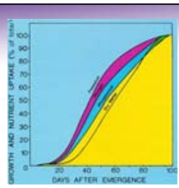


Intelligent Inputs: Fertility Considerations

Lucas Haag Ph.D., Associate Professor / Extension Agronomist
K-State Northwest Research-Extension Center, Colby
K-State Southwest Research-Extension Center, Tribune

Approaches to N Recs

- Maximum Return to Nitrogen (MRTN)
  - IA, MN, WI, IL, IN, MI, OH
  - State specific
  - No profile N credit, OM credit embedded
- NDSU MRTN
  - Does account for profile N
  - No explicit OM credit
- Mechanistic
  - KSU, CSU, UNL, OSU, ServiTech, AAL

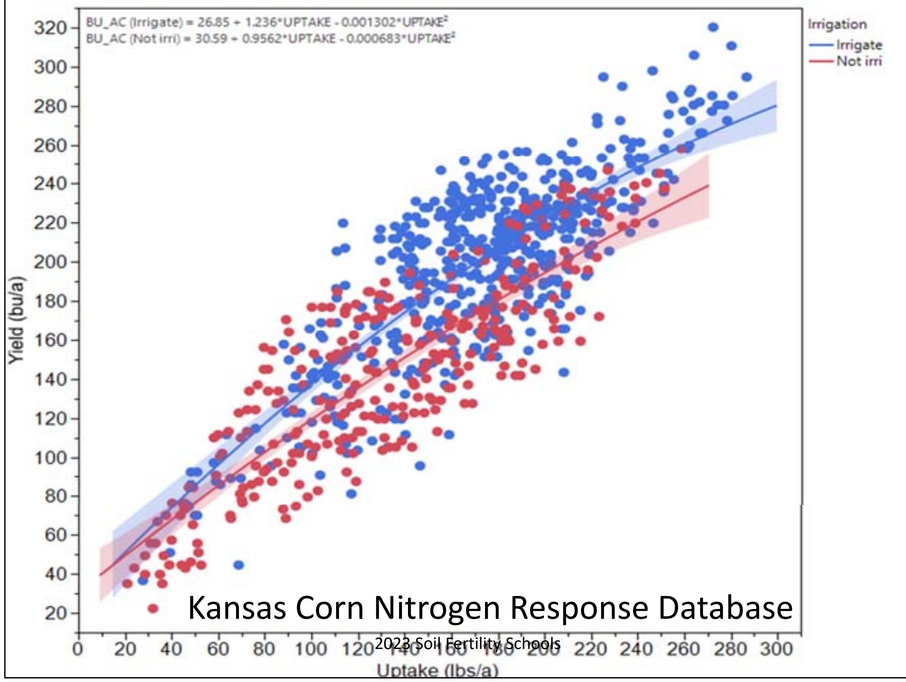
Lets talk about the mechanistic approach to N recommendations

- The overall idea is to think about peak plant uptake needs, and then work backwards

Nrec = YG x some factor – credits

Organic Matter, Profile NO_3, PCA

Common misconception is that it's a removal based system…. NOT TRUE!



Lets talk about the mechanistic approach to N recommendations

- So why this approach vs. what other states of done?
  - Residual Nitrate. In Kansas production systems it's real, it's measurable, and it's valuable
  - Wide range of yield potentials and environmental factors
    - Irrigated vs. Dryland
    - East to West
    - Heavy silt loams vs. blow sand

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Past K-State Recommendation

Corn Nitrogen Recommendations

Fertilizer N Required At Various Yield and Soil Organic Matter Levels Assuming Profile N Test Is Not Used (includes 30 Lb N/A residual default) [1]

Yield Goal (Bu/A)	Soil Organic Matter Content (%) 1.0	1.5	2.0	2.5	3.0	3.5	4.0
	- - - - - - - Lb N/A - - - - - - - -						
60	46	36	26	16	6	0	0
100	110	100	90	80	70	60	50
140	174	164	154	144	134	124	114
180	238	228	218	208	198	188	178
220	300	292	282	272	262	252	242

N Rec [2,3] = (Yield Goal × 1.6) – (% SOM × 20) – Profile N – Manure N – Other N Adjustments + Previous Crop Adjustments

[1] *Total N requirements presented include only Yield Goal and Soil Organic Matter Adjustments assuming profile N test not used. N rate should also be adjusted for Previous Crop, Manure and Other Appropriate N Rate Adjustments (see N rate adjustments for warm-season crops).*

[2] *Maximum fertilizer N recommendations are 230 lb N/A for Dryland Corn production and 300 lb N/A for Irrigated Corn production.*

[3] *A minimum fertilizer N application of 30 Lb N/A may be appropriate for early crop growth and development.*

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"Old" K-State Corn Nrec

Nrec = YG x 1.6 – Profile N – Soil OM Credit – Other Credits

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But what about lbs/bu?

"You KSU guys are nuts!
It doesn't take 1.6 lbs/bu, I can do it on 0.7!"

