Urea Formaldehydes and Triazones: What We Know

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Overview



- The agronomic case
- What it is
- How it works
- How it is used
- Results

Nitrogen management matters



- N is the most widely limiting nutrient for non-legume crops
- N is a building block for protein and part of chlorophyll
- Adequate levels required for optimal growth and seed production
- Nitrogen can be lost through volatilization, leaching and denitrification

Nitrogen Uptake Demand



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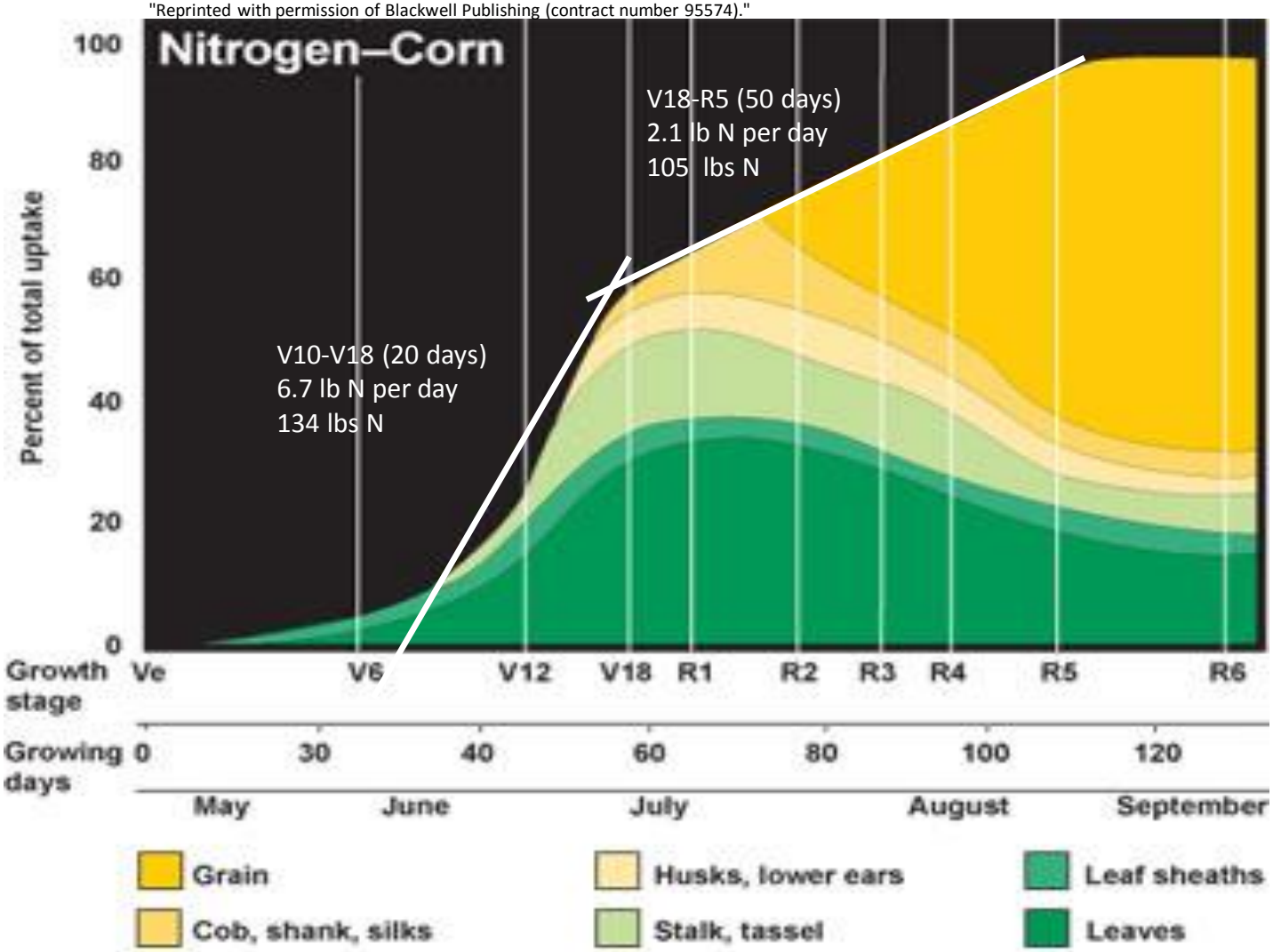
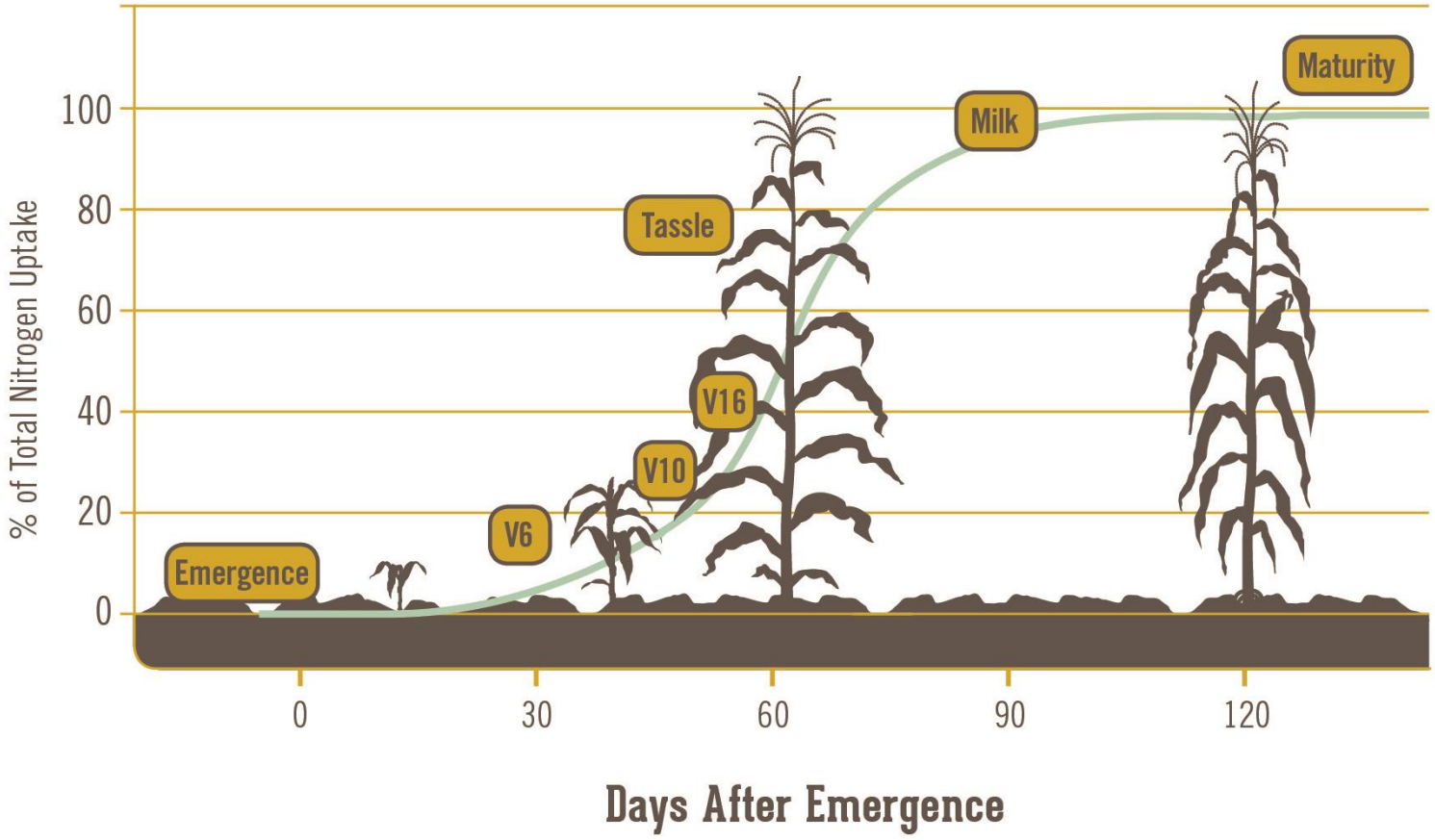


NITROGEN UPTAKE AND APPLICATION TIMING





Generalized nitrogen uptake pattern in corn.

Adapted from: Soil and Water Conservation Unit, USDA, ARS and Univ. of Nebraska

GROWER ECONOMICS OF N FERTILIZER APPLICATIONS

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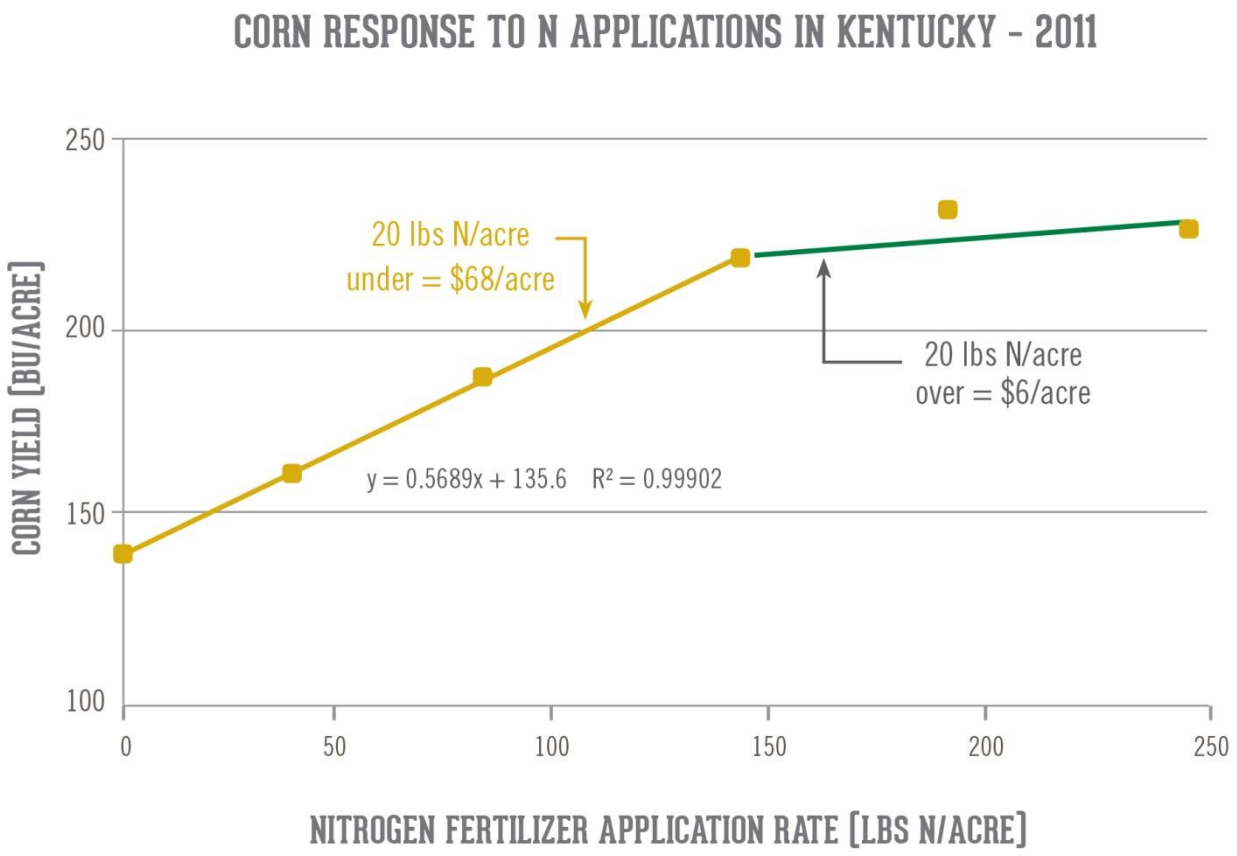

