

Dealing with High Input Prices, What are Producers' Options?

Kevin C. Dhuyvetter -- kcd@ksu.edu -- 785-532-3527
Terry L. Kastens -- tkastens@ksu.edu -- 785-532-5866



Department Agricultural Economics
Kansas State University
Fall 2005 Agricultural Economics Agent Updates

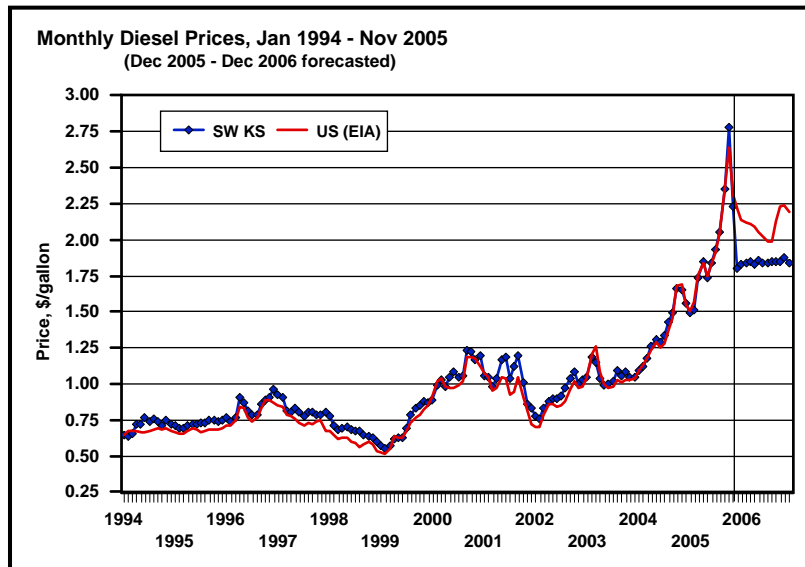


Background thoughts . . .

- Prices for energy-related inputs are at extremely high levels (all-time highs in many cases)
- Producers likely cannot do much about the prices they face, but they need to “understand the numbers” to make good decisions
- Major crop decisions producers have pertain to input levels, crop selection, and possibly negotiating leases on rented land

**Historical and forecasted
energy-related input prices
(diesel fuel, fertilizer, natural gas)**

**Diesel prices are at historically high levels, but appear to
be heading in the right direction...**



Historical and forecasted diesel prices during principal farming months...

Diesel Fuel Prices

Year	Mar-Oct Diesel Price			Year-to-year percent change		
	SW KS	US (EIA)	Average	SW KS	US (EIA)	Average
2000	\$1.09	\$1.04	\$1.07	-----	-----	-----
2001	\$1.09	\$0.98	\$1.04	0.6%	-6.1%	-2.7%
2002	\$0.94	\$0.88	\$0.91	-14.1%	-10.0%	-12.1%
2003	\$1.05	\$1.05	\$1.05	12.1%	18.6%	15.3%
2004	\$1.37	\$1.34	\$1.36	30.0%	28.4%	29.2%
2005	\$2.04	\$2.02	\$2.03	48.5%	49.9%	49.2%
2006 (F)	\$1.85	\$2.08	\$1.96	-9.3%	3.1%	-3.1%
05 - Avg(00-04)	\$0.93	\$0.96	\$0.94	83.5%	90.2%	86.8%
06 - Avg(00-04)	\$0.74	\$1.02	\$0.88	66.4%	96.0%	80.9%

F = forecast

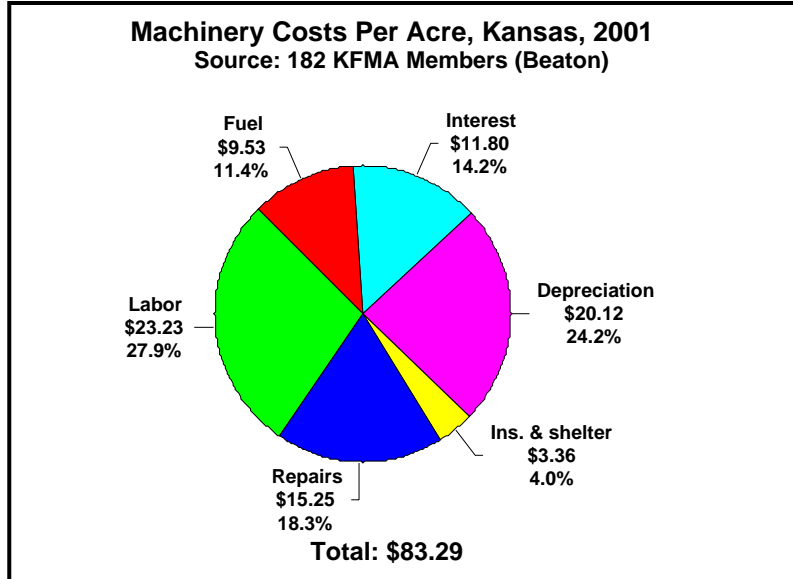
Effect diesel price has on machinery costs per acre based on fuel consumption...

Fuel Consumption and Diesel Price Impact for Various Field Operations

Operation	Fuel use gallons/acre	Fuel price increase, \$/gallon				
		\$0.25	\$0.50	\$0.75	\$1.00	\$1.25
Increase in operation cost, \$/acre						
Chisel plow	0.64	\$0.16	\$0.32	\$0.48	\$0.64	\$0.80
Field cultivator	0.34	\$0.09	\$0.17	\$0.26	\$0.34	\$0.43
Tandem disk	0.49	\$0.12	\$0.25	\$0.37	\$0.49	\$0.61
Min-till planter	0.53	\$0.13	\$0.27	\$0.40	\$0.53	\$0.66
No-till drill	0.81	\$0.20	\$0.41	\$0.61	\$0.81	\$1.01
Sprayer	0.11	\$0.03	\$0.06	\$0.08	\$0.11	\$0.14
Swather-conditioner	0.42	\$0.11	\$0.21	\$0.32	\$0.42	\$0.53
Round baler	0.77	\$0.19	\$0.39	\$0.58	\$0.77	\$0.96
Combine--wheat	1.31	\$0.33	\$0.66	\$0.98	\$1.31	\$1.64
Combine--soybeans	2.02	\$0.51	\$1.01	\$1.52	\$2.02	\$2.53
Combine--corn	1.93	\$0.48	\$0.97	\$1.45	\$1.93	\$2.41

Source: Lazarus and Selley (abbreviated version)

Fuel prices are extremely high, but fuel costs represent one of the smaller cost categories...



Estimated effect diesel price has on machinery costs per acre based on custom rates...

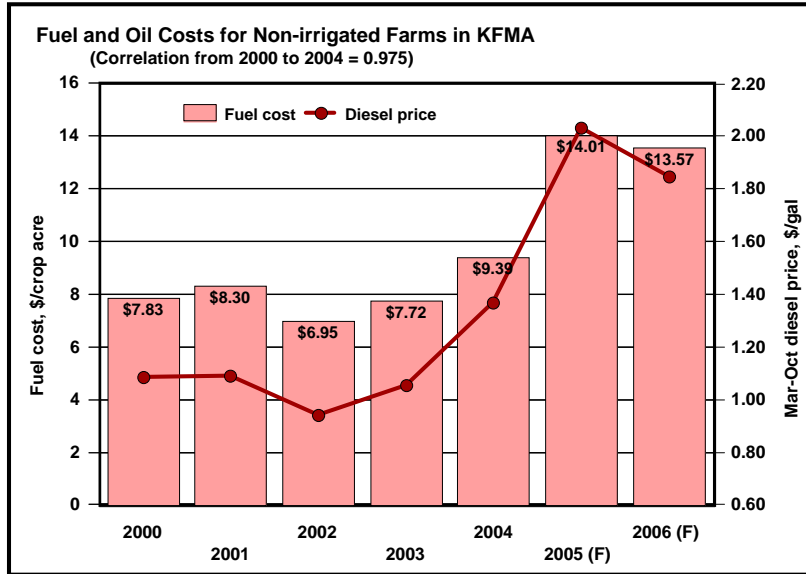
Fuel Consumption and Diesel Price Impact for Various Field Operations

