

## The Impact of Higher Input Prices on Crop Profitability

Kevin C. Dhuyvetter -- [kcd@ksu.edu](mailto:kcd@ksu.edu) -- 785-532-3527

Terry L. Kastens -- [tkastens@ksu.edu](mailto:tkastens@ksu.edu) -- 785-532-5866

Troy Dumler -- [tdumler@ksu.edu](mailto:tdumler@ksu.edu) -- 620-275-9164



Department of Agricultural Economics  
Kansas State University  
2006 Winter Meetings

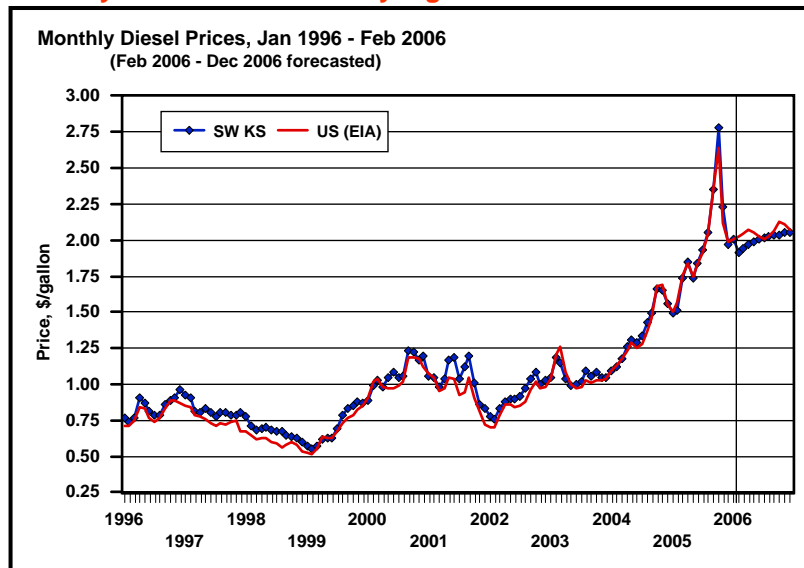
### Background thoughts . . .

- Prices for energy-related inputs are at very high levels relative to what we normally expect
- Producers likely cannot do much about the prices they face, but they need to “understand the numbers” to make good management decisions
- Major decisions crop producers have pertain to input levels, crop selection, tillage method, and possibly negotiating leases on rented land

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

3

Diesel prices are forecasted to be below 2005 peak level,  
but they are still at historically high levels ...



Based on 2/20/06 futures closing prices

4

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

**Diesel Fuel Prices**

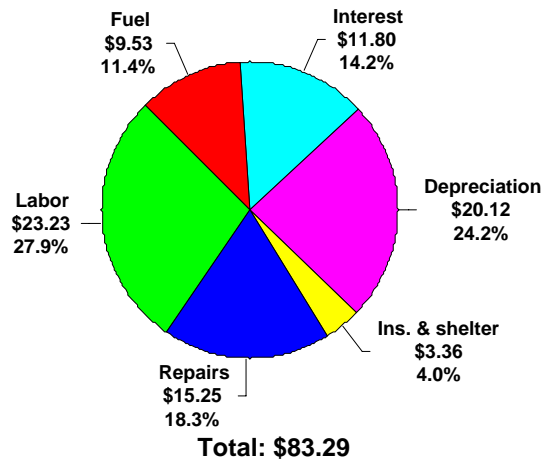
Year	Mar-Oct Diesel Price			Year-to-year percent change		
	SW KS	US (EIA)	Average	SW KS	US (EIA)	Average
2000	\$1.09	\$1.04	\$1.07	----	----	----
2001	\$1.09	\$0.98	\$1.04	0.6%	-6.1%	-2.7%
2002	\$0.94	\$0.88	\$0.91	-14.1%	-10.0%	-12.1%
2003	\$1.05	\$1.05	\$1.05	12.1%	18.6%	15.3%
2004	\$1.37	\$1.34	\$1.36	30.0%	28.4%	29.2%
2005	\$2.04	\$2.02	\$2.03	48.5%	49.9%	49.2%
2006 (F)	\$2.00	\$2.05	\$2.03	-1.5%	1.8%	0.2%
2006 - 2005	(\$0.03)	\$0.04	\$0.00	-1.5%	1.8%	0.2%
06 - Avg(00-04)	\$0.89	\$0.99	\$0.94	80.7%	93.7%	87.0%

F = forecast

Based on 2/20/06 futures closing prices

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

**Machinery Costs Per Acre, Kansas, 2001**  
Source: 182 KFMA Members (Beaton)



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

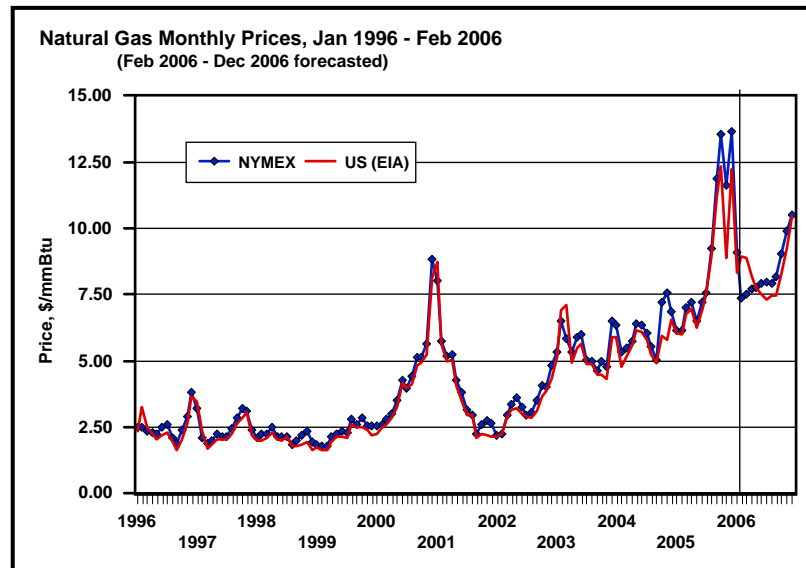
**Diesel Price Impact on Custom Rates for Various Field Operations**

Operation	Custom rate*	Fuel price increase, \$/gallon				
		(\$0.05)	\$0.00	\$0.10	\$0.25	\$0.50
Increase in custom rate, \$/acre						
Chiseling	\$8.45	(\$0.04)	\$0.00	\$0.08	\$0.19	\$0.39
Field cultivation	\$7.13	(\$0.03)	\$0.00	\$0.07	\$0.16	\$0.33
Disking	\$6.84	(\$0.03)	\$0.00	\$0.06	\$0.16	\$0.31
Min-till planter	\$10.94	(\$0.05)	\$0.00	\$0.10	\$0.25	\$0.50
No-till drill	\$11.45	(\$0.05)	\$0.00	\$0.10	\$0.26	\$0.52
Sprayer	\$4.26	(\$0.02)	\$0.00	\$0.04	\$0.10	\$0.20
Swather-conditioner	\$9.46	(\$0.04)	\$0.00	\$0.09	\$0.22	\$0.43
Round baler	\$8.24	(\$0.04)	\$0.00	\$0.08	\$0.19	\$0.38
Combine--wheat	\$15.24	(\$0.07)	\$0.00	\$0.14	\$0.35	\$0.70
Combine--soybeans	\$21.48	(\$0.10)	\$0.01	\$0.20	\$0.49	\$0.98
Combine--corn	\$21.68	(\$0.10)	\$0.01	\$0.20	\$0.50	\$0.99

