
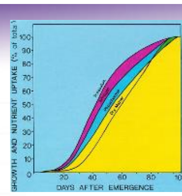

Economics of Soil Fertility Management

Lucas Haag Ph.D., Asst. Professor/Northwest Area Agronomist
K-State Northwest Research-Extension Center, Colby

With Cooperation Of:
Terry Kastens, Ph.D., Emeritus Professor, Agricultural Economics, K-State
Kevin Dhuyvetter, Ph.D., Technical Consultant, Elanco

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Knowledge for Life

Where are we now?

- Historical and Current Price Ratios
- Understanding Crop Response to Fertilizer
- Economics of Soil Testing and Data Quality
- Implications for site-specific management
- Products and Placement
- Current Research

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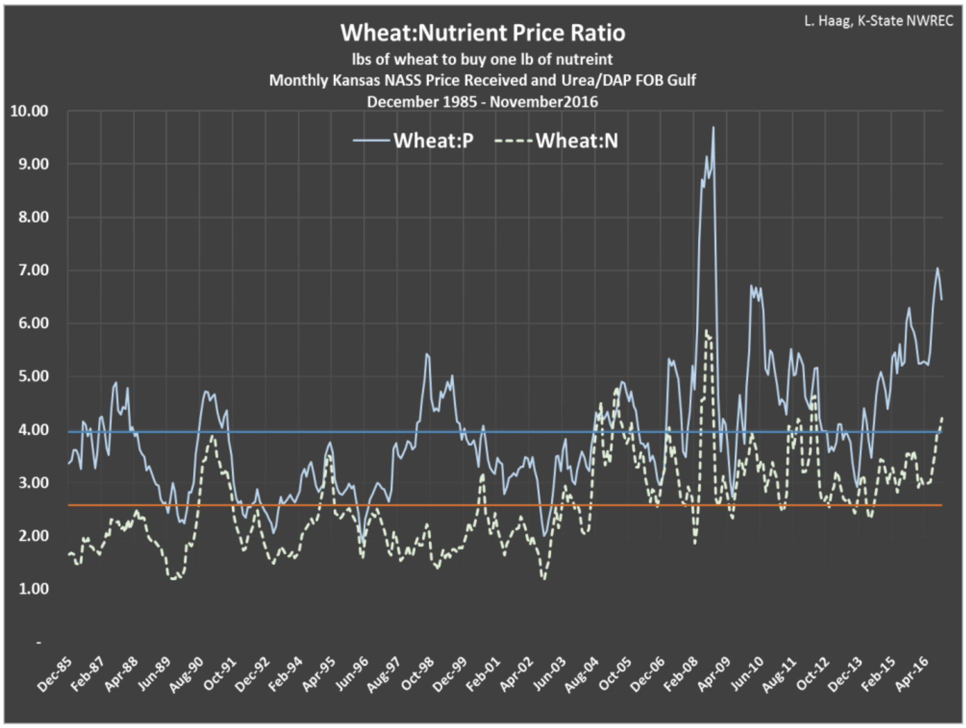
L. Haag, K-State NWREC
Wheat:Nutrient Price Ratio
lbs of wheat to buy one lb of nutreint
Monthly Kansas NASS Price Received and Urea/DAP FOB Gulf
December 1985 - November2016
Wheat:P
Wheat:N
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
-
Dec-85
Feb-87
Apr-88
Jun-89
Aug-90
Oct-91
Dec-92
Feb-94
Apr-95
Jun-96
Aug-97
Oct-98
Dec-99
Feb-01
Apr-02
Jun-03
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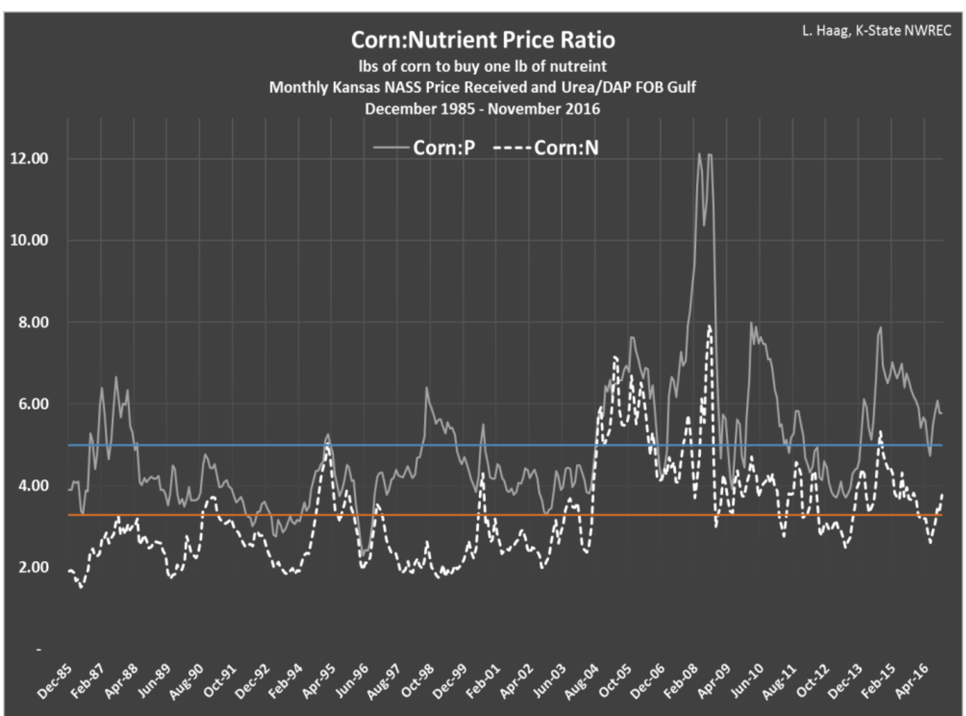
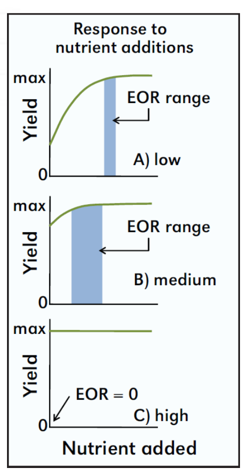
Aug-11
Oct-12
Dec-13
Feb-15
Apr-16


