Nutrient Management Considerations in a High Cost Environment

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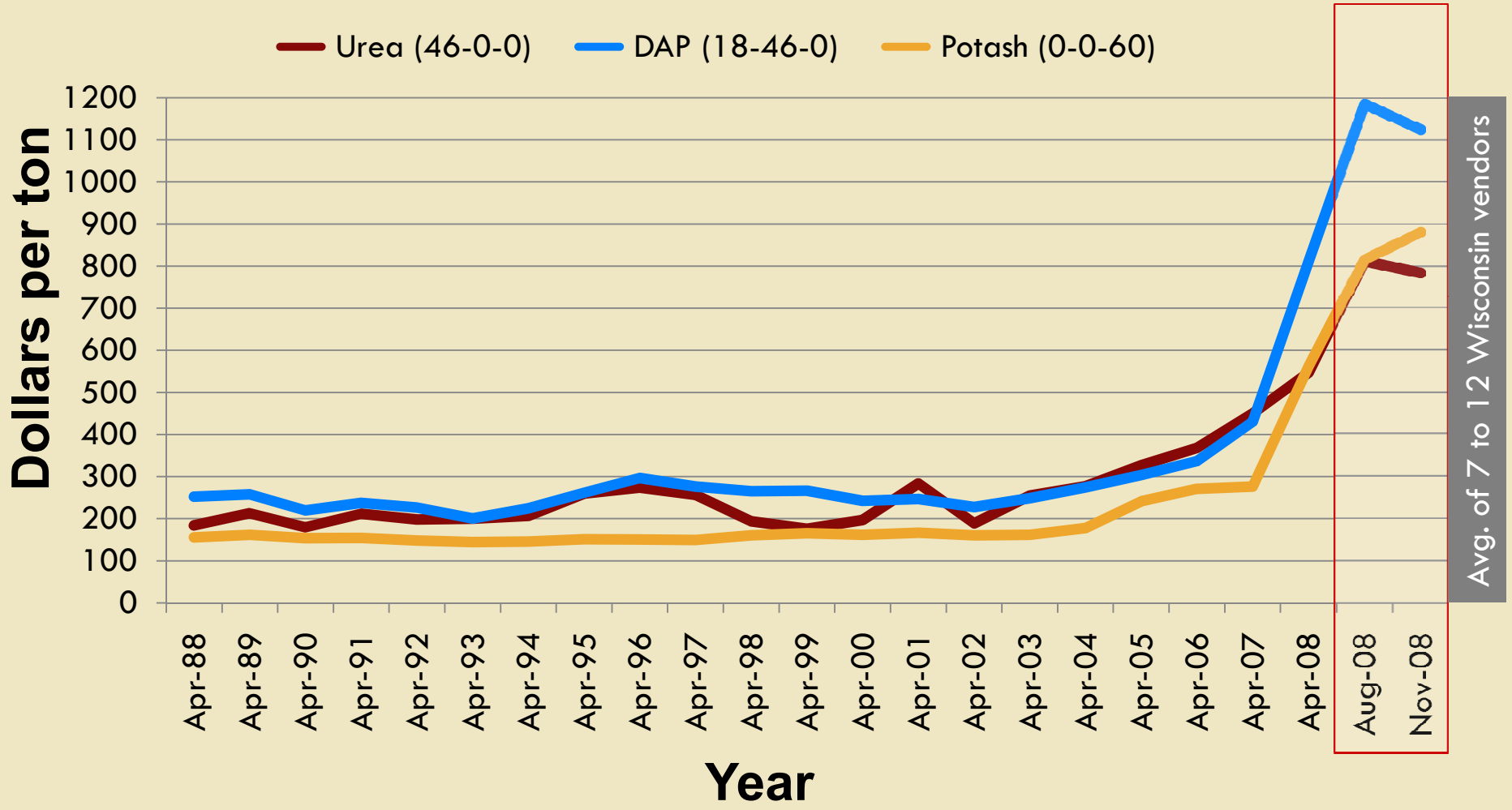
Fertilizer Prices

Average Midwest Fertilizer Price 1988 to 2008



Sources: 1988-2007 USDA-NASS.

Factors contributing to current fertilizer prices

- Global demand for N, P, and K is rising quickly
  - Need to feed more people
  - Better diets in developing world
  - Ethanol production
- Transportation costs increased
- Weak U.S. dollar
- High natural gas price

Source: The Fertilizer Institute, Spring 2008

Wisconsin N Fertilizer Prices
Oct. 24 – 31, 2008

Product	Fall Price		Spring Price (**VOLATILE**)		Average nutrient price		
					N	P_2O_5	K_2O
	$/ton	# sites	$/ton	# sites	$/lb of nutrient		
Anhydrous	1125	2	1199	1	0.69		
Amm.sulf	483	7	514	3			
Urea	784	8	749	4	0.85		
UAN 28%	521	4	549	5	0.93		
	$/gal						
Agrotain	63	2					
NServe	43	2					
NSN	124	3					

Wisconsin P and K Fertilizer Prices Oct. 24 – 31, 2008

Product	Fall Price		Spring Price (**VOLATILE**)		Average nutrient price		
					N	P_2O_5	K_2O
	$/ton	# sites	$/ton	# sites	$/lb of nutrient		
MAP	1138	2	1125	2	0.69	0.95	
DAP	1124	7	993	4	0.69	0.95	
10-34-0	1478	1	1150	1	0.69	1.97	
Potash	881	10	884	4			0.73
	$/gal						
Avail (½ gal/ton)	225	3	215	1			

Spring Price Forecast?

- Items from recent news articles
  - Less fertilizer being applied this fall
  - Inventories are high at some locations
    - Manufacturers may cut supply
  - Retailers may reduce price to stay competitive for spring sales
    - Could be very risky for retailers who paid top dollar
- Producers stay in contact with your retailers regarding price & availability
- Set up a google alert for fertilizer prices to stay on top of news stories