\* 2005 state average reported by Kansas Agricultural Statistics

**Increase in 2005 custom rates      -0.5%    0.0%    0.9%    2.3%    4.6%**

**Natural gas prices have been falling, but they are still at historically high levels...**



Based on 2/20/06 futures closing prices

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

### Natural Gas Prices

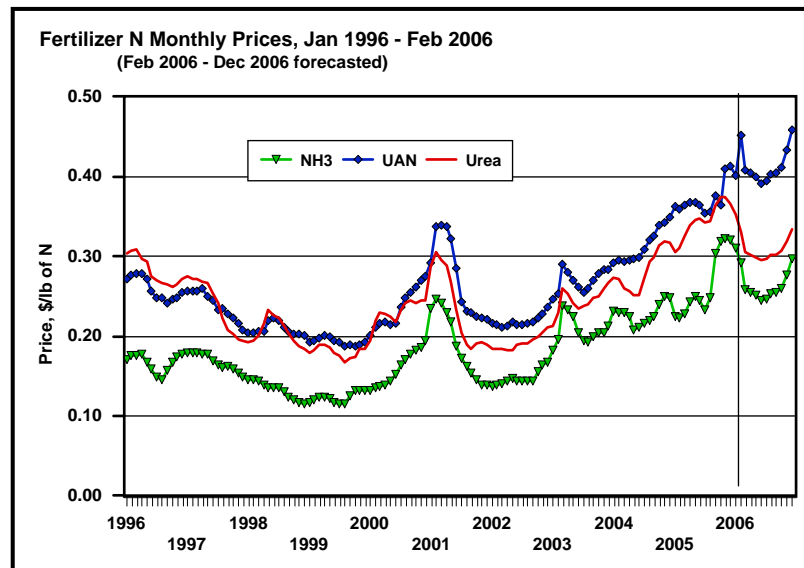
Year	Mar-Sep Natural Gas Price			Year-to-year percent change		
	NYMEX	US (EIA)	Average	NYMEX	US (EIA)	Average
2000	\$3.89	\$3.85	\$3.87	----	----	----
2001	\$3.85	\$3.49	\$3.67	-1.0%	-9.3%	-5.1%
2002	\$3.25	\$3.12	\$3.18	-15.5%	-10.7%	-13.2%
2003	\$5.40	\$5.24	\$5.32	66.0%	68.2%	67.1%
2004	\$5.81	\$5.63	\$5.72	7.6%	7.5%	7.5%
2005	\$8.09	\$8.37	\$8.23	39.2%	48.6%	43.9%
2006 (F)	\$8.23	\$7.87	\$8.05	1.7%	-6.0%	-2.2%
2006 - 2005	\$0.14	(\$0.50)	(\$0.18)	1.7%	-6.0%	-2.2%
06 - Avg(00-04)	\$3.79	\$3.60	\$3.70	85.4%	84.5%	84.9%

F = forecast

Based on 2/20/06 futures closing prices

9

## Nitrogen fertilizer prices are at historically high levels...



Based on 2/20/06 futures closing prices

10

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

### Fertilizer Prices (Corn Belt)

Year	NH3 (82%)	UAN (32%)	Urea (46%)	- P -	- K -	Wtd Avg	Yr-to-yr % 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)	0.291	0.407	0.338	0.234	0.199	0.303	13.6%
2006 - 2005	\$0.053	\$0.050	\$0.016	\$0.011	\$0.025	\$0.036	13.6%
Percent chg	22.2%	14.1%	5.0%	5.0%	14.3%	13.6%	
06 - Avg(00-04)	\$0.109	\$0.153	\$0.108	\$0.028	\$0.054	\$0.098	47.5%
Percent chg	60.3%	60.2%	46.7%	13.7%	37.5%	47.5%	

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

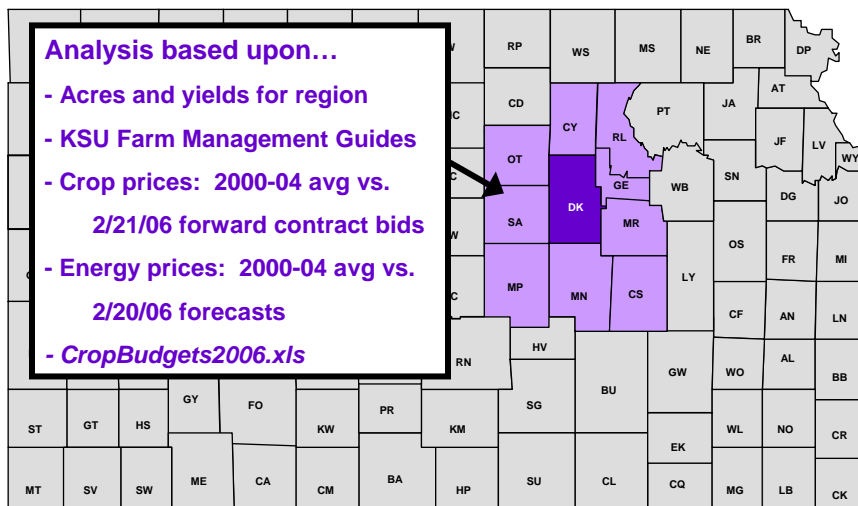
F = forecast (based on 2/20/06 futures closing prices)

12

## Analysis of Crop Profitability

### Analysis based upon...

- Acres and yields for region
- KSU Farm Management Guides
- Crop prices: 2000-04 avg vs. 2/21/06 forward contract bids
- Energy prices: 2000-04 avg vs. 2/20/06 forecasts
- CropBudgets2006.xls



15

## Cost scenarios...

Input	Average Prices	Current Prices
Machinery	2000-04 time-adjusted custom rates	2000-04 time-adjusted rates x 108.5%
Fertilizer	2000-04 avg	2006 forecast
N	\$0.212/lb	\$0.332/lb (+57%)
P	\$0.205/lb	\$0.234/lb (+14%)
K	\$0.144/lb	\$0.199/lb (+38%)
Irrigation	2000-04 avg \$1.18/inch	2006 forecast \$2.22/inch (+88%)

16

Microsoft Excel - KSU-CropBudgets2006 (DG Co -- Dryland crops).xls

Dryland crop budgets

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels							
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower	Alfalfa	Rotation1
Rotation (1 or 2, if none enter 0)	1	1	1	1	1	1	
Percent of rotation (total - 100%)	75.0%	3.0%	10.0%	12.0%	0.0%	0.0%	100%
<b>INCOME PER ACRE</b>							
A. Yield per acre	47.6	79.3	59.4	21.3	1,192.7	3.4	---
B. Price per unit	\$2.93	\$2.03	\$1.85	\$4.96	\$0.110	\$72.00	---
C. Net government payments	\$15.00	\$15.00	\$15.00	\$15.00	\$15.00	\$15.00	\$15.00
D. Indemnity payments	\$0.00	\$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	\$0.00
F. Returns/acre ((A x B) + C + D + E)	\$154.47	\$175.83	\$124.88	\$120.93	\$146.20	\$259.44	\$148.12
<b>COSTS PER ACRE</b>							
1. Seed	\$8.40	\$43.20	\$11.80	\$37.80	\$18.04	\$11.13	\$13.31
2. Herbicide	5.23	29.66	27.28	11.20	12.11	2.98	8.88
3. Insecticide / Fungicide	0.00	0.00	0.00	0.00	14.33	6.69	0.00
4. Fertilizer and Lime	26.10	25.99	17.84	8.85	15.75	21.84	23.20
5. Crop Consulting	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Crop Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Drying	0.00	0.00	0.00	0.00	4.65	0.00	0.00
8. Miscellaneous	6.50	6.50	6.50	6.50	6.50	6.50	6.50
9. Machinery Expense	56.87	49.83	57.10	47.46	46.85	113.74	55.55
10. Non-machinery Labor	6.70	7.50	7.50	5.50	6.50	12.50	6.66
11. Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12. Land Charge / Rent	43.35	43.35	43.35	43.35	43.35	43.35	43.35
G. SUB TOTAL	\$153.15	\$206.03	\$171.36	\$160.66	\$168.08	\$218.73	\$157.46
13. Interest on 1/2 Nonland Costs	4.39	6.51	5.12	4.69	4.80	7.02	4.56
H. TOTAL COSTS	\$157.54	\$212.54	\$176.48	\$165.35	\$172.88	\$225.75	\$162.02
I. RETURNS OVER COSTS (F - H)	(\$3.08)	(\$36.71)	(\$51.61)	(\$44.42)	(\$26.68)	\$33.69	(\$13.90)
J. TOTAL COSTS/UNIT (H/A)	\$3.31	\$2.68	\$2.97	\$7.75	\$0.14	\$66.49	---
K. RETURN TO ANNUAL COST ((I+13)/G)	0.86%	-14.66%	-27.13%	-24.73%	-13.02%	18.61%	-5.93%

Ready

## Dryland crops example profitability summary ...

### Comparison of Crop Returns under Various Input Price Scenarios

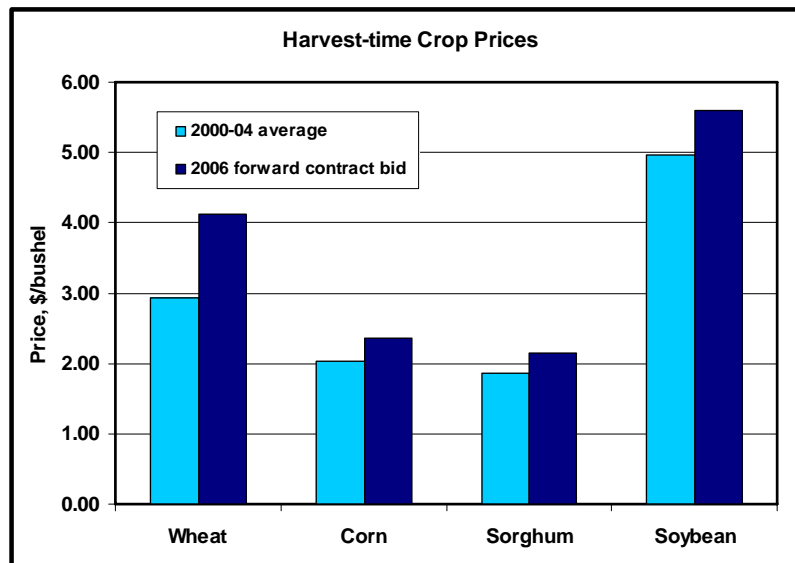
Crop	Wheat	Corn	Sorghum	Soybean	Wtd Avg
Base scenario <sup>1</sup>	(\$3.08)	(\$36.71)	(\$51.61)	(\$44.42)	(\$13.90)
At forecasted 2006 prices for...					
Fuel <sup>2</sup>	(\$8.08)	(\$41.10)	(\$56.63)	(\$48.59)	(\$18.79)
Fertilizer <sup>2</sup>	(\$12.34)	(\$45.10)	(\$55.96)	(\$44.98)	(\$21.60)
Irrigation pumping <sup>2</sup>	na	na	na	na	na
Fuel, fert, and irr pumping <sup>2</sup>	(\$17.33)	(\$49.46)	(\$60.96)	(\$49.16)	(\$26.48)
<b>Cost change, \$/ac</b>	<b>(\$14.25)</b>	<b>(\$12.75)</b>	<b>(\$9.36)</b>	<b>(\$4.74)</b>	<b>(\$12.58)</b>

<sup>1</sup>Returns based on current Farm Management Guide costs except fuel, fertilizer, and irrigation pumping (2000-04 avg) and long-run planning prices.