L. Haag, K-State NWREC
Corn:Nutrient Price Ratio
lbs of corn to buy one lb of nutreint
Monthly Kansas NASS Price Received and Urea/DAP FOB Gulf
December 1985 - November 2016
Corn:P
Corn:N
12.00
10.00
8.00
6.00
4.00
2.00
-
Dec-85
Feb-87
Apr-88
Jun-89
Aug-90
Oct-91
Dec-92
Feb-94
Apr-95
Jun-96
Aug-97
Oct-98
Dec-99
Feb-01
Apr-02
Jun-03
Aug-04
Oct-05
Dec-06
Feb-08
Apr-09
Jun-10
Aug-11
Oct-12
Dec-13
Feb-15
Apr-16

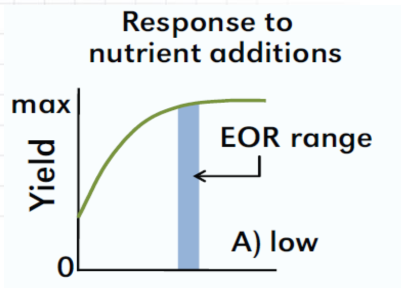
Grain:Nutrient Price Ratios

	Historical	Nov. 2016
Corn:Nitrogen	3.28	3.77
Wheat:Nitrogen	2.58	4.22
Corn:Phosphorus	4.99	5.77
Wheat:Phosphorus	3.96	6.46

Understanding Crop Response to Fertilizer

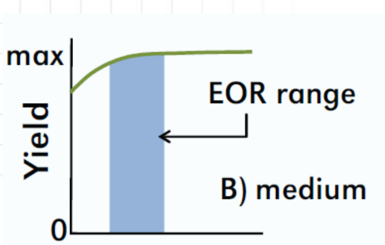


Understanding Crop Response to Fertilizer Low Soil Test Levels



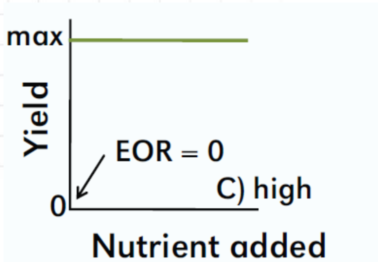
- Low yields without additional fertilizer
- EOR range is narrow
- Optimum rate is minimally affected by grain:nutrient price ratio

Understanding Crop Response to Fertilizer Medium Soil Test Levels



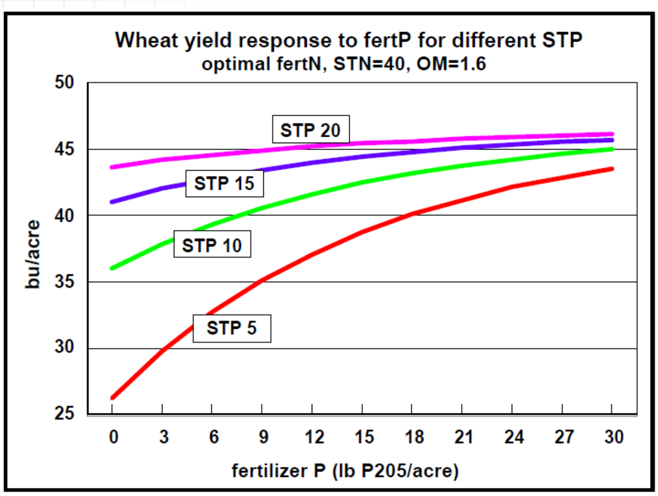
- Expected yield without fertilizer is higher
- Range of potentially optimal rates is wider
- In a single-year decision framework, EOR is very sensitive to grain:nutrient price ratio
- As price ratio↓ EOR ↑

Understanding Crop Response to Fertilizer
High Soil Test Levels

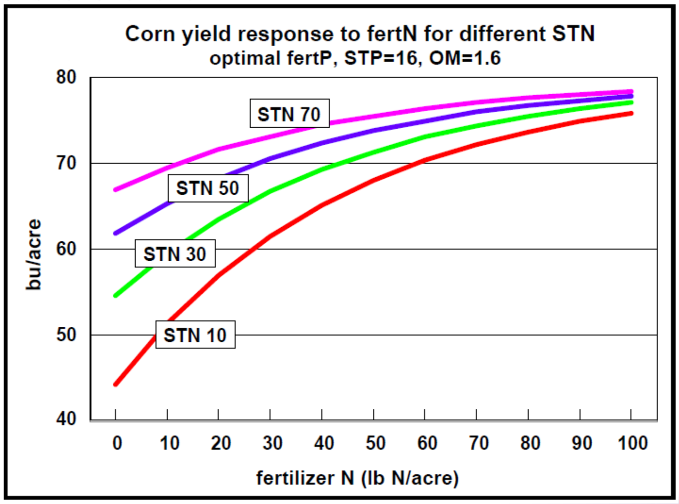


- No or minimal response to added fertilizer

Wheat Response to Soil Test P Level



Corn Response to Soil Test N Level



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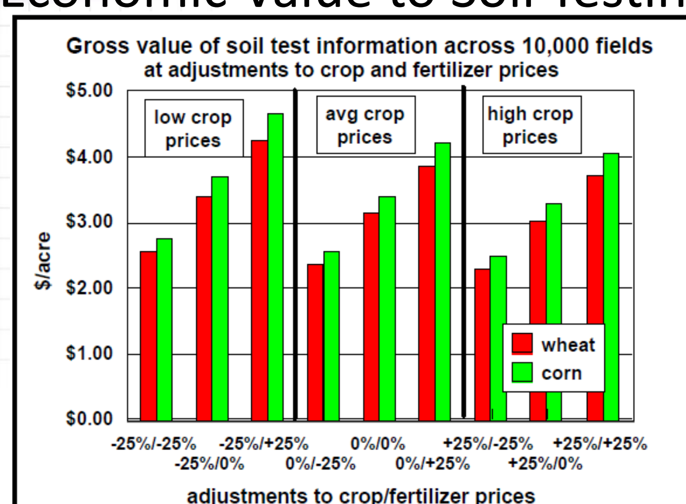
Knowledge for Life

Economic Value to Soil Testing



A 25% increase in fertilizer cost results in a
35% increase in returns to soil sampling