Source: Grove, 2011

SEASONAL AFFECT ON FERTILIZER

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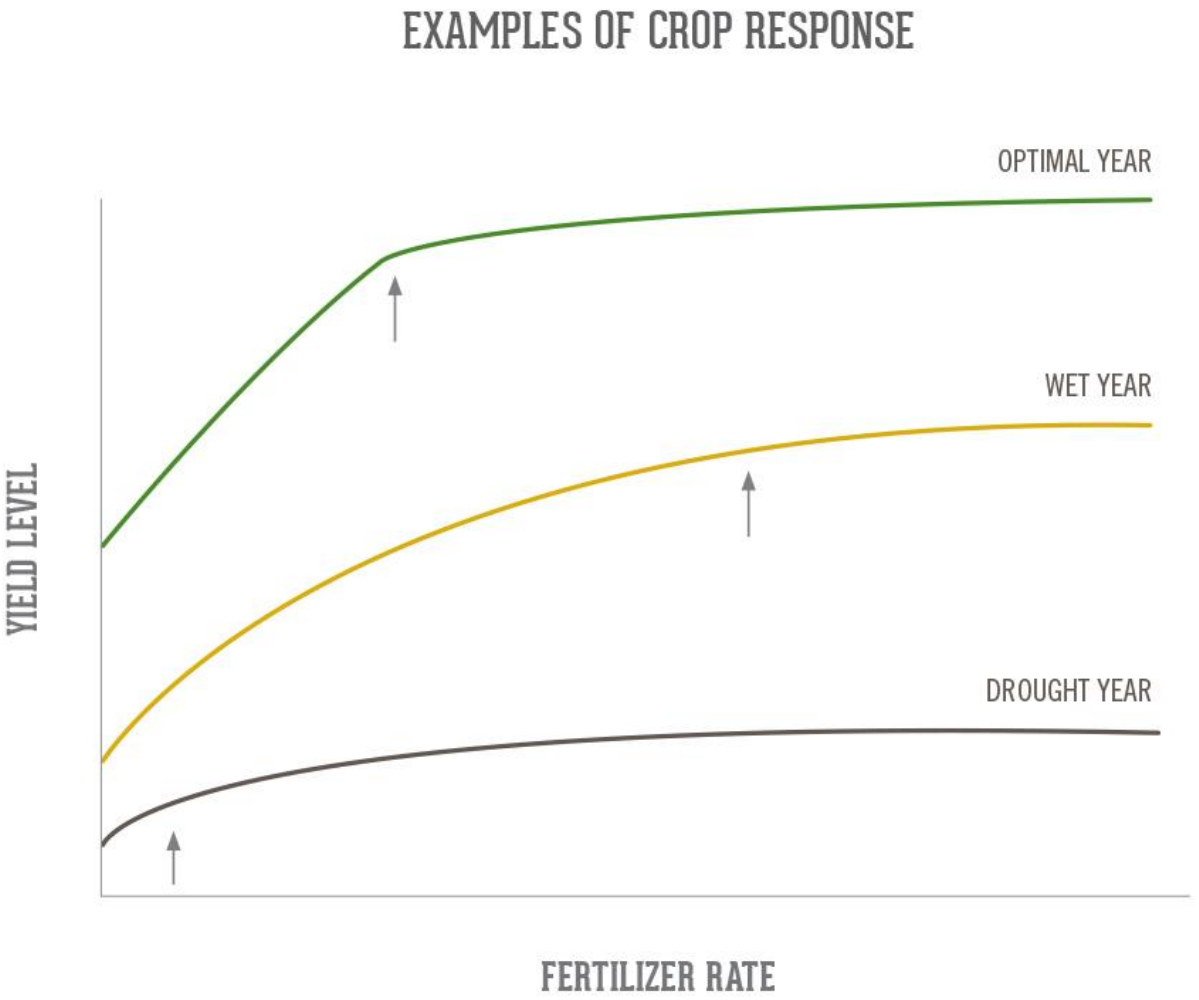
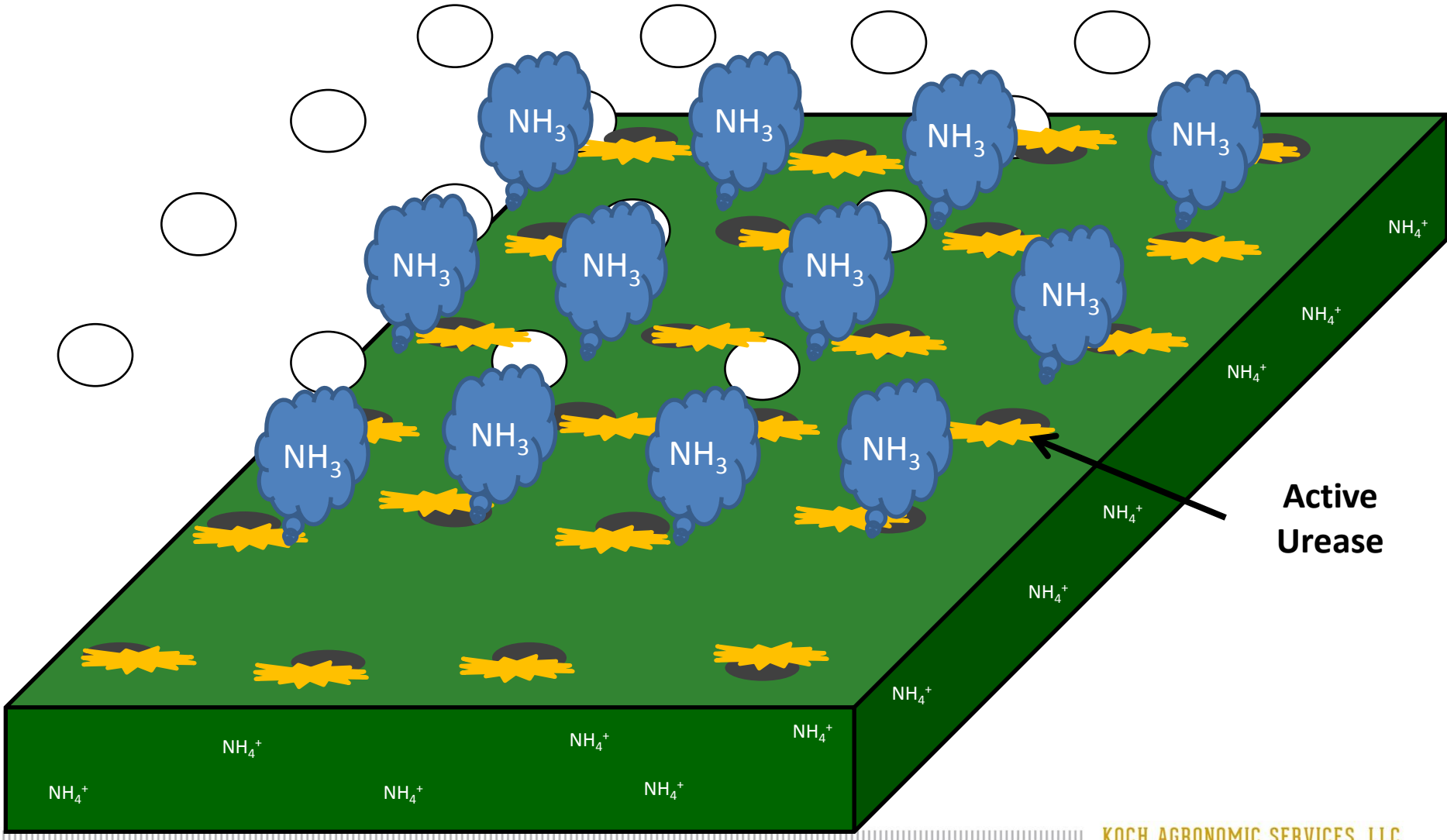


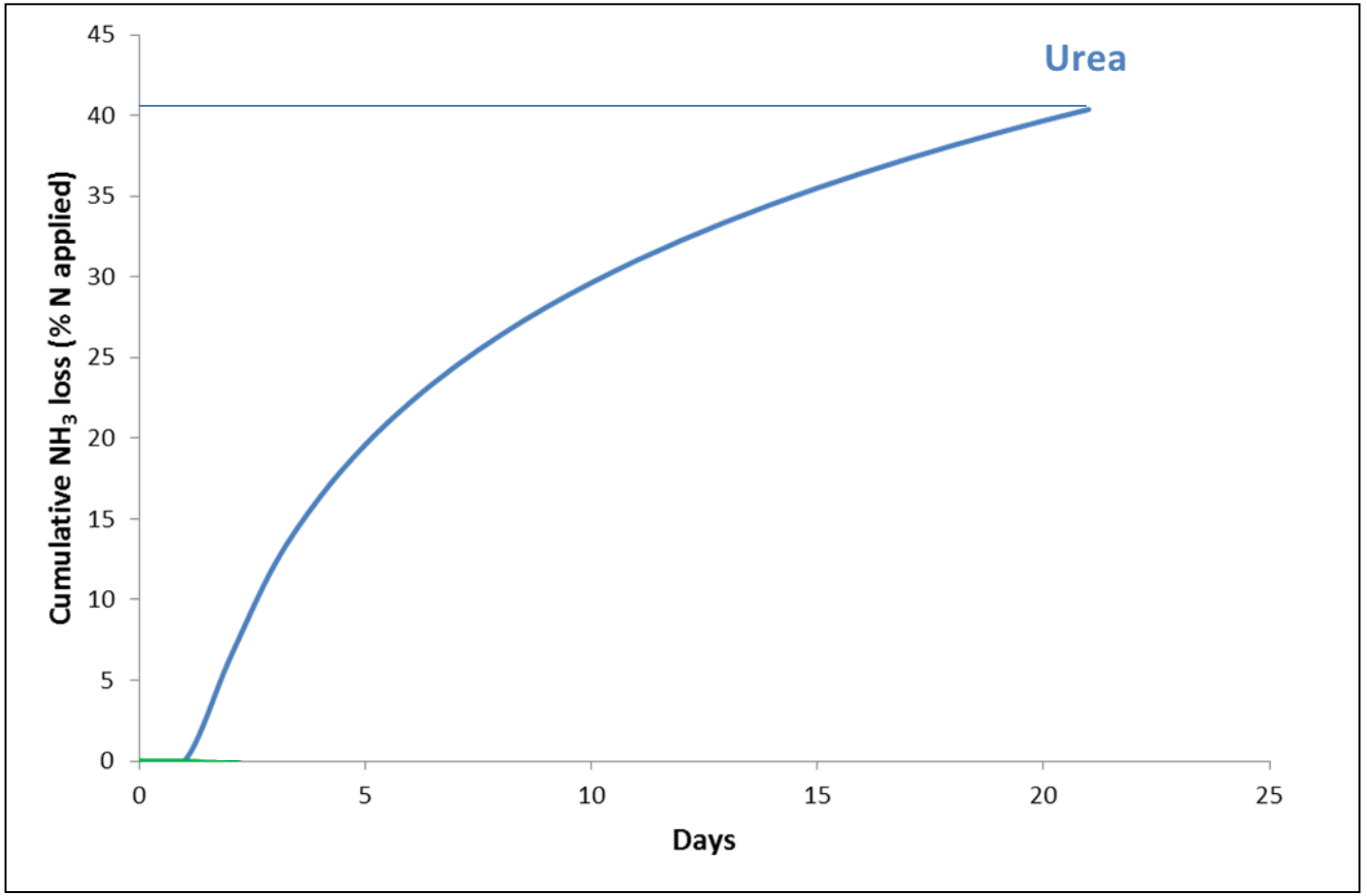
Enhanced efficiency fertilizers reduce the influence of weather on nitrogen loss.

