



Reduced Tillage Fertilizer Management

Bill Verbeten

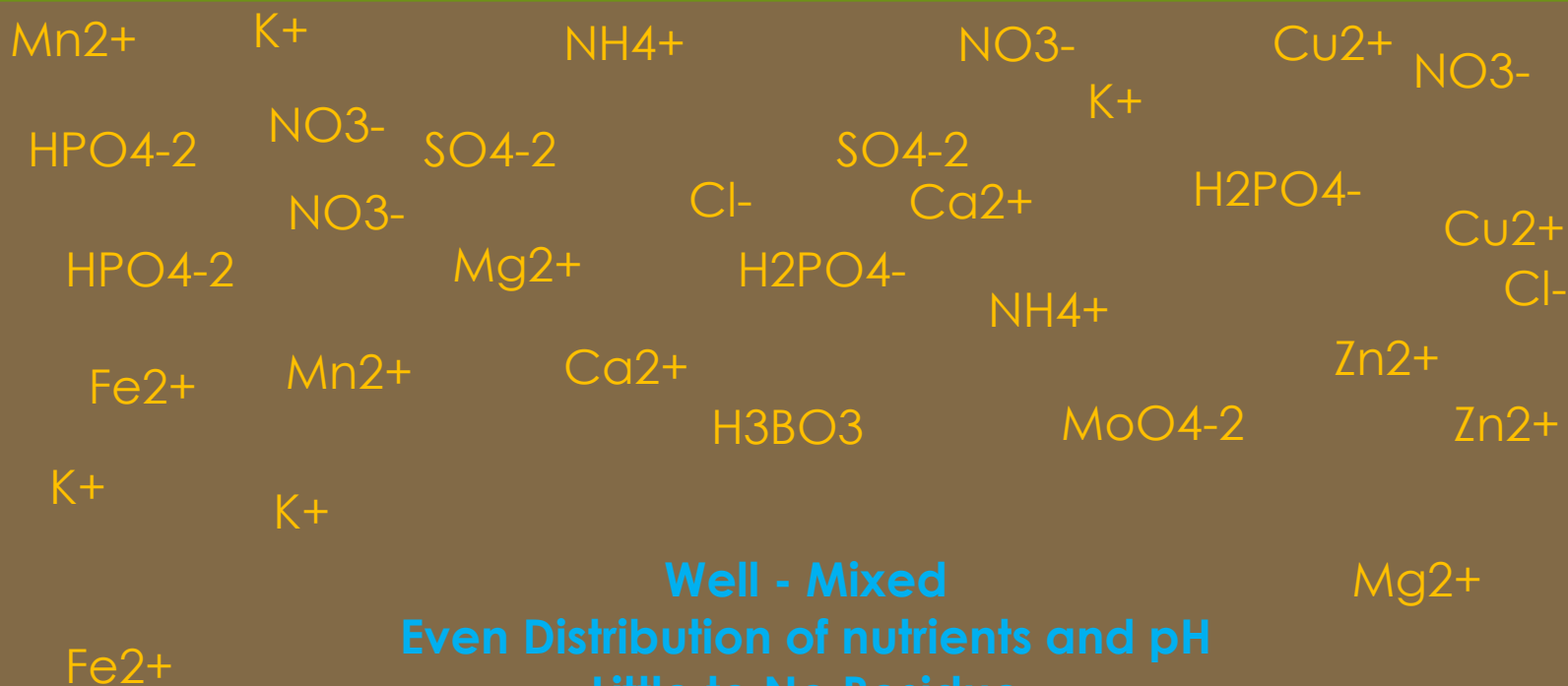
NWNY Dairy, Livestock, &
Field Crops Team



Take Home Points

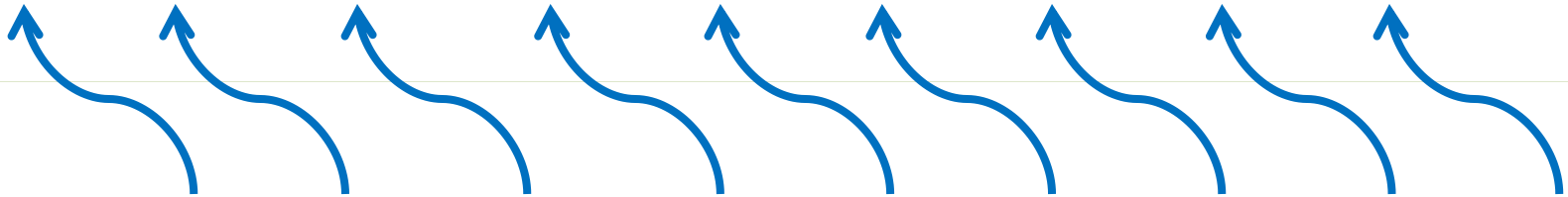
- **Fertilizer placement** is the main tool to manage crop fertility in reduced tillage systems
- **Yield responses** to fertilizer placement vary with tillage system, soil test levels, nutrient, weather, and soil types.