<sup>2</sup>All other costs and crop prices are the same as in base scenario (yields vary with fertilizer and irrigation costs).

18

## While input prices are higher, so are crop prices...



19

## Dryland crops example profitability summary ...

### Comparison of Crop Returns under Various Input Price Scenarios

Crop	Wheat	Corn	Sorghum	Soybean	Wtd Avg
Base scenario <sup>1</sup>	(\$3.08)	(\$36.71)	(\$51.61)	(\$44.42)	(\$13.90)
At forecasted 2006 prices for...					
Fuel <sup>2</sup>	(\$8.08)	(\$41.10)	(\$56.63)	(\$48.59)	(\$18.79)
Fertilizer <sup>2</sup>	(\$12.34)	(\$45.10)	(\$55.96)	(\$44.98)	(\$21.60)
Irrigation pumping <sup>2</sup>	na	na	na	na	na
Fuel, fert, and irr pumping <sup>2</sup>	(\$17.33)	(\$49.46)	(\$60.96)	(\$49.16)	(\$26.48)
<b>Crops<sup>2</sup></b>	<b>\$35.49</b>	<b>(\$27.30)</b>	<b>(\$46.85)</b>	<b>(\$38.59)</b>	<b>\$16.48</b>
<b>Cost change, \$/ac</b>	<b>(\$14.25)</b>	<b>(\$12.75)</b>	<b>(\$9.36)</b>	<b>(\$4.74)</b>	<b>(\$12.58)</b>

<sup>1</sup>Returns based on current Farm Management Guide costs except fuel, fertilizer, and irrigation pumping (2000-04 avg) and long-run planning prices.

<sup>2</sup>All other costs and crop prices are the same as in base scenario (yields vary with fertilizer and irrigation costs).

20

## Management options...

- While crop prices might be alleviating some of the problem, cost control will still be important
- What can producers do in response to the high input prices?
- Choices will center around crop selection and input use (i.e., fertilizer, fuel for machinery and irrigation)

21

## Crop selection...

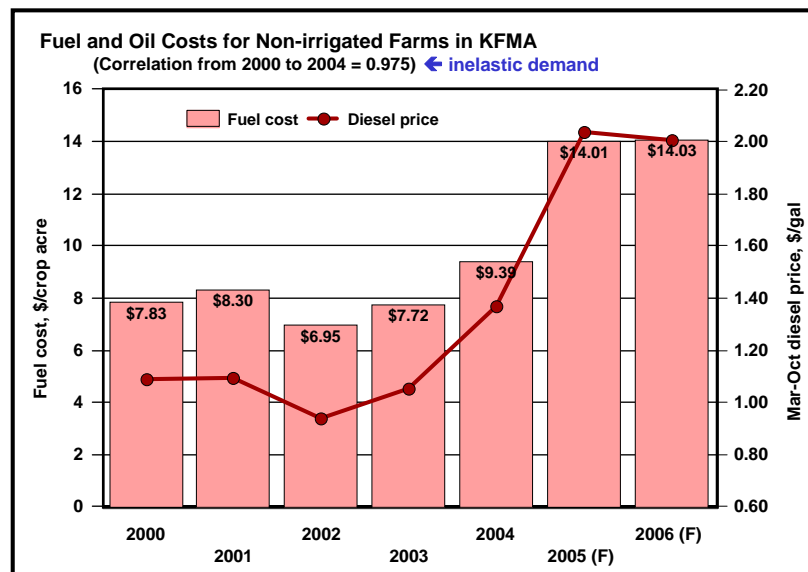
### K-State Crop Budgets as resources

- Projected budgets – Farm Management Guides
- Actual budgets – KFMA Enterprise Analysis
- *KSU-CropBudgets2006.xls*
- All are available on [www.agmanager.info](http://www.agmanager.info)



22

## Fuel costs per acre versus diesel prices...



Without any change, costs in 2005 & 2006 will be up substantially on average.

23

## What can producers do in response to higher machinery costs?

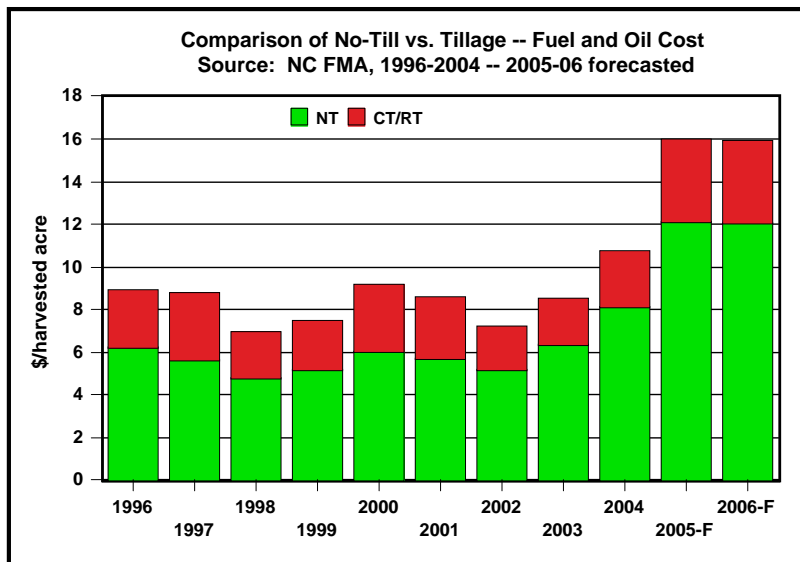
Without any change, costs of machinery operations will increase about 7-10% from more “normal” times.

### Things to consider...

- Reduce operations?
- Hire custom operators?
- Make sure machinery is properly maintained and used efficiently?
- Pass increased costs on to landowners?
- Nothing?

26

## Fuel-savings benefit of no-till increases at higher prices...

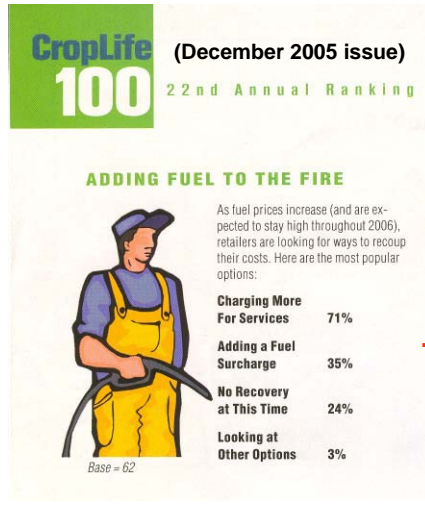


NT fuel generally 67-75% of CT/RT, savings could be as high as \$4/acre at current diesel prices...

29

## What can a producer do?

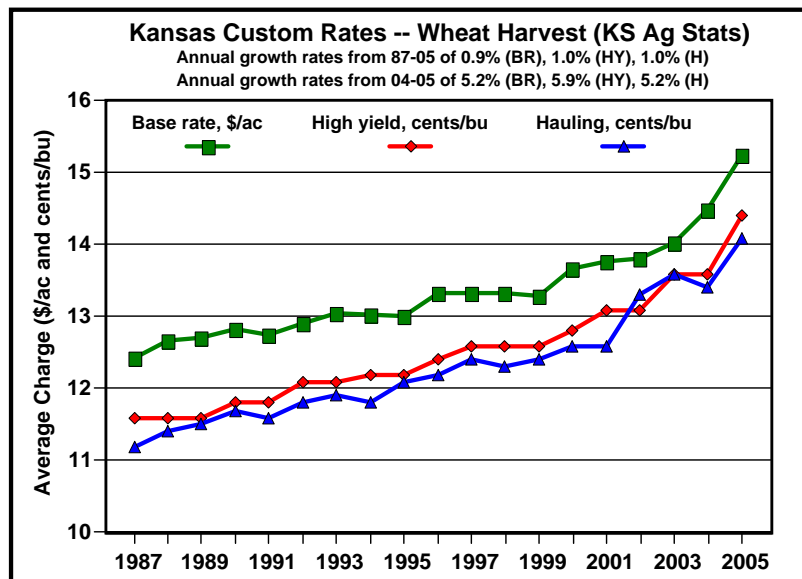
Hiring custom operators likely will not be the answer...