- The farm press as well as many producers and consultants want to think in terms of lbs/bu
  - A nice simple number for bragging rights
  - Probably not a bad approach in the corn belt
  - Maybe useful in less dynamic systems in Kansas (e.g. continuous irrigated corn)
- BUT:
  - If you don't know NO_3 at the beginning and end of the season, it's really not that useful of a number

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Nrec = YG x 1.6 – Profile N – Soil OM Credit – Other Credits

(130 x 1.6) – 40 lb/ac – (2.5 x 20)

208 – 40 – 50 = 118 lb/ac

= 0.9 lb/bu

Lets talk about the mechanistic approach to N recommendations

- Limitations
  - At the end of the day, its still a best guess (as is any N recommendation method)
  - Lots of moving pieces
    - Soil Efficiency
    - Fertilizer Efficiency
    - Organic Matter Mineralization

Corn

$$N\,{}^{lbs}/_{a} = \left[\frac{ie}{fe}EY - (se)NO3 - SOM - PCA\right] \times Price_{Adj}$$

Minimum N rate= 30 lbs/a

ie (corn internal efficiency) lbs/bu	
Irrigated	0.84
Non-Irrig	0.88

fe (fertilizer recovery efficiency)		
High efficiency	0.70	Injected + split applied
Default	0.65	Pre-plant
Low efficiency	0.55	Broadcast, fall-applied

se (“soil” NO3 efficiency)		
Low N loss	1.0	Medium texture or western KS
High N loss	0.7	Corse texture or eastern KS

Sorghum

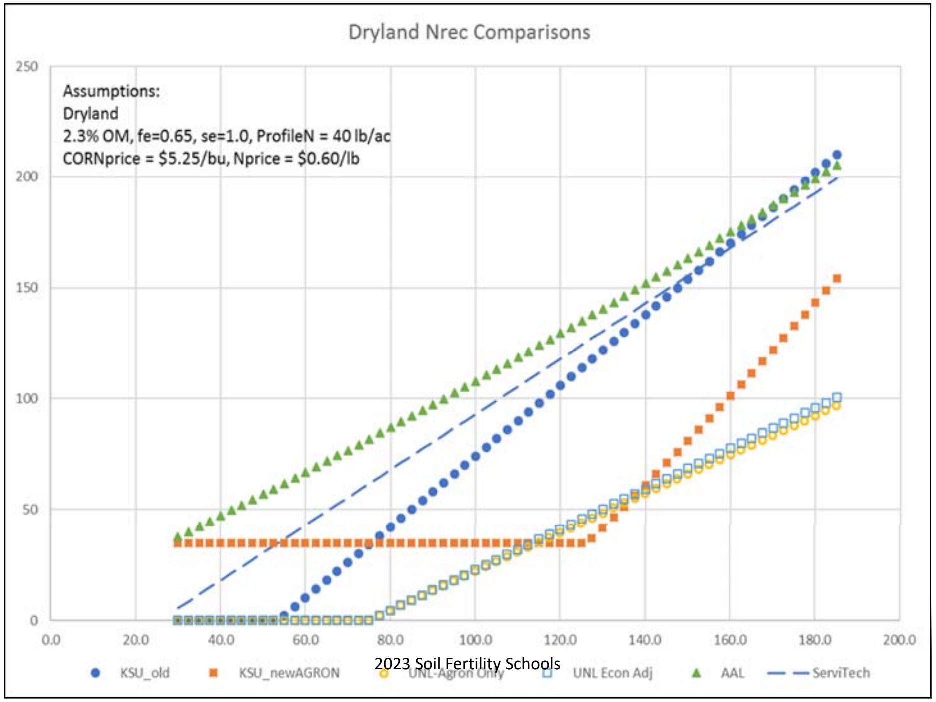
$$N\,{}^{lbs}/_{a} = \left[\frac{ie}{fe}EY - (se)NO3 - SOM - PCA\right] \times Price_{Adj}$$

