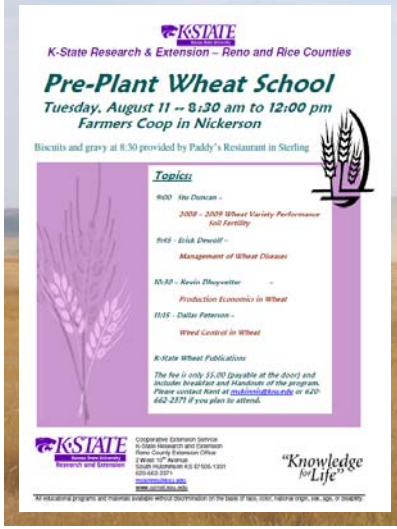
Wheat Production Economics



Kevin C. Dhuyvetter
kcd@ksu.edu -- 785-532-3527

Michael Langemeier
mlange@agecon.ksu.edu
785-532-1507

Department of Agricultural Economics
Kansas State University

AG MANAGER.INFO
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Outline of presentation…

- Overview of historical costs and returns for wheat and alternative crops
- Analysis of costs and returns by tillage system
- Impact of crop and fertilizer prices on economic optimal fertilizer rates

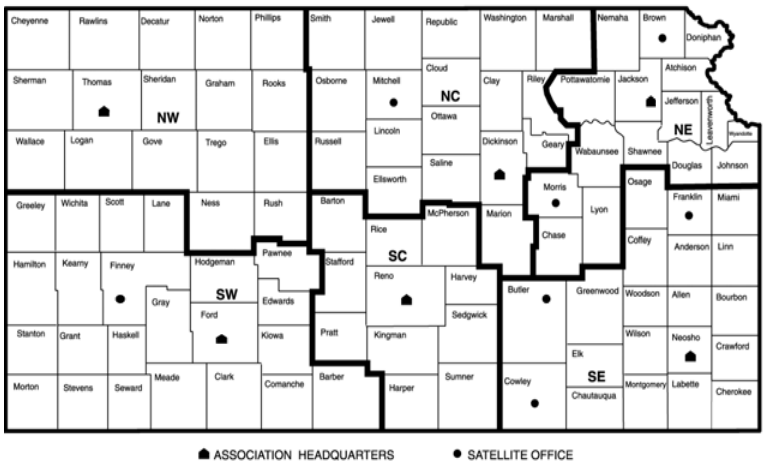
Crop economic considerations…

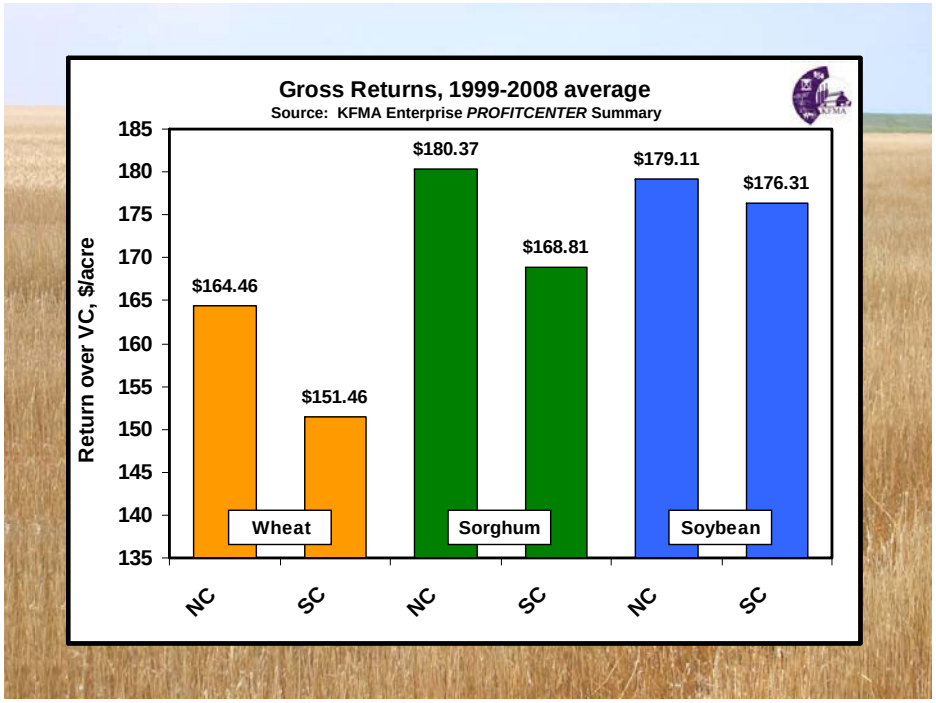
Historical profitability (wheat vs alternative crops)

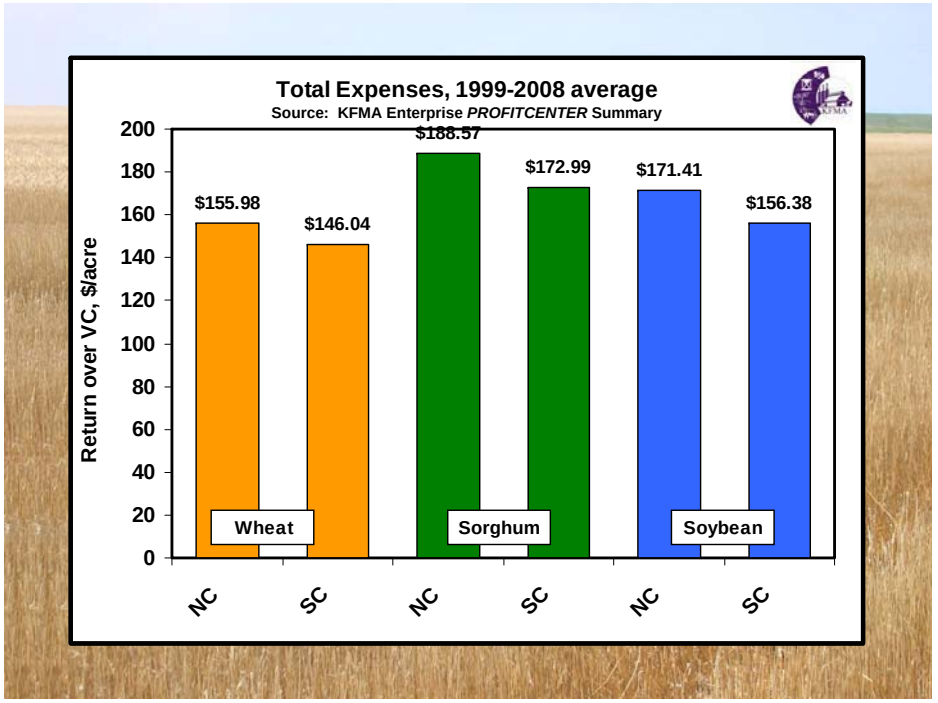
- Short run – return over variable costs
- Long run – return over total costs
- Variability of returns over time (i.e., risk)

