Nitrogen fertilizer management to increase efficiency

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Lucas Haag

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Overview

- Identifying nitrogen lost potential
- Management to increase N efficiency in corn
- The role of additives and other management tools

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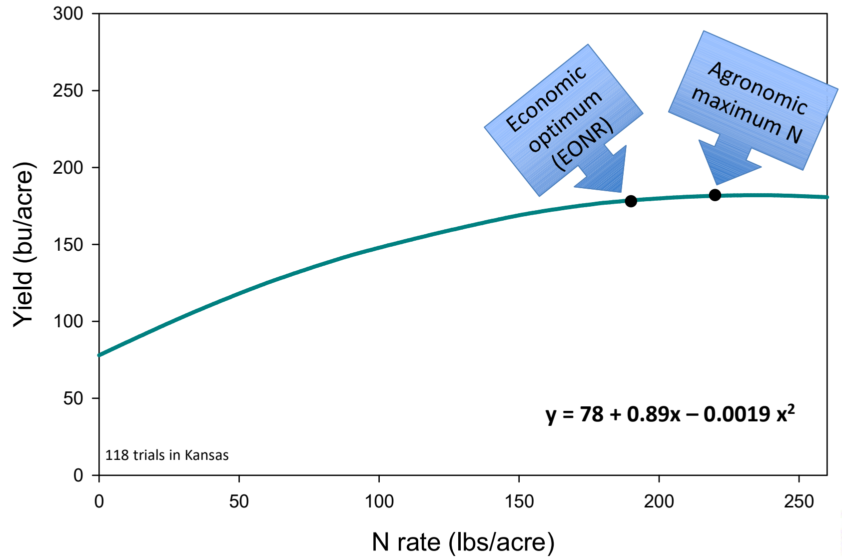
Economic optimum N vs maximum agronomic N?



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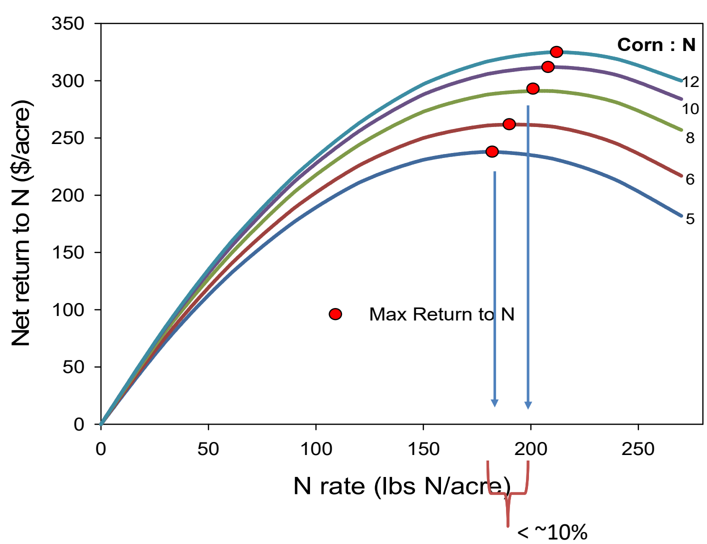
Should I cut back on N rates with current prices? How much?



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Managing nitrogen: key N processes affecting use efficiency

1. Volatilization
2. Denitrification
3. Leaching
4. Immobilization

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Soil temperature and nitrogen processes (driven by microbial activity)

- Nitrification ($NH4 \rightarrow NO3$): ~ 50 F
  - Also presence of oxygen in the soil
- Denitrification ($NO3 \rightarrow$ gas-N): ~ 75 F and higher
  - Also waterlogged conditions (no oxygen)

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Soil temperature and duration of waterlogged conditions on denitrification

Length of Saturation	Soil Temperature	Nitrate-N Loss
(days)	(degrees F)	(% of NO3 present)
5	55 - 60	10
10	55 - 60	25
3	75 - 80	60

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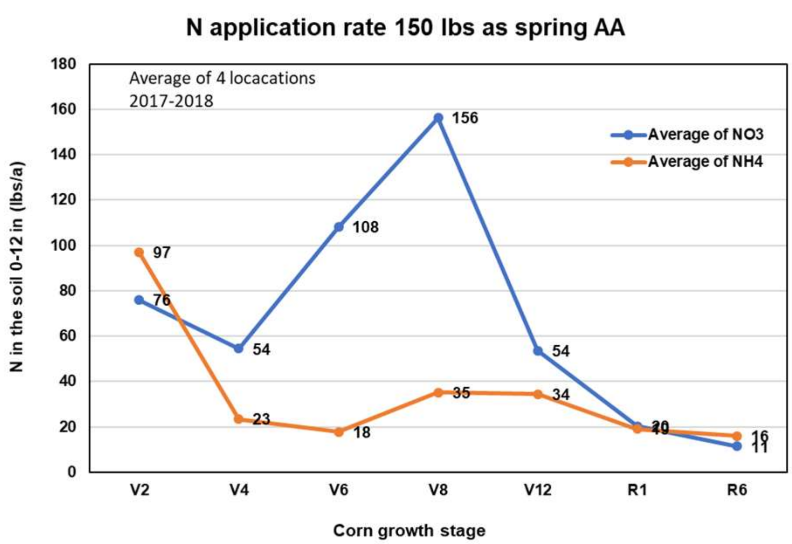
Soil N during the growing season