VOLATILIZATION



CUMULATIVE NITROGEN LOSS VIA VOLATILIZATION



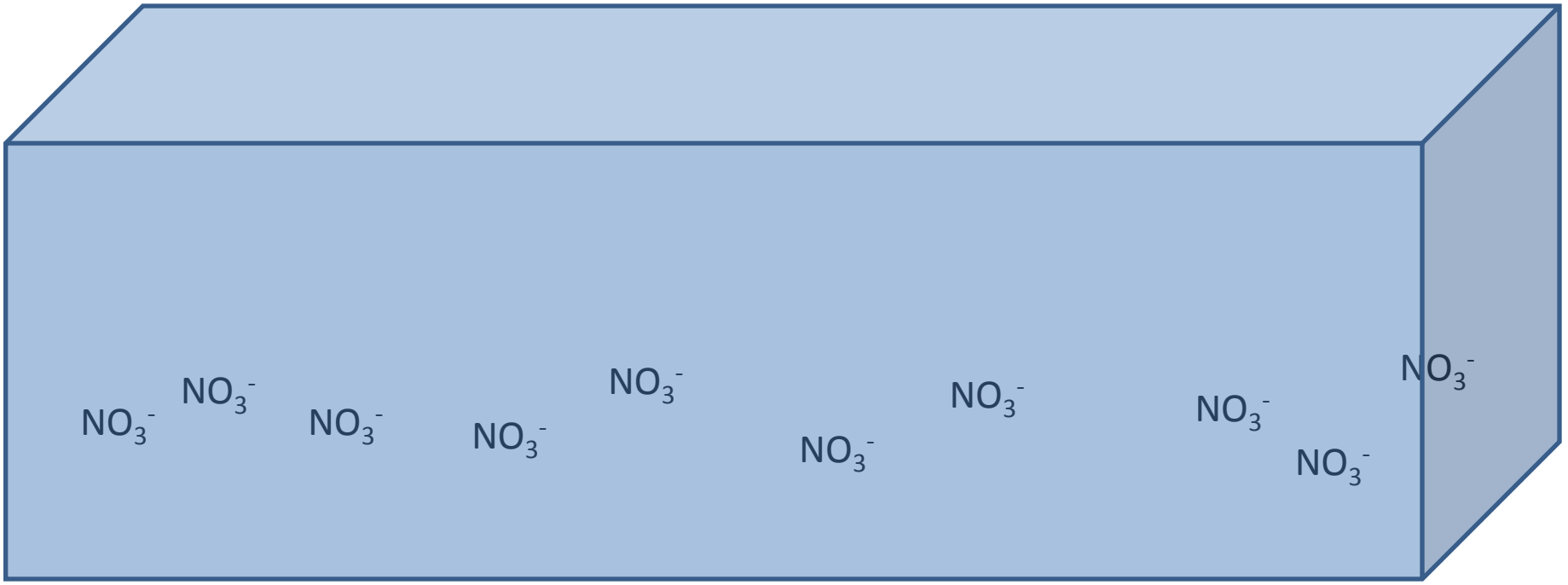


Compilation of university lab and field volatilization studies

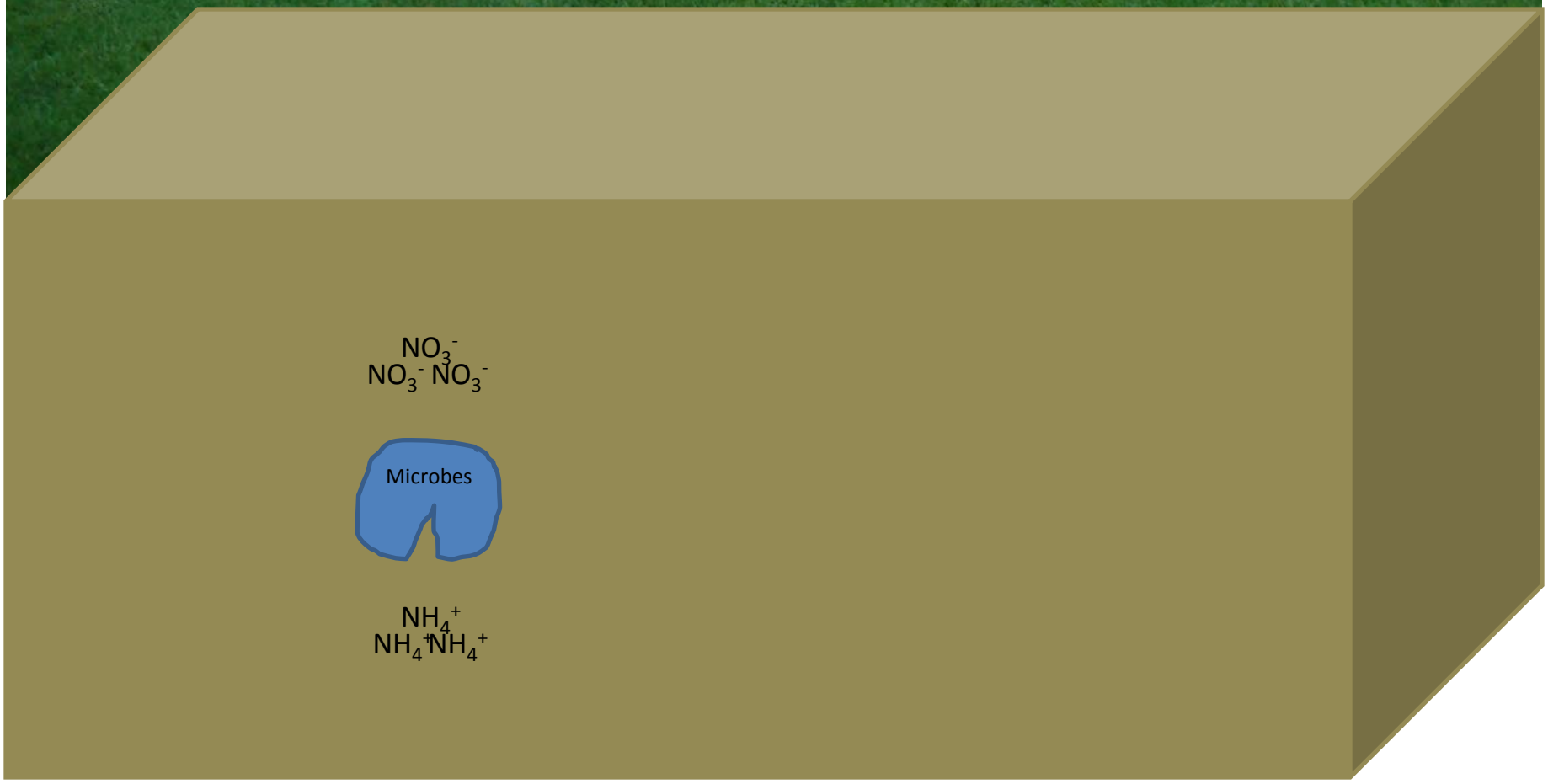
Sources: North Dakota State University, Oregon State University, Auburn University, University of Florida

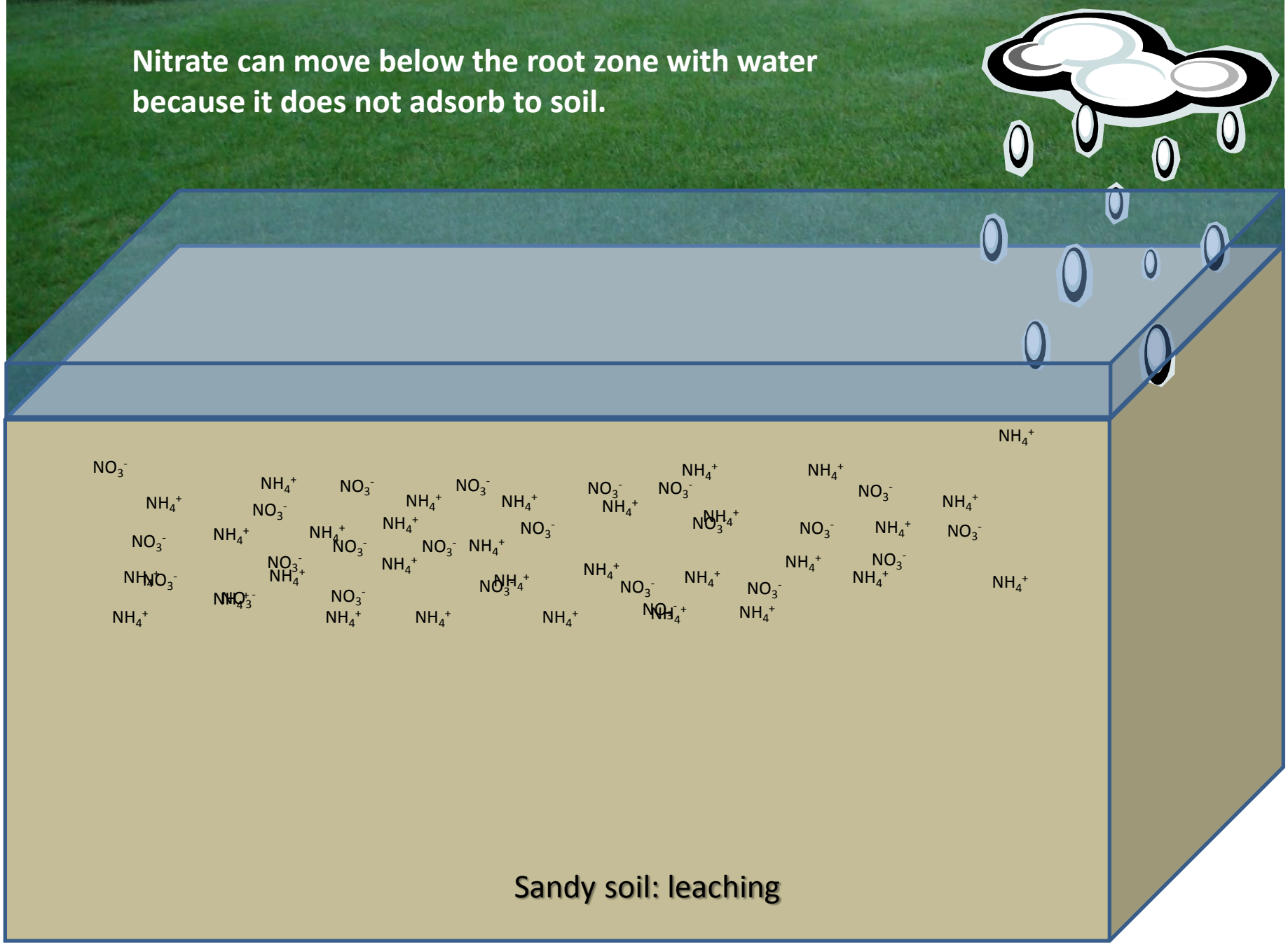
Leaching and Denitrification

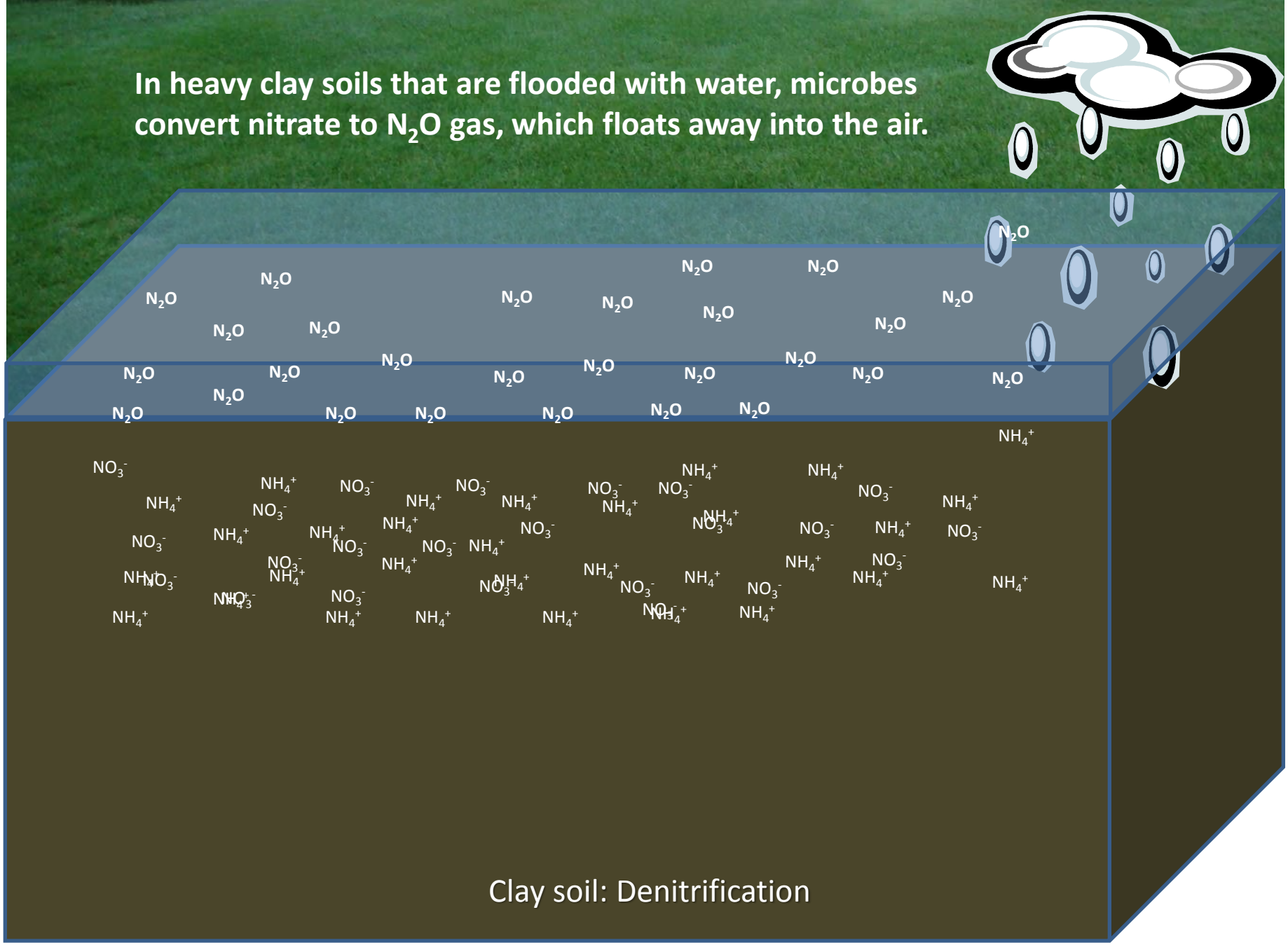




Nitrification: Ammonium (NH_4^+) transforms to Nitrate (NO_3^-)