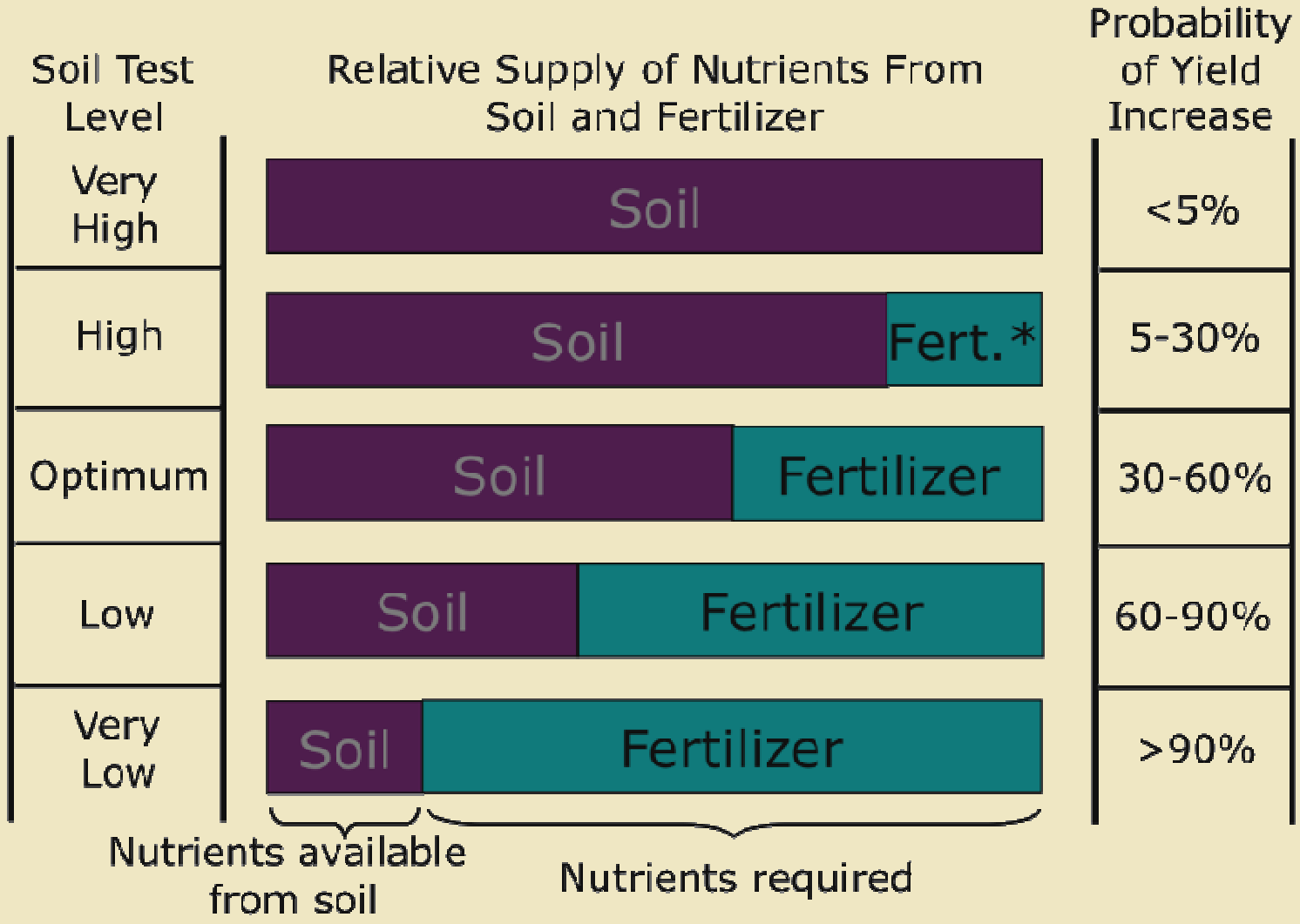
Soil Tests

Getting the most  for your fertilizer buck

- Start with a recent soil test
  - No more than 4 years old
- Cost of a soil test
  - $10/sample x 1 sample/5 acres = $2/acre
- Price of fertilizer
  - $0.95/ lb P_2O_5
  - $0.73/ lb K_2O
- Soil testing is an inexpensive, but beneficial tool
  - Soil testing reduces risk

What do soil test interpretation categories really mean?

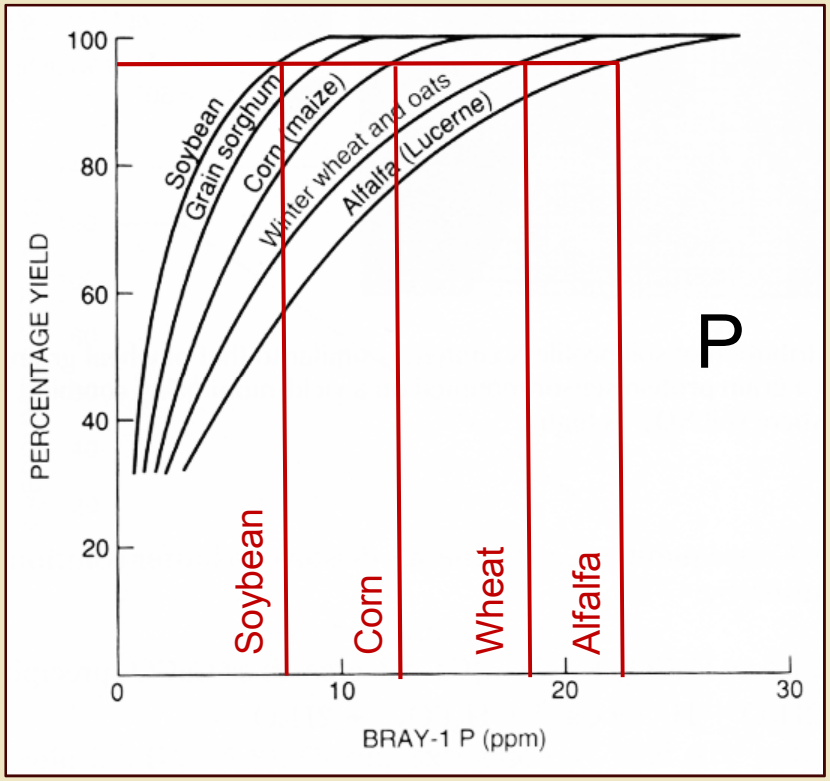
Soil Test Interpretation Categories

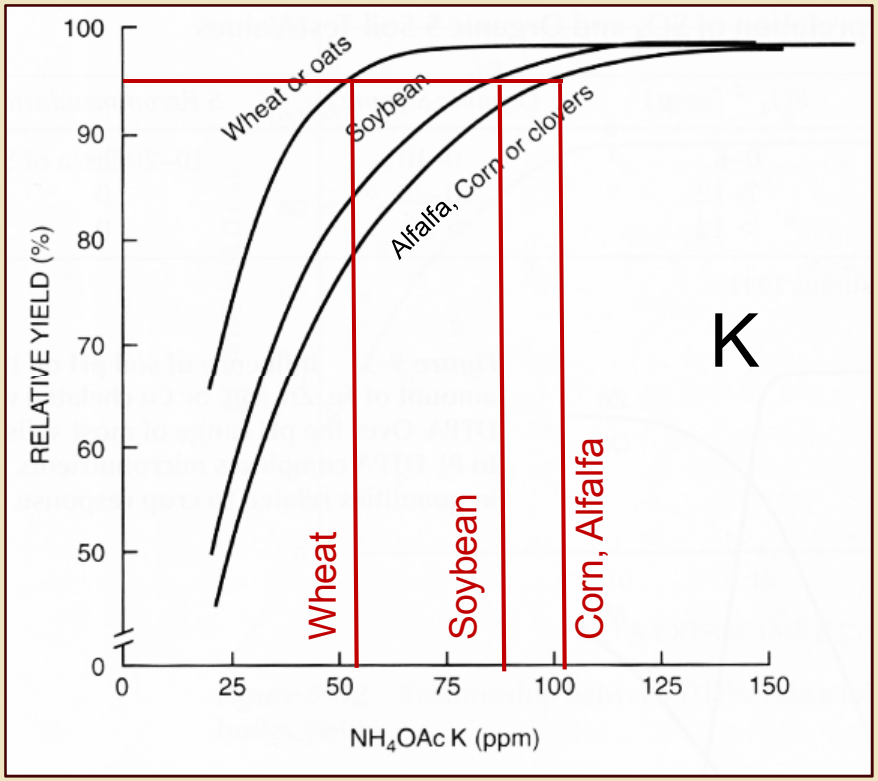


* Fertilizers used at high soil test levels are for starter or maintenance purposes

