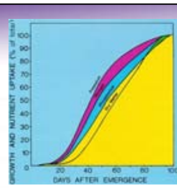

Intelligent Inputs for Corn: Nitrogen Considerations

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

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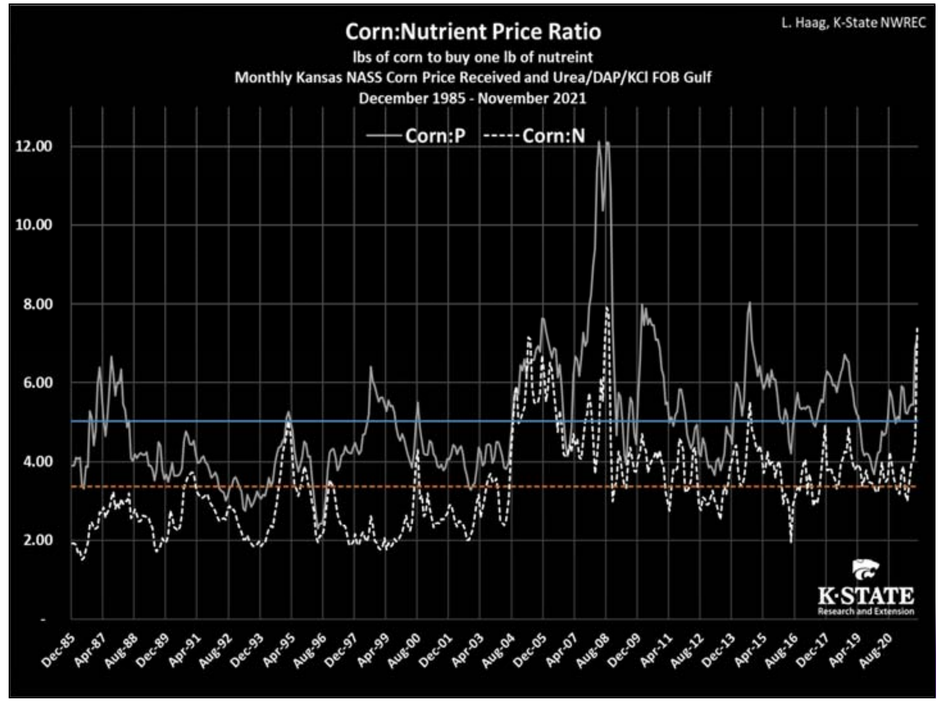

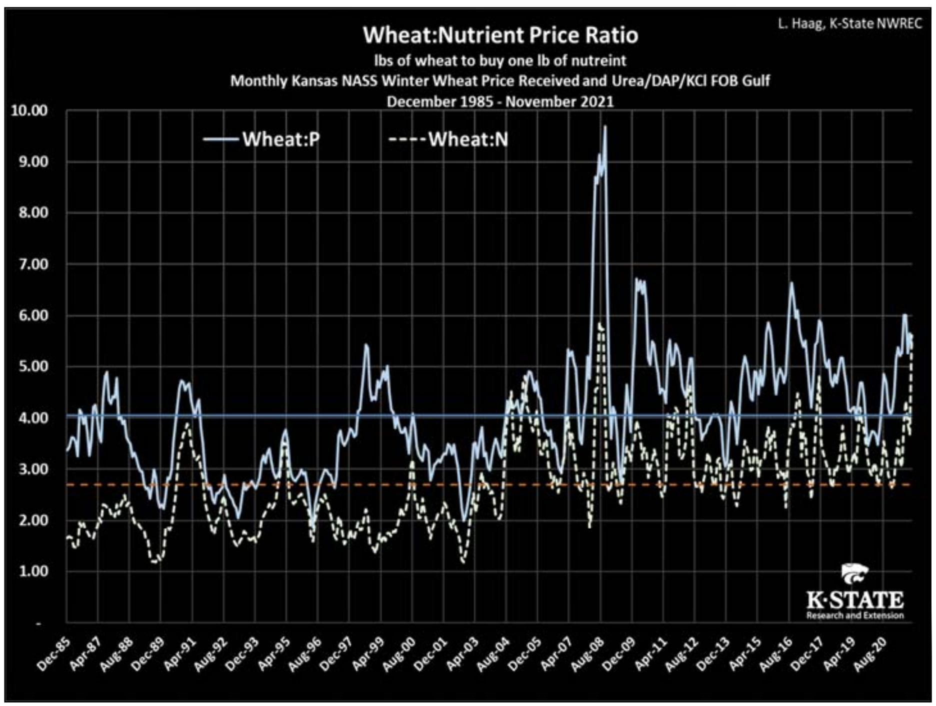

	Historical	Nov. 2021
Corn:Nitrogen	3.36	8.99
Wheat:Nitrogen	2.70	6.73
Corn:Phosphorus	5.02	7.26
Wheat:Phosphorus	4.05	5.43

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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