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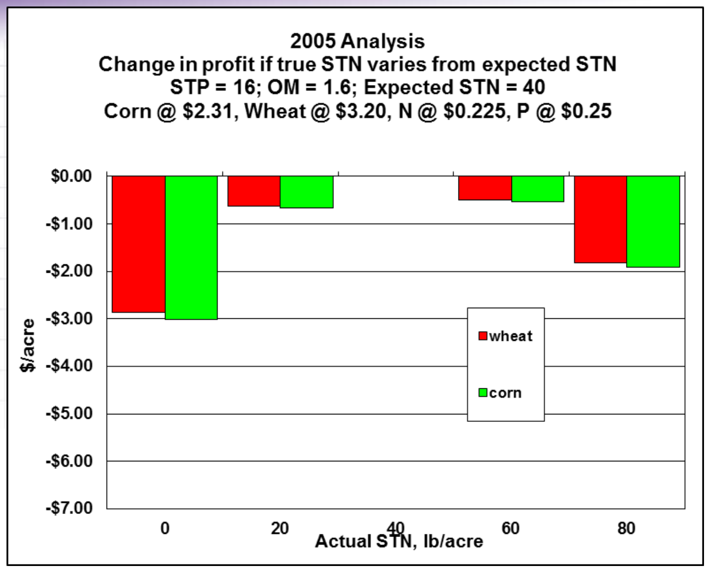

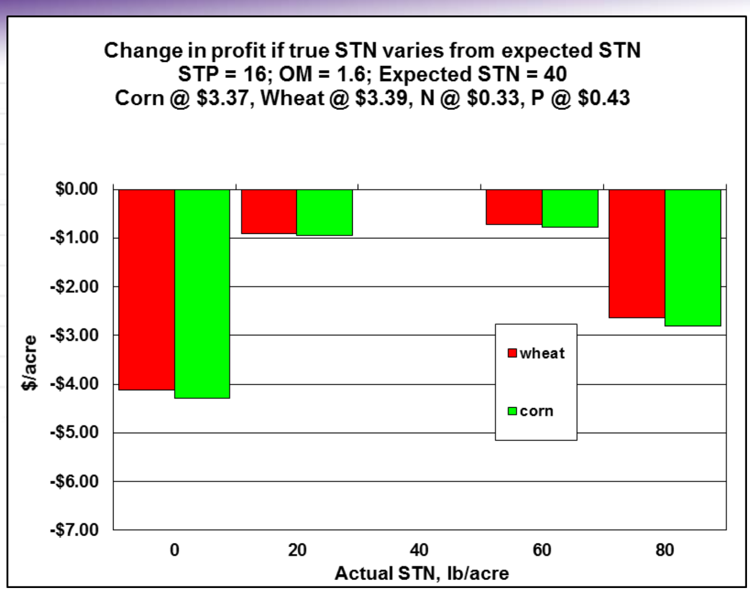

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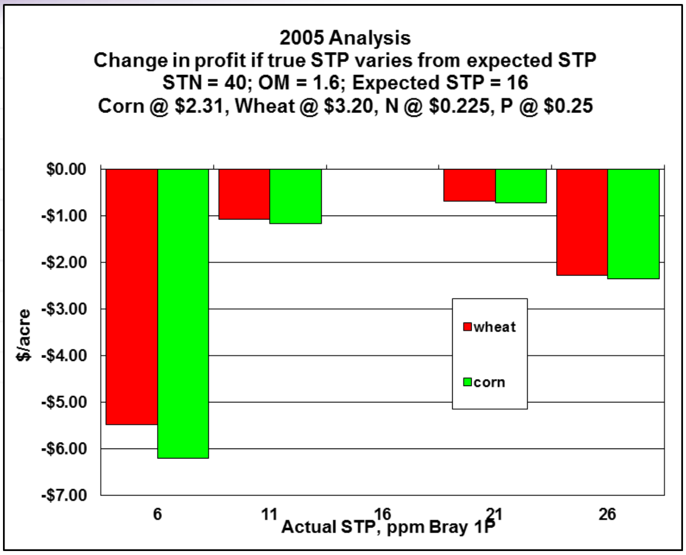

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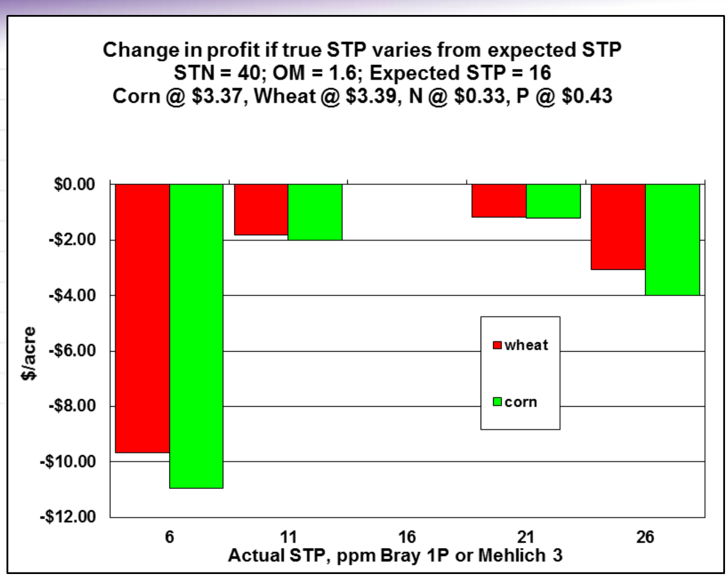

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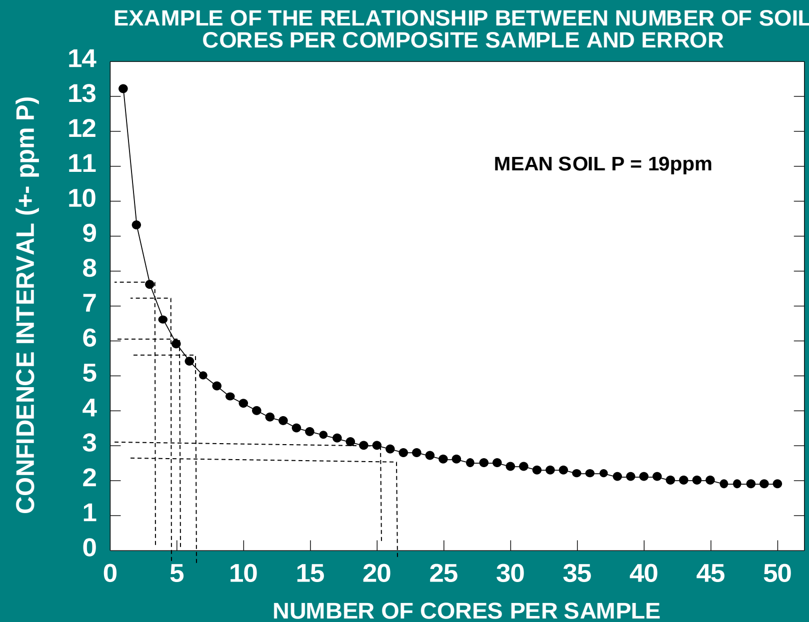
Data Quality

