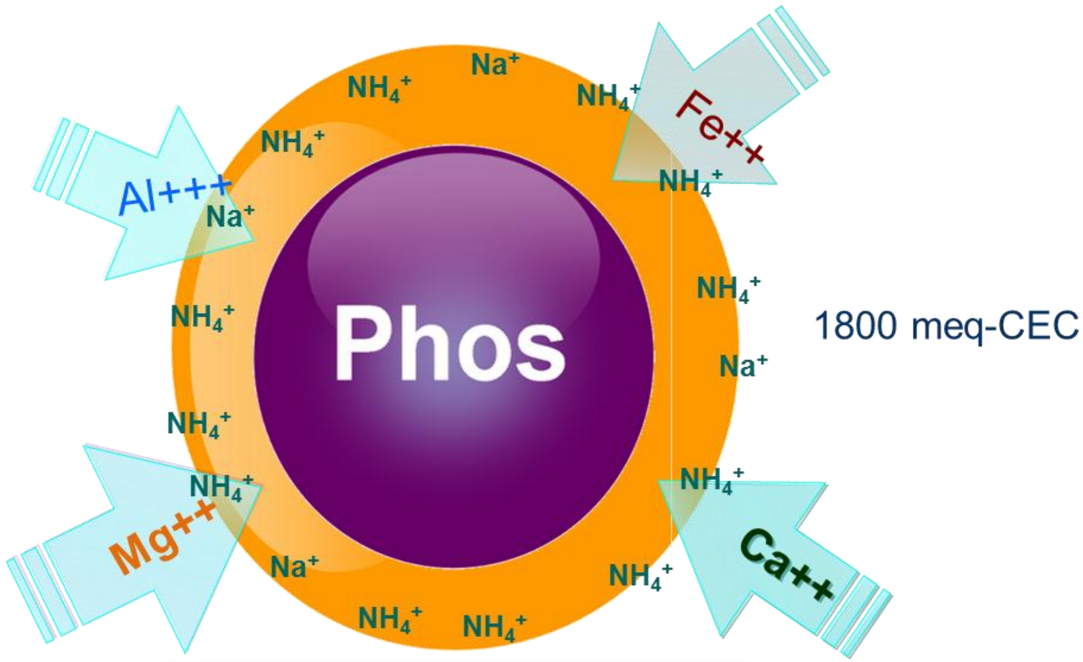
AVAIL

- An extremely high cation exchange capacity – about 1800 meq/100 gms.
- Structure is very specific to attracting and adsorbing multivalent cations.
- Polymer affects only very small portion of soil volume



Cation Adsorption Strength

Cations with greater adsorption strengths are held on exchange sites more tightly, are more difficult to replace and are released into the soil water solution less easily than others.

Cation	*Adsorption Strength*	*Ionic Radius (picometer)*
1. Hydrogen	Strongest	25
2. Aluminum	↑	53
Iron*		77
Nickel*		83
Copper*		87
3. Calcium		114
4. Magnesium √		86 √
5. Potassium		152
6. Ammonium	↓	---
7. Sodium √	Weakest	116 √