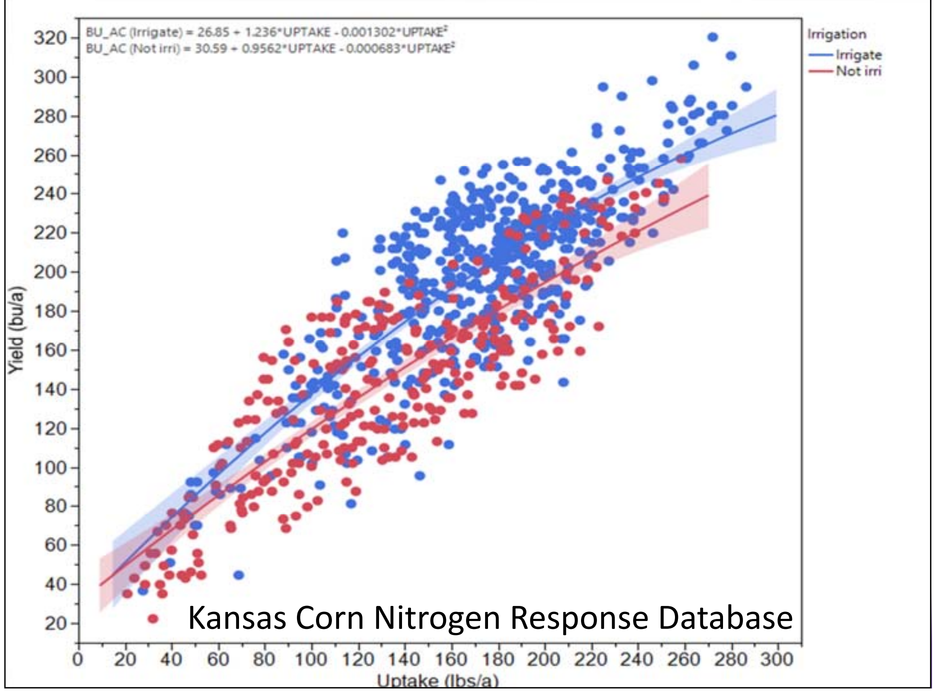
Lets talk about the mechanistic approach to N recommendations

- 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

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

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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

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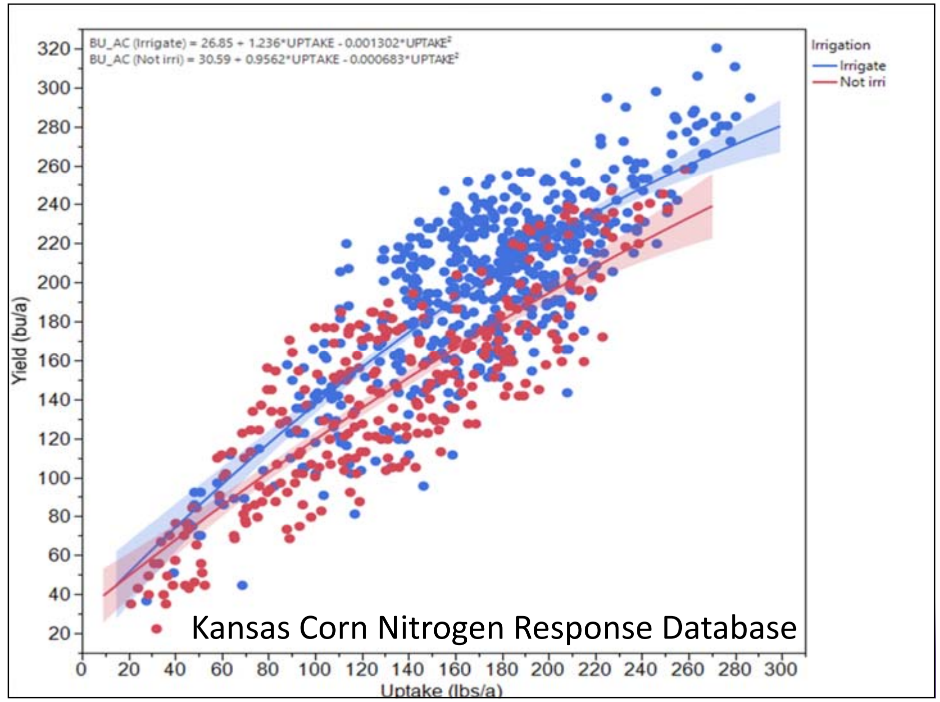

Corn

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

Minimum N rate= 30 lbs/a

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

fe (fertilizer recovery efficiency)			DRYLAND	IRRIGATED
High efficiency	0.70	Injected + split applied	0.88 / 0.70 = 1.3 lb/bu	0.84 / 0.70 = 1.2 lb/bu
Default	0.65	Pre-plant	0.88 / 0.65 = 1.4 lb/bu	0.84 / 0.65 = 1.3 lb/bu
Low efficiency	0.55	Broadcast, fall-applied	0.88 / 0.55 = 1.6 lb/bu	0.84 / 0.55 = 1.5 lb/bu

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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Sorghum

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

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	1.2 / 0.70 = 1.7 lb/bu
Default	0.65	Pre-plant	1.2 / 0.65 = 1.8 lb/bu
Low efficiency	0.55	Broadcast and applied in the fall	1.2 / 0.55 = 2.2 lb/bu