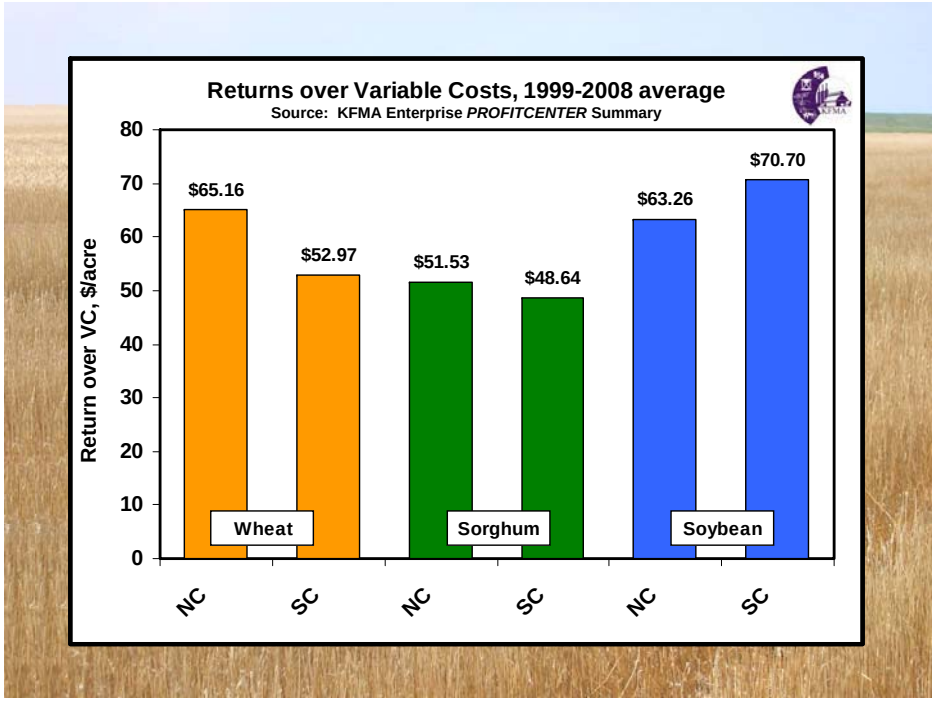
Difference in average costs and returns across producers (factors affecting profitability)

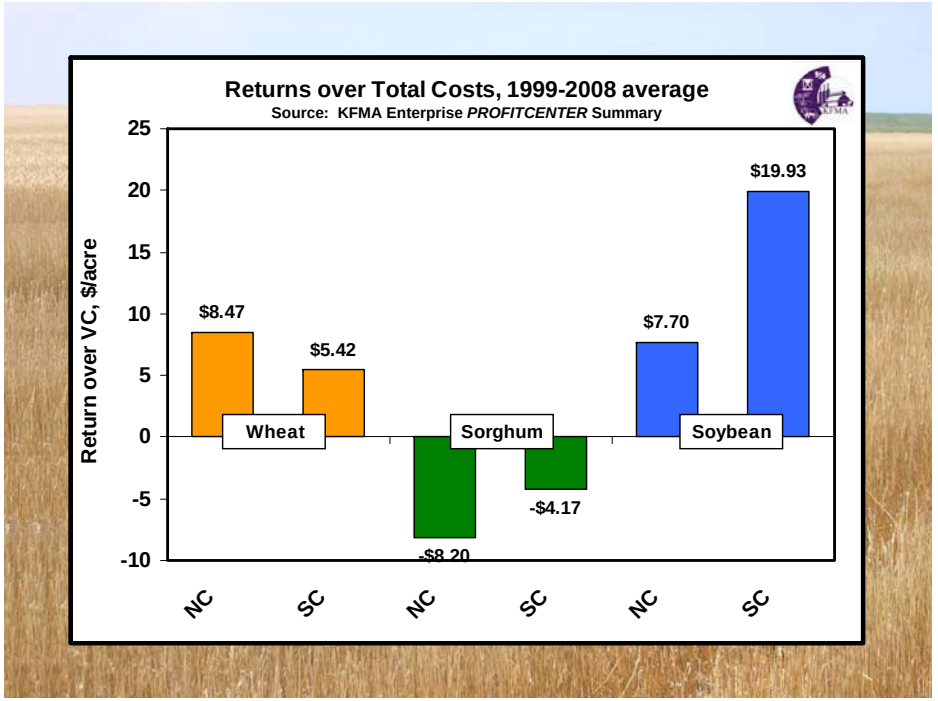
Kansas Farm Management Associations

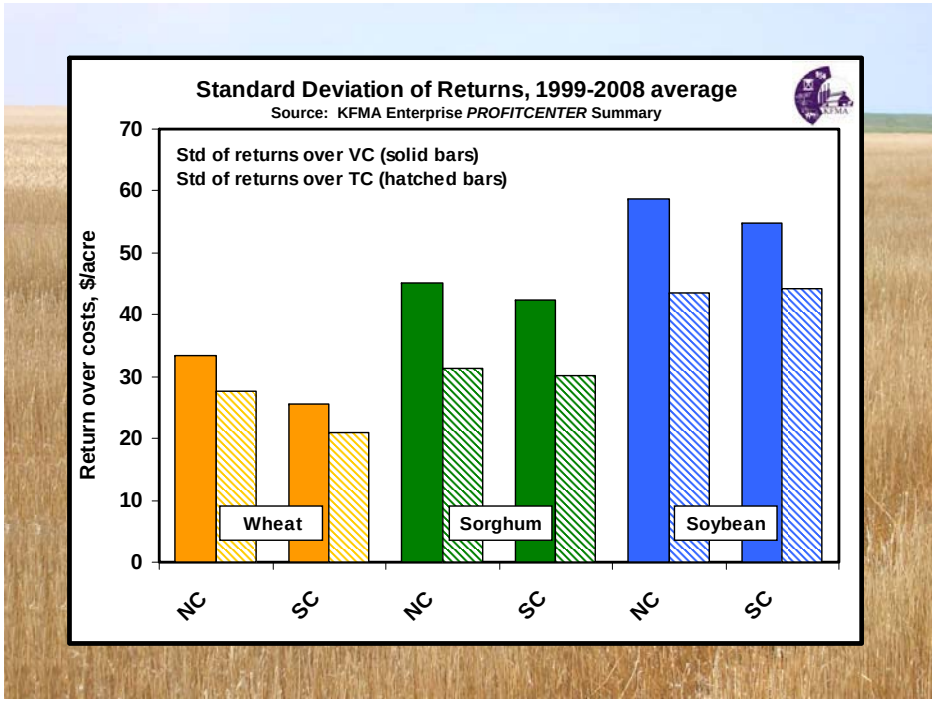



Gross Returns, 1999-2008 average
Source: KFMA Enterprise PROFITCENTER Summary
Return over VC, $/acre
185
180
175
170
165
160
155
150
145
140
135
$164.46
$151.46
$180.37
$168.81
$179.11
$176.31
Wheat
Sorghum
Soybean
NC
SC
NC
SC
NC
SC


Total Expenses, 1999-2008 average
Source: KFMA Enterprise PROFITCENTER Summary
Return over VC, $/acre
200
180
160
140
120
100
80
60
40
20
0
$155.98
$146.04
$188.57
$172.99
$171.41
$156.38
Wheat
Sorghum
Soybean
NC
SC
NC
SC
NC
SC


Returns over Variable Costs, 1999-2008 average
Source: KFMA Enterprise PROFITCENTER Summary
Return over VC, $/acre
80
70
60
50
40
30
20
10
0
$65.16
$52.97
$51.53
$48.64
$63.26
$70.70
Wheat
Sorghum
Soybean
NC
SC
NC
SC
NC
SC


Returns over Total Costs, 1999-2008 average
Source: KFMA Enterprise PROFITCENTER Summary
Return over VC, $/acre
25
20
15
10
5
0
-5
-10
$8.47
$5.42
-$8.20
-$4.17
$7.70
$19.93
Wheat
Sorghum
Soybean
NC
SC
NC
SC
NC
SC



Wheat Enterprise Efficiency and Profitability

- Objective
  - Discuss differences in wheat enterprise efficiency and net returns
- Data and Methods
  - Wheat enterprise data for 185 KFMA farms with continuous data from 2004 to 2008
  - Computed enterprise efficiency (cost of production) and profitability for each farm
  - Sorted farms into three groups based on profit