Operation	Custom rate*	Fuel price increase, \$/gallon				
		\$0.25	\$0.50	\$0.75	\$1.00	\$1.25
Increase in custom rate, \$/acre						
Chiseling	\$7.96	\$0.21	\$0.42	\$0.63	\$0.85	\$1.06
Field cultivation	\$6.27	\$0.17	\$0.33	\$0.50	\$0.67	\$0.83
Disking	\$6.84	\$0.18	\$0.36	\$0.54	\$0.73	\$0.91
Min-till planter	\$10.29	\$0.27	\$0.55	\$0.82	\$1.09	\$1.37
No-till drill	\$10.72	\$0.28	\$0.57	\$0.85	\$1.14	\$1.42
Sprayer	\$4.03	\$0.11	\$0.21	\$0.32	\$0.43	\$0.53
Swather-conditioner	\$8.90	\$0.24	\$0.47	\$0.71	\$0.94	\$1.18
Round baler	\$8.03	\$0.21	\$0.43	\$0.64	\$0.85	\$1.07
Combine--wheat	\$14.48	\$0.38	\$0.77	\$1.15	\$1.54	\$1.92
Combine--soybeans	\$20.06	\$0.53	\$1.06	\$1.60	\$2.13	\$2.66
Combine--corn	\$20.09	\$0.53	\$1.07	\$1.60	\$2.13	\$2.67

* 2004 state average from Kansas Agricultural Statistics (assumes 14.4% of custom rate is fuel costs)
2004 Mar-Oct average price of diesel = \$1.36/gallon

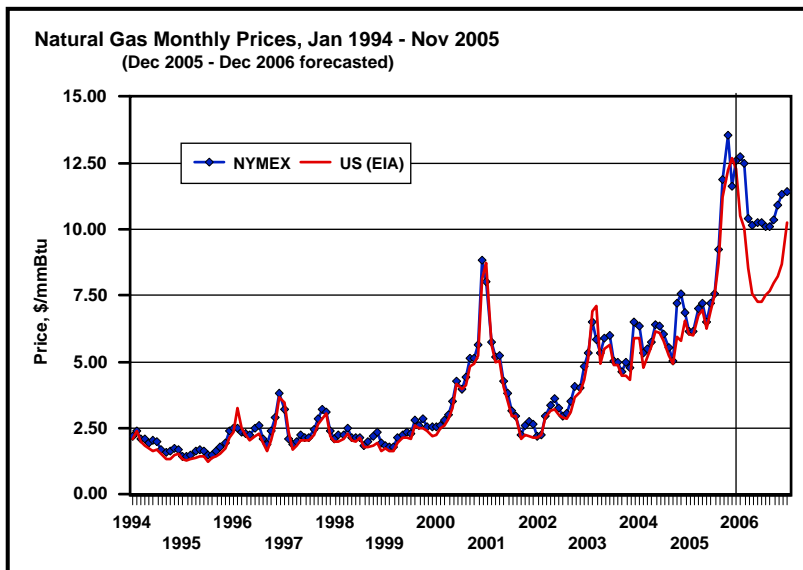
Increase in custom rate 2.7% 5.3% 8.0% 10.6% 13.3%

Fuel costs per acre versus diesel prices...



High correlation implies inelastic demand...

Natural gas prices are at historically high levels...



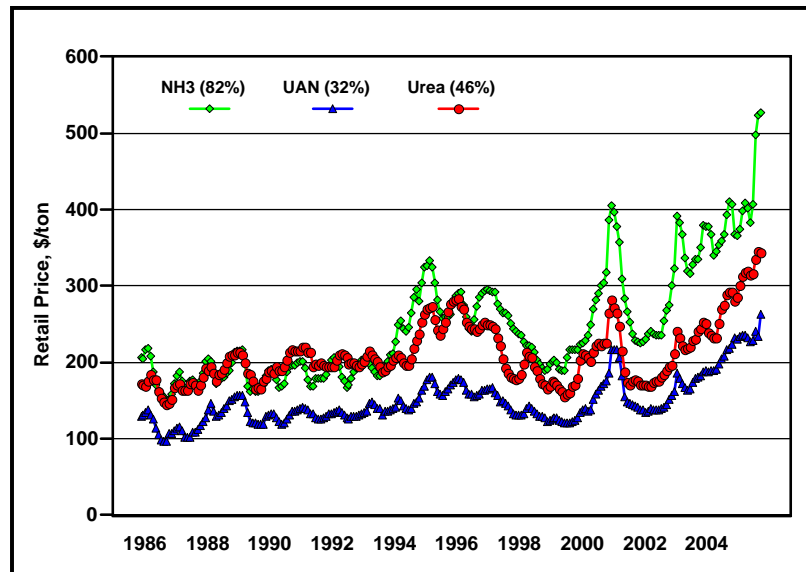
Historical and forecasted natural gas prices during principal farming months...

Natural Gas Prices

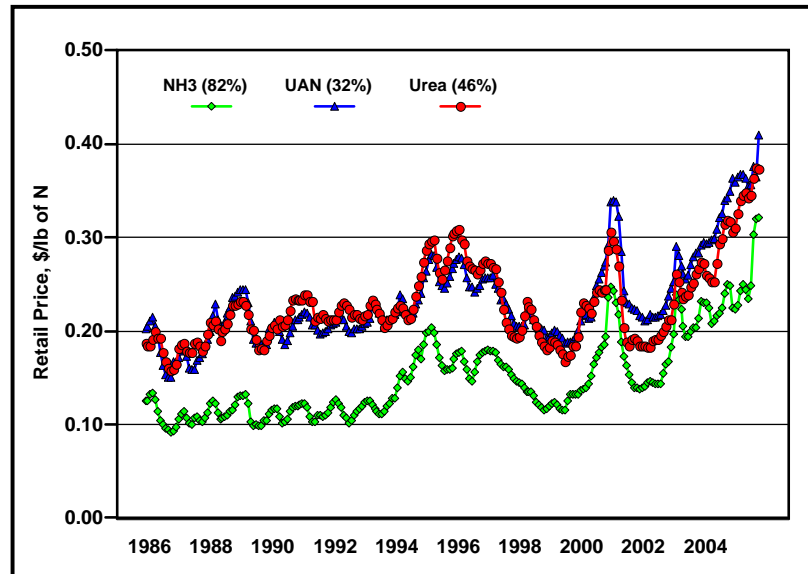
Year	Mar-Oct Natural Gas Price			Year-to-year percent change		
	NYMEX	US (EIA)	Average	NYMEX	US (EIA)	Average
2000	\$4.04	\$3.85	\$3.95	-----	-----	-----
2001	\$3.69	\$3.49	\$3.59	-8.6%	-9.3%	-9.0%
2002	\$3.35	\$3.12	\$3.23	-9.2%	-10.7%	-10.0%
2003	\$5.35	\$5.24	\$5.30	59.5%	68.2%	63.7%
2004	\$5.99	\$5.63	\$5.81	11.9%	7.5%	9.7%
2005	\$8.77	\$8.33	\$8.55	46.5%	47.8%	47.2%
2006 (F)	\$10.32	\$7.76	\$9.04	17.7%	-6.8%	5.8%
05 - Avg(00-04)	\$4.28	\$4.06	\$4.17	95.5%	95.3%	95.4%
06 - Avg(00-04)	\$5.84	\$3.50	\$4.67	130.2%	82.0%	106.7%

F = forecast

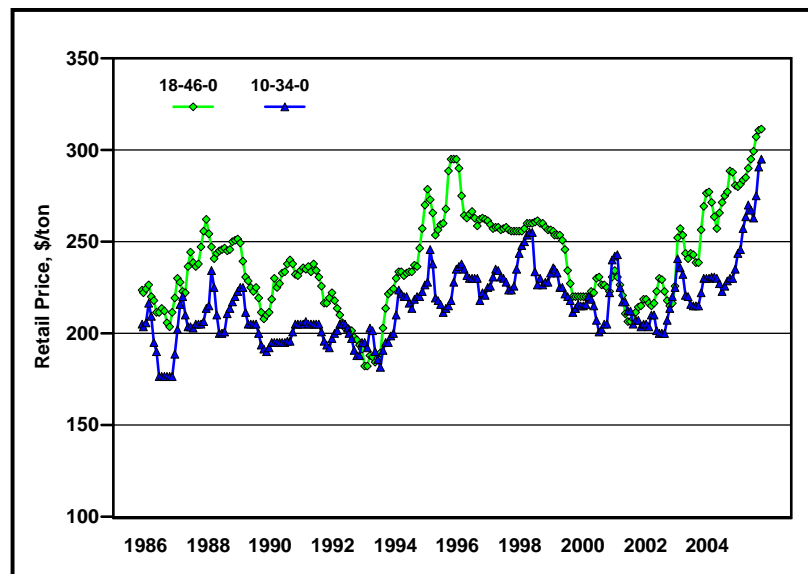
Historical monthly nitrogen fertilizer prices, Corn Belt