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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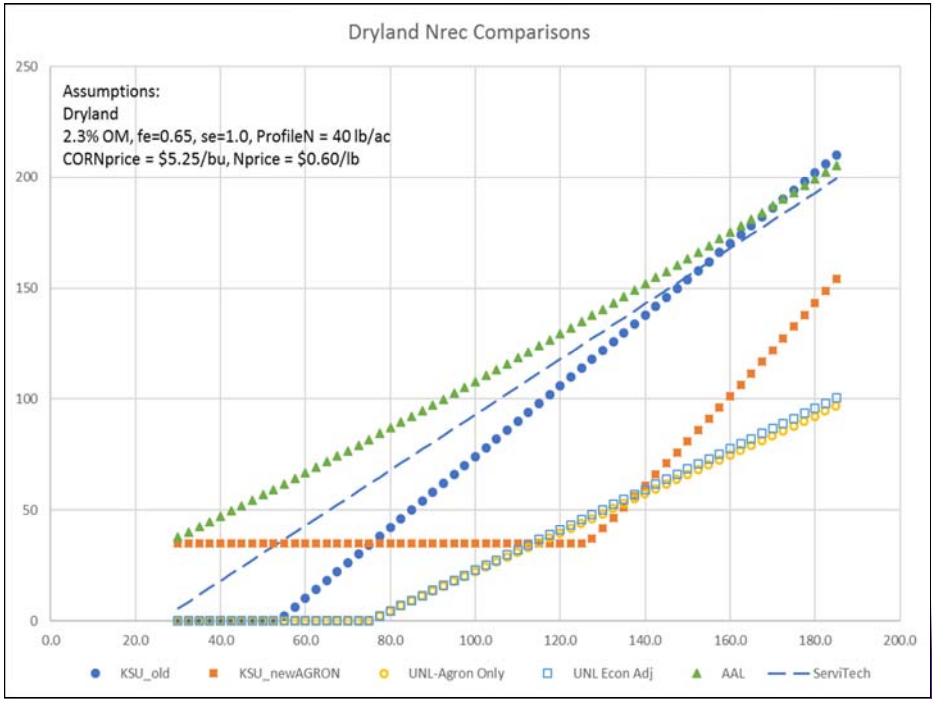
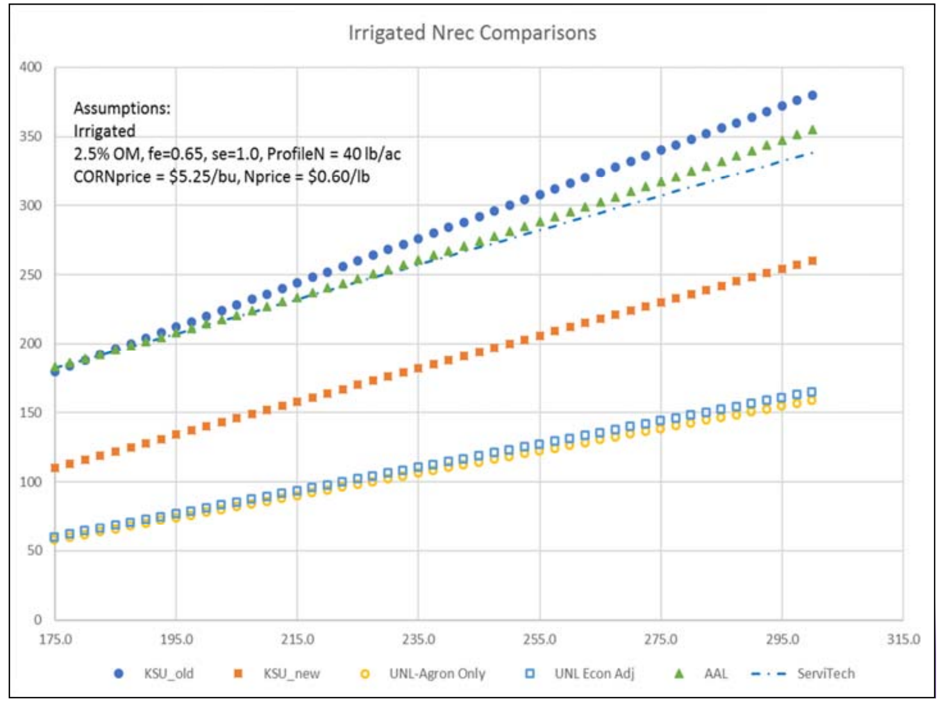
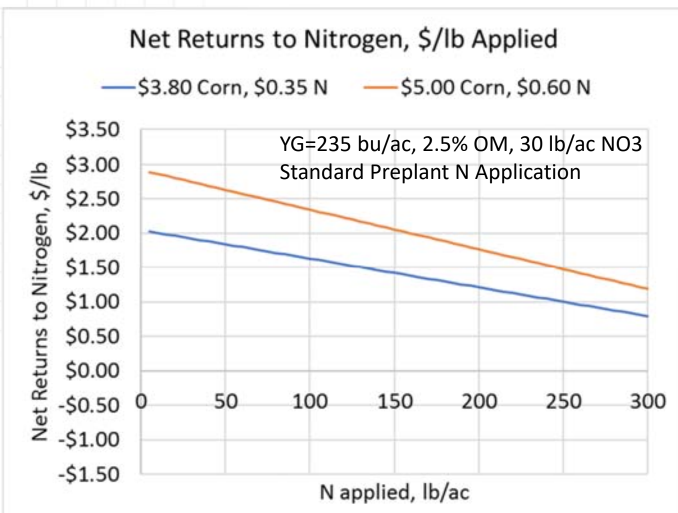




Nitrogen Pays – Year over Year



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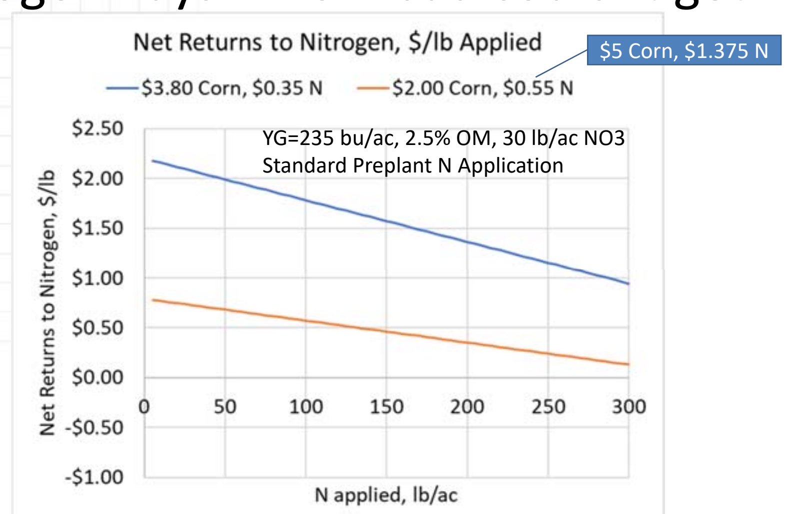
Nitrogen Pays – How bad could it get?