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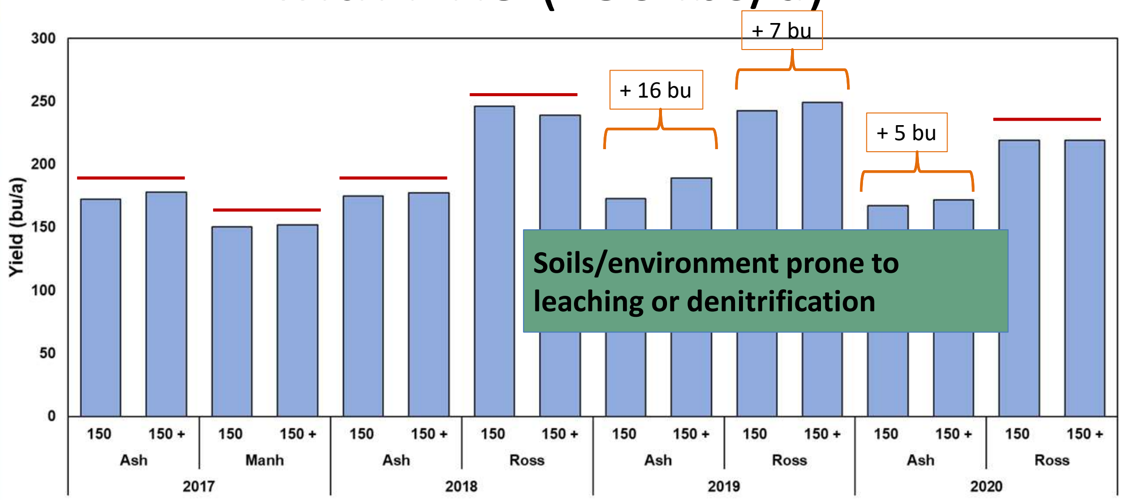
Use of nitrification inhibitor (N-serve) with NH3 (150 lbs/a)



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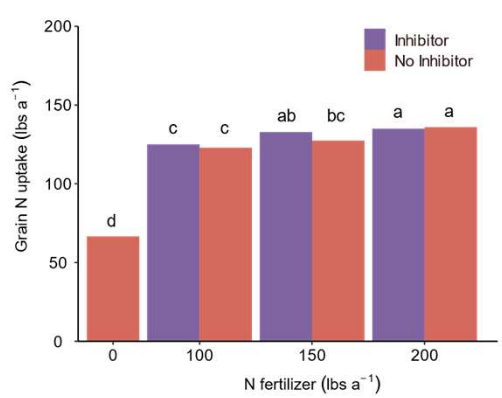
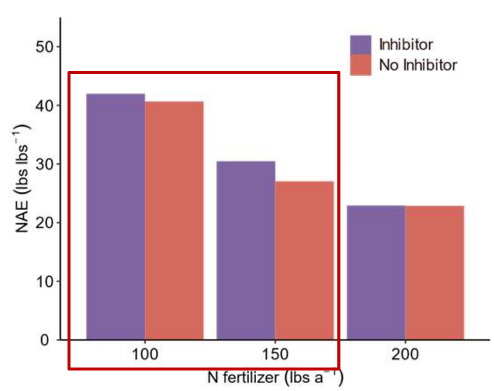
Use of nitrification inhibitor with anhydrous ammonia (over 10 site years)

Grain Nitrogen uptake with yield



Nitrogen fertilizer efficiency



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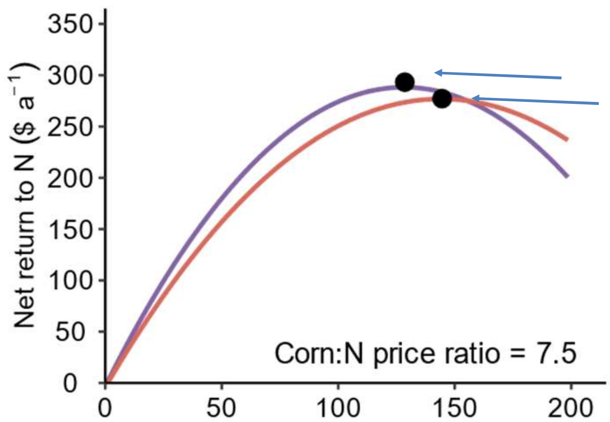
Use of nitrification inhibitor with anhydrous ammonia (over 10 site years)

Net return to N fertilizer



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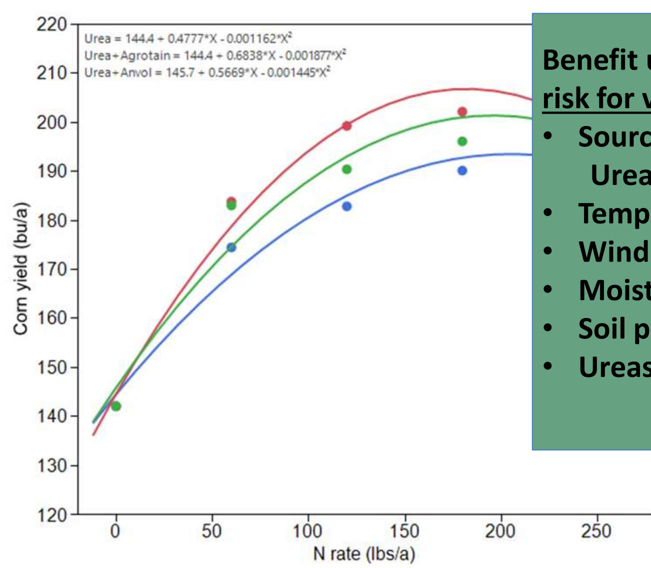
Urease inhibitors for side-dress urea



Benefit under <u>conditions with high risk for volatilization</u>

- **Source: urea!**
  Urea --> NH3 --> NH4
- **Temperature**
- **Wind**
- **Moisture**
- **Soil pH**
- **Urease in the soil (residue)**