√ *Hydrated ion radius affects adsorption strength*

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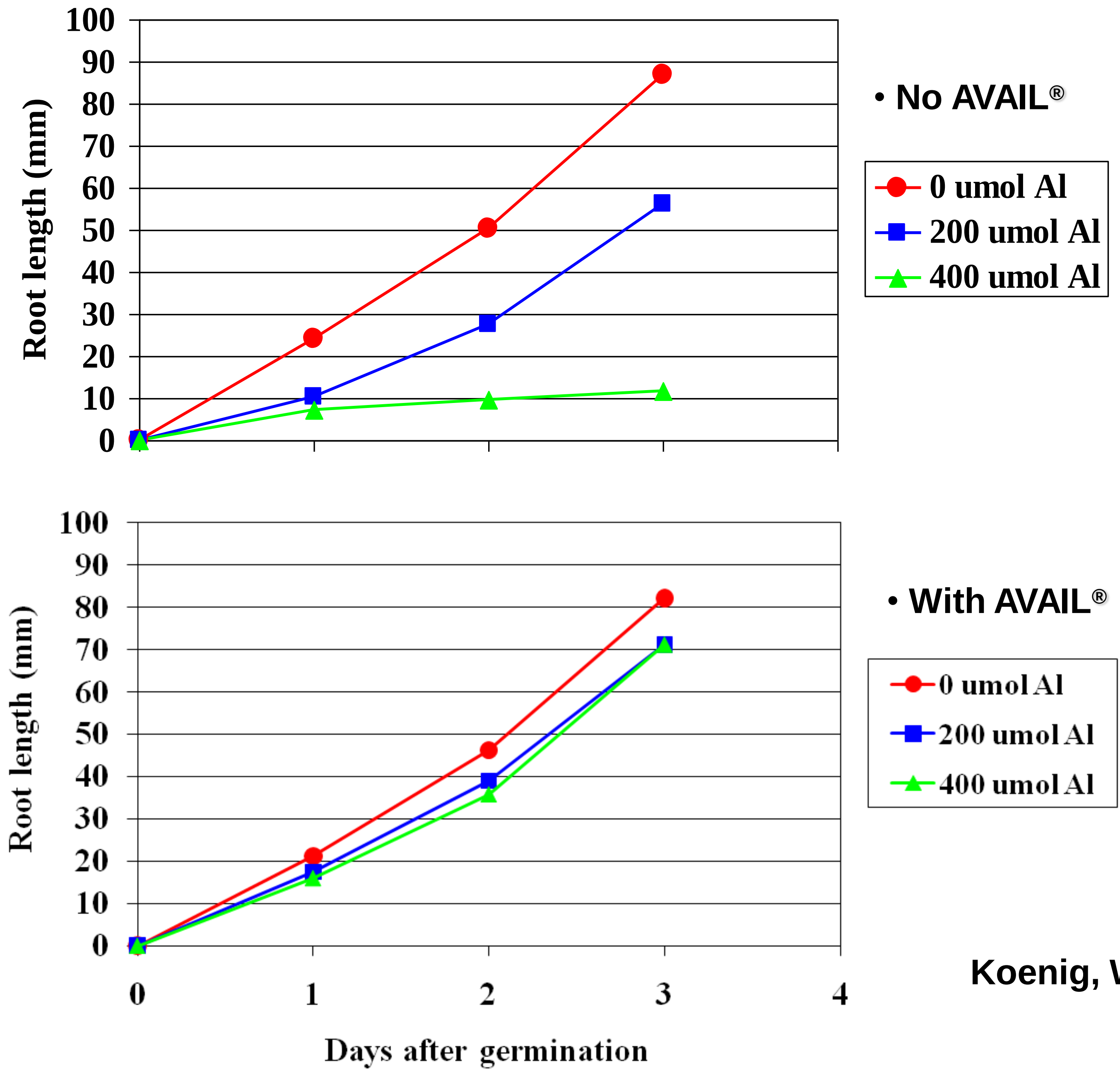
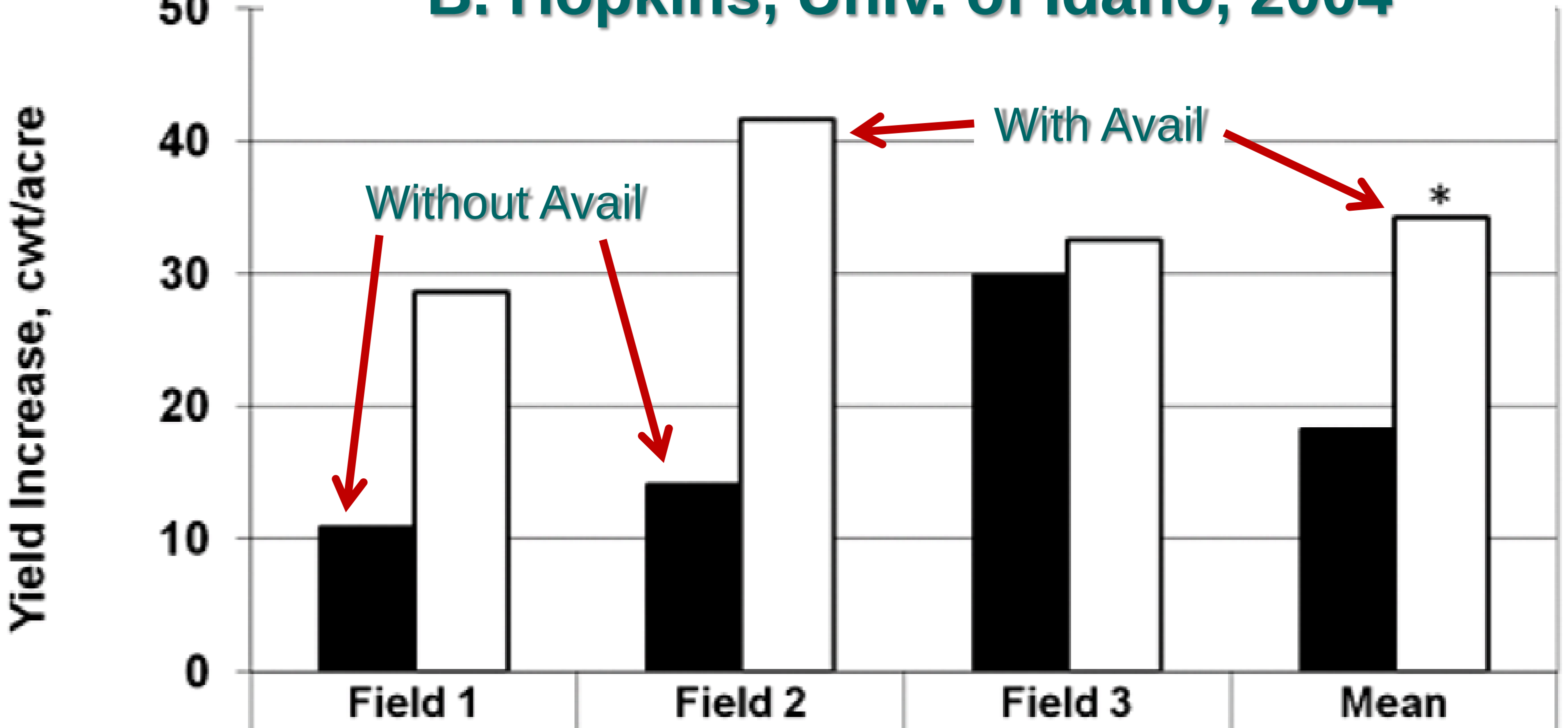
Aluminum Effects on Wheat - Low pH: 4.5