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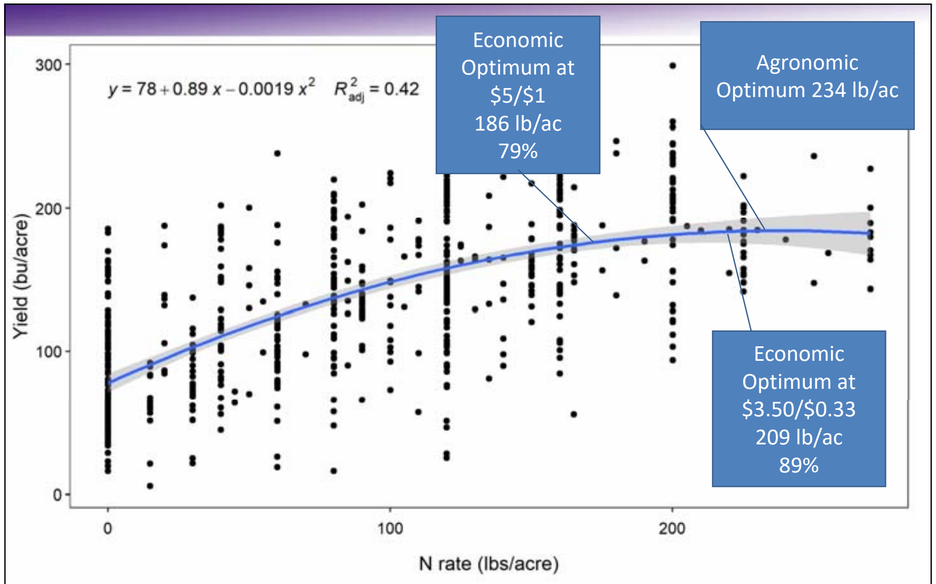


Economic Choices in N Management

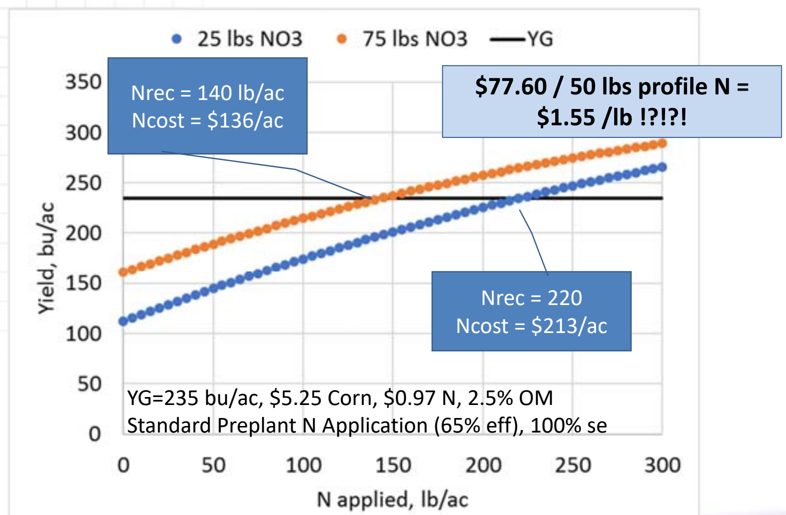
OK, we said that applying whatever N it takes to meet the yield goal is essentially a "no-brainer", even at today's fertilizer prices (because it's relative to crop prices)