Conventional Tillage Soil



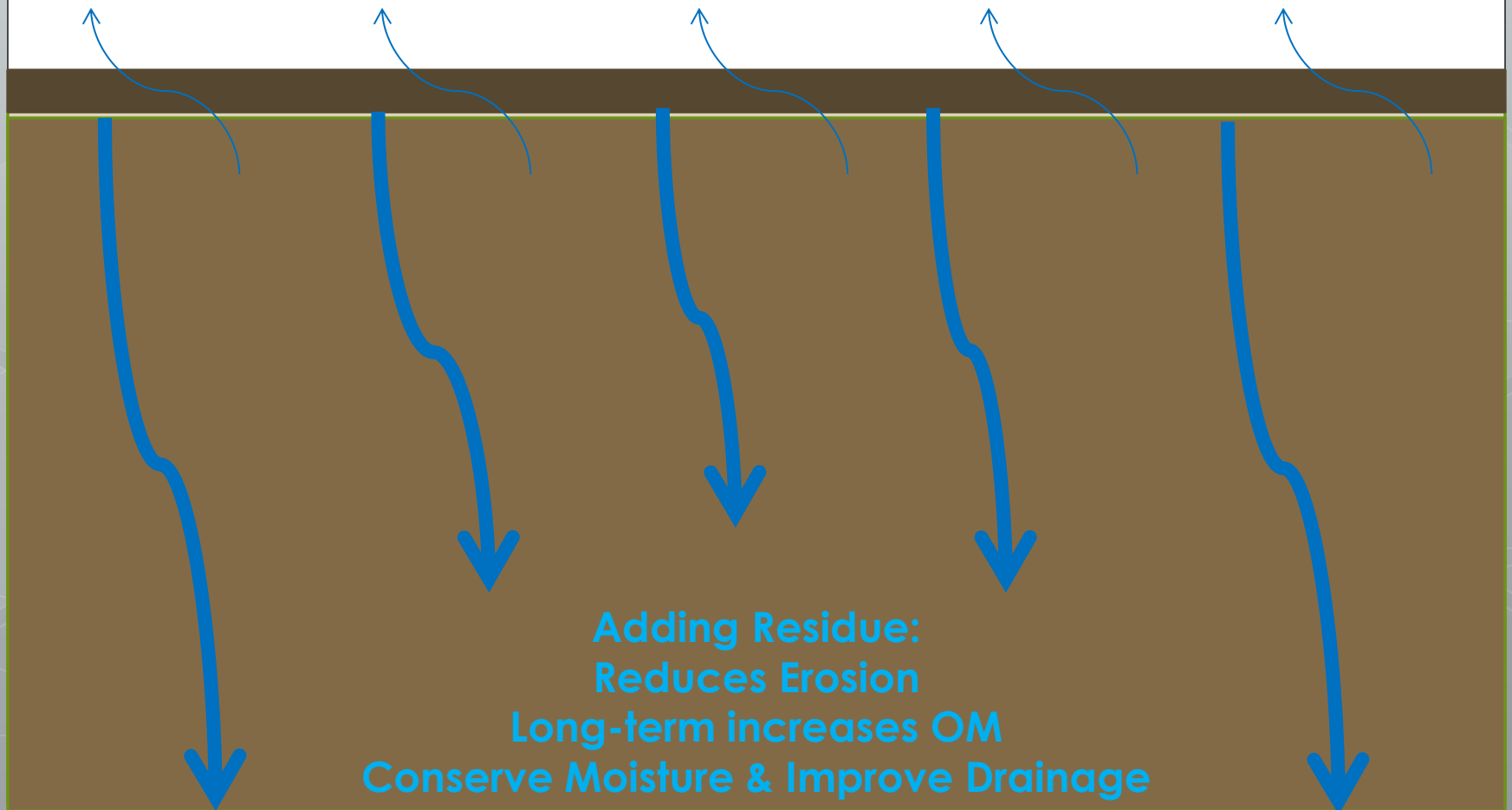
Well - Mixed
Even Distribution of nutrients and pH
Little to No Residue
Warms and dries quickly

Conventional Tillage Soil



**High Soil Erosion
Long term OM decreases
Moisture Lost Quickly**

No-Till Soil

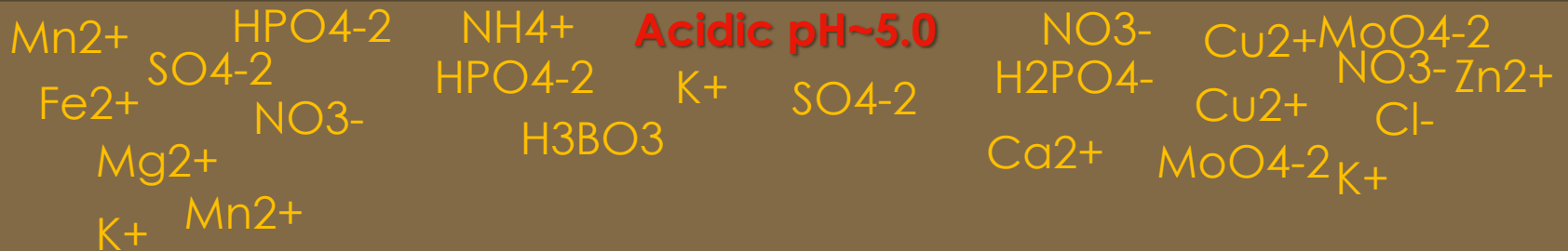
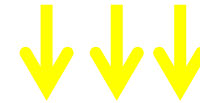


Triazine Herbicides



No Till Soil

Nitrogen Fertilizer

 Fe^{2+} **Neutral pH~6.5** Ca^{2+} NO_3^- Mg^{2+} Zn^{2+} K^+ $H_2PO_4^-$ Cl^-

Stratification of nutrients and pH
Residue Interacts with Fertilizer
Warms and dries slowly