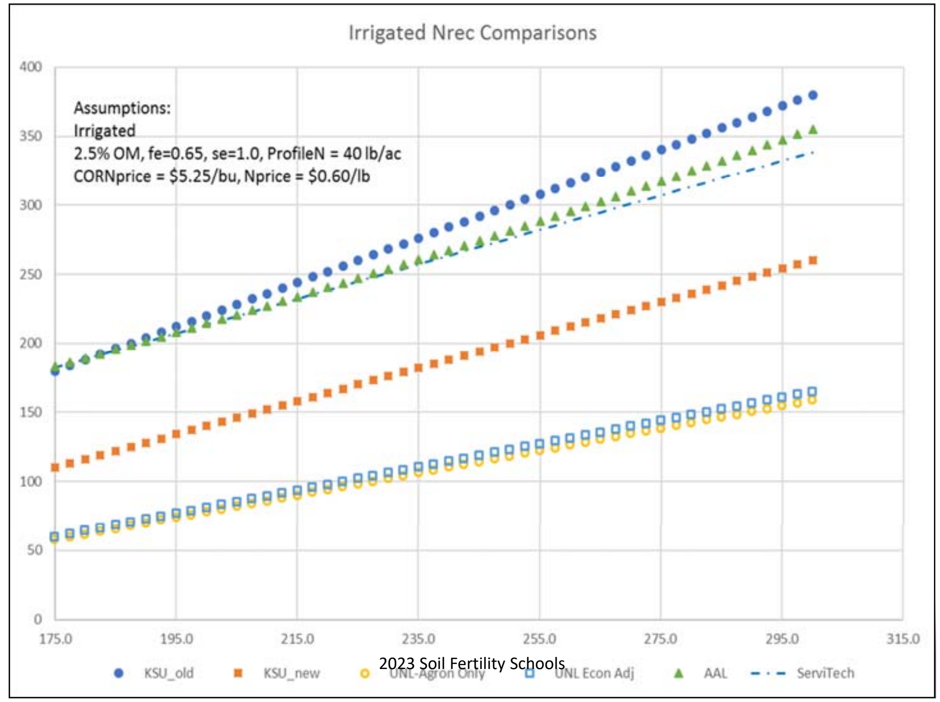
Minimum N rate= 30 lbs/a

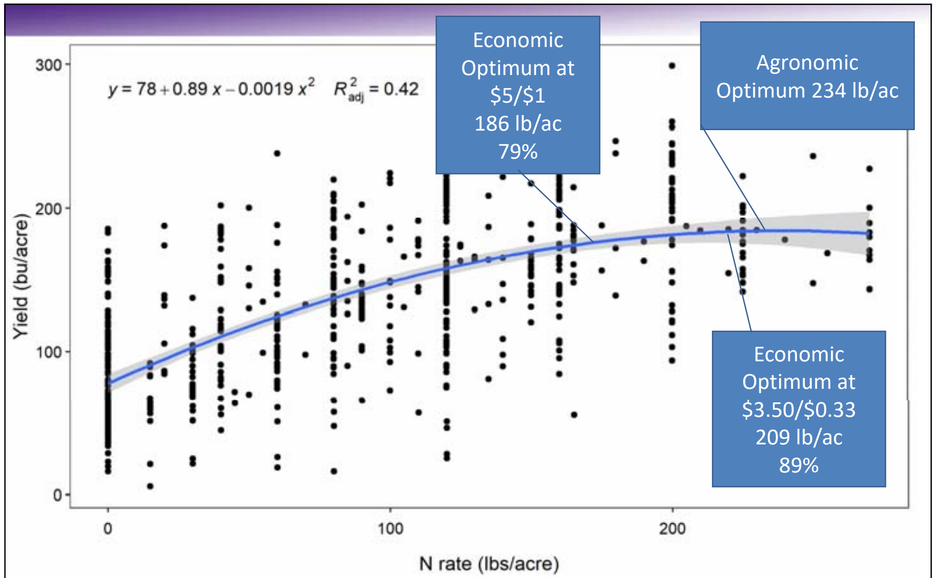
ie (sorghum internal efficiency), lbs/bu	
Sorghum	1.2

fe (fertilizer recovery efficiency)		
High efficiency	0.70	Injected + split applied
Default	0.65	Pre-plant
Low efficiency	0.55	Broadcast and applied in the fall

se (“soil” NO3 efficiency)		
Low N loss	1.0	Medium texture or western KS
High N loss	0.7	Corse texture or eastern KS







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Economic Choices in N Management

OK, we said that applying whatever N it takes to meet the yield goal is essentially a "no-brainer", even at today's fertilizer prices (because it's relative to crop prices)

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Economic Choices

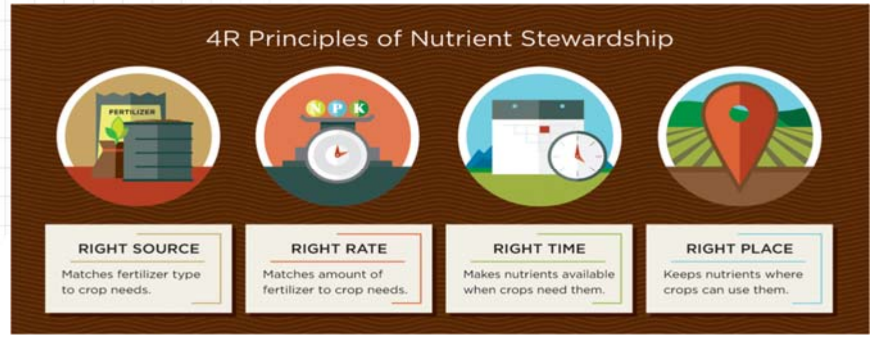
So where is there money to be made in Nitrogen management today?

1. Importance of using a proper yield goal
   1. For us in the west, this is heavily water driven

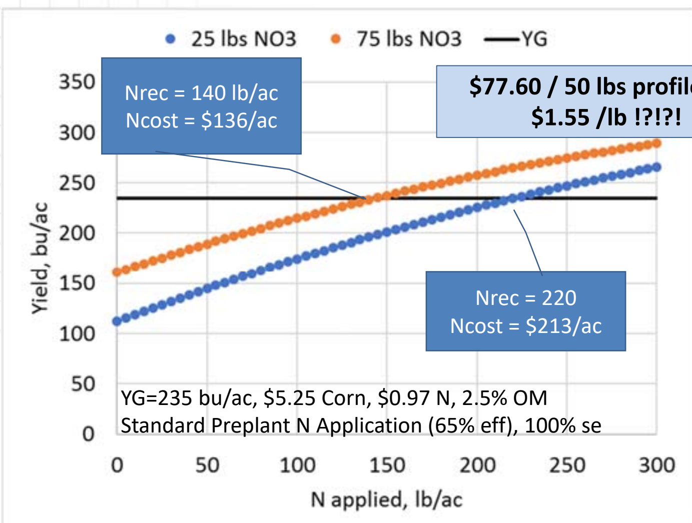
2. Knowing what we have. This is really important if we screwed up on step 1 last year (e.g. drought).