... while some custom operators might not increase their rates, something will likely have to give (quality of work?).

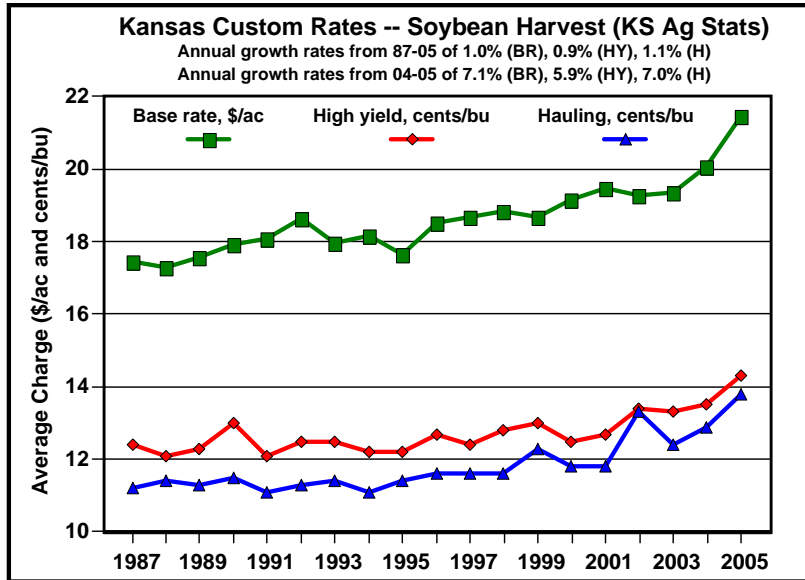
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## Custom harvesters raised their rates in 2005...



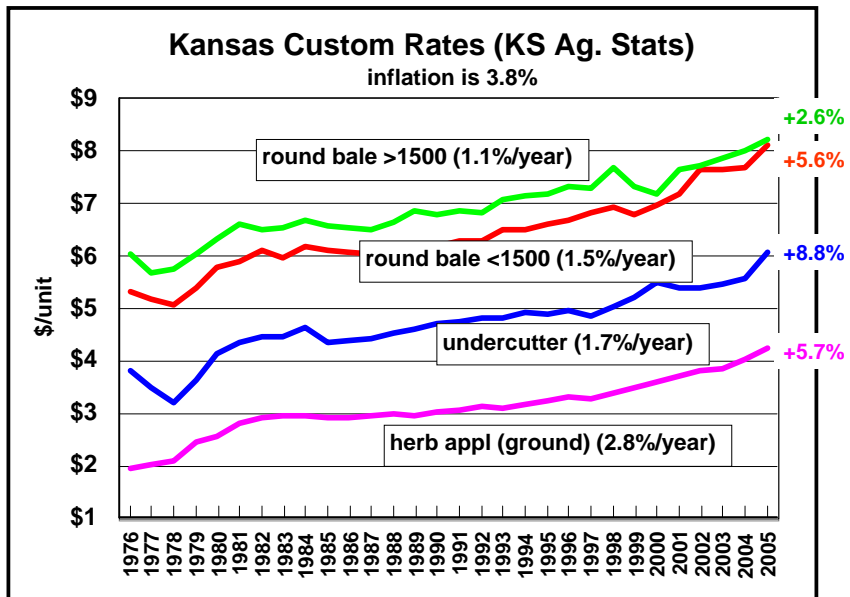
31

## Custom harvesters raised their rates in 2005...



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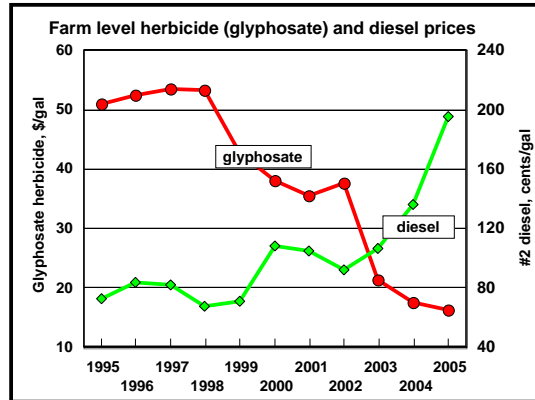
## Not all custom rates increased as much in 2005...



34

## What can a producer do?

- Benefits of “improved machinery operation” will depend on current situation. While benefit for most producers is likely quite small, cost of doing so is also likely small → *Just do it!*
- If you have been thinking of no-till, but have been reluctant to make the change --- now might be the time to make the switch!



Microsoft Excel - KSU Irrigation Energy Cost.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Impact of energy prices on irrigation pumping costs

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KSU Irrigation Energy Costs.xls -----  
A spreadsheet program to compare the costs of irrigation energy options.  
Version -- 11.08.05

**DESCRIPTION OF INPUTS**  
In the spreadsheet all blue numbers are inputs and all black numbers are calculated from these 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 PUBLICATIONS**  
This spreadsheet is based on the publication "Developing a Spreadsheet Template for Comparing Irrigation Energy Costs" (AF-161) by David A. Pacey and Freddie R. Lamm. In addition, K-State Farm Management Guide crop budgets and other useful information is available via the K-State Agricultural Economics website ([www.agmanager.info](http://www.agmanager.info)).

**Developed by:**

Kevin C. Dhuyvetter Extension Agricultural Economist Kansas State University voice: (785) 532-3527 FAX: (785) 532-6925 email: <a href="mailto:kcd@ksu.edu">kcd@ksu.edu</a>	Troy J. Dumler Extension Agricultural Economist, SW Kansas State University voice: (620) 275-9164 FAX: (620) 276-6028 email: <a href="mailto:tdumler@oznet.ksu.edu">tdumler@oznet.ksu.edu</a>
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KSU Irrigation Energy Costs.xls available at [www.agmanager.info](http://www.agmanager.info)

Intro / Irr energy costs /

start

11:40 AM

Microsoft Excel - KSU Irrigation Energy Cost.xls

IRRIGATION ENERGY COST COMPARISON

Print tables

Compares energy costs of irrigation pumping with different fuels at various prices and levels of performance. % NPPPC is percent of Nebraska Pumping Plant Performance Criteria.

INPUT-----

Acres	↑	Electric:	0.080 \$/kWh	90 % NPPPC
Inches Applied	↑	Nat. Gas:	6.00 \$/mcf	90 % NPPPC
Feet Lift	300	Diesel:	1.10 \$/gal	90 % NPPPC
PSI Pressure	20	Propane:	0.90 \$/gal	90 % NPPPC

OUTPUT-----

Energy Source	Energy Cost (\$)	Energy Use	Cost as percent of:			
			Elec.	Nat. Gas	Diesel	Propane
Electricity	3.98	50 kWh	100%	93%	103%	69%
Natural Gas	4.28	1 mcf	108%	100%	111%	74%
Diesel	3.87	4 gal	97%	90%	100%	67%
Propane	5.75	6 gal	145%	134%	148%	100%

Nebraska Pumping Plant Performance Criteria\*

0.885	whp-hr/kWh Electricity
61.7	whp-hr/mcf Natural Gas
12.5	whp-hr/gal Diesel
6.89	whp-hr/gal Propane

\* These factors represent what a well-designed and maintained irrigation pumping plant should be capable of doing (i.e., work done per unit of fuel) based on the Nebraska Pumping Plant Performance Criteria (NPPPC).