2017-2018

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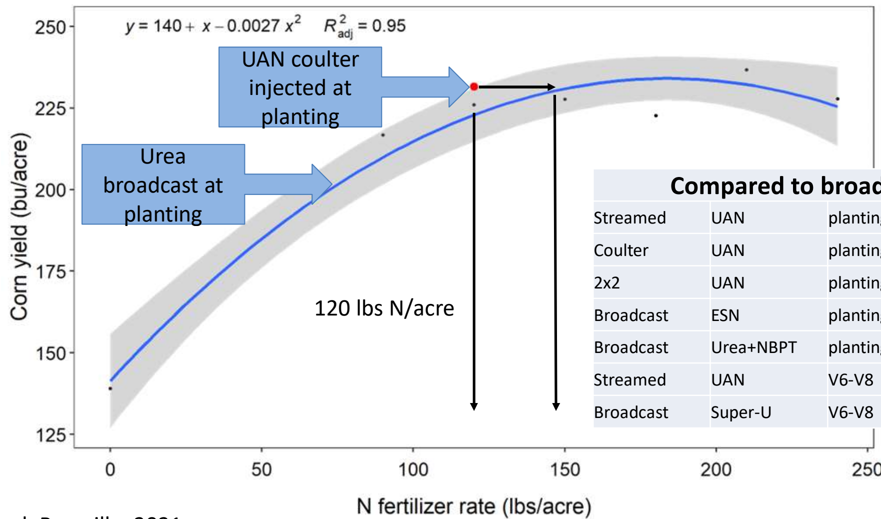
N fertilizer efficiency with improved management in corn



Compared to broadcast urea			
Streamed	UAN	planting	=
Coulter	UAN	planting	+
2x2	UAN	planting	+
Broadcast	ESN	planting	-
Broadcast	Urea+NBPT	planting	=
Streamed	UAN	V6-V8	-
Broadcast	Super-U	V6-V8	-

Irrigated, Rossville, 2021

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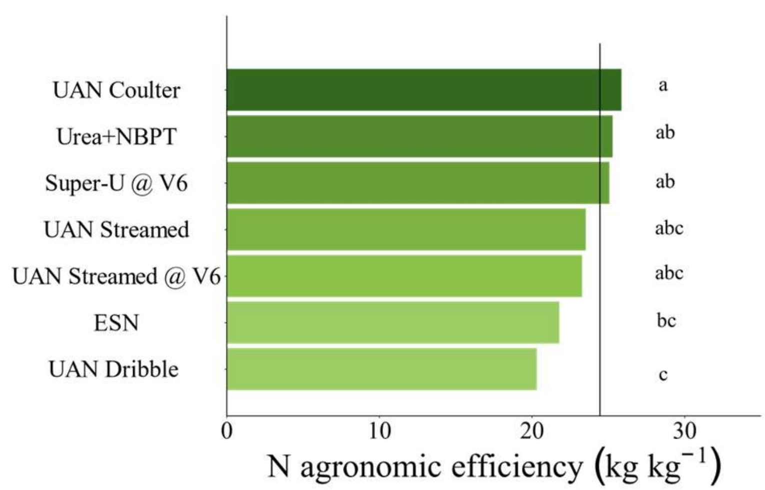
Nitrogen fertilizer source, time placement combinations to increase efficiency



4 sites 2022

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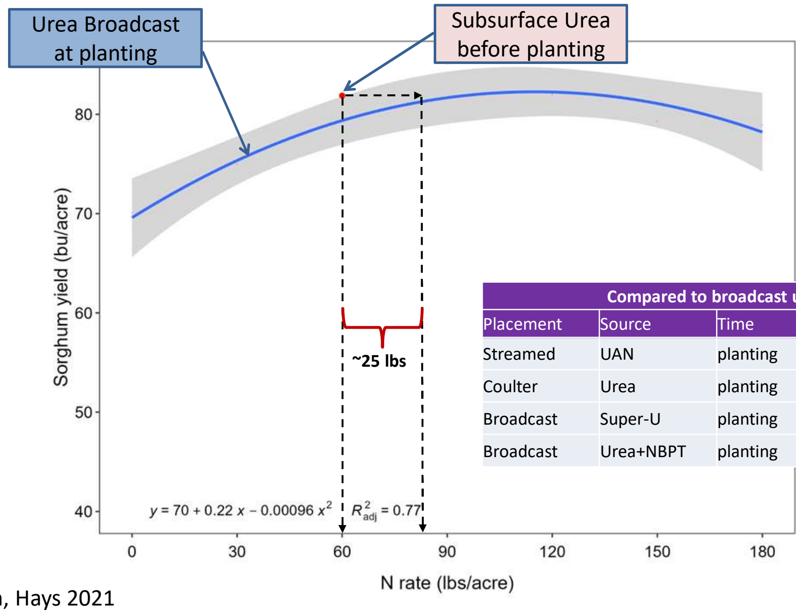
Sorghum and N fertilizer management



Compared to broadcast urea			
Placement	Source	Time	"Efficiency"
Streamed	UAN	planting	+
Coulter	Urea	planting	+
Broadcast	Super-U	planting	+
Broadcast	Urea+NBPT	planting	=

Sorghum, Hays 2021

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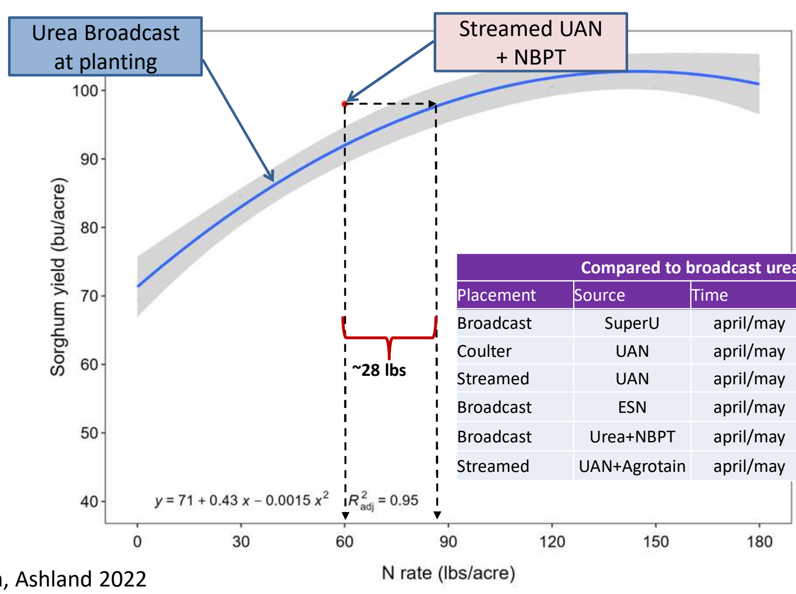
Sorghum and N fertilizer management



