Issues with N

When making N recommendations currently, we consider:

- Yield goal/potential (N need)
- Residual N in the soil: ST
- Mineralizable N from OM and Crop residue
- N in the irrigation water
- Manure
- Assume 50% NUE

Issues with the current N recommendations

- The system is designed for preplant N
- For accuracy, it requires a soil test for N
- NUE varies greatly from field to field and year to year, based on soils, management practices and weather
- Recommendations are Yield Goal based: they are bets on future based on passed performance.

Reality

- Optimum N rates vary from year to year.
  - N Need varies due to changes in yield
  - Carryover varies dramatically from field to field
  - In some environments, N loss can be significant at times.
  - People refuse to use the profile N soil test

What about sensors?

- Active sensors can be used to measure plant color and biomass to make N recommendations.
- We use plant N content and growth to estimate N supply rather than ST
- The system is designed to respond to current season issues

What about sensors

- Key issue: How quickly can a sensor differentiate crop N stress?
  - Corn, V-8 to V-10?
  - Sorghum, GS3 (equivalent to V-7?)
  - Wheat, Feeke's 3-4?
- How do you determine if it is stressed, compared to what?
  - Reference strip and possible control strip

The Basic Question

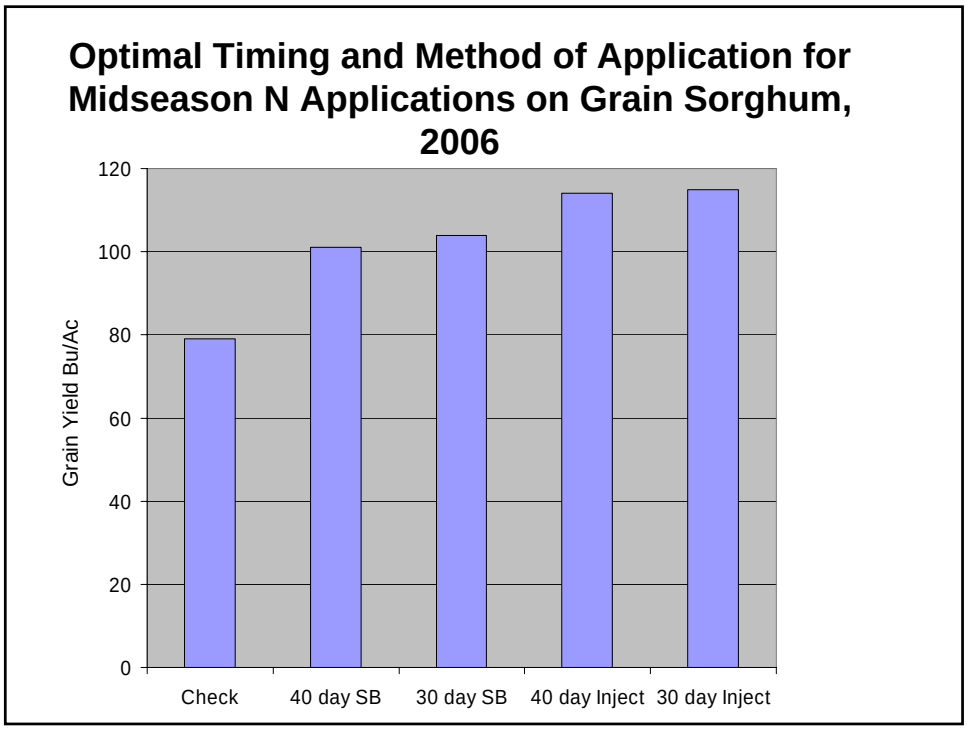
- Can a N management strategy be developed to:
  - reduce economic risk in bad years?
  - take advantage of the potential of good years?
  - enhance profitability in the long run?
  - fine-tune N needs in high yielding irrigated crops?
  - Reduce environmental risk in sensitive environments?