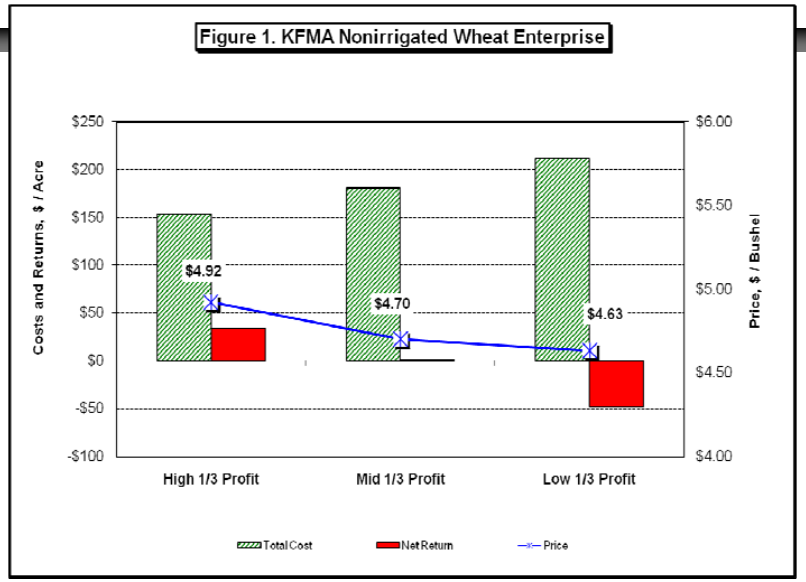
Wheat Enterprise Efficiency and Profitability…

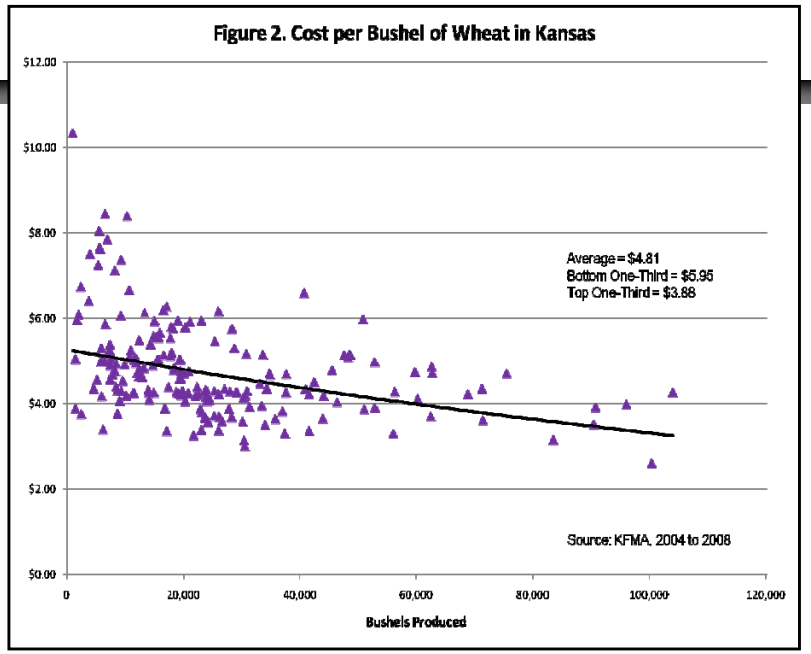
- The high profit group was more efficient, had more wheat acres, more crop acres, a higher yield, a higher price per bushel, and significantly lower costs.
- Total cost per acre for the high profit group was 28 percent lower than low profit group (15% lower than mid profit group).
- Fertilizer, machinery, and labor costs per acre were from 23 to 33 percent lower for the high profit group.

Kansas Farm Management Association: State Average
2004-2008 Nonirrigated Wheat Enterprise Sorted by Net Return to Management per Acre

	Profit Category			Difference between High 1/3 and Low 1/3	
	High 1/3 Per Acre	Mid 1/3 Per Acre	Low 1/3 Per Acre	Acres / $	%
Number of Farms	61	62	62		
Enterprise Acres	939	636	422	517	123%
Crop Acres	1,997	1,507	1,059	938	89%
Bushels Produced	28,772	19,185	11,624	17,148	148%
Yield per Acre	39.2	38.4	35.3	3.9	11%
Price per Bushel	$4.92	$4.70	$4.63	$0.29	6%
Technical Efficiency	0.915	0.797	0.699	0.216	31%
Cost Efficiency	0.683	0.573	0.452	0.231	51%
INCOME:					
Crop Income	$149.60	$142.18	$127.01	$22.58	18%
Government Payments	$17.86	$17.89	$18.07	($0.21)	-1%
Other Income	$20.66	$21.87	$19.35	$1.31	7%
Gross Income	$188.12	$181.93	$164.43	$23.69	14%
COSTS:					
Seed	$7.43	$9.45	$8.88	($1.45)	-16%
Fertilizer	$27.06	$33.07	$35.35	($8.29)	-23%
Herbicide-Insecticide	$6.68	$8.04	$7.90	($1.22)	-15%
Crop Insurance	$5.48	$6.31	$6.26	($0.78)	-12%
Machinery	$42.79	$47.72	$59.53	($16.74)	-28%
Labor	$24.57	$27.65	$36.86	($12.29)	-33%
Other	$6.94	$9.02	$11.99	($5.05)	-42%
Land	$20.92	$25.19	$27.54	($6.62)	-24%
Interest	$11.88	$14.10	$17.80	($5.92)	-33%
Total Cost	$153.75	$180.55	$212.11	($58.36)	-28%
Net Return to Management	$34.37	$1.38	($47.68)	$82.05	

Differences between profitability groups…



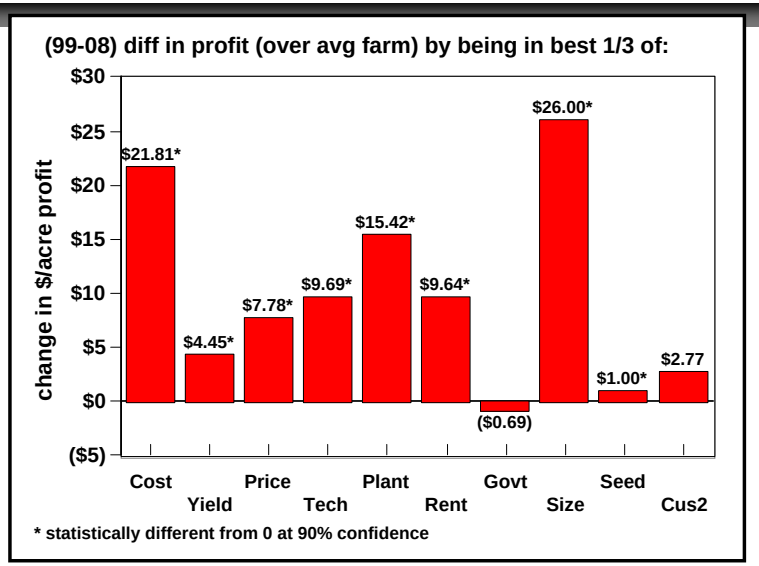


Machinery costs are important in explaining profitability differences across farms …

Kansas Farm Management Association Enterprise Analysis
Nonirrigated Crops -- State Averages, 2002-2006