ENERGY PUMPING COST/ACRE WITH ELECTRICITY

\$/kWh	Pressure (PSI)						
	5.0	15.0	25.0	35.0	45.0	55.0	65.0
\$0.050	2.24	2.40	2.57	2.74	2.90	3.07	3.23
\$0.060	2.68	2.88	3.08	3.28	3.48	3.68	3.88
\$0.070	3.13	3.36	3.60	3.83	4.06	4.29	4.53
\$0.080	3.58	3.85	4.11	4.38	4.64	4.91	5.17
\$0.090	4.03	4.33	4.62	4.92	5.22	5.52	5.82
\$0.100	4.47	4.81	5.14	5.47	5.80	6.13	6.47
\$0.110	4.92	5.29	5.65	6.02	6.38	6.75	7.11

conversion factor: 11.44  
TDH/lb of psi: 2.31  
square feet per acre: 43,560  
pounds/cubic foot water: 62.4  
percent: 100  
inch/foot: 12  
foot pound/minute-hp: 33,000  
minutes/hour: 60

## Irrigation pumping costs versus energy prices (100')...

### ENERGY PUMPING COST/ACRE WITH NATURAL GAS

\$/mcf	Pressure (PSI)						
	5.0	15.0	25.0	35.0	45.0	55.0	65.0
\$4.00	0.92	1.11	1.30	1.49	1.68	1.87	2.06
\$5.00	1.15	1.39	1.62	1.86	2.10	2.34	2.58
\$6.00	1.38	1.66	1.95	2.24	2.52	2.81	3.09
\$7.00	1.61	1.94	2.27	2.61	2.94	3.27	3.61
\$8.00	1.84	2.22	2.60	2.98	3.36	3.74	4.12
\$9.00	2.07	2.50	2.92	3.35	3.78	4.21	4.64
\$10.00	2.30	2.77	3.25	3.73	4.20	4.68	5.15

Based on applying 1.0 inches/acre and a lift of 100 feet

### ENERGY PUMPING COST/ACRE WITH DIESEL

\$/gal	Pressure (PSI)						
	5.0	15.0	25.0	35.0	45.0	55.0	65.0
\$0.75	0.85	1.03	1.20	1.38	1.56	1.73	1.91
\$1.00	1.13	1.37	1.60	1.84	2.07	2.31	2.54
\$1.25	1.42	1.71	2.01	2.30	2.59	2.89	3.18
\$1.50	1.70	2.05	2.41	2.76	3.11	3.46	3.82
\$1.75	1.99	2.40	2.81	3.22	3.63	4.04	4.45
\$2.00	2.27	2.74	3.21	3.68	4.15	4.62	5.09
\$2.25	2.55	3.08	3.61	4.14	4.67	5.19	5.72

Based on applying 1.0 inches/acre and a lift of 100 feet

## Irrigation pumping costs versus energy prices (300')...

### ENERGY PUMPING COST/ACRE WITH NATURAL GAS

\$/mcf	Pressure (PSI)						
	5.0	15.0	25.0	35.0	45.0	55.0	65.0
	----- Energy Cost (\$/Acre) -----						
\$4.00	2.57	2.76	2.95	3.14	3.33	3.52	3.71
\$5.00	3.21	3.45	3.69	3.92	4.16	4.40	4.64
\$6.00	3.85	4.14	4.42	4.71	4.99	5.28	5.56
\$7.00	4.49	4.83	5.16	5.49	5.83	6.16	6.49
\$8.00	5.13	5.52	5.90	6.28	6.66	7.04	7.42
\$9.00	5.78	6.20	6.63	7.06	7.49	7.92	8.35
\$10.00	6.42	6.89	7.37	7.85	8.32	8.80	9.27

Based on applying 1.0 inches/acre and a lift of 300 feet

### ENERGY PUMPING COST/ACRE WITH DIESEL

\$/gal	Pressure (PSI)						
	5.0	15.0	25.0	35.0	45.0	55.0	65.0
	----- Energy Cost (\$/Acre) -----						
\$0.75	2.38	2.55	2.73	2.90	3.08	3.26	3.43
\$1.00	3.17	3.40	3.64	3.87	4.11	4.34	4.58
\$1.25	3.96	4.25	4.55	4.84	5.13	5.43	5.72
\$1.50	4.75	5.10	5.46	5.81	6.16	6.51	6.87
\$1.75	5.54	5.96	6.37	6.78	7.19	7.60	8.01
\$2.00	6.34	6.81	7.28	7.75	8.22	8.69	9.16
\$2.25	7.13	7.66	8.19	8.71	9.24	9.77	10.30

Based on applying 1.0 inches/acre and a lift of 300 feet

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## Corn Nitrogen Rate Calculator

Finding the Maximum Return To N

This web site provides a process to calculate economic return to N application with different nitrogen and corn prices and to find profitable N rates directly from recent N rate research data. The method used follows a newly developed regional approach for determining corn N rate guidelines that is being implemented in several Corn Belt states.

Single Price Ratio | Multiple Price Ratios

Choose state: Iowa, Illinois, Minnesota, Wisconsin

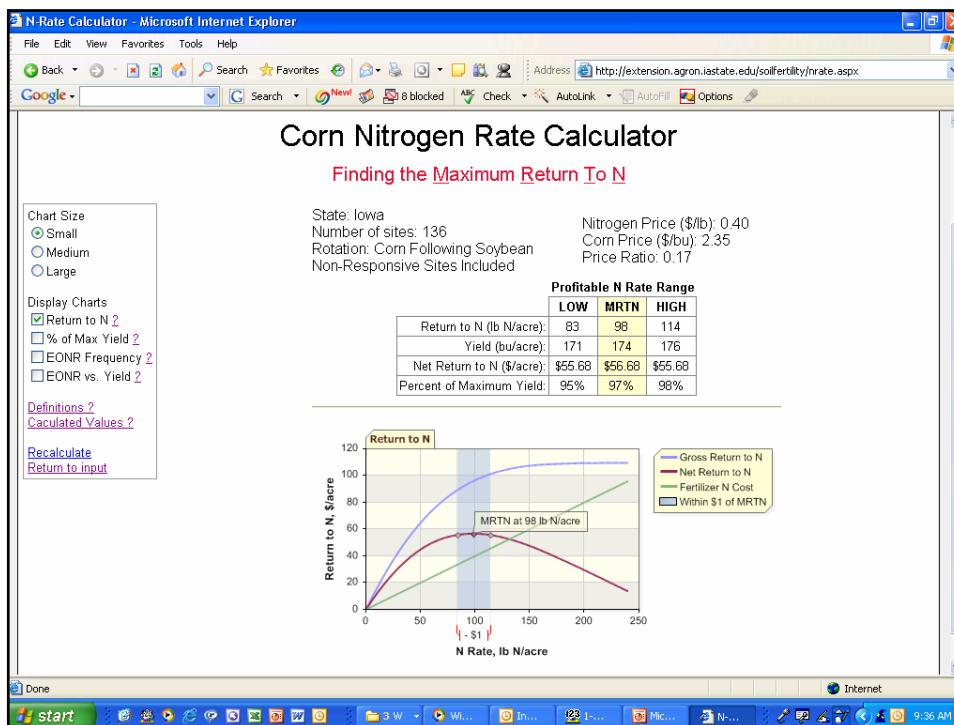
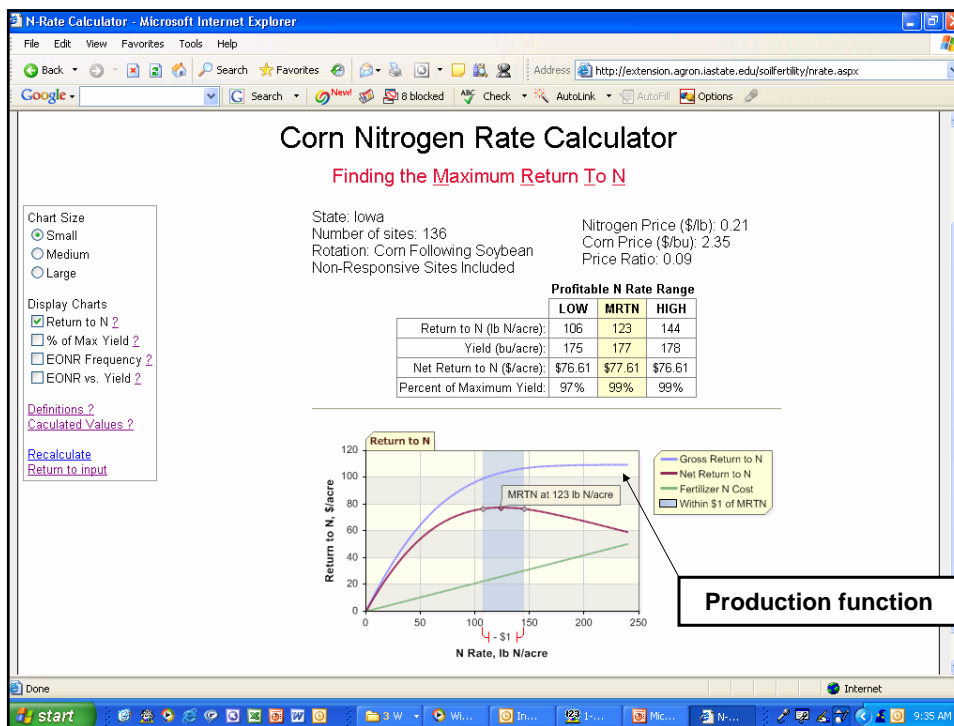
Choose rotation pattern(s):  
 Corn following soybean  
 Corn following corn

Include non-responsive sites

Set corn and nitrogen prices  
 Nitrogen price (\$/lb)

**Data to enter:**

- state
- rotation
- nitrogen price
- corn price





## Soil Test Interpretations and Fertilizer Recommendations

Nutrient Management

### KSU nitrogen recommendations...

#### Corn and grain sorghum

$N \text{ rec} = (\text{Yield Goal} \times 1.6) - (\%SOM \times 20) - \text{Profile N} - \text{Manure N} - \text{Other N Adjustments}$   
+ Previous Crop Adjustments