3. Economic benefits to implementing 4R
   i.e. reducing cost through improving fertilizer efficiency

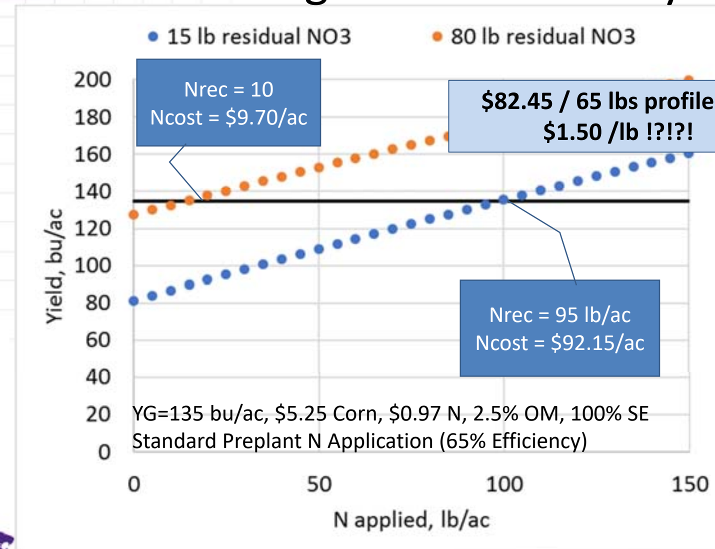
Management Decisions



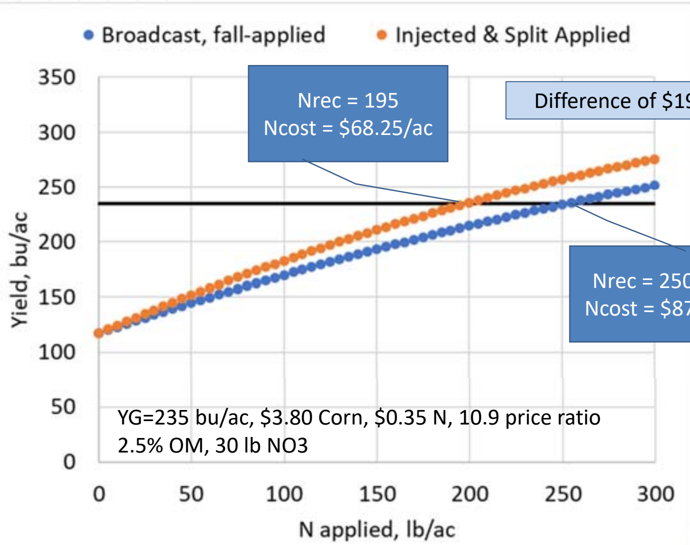
Value of Knowing Soil Nitrate - Irrigated



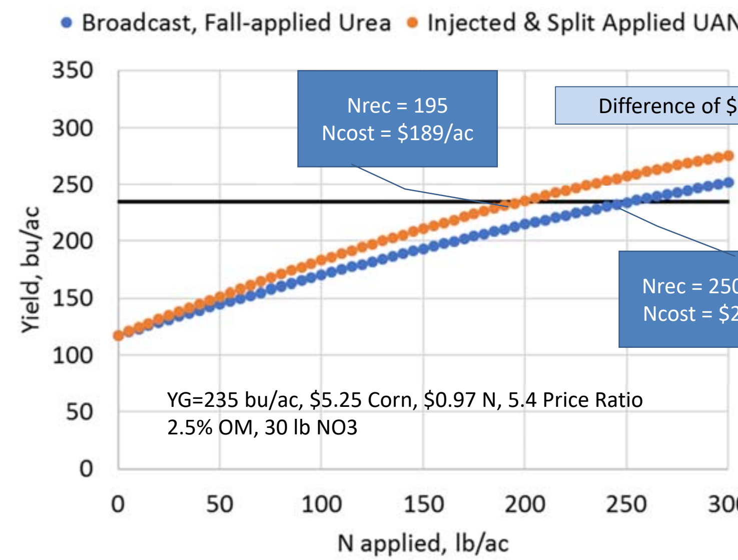
Value of Knowing Soil Nitrate - Dryland



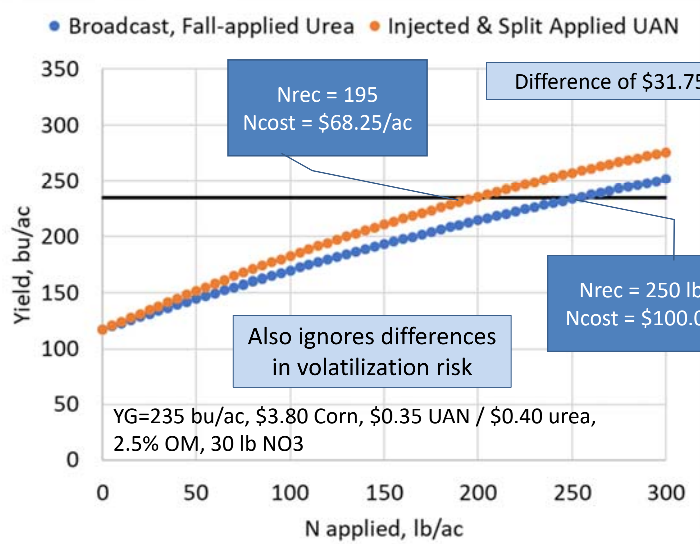
Economics of Timing and Placement



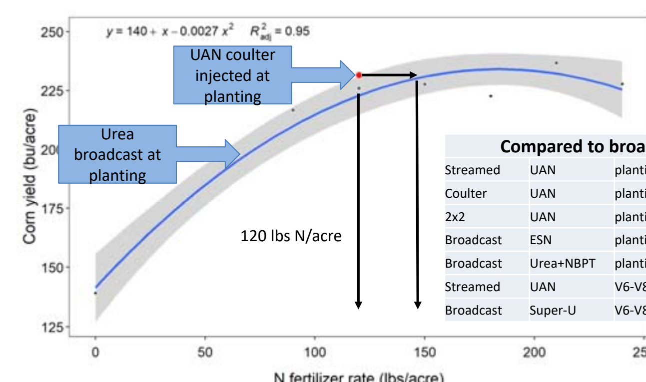
Economics of Timing and Placement



Economics of Product Price, Timing, and Placement



Results: 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	-

Rossville, 2021

Timing

- Some limitations in dryland, but still important
  - Moisture to move N into profile
  - Avoiding “tie-up”, minimizing volatilization potential
- Great opportunities with fertigation

