Dryland Cotton Fertility – Does it Pay $$

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Texas A&M AgriLife Research

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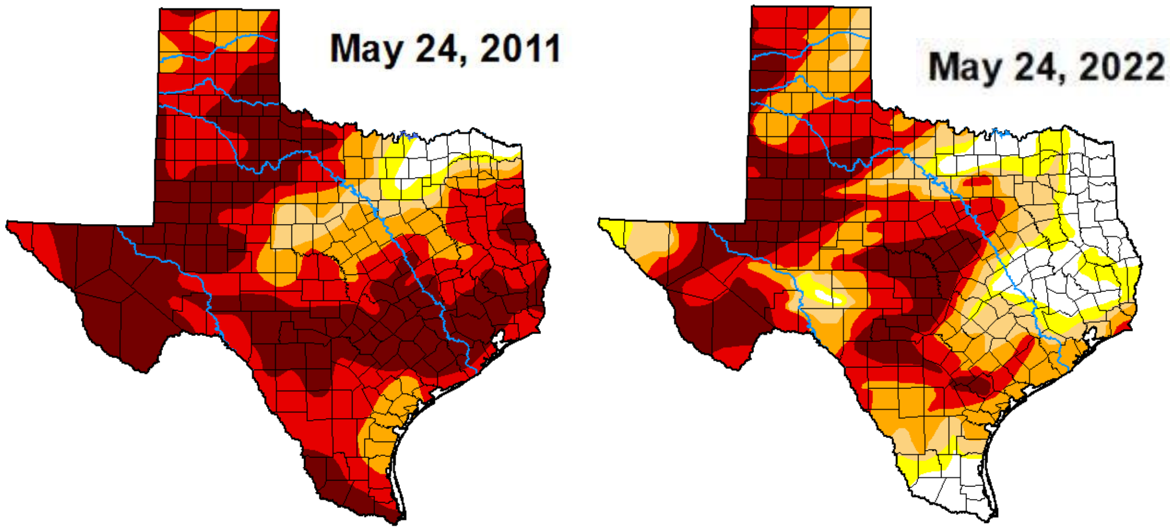
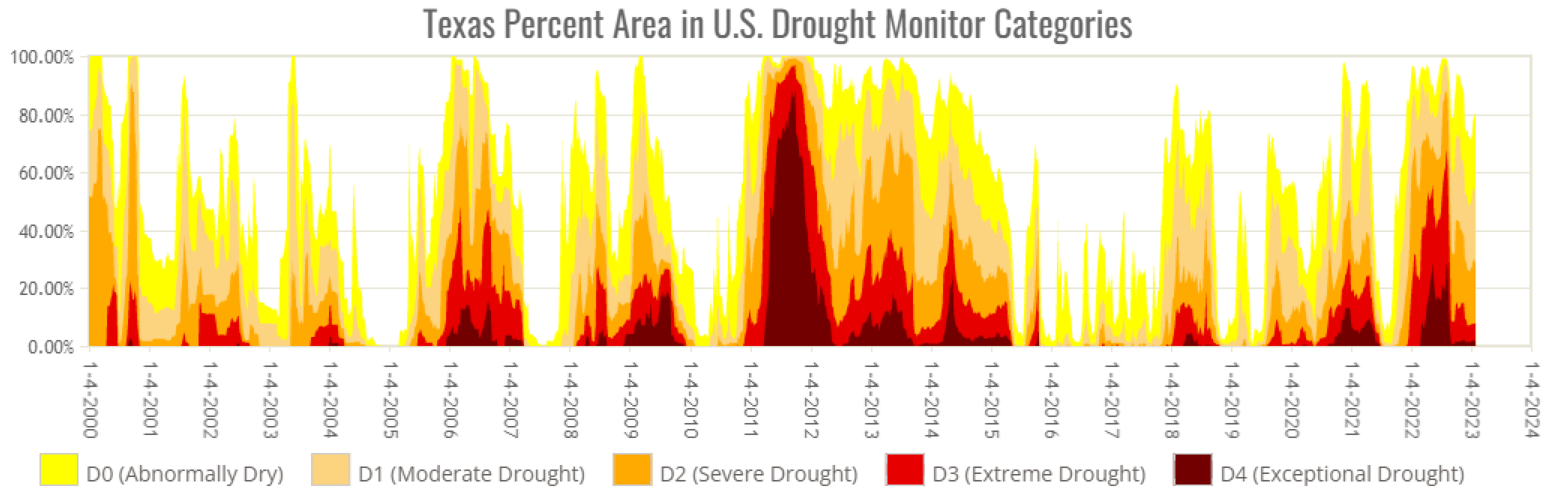
Farmer Concerns