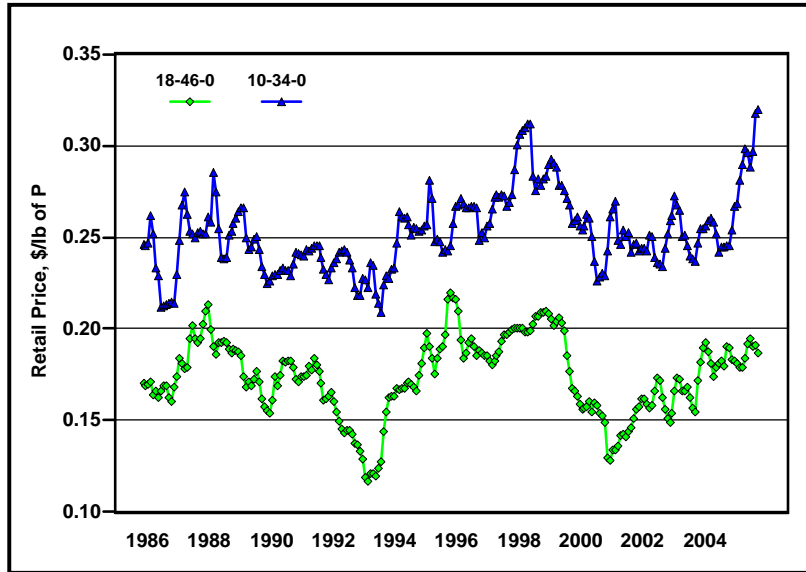
Historical monthly nitrogen fertilizer prices, Corn Belt



Historical monthly phosphorus fertilizer prices...

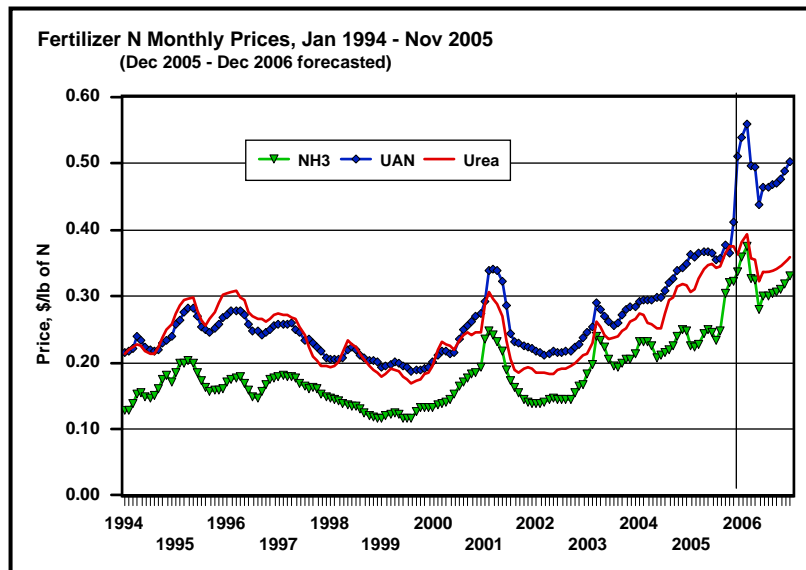


Historical monthly phosphorus fertilizer prices...



N is valued at simple average of NH₃, urea, and UAN prices

Nitrogen fertilizer prices are at historically high levels...



Historical and forecasted fertilizer prices during principal fertilizing months...

Fertilizer Prices (Corn Belt)

Percent of total	40.0%	17.5%	17.5%	20.0%	5.0%	100.0%	
	Oct-May Fertilizer Price/lb*						Year-to-year
Year	NH3 (82%)	UAN (32%)	Urea (46%)	- P -	- K -	Wtd Avg	% change
2000	\$0.136	\$0.204	\$0.205	\$0.211	\$0.148	\$0.175	-----
2001	\$0.217	\$0.305	\$0.272	\$0.193	\$0.148	\$0.234	33.2%
2002	\$0.141	\$0.218	\$0.187	\$0.201	\$0.144	\$0.175	-25.3%
2003	\$0.195	\$0.253	\$0.227	\$0.209	\$0.141	\$0.211	20.7%
2004	\$0.218	\$0.290	\$0.262	\$0.214	\$0.141	\$0.234	10.8%
2005	\$0.238	\$0.356	\$0.322	\$0.223	\$0.174	\$0.267	14.4%
2006 (F)	\$0.330	\$0.476	\$0.365	\$0.224	\$0.190	\$0.333	24.8%
05 - Avg(00-04)	\$0.057	\$0.103	\$0.092	\$0.017	\$0.029	\$0.061	29.9%
06 - Avg(00-04)	\$0.148	\$0.222	\$0.134	\$0.019	\$0.045	\$0.128	62.1%
05 / Avg(00-04)	31.2%	40.4%	39.7%	8.3%	20.4%	29.9%	
06 / Avg(00-04)	81.7%	87.6%	58.2%	9.0%	31.4%	62.1%	

* Oct-Dec of previous year (P = average of 10-34-0 and 18-46-0, K = muriate of potash)

F = forecast



Soil Test Interpretations and Fertilizer Recommendations

Department of Agronomy

MF-2586

Nutrient Management

KSU nitrogen recommendations...

Corn and grain sorghum

**N rec = (Yield Goal x 1.6) – (%SOM x 20) – Profile N – Manure N – Other N Adjustments
+ Previous Crop Adjustments**

Wheat

**N rec = (Yield Goal x 2.4) – (%SOM x 10) – Profile N – Manure N – Other N Adjustments
+ Previous Crop Adjustments + Tillage Adjustments + Grazing Adjustments**

Sunflowers

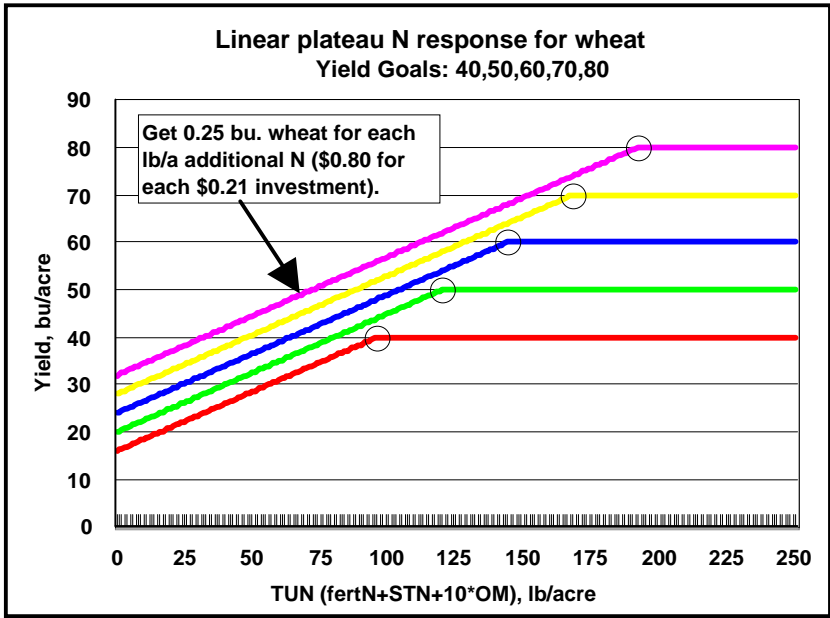
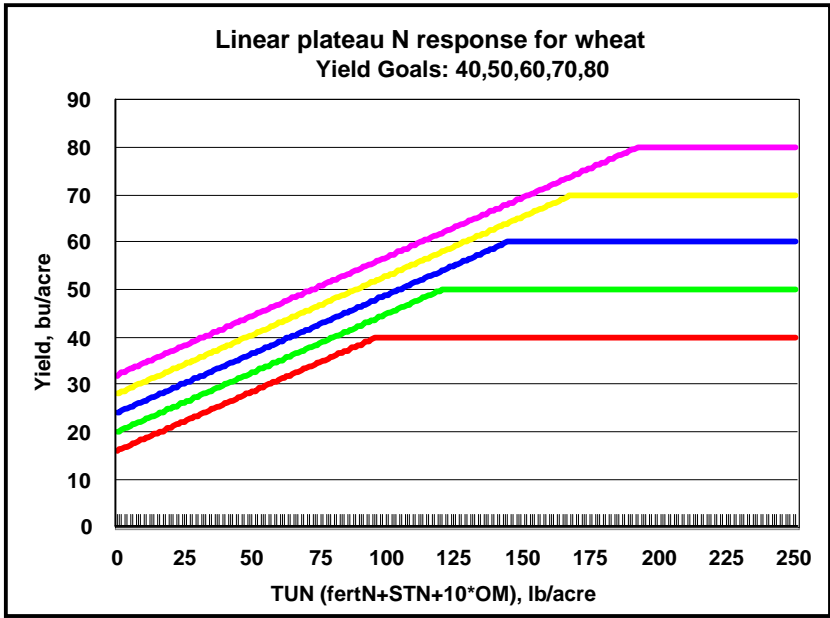
**N rec = (Yield Goal x 0.075) – (%SOM x 20) – Profile N – Manure N – Other N Adjustments
+ Previous Crop Adjustments**