- 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

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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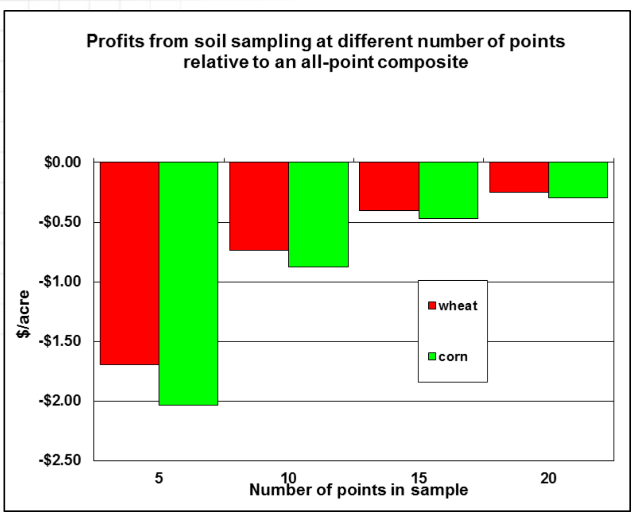
Economics of Accuracy



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The Role of Soil Testing

- Generating profits from soil testing is dependent on the tradeoff between the cost of gathering the information (labor and lab fees), and the benefits from having that information (more appropriate fertilizer rates)

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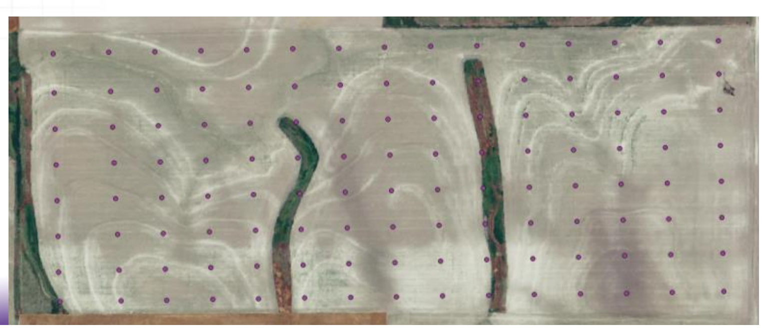
VRT Phosphorus Example

- 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



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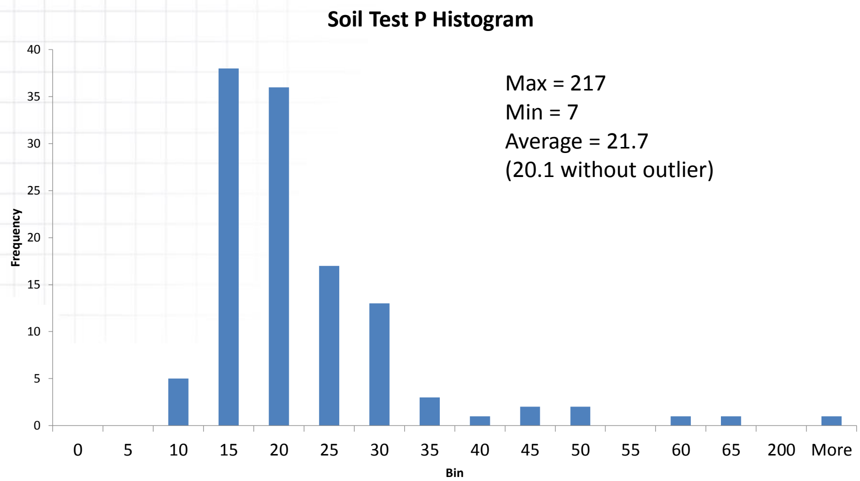
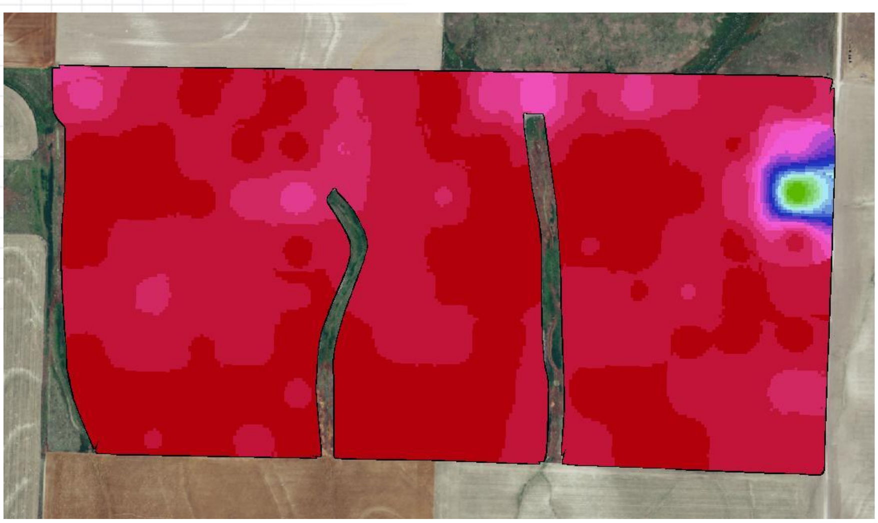
Soil Test Bray P1



Interpolated Soil Test Phosphorus



NOT A GOOD EXAMPLE OF INTERPOLATION!