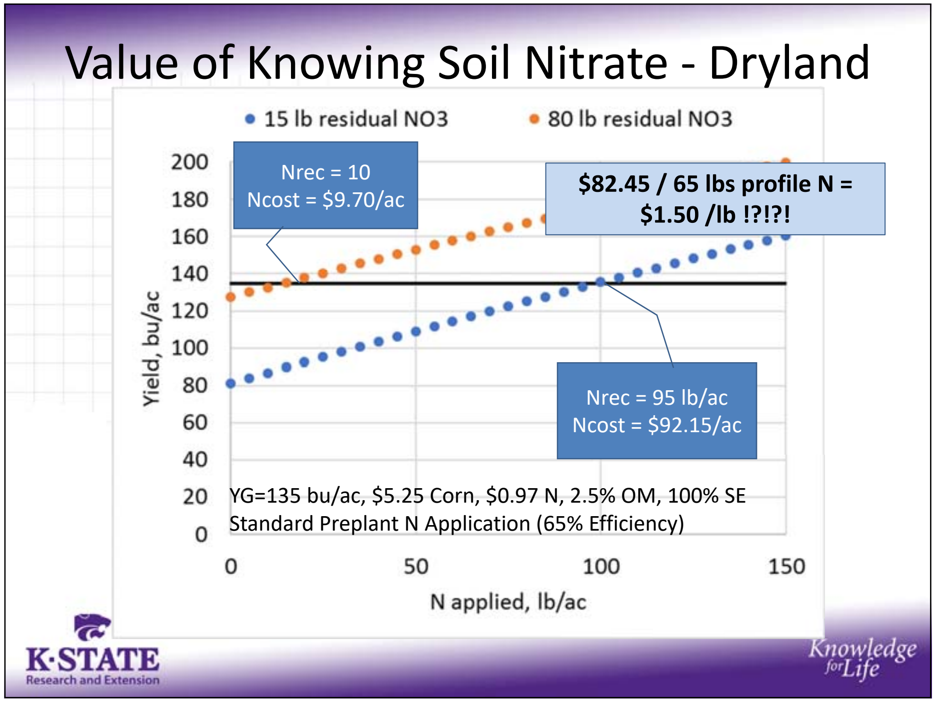
Economic Choices

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

Value of Knowing Soil Nitrate - Irrigated




Value of Knowing Soil Nitrate - Dryland
15 lb residual NO3
80 lb residual NO3
Nrec = 10
Ncost = $9.70/ac
$82.45 / 65 lbs profile N =
$1.50 /lb !?!?!
Nrec = 95 lb/ac
Ncost = $92.15/ac
YG=135 bu/ac, $5.25 Corn, $0.97 N, 2.5% OM, 100% SE
Standard Preplant N Application (65% Efficiency)
Yield, bu/ac
N applied, lb/ac
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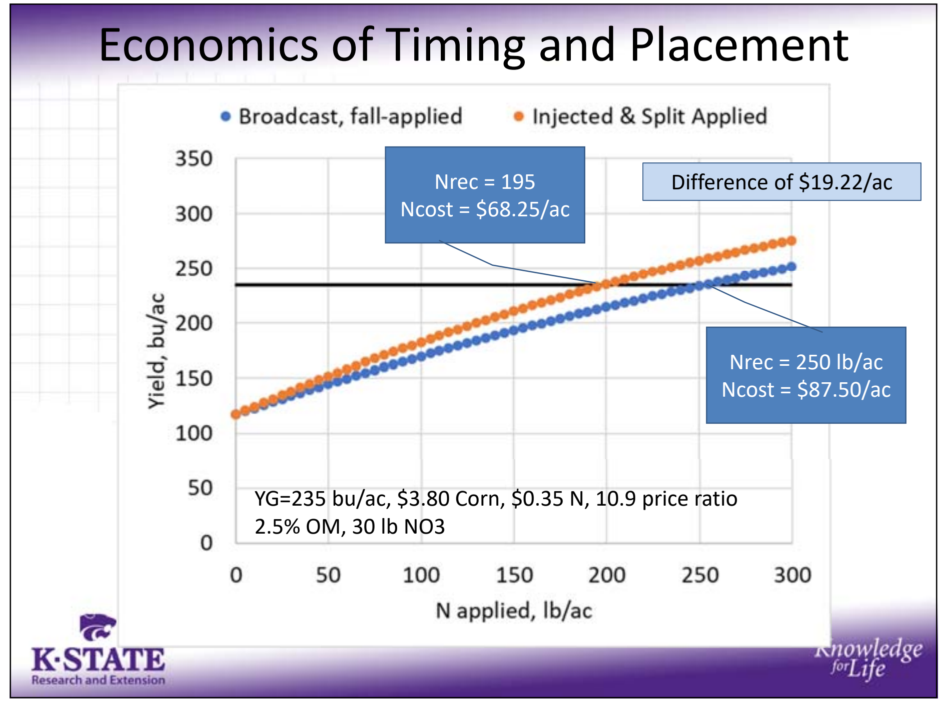
Economics of Timing and Placement
Broadcast, fall-applied
Injected & Split Applied
Nrec = 195
Ncost = $68.25/ac
Difference of $19.22/ac
Nrec = 250 lb/ac
Ncost = $87.50/ac
YG=235 bu/ac, $3.80 Corn, $0.35 N, 10.9 price ratio
2.5% OM, 30 lb NO3
Yield, bu/ac
N applied, lb/ac
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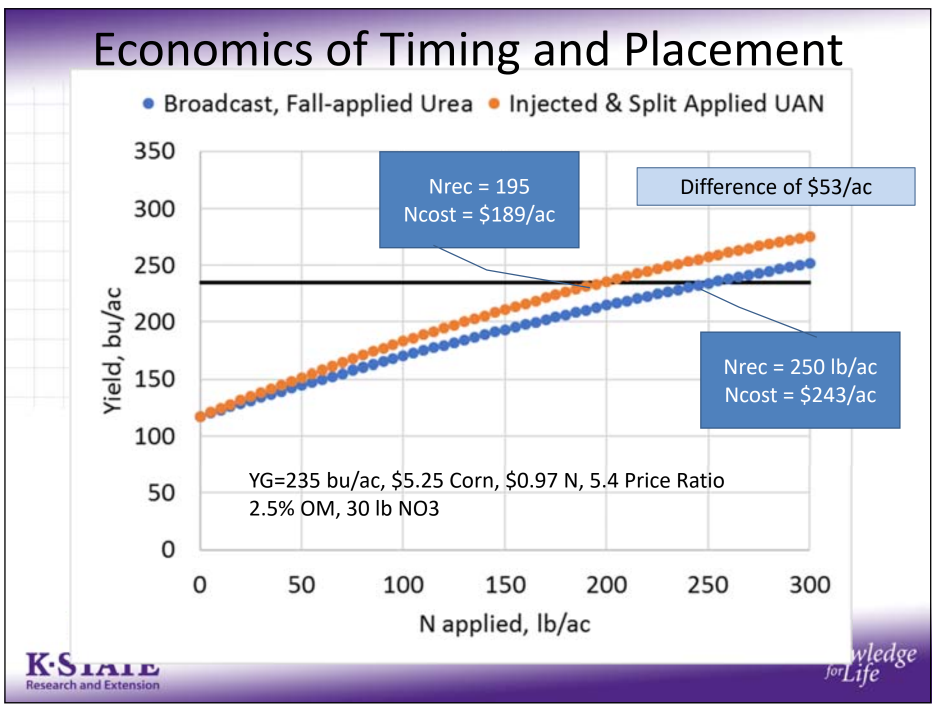
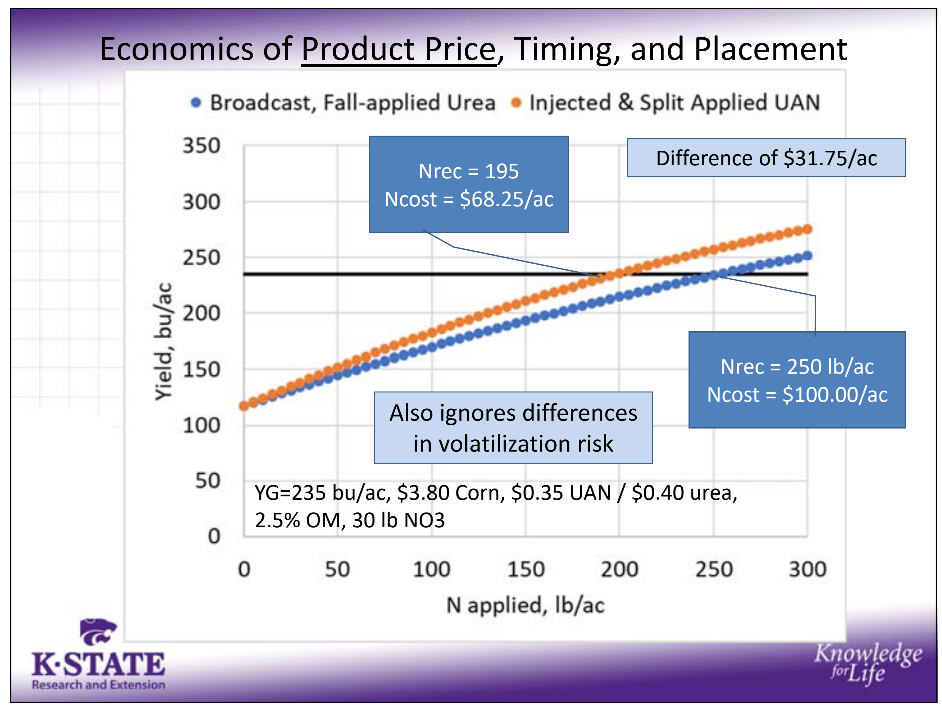