- Environment
- Instability of availability
- Costs





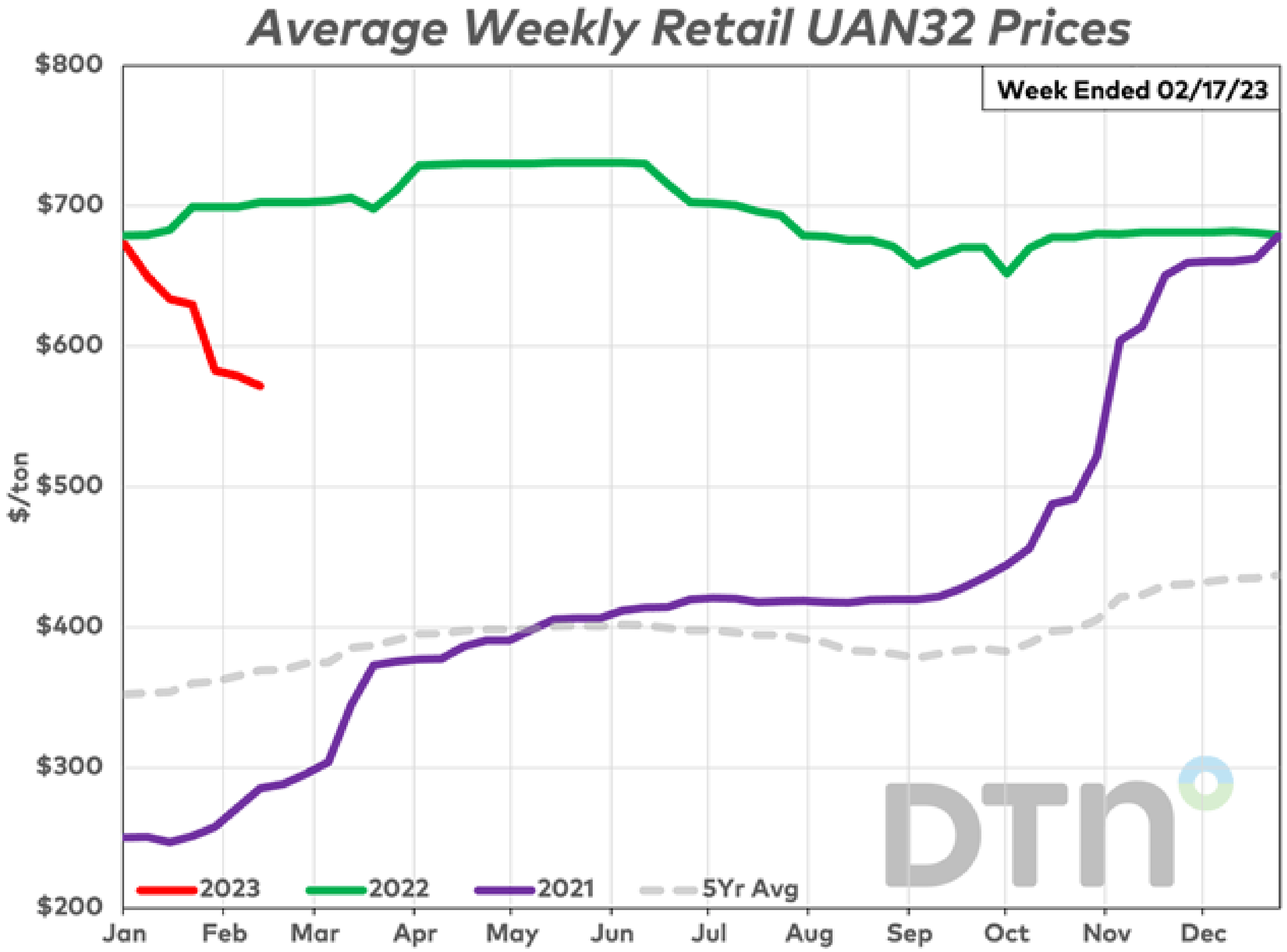
Farmer Concerns

TEXAS A&M AGRILIFE RESEARCH

- Environment
- Instability of availability
- Costs

Farmer Concerns

- **Environment**
- **Instability of availability**
- **Costs**
  UAN-32: $0.90/lb
  Urea: $0.75/lb N



Fertilizer Prices

Fertilizer	12/2/2022	02/21/2023
Urea	$795/ton	$686/ton ($0.75/lb N)
Anhydrous ammonia	$1,416/ton	$1,213/ton ($0.74/lb N)
UAN-32	$681/ton	$572/ton ($0.89/lb N)
MAP	$960/ton	$857/ton ($0.82/lb P_2O_5)
DAP	$926/ton	$838/ton ($0.91/lb P_2O_5)
10-34-0	$753/ton	$754/ton ($1.11/lb P_2O_5)
0-0-60	$831/ton	$692/ton ($0.58/lb K_2O)

Does Dryland Fertilizer Pay??

Does Dryland Fertilizer Pay?

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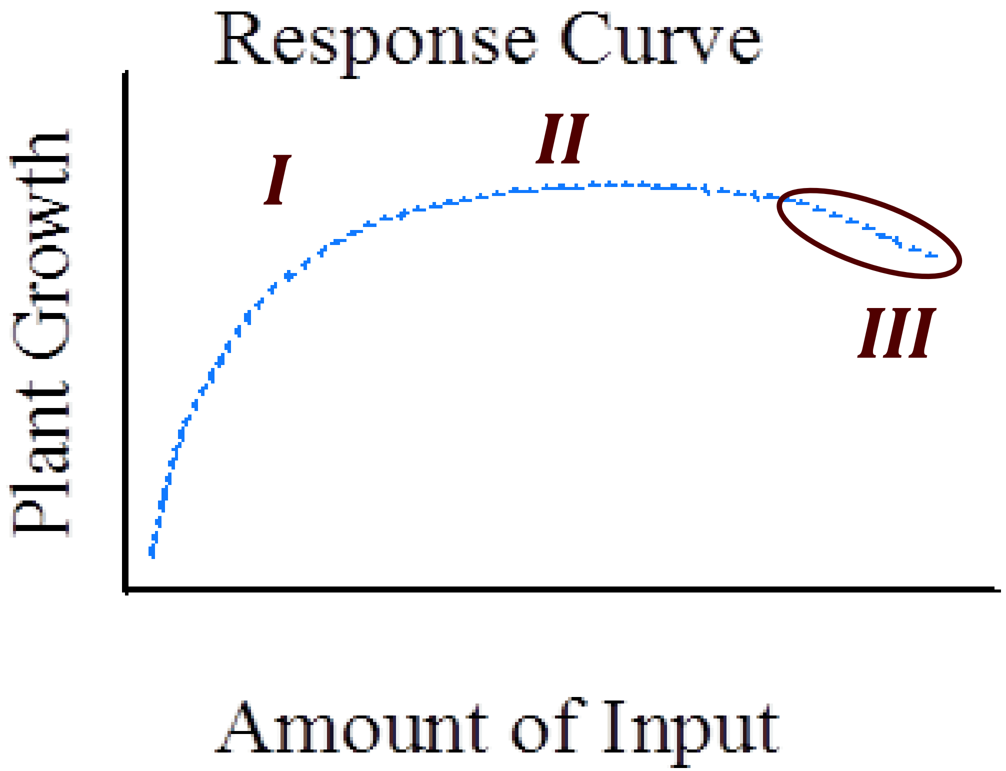
- Rule for making input decisions is balancing Marginal Revenue (MR) and Marginal Cost (MC)

I. MR > MC : Profitable decision

II. MR = MC : Point of profit maximization

III. MR < MC: Losing profits



Economic Questions: Will Keeling (will.keeling@ag.tamu.edu)

Does Dryland Fertilizer Pay?

- Assume fertilizer rates are based on soil test
  - 40 lb N/A as UAN-32 ($0.99/lb N) and 30 lb P/A as 10-34-0 ($1.11/lb P)
- Applied as UAN-32 and 10-34-0
- Lint ($0.80/lb) and cottonseed ($250/ton)

<u>100 lb lint yield increase</u>

- MR = (100 lb x $0.80) + (0.071 x $250) = $97.75
- MC = ($0.99 x 40 lb N/A) + ($1.11 x 30 lb P/A) + $5/A (app. cost) = $77.93
- **MR ($97.75) > MC ($77.93): <u>profitable decision</u>**
- **Net Benefit of $19.82/A**

<u>200 lb lint yield increase</u>

- MR = (200 lb x $0.80) + (0.142 x $250) = $195.50
- MC = ($0.99 * 40 lb N/A) + ($1.11 x 30 lb P/A) + $5/A (app. cost) = $77.93
- **MR ($195.50) > MC ($77.93): <u>profitable decision</u>**
- **Net Benefit of $117.57/A**