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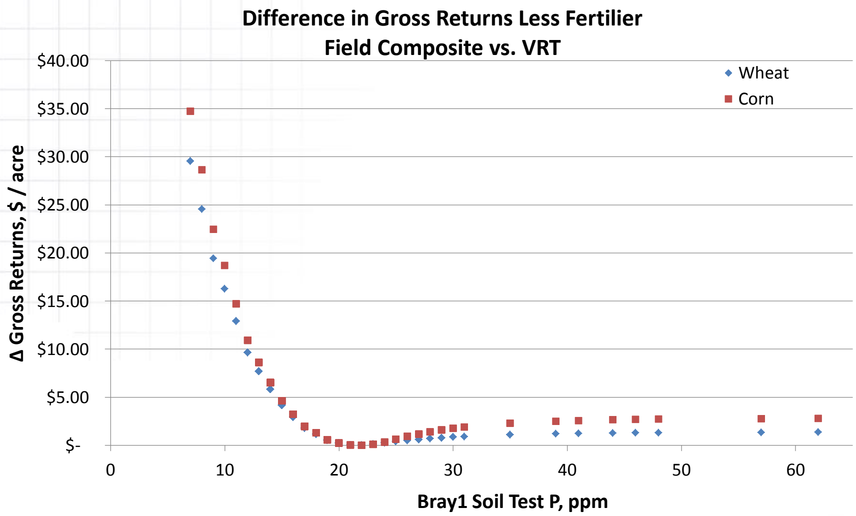
Returns to VRT



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Returns to VRT

- Average gross return on VRT P for wheat = ***$3.81/acre/year***
- Average gross return on VRT P for corn = ***$4.49/acre/year***
- 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

Phosphorus removal values

Crop	Unit	P_2O_5 (lb)
Corn	bushel	0.33
Grain Sorghum	bushel	0.40
Wheat	bushel	0.50
Sunflowers	pound	0.02
Oats	bushel	0.25
Soybeans	bushel	0.80

Crop Removal – the next step

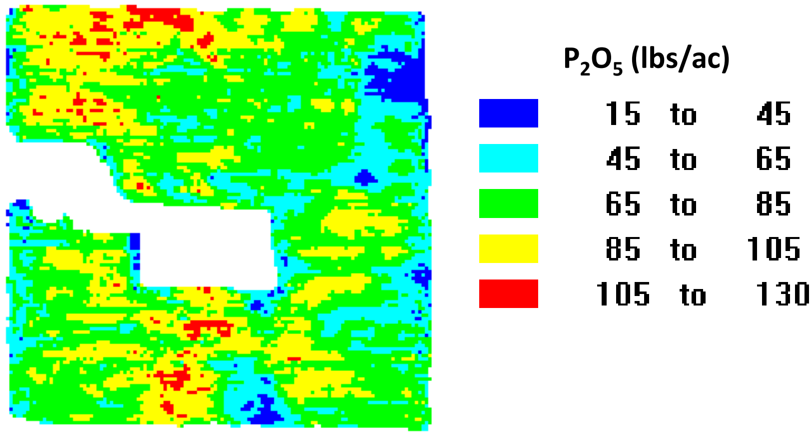
- Calculate crop removal
- Depending on over/under applications after crop removal, soil test levels will change.
- 18 lbs P_2O_5 is required to change STP one ppm.

- One cycle of a W-C-F rotation (using field averages)
  - Wheat yield = 60 bu/a, Corn yield = 110 bu/ac
  - STP = 22 ppm, P_2O_5 applied during seeding = 30 lb/a
  - Wheat Removal = 60 * 0.50 = 30 lbs P_2O_5 removed
  - Corn Removal = 110 * 0.33 = 36 lbs P_2O_5 removed
  - Total Crop Removal = 30+44 = 66 lbs P_2O_5 removed
  - STP change = 66-30=36 lb net removal, 36/18 = 2 ppm estimated drop
  - Final STP = 22 – 2.4 = 19.6 ppm

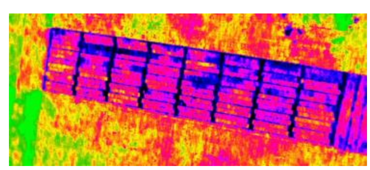
Crop Removal – the next step

- Perform crop removal and STP calculations at a site-specific scale for the field
- Potential Decision Rules
  - Land ownership/tenancy makes a difference
  - Decisions based on STP
    - IF STP > 30 then apply 0 or very minimal amount (intentional mining)
    - IF STP is >20 and <30 then apply removal rates
    - IF STP is <20 then apply removal + build (build rate?)
- VRT apply P to meet management goals

Using yield monitor data to look back…
4 Years of P Removal



In-Furrow Placement of Enhanced Efficiency Urea Fertilizers in Wheat



Lucas Haag, Northwest Area Agronomist
K-State Northwest Research-Extension Center, Colby
Alan Schlegel, Agronomist-in-Charge
Southwest Research-Extension Center, Tribune
Dorivar Ruiz-Diaz, Soil Fertility Specialist
Department of Agronomy, Manhattan

In-Furrow Urea

- Current K-State recommendations state no urea should be placed in-furrow with seed
- In the Northern Plains data would suggest that some low levels of urea in-furrow are safe
- New products on the market: ESN, NBPT, etc. may provide some level of safety

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Materials and Methods

- No-Till into chem-fallow, Certified CSU-Byrd, target 1.05 million seeds/ac
- Treatments (in addition to grower practice):
  - 10, 20, 30, 60 lbs/ac N as ESN, NBPT, or Urea
  - MAP to get 10 lbs/ac N (91 lbs/ac of MAP)
  - Control
- Locations:
  - Tribune, Colby, Herndon, and Hunter (2017) with KSU-Larry
- Measurements