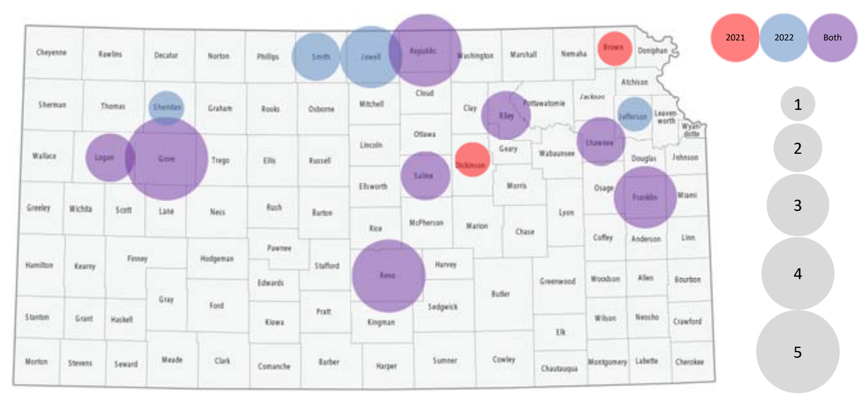
Source

- Cost per lb. of nutrient
  - Always do the math!
- Equipment Considerations
  - VRT Equipment
- Source vs. Timing of Application

Phosphorus corn response study

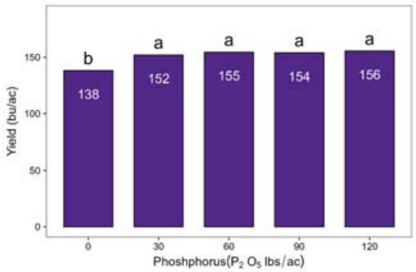
- Wheat P study (completed): results show higher STP critical value than current 20 ppm
- Corn P Study (ongoing)
- Other crops: Soybean and sorghum?
  - Ongoing project with the KSC on soybean

The study was set up in 13 sites in 2021 and 20 sites in 2022. Total of 33 sites

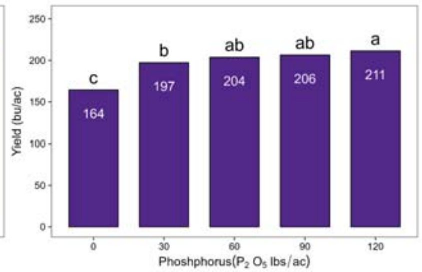


Yield response to P

Across all sites



Responsive sites only



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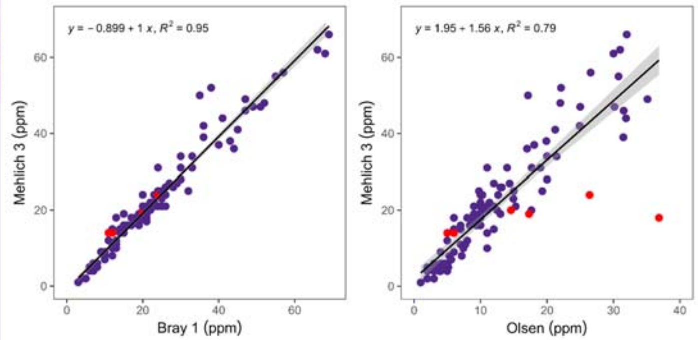
Different soil test phosphorus methods



Soils with a pH > 7.4 are indicated by red points.

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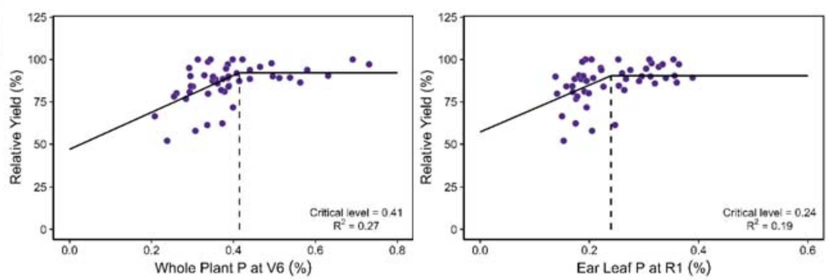
Relationship between relative yield and tissue concentration



2021 sites only

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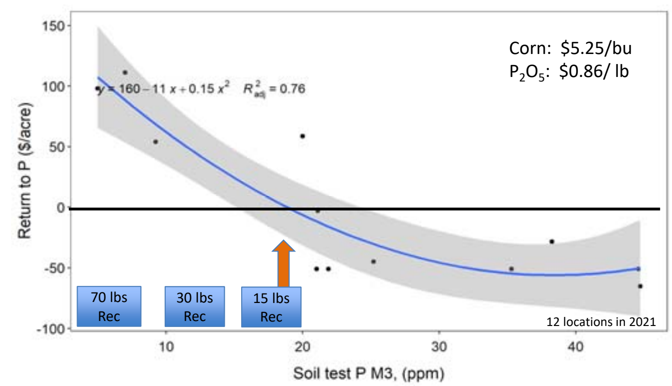
\$ return to 60 lbs of P_2O_5 in the year of application in corn