Modified from Tisdale et al., 2005

General relationships between soil test P and K levels and percent yield

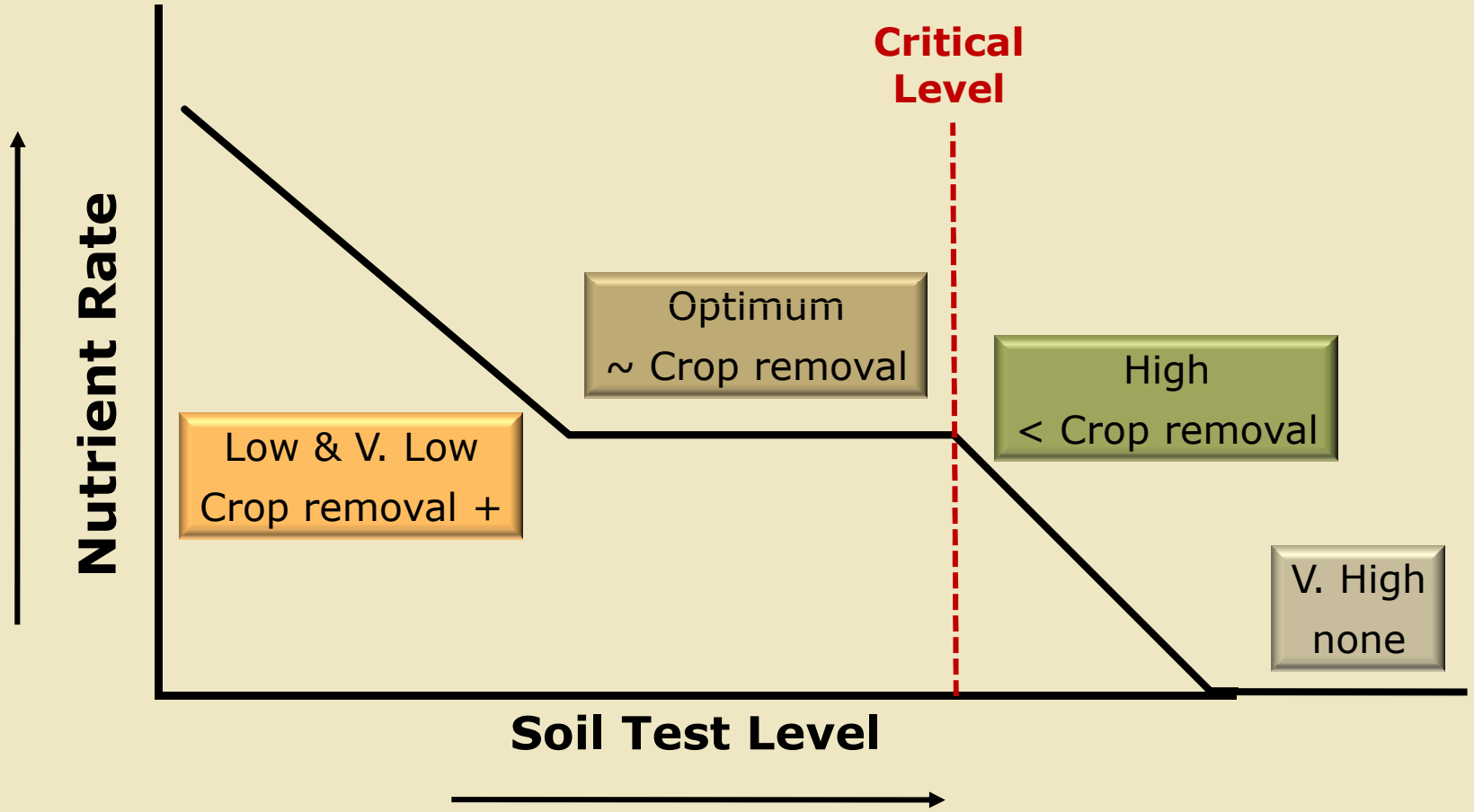




Critical soil test level is the soil test level where ~95% of total yield can be obtained without additional fertilizer

From Tisdale et al., 2005

Wisconsin's P and K recommendation system



Wisconsin soil test interpretation categories – Generalized

	Medium & fine-textured soils		Course-textured soils	
Crop	Optimum	No response	Optimum	No response
	---------- Soil Test P (ppm) ----------			
Alfalfa	16 – 23	> 30	26 – 37	> 55
Corn	14 – 18	> 28	23 – 32	> 42
Soybean	6 – 10	> 20	10 – 15	> 25
	---------- Soil Test K (ppm) ----------			
Alfalfa	91 – 120	> 170	81 - 120	> 180
Corn	81 – 100	> 140	66 – 90	> 130
Soybean	81 – 100	> 140	60 – 80	> 120

Nutrient use efficiency – Rule # 1

- **The first increment of nutrients applied has the greatest efficiency and potential for economic return**

Phosphorus & Potassium

Phosphorus – general guidelines

- Take nutrient credits from manure, biosolids, and other waste applications
  - Be sure these applications are in compliance with the nutrient management plan

Soil Test P Category	Options at current P prices (~$0.95/ lb P_2O_5)
High or Excessively High	Eliminate P applications; maybe ~10 lb P_2O_5/a as starter
Optimum	Apply near recommended rates (crop removal)
Low or Very Low	Reduce recommended rate by 10%; apply no less than crop removal rate Can't afford to build soil test levels in current econ. climate

Potassium – general guidelines

- Take nutrient credits from manure, biosolids, and other waste applications
  - Be sure these applications are in compliance with the nutrient management plan

Soil Test K Category	Options at current K prices (~$0.73/ lb K_2O)
Excessively High	No K recommended
High or Very High	Defer or reduce K applications; maybe benefits to K in starter
Optimum	Apply near recommended rates (crop removal)
Low or Very Low	Perhaps reduce recommended rate by 10%; do not apply less than crop removal Can't afford to build soil test levels in current econ. climate

Crop nutrient removal

Crop	Moisture (%)	lb P_2O_5 / unit yield	lb K_2O / unit yield
Alfalfa (T/a)	DM	13	60
Clover (T/a)	DM	13	60
Corn, grain (bu/a)	15.5	0.38	0.29
Corn, silage (T/a)	65	3.6	8.3
Corn, stover (T/a)	DM	4.6	32
Soybean (bu/a)	13	0.80	1.4
Wheat (bu/a)	13.5	0.50	0.35
Wheat straw (T/a)	DM	6.0	28

Additional crop nutrient removals can be found in UWEX Publication A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin*

- K leaches out of hay/stover/straw as it lies on the ground
- If selling stover/straw for value of nutrients, then it would be useful to sample for more accurate estimates

Lime

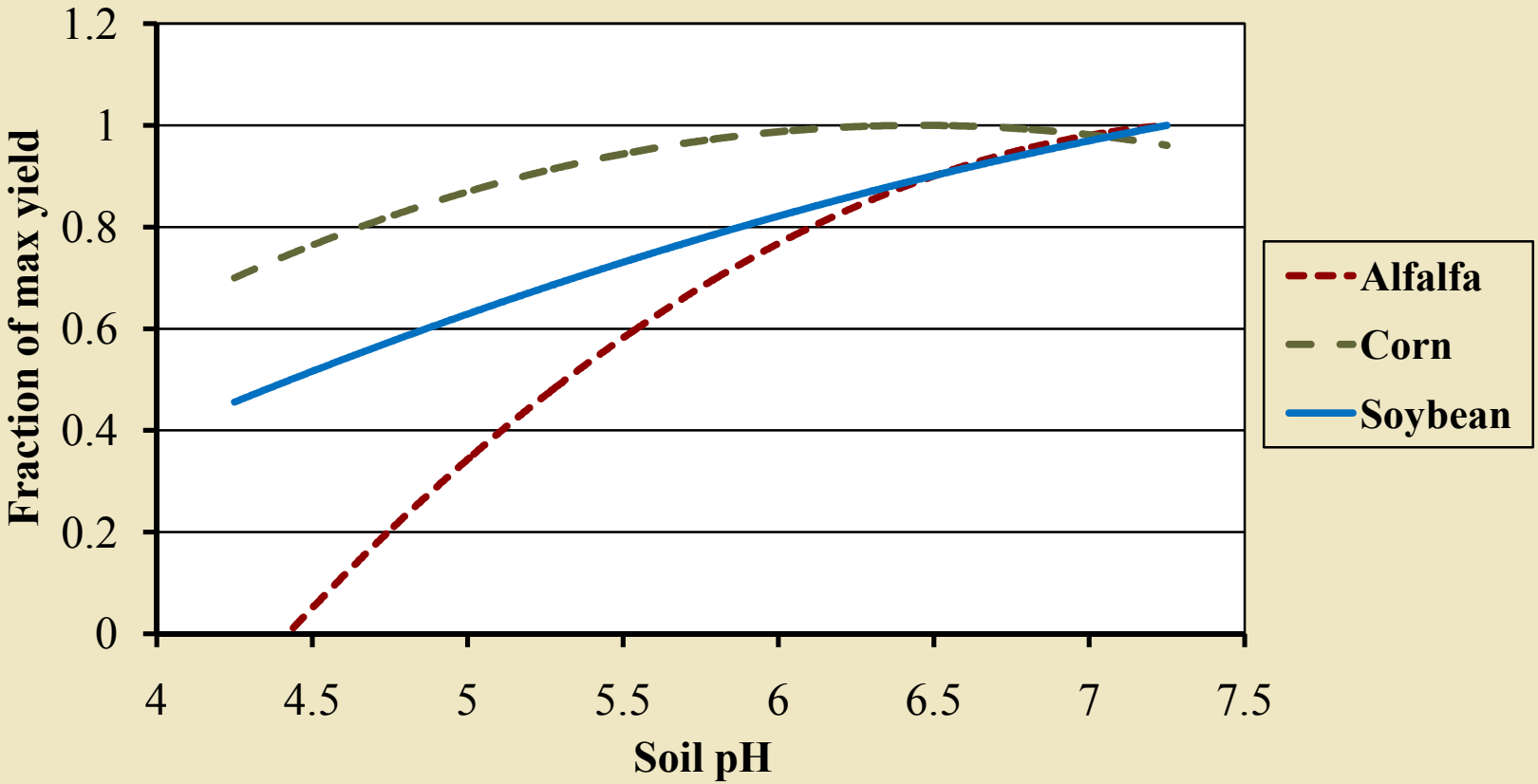
Target pH levels

- Maintaining soil pH at target pH for the most sensitive crop in the rotation will insure good yields