“The plan” we set out to test

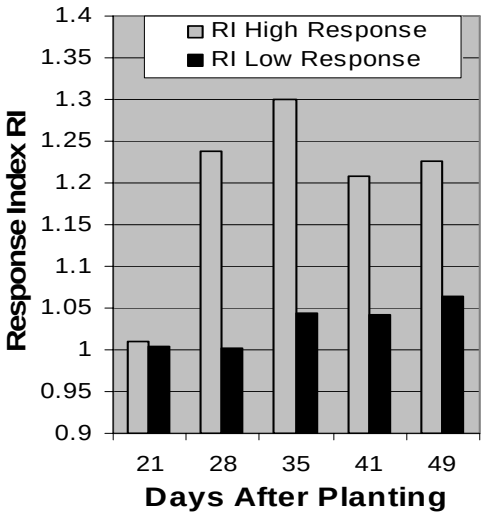
- Apply base/starter levels of N to carry the crop through the first 40-50 days of growth
- evaluate sorghum at 35-45 days after planting
  - If yield potential is low, soil moisture is limited and outlook bleak, add no more N, even if the sensor indicates it is needed.
  - If yield potential is good, but moisture reserves are low and outlook is not good ?????
  - If yield potential, profile moisture and outlook are good, add Sensor indicated N

The Plan Cont:

- Use standard ground equipment to inject N below the soil surface to enhance utilization.
  - Use standard sidedress equipment to minimize cost.
  - Inject N to enhance NUE, and also place it in the root zone to allow the crop to utilize it quickly. (Most Kansas sorghum farmers believe it won’t rain, and experience says they are right)


Optimal Timing and Method of Application for Midseason N Applications on Grain Sorghum, 2006
Grain Yield Bu/Ac
120
100
80
60
40
20
0
Check
40 day SB
30 day SB
40 day Inject
30 day Inject

How quickly can sensors detect N deficiency in sorghum?



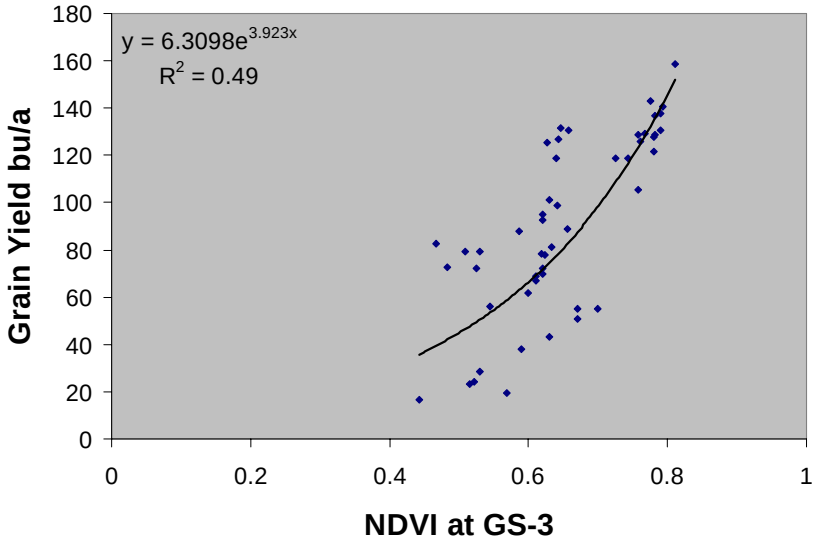
The KState System for sensor based N recommendations

- Use reference strips, areas of slightly above recommended N to ensure a well fertilized area as a base.
- Compare NDVI of reference strip to NDVI of bulk field:
  - NDVI Ref/NDVI Field = Response Index
  - Make measurements at GS-3, 7 leaves, or around 35 days after planting
  - Can normalize by adjusting for days since planting (INSEY) or GDD (86/50)