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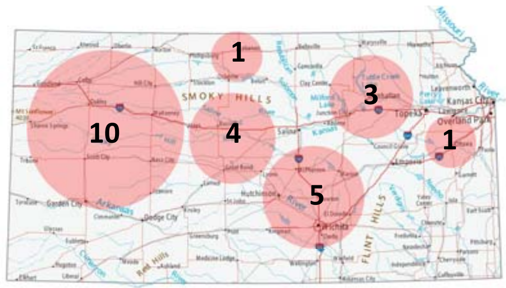
Phosphorus in wheat

- 24 locations in two years (2019 and 2020)
  - 18 Farmer's field
  - 6 University



Early and late plant response

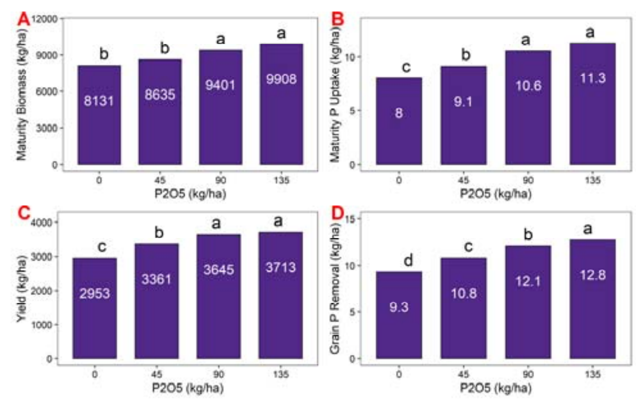
N **N + P** **N** **N + P**

Treatments

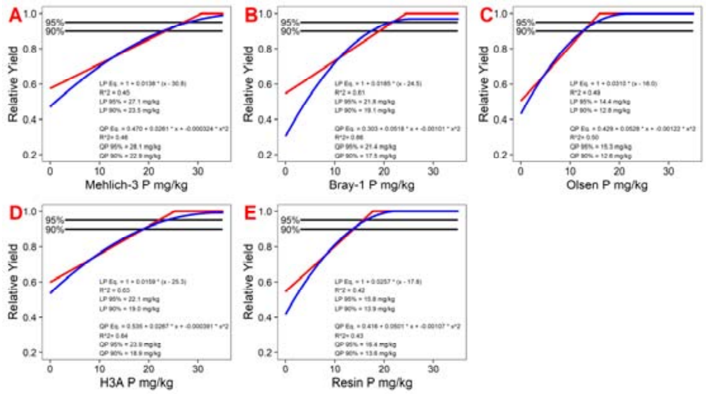
- 4 P fertilizer rates as fall broadcast pre-plant
  - Nitrogen 50 lbs as pre-plant and 50 lbs at spring green up
- RCBD Design with four reps

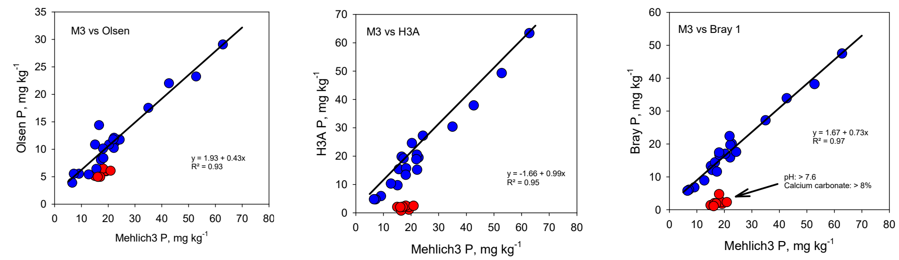
P rate (lbs P2O5/a)	N rate (lb N/ha)
0	0
0	100
40	100
80	100
120	100

Average wheat response across locations

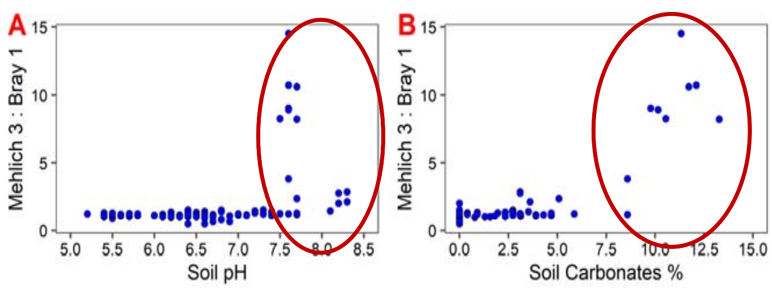


Soil test critical values at 90 and 95% relative yield with 5 soil test methods and two regression