KSU nitrogen recommendations vs. N price

- Recommendations do not explicitly include prices
- Mathematical relationship between expected yield and nitrogen (i.e., production function) is needed in order to adjust recommendations for prices
- Similar issues pertain to P & K recommendations (i.e., no way to adjust them for prices)
- We assume KSU had in mind these prices:
 - Wheat \$3.20/bu
 - Corn \$2.35/bu
 - fertN \$0.21/lb N

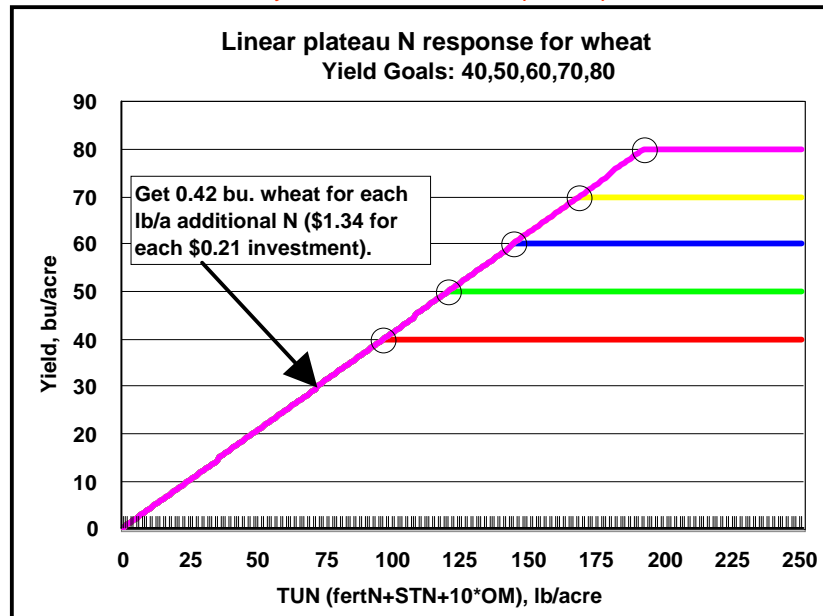
Nitrogen production function...

- In a limiting factor framework, it is generally believed that relationship between N and yield is linear for any given year and location (implies linear plateau production function)
- Linear plateau production function implies that optimal N will either be 0 or level where yield plateaus
- Average of multiple linear plateau production functions can be non-linear and this represents expectations of future N:yield relationship

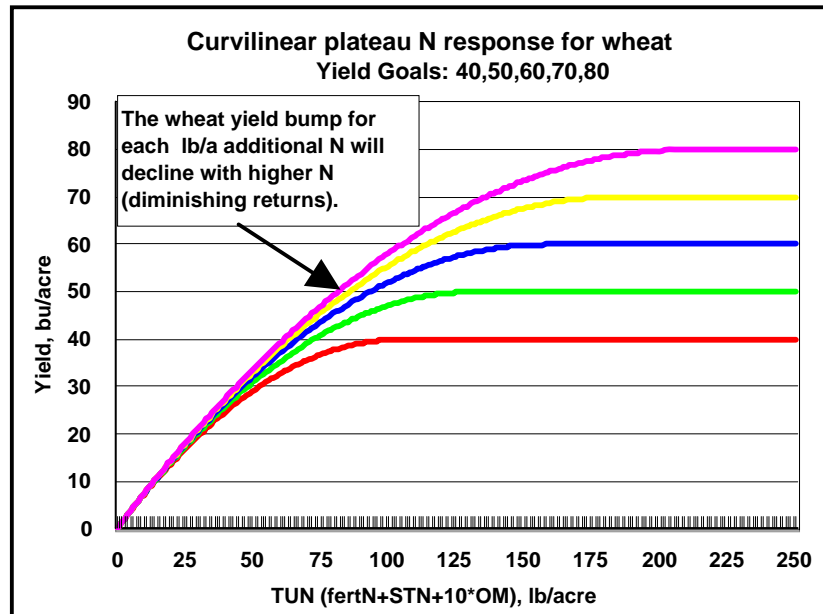


Price won't matter until fertN = \$0.80/lb, then optimal is 0 lb/acre

Functions could and likely should have 0-intercept if response is to total N

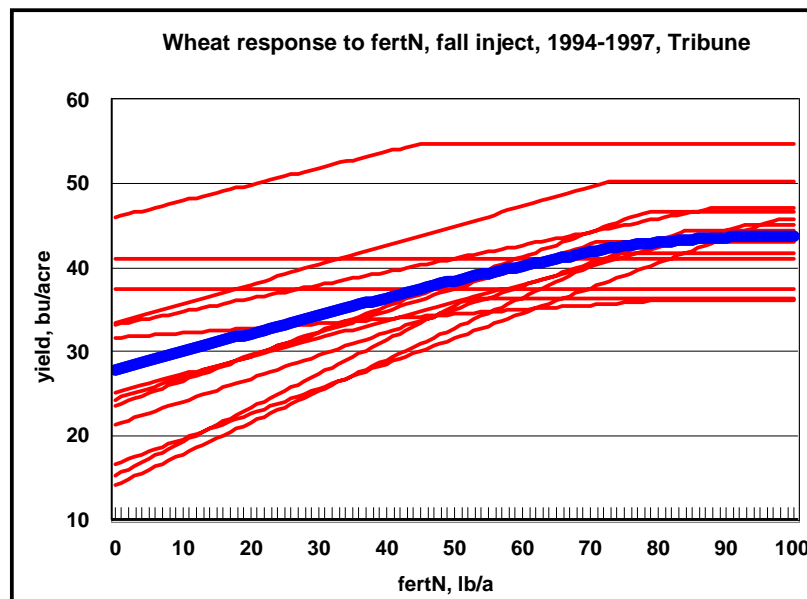


Functions might be curvilinear



Fertilizer N research in late 2005
Kastens, Dhuyvetter, Schlegel, and Dumler

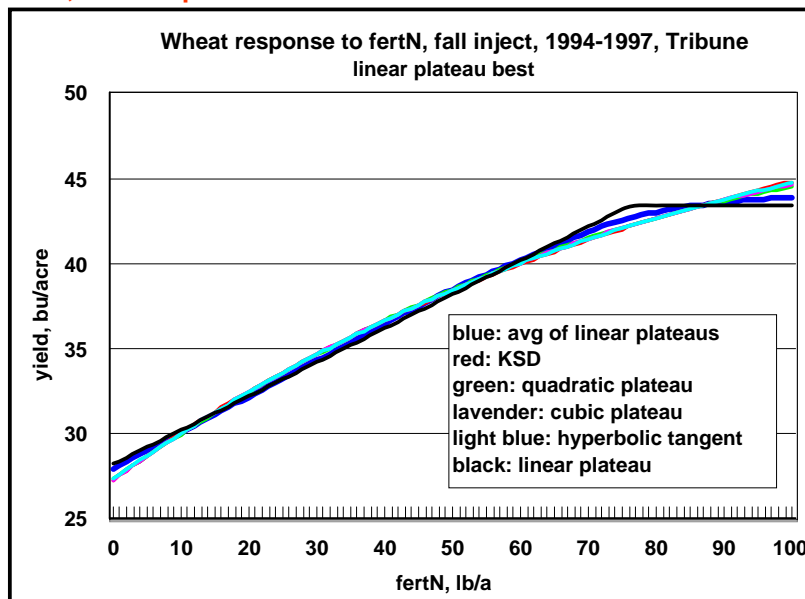
Average of linear plateaus can become non-linear...



