2007 F.A.C.T Conference

Adjusting Irrigation & N Rates for High Energy & Fertilizer Costs

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Department of Agronomy MF-2586

Soil Test Interpretations and Fertilizer Recommendations

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

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.*

Grain Sorghum 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 - - - - - - - -						
40	14	4	0	0	0	0	0
80	78	68	58	48	38	28	18
120	142	132	122	112	102	92	82
160	206	196	186	176	166	156	146
200	270	260	250	240	230	220	210

N Rec[2] = (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] *A minimum fertilizer N application of 30 Lb N/A may be appropriate for early crop growth and development.*

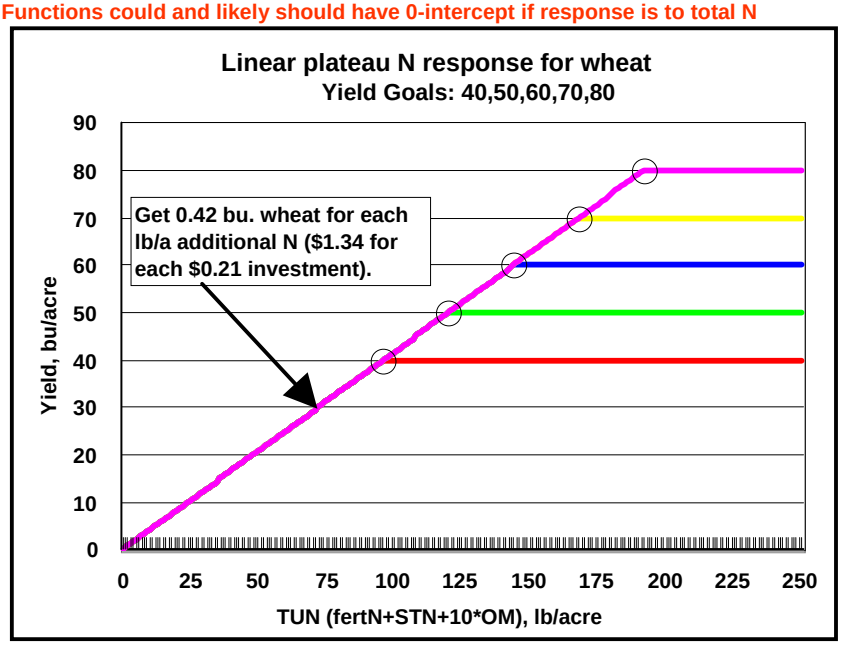
KSU nitrogen recommendations vs. prices

- **Recommendations do not explicitly include prices (for either nitrogen or crop)**
- **Recommendations do not differ between dryland and irrigated, with exception of max yield allowed**
- **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)**

Nitrogen production function…

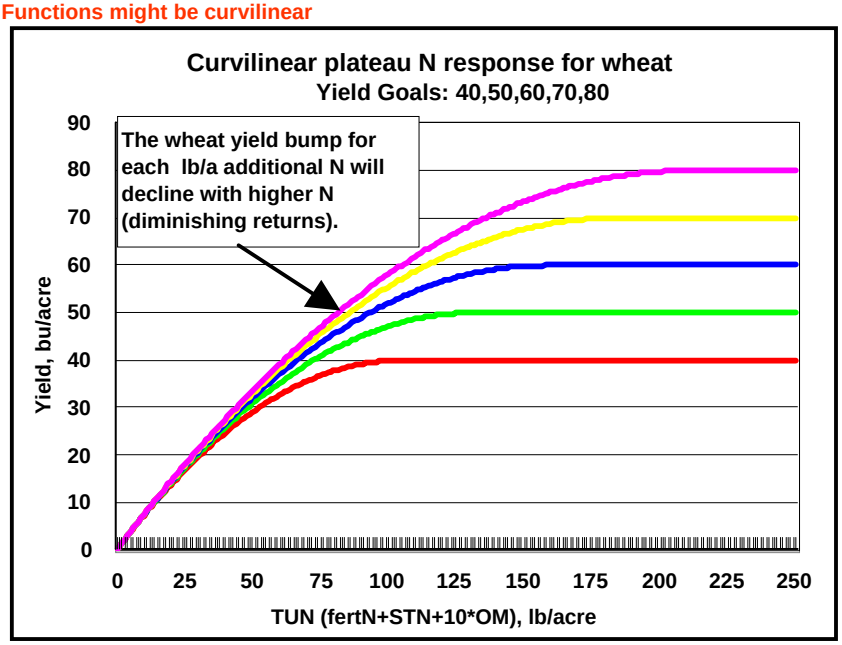
- In a limiting factor framework, it is generally believed that relationship between N and yield is linear for any given year and location (implies linear plateau production function)
- Linear plateau production function implies that optimal N will either be 0 or level where yield plateaus
- Average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

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



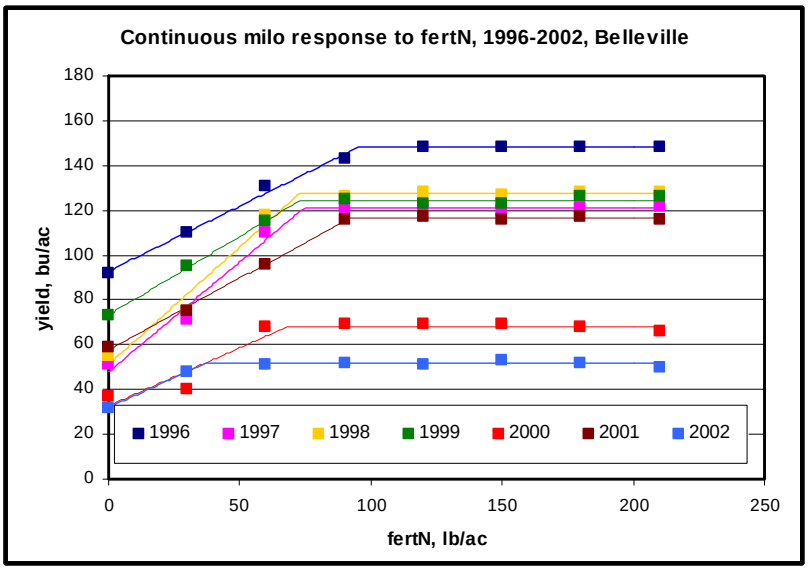
Price won't matter until fertN = $1.34/lb, then optimal is 0 lb/acre

Functions might be curvilinear



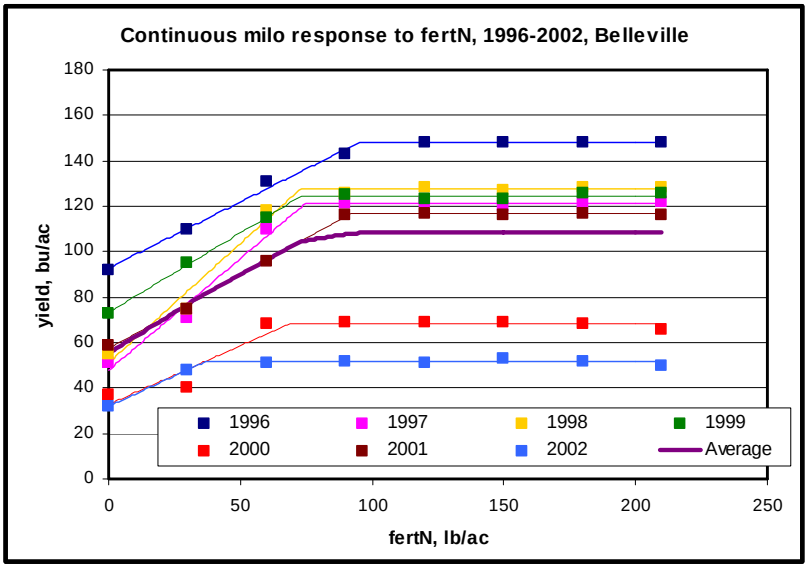
Fertilizer N research in late 2005
Kastens, Dhuyvetter, Schlegel, and Dumler

Yield response by year – linear plateau "fits" data quite well…

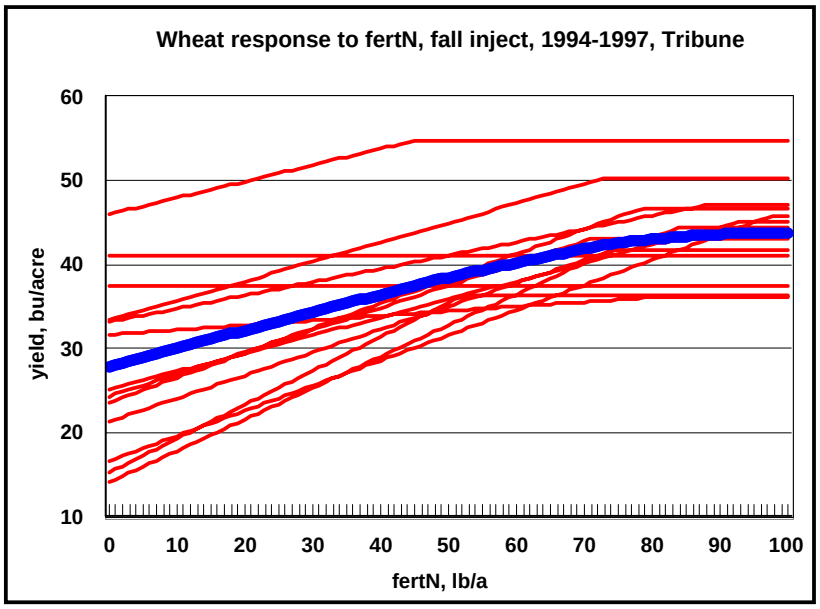


What would yield be for given fertN next year?