Fertility Challenges of No-Till

- Acidic surface pH
- Nitrogen lost in residue
- Phosphorous and potassium accumulate in the surface and are unavailable when the top 2 in. of soil dries out

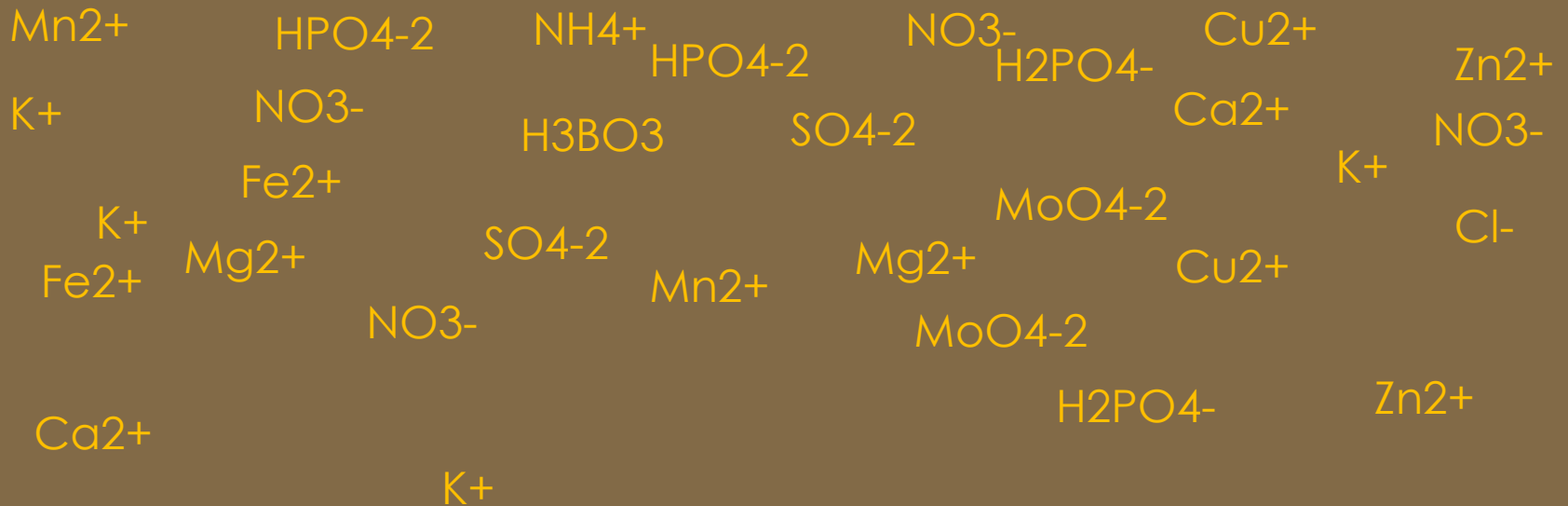
Fertility Solutions for No-Till

- Frequent applications of lime (1-2 tons every 1-2 years)
- Apply nitrogen in starter, inject/side-dress
- Phosphorous and potassium should be placed in starter (2 by 2 in.) and/or deep banded (6-10 in.)

Should fertility in reduced tillage systems be managed like no-till or like conventional tillage?

Depends on the tillage system.

Strip & Zone-Till Soils



Cl^- **Less Stratification of nutrients and pH**
Some Residue
Warms and dries quickly where tilled

Nutrient & pH Stratification?

- Not likely where strips and zones are tilled or vertical tillage implements are used

Response to Injecting Nitrogen?

- Yes
- Best to inject anhydrous ammonia or UAN solutions
- “Dribbling” UAN solutions has **more losses than injecting**, but less than broadcasting untreated UAN

Response to Pop-Up Nitrogen?

- Again, **yes**, but need to avoid salt injury
- Limit Pop-Up N + K₂O to 10 lb/acre in corn and drilled soybeans (7-8 inch rows)
 - 15-20 inch soybeans limit N+K₂O 5 lb /acre, none for 30 inch soybeans
- Reduce by 50% if on sand or dry conditions

Response to Starter Nitrogen?

- Limit **Starter** N + K₂O to 100 lb/acre in corn and 70 lb/acre in 30 inch soybeans
- Limit N to 40 lb/acre in corn & 20 lb/acre in soybeans

Responses to Starter or Deep Banded P?

- In no-till corn and soybeans , responses to **low soil test P** (Bray-1) *regardless of application method (broadcast vs. starter vs. deep banding)*
- Starter P *increases early growth*
 - Mallarino & Borges, *Iowa State University*
- However starter P is vital for wheat **establishment & yield**

How much P in Pop-Up and Starter?

- 20 lb/acre P₂O₅ in **Pop-Ups**
- 100 lb/acre P₂O₅ in **Starter**
 - Often limited by N in MAP & DAP
(40 lb/acre N in Corn, 20 lb/acre N in Soybeans)
- High P applications can cause Zn deficiency

Response to Starter or Deep Banding K?

- No-till corn and soybean yields **increased with starter and deep banded K**, even at optimal to high soil test K.