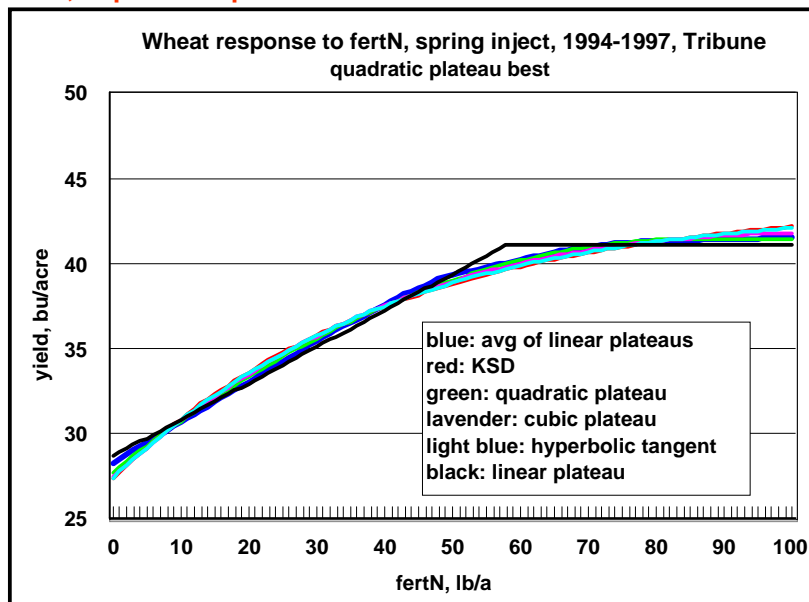
Functional form...

- Numerous functional forms could be used that would meet objectives. We considered:
 - Linear plateau, along with four different curvilinear forms
- Based on nitrogen fertilizer research studies from north central and western Kansas on wheat, corn, and milo, quadratic plateau model fit data better than alternatives most often
- Most non-linear models “look” very similar, but results (i.e., optimal N versus N price) do vary

Here, a linear plateau fit blue line the best



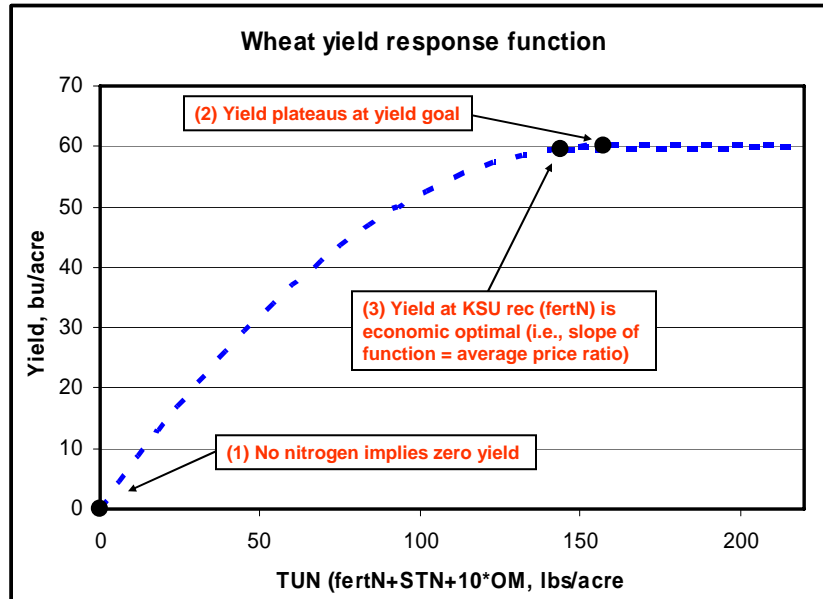
Here, a quadratic plateau fit blue line the best



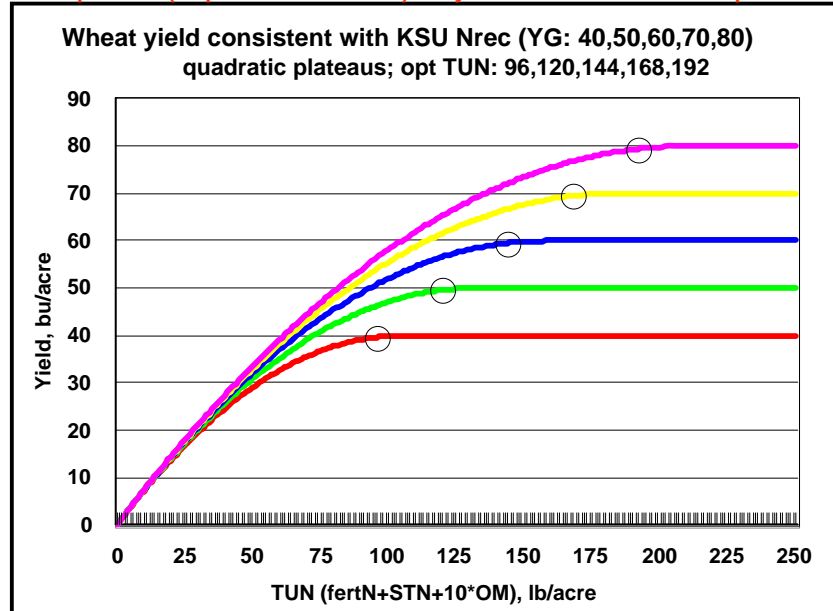
Nitrogen production function...

- Nice property of non-linear production function is that it implies diminishing marginal returns and thus prices matter
- Assumed functional form is quadratic plateau which allows diminishing returns – consistent with linear plateau in any given year
- Estimate model parameters such that
 - KSU Nrec is economic optimum at historical average prices
 - Yield plateau is equal to yield goal
 - Intercept goes through origin (i.e., 0 N equates to 0 yield)

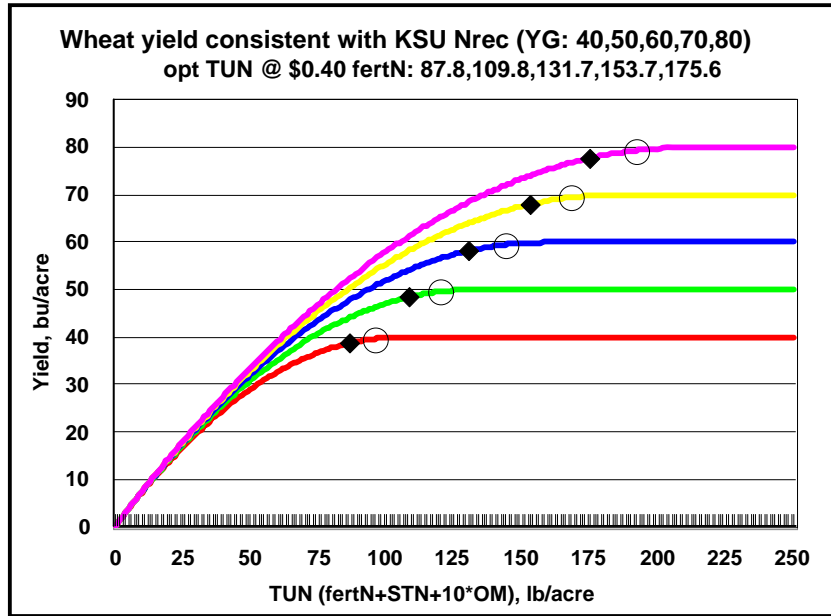
Defined points that allowed quadratic-plateau function to be defined...