Average of linear plateaus can become non-linear…



Average of linear plateaus can become non-linear…



Blue line is NOT based on a mathematical function

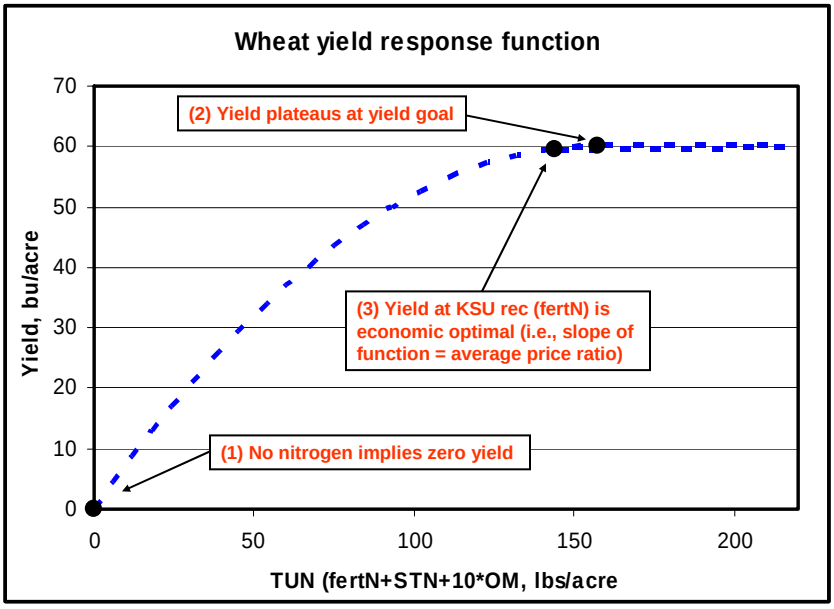
Functional form…

- **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**

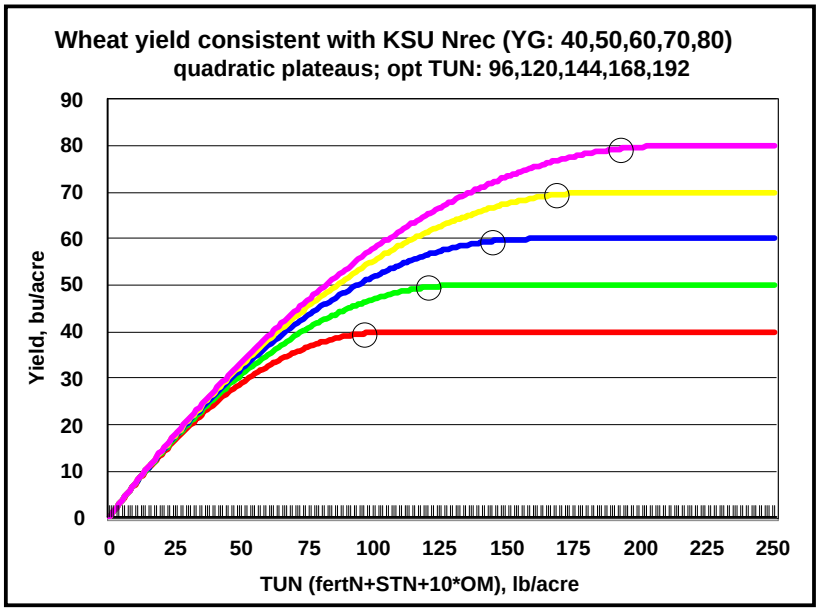
Nitrogen production function…

- 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)
  - We assume KSU had in mind these prices:
    - Wheat $3.20/bu
    - Corn $2.35/bu
    - fertN $0.21/lb N

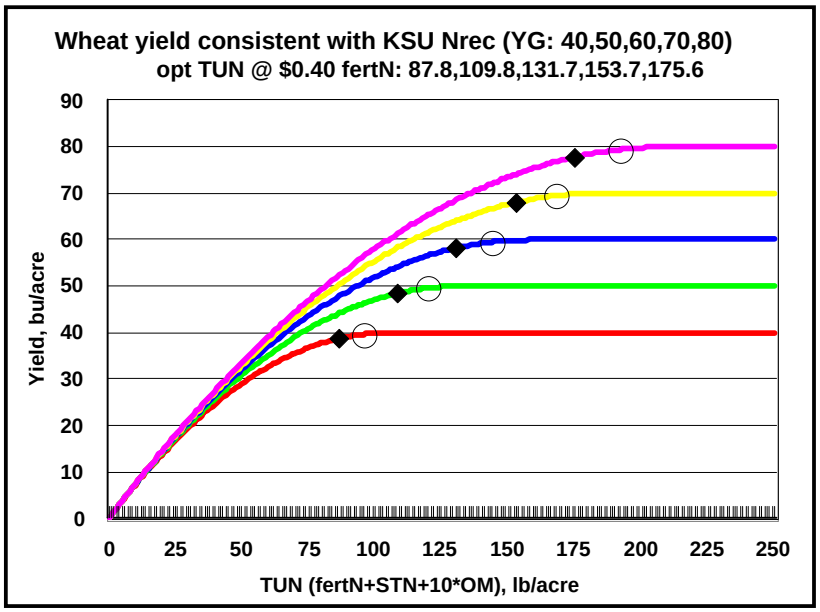
Defined points that allowed quadratic-plateau function to be defined…



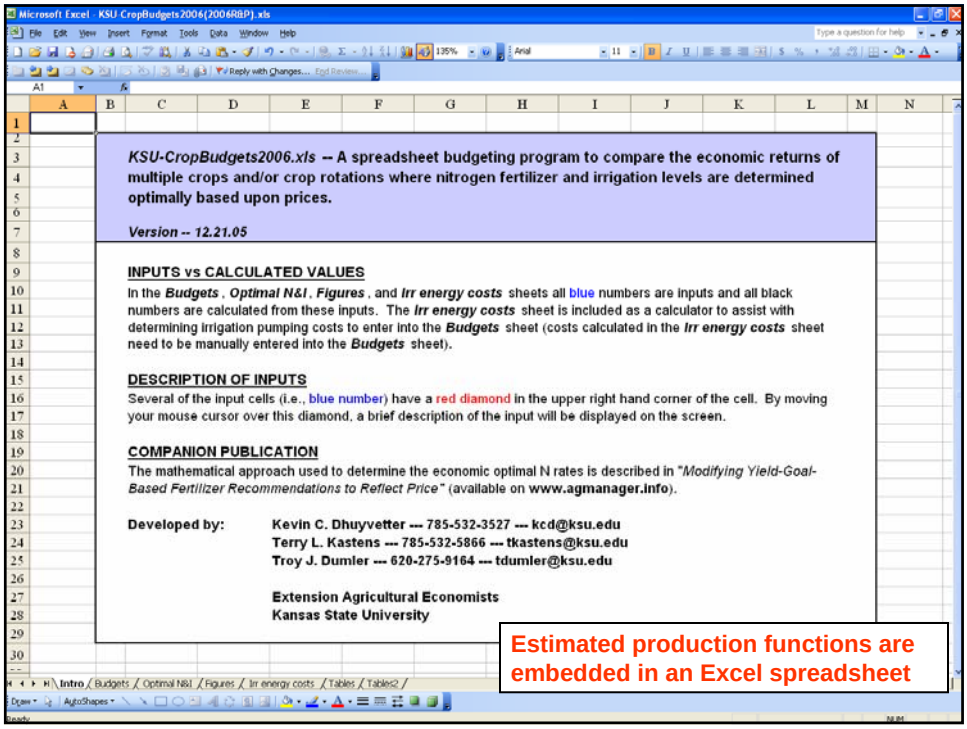
Same optimal N (slope there = 0.21/3.20) but yields about 1% lower than plateau