Economics of Timing and Placement
Broadcast, Fall-applied Urea
Injected & Split Applied UAN
Nrec = 195
Ncost = $189/ac
Difference of $53/ac
Nrec = 250 lb/ac
Ncost = $243/ac
YG=235 bu/ac, $5.25 Corn, $0.97 N, 5.4 Price Ratio
2.5% OM, 30 lb NO3
Yield, bu/ac
N applied, lb/ac
Research and Extension


Economics of Product Price, Timing, and Placement
Broadcast, Fall-applied Urea
Injected & Split Applied UAN
Nrec = 195
Ncost = $68.25/ac
Difference of $31.75/ac
Nrec = 250 lb/ac
Ncost = $100.00/ac
Also ignores differences
in volatilization risk
YG=235 bu/ac, $3.80 Corn, $0.35 UAN / $0.40 urea,
2.5% OM, 30 lb NO3
Yield, bu/ac
N applied, lb/ac
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Timing

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

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Source

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

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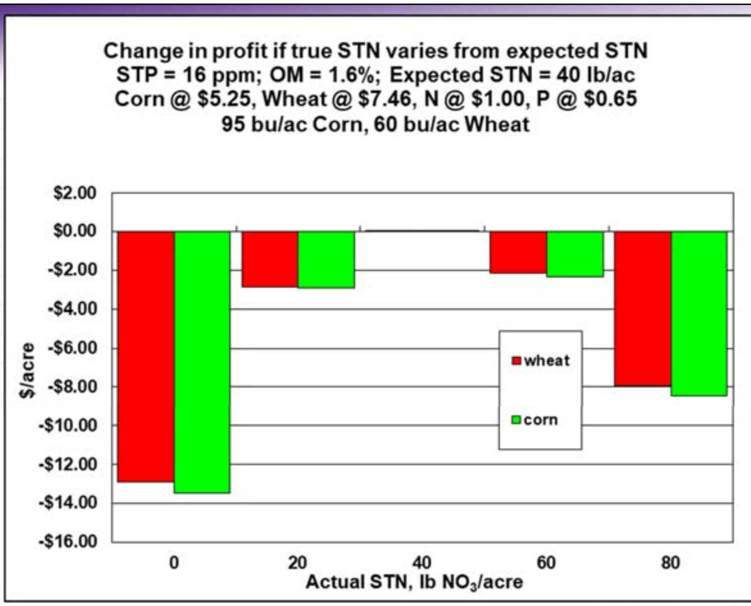