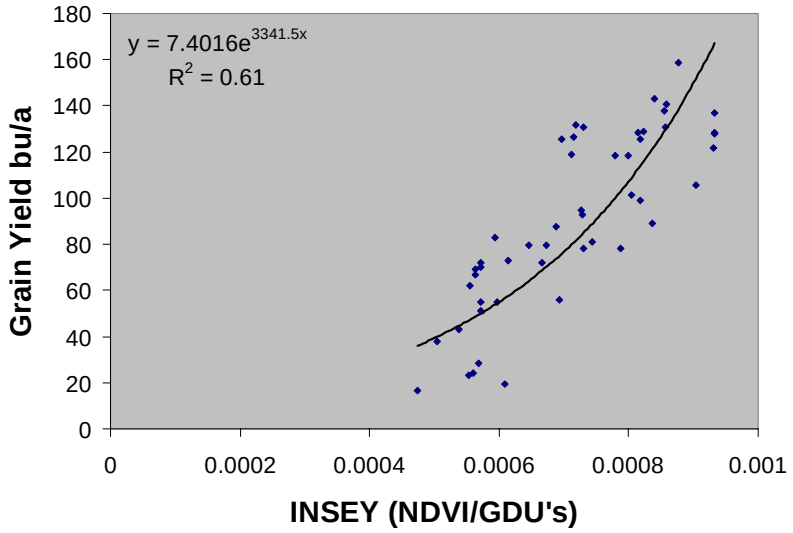
Components of KSU Sensor Based N Recommendations

- Sensor based potential yield at GS3
- RI based on reference and check at GS3
- Expected yield increase/response, or delta yield at that yield level and RI
- Expected Harvest index
- Expected N Uptake
- Expected NUE based on a SD application

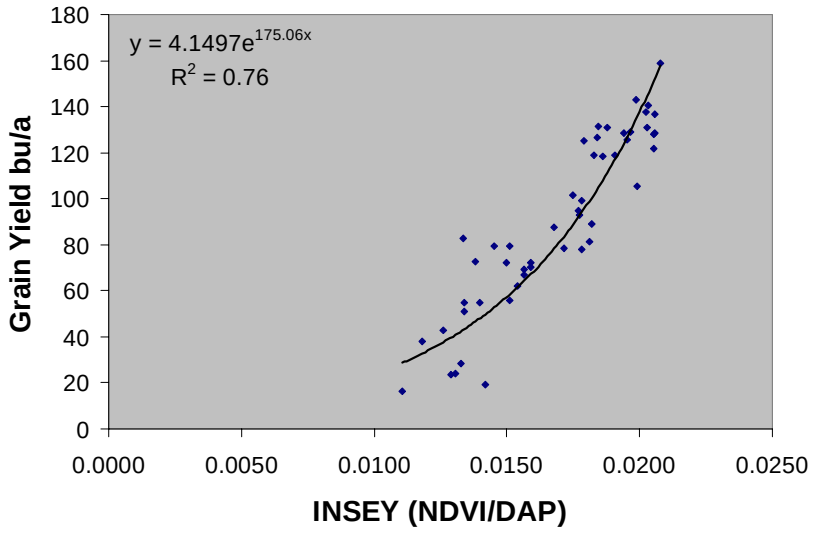
Grain Sorghum Yields vs. NDVI 2006-2008



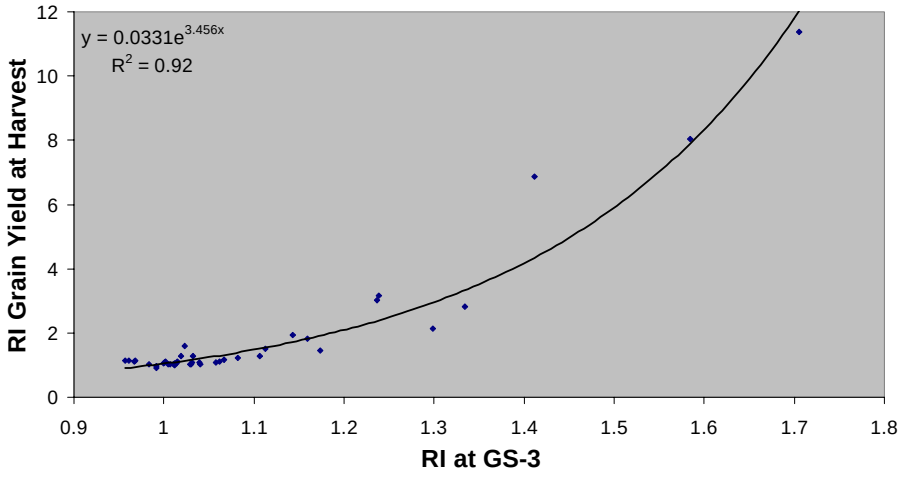
Grain Sorghum Yields vs. NDVI/GDU's 2006-2008