Slope at diamonds is 0.40/3.20



With more expensive N, you make more money by applying less


KSU-CropBudgets2006.xls -- A spreadsheet budgeting program to compare the economic returns of multiple crops and/or crop rotations where nitrogen fertilizer and irrigation levels are determined optimally based upon prices.
Version -- 12.21.05
INPUTS vs CALCULATED VALUES
In the Budgets, Optimal N&I, Figures, and Irr energy costs sheets all blue numbers are inputs and all black numbers are calculated from these inputs. The Irr energy costs sheet is included as a calculator to assist with determining irrigation pumping costs to enter into the Budgets sheet (costs calculated in the Irr energy costs sheet need to be manually entered into the Budgets sheet).
DESCRIPTION OF INPUTS
Several of the input cells (i.e., blue number) have a red diamond in the upper right hand corner of the cell. By moving your mouse cursor over this diamond, a brief description of the input will be displayed on the screen.
COMPANION PUBLICATION
The mathematical approach used to determine the economic optimal N rates is described in "Modifying Yield-Goal-Based Fertilizer Recommendations to Reflect Price" (available on www.agmanager.info).
Developed by:
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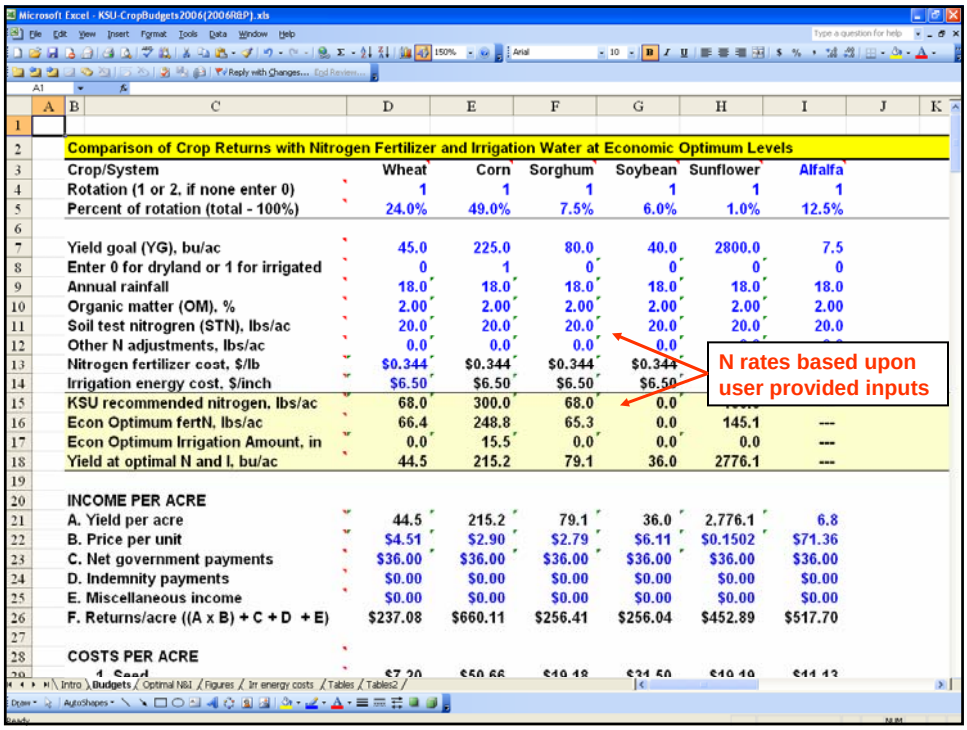
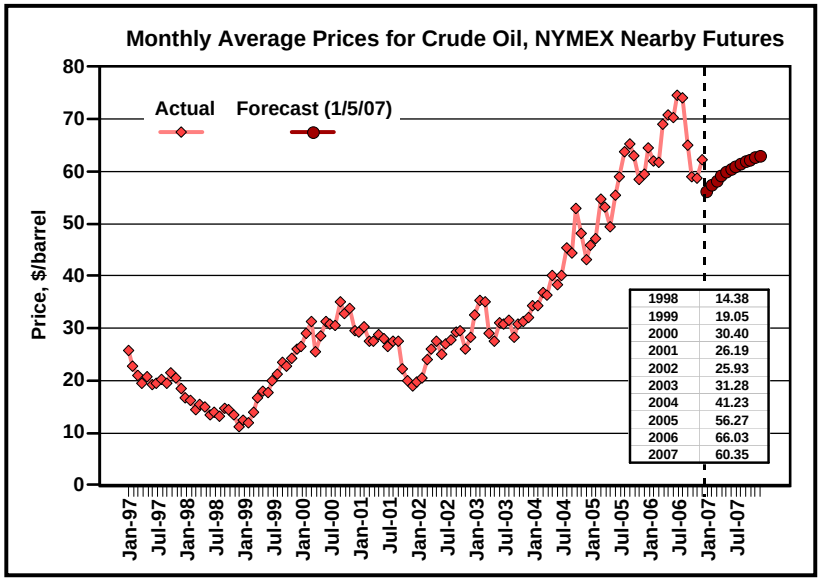
Extension Agricultural Economists
Kansas State University
Estimated production functions are embedded in an Excel spreadsheet


Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels
Crop/System | Wheat | Corn | Sorghum | Soybean | Sunflower | Alfalfa
Rotation (1 or 2, if none enter 0) | 1 | 1 | 1 | 1 | 1 | 1
Percent of rotation (total - 100%) | 24.0% | 49.0% | 7.5% | 6.0% | 1.0% | 12.5%
Yield goal (YG), bu/ac | 45.0 | 225.0 | 80.0 | 40.0 | 2800.0 | 7.5
Enter 0 for dryland or 1 for irrigated | 0 | 1 | 0 | 0 | 0 | 0
Annual rainfall | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0
Organic matter (OM), % | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00
Soil test nitrogen (STN), lbs/ac | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0
Other N adjustments, lbs/ac | 0.0 | 0.0 | 0.0 | 0.0
Nitrogen fertilizer cost, $/lb | $0.344 | $0.344 | $0.344 | $0.344
Irrigation energy cost, $/inch | $6.50 | $6.50 | $6.50 | $6.50
KSU recommended nitrogen, lbs/ac | 68.0 | 300.0 | 68.0 | 0.0
Econ Optimum fertN, lbs/ac | 66.4 | 248.8 | 65.3 | 0.0 | 145.1 | ---
Econ Optimum Irrigation Amount, in | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 | ---
Yield at optimal N and I, bu/ac | 44.5 | 215.2 | 79.1 | 36.0 | 2776.1 | ---
INCOME PER ACRE
A. Yield per acre | 44.5 | 215.2 | 79.1 | 36.0 | 2,776.1 | 6.8
B. Price per unit | $4.51 | $2.90 | $2.79 | $6.11 | $0.1502 | $71.36
C. Net government payments | $36.00 | $36.00 | $36.00 | $36.00 | $36.00 | $36.00
D. Indemnity payments | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00
E. Miscellaneous income | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00
F. Returns/acre ((A x B) + C + D + E) | $237.08 | $660.11 | $256.41 | $256.04 | $452.89 | $517.70
COSTS PER ACRE
N rates based upon user provided inputs