Recognize the opportunity



- Optimal year – *“top off the tank”*
- Wet year – Nitrogen loss needs to be replaced
- Moderate drought – foliar is a direct path
- Other stresses – cold, pests, delay maturity
- CPC activity
- Uptake of other nutrients

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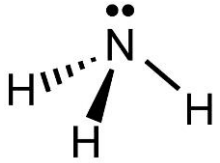
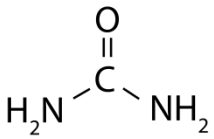
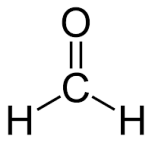
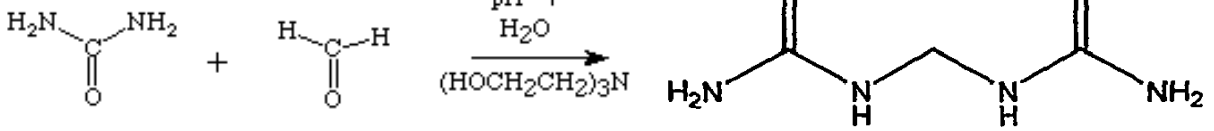
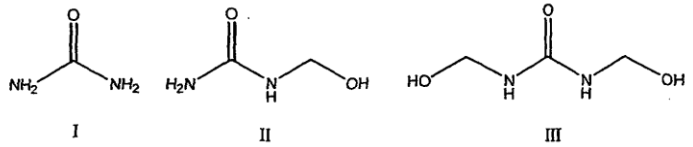
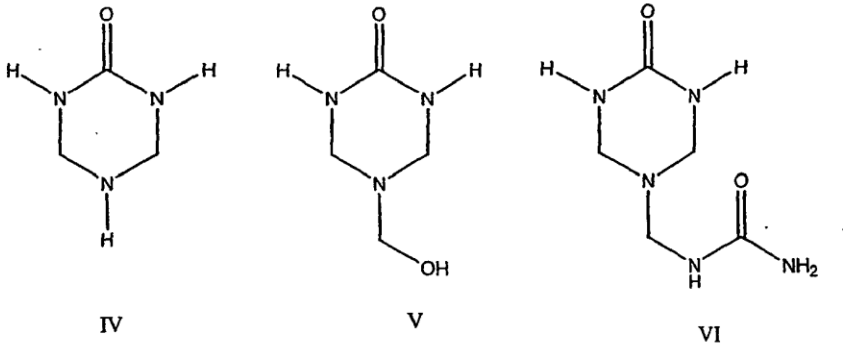
UF's and triazones – batch process

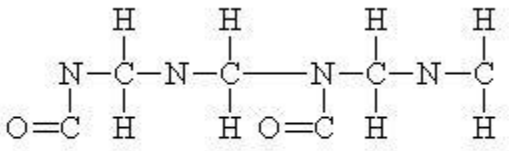




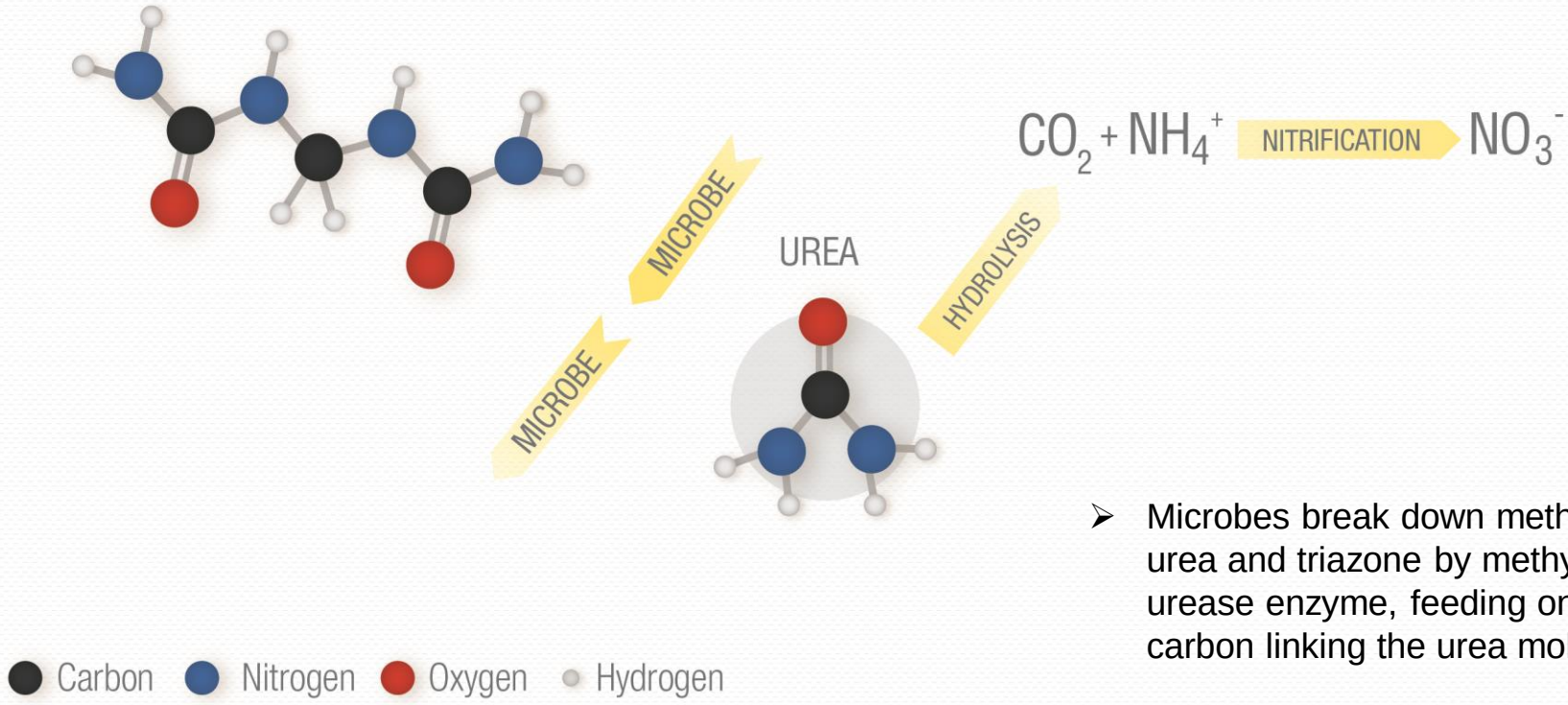






Urea Formaldehyde

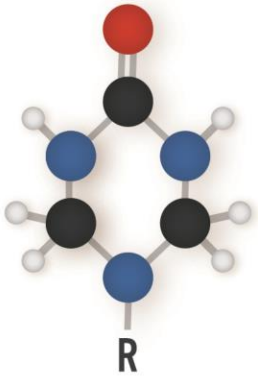
CONVERSION OF UF AND TRIAZONE POLYMERS TO PLANT-AVAILABLE FORMS OF NITROGEN



- Microbes break down methylene urea and triazone by methylene urease enzyme, feeding on the carbon linking the urea molecules
- Once urea molecules are cleaved by urease enzyme, they are converted to ammonium and nitrate.