Koenig, Washington State

Avail Effects On Potato Yields

B. Hopkins, Univ. of Idaho, 2004



	Field 1	Field 2	Field 3	Mean
■ US No. 1	11	14	30	18
□ Total	29	42	33	34

‘Other trials conducted in Idaho in 2005-2006 showed similar results, with significant potential to improve potato yields grown on calcareous soils (Jeff Stark, University of Idaho, *personal communication*)’

Bryan Hopkins, March, 2008 Crop Management

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Effect Of Phosphate and Avail On Potato Yield and Profit

Stark, Univ. Idaho, 2006

Treatment	P rate # P_2O_5/A	Total no. 1's cwt/A	Total yield cwt/A	Incentive adjusted price $/cwt	Gross return $/A
Check	0	224.9 a	311.2 a	4.68	1456
MAP, no AVAIL	60	224.6 a	330.4 b	4.68	1546
MAP + AVAIL	60	241.1 b	338.6 b	4.65	1575
MAP, no AVAIL	120	237.8 ab	343.6 b	4.63	1591
MAP + AVAIL	120	270.6 c	368.6 c	4.86	1791

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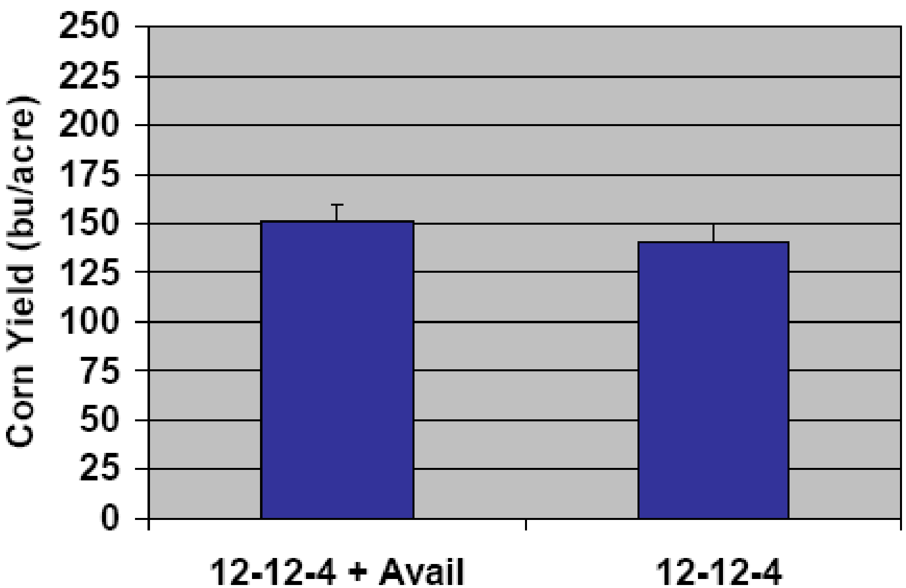
Improved Early Growth and Stress Tolerance

Winter 2007/08
Report on Field Studies

NC STATE UNIVERSITY



Dr. Ron Heiniger
North Carolina State University

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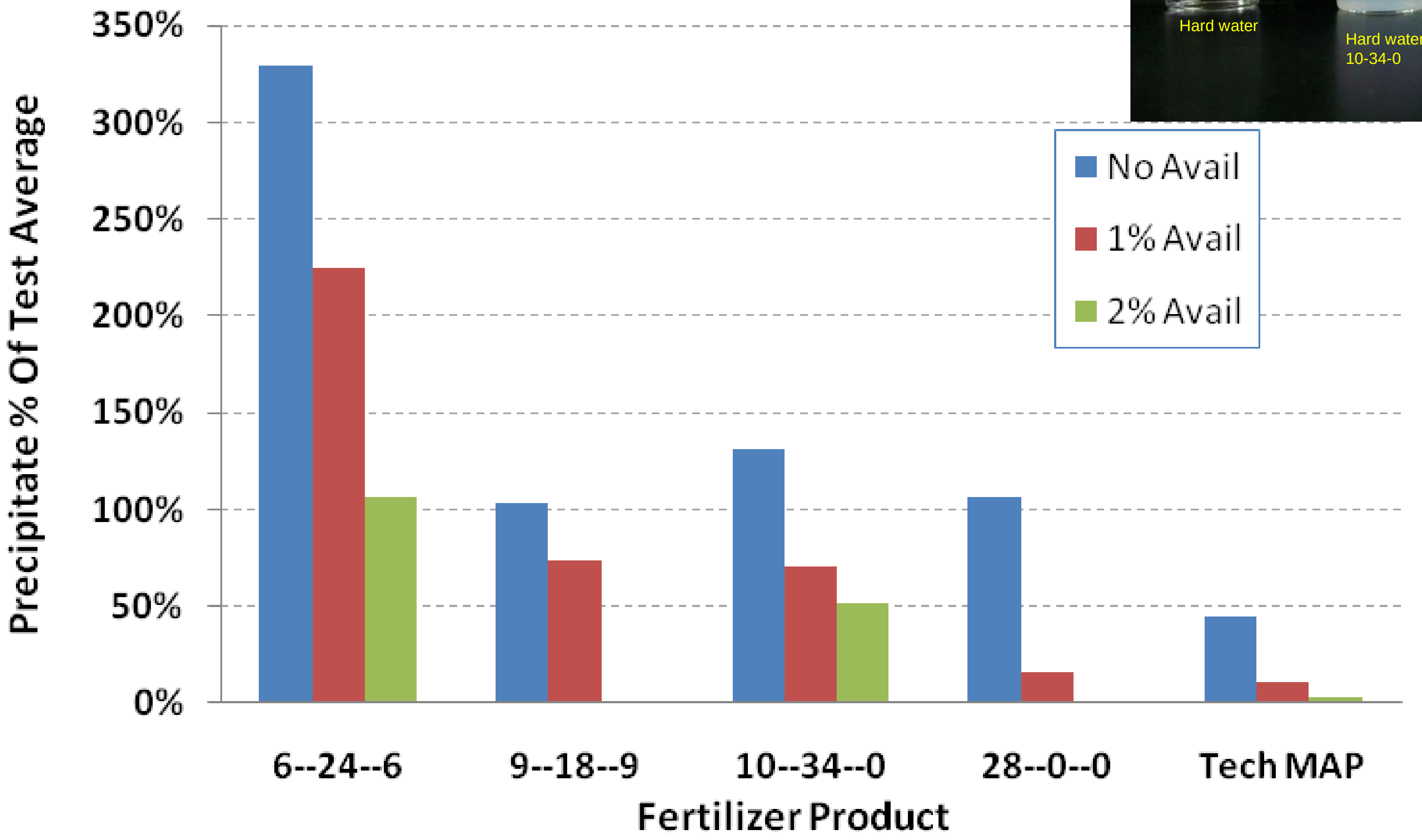
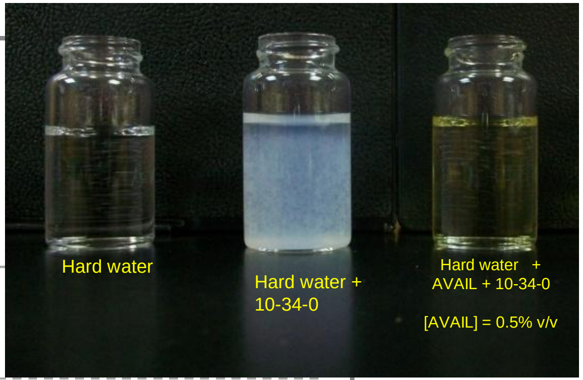
Initial Precipitate Results