Same optimal N (slope there = 0.21/3.20) but yields about 1% lower than plateau



Slope at diamonds is 0.40/3.20



Adjustments to KSU Nrecs at various N prices

Nitrogen Recommendations for Wheat

Yield goal, bu/ac	40	50	60	70	80
KSU N rec, lbs/ac	46	70	94	118	142
N price	Price adjusted N rec, lbs/ac				
\$0.25	44	68	91	115	139
\$0.30	42	65	88	111	134
\$0.35	40	62	85	107	130
\$0.40	38	60	82	104	126
\$0.45	36	57	78	100	121
N price	Price adjusted N rec reduction				
\$0.25	3.7%	3.1%	2.8%	2.6%	2.4%
\$0.30	8.4%	6.9%	6.2%	5.8%	5.5%
\$0.35	13.1%	10.8%	9.6%	9.0%	8.5%
\$0.40	17.8%	14.6%	13.1%	12.1%	11.5%
\$0.45	22.5%	18.5%	16.5%	15.3%	14.6%

SOM=2.0; STN=30; Wheat price=\$3.20

Adjustments to KSU Nrecs at various N prices

Nitrogen Recommendations for Corn

Yield goal, bu/ac	60	90	120	150	180
KSU N rec, lbs/ac	26	74	122	170	218
N price		Price adjusted N rec, lbs/ac			
\$0.25	24	72	119	166	213
\$0.30	23	69	115	161	208
\$0.35	21	66	111	157	202
\$0.40	19	63	107	152	196
\$0.45	17	60	104	147	190
N price		Price adjusted N rec reduction			
\$0.25	5.9%	3.1%	2.5%	2.3%	2.1%
\$0.30	13.3%	7.0%	5.7%	5.1%	4.8%
\$0.35	20.7%	10.9%	8.8%	7.9%	7.4%
\$0.40	28.1%	14.8%	12.0%	10.7%	10.0%
\$0.45	35.4%	18.7%	15.1%	13.6%	12.7%

SOM=2.0; STN=30; Corn price=\$2.35

Adjustments to KSU Nrecs at various N prices

Nitrogen Recommendations for Grain Sorghum

Yield goal, bu/ac	50	75	100	125	150
KSU N rec, lbs/ac	10	50	90	130	170
N price		Price adjusted N rec, lbs/ac			
\$0.25	9	48	87	127	166
\$0.30	7	45	84	122	160
\$0.35	5	42	80	117	155
\$0.40	3	40	76	113	149
\$0.45	1	37	73	108	144
N price		Price adjusted N rec reduction			
\$0.25	13.5%	4.1%	3.0%	2.6%	2.4%
\$0.30	31.9%	9.6%	7.1%	6.1%	5.6%
\$0.35	50.2%	15.1%	11.2%	9.7%	8.9%
\$0.40	68.6%	20.6%	15.2%	13.2%	12.1%
\$0.45	87.0%	26.1%	19.3%	16.7%	15.3%

SOM=2.0; STN=30; Sorghum price=\$2.10

Adjustments to KSU Nrecs at various N prices

Nitrogen Recommendations for Sunflowers

Yield goal, bu/ac	1,000	1,500	2,000	2,500	3,000
KSU N rec, lbs/ac	5	42.5	80	117.5	155

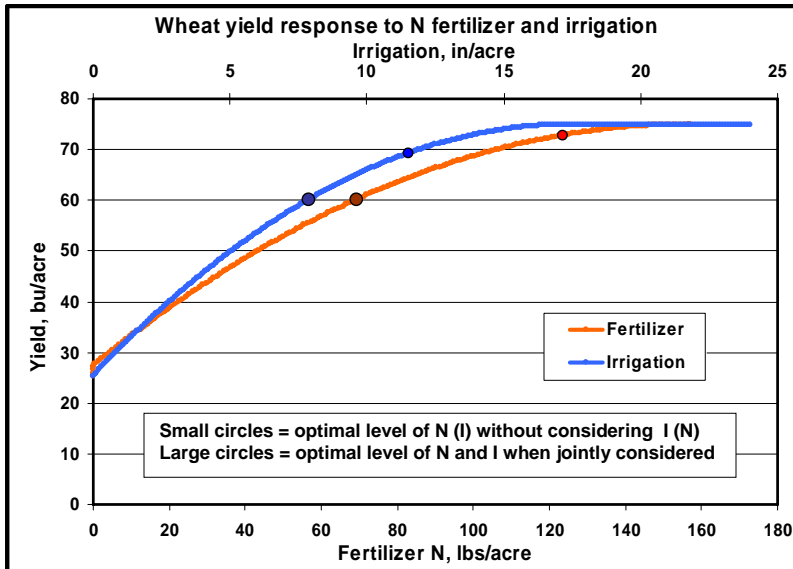
N price	Price adjusted N rec, lbs/ac				
\$0.25	4	41	78	115	152
\$0.30	3	39	75	111	148
\$0.35	1	37	72	108	144
\$0.40	0	35	70	105	140
\$0.45	0	33	67	101	135

N price	Price adjusted N rec reduction				
\$0.25	21.7%	3.8%	2.7%	2.3%	2.1%
\$0.30	48.8%	8.6%	6.1%	5.2%	4.7%
\$0.35	76.0%	13.4%	9.5%	8.1%	7.4%
\$0.40	100.0%	18.2%	12.9%	11.0%	10.0%
\$0.45	100.0%	23.0%	16.3%	13.9%	12.6%

SOM=2.0; STN=30; Sunflower price=\$0.12

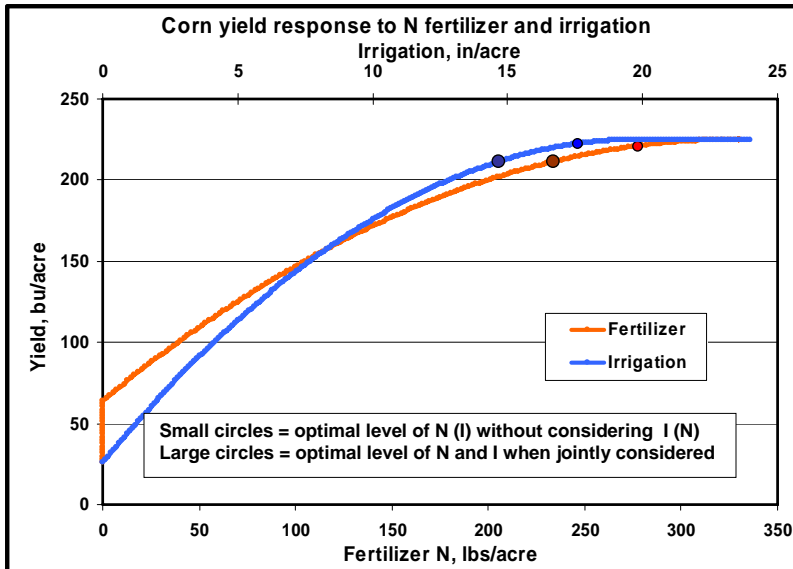
Extensions to research:
1) irrigation
2) phosphorus

When considering irrigation and N together, optimal values decrease significantly...



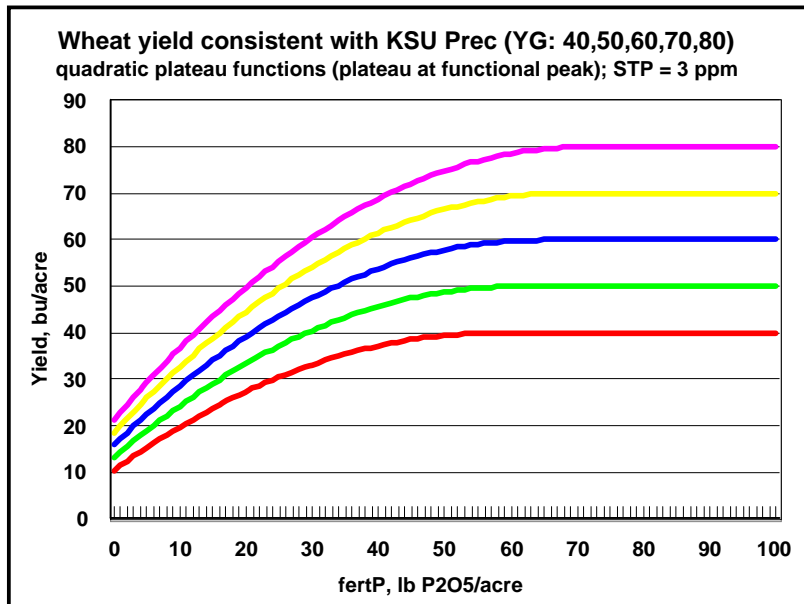
Wheat price = \$3.20/bu, N price = \$0.40/lb, irrigation cost = \$6.50/inch

When considering irrigation and N together, optimal values decrease significantly...