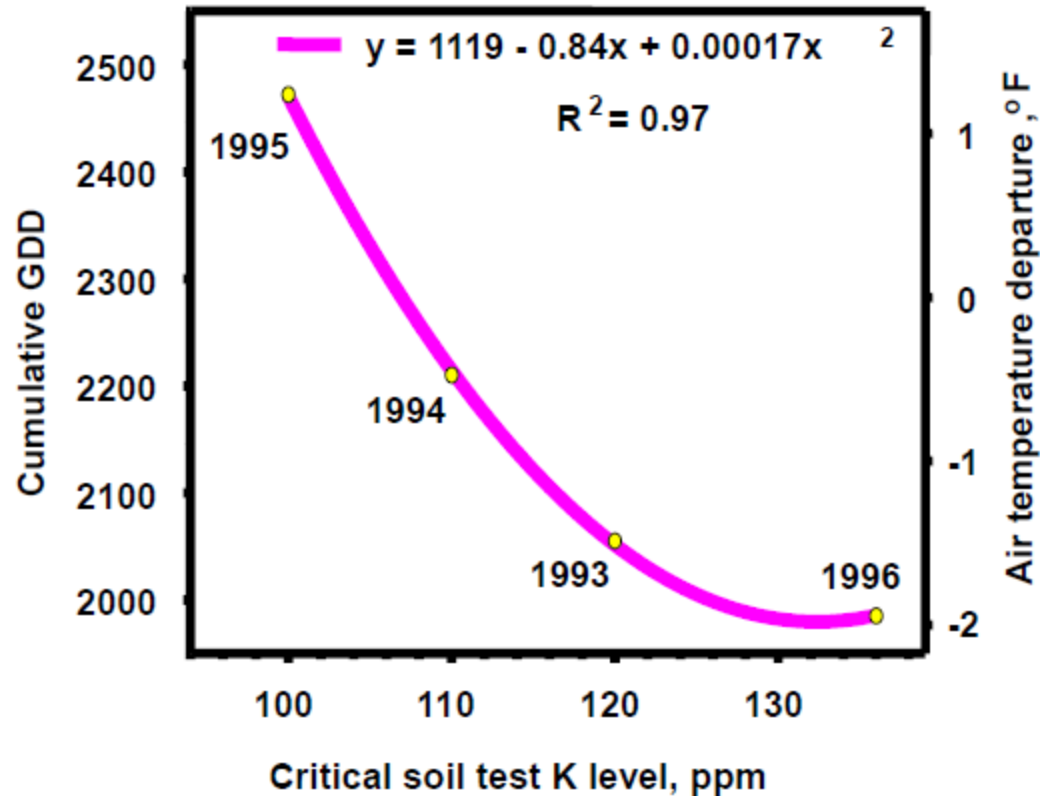
-Mallarino & Borges, *Iowa State University*

No Till Corn Response to K Starter

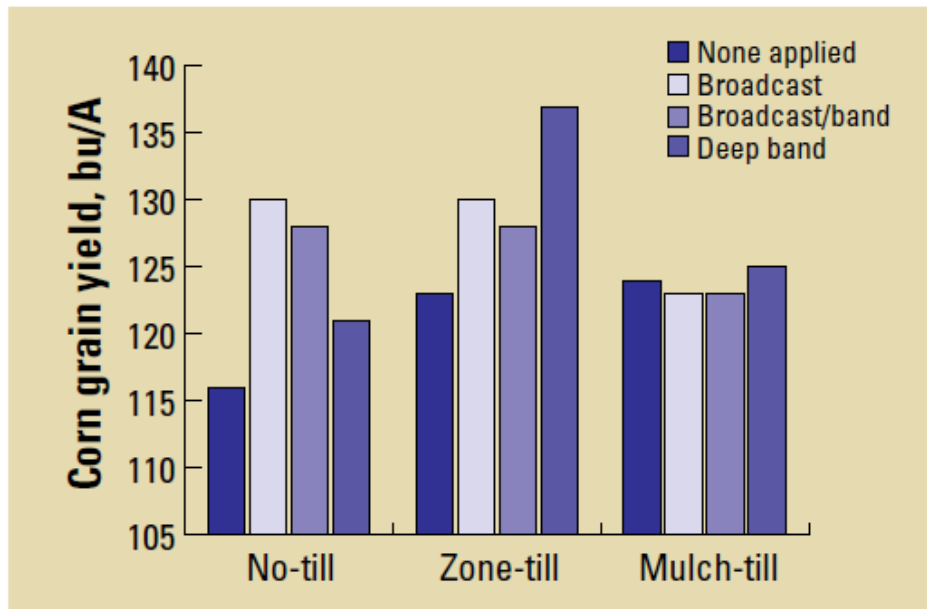
- Colder springs increase responsive soil test level

-Bundy & Andraski, University of Wisconsin.

No-Till Corn Response to Starter K



Corn Response to K in No-Till, Strip Till, & Mulch Till?



110 lb/acre K₂O

Tony Vyn, Ken
Janovicek, and Tom
Bruulsema,
University of Guelph

What makes sense for K?

- Responses likely to pop-up & starter K applications in reduced tillage systems.
- Opportunity for deep K placement in zone & strip till
- Response to K fertilization will be greater in cool years

Sulfur response?