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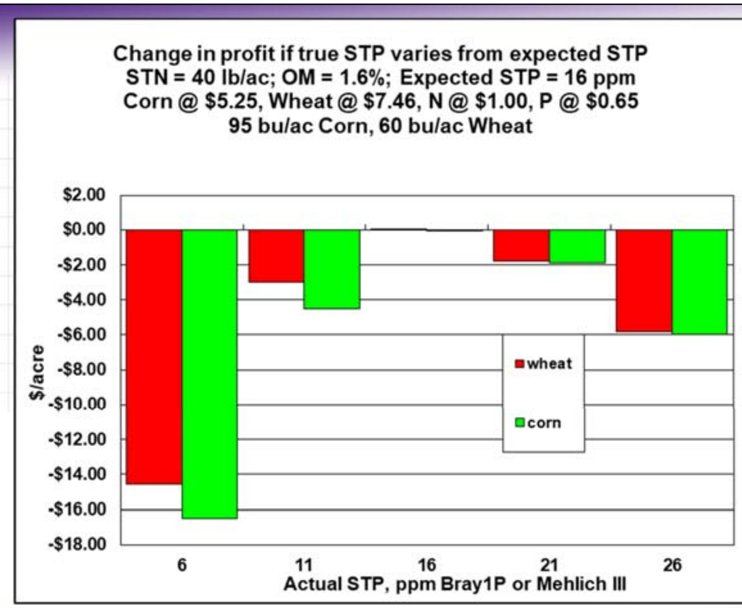

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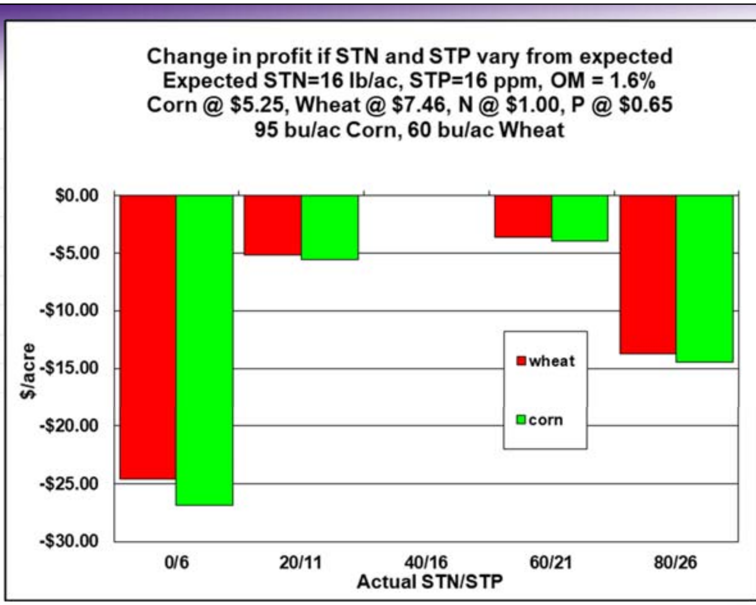

Data Quality

- The proceeding economics are based on having good data, as good of a representation of "truth" as we can reasonably obtain.
- Good decisions require good data
- Good soil test data comes from good procedures in the field

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Number of Cores to Make a Good Sample

- Soils vary across very short distances in nutrient supply due to many factors including:
  - Position on the landscape
  - Past erosion
  - Parent material of the soil
- We also induce variability on the soil
  - Band applications
  - Livestock grazing
- To account for this variation you should take 10-20 cores per sample

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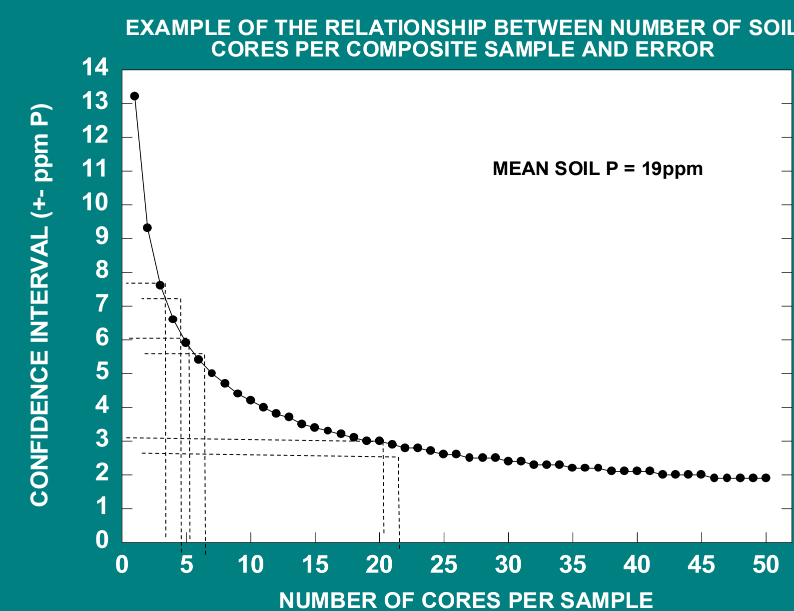
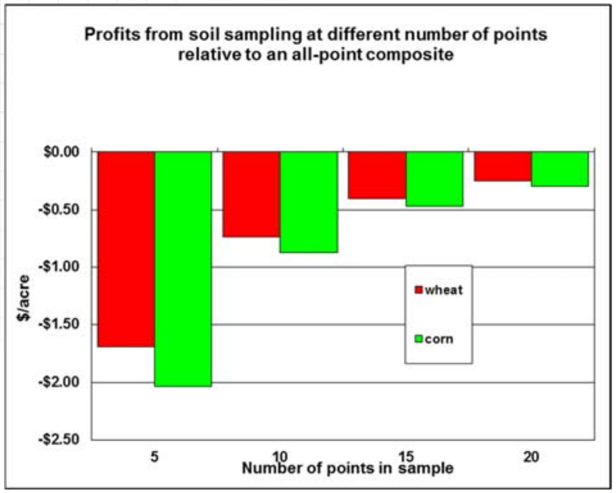