- Low pH can kill crops

Crop	Target pH
Alfalfa	6.8
Clover	6.6
Soybean	6.3
Corn	6.0
Wheat	6.0

Effect of soil pH on crop yield response



Variable rate application of nutrients

- This could be a year where it pays to variably apply nutrients
- Best chance of economic return are in fields with a lot of variability
  - Soil test levels ranging from low to high
    - Have areas requiring nutrients and other areas no need
- No right answer for everyone
  - Must look at soil test reports to get an handle on variability
  - Cost of application
- Remember variable rate can be crude
  - Off or On
  - Apply over some areas 2x, others 1x or 0x

Starter Fertilizer for Corn

Re-evaluating 2x2 starter fertilizer

- Assumptions:
  - 9-23-30 costs $1000/T, 100 lb/a of 9-23-30 applied 2x2
    - Starter fertilizer is $50/a
  - Corn is $4.15/bu
  - Need 12 bu/a increase to pay for cost of starter
- 100 Wisconsin sites 1995-1997
  - Average starter rate of 15-26-32
  - Range of soil test P and K levels, most had EH P & K
- Probably does not pay to use starter fertilizer on soils with VH and EH soil test levels in 2009
  - Caveat no-till

Yield increase of at least	Probability of yield increase
bu/a	%
4	49
6	34
8	18
10	10
12	6
16	5
20	3

Re-evaluating 2x2 starter fertilizer cont.

- K in starter can be important on soils with high soil test P levels (WI and PA research)
- S in starter may be important on soils with high soil test P levels (PA research)

- Remember on high P testing soils response to starter:
  - Is more likely to occur with later planting, greater RM hybrids
  - If soil test K is high or less (<140 ppm)

Re-evaluating 2x2 starter fertilizer cont.

- On optimum or lower testing soils, starter is a good way to apply some or all of the P and K

- Rates of 10-20-20 or 10-20-30 (N-P_2O_5-K_2O) have shown good results on optimum testing soils

Effect of starter placement and rate on corn yield in CL and SiCL soils in MN, 2004-2006

- 3 grades of starter
  - 10-34-0 5 and 10 gal/a
  - 4-10-10 5 and 10 gal/a
  - 3-18-18 3.4 and 6.8 gal/a
- Applied
  - With seed in 2004, 2005, and 2006
  - Single band above the seed in 2004, 2005, 2006
  - Dual band above the seed in 2004
  - Below seed in 2005 and 2006
- No yield difference between fertilizer rates (low or high), grade, or placement
  - Note no comparison to 2x2 placement

Lamb, 2008; see Proc. of 2008 Wis. Fertilizer, Aglime, and Pest Management Conf. http://www.soils.wisc.edu/extension/wfapmc/

Tips for safely using liquid fertilizers with/near the seed

- Do not use fertilizer with a salt index greater than 20.0
- Avoid using fertilizers containing ammonium thiosulfate as the salt index may be high
- Apply no more than 10 lb/a of N + K_2O in-furrow
- If the soil is dry at planting
  - Consider placing the fertilizer away from the seed
  - Sandy soils can be more problematic
- If dribbling the fertilizer on the soil surface, be sure
  - Seed is planted deep enough
  - There is adequate soil moisture for the fertilizer to diffuse

See Laboski, 2008 Proc. of 2008 Wis. Fertilizer, Aglime, and Pest Management Conf. http://www.soils.wisc.edu/extension/wfapmc/

Salt index of common liquid fertilizer formulations

Formulation	Salt index	Salt index per unit of plant nutrient (20 lb)	
2-20-20*	7.2	0.17	Formulated with potassium phosphate as K source
3-18-18*	8.5	0.22	
6-24-6*	11.5	0.32	
6-30-10*	13.8	0.30	
9-18-9*	16.7	0.48	
10-34-0**	20.0	0.45	Use caution in-furrow
7-21-7***	27.8	0.79	Not suggested for use in-furrow
4-10-10***	27.5	1.18	
28% UAN***	63.0	2.25	

Fertilizer form

- No appreciable difference between liquid and dry fertilizers with regard to nutrient availability

- Ortho vs. Poly phosphates
  - No difference

Nitrogen

N:Corn Price Ratio

Price of N ($/lb N)	Price of corn ($/bu)								
	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00
0.50	0.17	0.14	0.13	0.11	0.10	0.09	0.08	0.08	0.07
0.55	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.08
0.60	0.20	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.09
0.65	0.22	0.19	0.16	0.14	0.13	0.12	0.11	0.10	0.09
0.70	0.23	0.20	0.18	0.16	0.14	0.13	0.12	0.11	0.10
0.75	0.25	0.21	0.19	0.17	0.15	0.14	0.13	0.12	0.11
0.80	0.27	0.23	0.20	0.18	0.16	0.15	0.13	0.12	0.11
0.85	0.28	0.24	0.21	0.19	0.17	0.15	0.14	0.13	0.12
0.90	0.30	0.26	0.23	0.20	0.18	0.16	0.15	0.14	0.13
0.95	0.32	0.27	0.24	0.21	0.19	0.17	0.16	0.15	0.14
1.00	0.33	0.29	0.25	0.22	0.20	0.18	0.17	0.15	0.14

Nitrogen Guidelines for Corn in Wisconsin

N:Corn Price Ratio (see other side)

SOIL	PREVIOUS CROP	0.05	0.10	0.15	0.20
		LBS N/ACRE (total to apply)[3]			
high/very high yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[4]	**165**[1] 135-----■----190[2]	**135** 120--■---155	**120** 100---■--135	**105** 90--■--120
	Soybean, Small grains[5]	**140** 110-----■---160	**115** 100--■--130	**100** 85--■--115	**90** 70---■-100
medium/low yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[4]	**120** 100---■---140	**105** 90--■--120	**95** 85-■--110	**90** 80-■-100
	Soybean, Small grains[5]	**90** 75--■---110	**60** 45--■-70	**50** 40-■-60	**45** 35-■-55
sands/ loamy sands	Irrigated—**All crops**[4]	**215** 200--■--230	**205** 190--■--220	**195** 180--■--210	**190** 175--■-200
	Non-irrigated—**All crops**[4]	**120** 100---■---140	**105** 90--■--120	**95** 85-■--110	**90** 80-■-100

1-3-2006-10M

[1] Maximum return to N (MRTN) rate. [2] Range within $1/acre of MRTN rate. [3] Includes N in starter. [4] Subtract N credits for forage legumes, legume vegetables, animal manures, green manures. [5] Subtract N credits for animal manures and second year forage legumes.