	Corn	Irr Corn	Sorghum	Wheat	Soybean	Alfalfa
Number of Farms	45	15	85	178	74	34
Machinery Costs, $/acre						
High profit farms	$59.28	$73.77	$51.08	$51.54	$54.10	$74.13
Mid profit farms	$62.57	$82.49	$60.09	$55.48	$62.84	$79.48
Low profit farms	$90.82	$104.98	$73.22	$75.72	$75.98	$109.15
High less low, $	**-$31.53**	**-$31.21**	**-$22.14**	**-$24.18**	**-$21.88**	**-$35.02**
High less low, %	**-34.7%**	**-29.7%**	**-30.2%**	**-31.9%**	**-28.8%**	**-32.1%**
Differences between high profit farms and low profit farms in …						
Net returns	**$91.30**	**$138.74**	**$81.43**	**$65.74**	**$73.87**	**$133.79**
Total costs	**-$93.54**	**-$125.79**	**-$50.96**	**-$53.84**	**-$53.15**	**-$65.86**
Cost/net returns	**102.5%**	**90.7%**	**62.6%**	**81.9%**	**72.0%**	**49.2%**
Mach/total costs	**33.7%**	**24.8%**	**43.4%**	**44.9%**	**41.2%**	**53.2%**
Mach/net returns	**34.5%**	**22.5%**	**27.2%**	**36.8%**	**29.6%**	**26.2%**

Factors affecting profit differences…



Relative Efficiency of No-Till Production

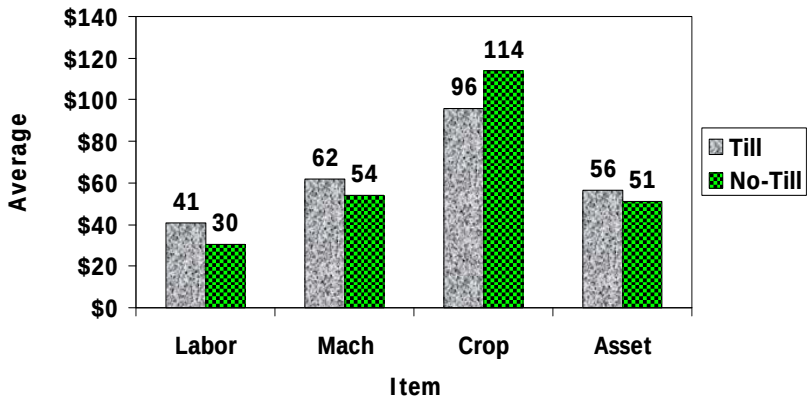
- Central KFMA Farms, 2008
  - Detailed Cost Analysis
    - Crop cost comparisons on per harvested acre basis
  - Whole-Farm Data
    - Farm size and type
    - Financial ratios and efficiency measures
    - Income shares (feed grains, hay and forage, oilseeds, small grains, beef, dairy)
    - Cost shares (labor, livestock, seed, fertilizer, chemicals, and capital)

Detailed Cost Comparisons

- Crop Cost Comparisons per Harvested Acre
  - Labor
    - Hired labor and opportunity charges on operator and family labor
  - Machinery
    - Repairs on machinery and equipment, machine hire, gas, fuel, oil, and depreciation on machinery and equipment
  - Crop
    - Seed, crop insurance, fertilizer, herbicide, and miscellaneous costs such as irrigation energy, crop storage and marketing, and crop supplies
  - Improvements, Asset Charges, and Other Expenses

Detailed Cost Analysis

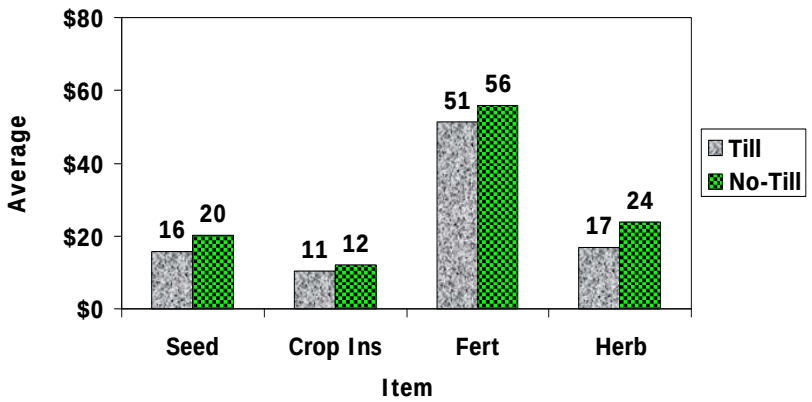
Cost Categories: NC KFMA, 2008



Total: Till = $255 and No-Till = $249

Detailed Cost Analysis

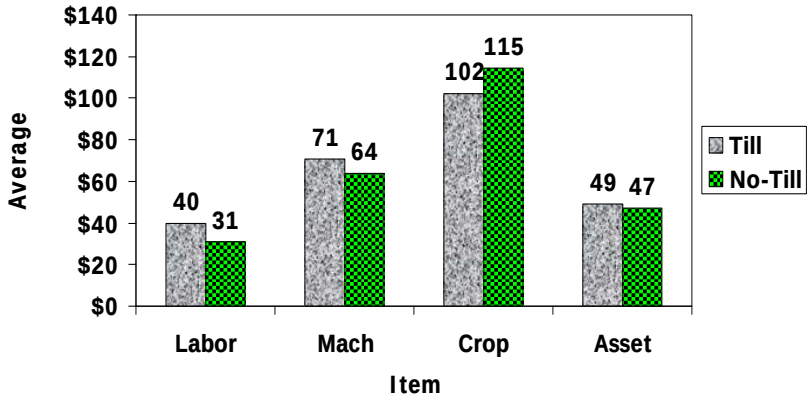
Crop Expense: NC KFMA, 2008



Total: Till = $96 and No-Till = $114 (totals do not add due to rounding)

Detailed Cost Analysis

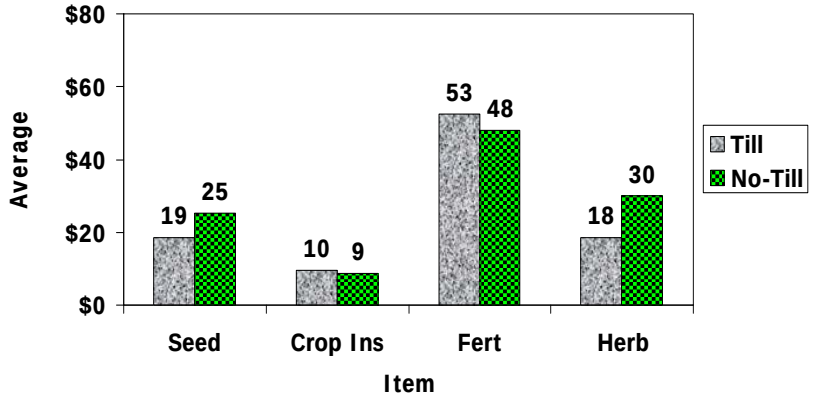
Cost Categories: SC KFMA, 2008



Total: Till = $262 and No-Till = $257

Detailed Cost Analysis

Crop Expense: SC KFMA, 2008

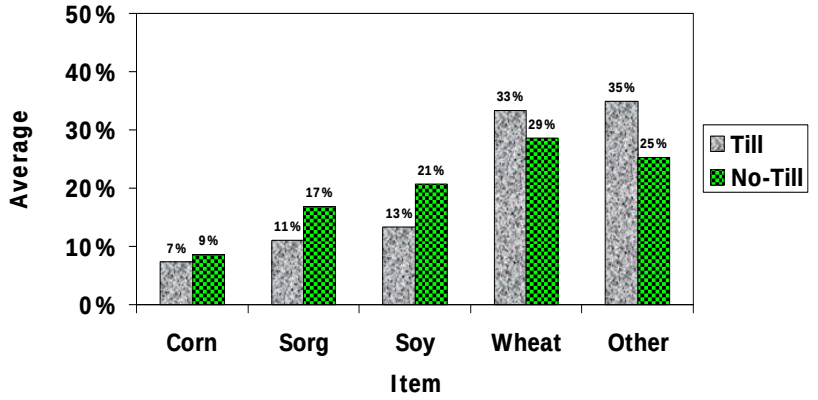


Total: Till = $102 and No-Till = $115 (totals do not add due to rounding)