Grain Sorghum Yields vs. INSEY 2006-2008

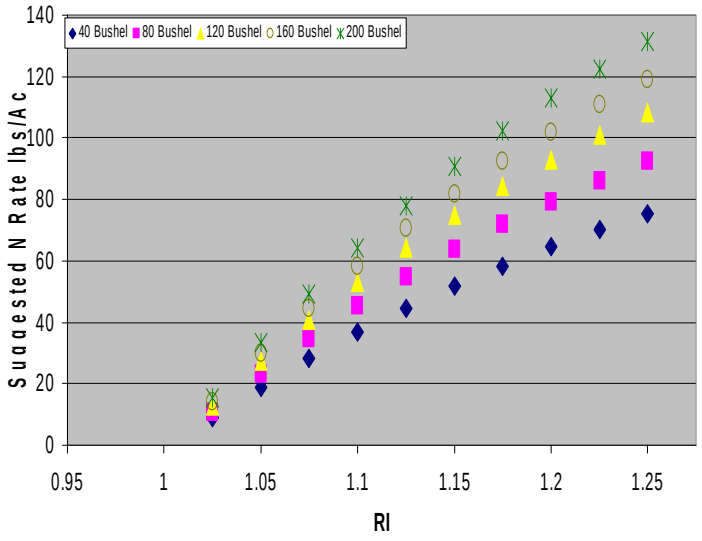


Response Index at GS-3 vs. Response Index Grain Yield at Harvest 2006-2008



Sorghum Nitrogen Sensor Calculator

NDVI Reference Strip	0.7
NDVI Farmer Practice	0.59
Max Yield for Area bu/ ac	120
Days from planting to sensing	50
Grain Price $/ Bu	3
Nitrogen Price $/ lb N	0.7
Application Cost $/ Ac	5
Nitrogen Efficiency % recovered	50
Stop Here, do not add anymore inputs pass this line	
Expected Response Index of Grain Yield	2.00
Yield Potential with N	57.75
Yield Potential without N	28.91
Nitrogen Recommendation lbs N/ Ac	54.81
Gross Return (no Nitrogen) $/ ac	86.72
Gross Return (using N Rec) $/ ac	129.89



Performance of current soil test Based N Fertilizer Recommendations: 2006-2008

Location	Year	Yield Goal	Actual Yield	Soil Test Rec.	Actual N Resp.	Soil Diff.
Belleville	2006	100	96	40	0	40
Manhattan	2006	140	155	60	33	27
Partridge	2006	80	32	42	55	-13
Tribune	2006	80	128	30	15	15
Manhattan	2007	120	109	130	105	25
Partridge	2007	80	70	40	20	20
Tribune	2007	80	79	54	0	54
Manhattan	2008	140	128	77	45	32
Ottawa	2008	80	64	56	60	-4
Partridge	2008	80	123	41	15	26
Mean difference						26