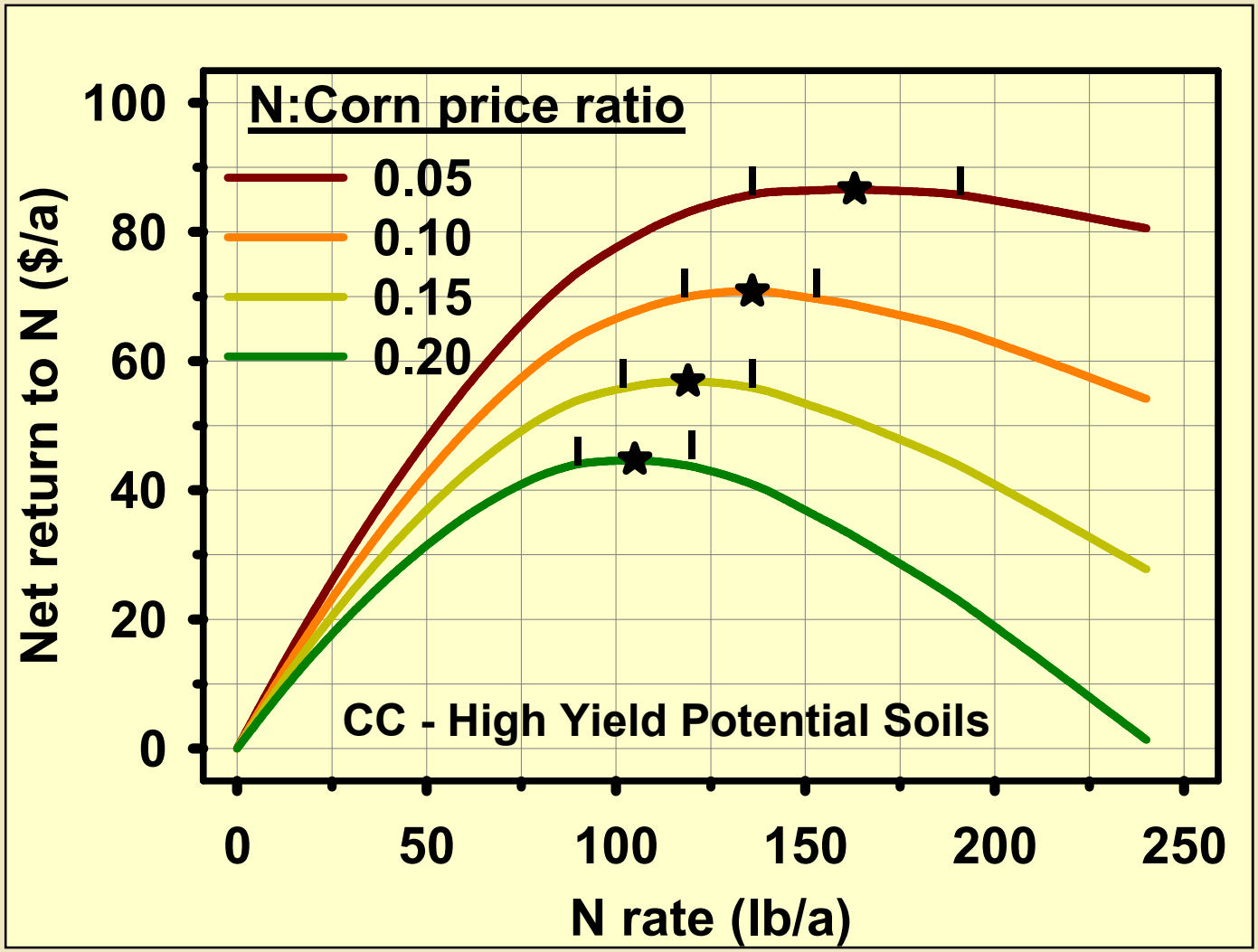
Some guidelines for using ranges

Situation	Portion of Range to Use		
	low	mid	high
> 50 % residue cover at planting			✓
Previous crop is small grain on medium/fine textured soils	✓	✓	
100 % of N is from organic sources			✓
	Plus up to 20 lb N/a in starter fertilizer may be applied		
If there is a likelihood of residual N (carryover N)	✓		
	Or use PPNT		

Some guidelines for using ranges

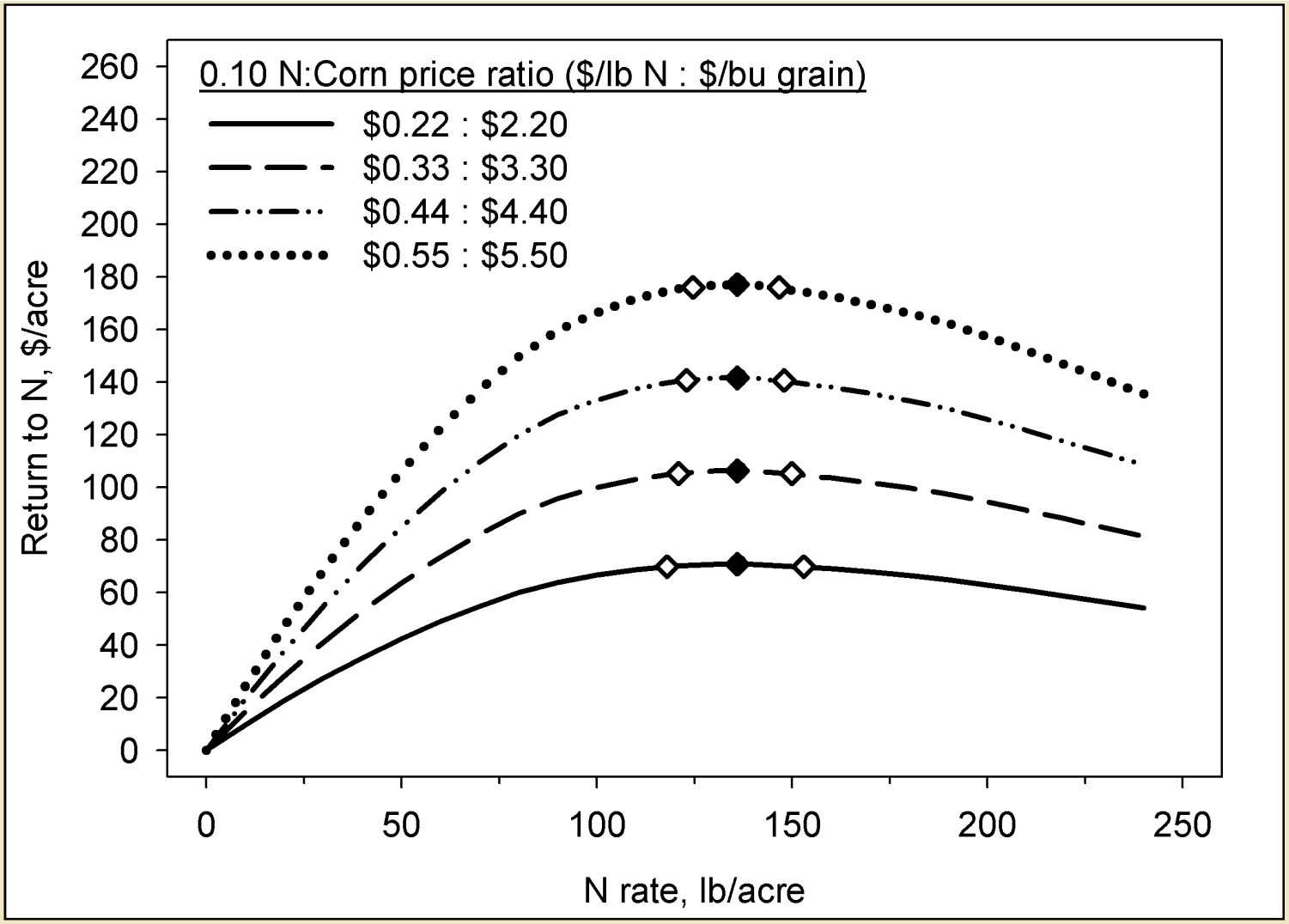
Situation	Portion of Range to Use		
	low	mid	high
Medium & fine-textured soils with < 2.0 % OM			✓
Medium & fine-textured soils with > 10.0 % OM	✓		
Course-textured soils with < 2.0 % OM			✓
Course-textured soils with > 2.0 % OM	✓	✓	

Profitable N Rates



- A range of N rates can produce profitable yields
- Economics clearly drives the profitable N rate