Staggenborg, KSU





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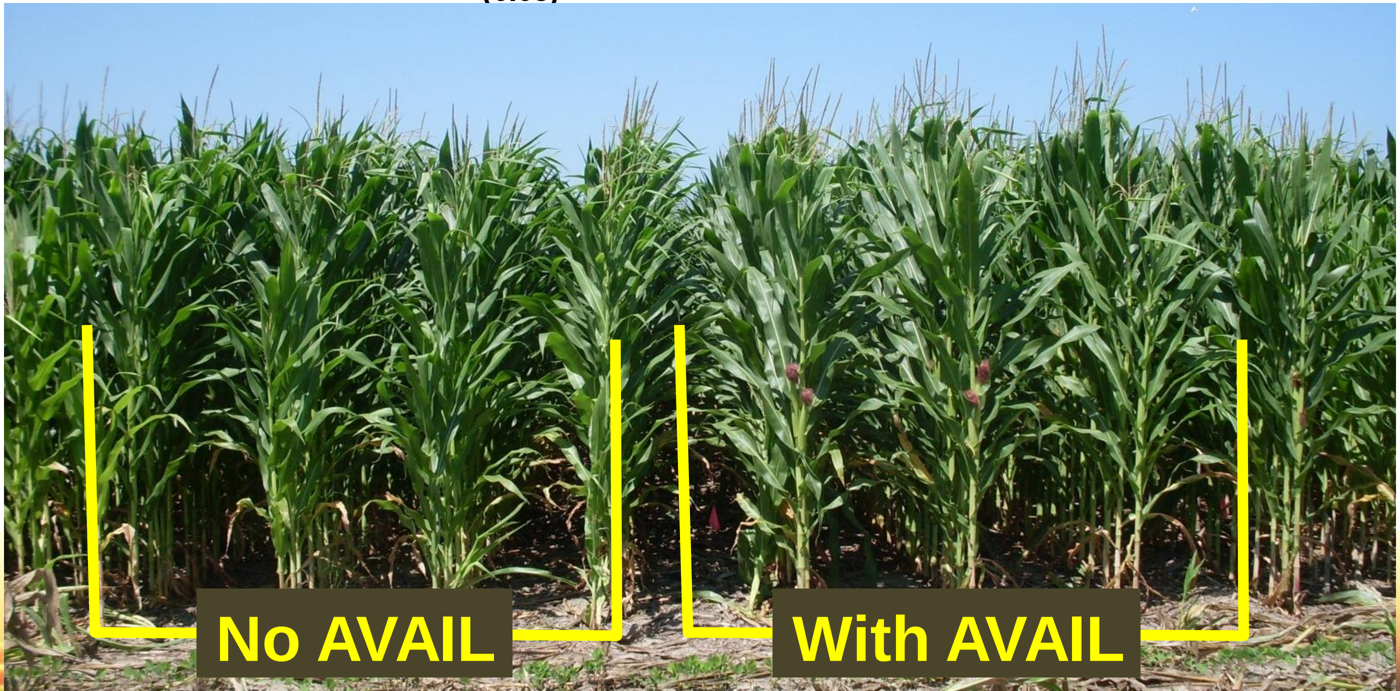
N Source and Avail Effects On Subsurface Drip Irrigation Applied Fertilizer