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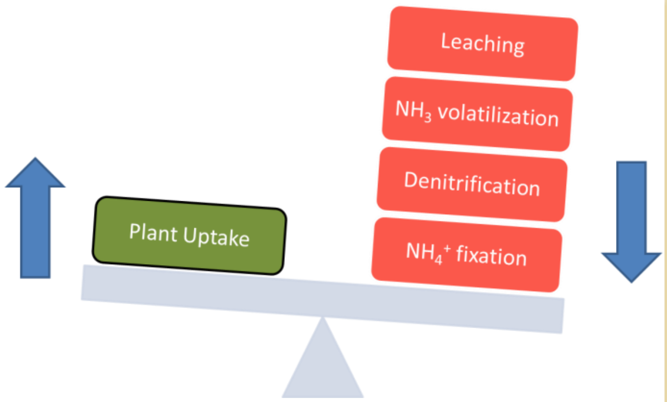
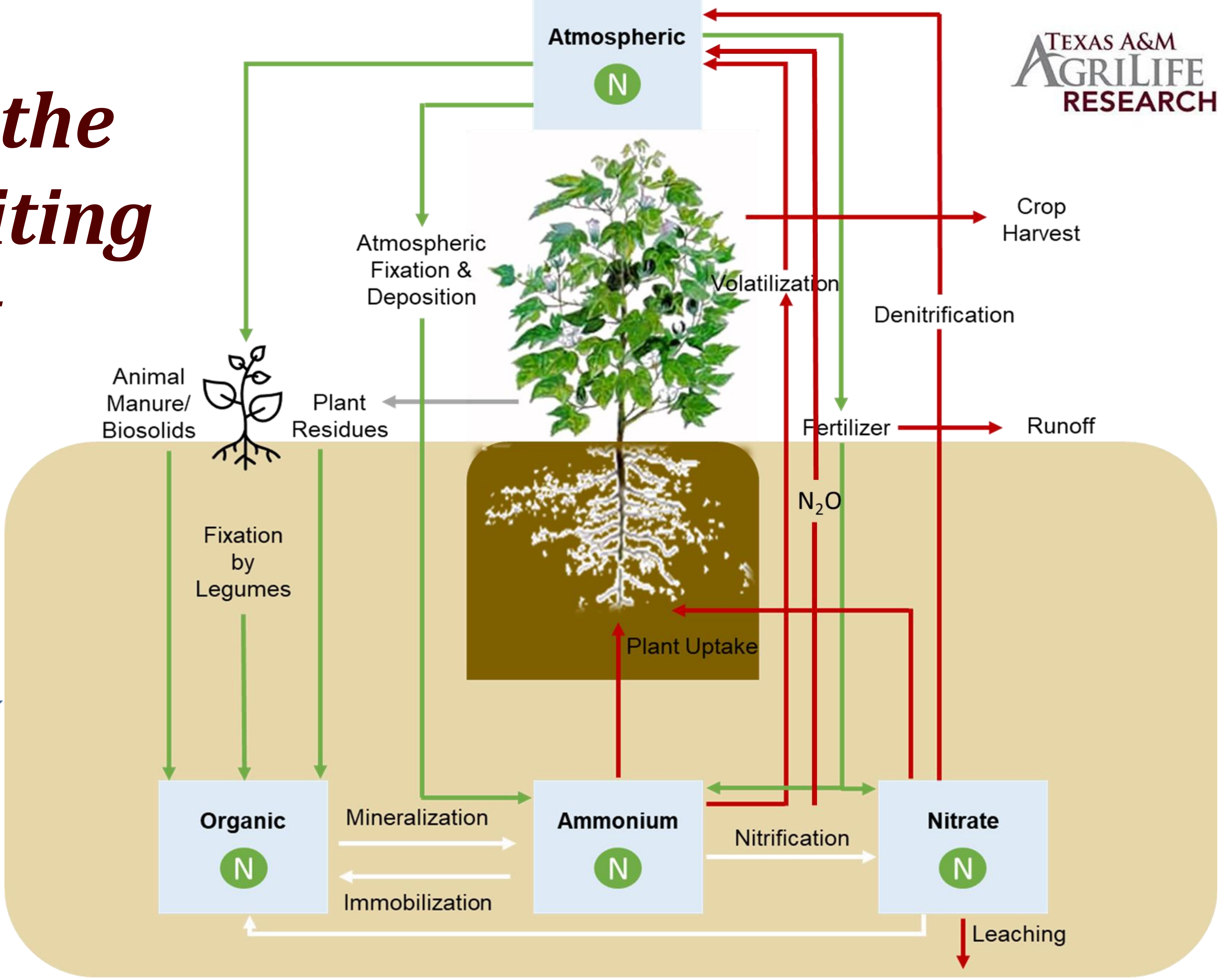
YES!

Nitrogen

-ammonium (NH_4^+) & nitrate (NO_3^-)-

Nitrogen is the greatest limiting nutrient





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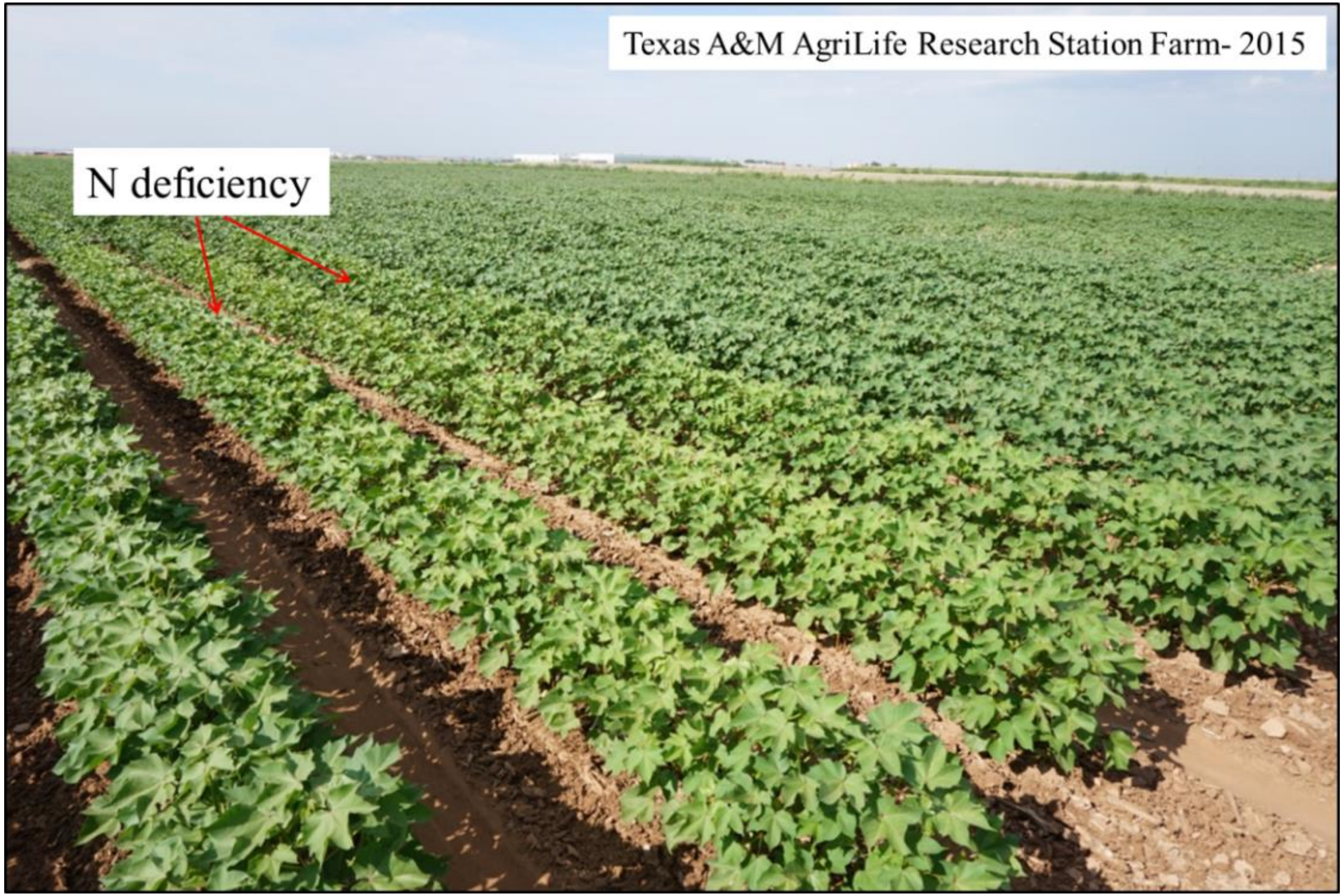
Nitrogen Rates *(based on yield goal)*