Compared to broadcast urea			
Placement	Source	Time	"Efficiency"
Broadcast	SuperU	april/may	+
Coulter	UAN	april/may	+
Streamed	UAN	april/may	=
Broadcast	ESN	april/may	+
Broadcast	Urea+NBPT	april/may	+
Streamed	UAN+Agrotain	april/may	+

Sorghum, Ashland 2022

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Managing nitrogen in season: key processes affecting N use efficiency

Loss process	N form	Management options

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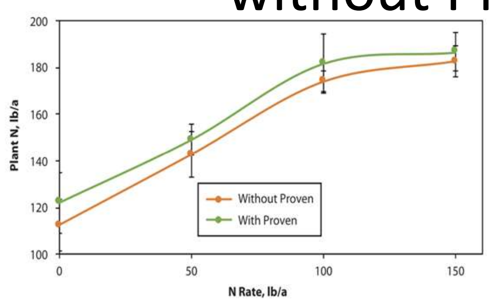
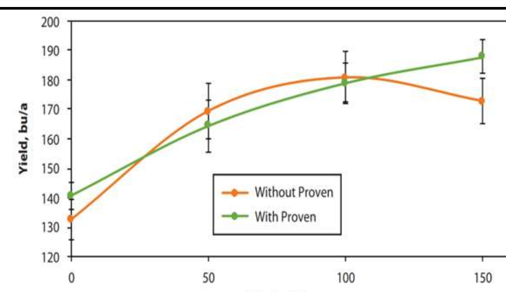
Corn response to N applied with and without PivotBio-Proven



Plant N uptake

Grain yield



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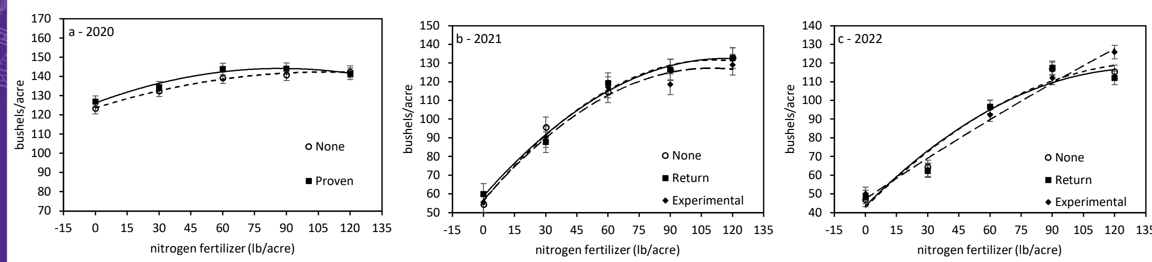
CW Rice, Manhattan, 2022

Grain sorghum response to N and PivotBio-Proven



Roozeboom, Haag, Ruiz Diaz, and Rice

Increasing nitrogen use/ minimize loses

- Combination of source, placement and time based on risk for N loss for specific condition
- Use of inhibitors can help during years/conditions of N loses (consider "average" multi-year)
- Biologicals/inoculants for N fixing show inconsistent results for N in field conditions
  - Basic research show potential, and ongoing developments

Manure nutrients

	% Dry Matter	Total N	NH_4	P_2O_5	K_2O
		- - - - - - - lbs/ton - - - - - -			
Dairy	21	9	5	4	10
Beef	50	21	8	18	26
Swine	18	8	5	7	7
Poultry	75	56	36	45	34

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Average animal manure micronutrient content of different sources

Manure source	Iron	Manganese	Boron	Zinc	Copper
	-----------------lb/wet ton---------------------				
Dairy solid	0.5	0.06	0.01	0.03	0.01
Swine solid	19.0	1.09	0.04	0.79	0.50
Poultry	3.0	0.61	0.08	0.48	0.66
	-----------------lb/1000 gal---------------------				
Dairy liquid	0.9	0.11	0.03	0.11	0.12
Swine liquid	2.5	0.23	0.06	1.03	0.62

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Manure nitrogen availability

- Inorganic N is all available.
- Organic N available the first year compared with fertilizer (MF-2562):
  - ✓ Liquid manure: 30%
  - ✓ Solid manure: 25%
  - ✓ Compost: 20%
- As for fertilizers, these numbers indicate potential availability.
- Assumes injection or incorporation and "best management practices".

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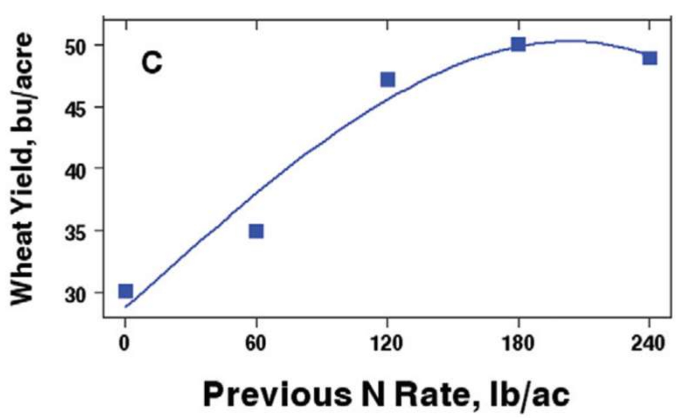
Residual soil nitrate: effects on wheat yield