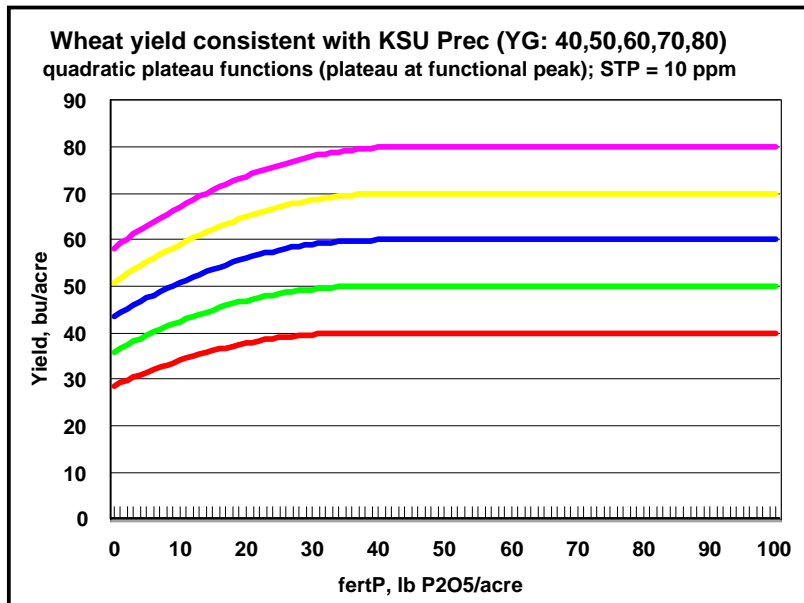
Corn price = \$2.35/bu, N price = \$0.40/lb, irrigation cost = \$6.50/inch

The framework works on P as well as N (here showing STP of 3 ppm)



Now can't do a P-encompassing x-axis however

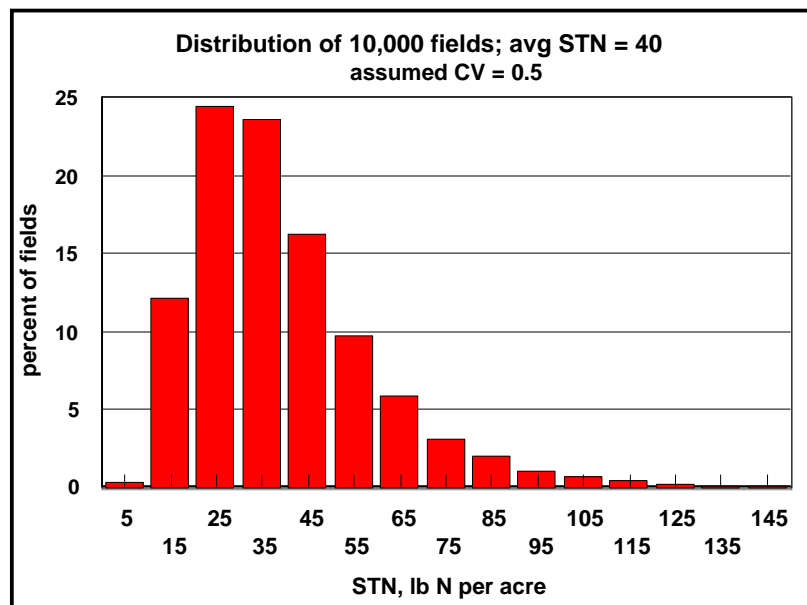
The framework works on P as well as N (here showing STP of 10 ppm)



Soil testing considerations

- If STN varies but the variation is unknown it will be more profitable to apply more fertN than KSU or model recommends
 - because 1 lb/a above optimal rate will lose less money than a deficiency of 1 lb/a
 - Effect can be large in terms of fertN rate, perhaps 10-20 lb/a difference
 - How much STN variation is assumed in a single soil sample?
 - Do KSU Nrecs already assume this?
 - Not an issue if STN is 0, like in the east
 - Means KSU must assume stability of STN

Assume considerable variation of soil tests across fields



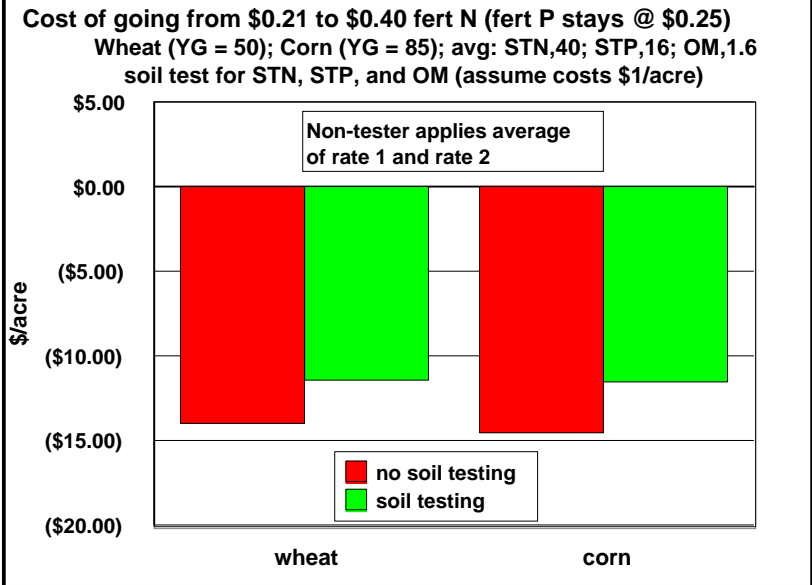
Manager who doesn't soil test: assumptions

- Application style: uniform rate across all fields in farm
- Application rate:
 1. Manager has a “feel” for typical or average STN on farm, perhaps from occasional random field sampling; applies this STN to KSU Nrec formula or model
 2. Manager has a “feel” for the uniform rate applied to his farm that would have maximized profits over space and time

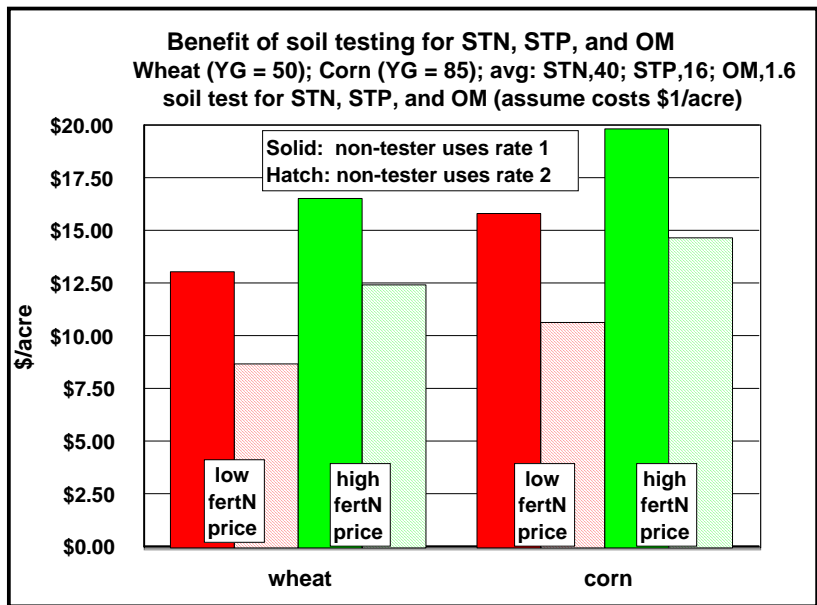
Across 10,000 simulated fields we:

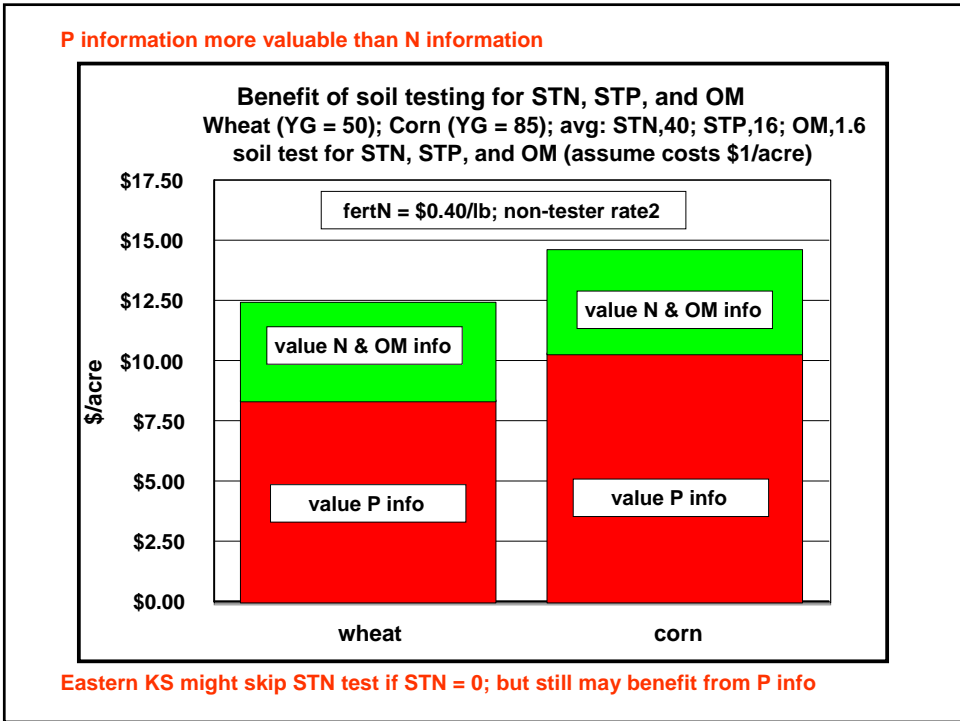
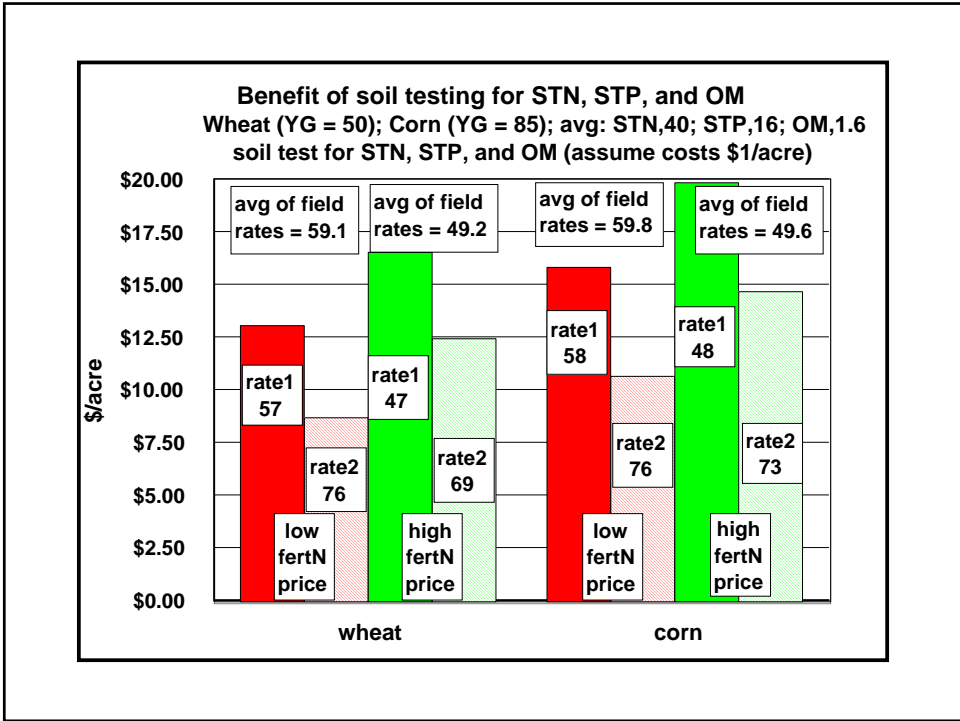
- Represent rate 1 by plugging the single 10,000-field average, for each of STN, STP, and OM into the model
- Represent rate 2 by finding the uniform rate that maximizes total profit across all fields
 - **Notice that this rate could not be formally known by non-tester**
- Represent soil-tester by applying each field's unique rate coming from model
 - **No consideration of sub-field variability and possible impact on optimal rates**

Assume \$5.00/acre N application charge can be foregone if 0 N rate best



Assume \$5.00/acre N application charge can be foregone if 0 N rate best





Summary ...

- In order to determine how to adjust fertN rates in response to prices, a mathematical relationship between N and yield is needed
- A quadratic-plateau function can be “backed out” of KSU N recs
- Quadratic-plateau function allows diminishing returns, but is also consistent with linear plateau across years
- Nitrogen prices of \$0.35-\$0.40/lb lead to reductions in KSU N recs of 10-30% (significantly higher if irrigation costs are simultaneously considered)
- **Soil sampling pays!**
 - As long as you don't represent too much variation with a single soil sample

**Impact of high input
prices on leases**

Impact of high costs on leases ...

KSU-Lease.xls is a tool that can be used to analyze the impact of current costs have on equitable crop share leases as well as their cash-rent equivalents

The impact high costs have on leases will depend on each specific situation due to how producers change (or not change) production practices in response to these high prices

→ producers should “run their own numbers”

Dryland example assumptions ...

- 75% of land cropped annually (58.3% wheat and 41.7% milo) with other 25% fallow
- Equitably share all fertilizer on both crops (tenant pays application costs)
- Equitably share herbicide and application costs on milo
- Initial analysis is based on fuel and fertilizer costs at 2000-04 averages
- Examined impact on equitable crop share and cash rent equivalent with increased costs (all else held constant)

Dryland example summary ...

	Equitable share	Cash rent	Profit
Base scenario	66.2 / 33.8	\$29.98	-\$2.99
Increased fertilizer costs	66.2 / 33.8	\$25.40	-\$13.36
Increased fuel costs	67.6 / 32.4	\$28.04	-\$7.47
Increased fuel and fert costs	67.6 / 32.4	\$23.50	-\$17.84

Irrigated example assumptions ...

- Rotation -- 67% corn and 33% soybeans
- Equitably share fertilizer, herbicides, insecticides, and irrigation energy (tenant pays application costs on fertilizer, shared on others)
- Tenant owns center pivot and motor, landowner owns well, pump and gearhead (tenant pays 75% of irrigation repairs, landowner 25%)
- Initial analysis is based on fuel and fertilizer costs at 2000-04 averages
- Examined impact on equitable crop share and cash rent equivalent with increased costs (all else held constant)

Irrigated example summary ...

	Equitable share	Cash rent	Profit
Base scenario	74.9 / 25.1	\$62.41	-\$18.95
Increased fertilizer costs	74.9 / 25.1	\$51.64	-\$44.94
Increased pumping costs	74.9 / 25.1	\$37.16	-\$79.89
Increased fuel costs	75.6 / 24.4	\$58.87	-\$27.64
Increased costs (ALL)	75.6 / 24.4	\$23.03	-\$114.56

Summary ...

- **High input prices will have significant impact on crop returns in 2006**
 - Irrigated crops impacted more than dryland crops
 - Feedgrains impacted more than soybeans
 - How producers "manage" for this will depend on their unique situations
- **High diesel fuel prices will impact returns, but they have relatively minor impact on equitable crop share percentages**
- **Crop share tenants will not be impacted nearly as much as those cash renting (assuming fertilizer and irrigation pumping expenses are being shared)**

Summary ...

- Producers need to “do their homework” to make sure they understand the numbers before talking to their landowner(s)
- Tenants need to think long-term when negotiating with landowners
 - Impact of losing or giving up land?
 - Have “good times” been shared?
- Good landlord/tenant communications will be critical as we go through these tough economic times

The screenshot shows a web browser window titled "AgManager: Providing Agricultural Economic Information on Crops, Livestock, Marketing and Outlo - Microsoft Internet Explorer". The address bar shows "http://www.agmanager.info/". The website content includes:

- AG MANAGER.INFO** logo with "Kansas State Research & Extension" below it.
- Navigation menu: [about](#), [contributors](#), [useful links](#), [site map](#), [feedback](#), and a search box.
- Left sidebar menu:
 - Agribusiness
 - Crops
 - Energy Prices
 - Farm Management
 - Human Resources
 - Income Tax & Law
 - Livestock & Meat
 - Policy
 - Ag Econ News
 - Contributors
 - Programs
 - Sponsors
 - Upcoming Events
- Main content area:
 - Header: "A Website Providing Information and Tools For The Competitive Business"
 - Image: A collage of agricultural images with "www.agmanager.info" overlaid.
 - Section: "Questions ?" with the **MAST** logo and tagline "Network with Successful Peers" and "Management Analysis and Strategic Thinking".
 - Contact info: "Contact Us: Department of Agricultural Economics 342, Waters Hall, Manhattan, KS 66506 (765) 532-6823"
 - Footer: "Department of Agricultural Economics | K-State Research & Extension | College of Agriculture | Kansas State University"
- Right sidebar: "Site Updates" section with a list of recent articles and their authors, including "Modifying Fertilizer Recs to Reflect Price", "Impact of Energy Prices on KS Farm Costs", "Livestock and Hay Charts", "Updated Cattle Databases", "Updated Crop Basis Tool", "Monthly NH3 and Diesel Price Forecasts", "In The Cattle Markets", "The U.S. Ethanol Industry", "Livestock Farm Management Update", "Crop Basis Maps", "Livestock Risk Protection", "Grain Outlook", and "Cost Comparison of Silage Storage Alternatives".