1st bale:
40 lb N/A/bale

2+ bales:
35-40 lb N/A/bale

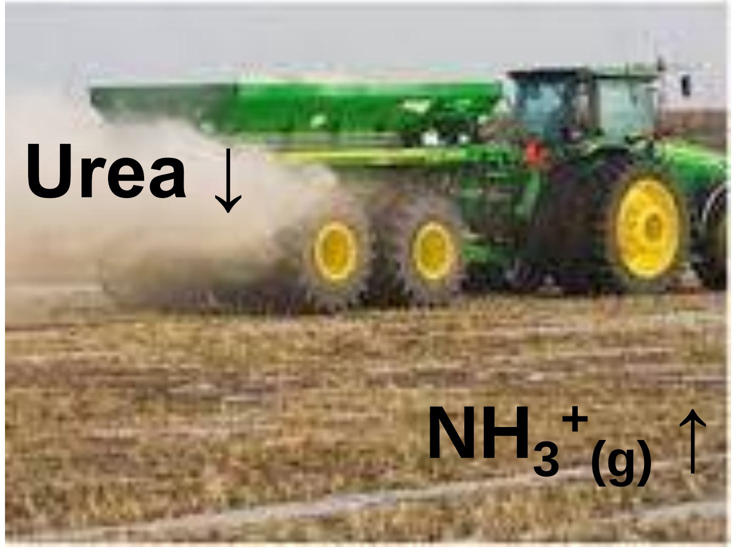


Ammonia Volatilization

$NH_4^+ \leftrightarrow NH_3 \uparrow + H^+$

The gaseous loss of ammonia (NH_3) that may occur when ammonium (NH_4^+) is surface applied to a **calcareous soil** or when urea [$(NH_2)_2CO$] is surface applied to **any soil**.

Loss may be *50* to *75%* of added N



Ammonia Volatilization

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Environmental Factors ↑ Volatilization

- Soil pH – can happen at any pH but greater when pH > 7.0
- Water content of surface soil – moist surface required for hydrolysis

$$(NH_2)_2CO + 2\,H_2O \overset{\text{urease}}{\leftrightarrow} (NH_4)_2CO_3$$

- SOM↑ → Microbial activity↑ → Urease↑ → Urea hydrolysis ↑
- <0.25” rain can result in ↑ **NH_3**
- Wind↑ → Evap.↑ → ↑ **NH_3**
- Temp↑ → Urease, Evap.↑ → ↑ **NH_3**

Ways to ↓ Volatilization

- Incorporation to > 0.5” will ↓ loss by >50%
- Addition of 0.25” to 0.5” irrigation to move below surface prior to hydrolysis (urea is uncharged, water-soluble molecule)
- Use of sulfur-coated urea
- Use of urease inhibitors to temporarily reduce activity of urease enzyme (NBPT)
- Use urea phosphate or other acid forming fertilizers containing urea
- Addition of $CaCl_2$, KCl, etc with urea (more effective in alkaline soil)

Mineralization and Immobilization

Organic N ↔ Inorganic N
Equilibrium in soils
(Nitrogen cycling)

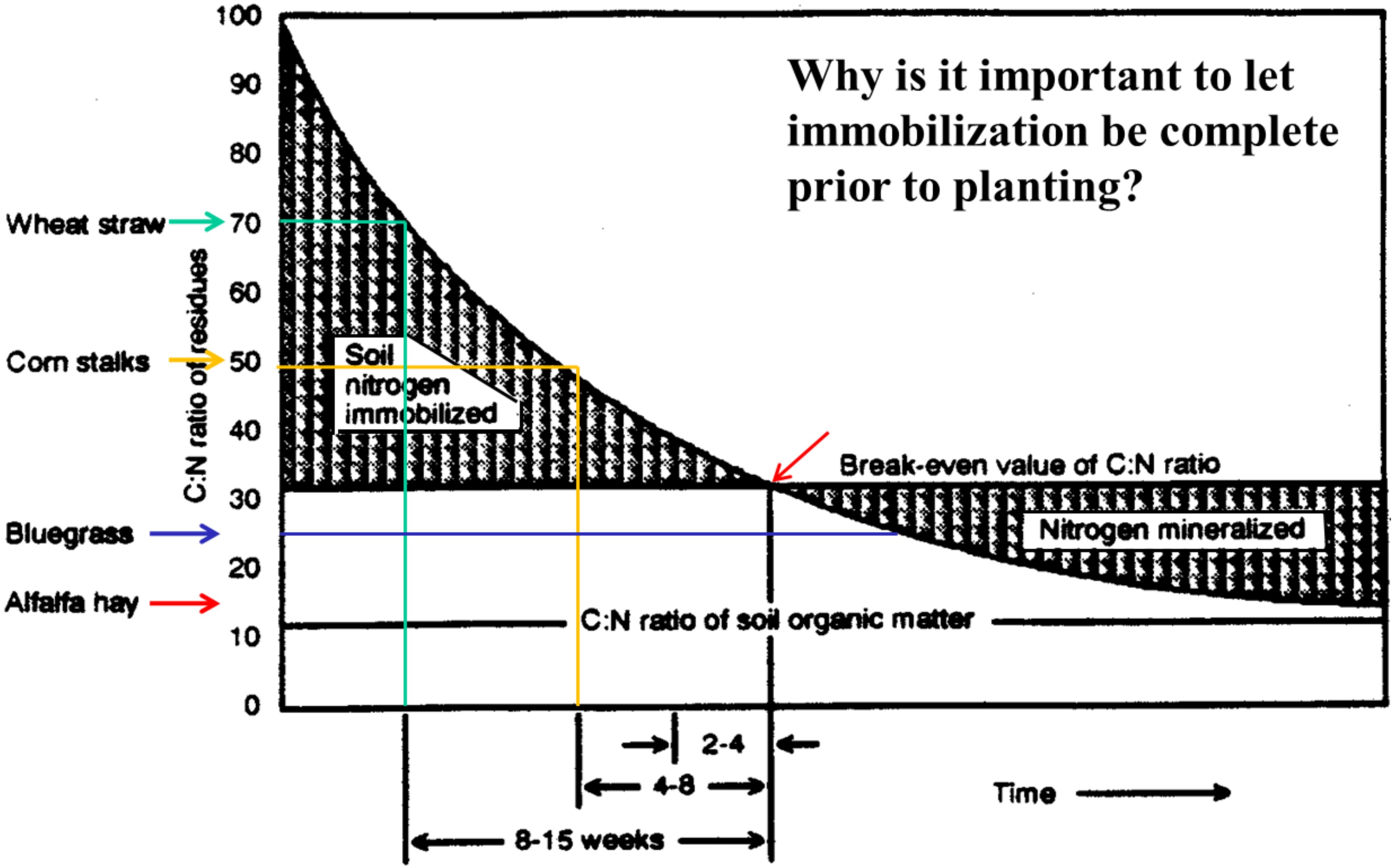
Mineralization – conversion of plant-unavailable organic N to plant-available inorganic N (NH_4^+); C:N < 30:1

Immobilization – conversion of plant-available inorganic N (NH_4^+, NO_3^-) to plant-unavailable organic N (**microbial tissues**); C:N > 30:1

Practical significance??