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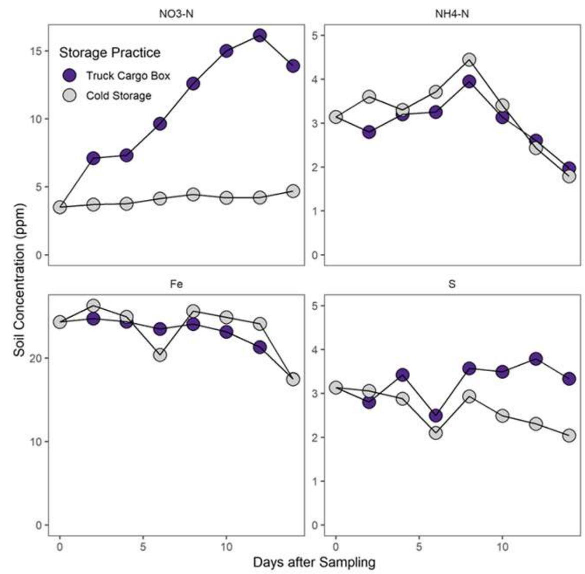
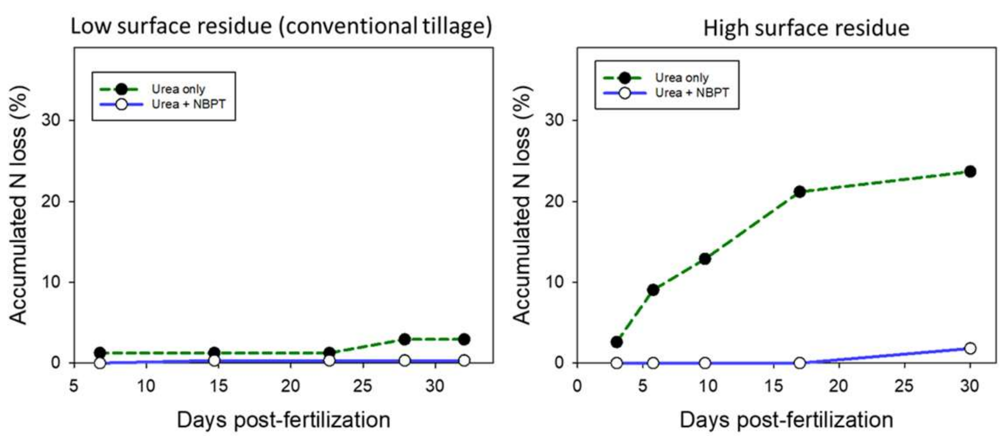
Soil sample handling: effects on NO3



Nitrogen volatilization loss from top-dress urea in wheat



Impact of sample handling practices on soil test results

Bryan Rutter

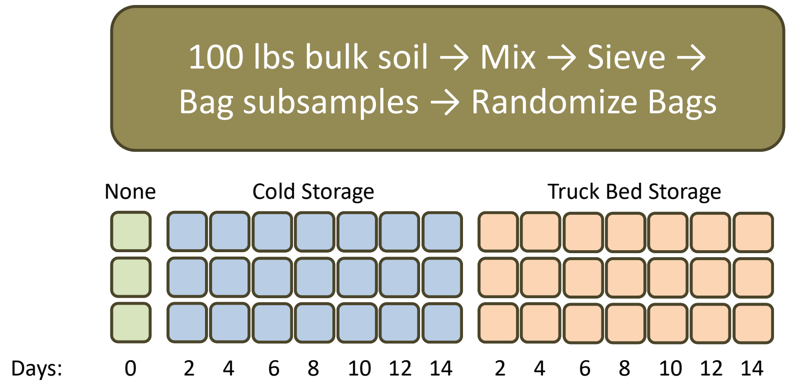
KSRE Soil Test Lab

Research Questions

Current recs are to get samples to the lab asap…

- Common sense, but Murphy's Law…
- What happens if it takes a while to get samples into the lab?
- What if storage conditions aren't ideal in the mean time?

Lab Study: Experiment Design



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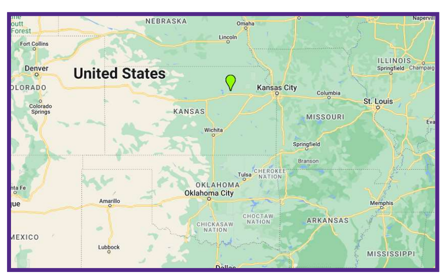
Lab Study: Site Description

Soil pH	SOM %	Sand %	Silt %	Clay %	CEC meq/100g
7.6	2.7	18	62	20	15



- Dryland, Strip-till
- Silt Loam
- Water content = 19 %

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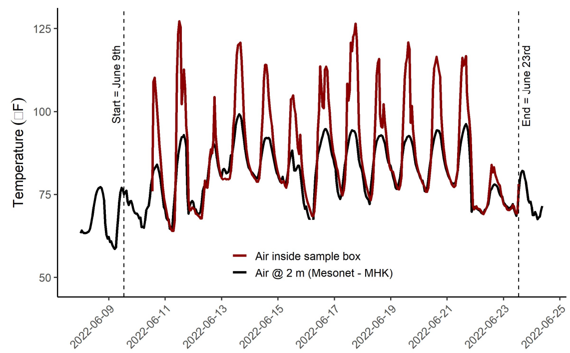
Box temperature



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Soil Tests and Comparisons

Soil pH, Buffer pH, SOM, N, P, K, S, Cu, Fe, Mn, Zn

- Storage Environment
- Time
- Storage x Time

Soil tests grouped by effects

No Changes	Change Over Time Only	Time x Storage
Soil pH	Cu	NO_3-N
Buffer pH	Fe	S
SOM	Mn	
P	Zn	
K		
NH_4-N		

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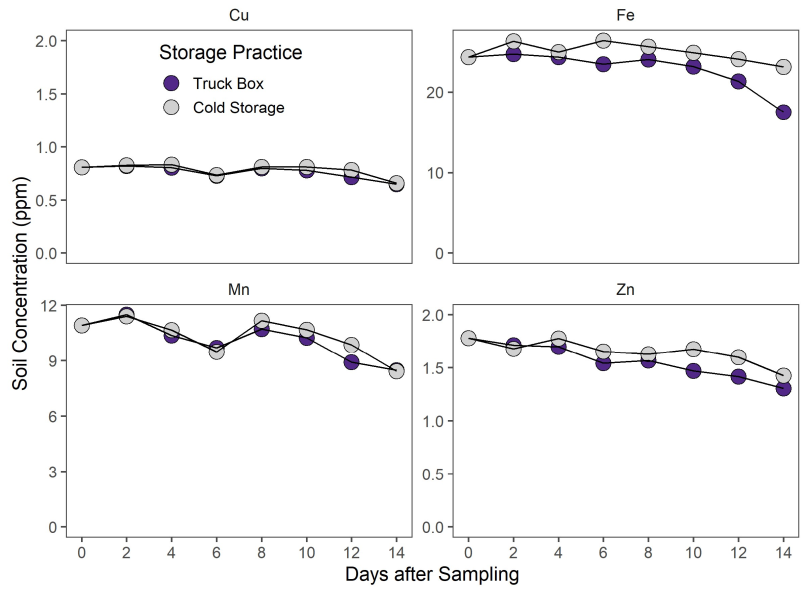
Micronutrients

- Statistical significance
- Agronomic significance?