S. Staggenborg and J. Olson, Kansas State Univ., 2009

Subsurface Drip Irrigation Treatments	With Starter	Without Starter
Control	196	195
6-24-6	213	203
6-24-6 + Avail	226	200
9-18-9	200	194
9-18-9 plus Avail	211	204

LSD $_{(0.05)}$ 11.0



Plant Nutrition & Humic Substances

Bryan G. Hopkins & Jeff Stark

University of Idaho
College of Agriculture and Life Sciences

UI Research on Humic Acid

- 0, 15, & 30 gallons/a of 10-34-0
- 3 inches to the side of seed
- With and without Humic Acid
  - 1:10 ratio of humic acid to 10-34-0
    - check
    - 15 gal 10-34-0 $\pm$ 1.5 gal HA
    - 30 gal 10-34-0 $\pm$ 3.0 gal HA
- 3 years
- Calcareous soil
- Medium soil test P
- Russet Burbank

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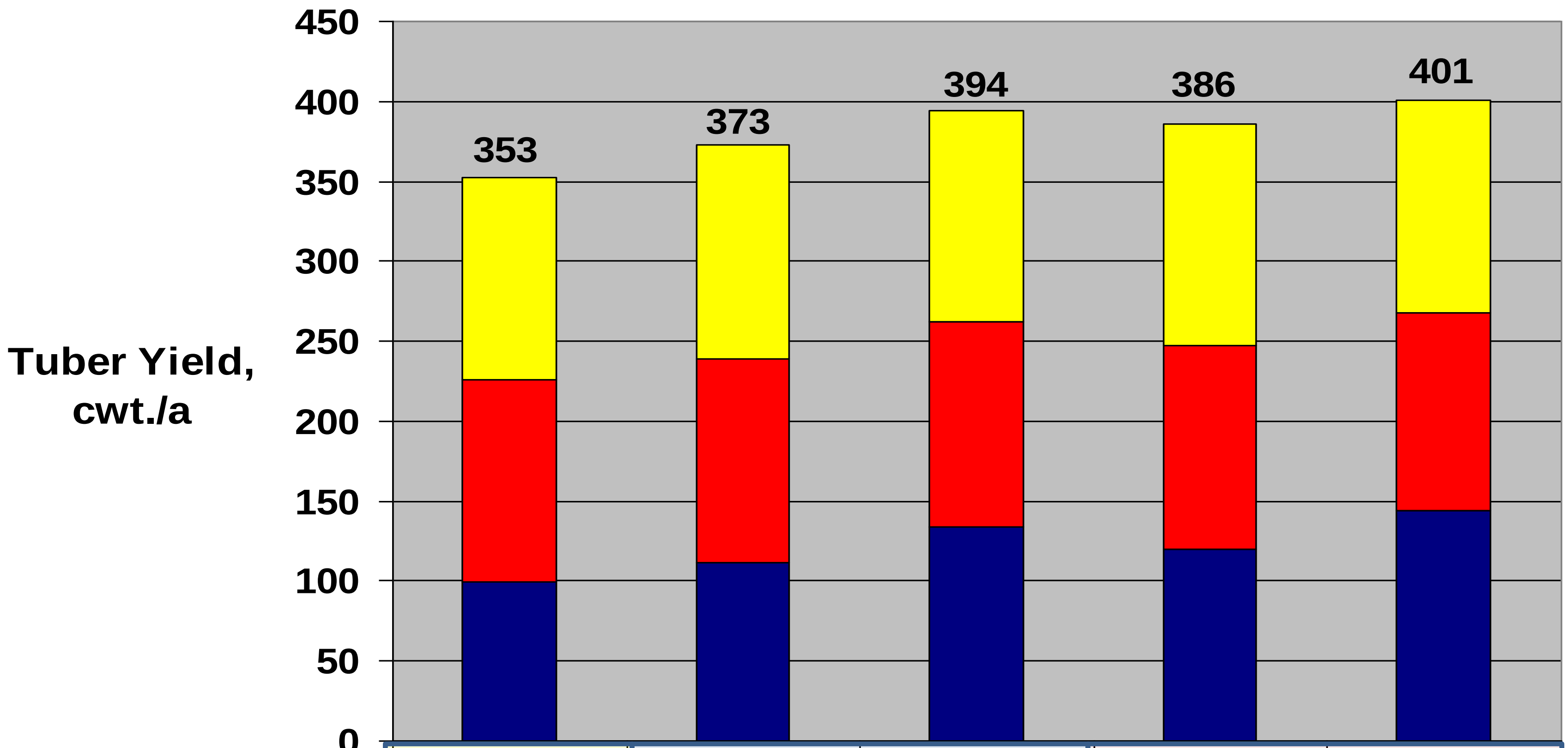
Humic Acid and Potato Production.