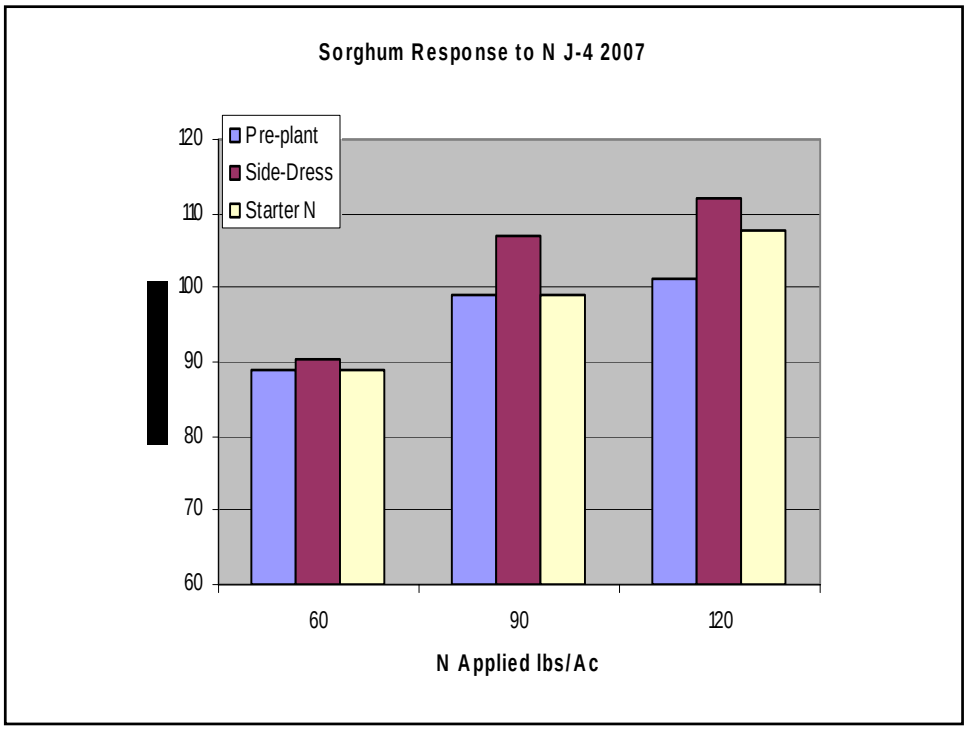
Performance of Sensor Based N Fertilizer Recommendations: 2006-2008

Location	Year	Sensor Yield	Actual Yield	Sensor Rec.	Actual N Resp.	Sensor Dif
Belleville	2006	95	96	0	0	0
Manhattan	2006	160	155	33	33	0
Partridge	2006	48	32	57	55	2
Tribune	2006	130	128	24	15	9
Manhattan	2007	111	109	98	105	-7
Partridge	2007	77	70	15	20	-5
Tribune	2007	71	79	0	0	0
Manhattan	2008	151	128	45	45	0
Ottawa	2008	58	64	55	60	-5
Partridge	2008	140	123	30	15	15
Mean difference						4.3

Sensor Based N Fertilizer Recommendation Summary 2006-2008

Location	Year	Sensor Yield	Actual Yield	Soil Test Rec.	Sensor Rec.	Actual N Resp.	Soil Diff.	Sensor Diff.
Belleville	2006	95	96	40	0	0	40	0
Manhattan	2006	160	155	60	33	33	27	0
Partridge	2006	48	32	42	57	55	-13	2
Tribune	2006	130	128	30	24	15	15	9
Manhattan	2007	111	109	130	98	105	25	-7
Partridge	2007	77	70	40	15	20	20	-5
Tribune	2007	71	79	54	0	0	54	0
Manhattan	2008	151	128	77	45	45	32	0
Ottawa	2008	58	64	56	55	60	-4	-5
Partridge	2008	140	123	41	30	15	26	15