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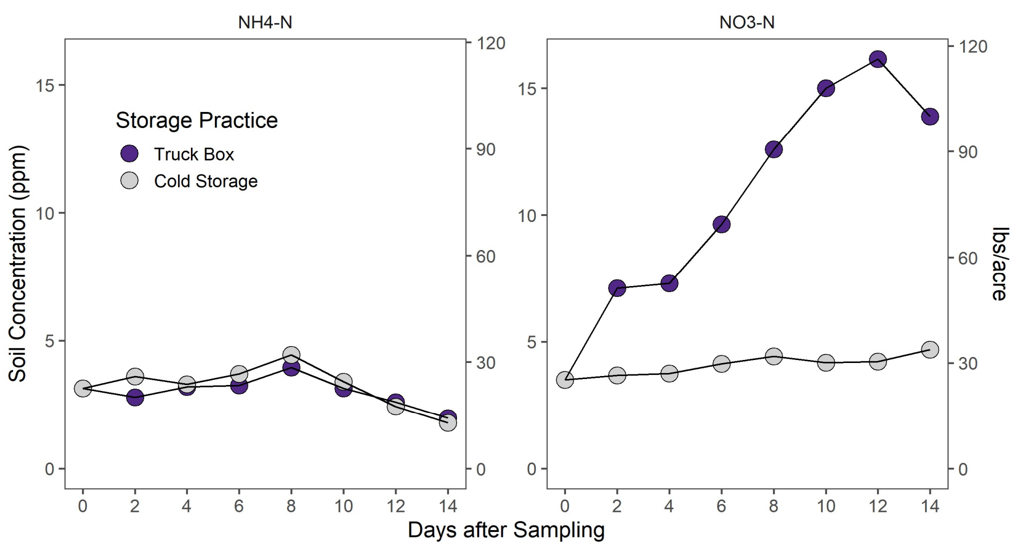
Closer look at Nitrogen



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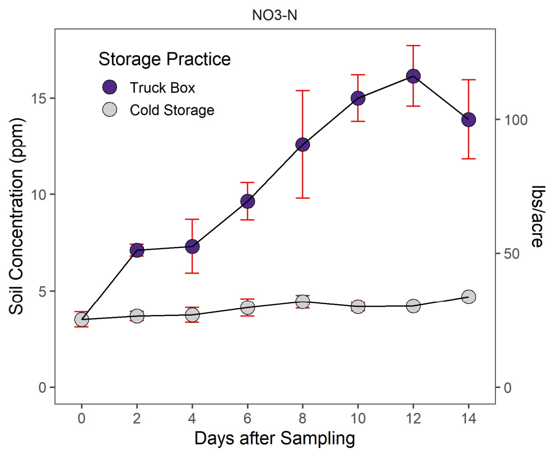
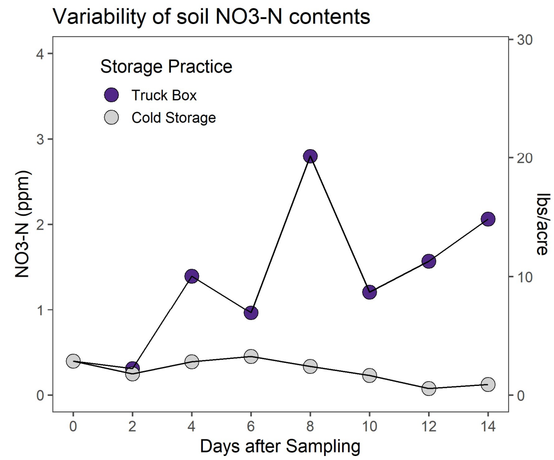
Effects on variability?





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Conclusions

- Sample handling affects soil tests, especially N
- Warm storage temps corresponded to large increases in NO_3 over time
- Warm temps may increase NO_3 variability

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Recommendations and Guidelines

- Get samples to the lab A.S.A.P
  - Let this be my problem, not yours…

If unable to get to the lab soon:

- Air-dry if you can
- Refrigerate < 40 F if you can't air-dry

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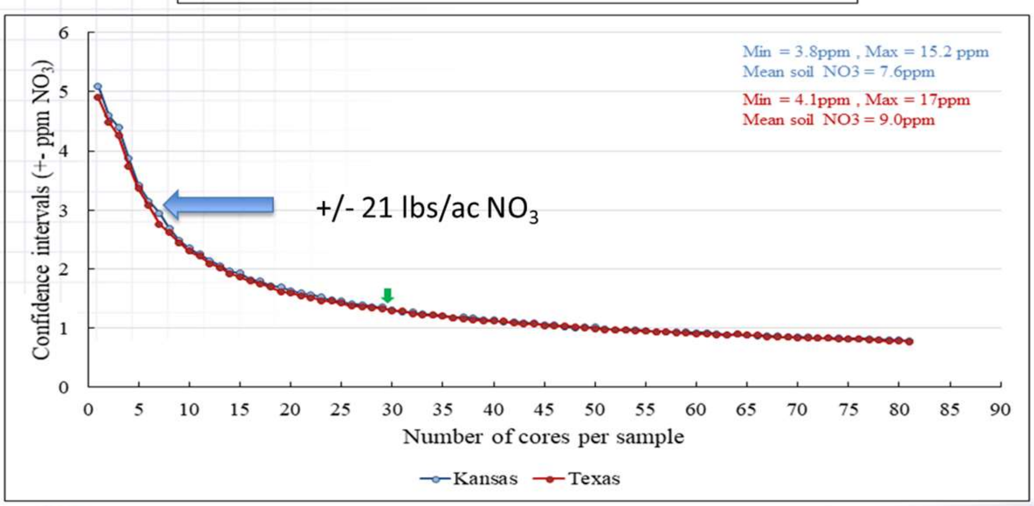
Relationship between number of soil cores per composite sample and error for 0-24 inches