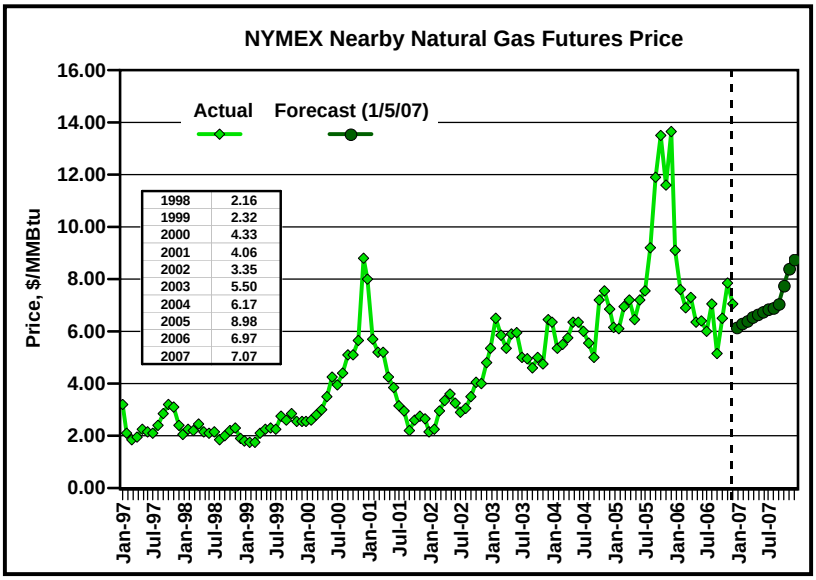
A quick look at prices

Crude oil prices – getting a little break, but still at high levels…



2007 forecast based on 1/5/07 closing futures prices

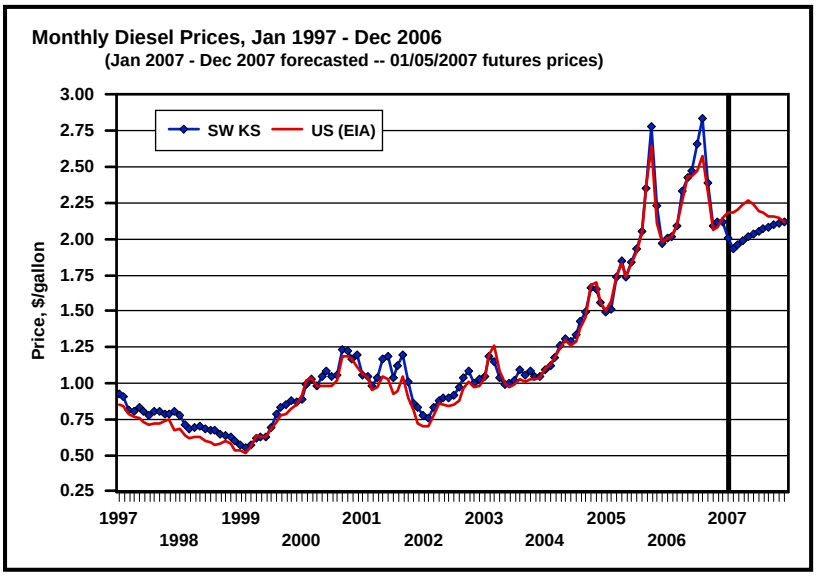
Natural gas prices – steady to up slightly from last year…



2007 forecast based on 1/5/07 closing futures prices

What do these crude oil and natural gas prices imply for crop input costs?

Historical and forecasted diesel fuel prices



Diesel fuel prices are forecasted to be down from last year…

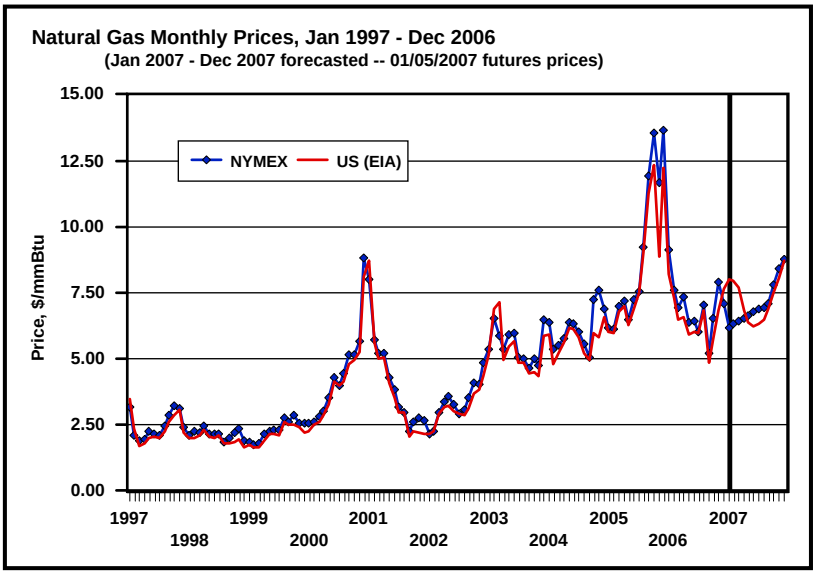
Off-road Diesel Fuel Prices

	Mar-Oct Diesel Price			Year-to-year percent change		
Year	SW KS	US (EIA)	Average	SW KS	US (EIA)	Average
2000	$1.09	$1.05	$1.07	-----	-----	-----
2001	$1.09	$0.98	$1.04	0.6%	-6.5%	-2.9%
2002	$0.94	$0.88	$0.91	-14.1%	-10.1%	-12.2%
2003	$1.05	$1.05	$1.05	12.1%	19.1%	15.5%
2004	$1.37	$1.35	$1.36	30.0%	28.9%	29.5%
2005	$2.04	$2.01	$2.02	48.5%	49.2%	48.9%
2006	$2.41	$2.34	$2.37	18.6%	16.0%	17.3%
2007 (F)	$2.04	$2.21	$2.12	-15.4%	-5.6%	-10.6%
2007 - 2006	($0.37)	($0.13)	($0.25)	-15.4%	-5.6%	-10.6%
07 - Avg(00-04)	$0.93	$1.15	$1.04	83.9%	108.2%	95.8%

F = forecast

SW KS forecasts based on 1/5/07 crude oil futures price

Historical and forecasted natural gas prices…



Natural gas prices for summer months are forecasted to be up from last year…

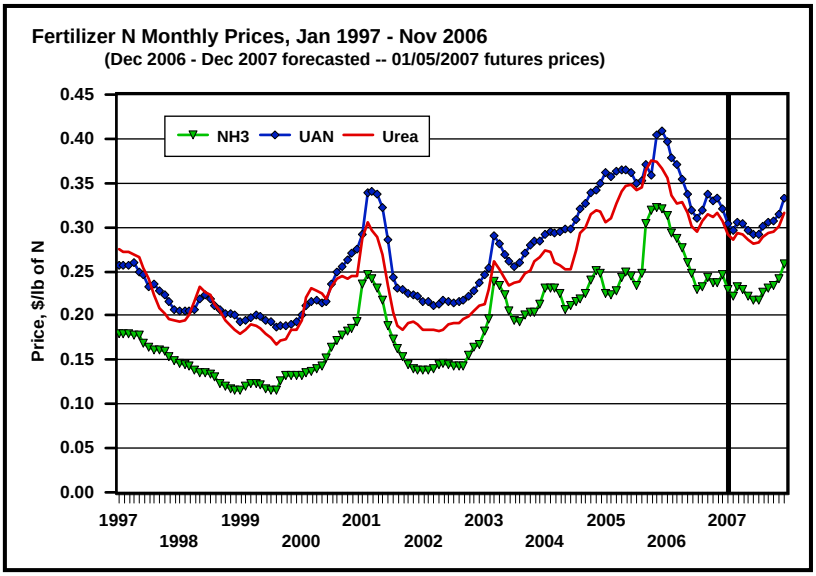
Natural Gas Prices

	Mar-Sep Natural Gas Price			Year-to-year percent change		
Year	NYMEX	US (EIA)	Average	NYMEX	US (EIA)	Average
2000	$3.89	$3.69	$3.79	-----	-----	-----
2001	$3.85	$3.66	$3.76	-1.0%	-0.7%	-0.9%
2002	$3.25	$3.03	$3.14	-15.5%	-17.2%	-16.3%
2003	$5.40	$5.35	$5.37	66.0%	76.3%	71.0%
2004	$5.81	$5.58	$5.70	7.6%	4.5%	6.0%
2005	$8.09	$7.81	$7.95	39.2%	39.8%	39.5%
2006	$6.48	$6.10	$6.29	-19.8%	-21.9%	-20.8%
2007 (F)	$6.76	$6.69	$6.72	4.3%	9.6%	6.9%
2007 - 2006	$0.28	$0.59	$0.43	4.3%	9.6%	6.9%
07 - Avg(00-04)	$2.32	$2.42	$2.37	52.3%	56.9%	54.5%

F = forecast

NYMEX forecasts based on 1/5/07 natural gas futures price

Historical and forecasted nitrogen prices, Corn Belt



N fertilizer prices are forecast to be down considerably from last year…

Fertilizer Prices (Corn Belt)