Sulfur Recommendations

Sulfur Soil Test	Relative Level	Soil Texture			
		Coarse		Medium/Fine	
		Tilled ¹	Strip-till or no-till	Tilled	Strip-till or no-till
<i>lb/acre 2 feet</i>					
.....lb/acre sulfur recommended.....					
0 - 9	Very low	25	25	25	25
10 - 19	Low	25	25	15	25
20 - 29	Medium	15	25	0	15
30 - 39	High	15	15	0	15
> = 40	Very high	0	0	0	0

¹ Conventional tillage

South Dakota State
Fertility Guide 2005

- Most crops will still respond to between **10 and 25 lb/acre of sulfur** regardless of tillage systems.

Micro-Nutrients in Reduced Tillage?

- Micro-nutrient application most responsive to
 - Low OM, sandy soils
 - Dry years
 - pH extremes (i.e. not 6.0-7.0)
 - Extremely high OM soils
 - No manure application

Increases in OM and Organic Nitrogen in Reduce Tillage?

- Long-term investment
- 1% OM = 10 tons of OM in the plow layer
- Most residue (80-90%) is oxidized to CO₂ within 2 years

Increases in OM and Organic Nitrogen in Reduced Tillage?

- Work in NY has shown that:
 - No OM addition decreases OM
 - Adding manure maintains OM
 - Adding 15-30 tons/acre of compost per year increase OM by 0.5% in 5 years

Take Home Points


- **Fertilizer placement** is the main tool to manage crop fertility in reduced tillage systems
- *Yield responses* to fertilizer placement **vary** with tillage system, soil test levels, nutrient, weather, and soil types.

Questions?



Nitrogen Stabilizers

Bill Verbeten
NWNY Dairy, Livestock, &
Field Crops Team



Take Home Points

- Nitrogen stabilizers act as **nitrification inhibitors, urease inhibitors, or slow release fertilizers.**
- Nitrogen stabilizers **reduce nitrogen losses** for varying amounts of time (10 days to 10 weeks)