#### Wheat

$N \text{ rec} = (\text{Yield Goal} \times 2.4) - (\%SOM \times 10) - \text{Profile N} - \text{Manure N} - \text{Other N Adjustments}$   
+ Previous Crop Adjustments + Tillage Adjustments + Grazing Adjustments

#### Sunflowers

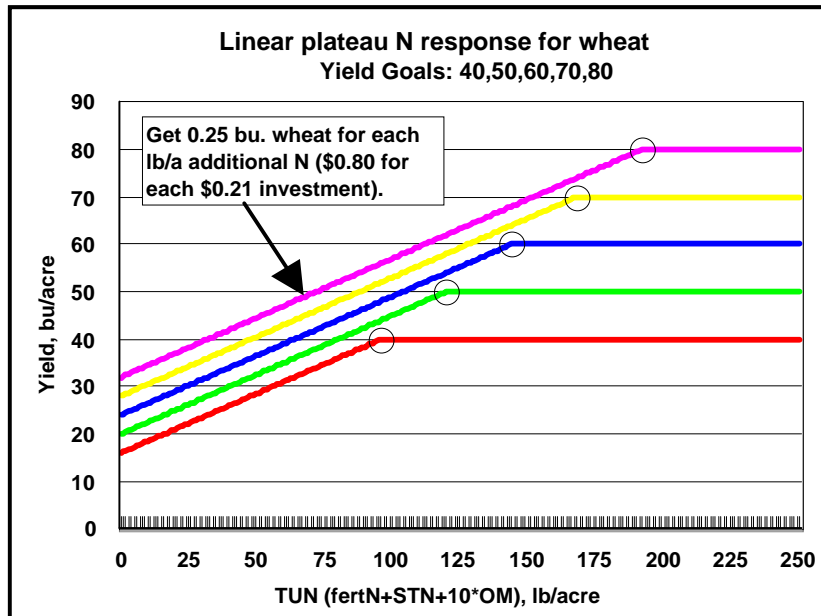
$N \text{ rec} = (\text{Yield Goal} \times 0.075) - (\%SOM \times 20) - \text{Profile N} - \text{Manure N} - \text{Other N Adjustments}$   
+ Previous Crop Adjustments

### 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

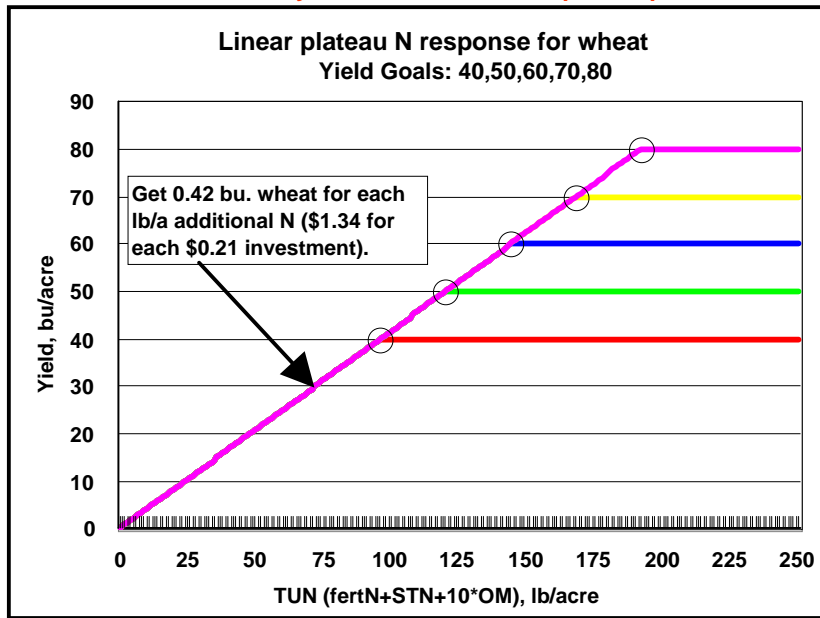
## Nitrogen production function...

- 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



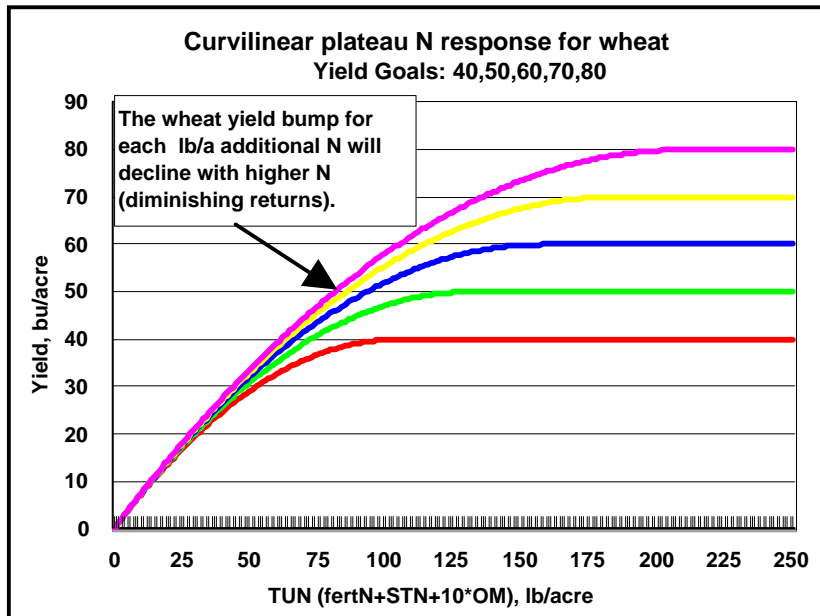
Price won't matter until fertN = \$0.80/lb, then optimal is 0 lb/acre

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



50

Functions might be curvilinear

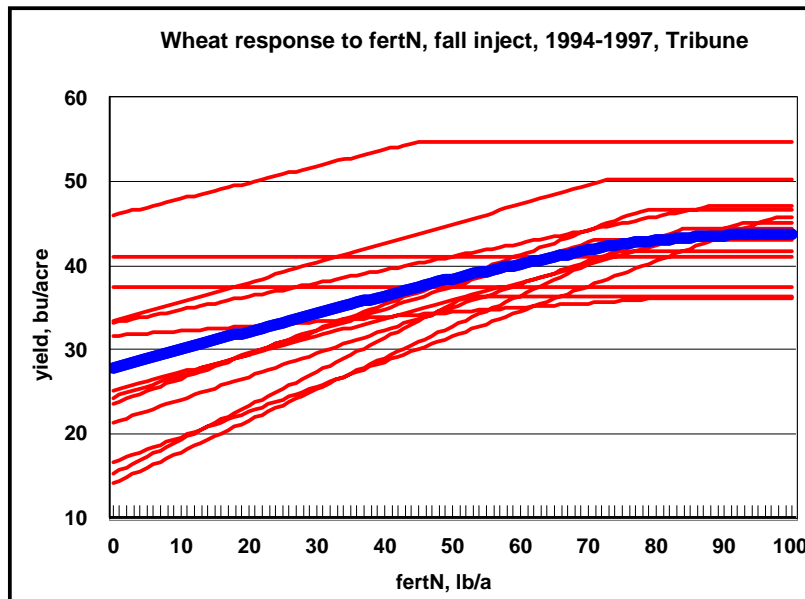


51

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

52

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



53

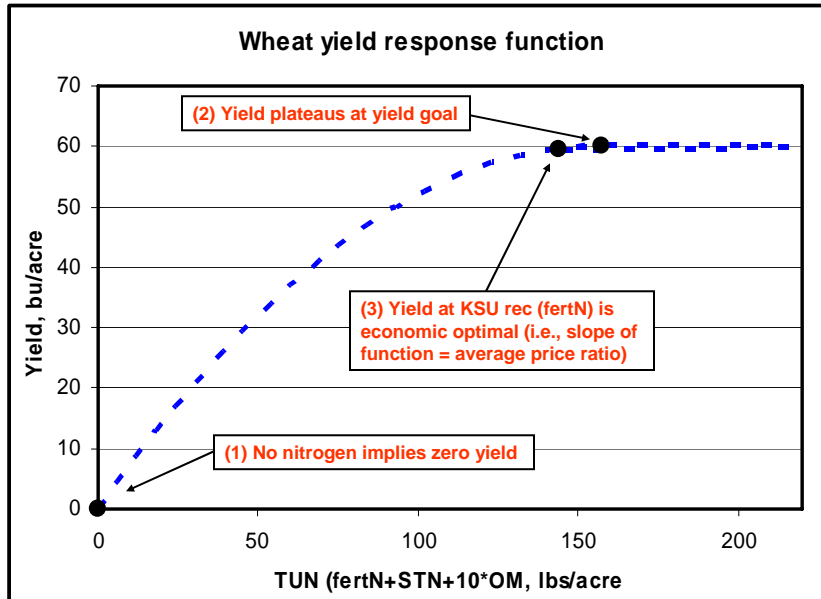
### **Functional form...**

- **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**

### **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...



58

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Excel spreadsheet for calculating optimal N and irrigation levels