Fall stand count	Spring Vigor
Head Counts	Grain Yield and Protein

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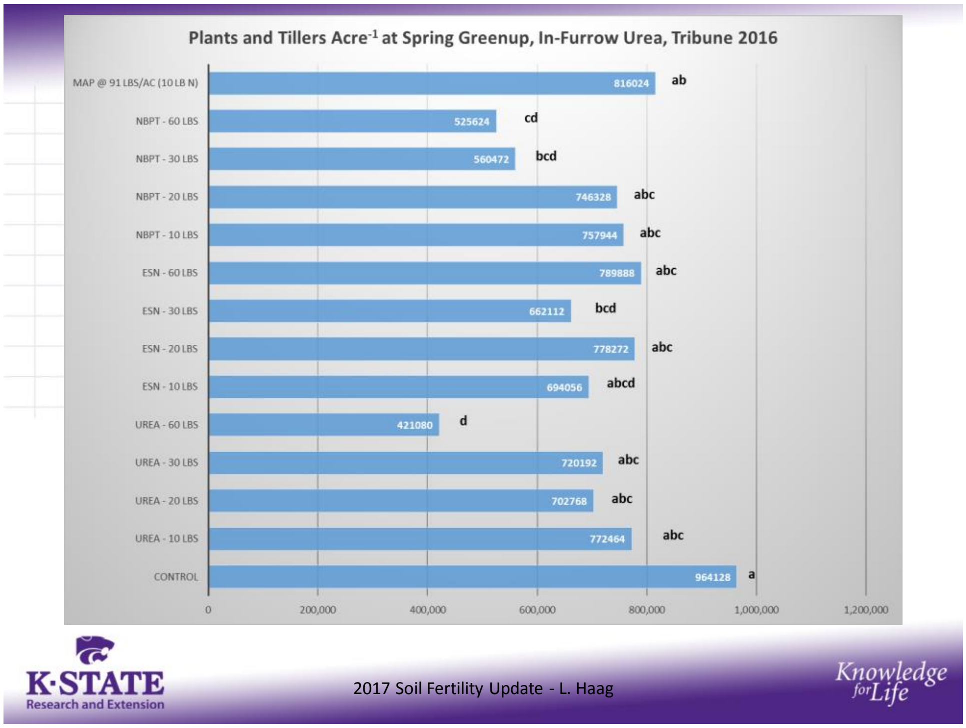
Visual – Mitchell Co. 2/9/17

60 lb/ac Urea   60 lb/ac ESN

Visual – Mitchell Co. 2/9/17

Control

MAP for 10 lbs of N
(91 lb/ac material)


Plants and Tillers Acre-1 at Spring Greenup, In-Furrow Urea, Tribune 2016
MAP @ 91 LBS/AC (10 LB N) 816024 ab
NBPT - 60 LBS 525624 cd
NBPT - 30 LBS 560472 bcd
NBPT - 20 LBS 746328 abc
NBPT - 10 LBS 757944 abc
ESN - 60 LBS 789888 abc
ESN - 30 LBS 662112 bcd
ESN - 20 LBS 778272 abc
ESN - 10 LBS 694056 abcd
UREA - 60 LBS 421080 d
UREA - 30 LBS 720192 abc
UREA - 20 LBS 702768 abc
UREA - 10 LBS 772464 abc
CONTROL 964128 a
0
200,000
400,000
600,000
800,000
1,000,000
1,200,000
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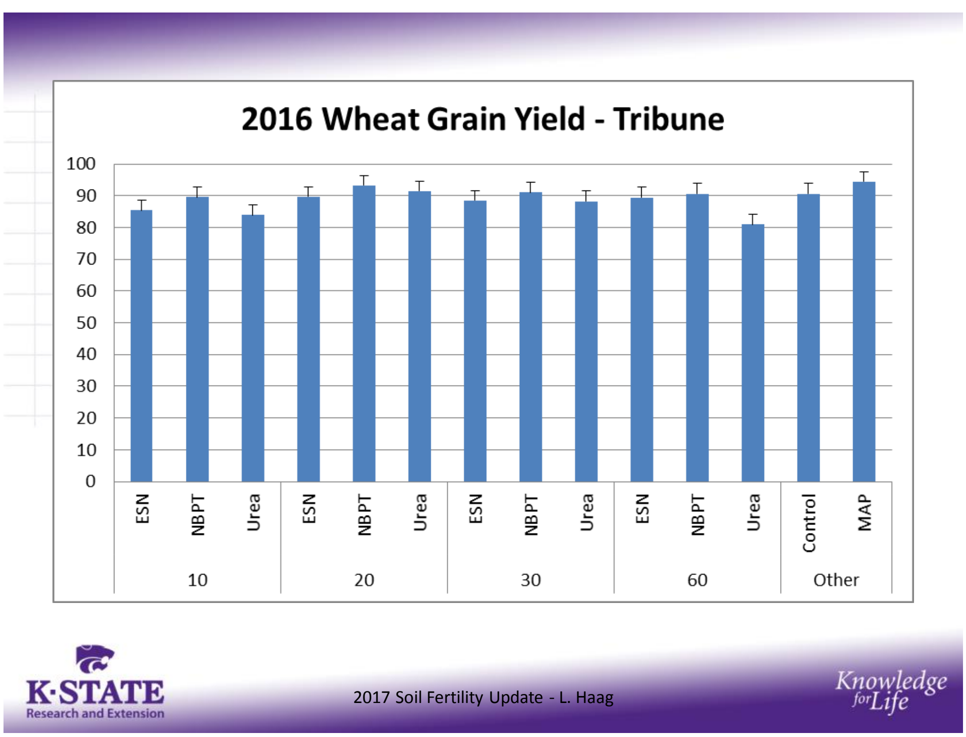
2016 Wheat Grain Yield - Tribune
100
90
80
70
60
50
40
30
20
10
0
ESN
NBPT
Urea
Control
MAP
10
20
30
60
Other
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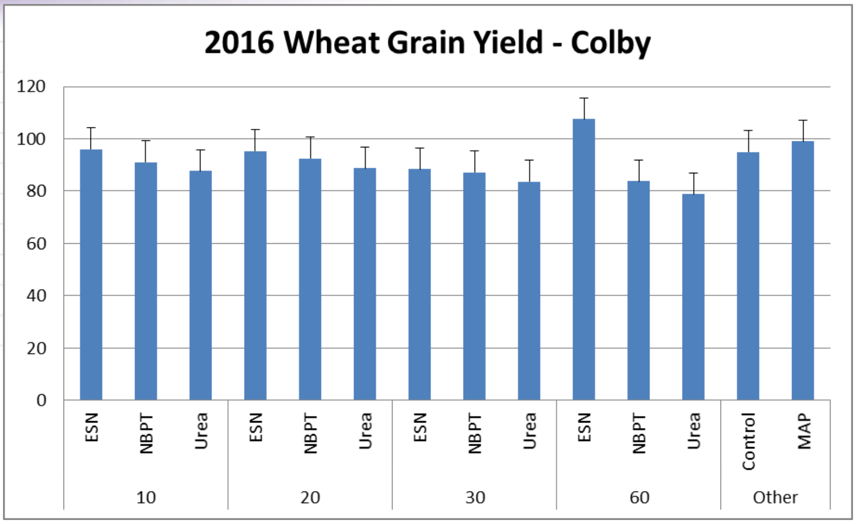
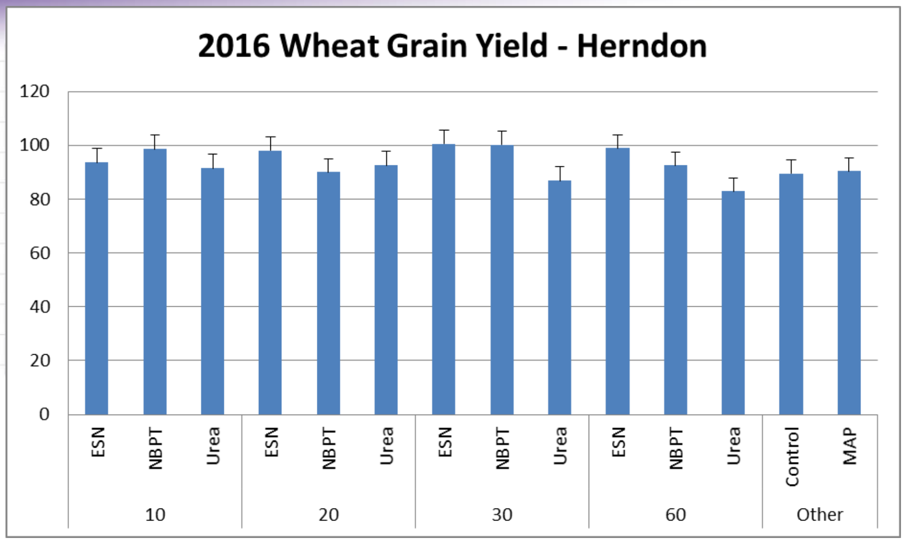