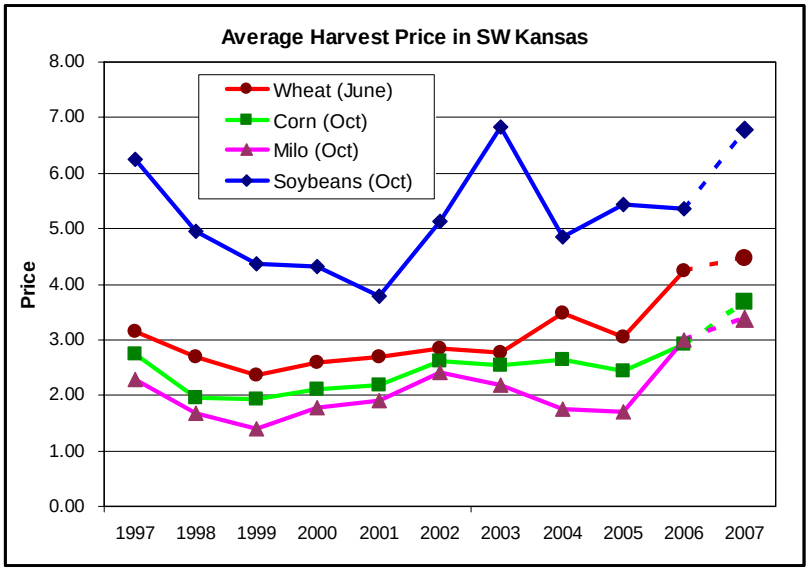
Percent of total	40.0%	35.0%	20.0%	0.0%	0.0%	95.0%	
			Oct-May Fertilizer Price*				Yr-to-yr
Year	NH3 (82%)	UAN (32%)	Urea (46%)	- P -	- K -	Wtd Avg	% change
2000	$0.136	$0.204	$0.205	$0.211	$0.148	$0.167	-----
2001	$0.217	$0.305	$0.272	$0.193	$0.148	$0.248	48.7%
2002	$0.141	$0.218	$0.187	$0.201	$0.144	$0.170	-31.3%
2003	$0.195	$0.253	$0.227	$0.209	$0.141	$0.212	24.7%
2004	$0.218	$0.290	$0.262	$0.214	$0.141	$0.241	13.6%
2005	$0.238	$0.355	$0.322	$0.223	$0.174	$0.284	17.8%
2006	$0.299	$0.376	$0.347	$0.262	$0.210	$0.320	12.9%
2007 (F)	$0.232	$0.311	$0.298	$0.232	$0.218	$0.261	-18.5%
2007 - 2006	($0.067)	($0.065)	($0.049)	($0.030)	$0.008	($0.059)	-18.5%
07 - Avg(00-04)	$0.051	$0.057	$0.067	$0.027	$0.073	$0.054	25.9%

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

F = forecast

Forecasts based on 1/5/07 natural gas futures price

Forecasted crop prices are at recent highs…



2007 prices based on 1/8/05 closing futures prices adjusted for basis

Forecasted crop prices are at recent highs…

Harvest Crop Prices, Southwest Kansas^

Year	Wheat	Corn	Sorghum	Soybeans
2000	$2.60	$2.12	$1.77	$4.31
2001	$2.70	$2.18	$1.89	$3.79
2002	$2.85	$2.61	$2.42	$5.14
2003	$2.78	$2.54	$2.18	$6.83
2004	$3.49	$2.63	$1.74	$4.85
2005	$3.05	$2.45	$1.70	$5.44
2006	$4.25	$2.92	$3.00	$5.35
2007 F	$4.47	$3.69	$3.39	$6.79
2007 - 2006	$0.22	$0.77	$0.39	$1.44
2007 - Avg(00/04)	$1.59	$1.27	$1.39	$1.81

^ Source: Kansas Agricultural Statistics (wheat = June, corn, milo, and soybeans = October)

F = forecast based on 1/8/07 closing futures prices adjusted for basis

Price forecasts relative to last year:

Diesel:	**down ~10%**
Natural gas:	**up ~7%**
N fertilizer:	**down ~18%**
Crop prices:	**up 5 to 30%**

Adjustments to KSU Nrecs at various wheat and N prices

Nitrogen Recommendations for Wheat

Yield goal, bu/ac			45					60		
KSU N rec, lbs/ac*			68					104		
N price	Wheat price, $/bu					Wheat price, $/bu				
$/lb	$2.50	$3.00	$3.50	$4.00	$4.50	$2.50	$3.00	$3.50	$4.00	$4.50
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	66	68	69	70	71	101	104	106	107	108
$0.25	63	65	67	68	70	97	100	103	105	106
$0.30	60	63	65	67	68	93	97	100	102	104
$0.35	56	60	63	65	66	89	93	97	99	101
$0.40	53	57	60	63	64	84	90	94	97	99
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	3.3%	0.2%	-1.9%	-3.6%	-4.8%	2.9%	0.2%	-1.7%	-3.1%	-4.2%
$0.25	7.8%	4.0%	1.3%	-0.7%	-2.3%	6.8%	3.5%	1.2%	-0.6%	-2.0%
$0.30	12.4%	7.8%	4.6%	2.1%	0.2%	10.8%	6.8%	4.0%	1.9%	0.2%
$0.35	17.0%	11.6%	7.8%	5.0%	2.8%	14.8%	10.2%	6.8%	4.4%	2.4%
$0.40	21.5%	15.5%	11.1%	7.8%	5.3%	18.8%	13.5%	9.7%	6.8%	4.6%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0

* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

Adjustments to KSU Nrecs at various sorghum and N prices

Nitrogen Recommendations for Grain Sorghum

Yield goal, bu/ac			60					90		
KSU N rec, lbs/ac*			36					84		
N price	Grain sorghum price, $/bu					Grain sorghum price, $/bu				
$/lb	$1.90	$2.40	$2.90	$3.40	$3.90	$1.90	$2.40	$2.90	$3.40	$3.90
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	36	38	39	40	41	83	87	89	90	91
$0.25	33	36	37	39	39	80	84	86	88	89
$0.30	31	34	36	37	38	76	81	84	86	87
$0.35	28	32	34	36	37	73	78	81	84	86
$0.40	26	30	33	35	36	69	75	79	82	84
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	1.0%	-4.7%	-8.4%	-11.0%	-12.9%	0.6%	-3.0%	-5.4%	-7.1%	-8.3%
$0.25	7.7%	0.7%	-3.9%	-7.2%	-9.6%	5.0%	0.4%	-2.5%	-4.6%	-6.2%
$0.30	14.5%	6.0%	0.5%	-3.4%	-6.3%	9.3%	3.9%	0.3%	-2.2%	-4.1%
$0.35	21.3%	11.4%	4.9%	0.4%	-3.0%	13.7%	7.3%	3.2%	0.2%	-2.0%
$0.40	28.0%	16.7%	9.4%	4.1%	0.3%	18.0%	10.8%	6.0%	2.7%	0.2%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0
* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

Adjustments to KSU Nrecs at various corn and N prices

Nitrogen Recommendations for Corn

Yield goal, bu/ac			75					125		
KSU N rec, lbs/ac*			60					140		
N price	Corn price, $/bu					Corn price, $/bu				
$/lb	$2.00	$2.50	$3.00	$3.50	$4.00	$2.00	$2.50	$3.00	$3.50	$4.00
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	59	61	63	64	64	138	142	144	146	147
$0.25	56	59	61	62	63	133	138	141	143	145
$0.30	53	57	59	60	62	129	134	138	141	143
$0.35	50	54	57	59	60	124	130	135	138	140
$0.40	48	52	55	57	59	119	127	132	135	138
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	2.0%	-1.8%	-4.3%	-6.1%	-7.4%	1.4%	-1.3%	-3.0%	-4.3%	-5.3%
$0.25	6.7%	2.0%	-1.1%	-3.4%	-5.1%	4.8%	1.4%	-0.8%	-2.4%	-3.6%
$0.30	11.4%	5.8%	2.0%	-0.7%	-2.7%	8.1%	4.1%	1.4%	-0.5%	-1.9%
$0.35	16.1%	9.5%	5.1%	2.0%	-0.4%	11.5%	6.8%	3.7%	1.4%	-0.3%
$0.40	20.8%	13.3%	8.3%	4.7%	2.0%	14.9%	9.5%	5.9%	3.3%	1.4%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0
* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