Department of Agricultural Economics | KS State Research & Extension | College of Agriculture | Kansas State University

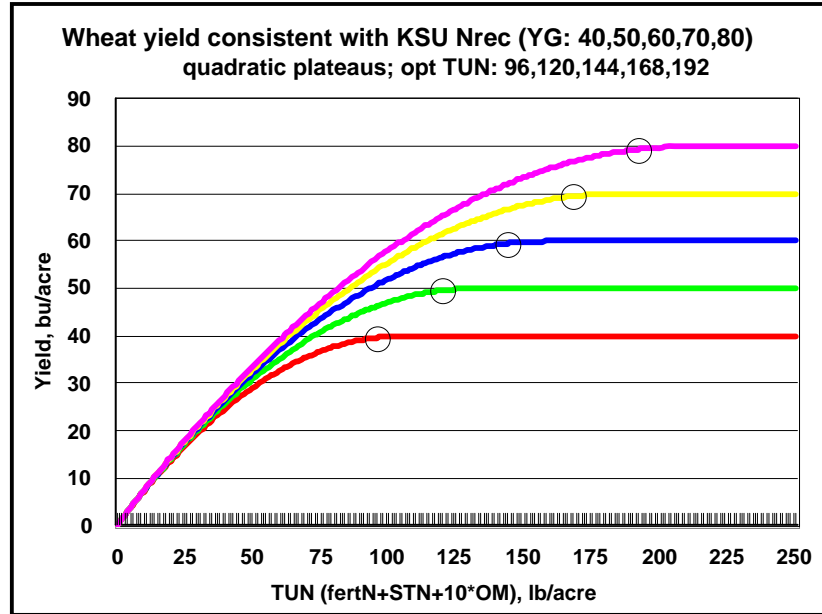
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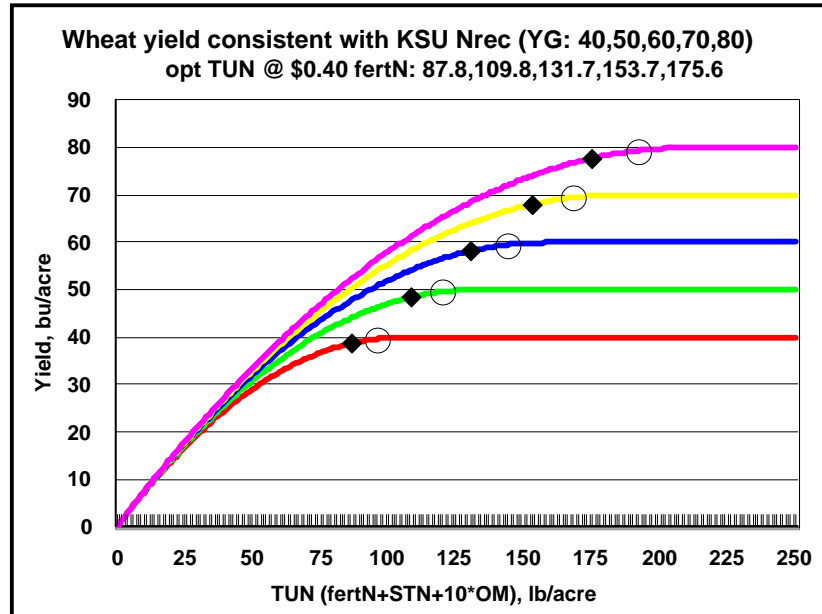
- Monthly NH3 and Diesel Price Forecasts  
January 14, 2006 by Kevin Dhuyvetter
- Updated Crop Basis Tool  
January 11, 2006 by Kevin Dhuyvetter
- Updated Cattle Databases  
December 23, 2005 by Jim Mintert
- Livestock and Hay Charts  
December 23, 2005 by Jim Mintert
- Crop Basis Maps  
December 21, 2005, by Kevin Dhuyvetter
- In The Cattle Markets  
December 20, 2005 by Jim Mintert/LMIC
- Grain Outlook  
December 15, 2005 by Mike Woolverton
- KSU-Crop Budgets 2006.xls**  
December 13, 2005 by Dhuyvetter et al.
- Modifying Fertilizer Recs to Reflect Price  
December 2, 2005 by Kastens et al.
- Impact of Energy Prices on KS Farm Costs  
December 2, 2005 by Dhuyvetter et al.

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



60

Slope at diamonds is 0.40/3.20



61

### Dryland optimal fertilizer N values – Long-run N and crop prices

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	75.0%	3.0%	10.0%	12.0%	0.0%
Yield Goal (YG), bu/ac	48.0	80.0	60.0	22.0	1200.0
Enter 0 for Dryland or 1 for Irrigated	0	0	0	0	0
Annual rainfall	28.0	28.0	28.0	28.0	28.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.212	\$0.212	\$0.212	\$0.212	\$0.212
Irrigation energy cost, \$/inch	\$2.220	\$2.220	\$2.220	\$2.220	\$2.220
KSU recommended nitrogen, lbs/ac	75.2	68.0	36.0	0.0	30.0
Econ Optimum fertN, lbs/ac	74.1	66.2	34.8	0.0	29.3
Econ Optimum Irrigation Amount, in	0.0	0.0	0.0	0.0	0.0
Yield at optimal N and I, bu/ac	47.6	79.3	59.4	21.3	1192.7
B. Price per unit	\$2.93	\$2.03	\$1.85	\$4.96	\$0.110

Optimal rates are very close to KSU recommendations because prices are similar to long-term averages

65

### Dryland optimal fertilizer N values – Current N and long-run crop prices

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	75.0%	3.0%	10.0%	12.0%	0.0%
Yield Goal (YG), bu/ac	48.0	80.0	60.0	22.0	1200.0
Enter 0 for Dryland or 1 for Irrigated	0	0	0	0	0
Annual rainfall	28.0	28.0	28.0	28.0	28.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.332	\$0.332	\$0.332	\$0.332	\$0.332
Irrigation energy cost, \$/inch	\$2.220	\$2.220	\$2.220	\$2.220	\$2.220
KSU recommended nitrogen, lbs/ac	75.2	68.0	36.0	0.0	30.0
Econ Optimum fertN, lbs/ac	67.3	59.0	28.8	0.0	25.0
Econ Optimum Irrigation Amount, in	0.0	0.0	0.0	0.0	0.0
Yield at optimal N and I, bu/ac	46.9	78.4	58.5	21.3	1182.2
B. Price per unit	\$2.93	\$2.03	\$1.85	\$4.96	\$0.110

Optimal rates are about 10-15% less than KSU recommendations at high N price

66

### Dryland optimal fertilizer N values – Current N and crop prices

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	75.0%	3.0%	10.0%	12.0%	0.0%
Yield Goal (YG), bu/ac	48.0	80.0	60.0	22.0	1200.0
Enter 0 for Dryland or 1 for Irrigated	0	0	0	0	0
Annual rainfall	28.0	28.0	28.0	28.0	28.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.332	\$0.332	\$0.332	\$0.332	\$0.332
Irrigation energy cost, \$/inch	\$2.220	\$2.220	\$2.220	\$2.220	\$2.220
KSU recommended nitrogen, lbs/ac	75.2	68.0	36.0	0.0	30.0
Econ Optimum fertN, lbs/ac	72.7	61.8	31.1	0.0	26.5
Econ Optimum Irrigation Amount, in	0.0	0.0	0.0	0.0	0.0
Yield at optimal N and I, bu/ac	47.5	78.8	58.9	21.3	1186.2
B. Price per unit	\$4.12	\$2.35	\$2.14	\$5.60	\$0.125

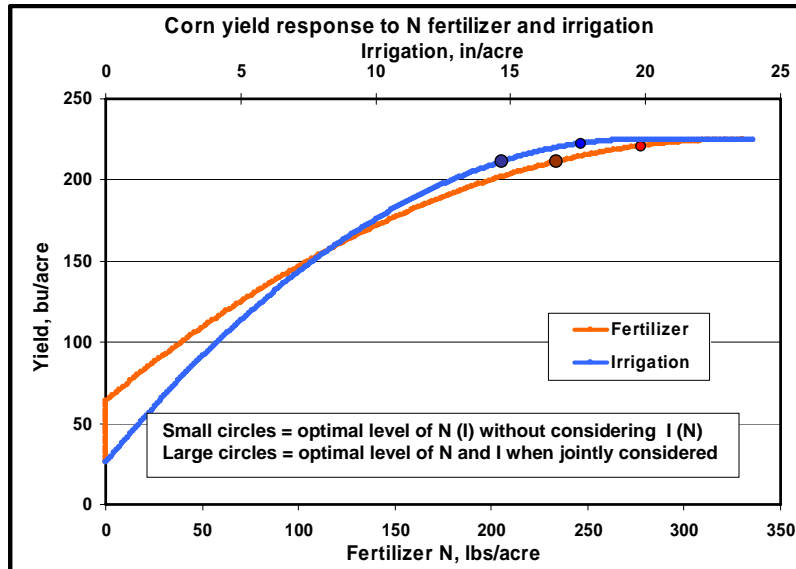
Optimal rates vary crop by crop due to N/crop price relationship