Effect of price level on profitable range

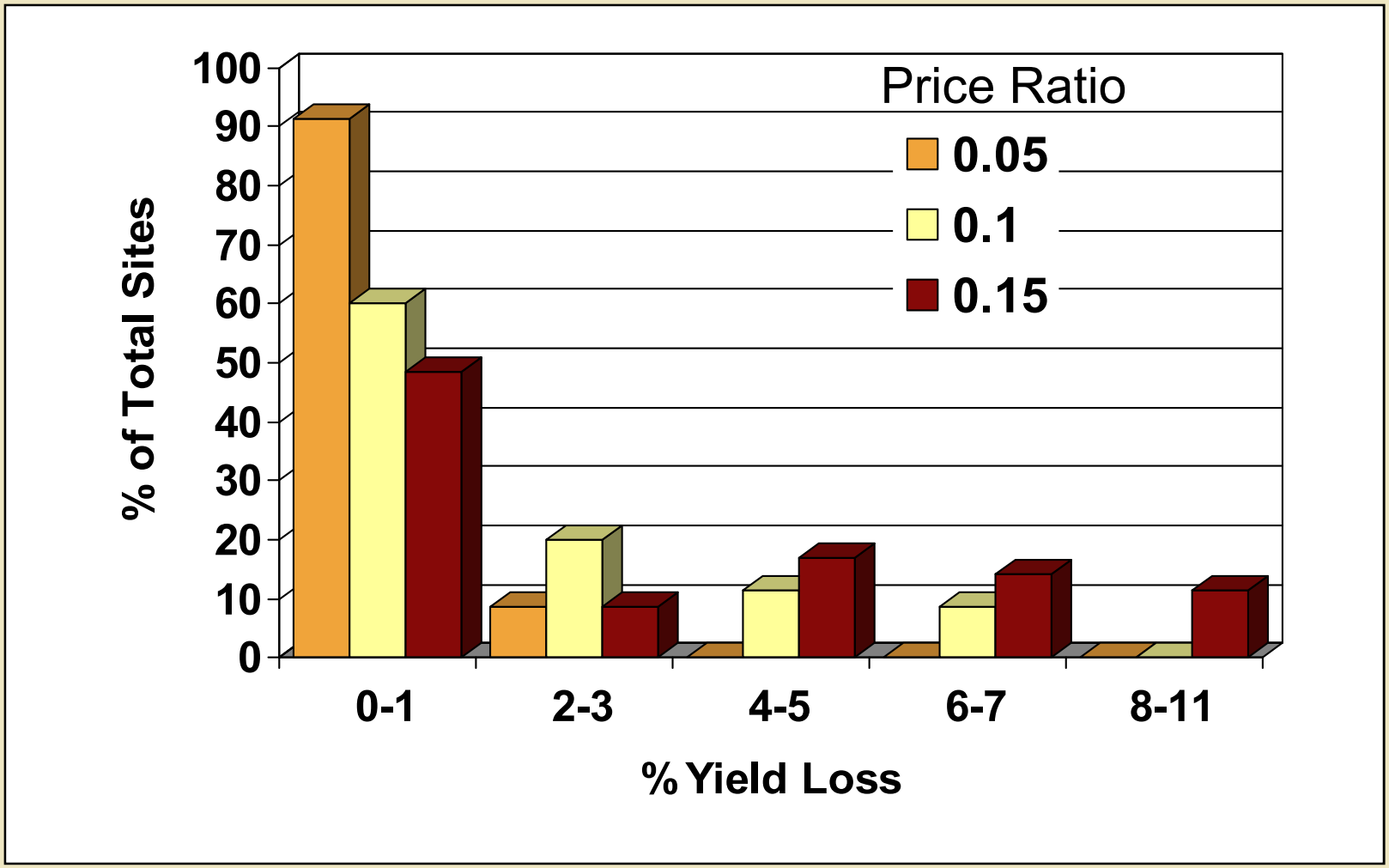


2006 & 2007 Yield loss with MRTN Not considering economics

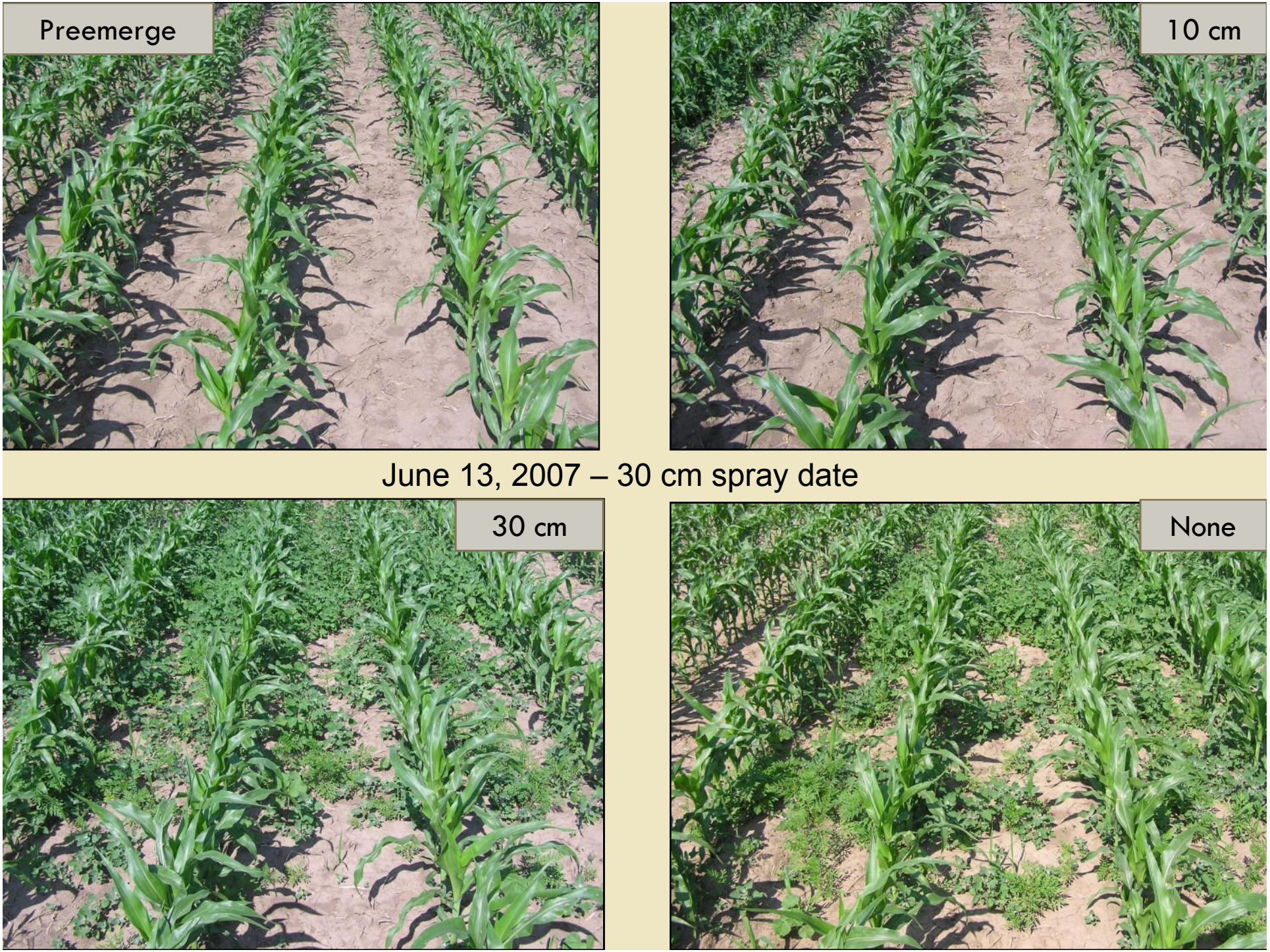
- Calculated potential yield loss

$$\frac{\text{Maximum Yield} - \text{Yield at MRTN rate}}{\text{Maximum Yield}} \times 100$$