The Issue of Heading Date, Climate and Yield

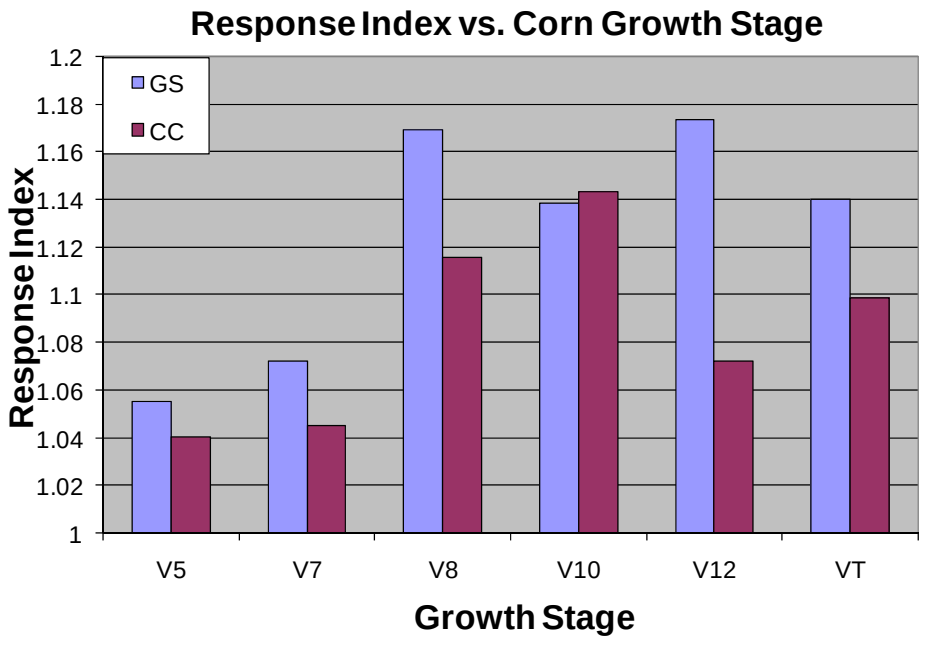


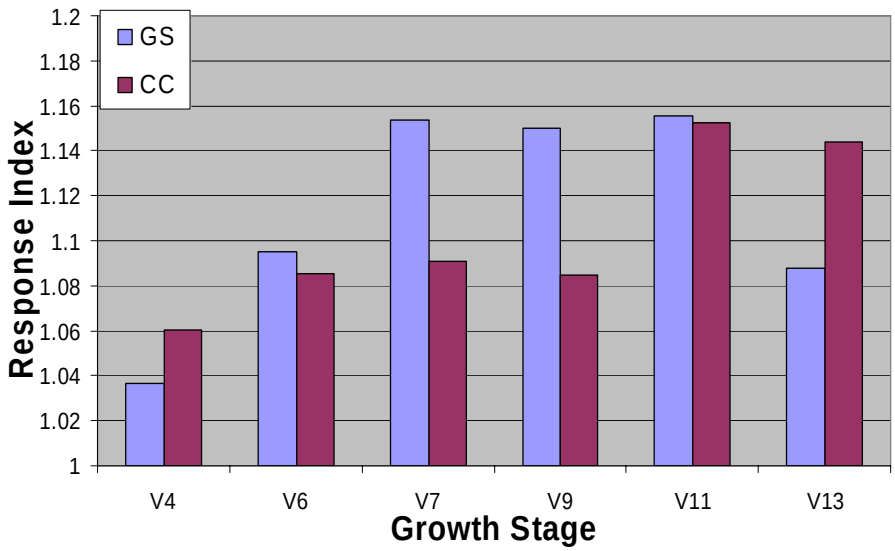
Objective

- Optimize N Use Efficiency in Irrigated Corn Production through the use of Split N Applications Guided by Sensor Based Technology.
  - Ensure adequate N for sustained high yielding production, regardless of environmental conditions.
  - Reduce current N use on many pivots, saving money in fertilizer cost.
    - Long-term goal of 0.9 pounds N fertilizer applications or less, per bushel of corn grain.
  - Leave little N in the soil profile for loss to surface or groundwater at seasons end.

Procedures

- Primary Locations, sprinkler irrigated, established 2007
  - Kansas River Valley, Rossville
  - SWREC, Tribune
- Secondary Locations, established 2008
  - WKREC, Colby: furrow irrigated
  - Agronomy Farm, Manhattan: dryland
- Additional dryland locations planned in 2009





2007&8 Results: Rossville

Treatment	Total N applied		Yield	
	2007	2008	2007	2008
Starter only	20	20	135	82
120 S+ pre	120	120	219	213
160	160	160	218	228
200	200	200	227	234
120 split	120	120	223	201
160 split	160	160	224	222
200 split	200	200	219	226
120 + GS	125	163	224	224
120 + CC	125	178	224	222
120 + Spad	130	143	215	210
GS + Spad	120	130	214	227
CC + Spad	120	175	212	230

Plans: Where are we going in 2009?

- "fine tuning" the draft sorghum rate calculator used in 2008. Our current version is on the ST Lab website and GreenSeeker control system.
- Continue fine tuning the sorghum system
- Focus more attention on corn and wheat
  - Draft wheat N rate calculator is running
  - Corn calculator will likely be available in 2010