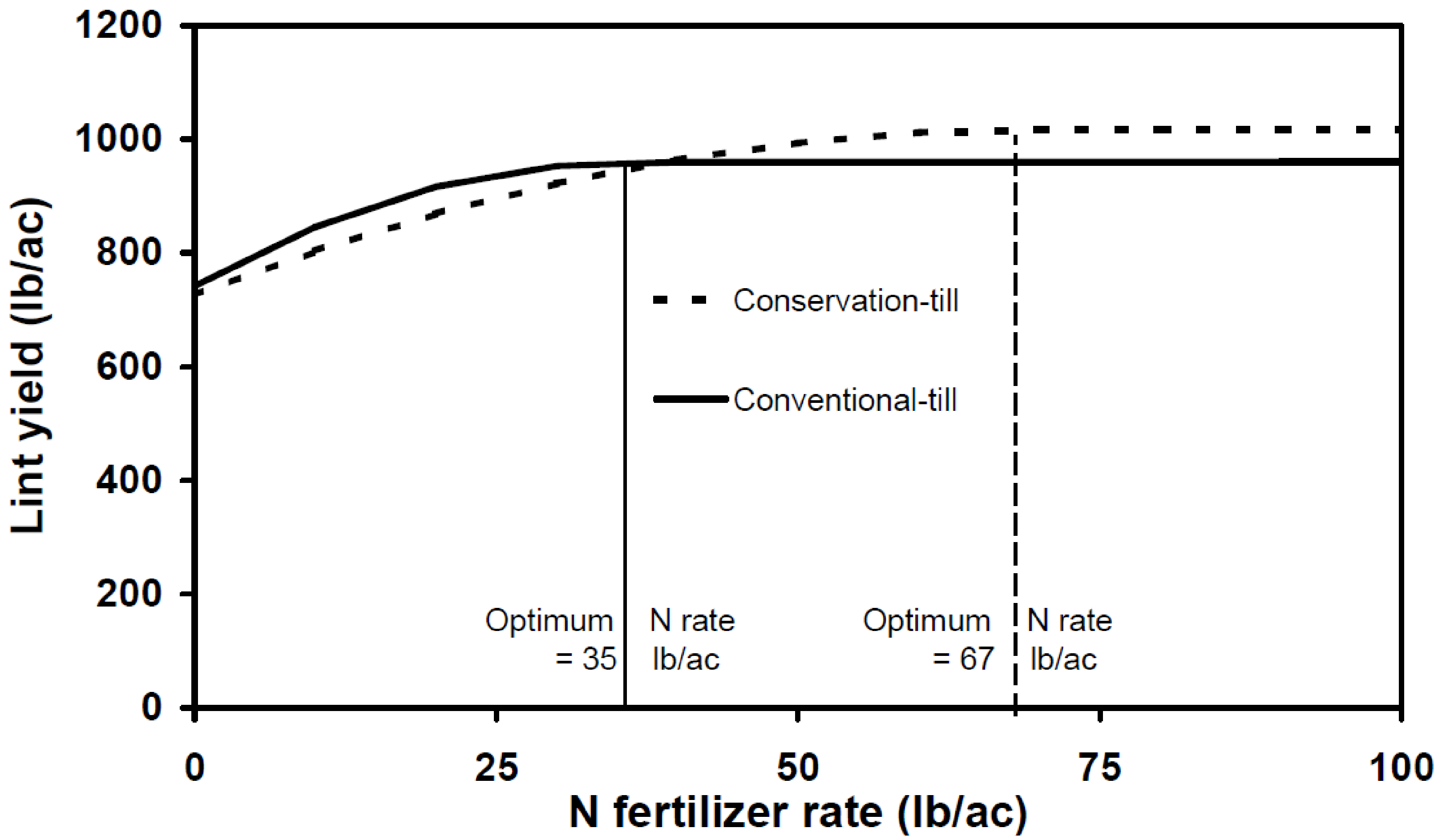
Determining Factor for Net N Mineralization or Immobilization

Time required for completion of N immobilization as affected by C:N ratio of crop residue



Soil Health and Nitrogen

AG-CARES, Lamesa, TX



Source: Nutrient Management of Conservation-Till Cotton in Terminated-Wheat
K.F. Bronson, J.W. Keeling, R.K. Boman, J.D. Booker, and H.A. Torbert, April 2004

Soil Health and Nitrogen Management

AG-CARES, Lamesa, TX

Evaluate yield response to added N fertilizer <u>at different times</u> in conventional and conservation management

Managment systems

1. Continuous cotton (CC)
2. CC with rye cover (CCRC)
3. Wheat-fallow-cotton rotation

Nitrogen treatments

1. Farm Practice (120 lb N/A; 3-4 applications)
2. Preplant (+30 lb N/A; 150 lb N/A)
3. Emergence +3 wks (+30 lb N/A; 150 lb N/A)
4. PHS + 2 wks (+30 lb N/A; 150 lb N/A)

Cotton Yield

3-year averages

Cropping System	Nitrogen fertilization strategies				
	FP	PPN	PEN	PHSN	
	Lint yield (lint acre^{-1})				AVG
CC	723	787 (8.9%)	715 (-1.1%)	683 (-5.5%)	**727**
CCRC	806	938 (16.4%)	965 (19.6%)	857 (6.2%)	**891** (23.3%)
CWR	1,134	1,032 (-9.0%)	1,117 (-1.5%)	1,064 (-6.2%)	**1,087** (50.4%)
AVG	**888**	**919** (3.5%)	**932** (5.0%)	**868** (-2.2%)	

Fertilization strategies:

- FP = farmers practices (120 lb N A^{-1})
- PPN = FP + 30 lb N A^{-1} at preplant
- PEN = FP + 30 lb N A^{-1} at post emerg. + 2 wks
- PHSN = FP + 30 lb N A^{-1} at pinhead square + 2 wks

Cropping systems:

- CC = Continuous cotton, conventional tillage (>25 yrs)
- CCRC = Continuous cotton-Rye cover
- CWR = Cotton-Wheat rotation

Gross Margins

3-year averages

Cropping System	Nitrogen fertilization strategies: FP	PPN	PEN	PHSN	
	Gross Margin ($ acre^{-1})				AVG
CC	434	489 (12.7%)	441 (1.6%)	420 (-3.3%)	**336**
CCRC	489	591 (20.7%)	608 (24.3%)	536 (9.5%)	**556** (65.5%)
CWR	609	575 (-5.6%)	610 (0.3%)	587 (-3.6%)	**595** (77.1%)
AVG	**511**	**552** (8.0%)	**553** (8.2%)	**514** (0.6%)	

Fertilization strategies:

- FP = farmers practices (120 lb N A^{-1})
- PPN = FP + 30 lb N A^{-1} at preplant
- PEN = FP + 30 lb N A^{-1} at post emerg. + 2 wks
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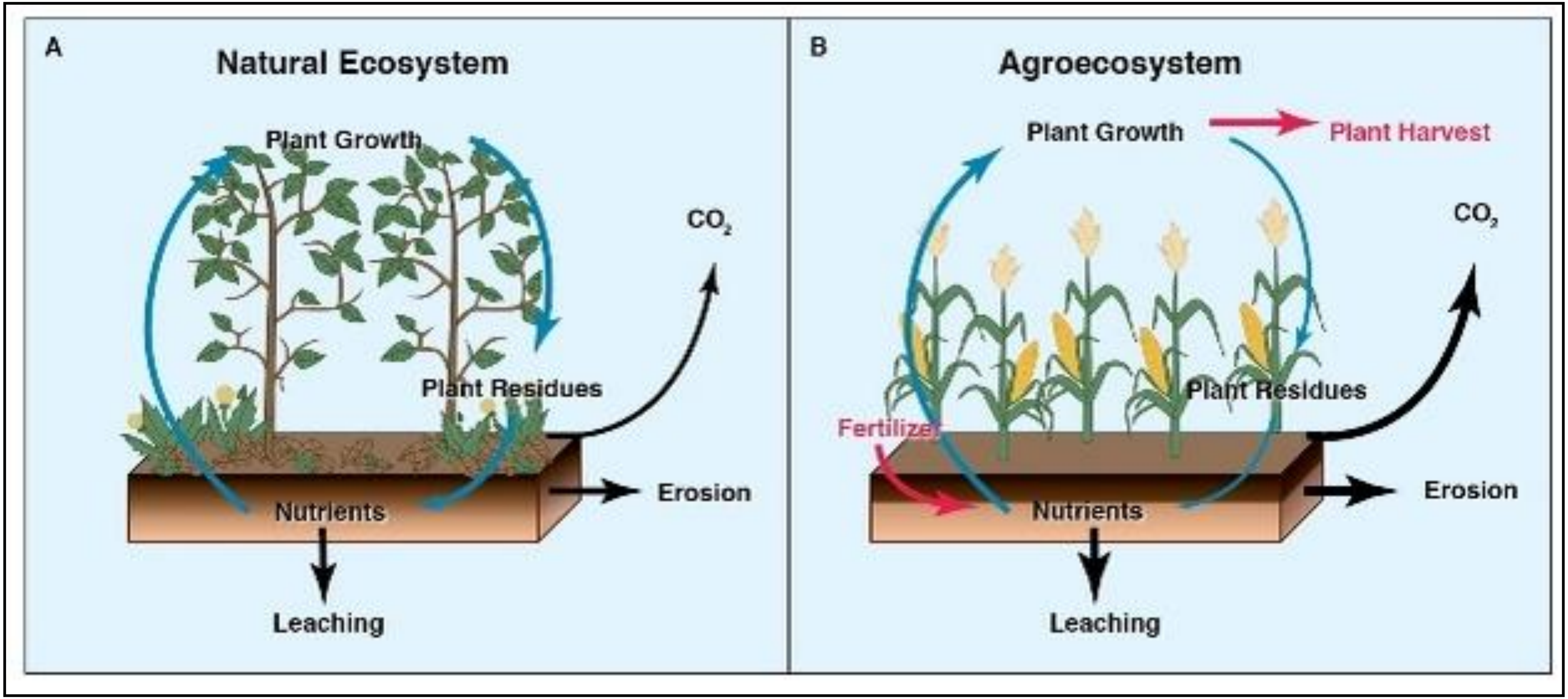
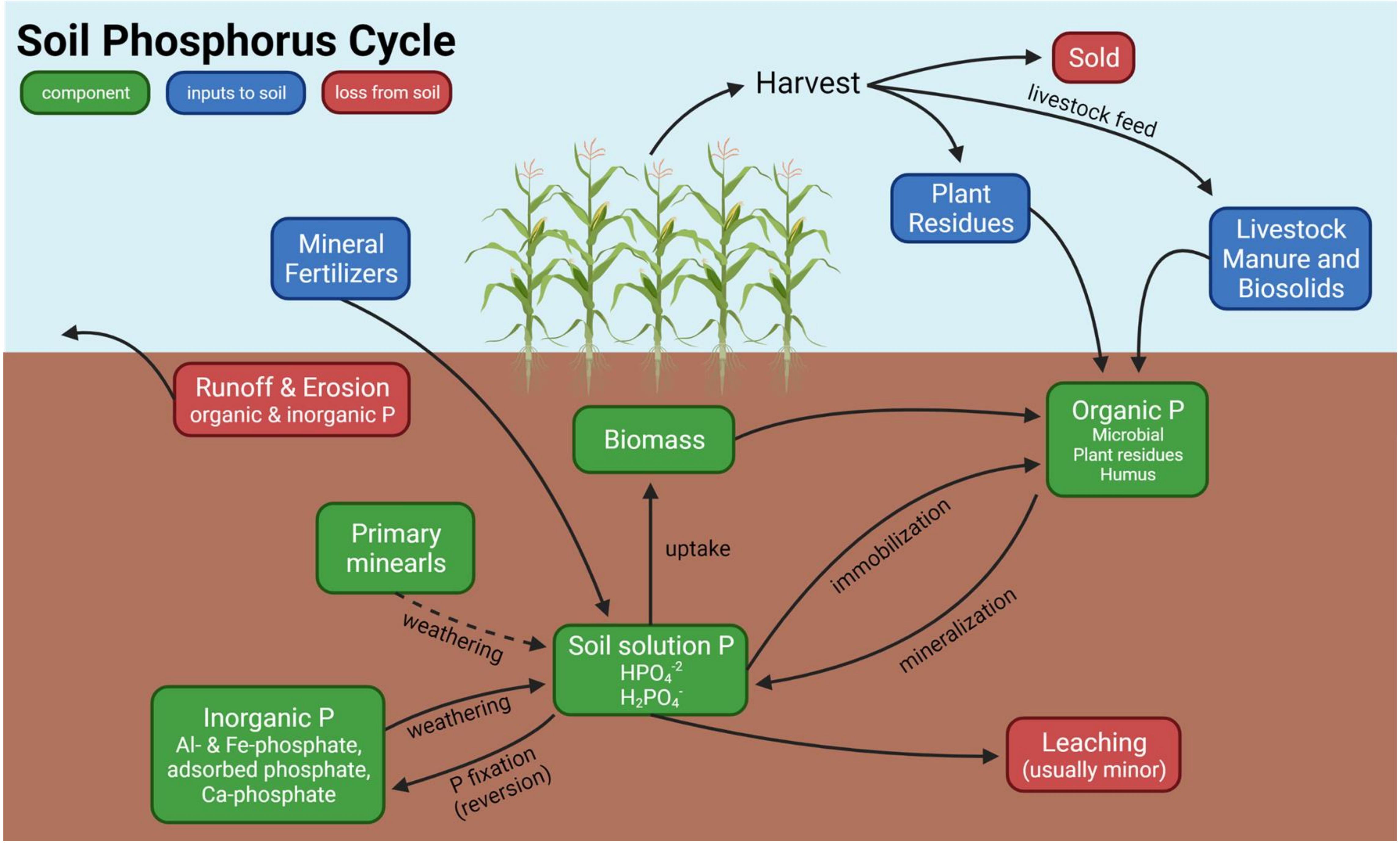
Phosphorus