Adjustments to KSU Nrecs at various corn and N prices

Nitrogen Recommendations for Corn

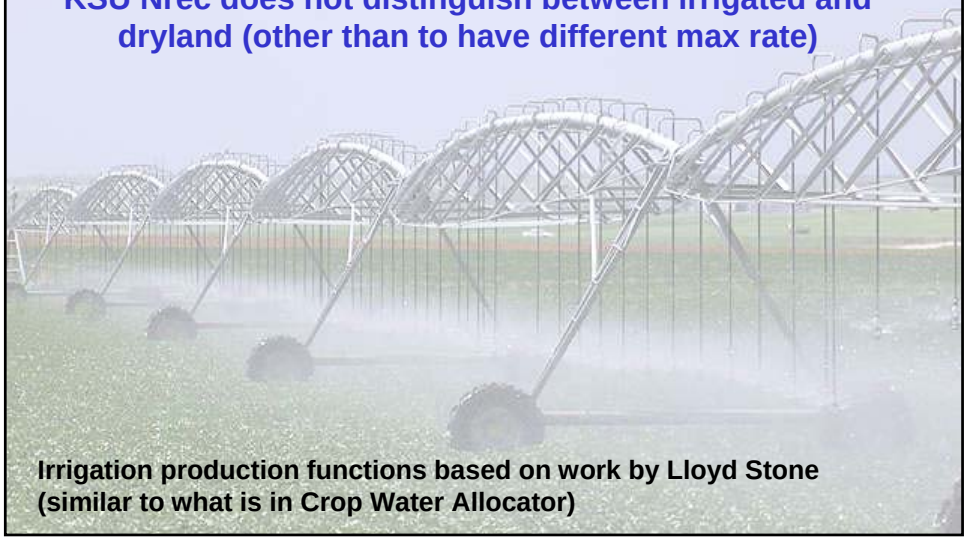
Yield goal, bu/ac			175					225		
KSU N rec, lbs/ac*			220					300		
N price	Corn price, $/bu					Corn price, $/bu				
$/lb	$2.00	$2.50	$3.00	$3.50	$4.00	$2.00	$2.50	$3.00	$3.50	$4.00
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	217	222	226	228	230	296	303	308	311	313
$0.25	211	217	222	225	227	288	296	302	306	309
$0.30	204	212	217	221	224	279	290	296	301	305
$0.35	197	207	213	217	220	271	283	291	296	301
$0.40	191	201	208	213	217	263	276	285	292	296
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	1.3%	-1.1%	-2.7%	-3.9%	-4.7%	1.2%	-1.1%	-2.6%	-3.6%	-4.4%
$0.25	4.3%	1.3%	-0.7%	-2.1%	-3.2%	4.0%	1.2%	-0.7%	-2.0%	-3.0%
$0.30	7.3%	3.7%	1.3%	-0.4%	-1.7%	6.8%	3.5%	1.2%	-0.4%	-1.6%
$0.35	10.2%	6.1%	3.3%	1.3%	-0.2%	9.7%	5.7%	3.1%	1.2%	-0.2%
$0.40	13.2%	8.5%	5.3%	3.0%	1.3%	12.5%	8.0%	5.0%	2.8%	1.2%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0

* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

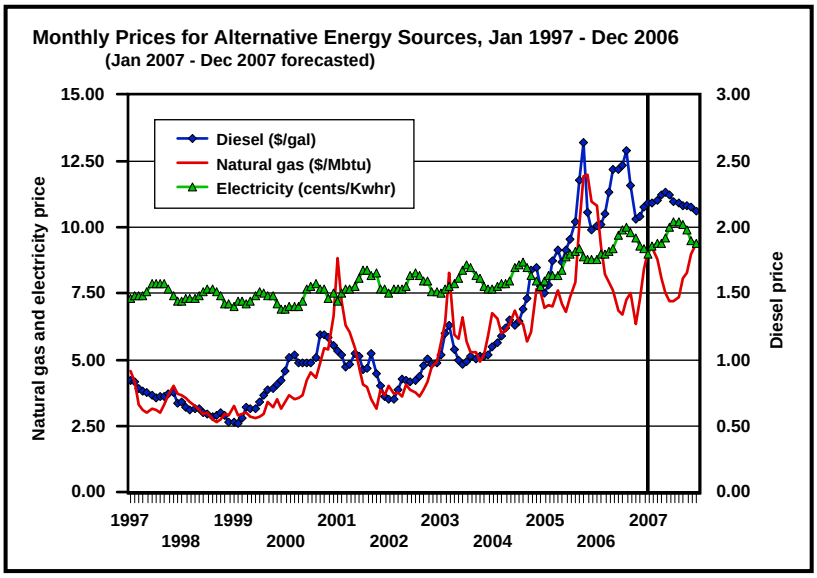
What about N rates under irrigation?

KSU Nrec does not distinguish between irrigated and dryland (other than to have different max rate)

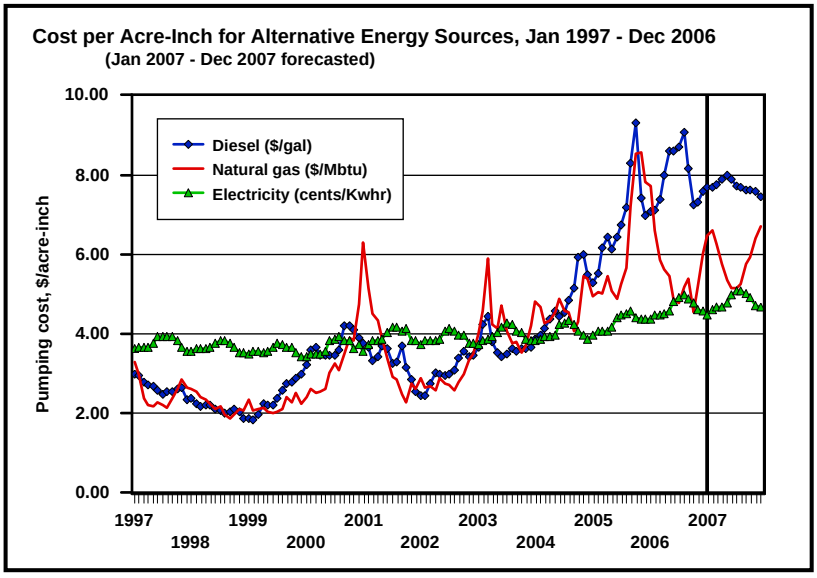


Irrigation production functions based on work by Lloyd Stone (similar to what is in Crop Water Allocator)

Alternative energy prices…



Alternative energy prices…



Forecasted pumping costs relative to last year depends on energy source…

Pumping Cost per Acre-Inch*

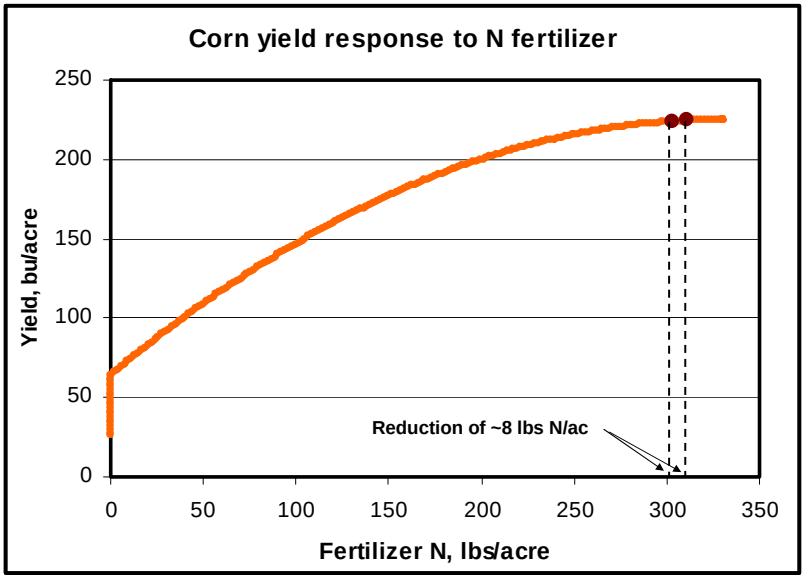
	Mar-Sep			Year-to-year percent change		
Year	Diesel	Nat gas	Electricity	Diesel	Nat gas	Electricity
2000	$3.61	$2.93	$3.72	-----	-----	-----
2001	$3.48	$3.48	$4.00	-3.5%	18.7%	7.6%
2002	$3.03	$2.72	$3.97	-13.0%	-22.0%	-0.7%
2003	$3.69	$4.37	$4.08	21.9%	60.9%	2.9%
2004	$4.58	$4.47	$4.13	24.1%	2.2%	1.0%
2005	$6.77	$5.50	$4.33	47.7%	23.2%	5.0%
2006	$8.36	$5.31	$4.74	23.5%	-3.5%	9.3%
2007 (F)	$7.79	$5.53	$4.89	-6.9%	4.1%	3.3%
2007 - 2006	($0.57)	$0.22	$0.16	-6.9%	4.1%	3.3%
07 - Avg(00-04)	$4.11	$1.94	$0.91	111.7%	53.9%	23.0%