Herndon - 2016



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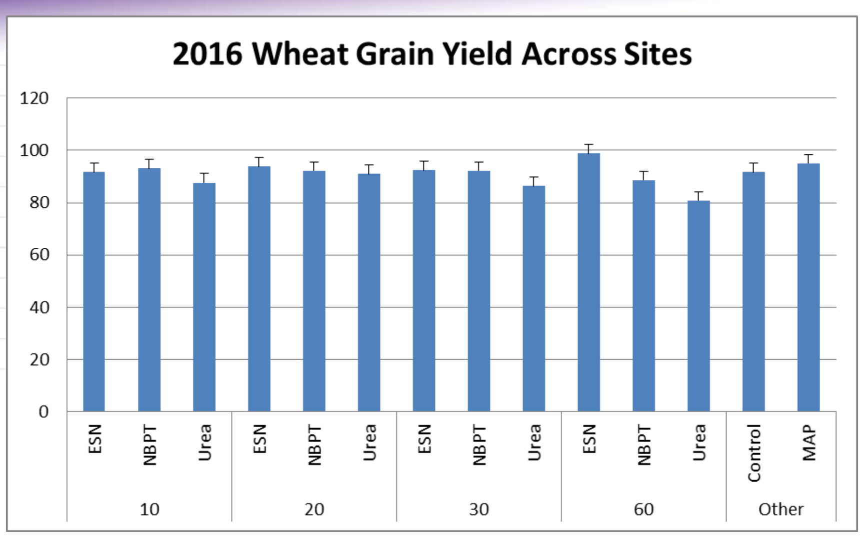

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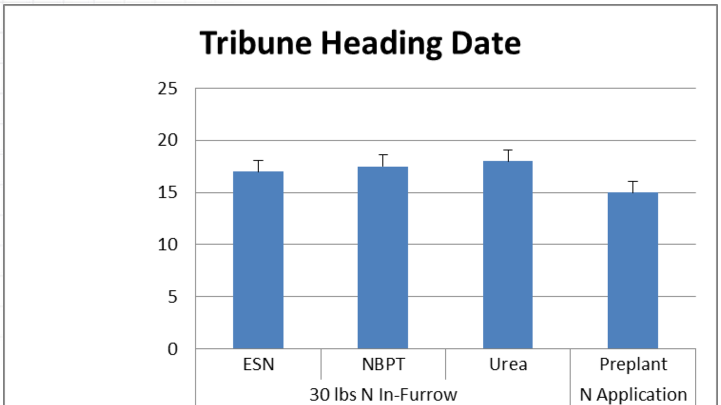
Effect on Heading Date?



	ESN	NBPT	Urea	Preplant N Application
May Heading Date	17	17.5	18	15

Later maturing spring tillers?

Current Thoughts

- Its going to take more site-years to sort this out
- Preliminary data would suggest that ESN offers some improved safety over Urea
  - How much? What's the safe rate through time?

In-Furrow Humic Acid in Grain Sorghum – Year 1



Lucas Haag, Northwest Area Agronomist, NWREC-Colby
Jeanne Falk Jones, Sunflower Dist. Agronomist
Alan Schlegel, Agronomist-in-Charge, SWREC-Tribune

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Rationale

- We had received reports of in-furrow applications of humic acid reducing the occurrence of iron chlorosis

Materials and Methods

- Two Products Used
  - Raw Humic Acid (Soil Boost), 72% humic acid
  - Humic DG (The Andersons), 70% humic acid
- IDC Tolerant Hybrid, P87P06 used
- Planted in 30” rows, 45,000 seed drop
- 4 Replications per location
- 4 Locations
  - Colby, Wallace 1, Wallace2, Wallace 3

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In-Furrow Rates

Product	30" Rate	Equivilent 10" Rate
	lbs/acre	
Raw Chipped Humic Acid	0	0
	10	30
	20	60
	30	90
	40	120
	70	210
Humic DG	7	21
	14	42
	21	63
	28	84
	35	105