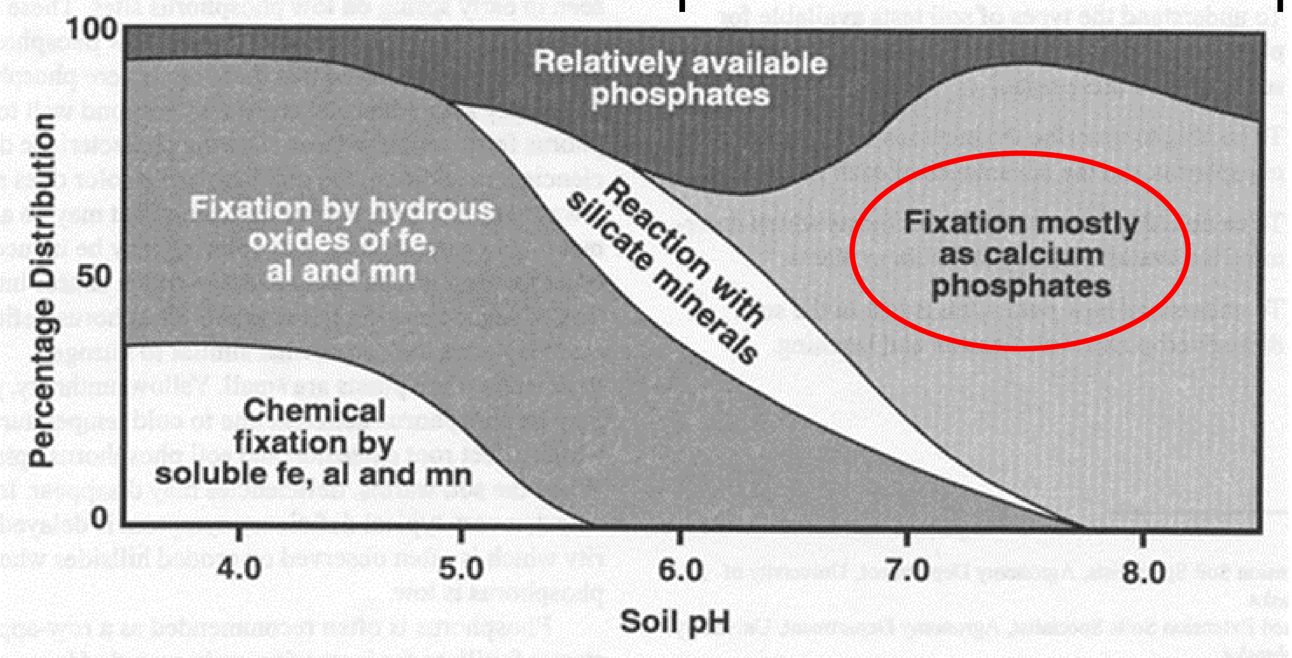


Over time you will mine your soil……


Soil Phosphorus Cycle
component
inputs to soil
loss from soil
Harvest
Sold
livestock feed
Plant Residues
Livestock Manure and Biosolids
Mineral Fertilizers
Runoff & Erosion
organic & inorganic P
Biomass
Organic P
Microbial
Plant residues
Humus
uptake
immobilization
mineralization
Primary minearls
weathering
Soil solution P
HPO_4^{-2}
$H_2PO_4^-$
Inorganic P
Al- & Fe-phosphate,
adsorbed phosphate,
Ca-phosphate
weathering
P fixation
(reversion)
Leaching
(usually minor)

Phosphorus Placement

- Phosphorus added to soil quickly becomes fixed in less available forms
- Banding (pre-plant or starter) and fertigation is more efficient than broadcasting pre-plant
  - Calcium carbonates binding or “fixing” most of the phosphorus (as calcium phosphate) when broadcasted – incorporation does not help



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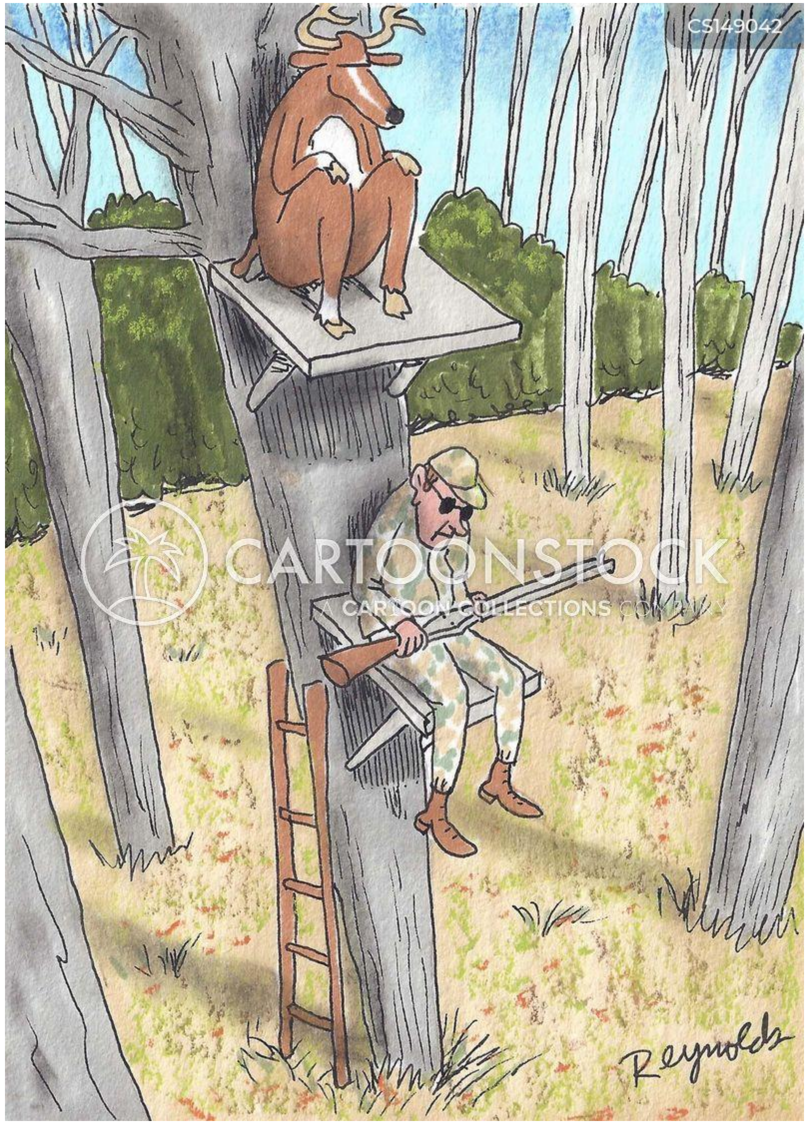
Final Thoughts…

- Proactive strategies to increase fertilizer use efficiency
  - 4Rs of Nutrient Management
    Right *Source*
    Right *Rate*
    Right *Time*
    Right *Placement*
  - Fertilizer rates based on yield goals and crop removal
  - Implementing conservation management may require adjustment of N fertilization
  - Read labels, do your own math, and keep it simple…

"Ever vigilant"



How to make more COST-efficient fertilizer decisions?