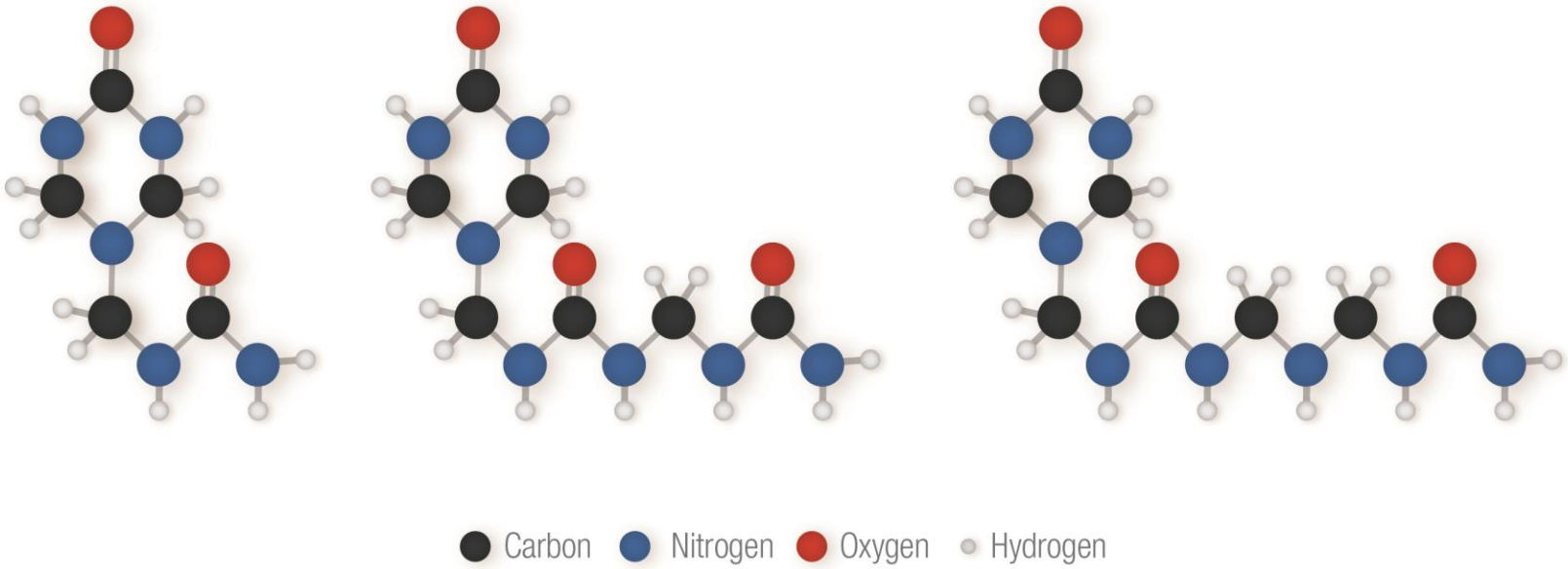
TRIAZONE



Carbon Nitrogen Oxygen Hydrogen **R** Organic alkyl radical



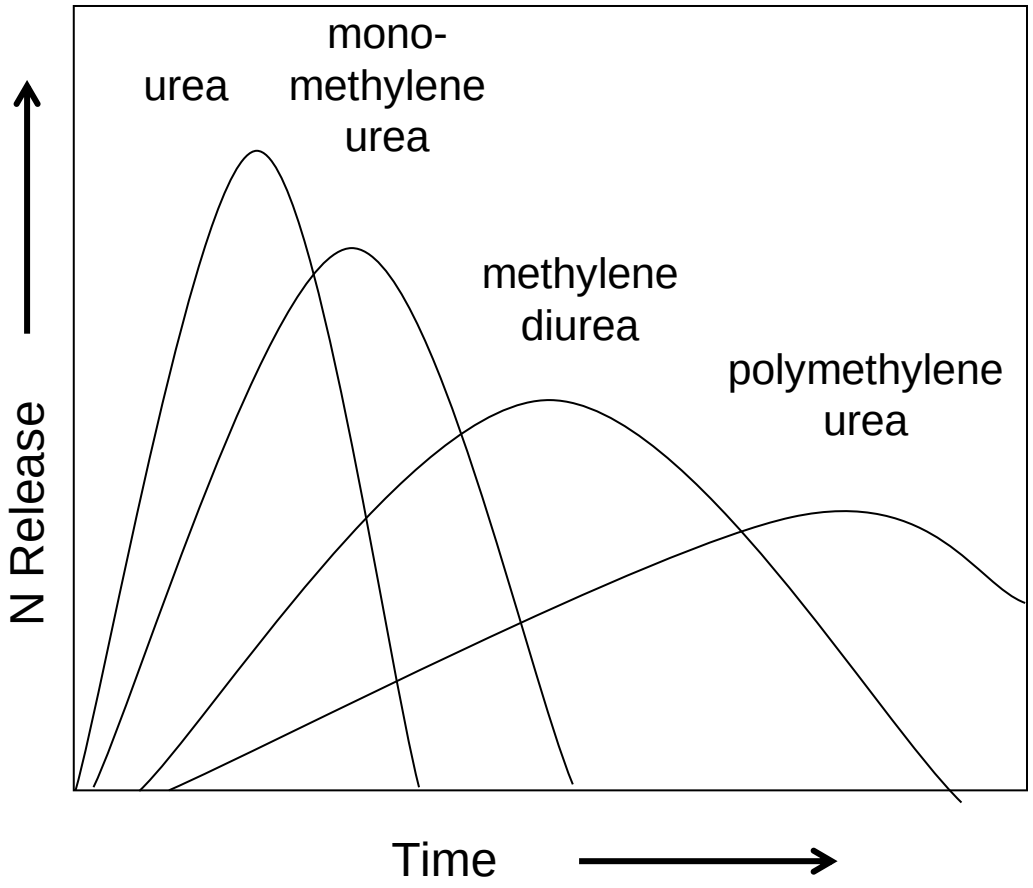
TRIAZONE



Release Curves for Various Methylene Urea Chains



- Slow Release Nitrogen
  - Delay N availability
  - N available through chemical/biological breakdown
  - Release rate determined by:
    - Chemical structure
    - Molecular weight
    - Environmental conditions



Nitamin® enhanced efficiency fluid N fertilizer

- **Liquid, slow-release N fertilizer**
- **Patented urea-based polymer**
- **Clear water soluble solution**
- **Nitrogen released by methylene urease enzyme**
- **Release rate is dependent on temperature and biological activity**

- $Q_{10} = 2$

Overview



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Fluid foliar applications



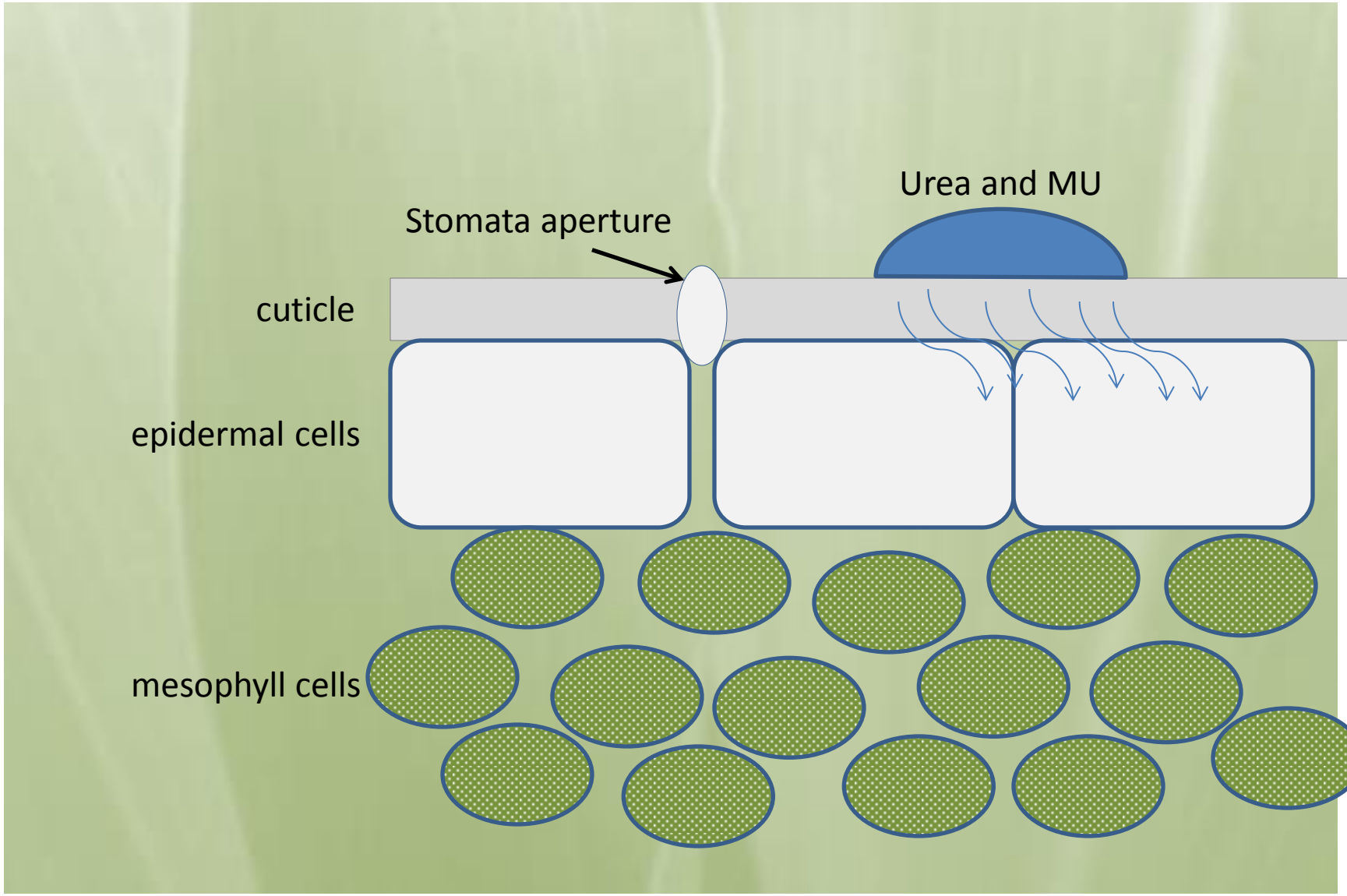
- Low rates
- Aerial or high-clearance equipment
- Typically combined with fungicide application
- Stress recovery or supplemental N

Drip fertigation – high value crops



FOLIAR UPTAKE MECHANISM





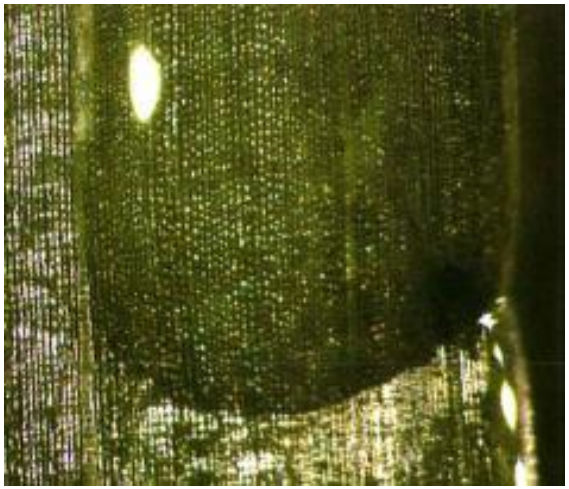
FOLIAR UPTAKE MECHANISM



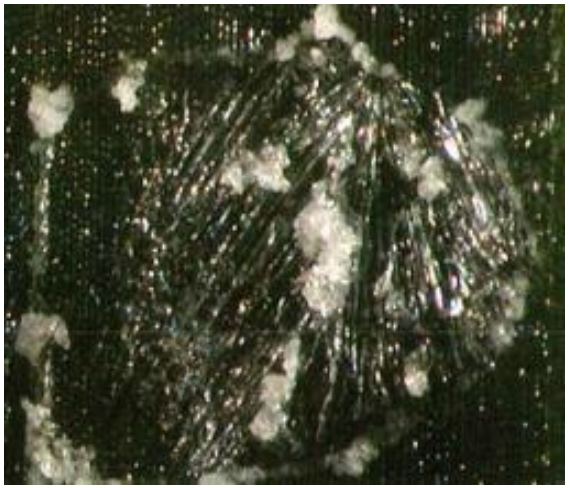
- Foliar applied fertilizers uptake is through leaf cuticle
- Nonpolar molecules (e.g., UF and Triazones) pass easier through leaf cuticle than polar molecules (e.g., NH_4^+, NO_3^-)
- Leaf cuticle pores diameter range between 1–5 nm while urea molecule has a diameter of 0.42 nm
- Methylene urea and Triazones have diameter ranging at 0.84–1.26 nm