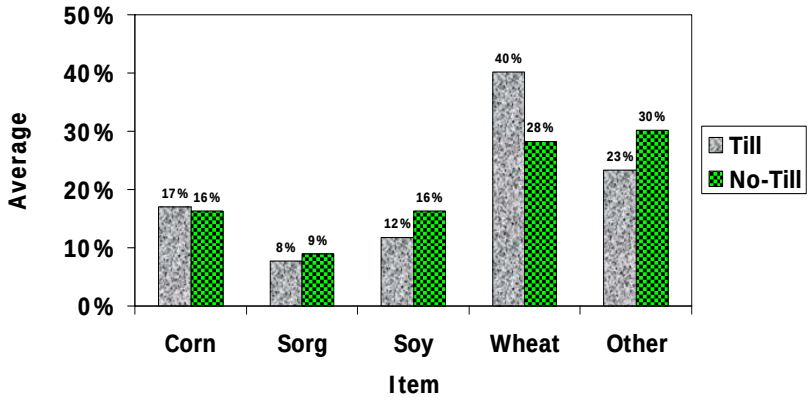
Value of Farm Production

- KFMA Data, Central Kansas, 2008
  - Value of Farm Production (VFP)
    - Sum of livestock, crop, and other income computed on an accrual basis minus accrual feed purchased.
    - Average VFP: NC KFMA
      - Tillage Farms: $339,726
      - No-Till Farms: $586,848 +72.7%
    - Average VFP: SC KFMA
      - Tillage Farms: $430,845
      - No-Till Farms: $835,258 +93.9%

VFP Sources: NC KFMA, 2008



VFP Sources: SC KFMA, 2008



Whole-Farm Data: 5-Year Averages

- KFMA farms in central Kansas with continuous data from 2004 to 2008.
- To be classified as a "no-till" farm, a farm had to utilize a no-till production system for all of their crops (in 2008).
- Number of Farms
  - 77 no-till farms
  - 234 mixed tillage farms

Whole-Farm Data: Definitions

- Value of Farm Production
  - Sum of livestock, crop, and other income computed on an accrual basis minus accrual feed purchased.
- Net Farm Income
  - Return to operator's labor, management, and equity (net worth) computed on an accrual basis.
- Less Tillage Index
  - Computed by dividing herbicide and insecticide cost by total crop machinery cost which includes repairs, fuel, auto expense, machinery and equipment depreciation, crop machine hire, and an opportunity interest charge on crop machinery and equipment investment.

Comparison of Farm Types, Central Kansas

Farm Characteristics	No-Till	Mixed Tillage
Value of Farm Production	$468,629 +72.7%	$324,832
Net Farm Income	$108,467	$71,510
Total Acres	2,173 +22.1%	1,780
Less Tillage Index	0.173	0.115

Whole-Farm Data: Definitions

- **Profit Margin**
  - Computed by dividing net farm income plus cash interest paid minus opportunity charges on operator and family labor by value of farm production.
- **Asset Turnover Ratio**
  - Computed by dividing value of farm production by total farm assets.
- **Technical Efficiency Index (ranges from 0 to 1)**
  - Farms with an index of 1 are using the best available technologies and producing on the production frontier.
- **Cost Efficiency Index (ranges from 0 to 1)**
  - Farms with an index of 1 are producing at the lowest cost per unit of aggregate output.

Comparison of Farm Types, Central Kansas

Financial Ratios and Efficiency	No-Till	Mixed Tillage
Profit Margin	0.1676	0.1233
Asset Turnover Ratio	0.4070	0.3199
Cost Efficiency	0.662	0.605

Technical Efficiency was not significantly different between the two groups of farms.

Comparison of Farm Types, Central Kansas

Income Shares	No-Till	Mixed Tillage
Feed Grains	0.2303	0.1805
Oilseeds	0.1687	0.1059
Small Grains	0.2271	0.3071

There was not a significant difference between hay and forage, beef, or dairy income shares.

Comparison of Farm Types, Central Kansas

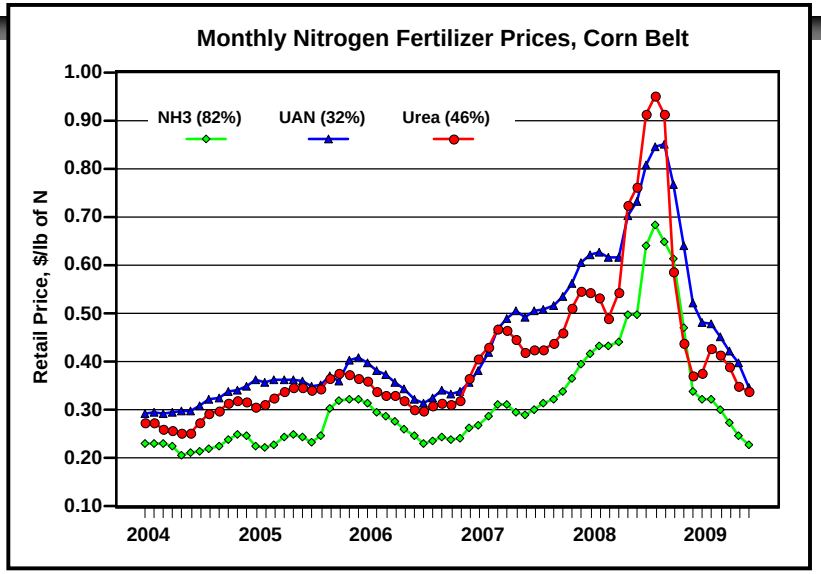
Cost Shares (as percent of VFP)	No-Till	Mixed Tillage
Labor	0.1702	0.2299
Seed	0.0663	0.0534
Chemicals	0.0797	0.0552
Capital	0.5626	0.6695

There was not a significant difference between livestock and fertilizer cost shares.

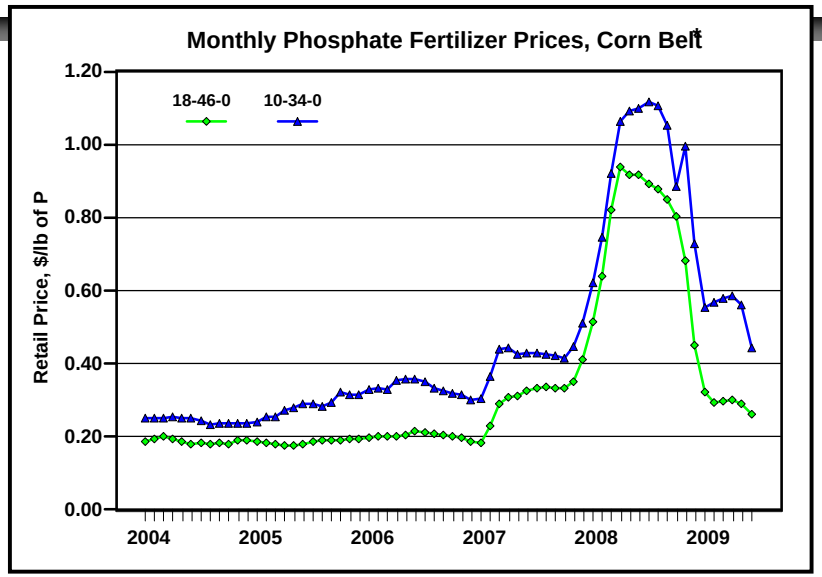
Fertilizer Economics –
How do prices impact recommended rates?