Busting Myths

- Fertilizers kill soil microbes…. **FALSE**
- Inorganic fertilizers make soil unhealthy… **FALSE**
- More is always better… **FALSE**
- Foliar fertilizers can replace soil applied… **FALSE**
- Fertilizer is not needed when using biologicals… **FALSE**

txsoillab.com

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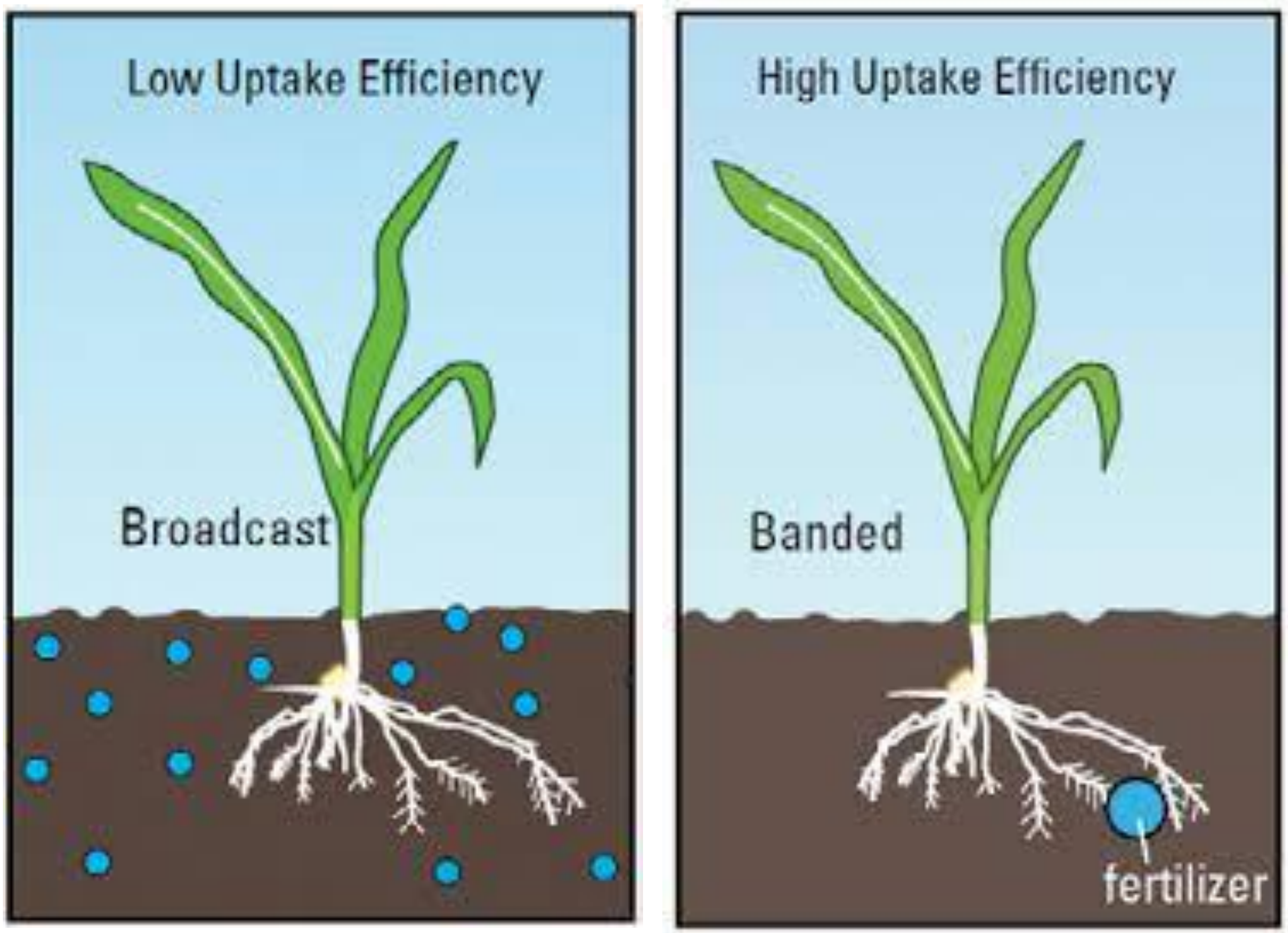
Phosphorus Placement

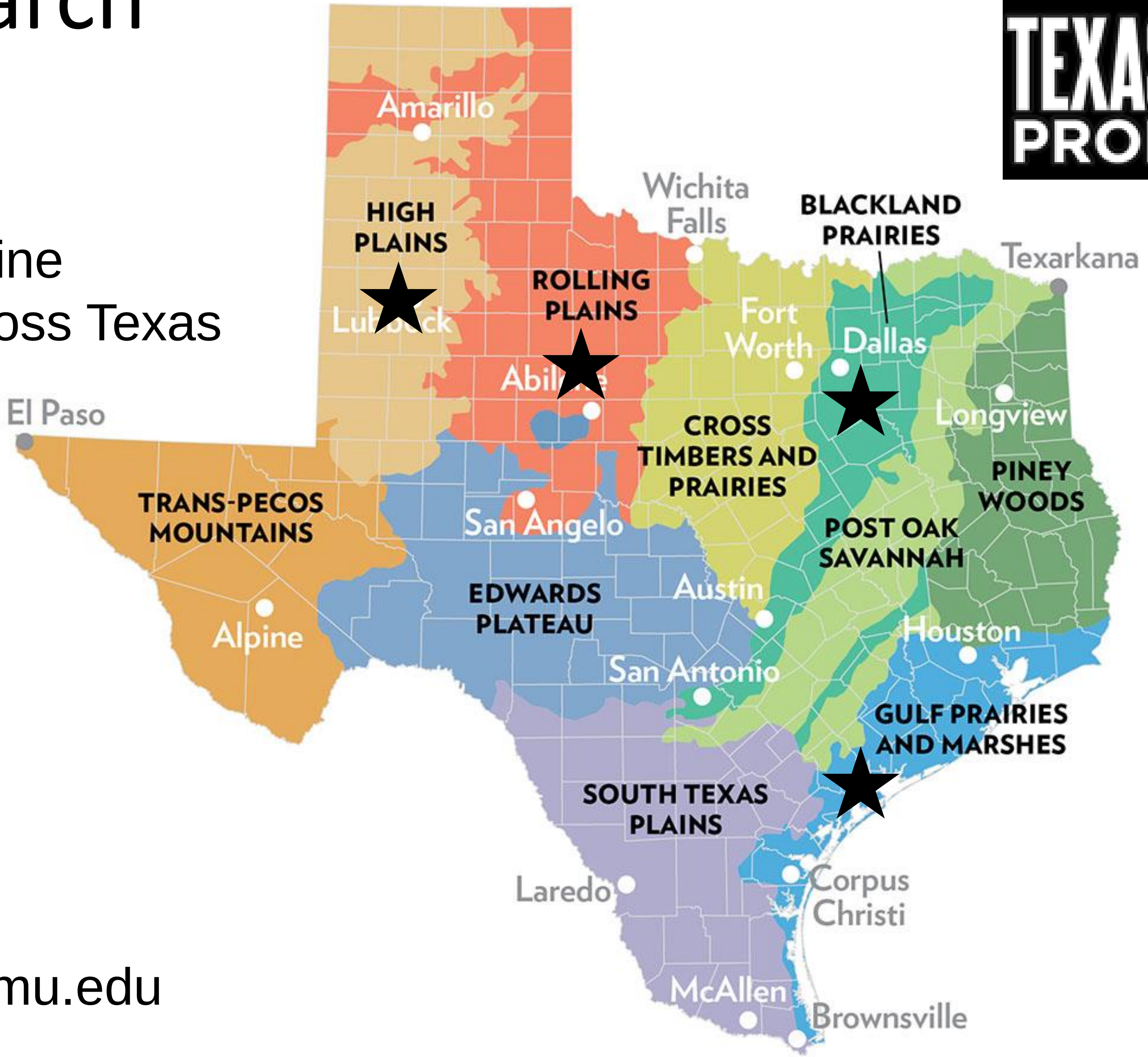
Broadcast versus Band

Rates can be reduced when applied in a band compared to broadcast – exposed to less soil



2023 Research

Need your help!
Project aimed at establishing baseline carbon values across Texas



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SORGHUM CHECKOFF

cotton

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TEXAS A&M AGRILIFE EXTENSION

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