Nutrient Uptake Forms-N

- Crops take up
 - Mostly Nitrate, NO_3^-
 - Some Ammonium NH_4^+

The Nitrogen Cycle

Bill Verbeten Cornell Cooperative Extension

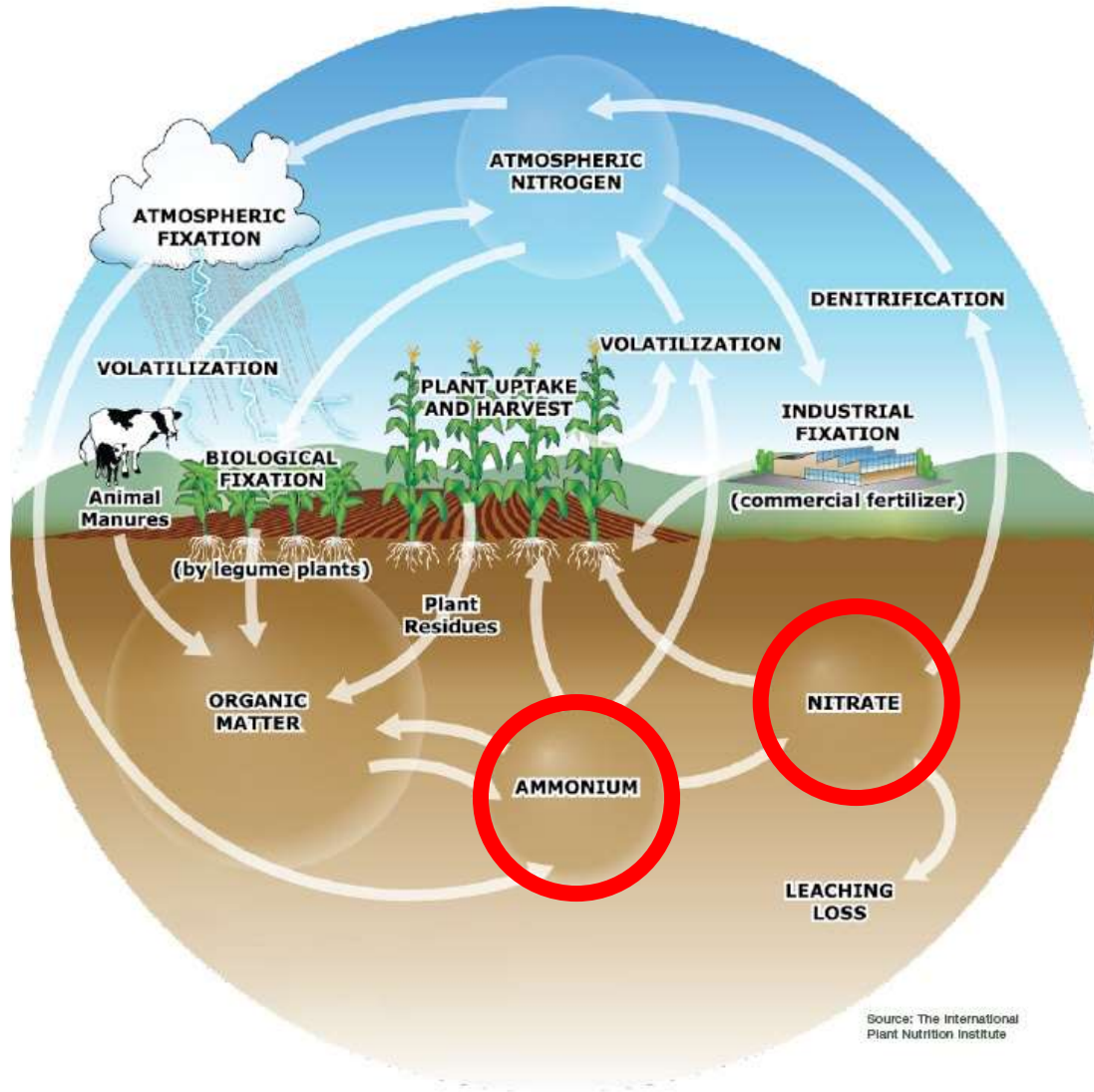


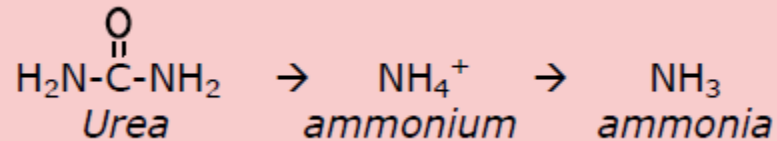
Image Source: fertilizer101.org

Nitrogen Fertilizers

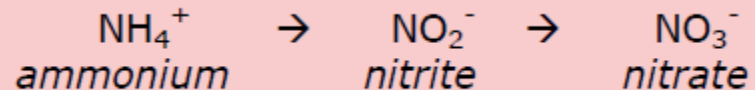
- NH_4^+
 - Anhydrous NH_3
 - Urea Ammonium Nitrate (UAN)
 - Ammonium Sulfate (AMS)
 - Urea
- Monoammonium phosphate (MAP)
- Diammonium phosphate (DAP)
- NO_3^-
 - Calcium nitrate
 - Potassium nitrate
 - Sodium nitrate

Nitrogen Fertilizers

- NH₄⁺ fertilizers can be...
 - Lost through NH₃ volatilization



- Converted to NO₃ (nitrification)



Nitrogen Fertilizers

- NO₃⁻ fertilizers can be...
 - Lost through denitrification
 - Lost through leaching from root zone

The Nitrogen Cycle

Bill Verbeten Cornell Cooperative Extension

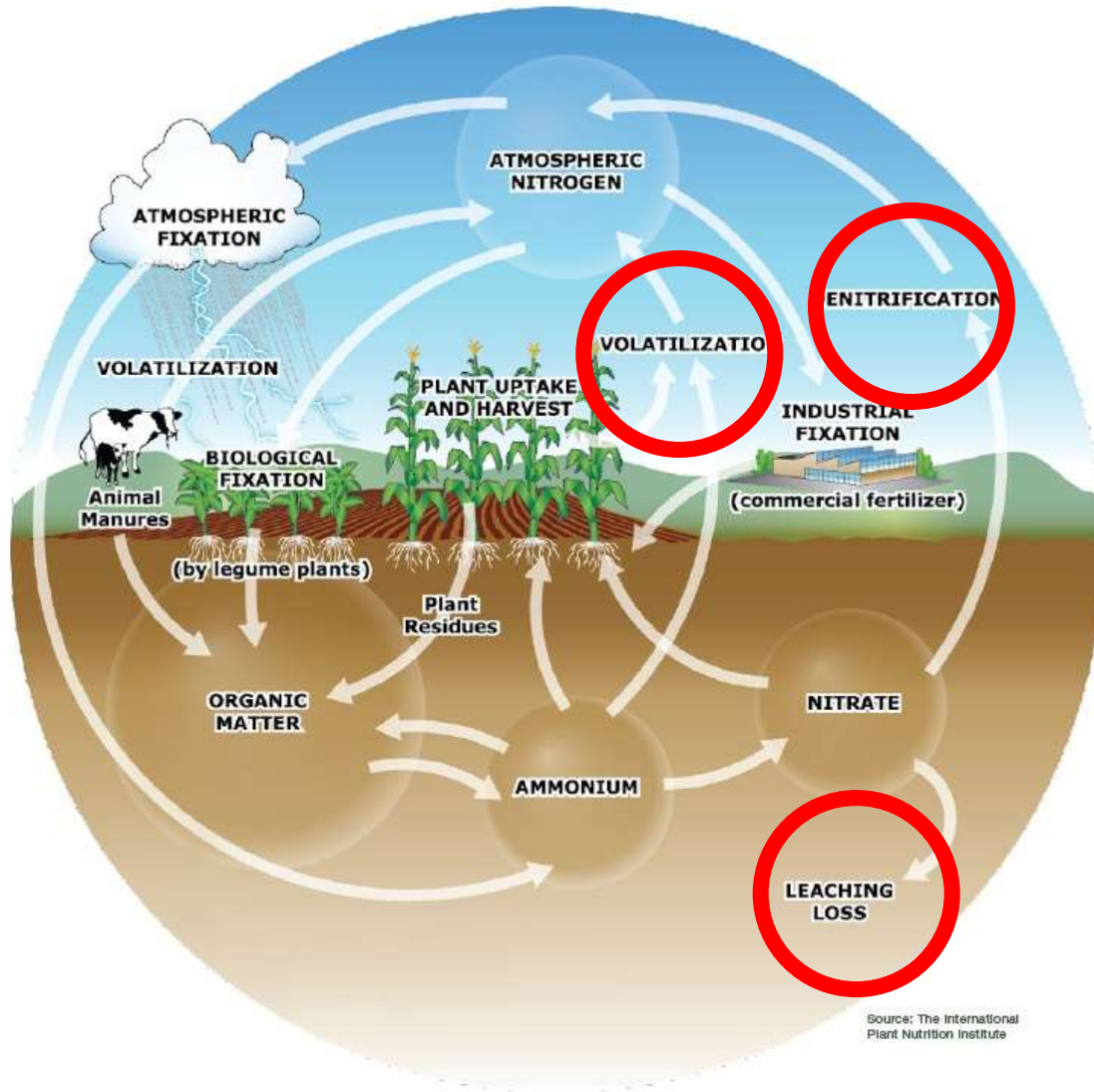
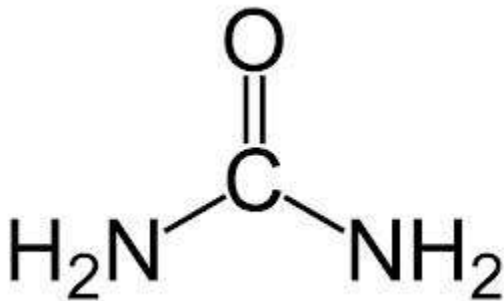