* Based on 300 feet of lift and 20 psi

F = forecast

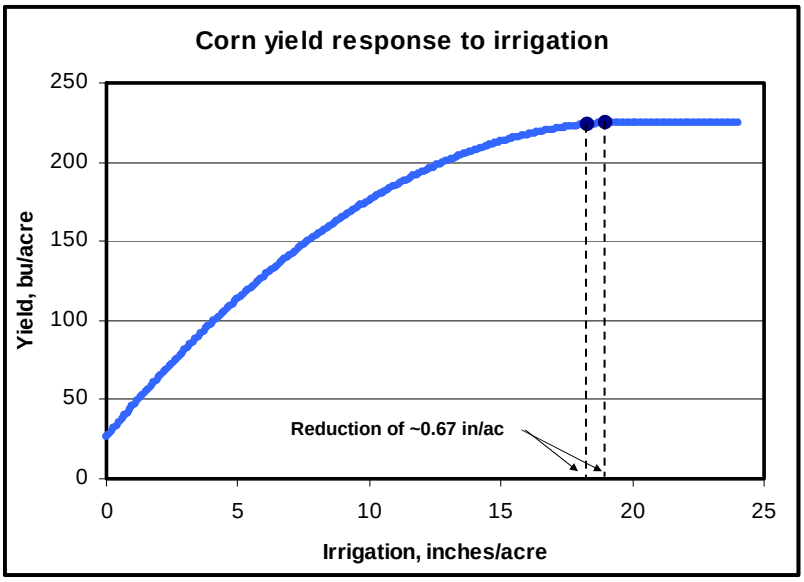
EIA forecasts as of 1/5/07

At projected corn prices, change in optimal N is relatively small due to higher N price…



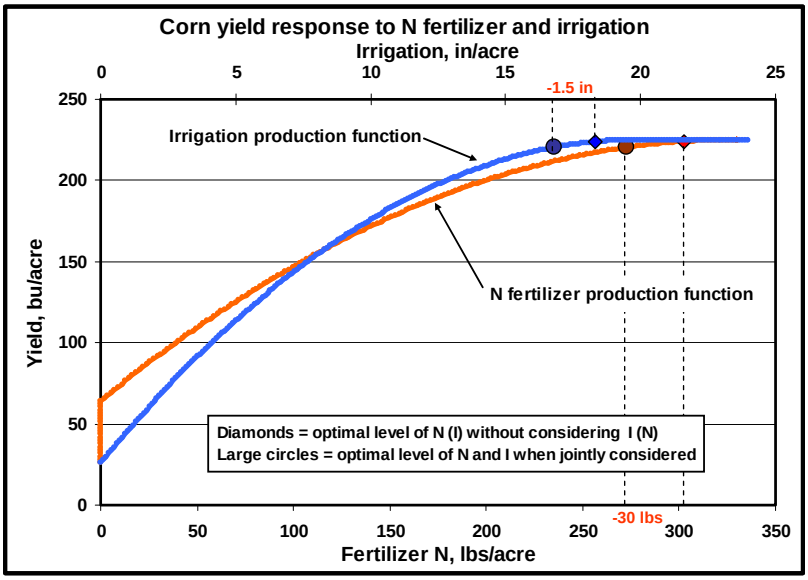
Corn $3.70/bu; N cost = $0.21/lb vs. $0.30/lb

At projected corn prices, change in optimal water is relatively small due to higher pumping costs price…



Corn $3.70/bu; irrigation cost = $3.50/in vs. $6.00/in

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



Corn $3.70/bu; N $0.30/lb, irrigation cost = $6.00/in

Adjustments to KSU Nrecs at various corn and N prices

Nitrogen Recommendations for Corn

Yield goal, bu/ac			175					225		
KSU N rec, lbs/ac*			220					300		
N price	Corn price, $/bu					Corn price, $/bu				
$/lb	$2.00	$2.50	$3.00	$3.50	$4.00	$2.00	$2.50	$3.00	$3.50	$4.00
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	217	222	226	228	230	296	303	308	311	313
$0.25	211	217	222	225	227	288	296	302	306	309
$0.30	204	212	217	221	224	279	290	296	301	305
$0.35	197	207	213	217	220	271	283	291	296	301
$0.40	191	201	208	213	217	263	276	285	292	296
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	1.3%	-1.1%	-2.7%	-3.9%	-4.7%	1.2%	-1.1%	-2.6%	-3.6%	-4.4%
$0.25	4.3%	1.3%	-0.7%	-2.1%	-3.2%	4.0%	1.2%	-0.7%	-2.0%	-3.0%
$0.30	7.3%	3.7%	1.3%	-0.4%	-1.7%	6.8%	3.5%	1.2%	-0.4%	-1.6%
$0.35	10.2%	6.1%	3.3%	1.3%	-0.2%	9.7%	5.7%	3.1%	1.2%	-0.2%
$0.40	13.2%	8.5%	5.3%	3.0%	1.3%	12.5%	8.0%	5.0%	2.8%	1.2%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0

* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

Adjustments to KSU Nrecs at various corn and N prices

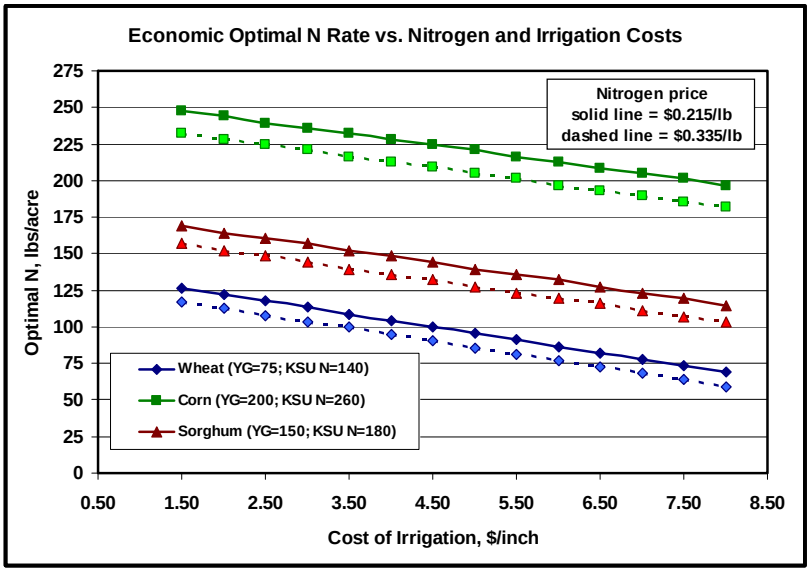
Nitrogen Recommendations for Irrigated Corn

Yield goal, bu/ac			225					225		
KSU N rec, lbs/ac*			300					300		
Irrigation pumping cost, $/ac-in			$3.50					$6.00		
N price	Corn price, $/bu					Corn price, $/bu				
$/lb	$2.00	$2.50	$3.00	$3.50	$4.00	$2.00	$2.50	$3.00	$3.50	$4.00
	Price adjusted N rec, lbs/ac					Price adjusted N rec, lbs/ac				
$0.20	264	278	286	293	297	241	260	271	280	286
$0.25	256	271	280	288	293	232	253	265	275	282
$0.30	247	264	275	282	289	225	245	260	269	276
$0.35	240	258	269	278	284	216	240	254	265	273
$0.40	230	251	264	273	280	208	232	249	260	269
N price										
	Price adjusted N rec reduction					Price adjusted N rec reduction				
$0.20	12.1%	7.2%	4.8%	2.3%	1.1%	19.5%	13.4%	9.7%	6.6%	4.8%
$0.25	14.6%	9.7%	6.6%	4.1%	2.3%	22.6%	15.8%	11.5%	8.5%	6.0%
$0.30	17.7%	12.1%	8.5%	6.0%	3.5%	25.0%	18.3%	13.4%	10.3%	7.8%
$0.35	20.1%	14.0%	10.3%	7.2%	5.4%	28.1%	20.1%	15.2%	11.5%	9.1%
$0.40	23.2%	16.4%	12.1%	9.1%	6.6%	30.6%	22.6%	17.1%	13.4%	10.3%