Hopkins and Stark, Univ. Idaho

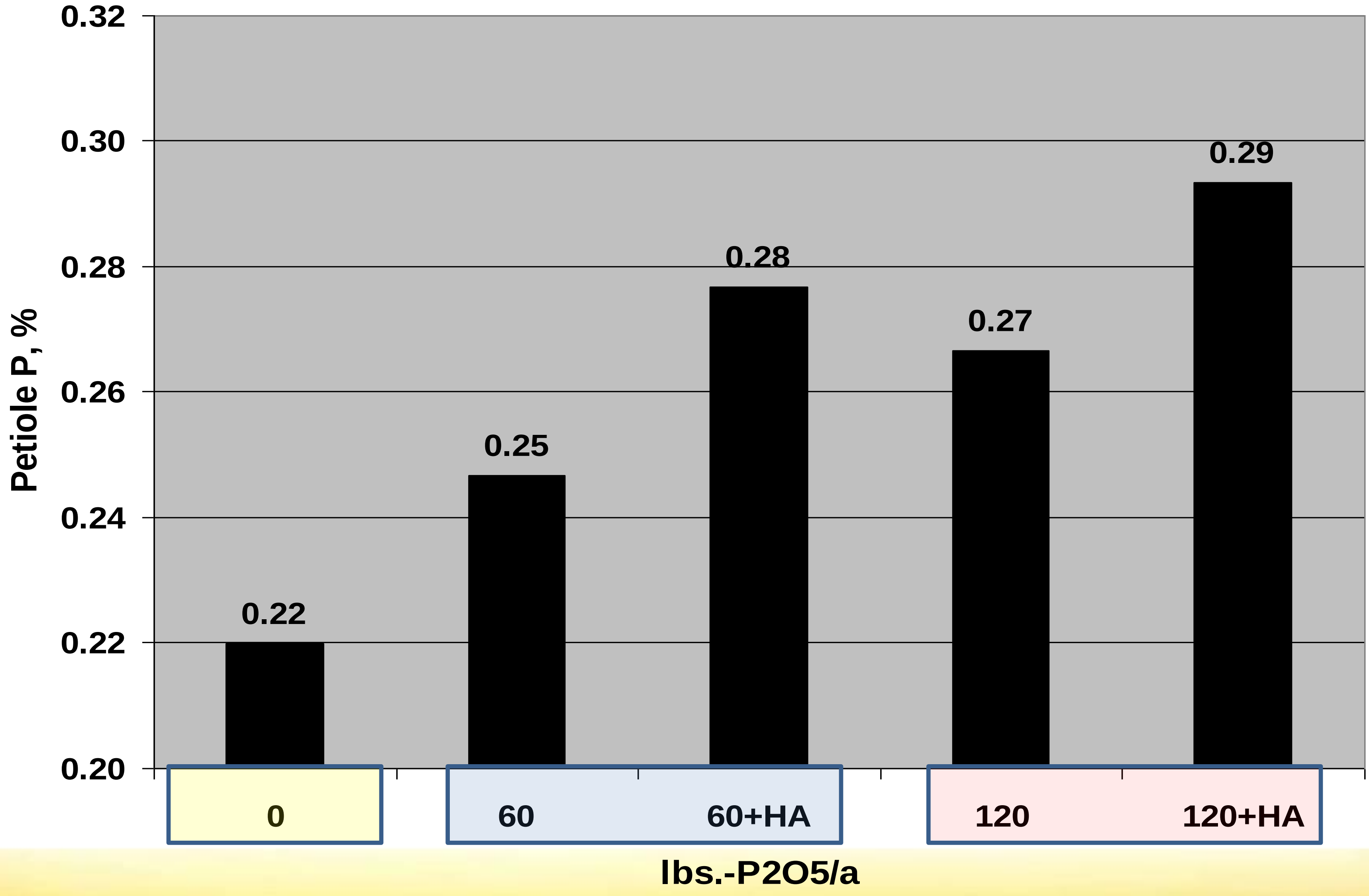


	0	60	60+HA	120	120+HA
U.S. No.2	127	133	131	139	133
U.S. No.1 4-10 oz.	126	128	129	127	124
U.S. No. 1 > 10 oz.	99	111	133	120	144

lbs.-P2O5/a

Humic Acid and Potato Production.

Hopkins and Stark, Univ. Idaho



Fertilizer Best Mana

Fertilizer BMPs —

Fertilizer Management Practices for Potato Production in the Pacific Northwest

By Robert Mikkelsen and Bryan Hopkins

Potatoes are grown in almost every state and province in North America. Some potatoes are grown for fresh consumption, while others are used for processing into fries, chips, or frozen products. Whatever the end use, the objective of every potato grower is to provide high quality potatoes that meet the market objectives at a price that is economically profitable and environmentally sustainable.

Potatoes are an important part of our diet. In North America, a typical consumer uses over 130 lb of potatoes each year (fresh and processed). Global consumption of potatoes continues to increase…with the largest consumers in Eastern Europe and with China now the world's largest potato producer.

Of the 40 billion pounds (400 million hundred weight) of potatoes grown in the USA in 2007, over 60% of the fall production occurs in the Pacific Northwest. A unique combination of soil, environment, and management practices has led to the success of the potato

Fertilizer BMPs for potatoes are based on applying the right source of nutrients at the right rate, right time, and right place.