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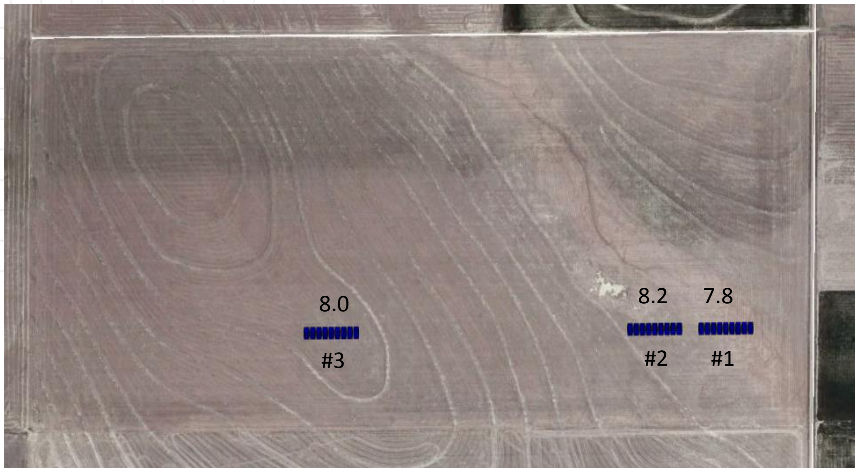
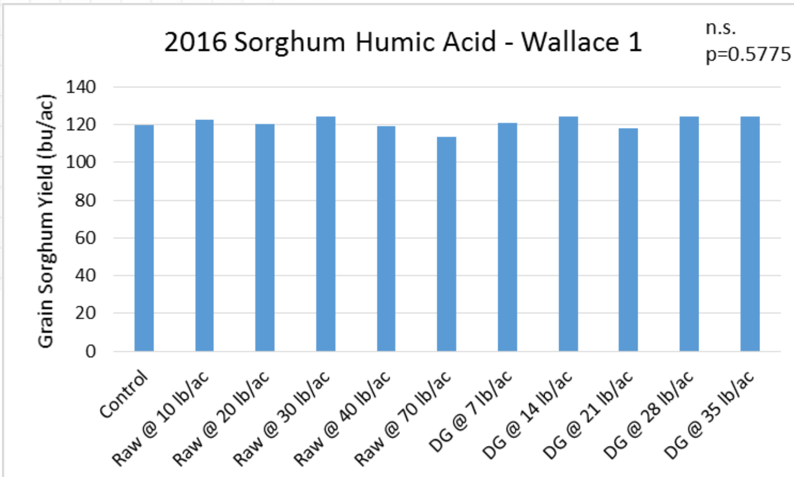
Locations - Wallace



Locations - Colby

Results – Wallace 1



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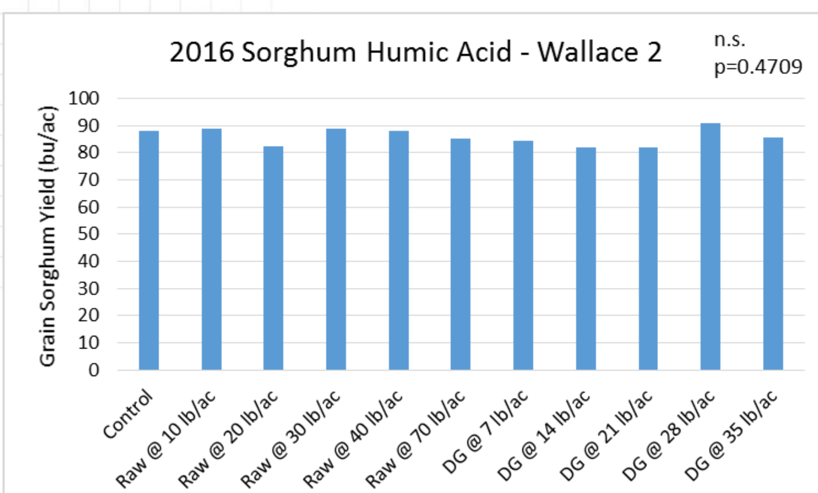
Results – Wallace 2



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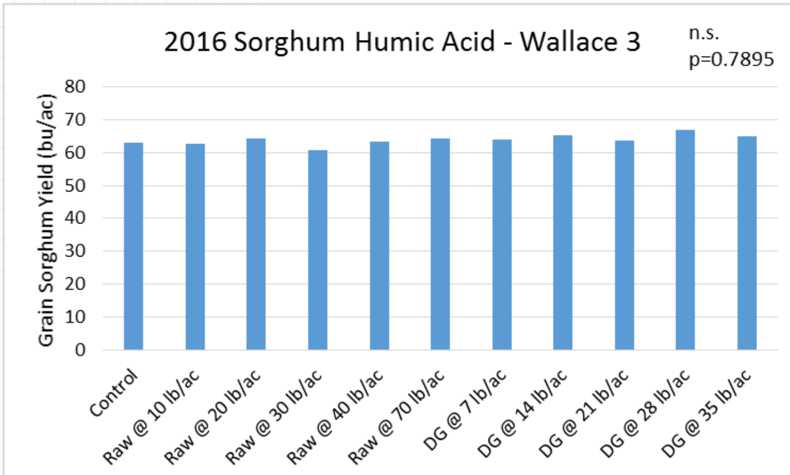
Results – Wallace 3



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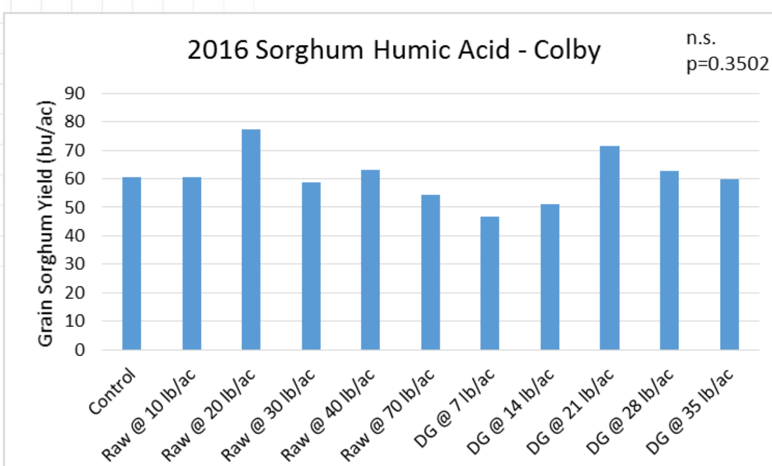
Results - Colby



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Summary

- In year one of the study, across four locations, we did not see a statistical or numerical response to in-furrow applications of humic acid in grain yield or IDC score
- We are considering extending the study another year

Other Thoughts for 2017 Crop Planning

- Record wheat crop, with low protein (<11.5)
- In many areas a record fall crop
- Environmental Effects on Applying N
- Even at current prices, broad sweeping reductions in fertilizer application without any guiding information could cost you money


Questions?
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