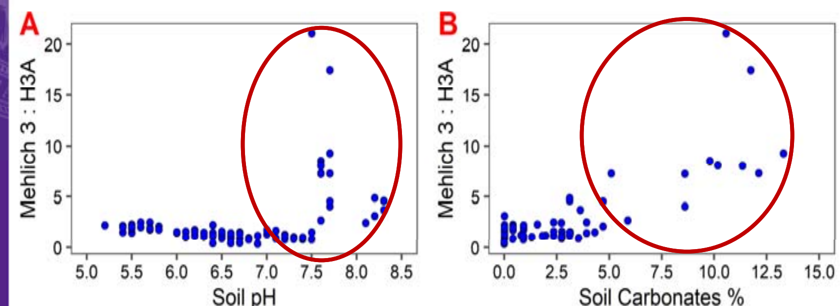




Mehlic-3 : Bray 1 vs soil pH and carbonates

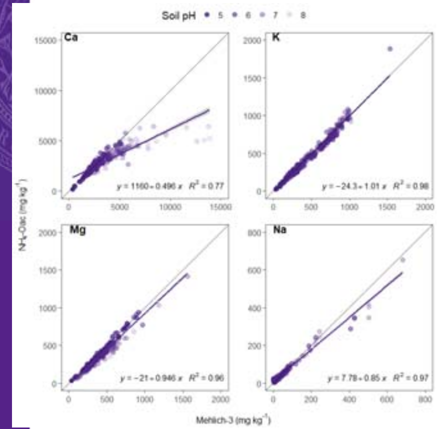


Mehlic-3 : H3A vs soil pH and carbonates



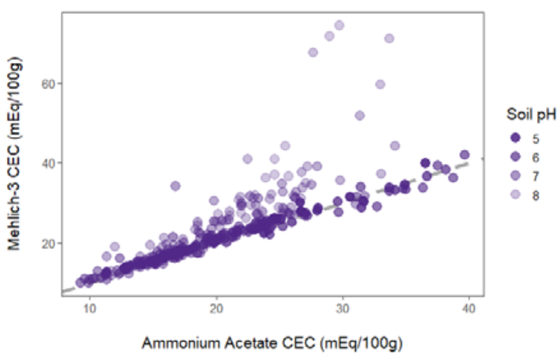
Cation extraction methods vs soil pH

M3 vs AA: extractable cations

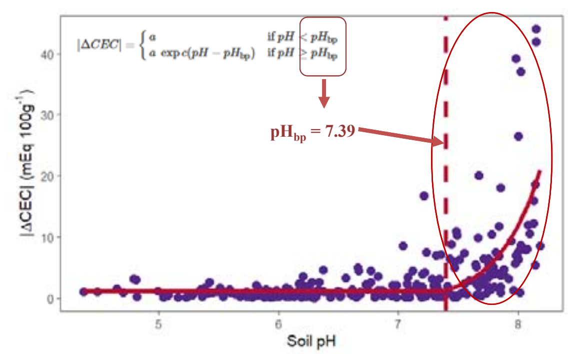


- Strong correlations between M3 and AA extractable cations
- Simple linear regression models fit K, Mg, and Na data
  - Influence of soil pH appears negligible
- Curvilinear relationship for Ca
  - Strongly influenced by soil pH

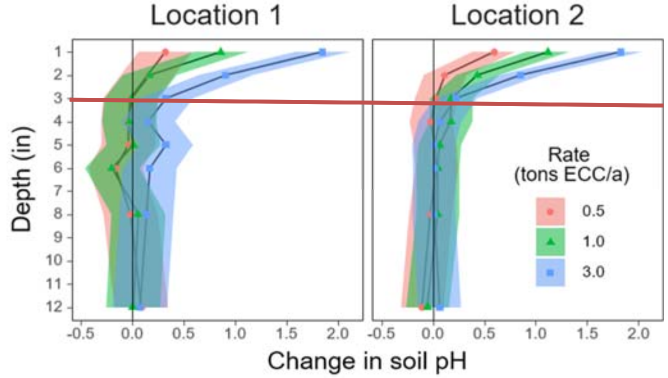
M3 vs AA: cation exchange capacity



Cation exchange capacity difference vs. soil pH



Changes in soil pH with surface lime application in no-till



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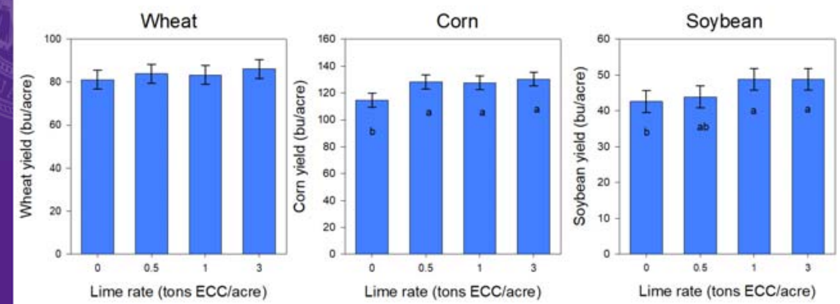
Yield response to surface lime application for wheat, corn and soybean



Crop rotation in this order: wheat, corn, soybean (2017-2019)

Kansas State University

Impact of sample handling practices on soil test results

Bryan Rutter

KSRE Soil Test Lab

Kansas State University

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?

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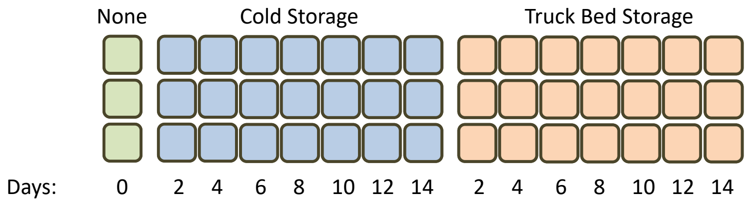
Lab Study: Experiment Design