2006 & 2007 Yield loss with MRTN Not considering economics

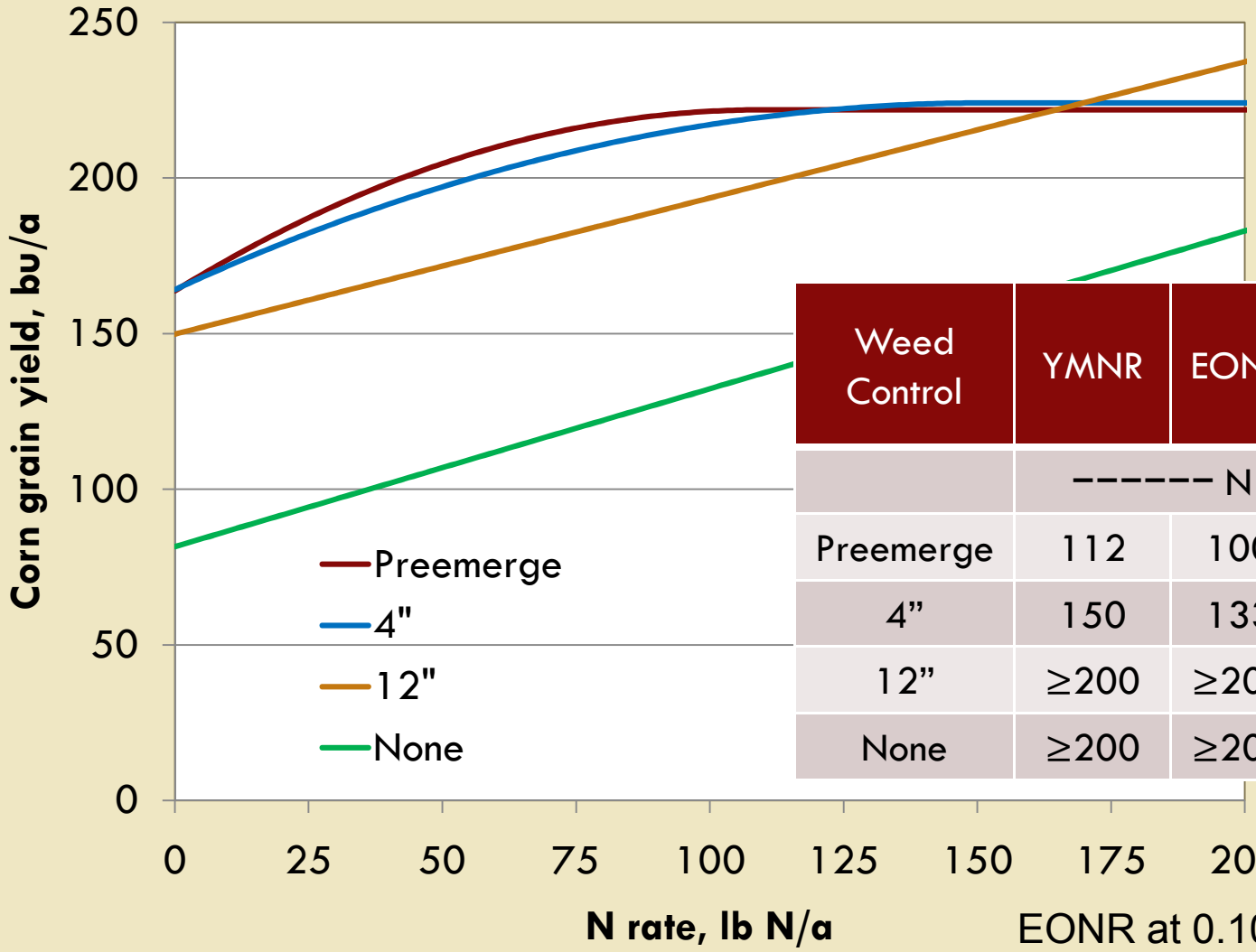


Control weeds for max. NUE


Preemerge
10 cm
June 13, 2007 – 30 cm spray date
30 cm
None


Preemerge
10 cm
Mid July 2007
30 cm
None

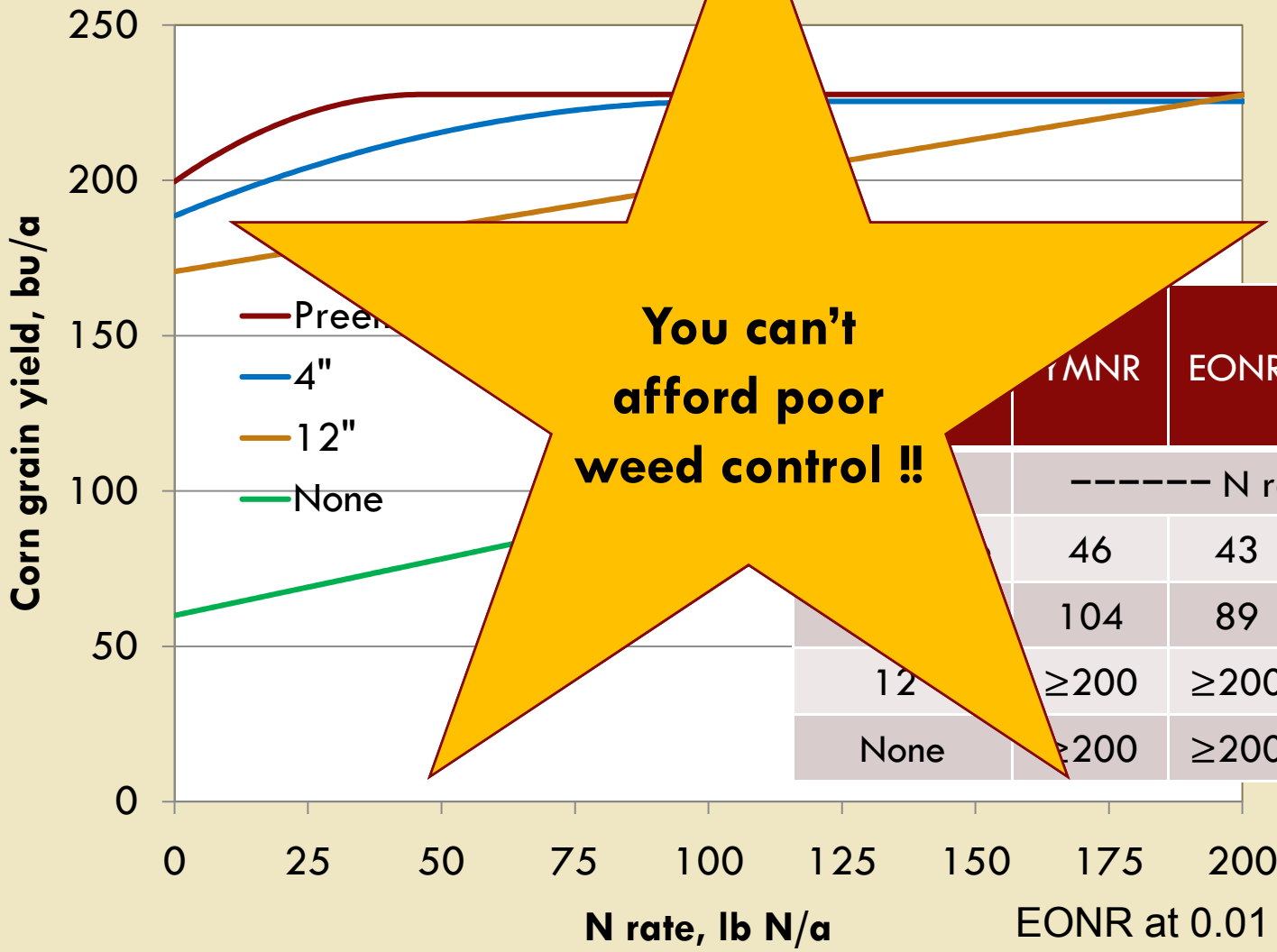
Effect of N rate & timing of weed control on corn grain yield, 2006



Weed Control	YMNR	EONR	N need to attain yield at preemerge EONR
	------ N rate, lb N/a ------		
Preemerge	112	100	100
4”	150	133	120
12”	≥200	≥200	164
None	≥200	≥200	>200

EONR at 0.10 N:corn price ratio

Effect of N rate & timing of weed control on corn grain yield, 2007



You can't afford poor weed control !!

	rMNR	EONR	N need to attain yield at preemerge EONR
	------ N rate, lb N/a ------		
	46	43	43
	104	89	105
12	≥200	≥200	200
None	≥200	≥200	>200

EONR at 0.01 N:corn price ratio

Should you protect your N?