Kevin C. Dhuyvetter -- kcd@ksu.edu -- 785-532-3527
Terry L. Kastens -- tkastens@ksu.edu -- 785-626-9000

Extreme volatility in nitrogen prices recently…

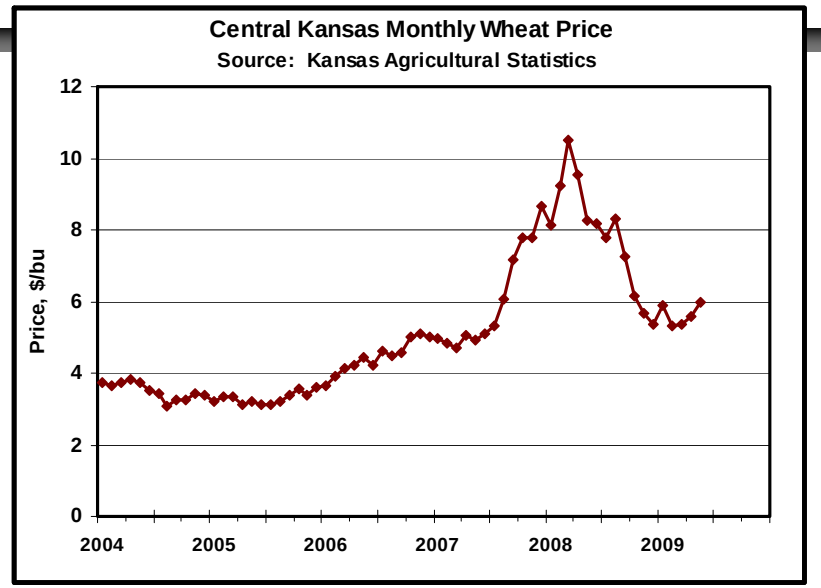


Not just nitrogen prices that have been volatile…

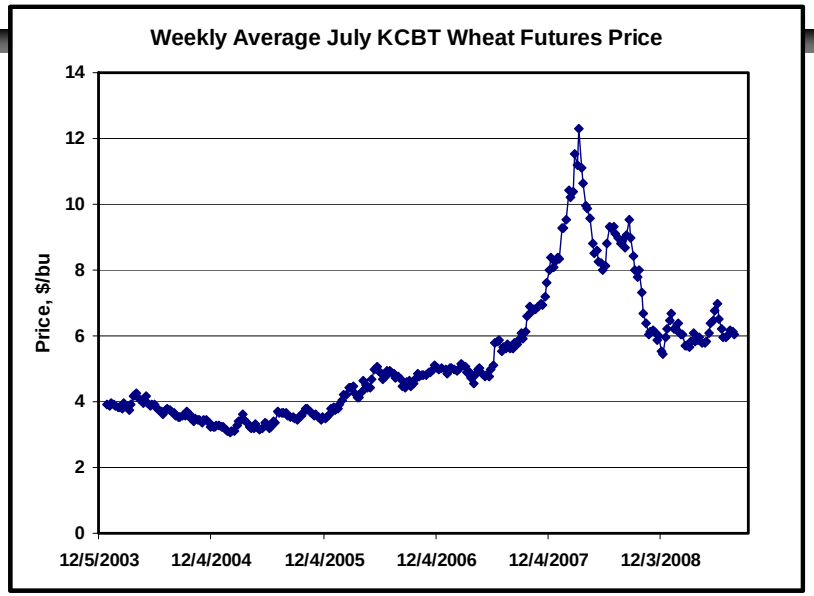


* Value of P calculated after deducting value of N at price of Urea (18-34-0) and UAN (10-34-0)

Cash wheat prices have also been highly variable…



Wheat futures prices have been very volatile…



Soil Test Interpretations and Fertilizer Recommendations

K-STATE Kansas State University 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

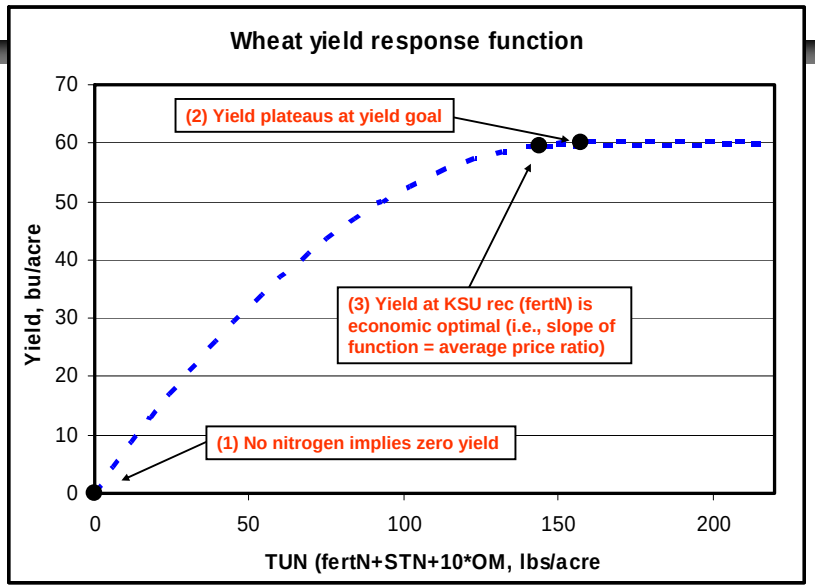
Sunflowers

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)
- Production functions were estimated that are consistent with KSU N recommendations at the following prices:
  - Wheat $3.20/bu
  - Corn $2.35/bu
  - fertN $0.21/lb N