100 lbs bulk soil → Mix → Sieve →
Bag subsamples → Randomize Bags

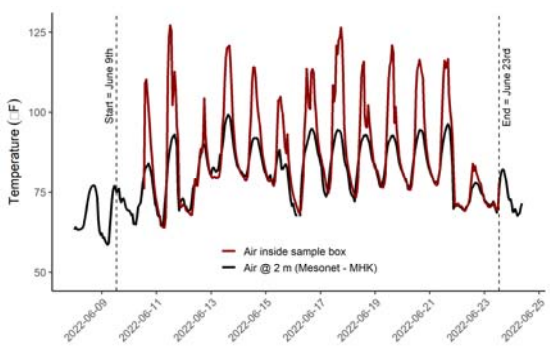


Lab Study: Site Description

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

- Silt Loam
- Water content = 19 %

Box temperature



Soil Tests and Comparisons

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

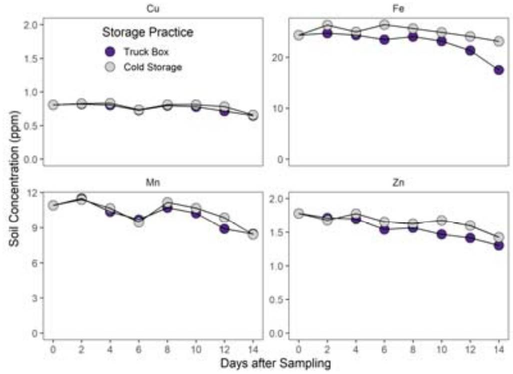
- Storage Environment
- Time
- Storage x Time

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		

Micronutrients

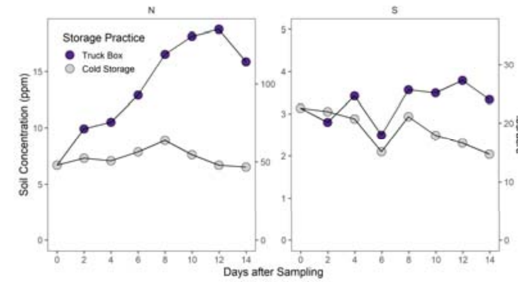
- Statistical significance
- Agronomic significance?



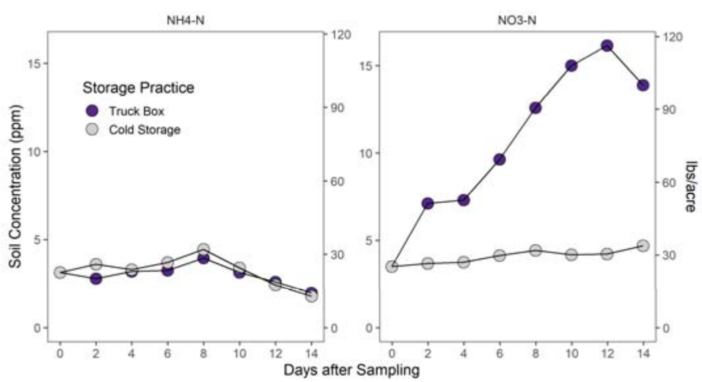
Nitrogen and Sulfur

lbs/ac = ppm x 0.3 x 24 inches

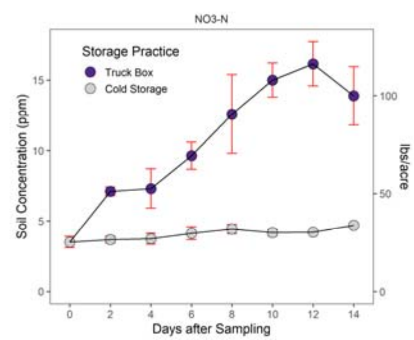
- Variability, but trends are clear
- Differences in inorganic N are large
- Representative sample?

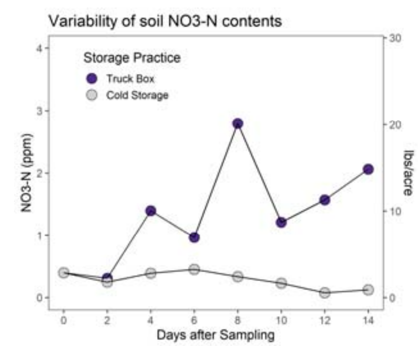


Closer look at Nitrogen



Effects on variability?





Conclusions

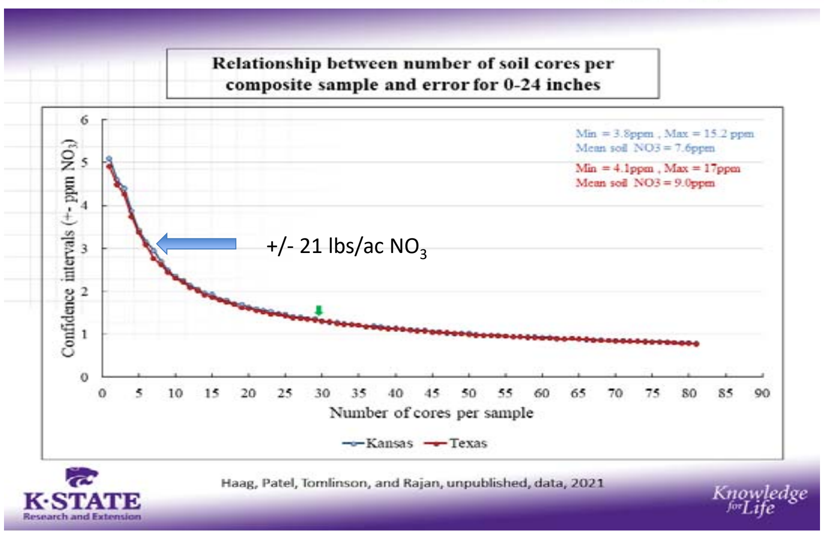
- Sample handling affects soil tests, especially N
- Warm storage temps corresponded to large increases in NO_3 over time
- Warm temps may increase NO_3 variability

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



Questions and Discussion

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