FOLIAR APPLICATION





MU/Triazone fertilizer 30-0-0



Liquid Urea 20-0-0

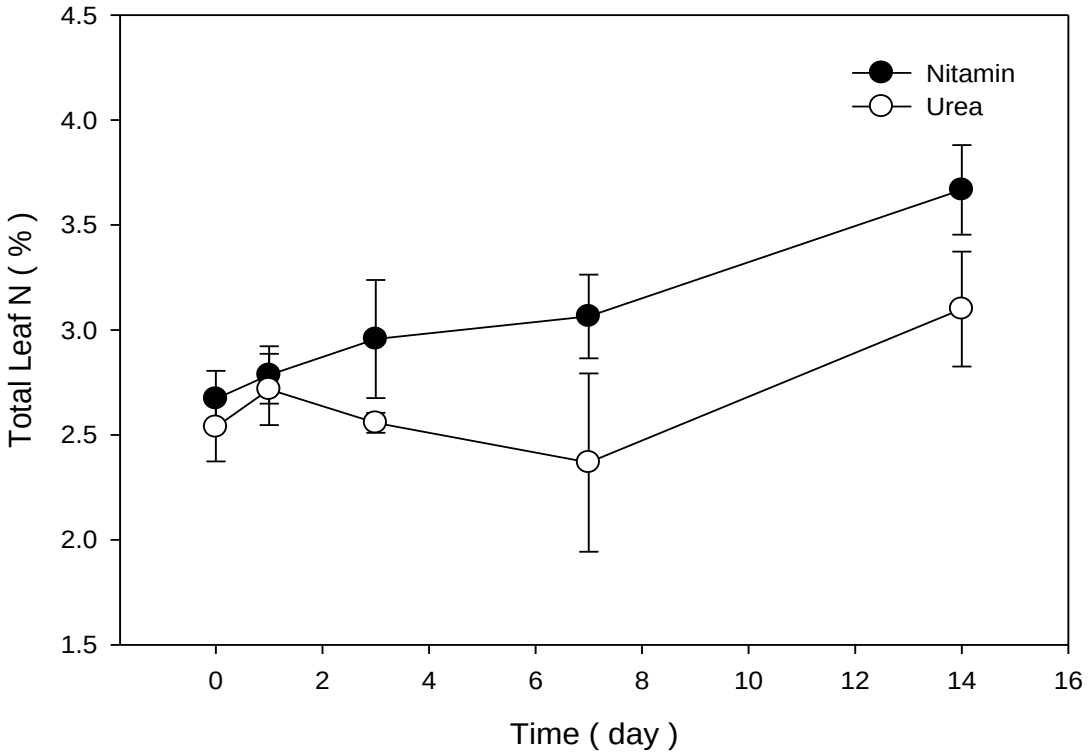
30 minutes after application

*Only nutrients in solution can be absorbed by leaf surface



Nitamin® 30L fertilizer vs. urea solution

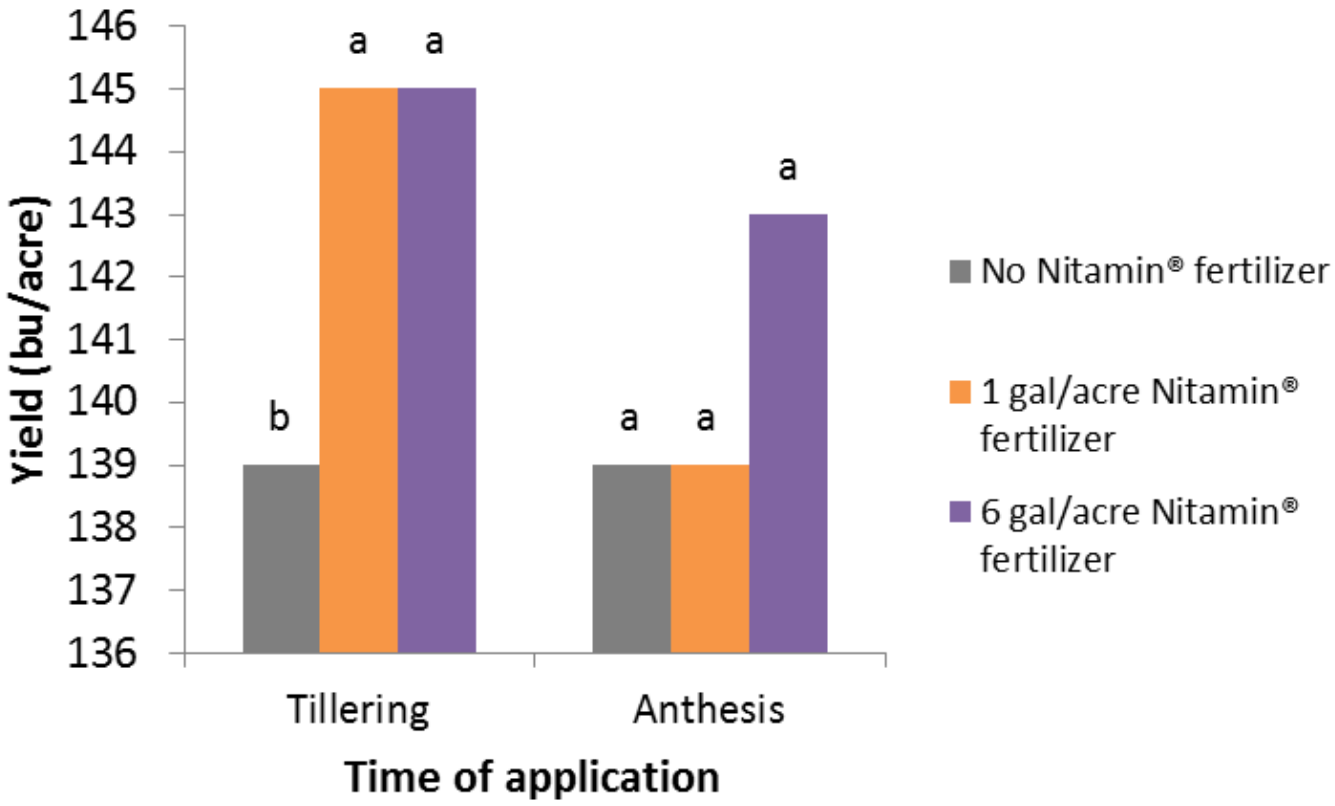
From day 3 to 14 Nitamin fertilizer treated leaves had up to a 33% increase in total N



Leaf N concentration of foliar applied ^{15}N treated leaves

WINTER WHEAT YIELD IN WASHINGTON



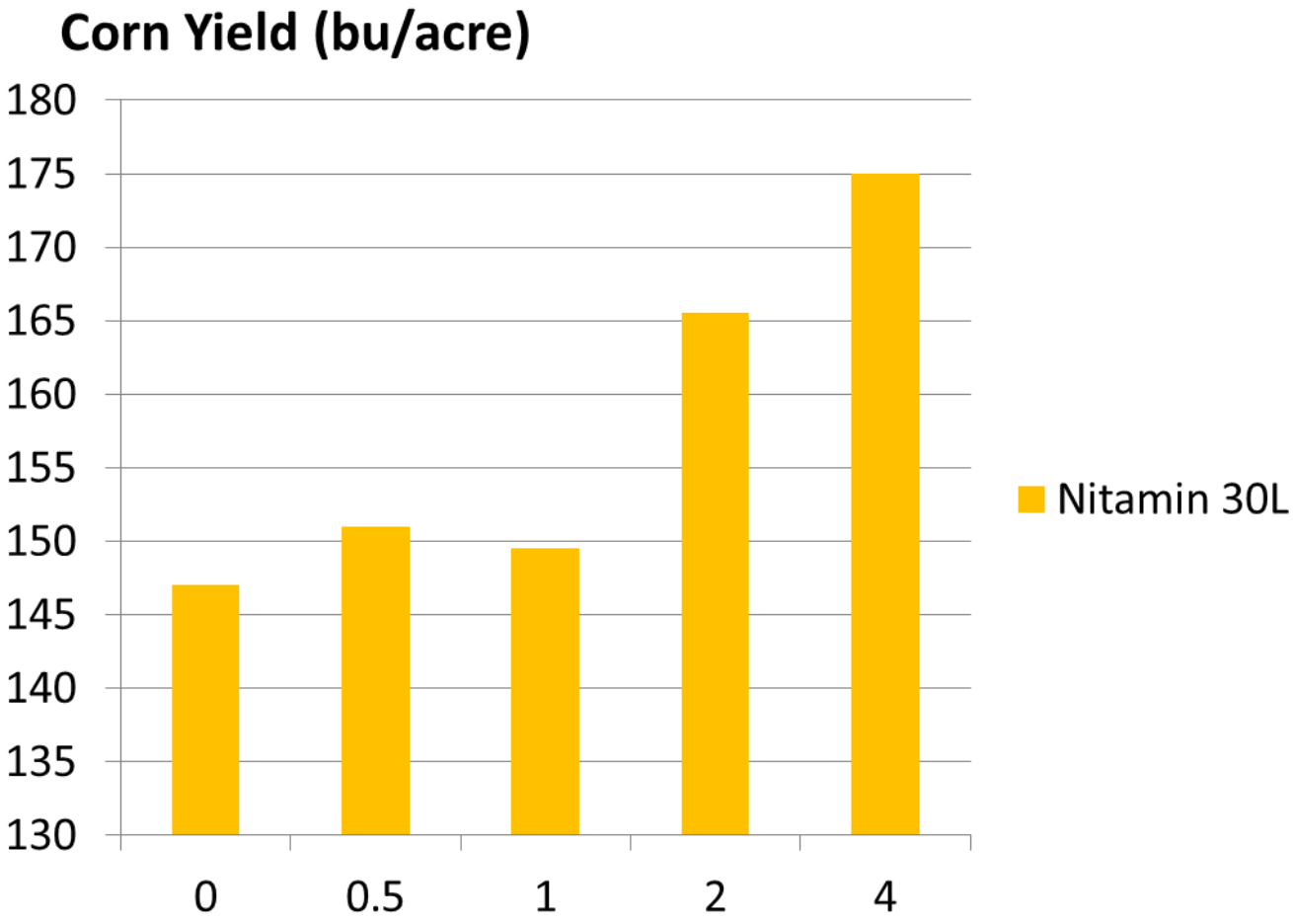


- 115 lbs N/acre was deep banded at planting through conventional fertilizer
- Within time of application, bars followed by the same letter are not statistically different
- Source: Washington State University, 2009.

nitamin

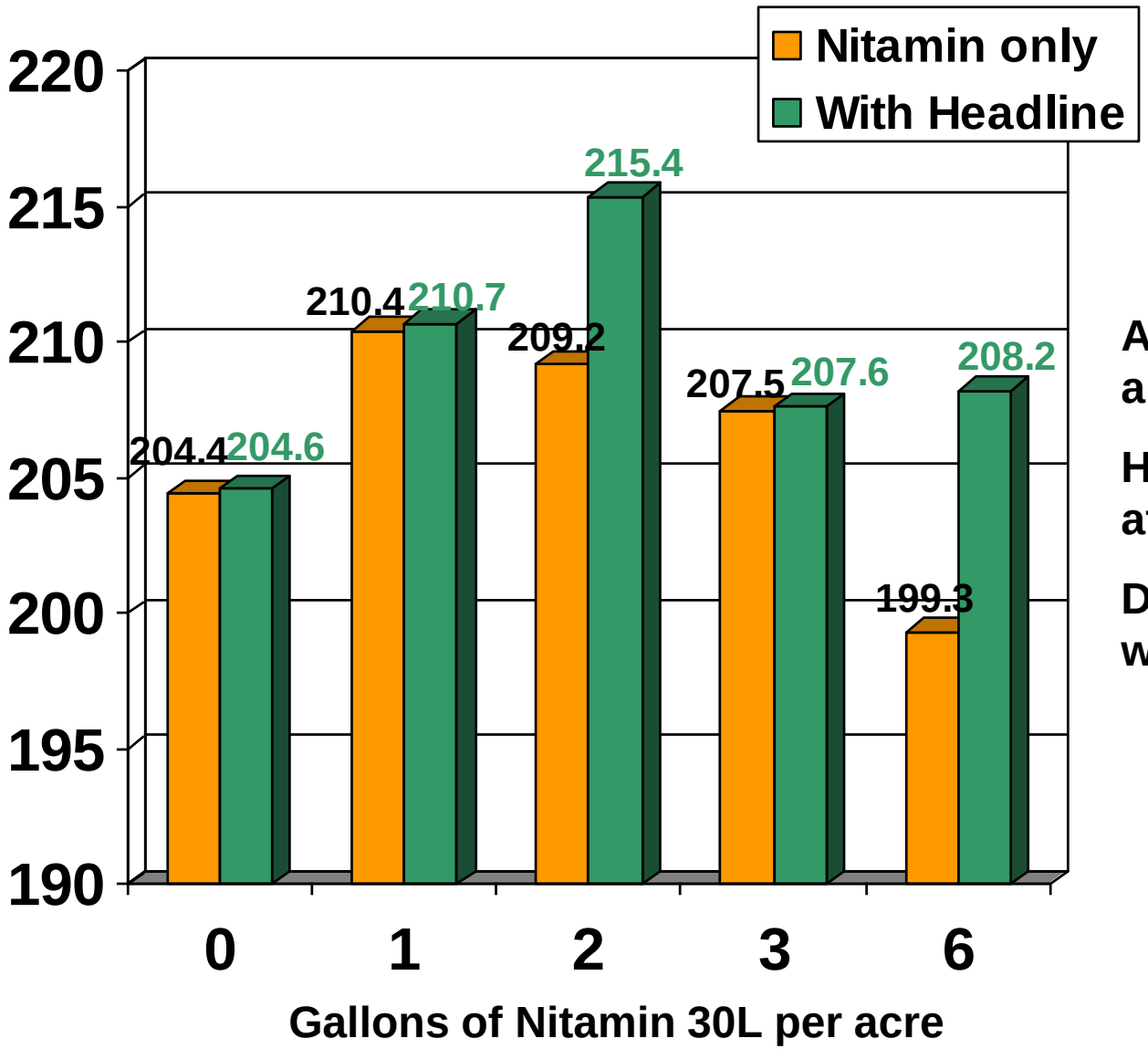
Corn Yields in Missouri





Source: Dr. Kelly Nelson, U of Missouri

Foliar on corn - Iowa



All treatments applied at VT/R1

Headline applied at 6 oz/A

Disease pressure was ~ 1%

Source: Dr. Robertson, Iowa State University, 2008

Cotton Defoliation Trial

Treatments:

1. Mepiquat Cl alone at 3.2 fl oz/acre, or
2. Mepiquat Cl combined with Nitamin® 30L at 8 or 16 fl oz/acre

Measurements:

- Defoliant applied Sept. 7, 2006
- Defoliation % measured 6 and 11 dat
- Regrowth evaluated 18 dat
- Harvested 19 dat (9/26/06)

Source: Dr. Charles Burmester, Auburn University, 2006

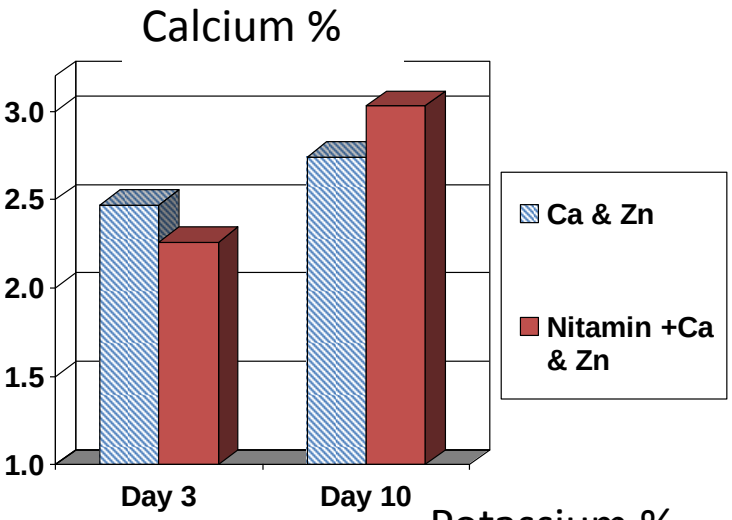
Cotton Defoliation Trial

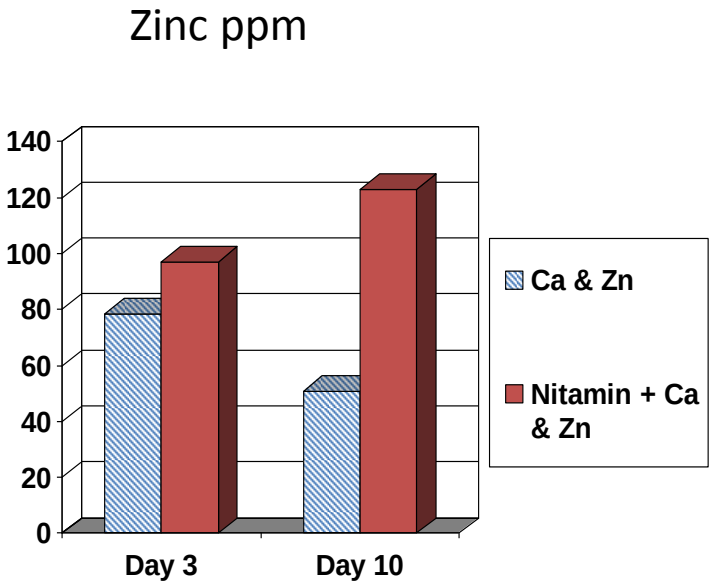
Treatment	Defoliation (%) 6 DAT	Defoliation (%) 11 DAT	Regrowth (%) 18 DAT	Yield lb./acre 19 DAT
Mepiquat Cl **3.2 fl oz/ac**	**43.3**	**66.7**	**31.7**	**924**
Mepiquat Cl **3.2 fl oz/ac +** NITAMIN® 30L **8 fl oz/ac**	**60.0**	**76.7**	**25**	**1023**
Mepiquat Cl **3.2 fl oz/ac +** NITAMIN® 30L **16 fl oz/ac**	**66.7**	**88.3**	**28.3**	**1020**

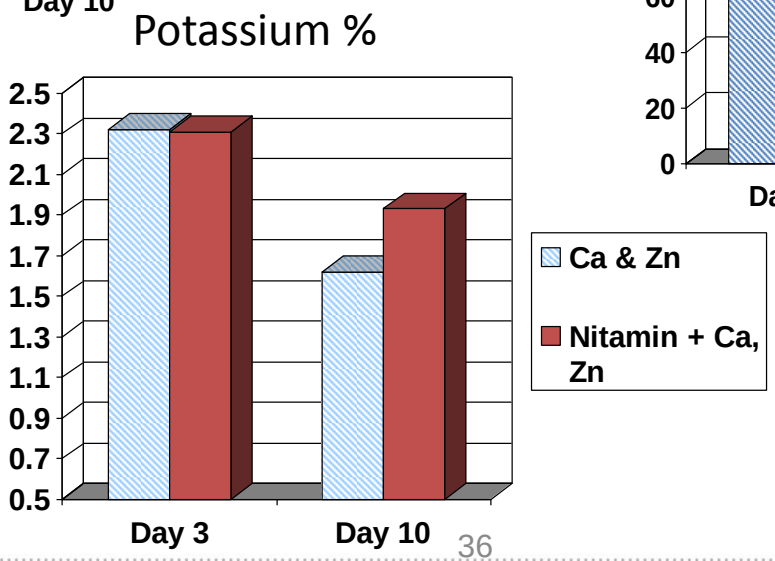
Source: Dr. Charles Burmester, Auburn University, 2006



Improved Nutrients Absorption of Foliar treatments applied on snap beans at R1



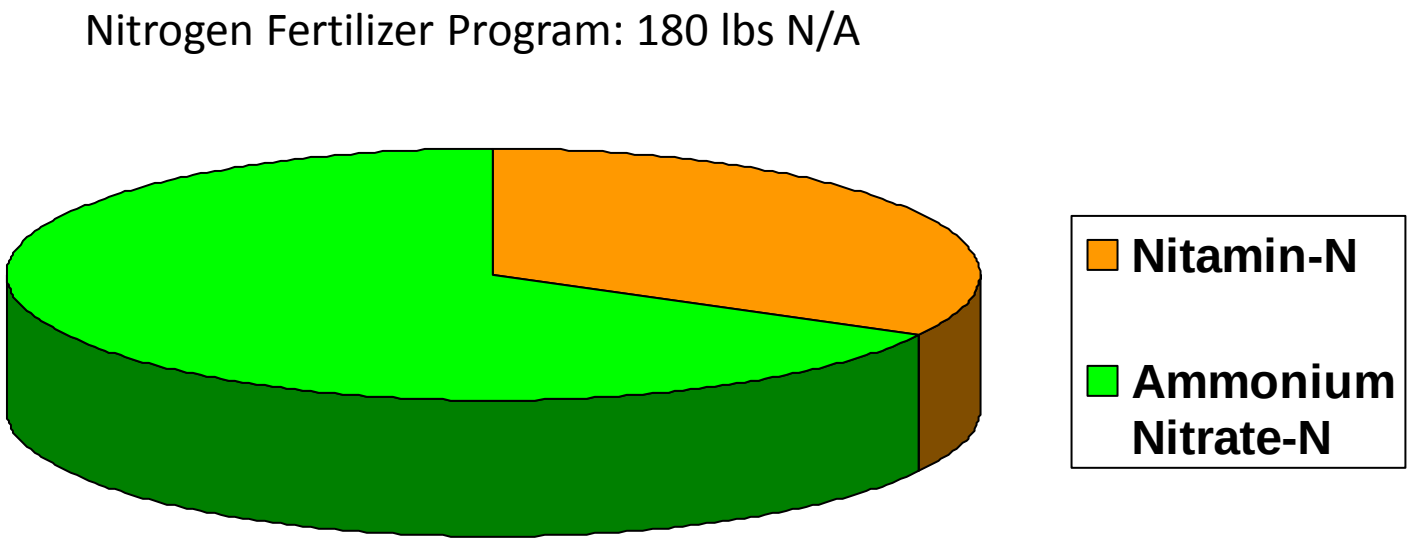




Source: Russ Wallace, Ph.D, Texas A&M

Nitamin® 30L Valencia Orange Trial: Foliar

Lake Alfred, FL, 2005 - 2007



Nitamin® 30L – 60 lb. N foliar applied from 30L in two equal sprays at bloom and five weeks later. Plus 120 lb. N was applied using a conventional fertilizer source (8-2-8) in two ground applications (Feb & Oct.). A total of 180 lb. N/acre/year was applied.

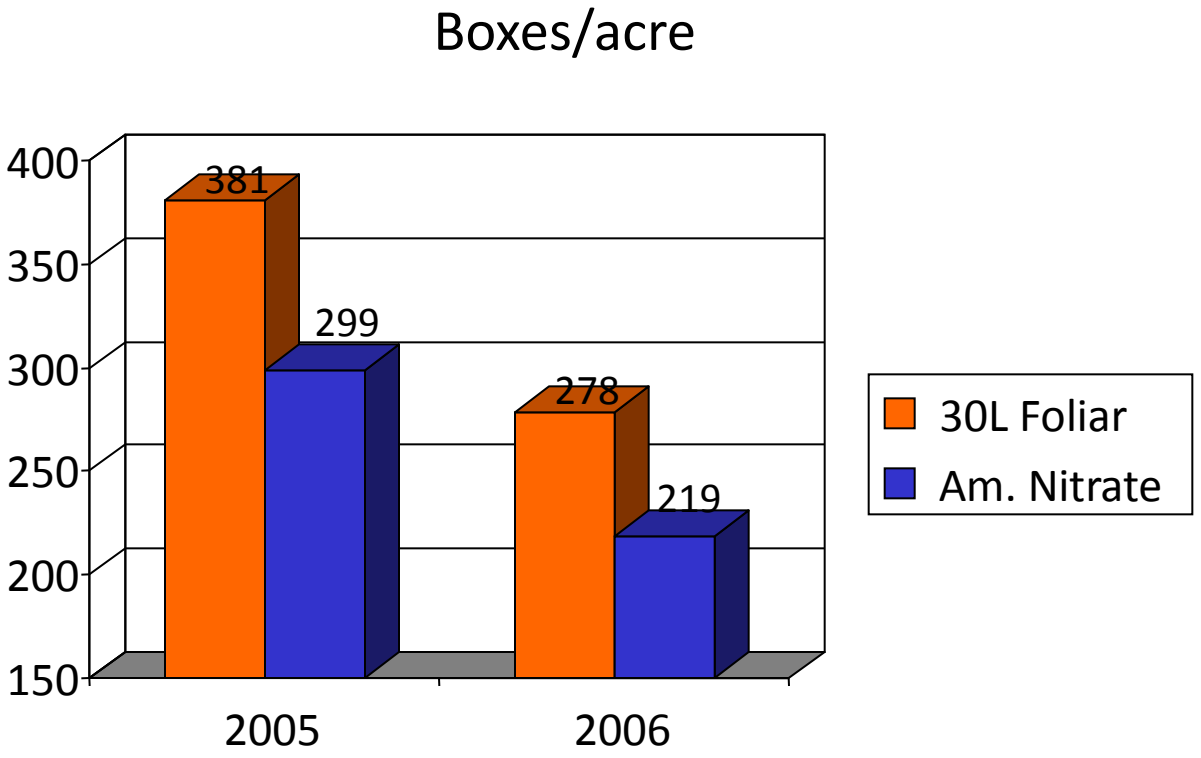
Conventional program - 8-2-8 was ground applied in three equal split applications (Feb, April & Oct.) to supply a total of 180 lb. N/acre/year.