Image Source:
fertilizer101.org

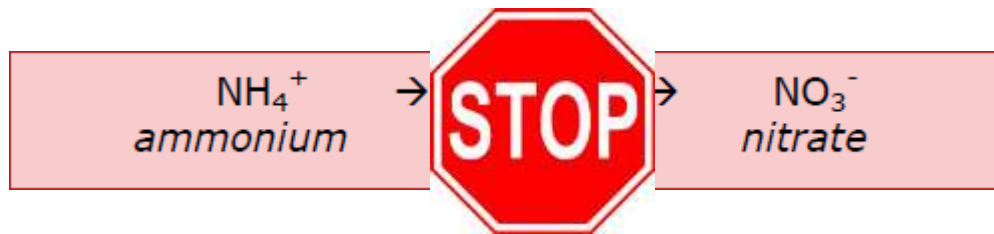
Nitrogen Fertilizers

- Urea fertilizers
 - Also lost through NH₃ volatilization
 - And converted to NO₃



Nitrogen Fertilizers

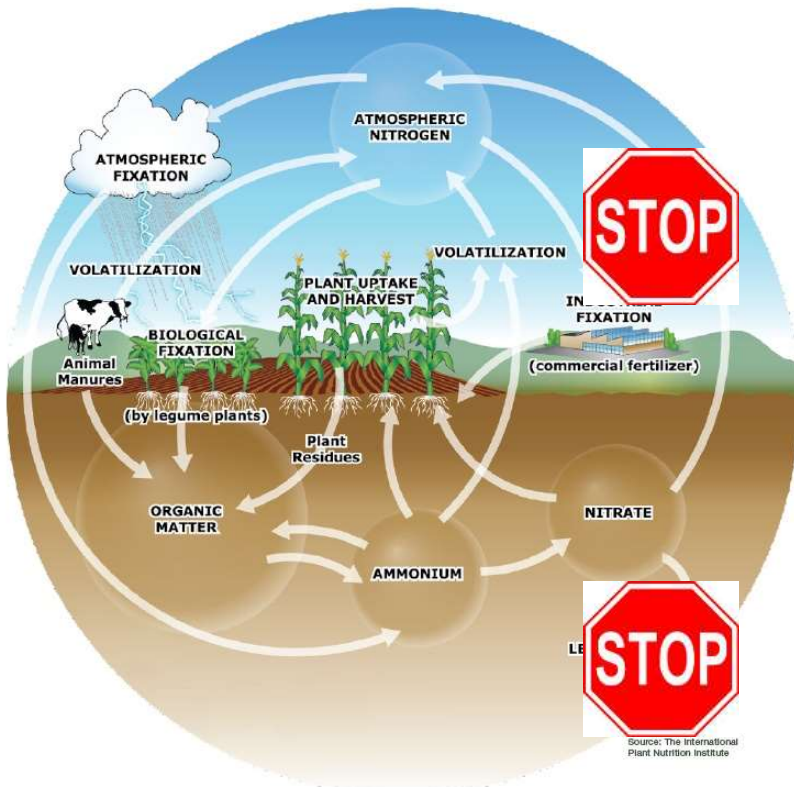
- **Nitrification Inhibitors**
 - Inhibits *Nitrosomonas* bacteria
 - Reduces losses for 4-10 weeks



- N-Serve & Instinct (Dow AgroSciences) **nitrapyrin**
- Guardian (Conklin) dicyandiamide, **DCD**