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

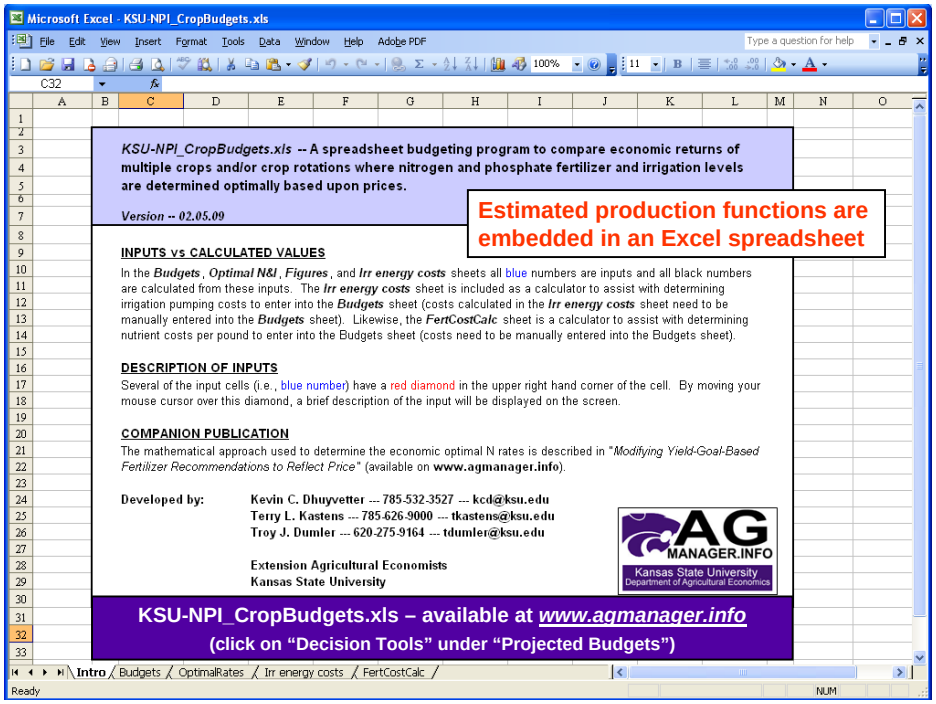


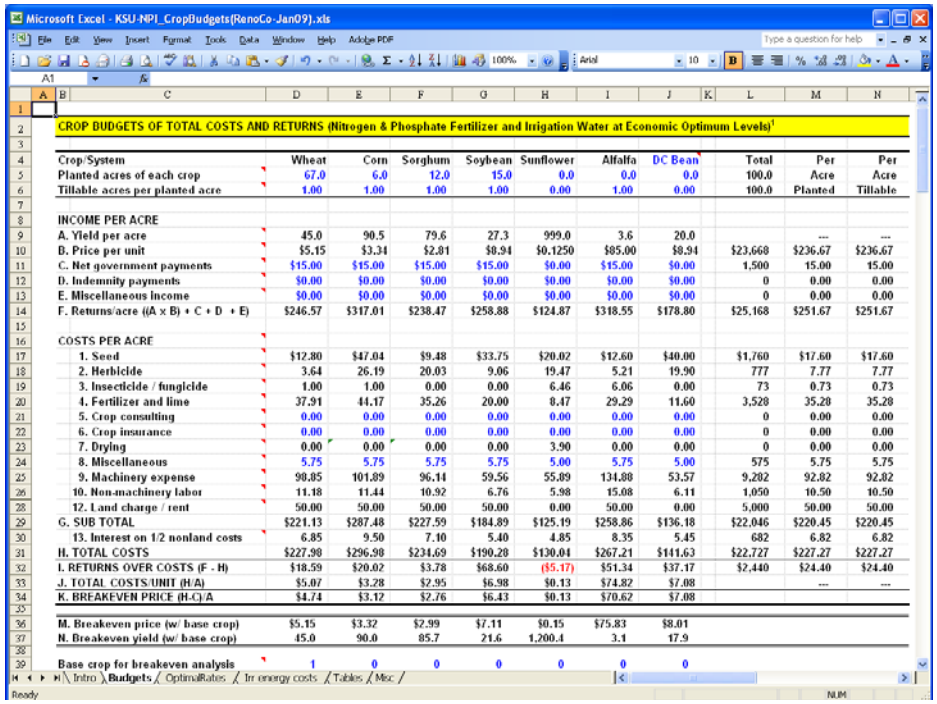
Operationalizing production function…

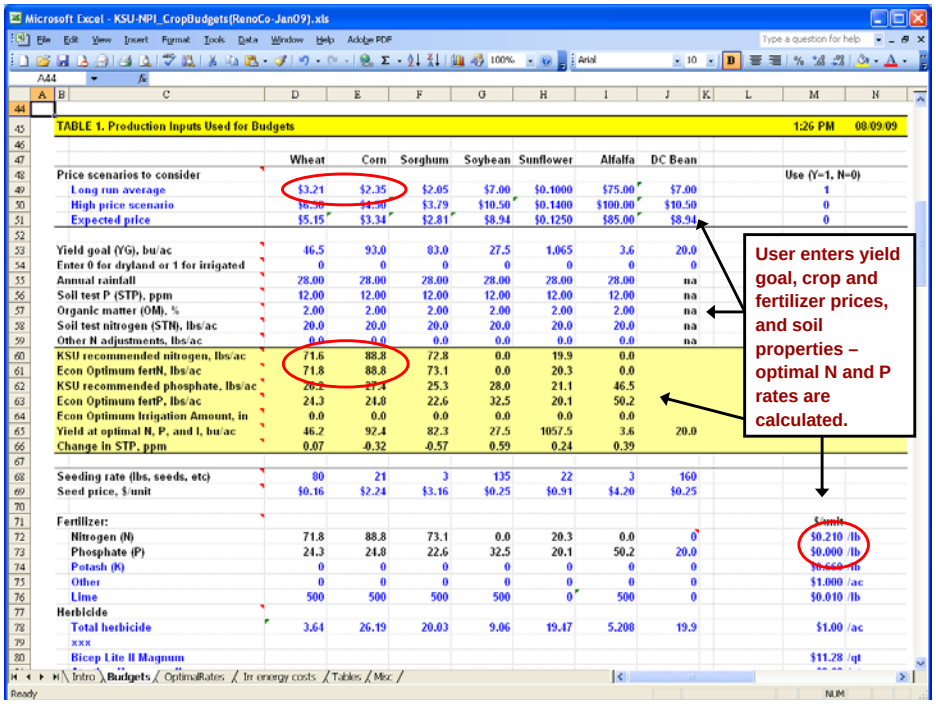
- Everything was embedded in an Excel spreadsheet so that users could determine optimal fertilizer N rates based on fertilizer N prices and crop prices
- We could use the spreadsheet to recommend some "typical" percentage cutbacks on fertilizer – dealers had been requesting such info throughout 2005