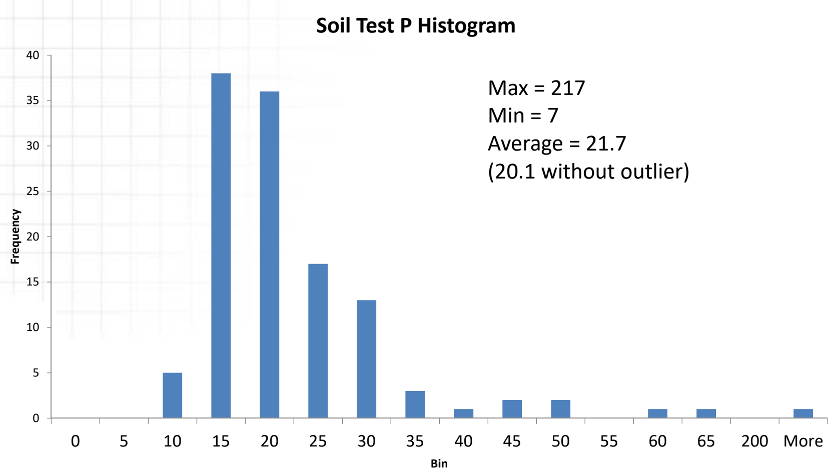
Economics of Accuracy



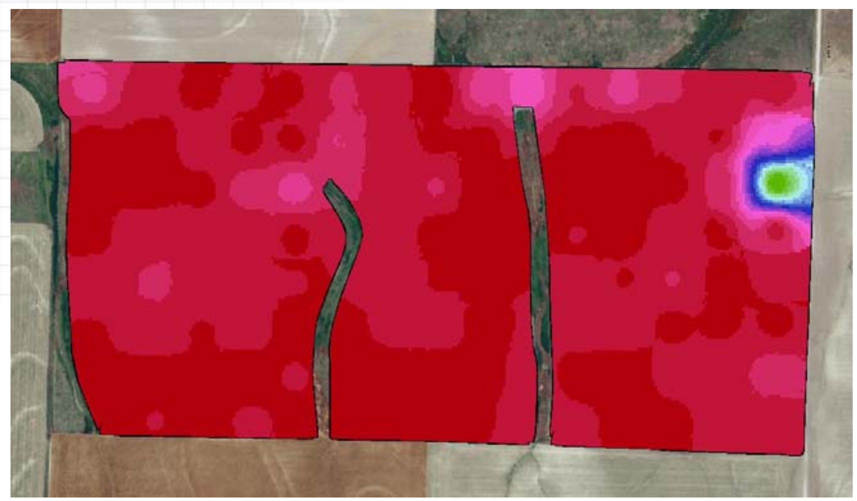
VRT Phosphorus Example

- No other data is available (i.e. yield data)
- Field is located in NW Kansas and was grid sampled on 2.5 ac grids
- Samples consisted of 15 cores, so an estimated CI of +/- 3.5 ppm

Soil Test Bray P1

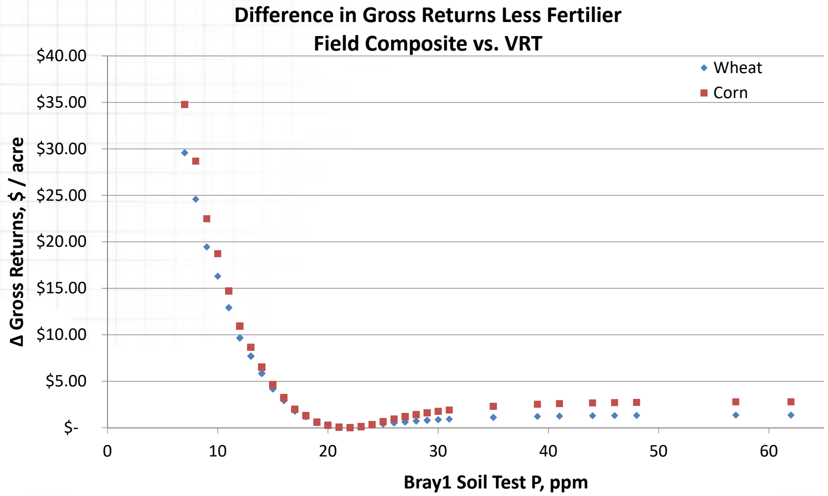


Interpolated Soil Test Phosphorus



NOT A GOOD EXAMPLE OF INTERPOLATION!

Returns to VRT



Returns to VRT

- Average gross return on VRT P for wheat = ***<u>$3.81/acre/year</u>***
- Average gross return on VRT P for corn = ***<u>$4.49/acre/year</u>***
- The above gross figures would need to cover sampling cost and the portion of machinery and labor cost related to VRT implementation

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Can we stretch the value of intensive sampling?

- ROI on intensive sampling increases dramatically as the number crops benefiting from the information increases (spreading fixed cost)
- Checkbook approach for nutrients using initial intensive soil test and removal rates from yield monitor data

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2020 KARA Crop Production Update
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Questions?

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