67

Extensions to research:  
 1) irrigation  
 2) phosphorus  
 3) value of soil sampling

68

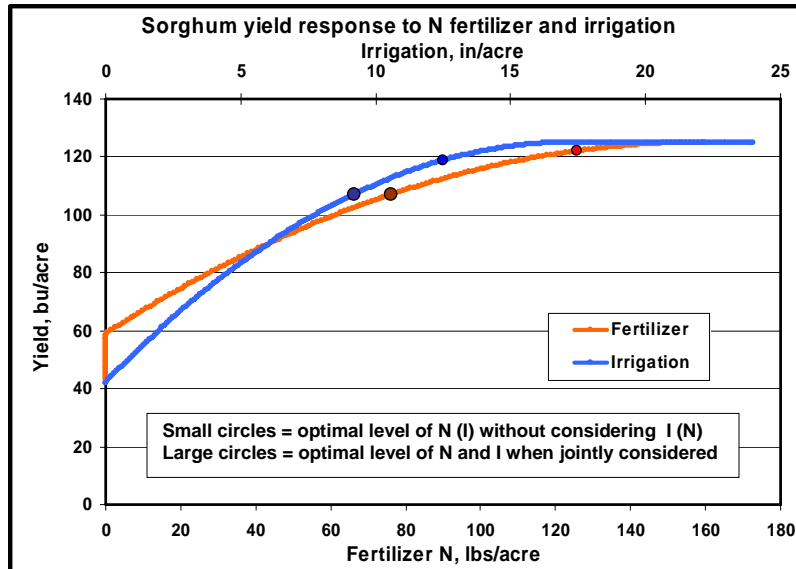
When considering irrigation and N together, optimal values decrease significantly...



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

69

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



Sorghum price = \$2.10/bu, N price = \$0.40/lb, irrigation cost = \$6.50/inch

71

**Irrigated optimal fertilizer N values @ \$0.21/lb N & \$3.10/in**

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	24.0%	49.0%	7.5%	6.0%	1.0%
Yield Goal (YG), bu/ac	75.0	225.0	125.0	65.0	2800.0
Enter 0 for Dryland or 1 for Irrigated	1	1	1	1	1
Annual rainfall	18.0	18.0	18.0	18.0	18.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.21	\$0.21	\$0.21	\$0.21	\$0.21
Irrigation energy cost, \$/inch	\$3.10	\$3.10	\$3.10	\$3.10	\$3.10
KSU recommended nitrogen, lbs/ac	140.0	300.0	140.0	0.0	150.0
Econ Optimum fertN, lbs/ac	112.3	278.3	113.5	0.0	124.6
Econ Optimum Irrigation Amount, in	12.6	17.1	12.8	16.6	15.0
Yield at optimal N and I, bu/ac	71.1	221.0	119.5	58.5	2706.4

Optimal rates are below KSU recommendations because of irrigation

**Irrigated optimal fertilizer N values @ \$0.40/lb N & \$3.10/in**

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	24.0%	49.0%	7.5%	6.0%	1.0%
Yield Goal (YG), bu/ac	75.0	225.0	125.0	65.0	2800.0
Enter 0 for Dryland or 1 for Irrigated	1	1	1	1	1
Annual rainfall	18.0	18.0	18.0	18.0	18.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.40	\$0.40	\$0.40	\$0.40	\$0.40
Irrigation energy cost, \$/inch	\$3.10	\$3.10	\$3.10	\$3.10	\$3.10
KSU recommended nitrogen, lbs/ac	140.0	300.0	140.0	0.0	150.0
Econ Optimum fertN, lbs/ac	96.7	250.7	95.9	0.0	110.3
Econ Optimum Irrigation Amount, in	10.9	15.6	11.1	16.6	13.5
Yield at optimal N and I, bu/ac	68.0	215.6	114.5	58.5	2630.3

Optimal rates decrease 10-15% at high N price

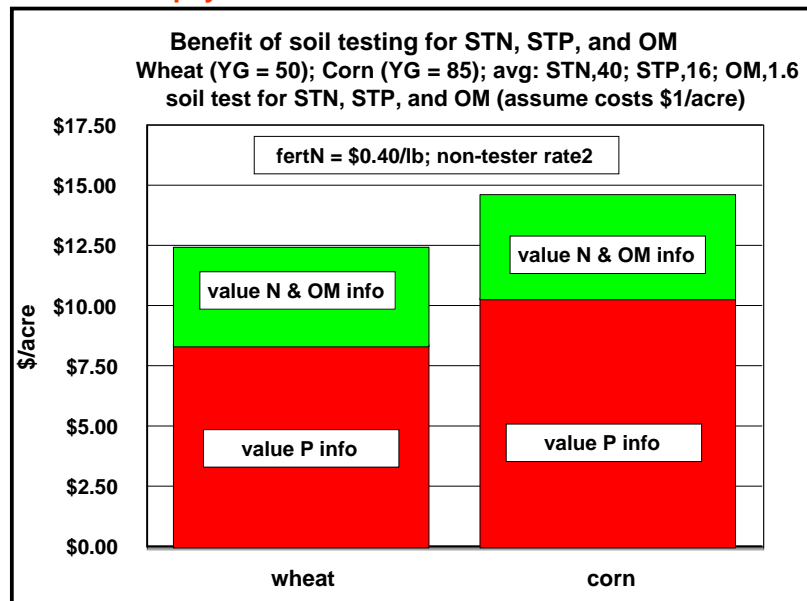
### Irrigated optimal fertilizer N values @ \$0.40/lb N & \$6.50/in

Comparison of Crop Returns with Nitrogen Fertilizer and Irrigation Water at Economic Optimum Levels					
Crop/System	Wheat	Corn	Sorghum	Soybean	Sunflower
Rotation (1 or 2, if none enter 0)	1	1	1	1	1
Percent of rotation (total - 100%)	24.0%	49.0%	7.5%	6.0%	1.0%
Yield Goal (YG), bu/ac	75.0	225.0	125.0	65.0	2800.0
Enter 0 for Dryland or 1 for Irrigated	1	1	1	1	1
Annual rainfall	18.0	18.0	18.0	18.0	18.0
Organic matter (OM), %	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
Other N adjustments, lbs/ac	0.0	0.0	0.0	0.0	0.0
Nitrogen fertilizer cost, \$/lb	\$0.40	\$0.40	\$0.40	\$0.40	\$0.40
Irrigation energy cost, \$/inch	\$6.50	\$6.50	\$6.50	\$6.50	\$6.50
KSU recommended nitrogen, lbs/ac	140.0	300.0	140.0	0.0	150.0
Econ Optimum fertN, lbs/ac	66.5	224.9	66.9	0.0	82.7
Econ Optimum Irrigation Amount, in	7.6	14.2	8.3	15.2	10.6
Yield at optimal N and I, bu/ac	59.2	208.6	102.7	58.5	2419.5

At high N and irrigation costs, optimal rates decrease significantly

75

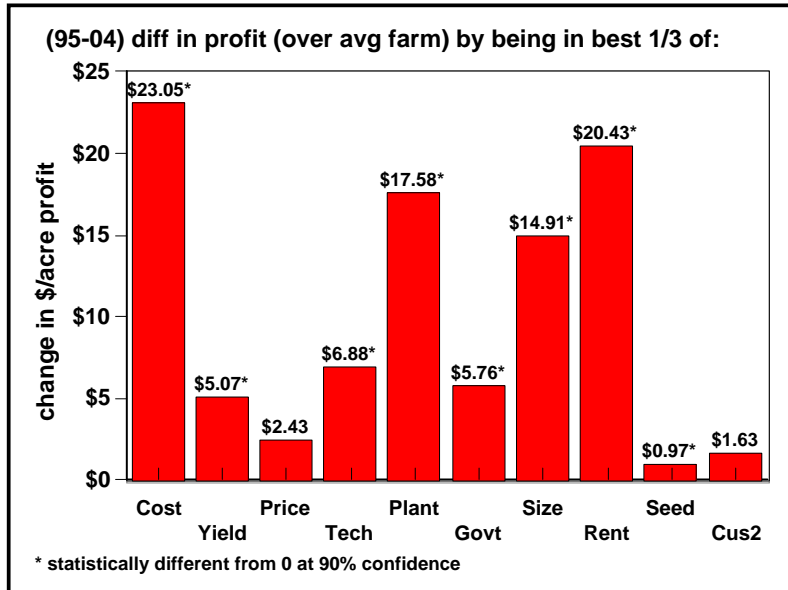
### Soil test – it pays!



P information more valuable than N information

85

**Good cost management will likely be even more valuable with high input prices...**



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- [Modifying Fertilizer Recs to Reflect Price](#)  
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November 8, 2005 by *Dhuyvetter et al*

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