Haag, Patel, Tomlinson, and Rajan, unpublished, data, 2021

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Knowledge for Life

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Summary - Corn

pH decreased ~ 0.5 unit by N

SOM increased ~ 0.3% by N & P

Soil test P not maintained with 40 P

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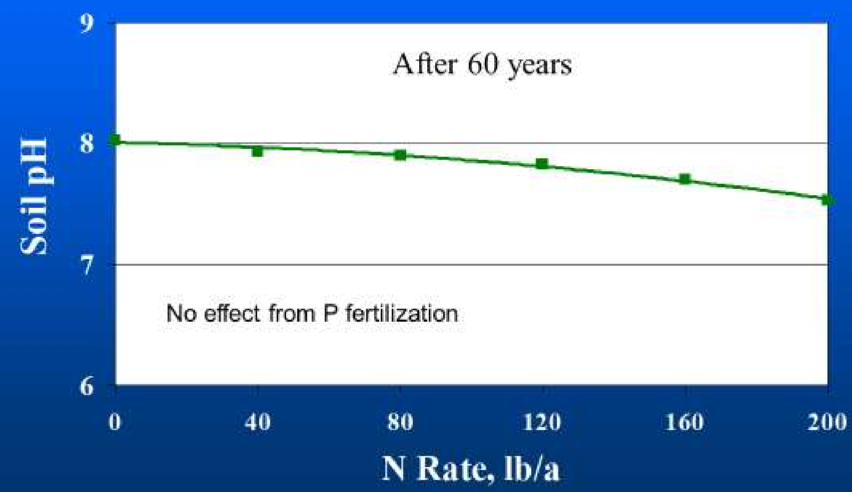
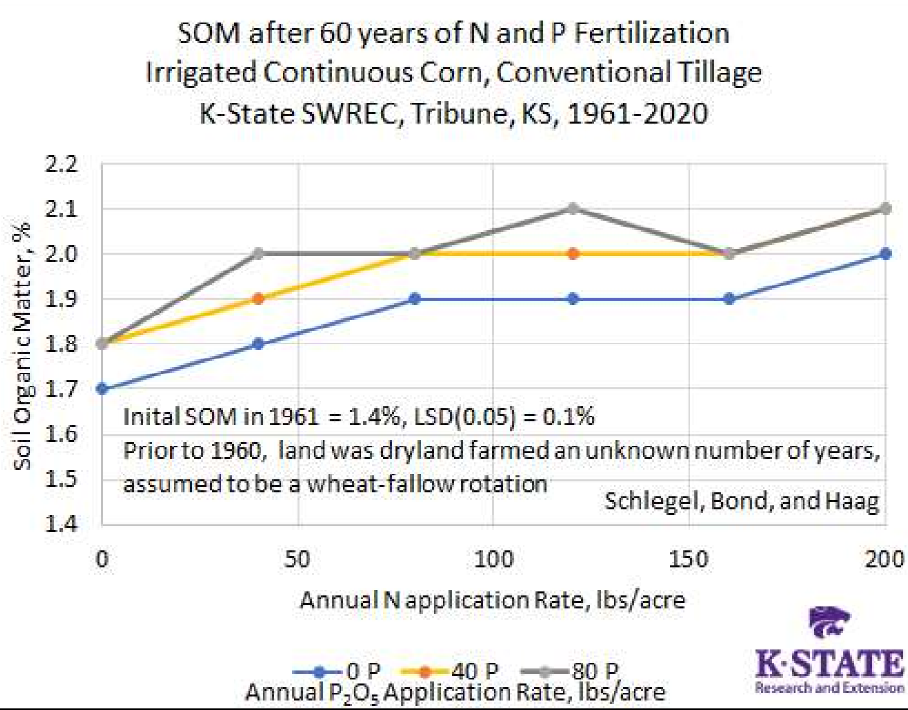
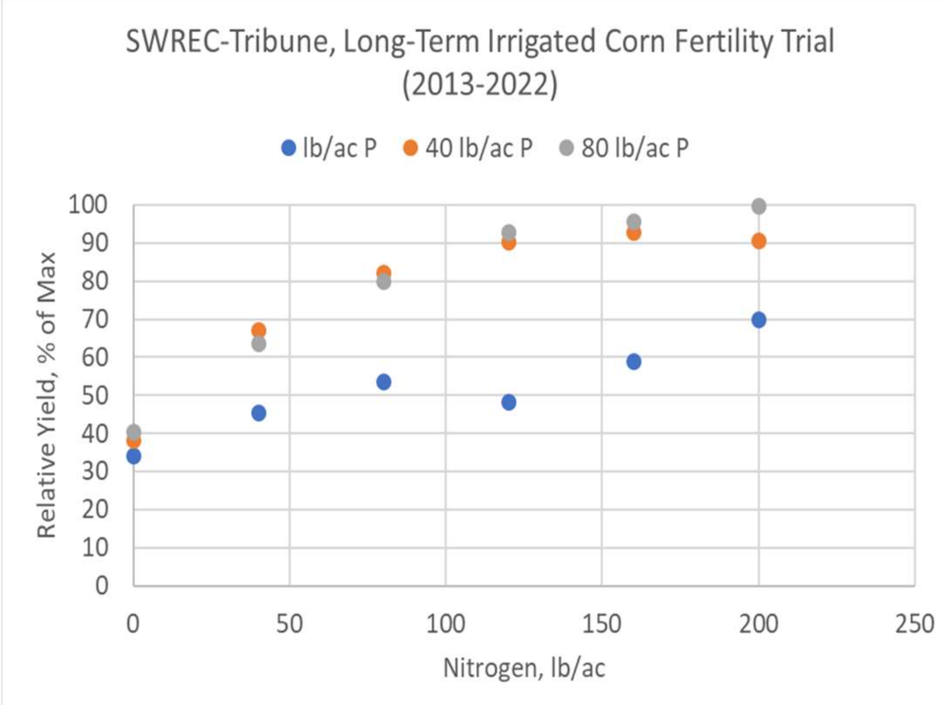
Long-term Corn Fertility