Nitrogen Fertilizers

The Nitrogen Cycle



Nitrification Inhibitors

- Reduce N losses from Leaching & Denitrification

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Nitrogen Fertilizers

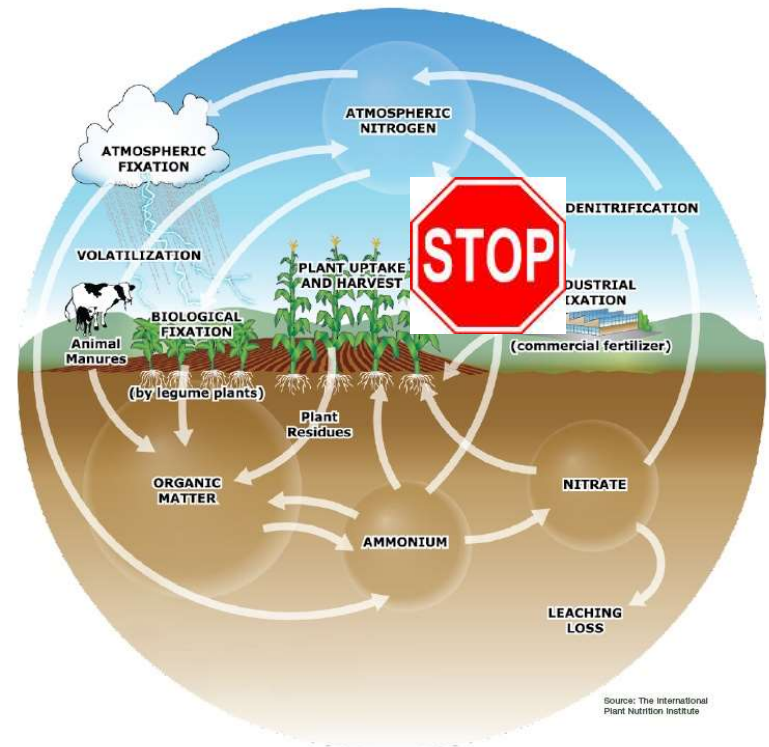
Urease Inhibitors

Agrotain

(Agrotain International LLC)

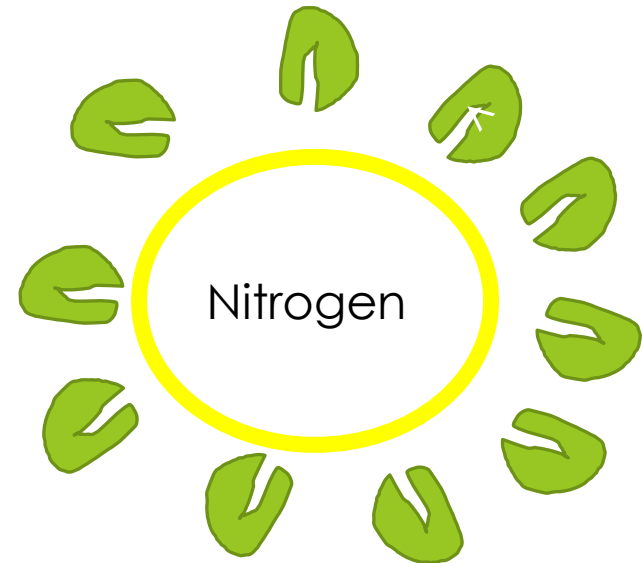
N-butyl thiophosphoric triamide, **NBPT**

The Nitrogen Cycle

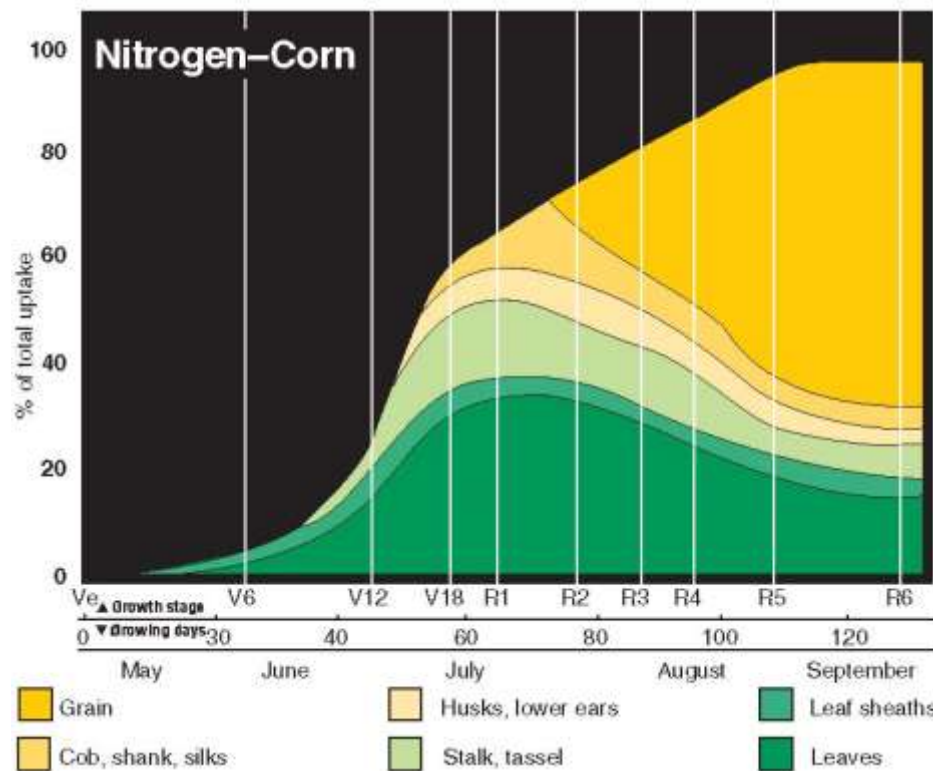


Nitrogen Fertilizers

- **Slow release**
 - Microbes break down protective layer
 - Sulfur coated urea, **ESN**, (Agrium)
 - **Osmocote** (Scotts)
 - Isobutylidene diurea, **IBDU**, (Nu-Gro)



Nitrogen Uptake



From:
plantsci.missouri.edu

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Questions?