Types of "stabilitzer/protectants"

- Urease inhibitors
  - Temporarily prevents N volatilization from surface applied urea (eg. Agrotain (NBPT))
- Nitrification inhibitors
  - Temporarily prevents NH_4^+ conversion to NO_3^- (eg. NServe (nitrapyrin), Instinct, DCD)
- Polycoated urea
  - Delayed release (eg. ESN)
- Sulfur coated urea

Do protectants pay?

- Yes, if you have situations for N loss
  - Surface applied urea, no incorporation within 3 days
  - Wet soils – sometimes, denitrification
  - Sandy soils – sometimes, leaching
  - Fall applied N – may still have losses leach/denitrification

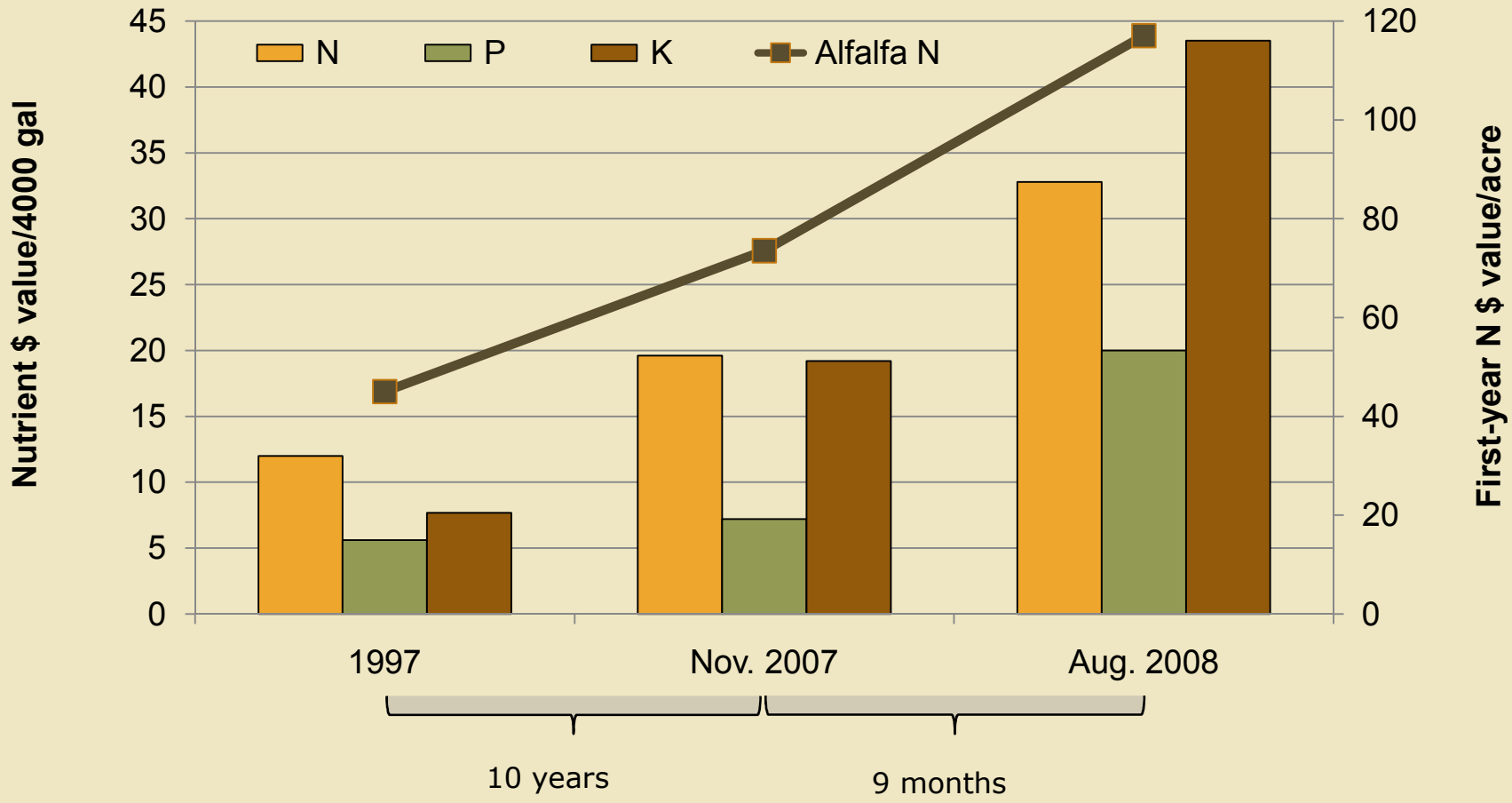
Silver bullet or Snake oil?

New products, non-traditional soil additives, growth stimulants, ect.

- If it sounds too good to be true, then it probably is
- Is it registered with DATCP?
- Can the company provide you with independent research data that has been collected within the region?
- http://www.agronext.iastate.edu/soilfertility/nutrienttopics/addbyproducts.html

Value of manure

1st year nutrient value of 4,000 gal of dairy manure



Average value of 1st year available nutrients in a 4,000 gallon tank of liquid dairy manure. Plus value of 1st year alfalfa N credit (good stand, limited regrowth; OR fair stand with >6" regowth)

Manure nutrient credits

- All manure nutrients are not available
- Total nutrient content = inorganic + organic
- Nutrient credit is dependent upon
  - 1st year nutrient availability coefficient
    - 30% of total N if no incorporation
    - 40% of total N if incorporated within 3 days
    - 60% of total P_2O_5
    - 80% of total K_2O
  - Rate of manure applied

First year available manure nutrients

Species	---------- N ----------		P_2O_5	K_2O
	Surface	incorporated		
Solid manure	---------- lb/ton ----------			
Dairy	3	4	3	7
Beef	4	5	5	9
Turkey	20	24	24	24
Liquid manure	---------- lb/1000 gal ----------			
Dairy	7	10	5	16
Beef	5	7	5	16
Swine in pit	25	33	25	24
Swine out pit	17	22	10	16
Poultry	8	10	6	10

Additional animal species can be found in UWEX Publication A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin*

Consider using other waste products

Use legume N credits

Forage legume N credits

Crop/stand density	Med/fine textured soils		Sands/loamy sands	
	Regrowth (inches)			
	> 8	< 8	> 8	< 8
	---------- lb N/a to credit ----------			
1st year credit				
Alfalfa				
Good (70-100% alfalfa, >4 plant/ft^2)	190	150	140	100
Fair (30-70% alfalfa, 1.5-4 plant/ft^2)	160	120	110	70
Poor (0-30% alfalfa, <1.5 plant/ft^2)	130	90	80	40
Red clover, birdsfoot trefoil	80% of alfalfa for similar stands			
Vetch	160	90	110	40
2nd year credit				
All crops, good or fair stand	50	50	0	0

Green manure N credits

Crop	< 6" growth	> 6" growth
	---------- lb N/a to credit ----------	
Alfalfa	40	60 – 100 [a]
Clover, red	40	50 – 80 [a]
Clover, sweet	40	80 – 120 [a]
Vetch	40	40 – 90 [a,b]

[a] Use the upper end of the range for spring seeded green manures that are plowed under the following spring. Use the lower end of the range for fall seedings.

[b] If top growh is more than 12" before tillage credit 110 – 160 lb N/a

Pre-sidedress nitrate test (PSNT)

- Use PSNT to confirm manure credits
- PSNT can also be used to confirm alfalfa credits

- When/how to sample:
  - When corn is 6-12” tall
  - Composite 15 – 1 foot soil cores (representing ~20 acres)

Questions?