0-6", Tribune, KS 2020



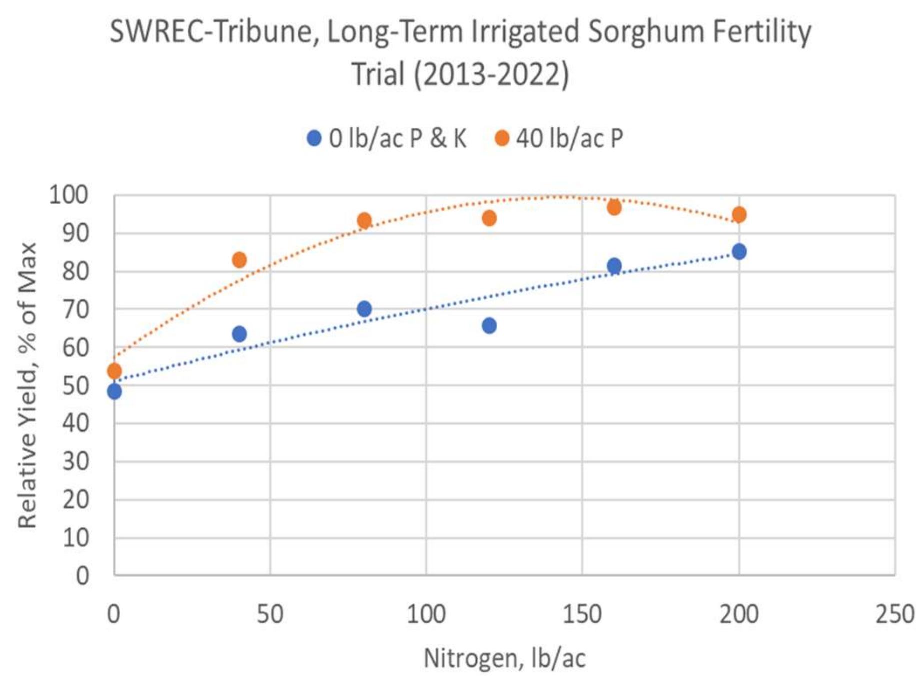


Summary – Grain Sorghum

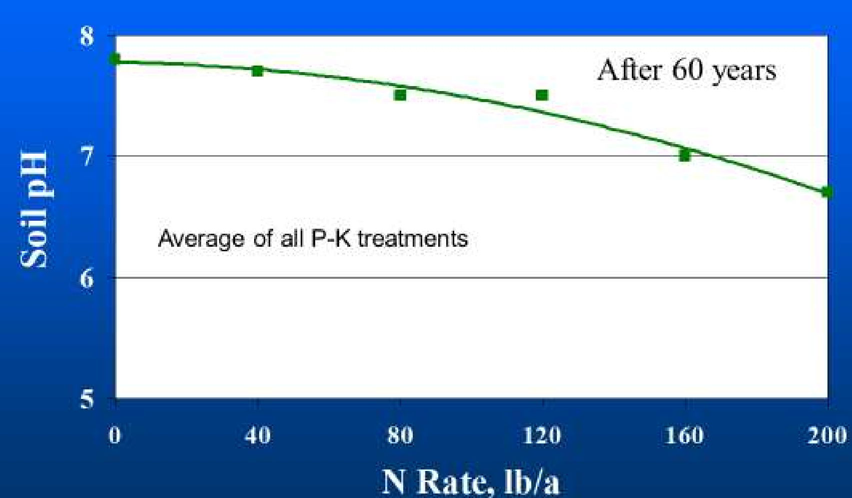
pH decreased ~ 1.2 unit by N

SOM increased ~ 0.5% by N & P

Soil test P increased with 40 P

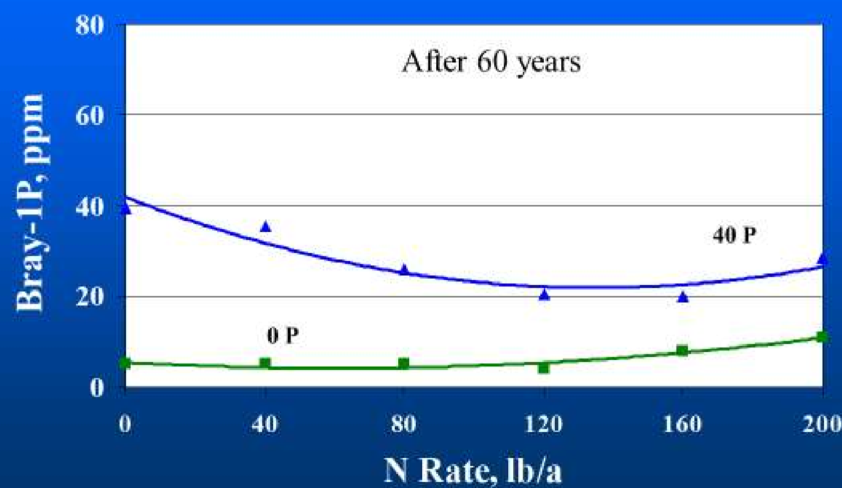


Long-term Sorghum Fertility



0-6", Tribune, KS 2020

Long-term Sorghum Fertility



Average of w/ and w/0 K,
0-6" Tribune, KS 2020

Discussion on New Recommendations

Questions/ Discussion

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