" University research has documented positive responses to P fertilizer additives that may enhance P solubility and plant uptake, such as liquid polymer stabilizers and humic materials. Consider evaluating these materials on a portion *of the field receiving fertilizer P."*

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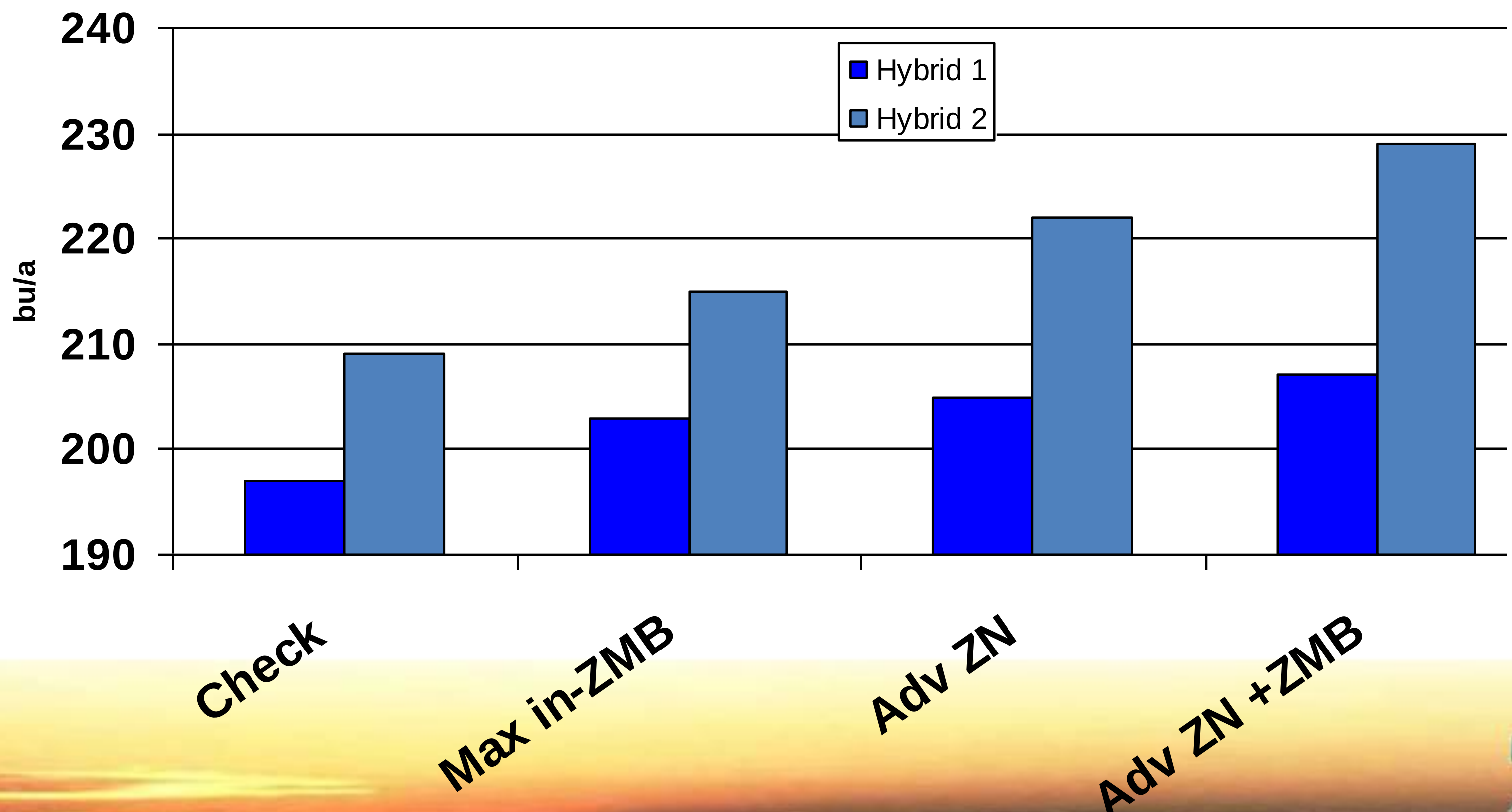
Winfield Solutions & Croplan Genetics