Soil organic matter (SOM)=2.0; Soil test nitrogen (STN)=20; Other N adjustment=0

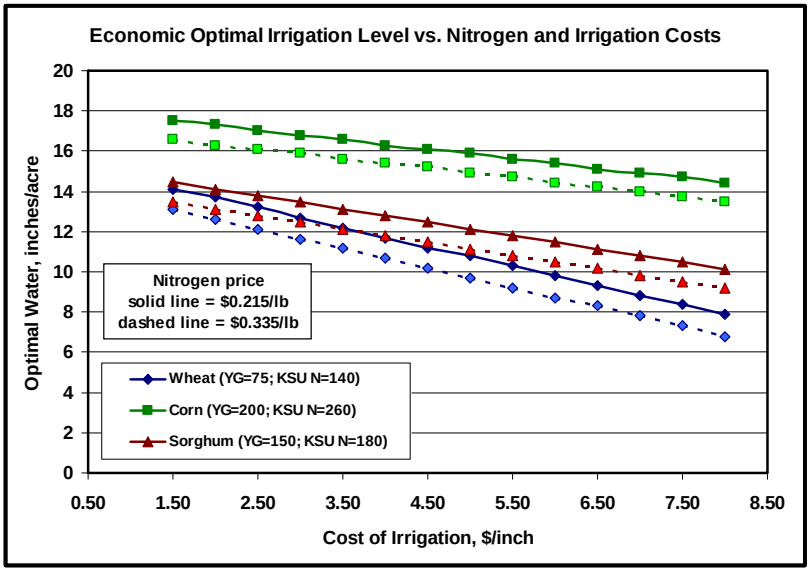
* Based on formulas reported in *Soil Test Interpretations and Fertilizer Recommendations* (MF-2586)

Optimal N rate…



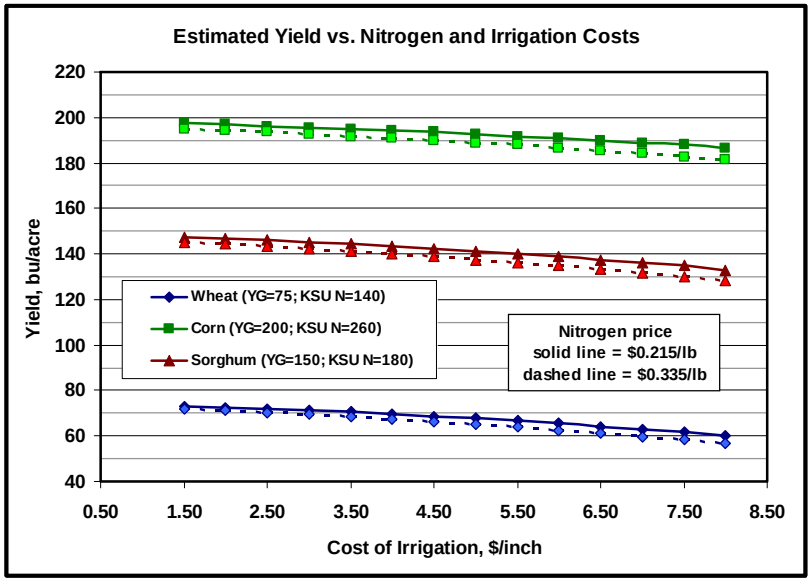
Increase in NUE = 29.6%, 14.3%, 21.7% for wheat, corn, and sorghum, respectively.
($3/ac-in & $0.215/lb N prices → $6/ac-in & $0.335/lb N)

Optimal irrigation rate…

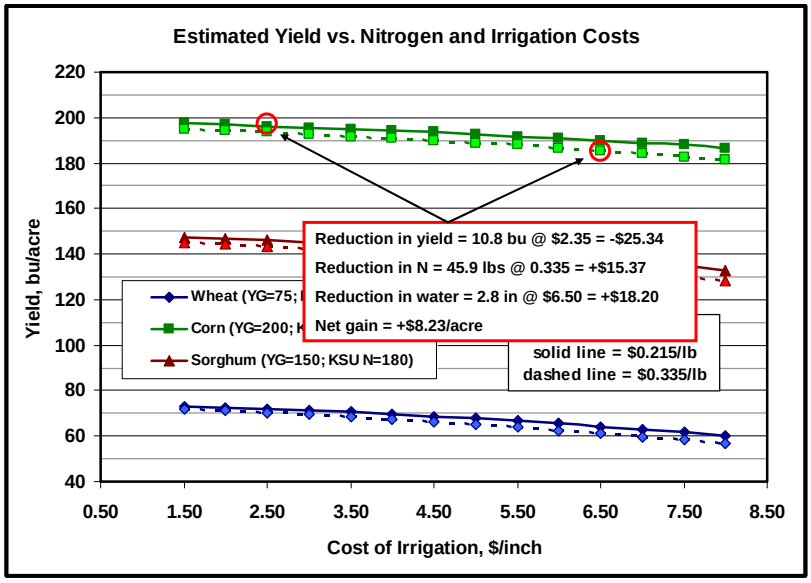


Increase in IWUE = 28.0%, 11.2%, 19.3% for wheat, corn, and sorghum, respectively.
($3/ac-in & $0.215/lb N prices → $6/ac-in & $0.335/lb N)

Estimated yield…



Impact of reduced yield…

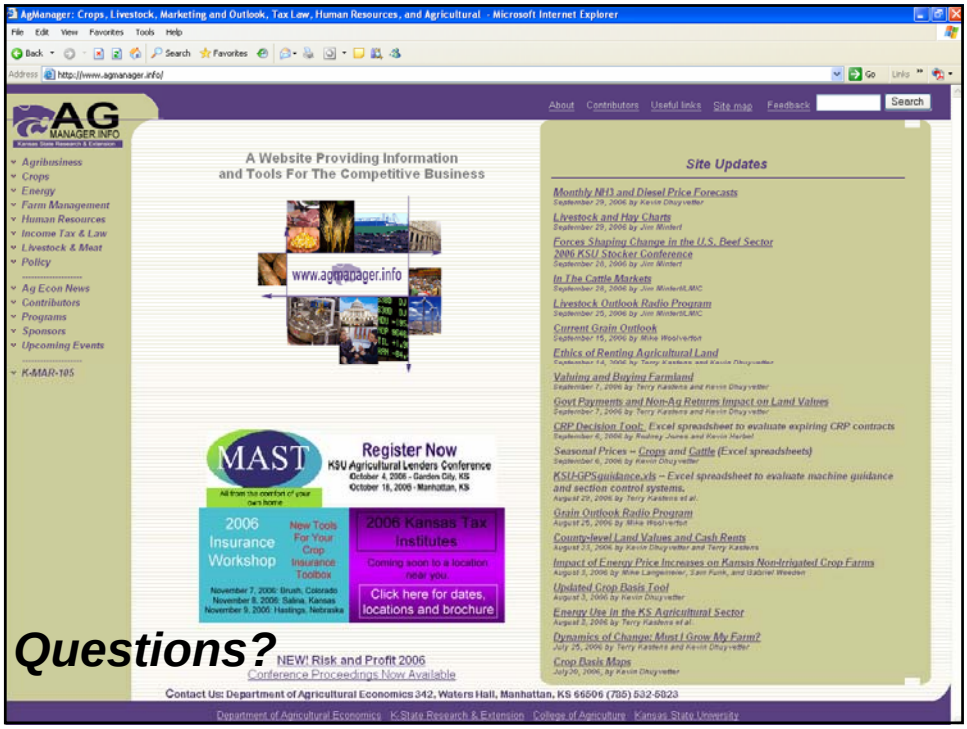


Summary …

- 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 within any site-year
- Even with high N prices, economic optimal N rates for 2007 dryland crops are nearly identical to KSU N recs due to strong crop prices

Summary …

- Cost of ignoring prices in N recommendations has been low in the past, but with increasing N prices, cost of following non-optimal rate increases
- Optimal N rates for irrigated fields is considerably lower than KSU N recs (10-15%) due to high pumping costs as well as high N prices
- Nitrogen fertilizer and irrigation production functions have been estimated and embedded within the *KSU-CropBudgets2006.xls* spreadsheet that allow producers to determine optimal N rates for their own farms/fields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KSU-GPSguidance.xls -- Excel spreadsheet to evaluate machine guidance and section control systems.
Grain Outlook Radio Program
County-level Land Values and Cash Rents
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