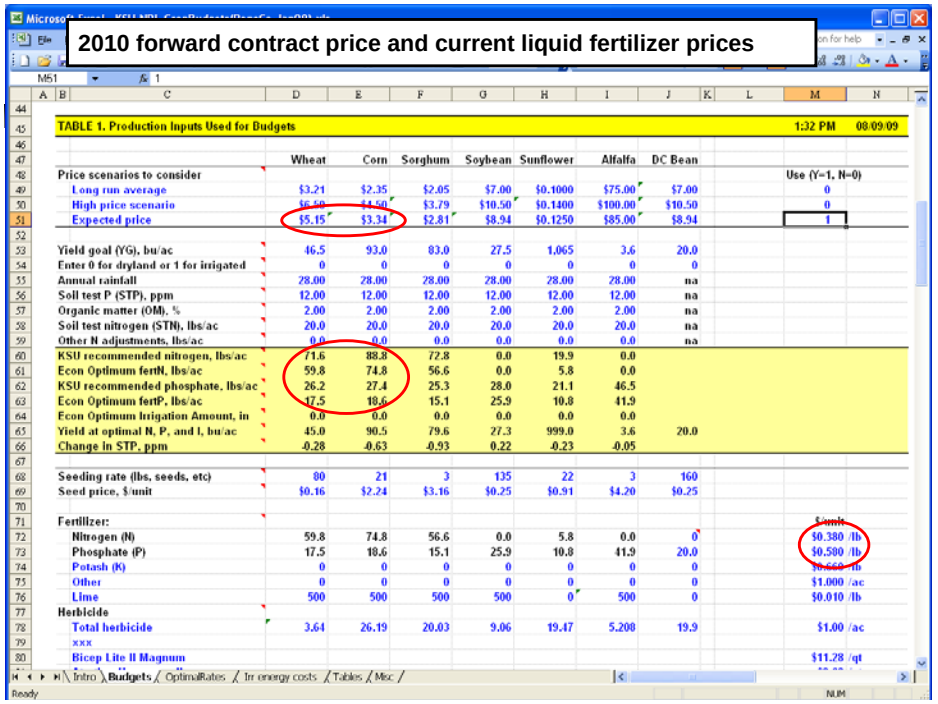
Late summer early Fall 2008 …

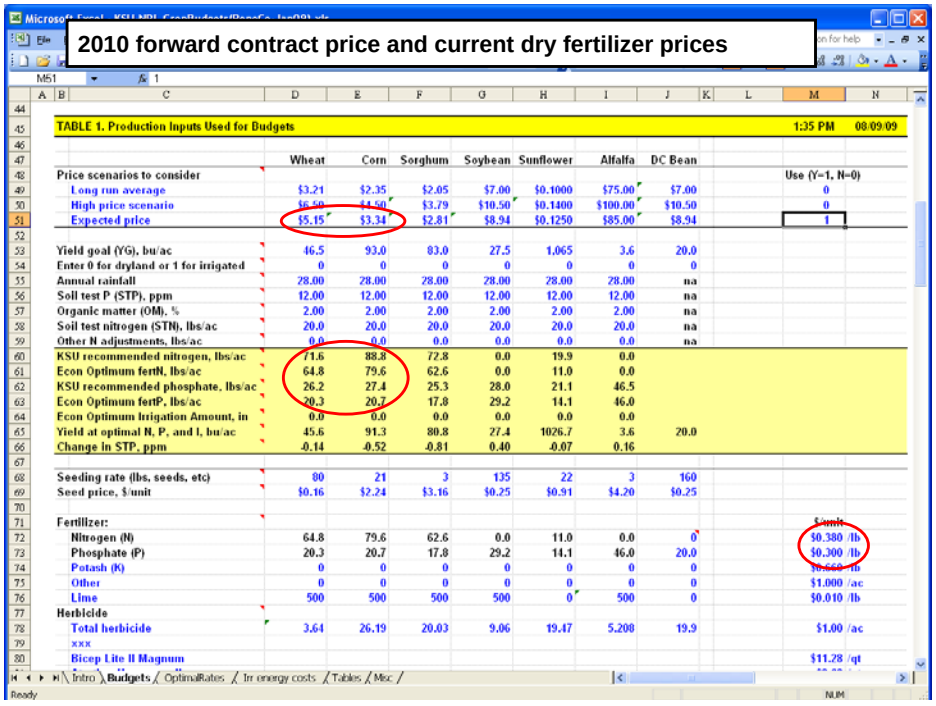
- Very high fertilizer prices and not just N
- Falling crop prices
- Producers asking about price-based adjustments again, especially related to high P prices ($1.20/lb P2O5??)
- And so we adjust the decision spreadsheet again… …this time incorporating P
  - Use MF-2586 sufficiency P recs











Scenarios considered (winter 2008/09 meetings)…

- **Dry versus liquid N & P fertilizer prices**
  - Dry: N = $0.365 and P = $0.495
  - Liquid: N = $0.535 and P = $0.896
- **Fertilizer rates**
  - Economic optimal
  - 75% of economic optimal (under fertilize)
  - 125% of economic optimal (over fertilize)
- **Expected crop prices**
  - Wheat = $5.58; Corn = $3.85; Milo = $3.30; Soybean = $8.47
  - Varying crop prices impacts optimal rates and overall returns, but does not change overall conclusions

Crop yield at expected 2009 crop prices and various fertilizer scenarios…

Model-Estimated Yield vs Fertilizer Price and Rate (% of economic optimal)							
	Wheat	Corn	Milo	Soybean	DC Beans	Total	Average
Acres	25.5	20.5	8.5	25.5	20.0	100.0	
Dry N & P Prices (N=$0.365 and P=$0.495)							
A. Economic optimal rates							
	45.4	110.2	84.9	34.9			
B. 75% of economic optimal rates (under fertilize)							
	42.8	104.0	80.7	34.2			
C. 125% of economic optimal rates (over fertilize)							
	46.2	111.7	86.3	35.0			
Liquid N & P Prices (N=$0.535 and P=$0.896)							
D. Economic optimal rates							
	43.7	107.6	81.7	34.5			
E. 75% of economic optimal rates (under fertilize)							
	40.7	100.5	77.1	33.7			
F. 125% of economic optimal rates (over fertilize)							
	44.6	109.8	83.5	34.9		xxx	xxx

1) Economic optimal yields are 1-4% higher at lower priced fertilizer (dry).

2) Over-fertilizing results in yields about 1% higher than optimal rate yields.

3) Under-fertilizing results in yields about 5% lower than optimal rate yields.

Return over costs at expected 2009 crop prices and various fertilizer scenarios…

Return Over Costs vs Fertilizer Price and Rate (% of economic optimal)							
	Wheat	Corn	Milo	Soybean	DC Beans	Total	Average
Acres	25.5	20.5	8.5	25.5	20.0	100.0	
Dry N & P Prices (N=$0.365 and P=$0.495)							KSU rates $36.75
A. Economic optimal rates							
	$17.62	$79.46	$11.99	$54.08		$3,842	$38.42
B. 75% of economic optimal rates (under fertilize)							
	$12.53	$71.03	$8.73	$52.07		$3,461	$34.61
C. 125% of economic optimal rates (over fertilize)							
	$13.04	$71.36	$7.23	$51.32		$3,448	$34.48
Liquid N & P Prices (N=$0.535 and P=$0.896)							KSU rates $17.03
D. Economic optimal rates							
	$1.66	$54.53	-$3.76	$43.34		$2,350	$23.50
E. 75% of economic optimal rates (under fertilize)							
	-$3.53	$46.85	-$6.65	$42.03		$2,002	$20.02
F. 125% of economic optimal rates (over fertilize)							
	-$3.53	$44.68	-$9.13	$41.21		$1,915	$19.15

Return over costs at expected 2009 crop prices and various fertilizer scenarios…

Return Over Costs vs Fertilizer Price and Rate (% of economic optimal)							
	Wheat	Corn	Milo	Soybean	DC Beans	Total	Average
Acres	25.5	20.5	8.5	25.5	20.0	100.0	
Dry N & P Prices (N=$0.365 and P=$0.495)							KSU rates $36.75
A. Economic optimal rates							
	$17.62	$79.46	$11.99	$54.08		$3,842	$38.42
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	$13.04	$71.36	$7.23	$51.32		$3,448	$34.48
Liquid N & P Prices (N=$0.535 and P=$0.896)							KSU rates $17.03
D.						$2,350	$23.50
E.						$2,002	$20.02
F.						$1,915	$19.15

1) Economic impact of over- or under-fertilizing is about the same at lower priced fertilizer (dry).

2) At higher fertilizer prices (liquid), over-fertilizing starts becoming worse than under-fertilizing.

3) Fertilizer price (dry vs. liquid) has bigger impact on returns than deviations from the optimal rate.

Side issues with P

- Following MF-2586 N and Precs, depending upon crop and rotation, will end up over time at 11-14 ppm STP
- At crop prices and high fertilizer prices shown (esp P), would end up at much lower STP, perhaps 5-10 ppm
- Seems weird to end up that low but is it wrong?
  - Haven't seen such prices before

Critical issues to think about

- Are MF-2586 rates really predicated on "other factors not limiting?"
- Can we fully compensate for low soil fertility with fertilizer?
- Might application methods and timing modify our results?
- What about using fertilizer P to compensate for low soil pH?

So, what should one do?

- Use the spreadsheet! If your intuition causes you to question the results:
  - Average the results with some other method
  - Use the adjustment factors in the spreadsheet
  - Question your intuition
- Likely, no one would ignore prices forever, i.e., regardless of their levels

Summary…

- Wheat historically has compared quite well economically in central Kansas (equal or better returns with less risk than other crops)
- No-till farms tend to be larger, have slightly better profit margins (i.e., more efficient), and have less wheat in crop mix than mixed tillage farms
- High grain prices have offset much of the impact of high fertilizer prices such that optimal rates have not changed significantly
- Large difference in price of liquid versus dry P can affect what is optimal