2008 Corn Seed Treatment

Burwell Ne. 1.7 ppm DTPA ZN Sandy Loam soil



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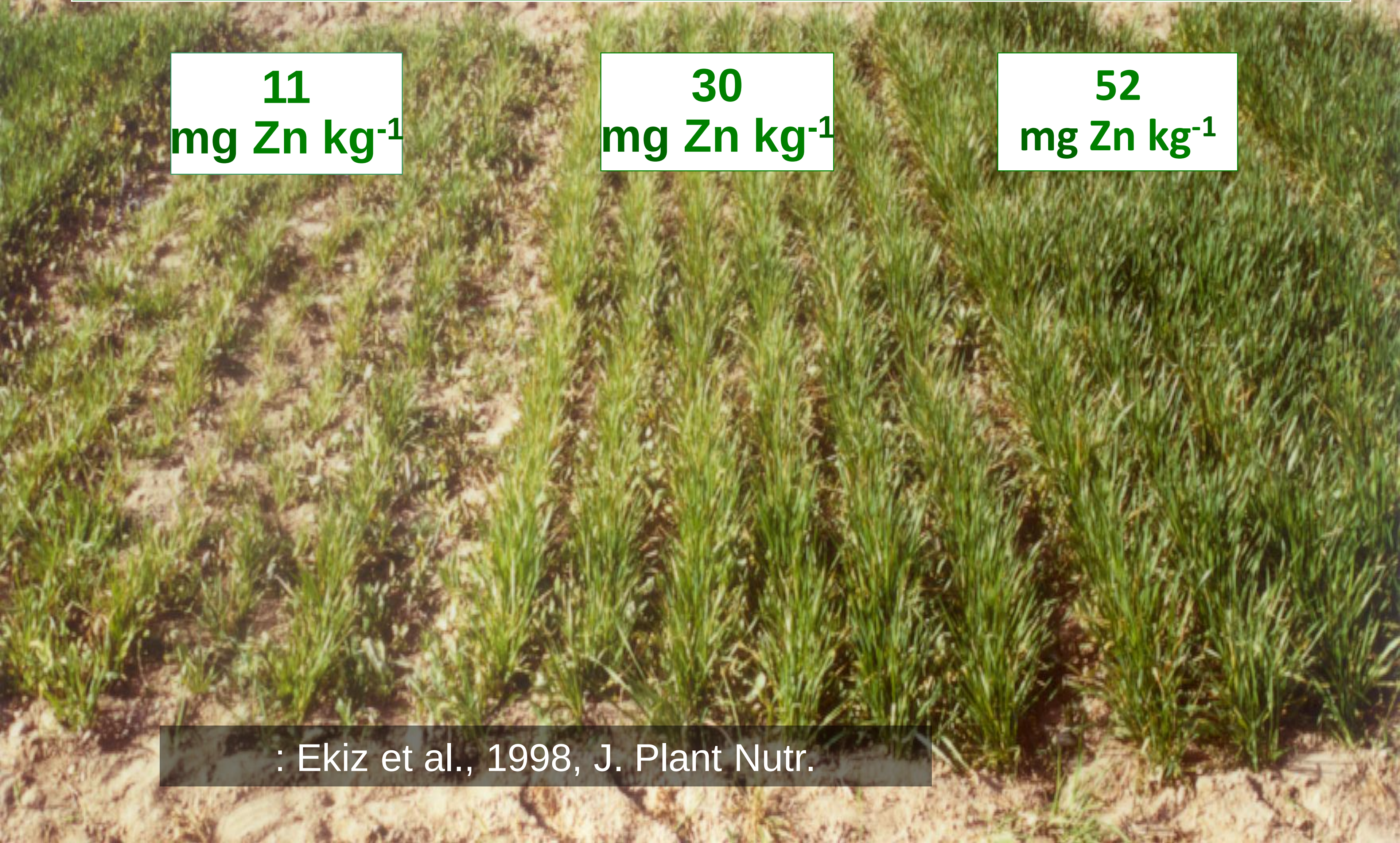
Effect od Seed Zn on Growth of Wheat in Central Anatolia



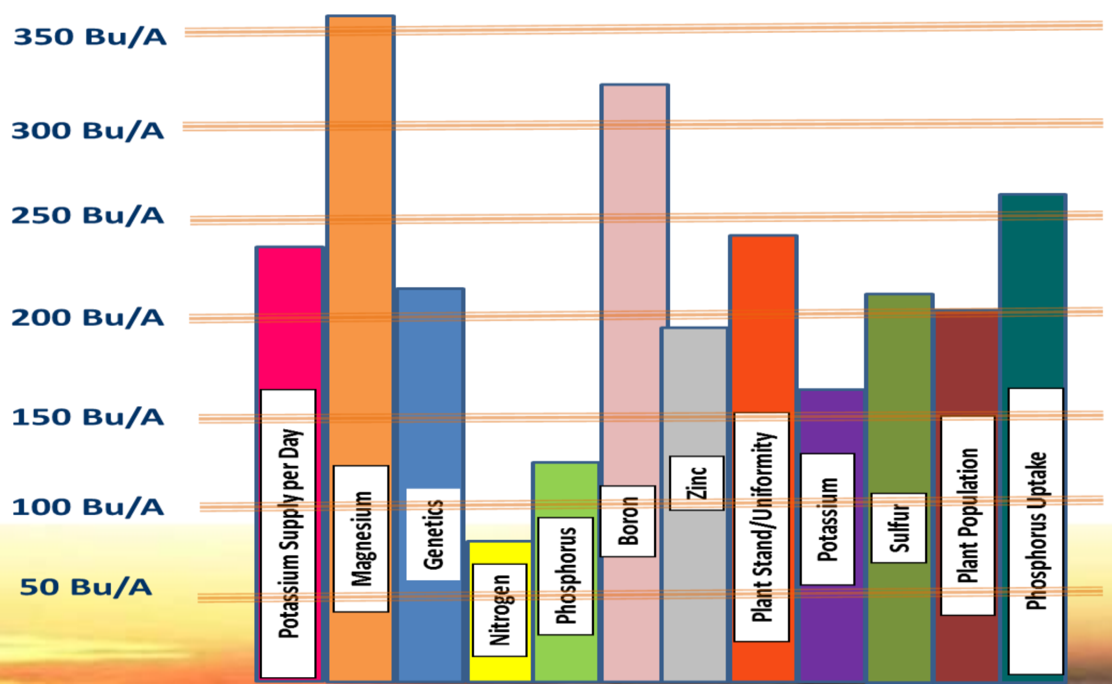
: Ekiz et al., 1998, J. Plant Nutr.

Interaction Of New Technologies/Practices With Corn Yield

University of Illinois and Mosaic

	Traditional Program	Enhanced Program
	208 bu/a	274 bu/a
	Yield Increase Attributed To Individual New Practice:	
	- - - - - - *bu/a* - - - - -	
Additional P, S, Zn (MEZ)	7	18
Additional Sidedress N	16	24
Higher Plant Population	-15	14
Fungicide Application	-4	12
Genetics - Triple Stack	8	27

Traditional Program - University of Illinois Recommendations Without Any Enhanced Input
Enhanced Program - University of Illinois Recommendations Plus All Enhanced Inputs



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New Technologies: Products and Additives

Thank You

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785-770-0009