Location: Flatwoods grove

Source: Dr. Albrigo and Dr. Syvertsen, UF/IFAS, 2005-2006

Nitamin® 30L Valencia Orange Trial: Foliar

Lake Alfred, FL, 2005 - 2007



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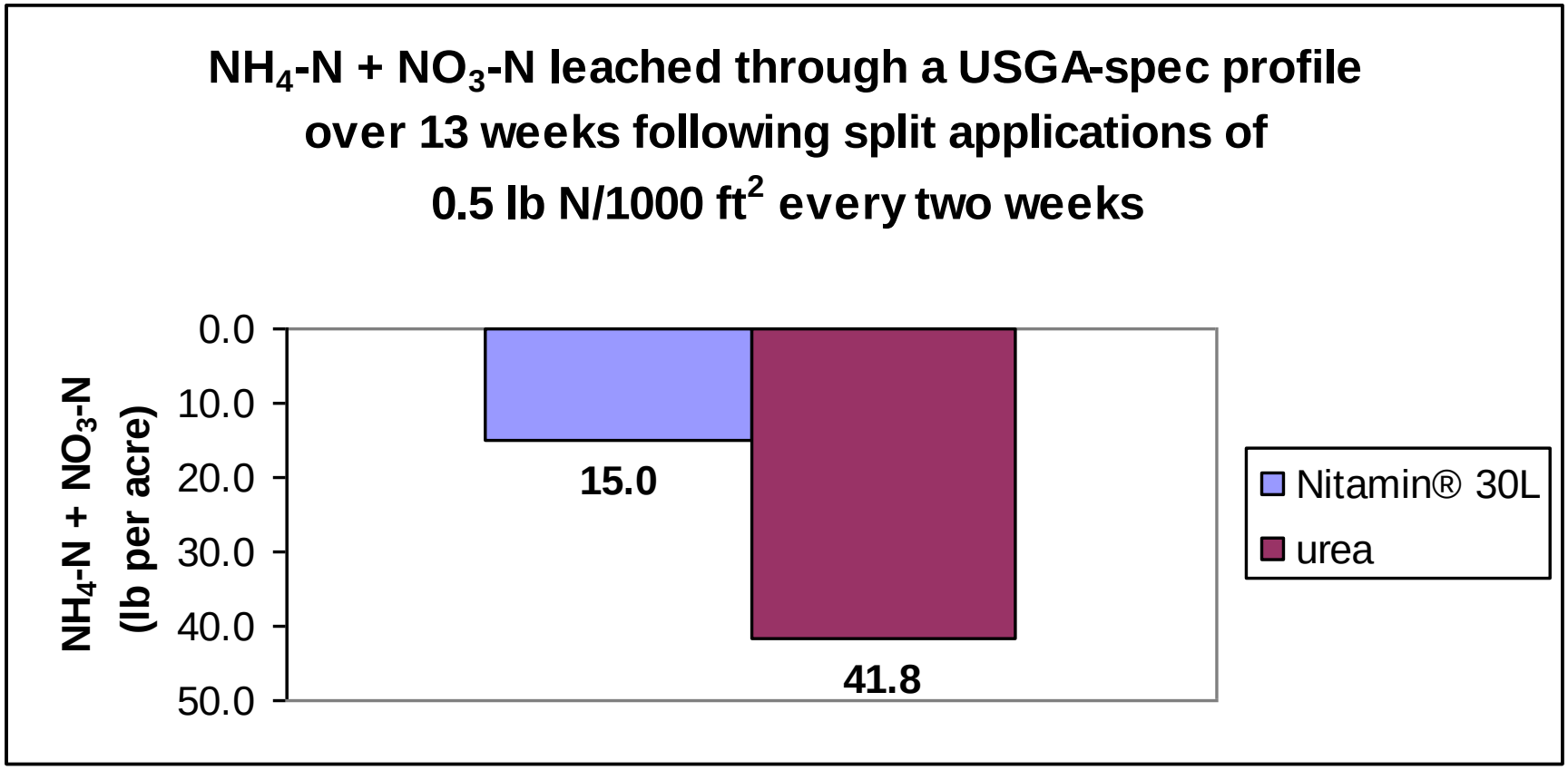
Year to year change: Hurricane recovery and biennial yield cycle (Albrigo and Syvertsen)

Source: Dr. Albrigo and Dr. Syvertsen, UF/IFAS, 2005-2006

N-Leaching Study



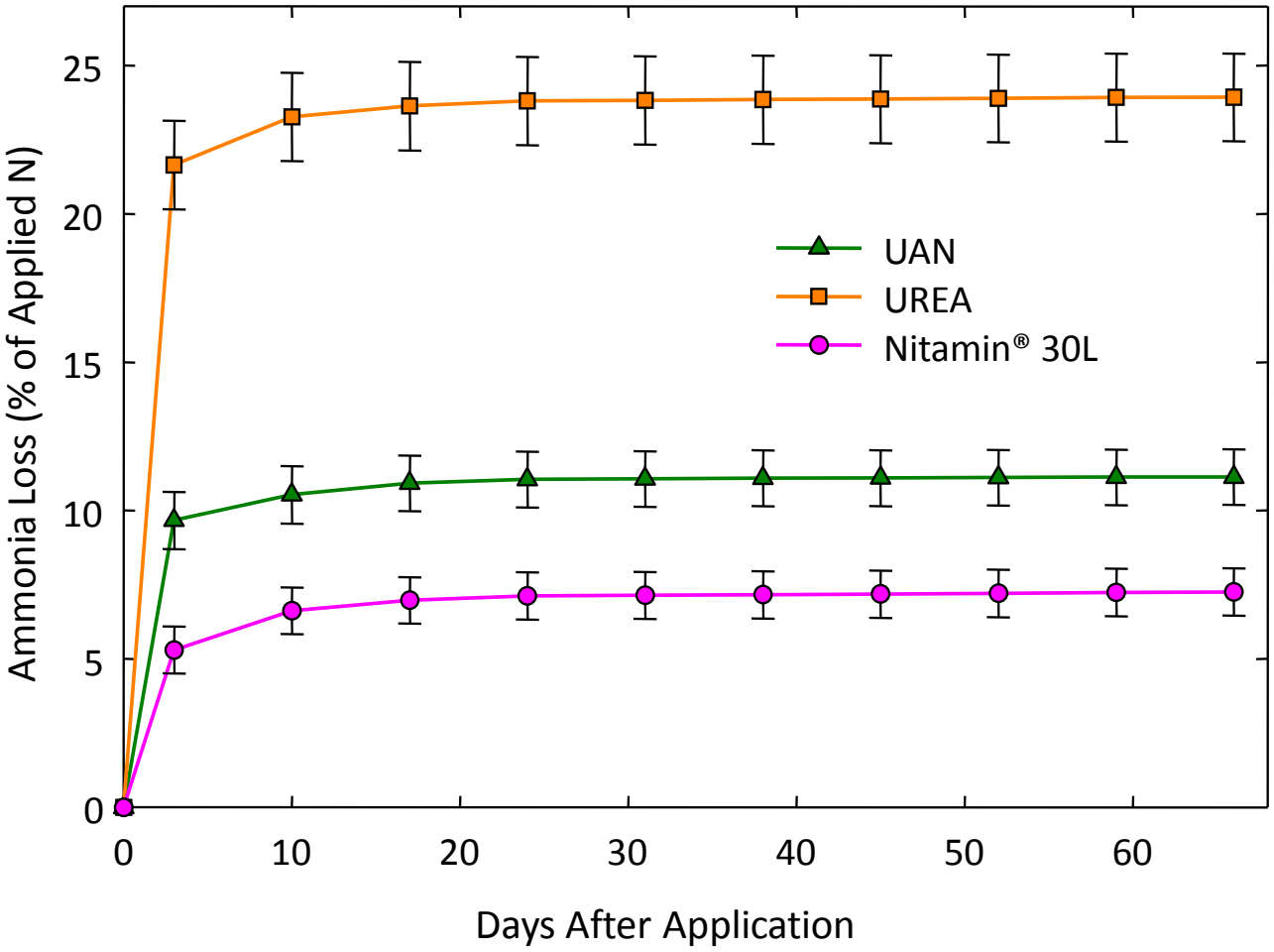
Bermudagrass leaching trial results: NH_4 + NO_3



Total applied: 88 lb N per acre

Source: Dr. John Cisar, UF/IFAS, 2006

Ammonia Volatilization Study



Source: Dr. Miguel Cabrera, University of Georgia, 2006

Fletcher, NC – Sept 15, 2005

Prior to 2nd harvest

Nitamin® 30L left *grower standard right*

(both applied at 200 lb. N/acre)

Source: Dr. Doug Sanders and Dr. Luz Reyes, NC State U., 2005

Tomato yields, Clinton, NC 2005
(25# boxes/Acre)



Treatment	Total	Marketable
200 Std	1621	1441
300 Std	2004	1766
150 30L	1995	1789
200 30L	2121	1857
250 30L	1984	1779
LSD < 0.05	265	302

Std – $NaN0_3$ injected in weekly applications providing 150 or 250 lb. N per acre during the growing season

Source: Dr. Doug Sanders and Dr. Luz Reyes, NC State U., 2005

Tomato Nutrient Removal

NC State Trial, Fletcher, NC, 2005



	Nitrogen	
TMT.	g/plant	lb./acre
200 Std	6.4	70.5
300 Std	6.9	76.1
175 30L	10.1*	111.3
250 30L	10.0*	110.2
175 Dry	10.9*	120.1
250 Dry	10.4*	114.6
LSD 0.05	2.2	

Nitamin® 30L Grower Standard

Source: Dr. Doug Sanders and Dr. Luz Reyes

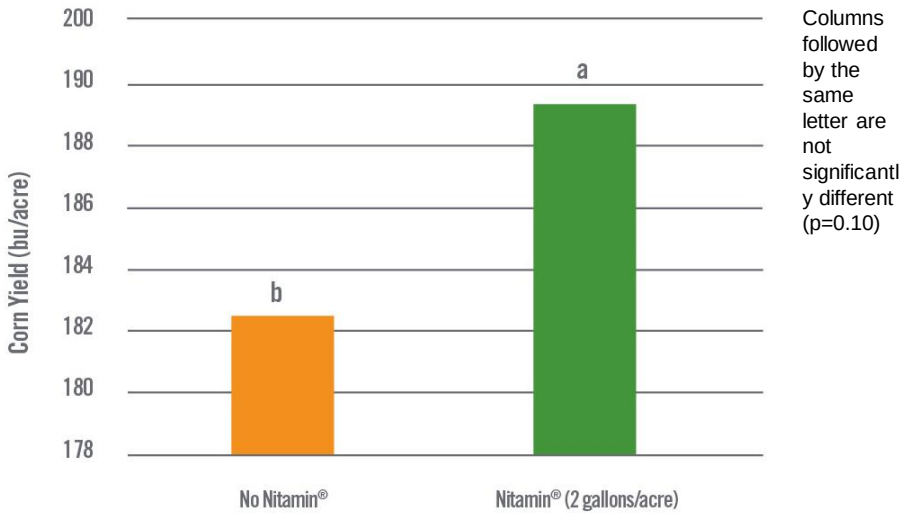
Fletcher, NC – Sept 15, 2005

Before 2nd harvest top, after harvest bottom

Nitamin® Foliar Fertilizer on Corn

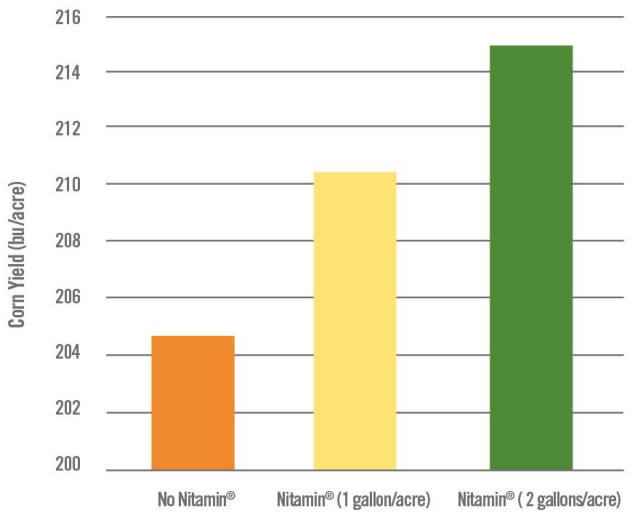


- Replicated research results from two years of trials at four Midwestern universities show
  - Foliar application of 2 gallons per acre at tasseling increased corn yield an average of 7 bushels per acre



Columns followed by the same letter are not significantly different (p=0.10)

Average of a study conducted at four Midwestern universities over two years.



Trial conducted by Iowa State University the labeled rate of a strobilurin fungicide.



Benefits of Foliar Applications of Methylene Urea

- Higher N concentration than liquid urea
- Lower leaf burn potential
- Humectant properties (keeps leaf wetter longer)
- Good tank mix partner for other CPC's
- Effective nitrogen delivery at critical growth stages

BLENDING “WATCH-OUTS”



- Jar blends should always be performed at the customer site and monitored for required stability
- Do not make UF & Triazone blends that are below pH 5
- Blends with a pH below 7 will not be stable for extended periods (depends on pH)
- Blends with pH 5-7 should be used quickly

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