Proceedings of the 2nd Annual Nitrogen: Minnesota's' Grand Challenge & Compelling Opportunity Conference

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Will changing weather patterns affect nitrogen management

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Nitrogen: Minnesota's Grand Challenge & Compelling Opportunity Conference

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ADAPT to CHANGE!

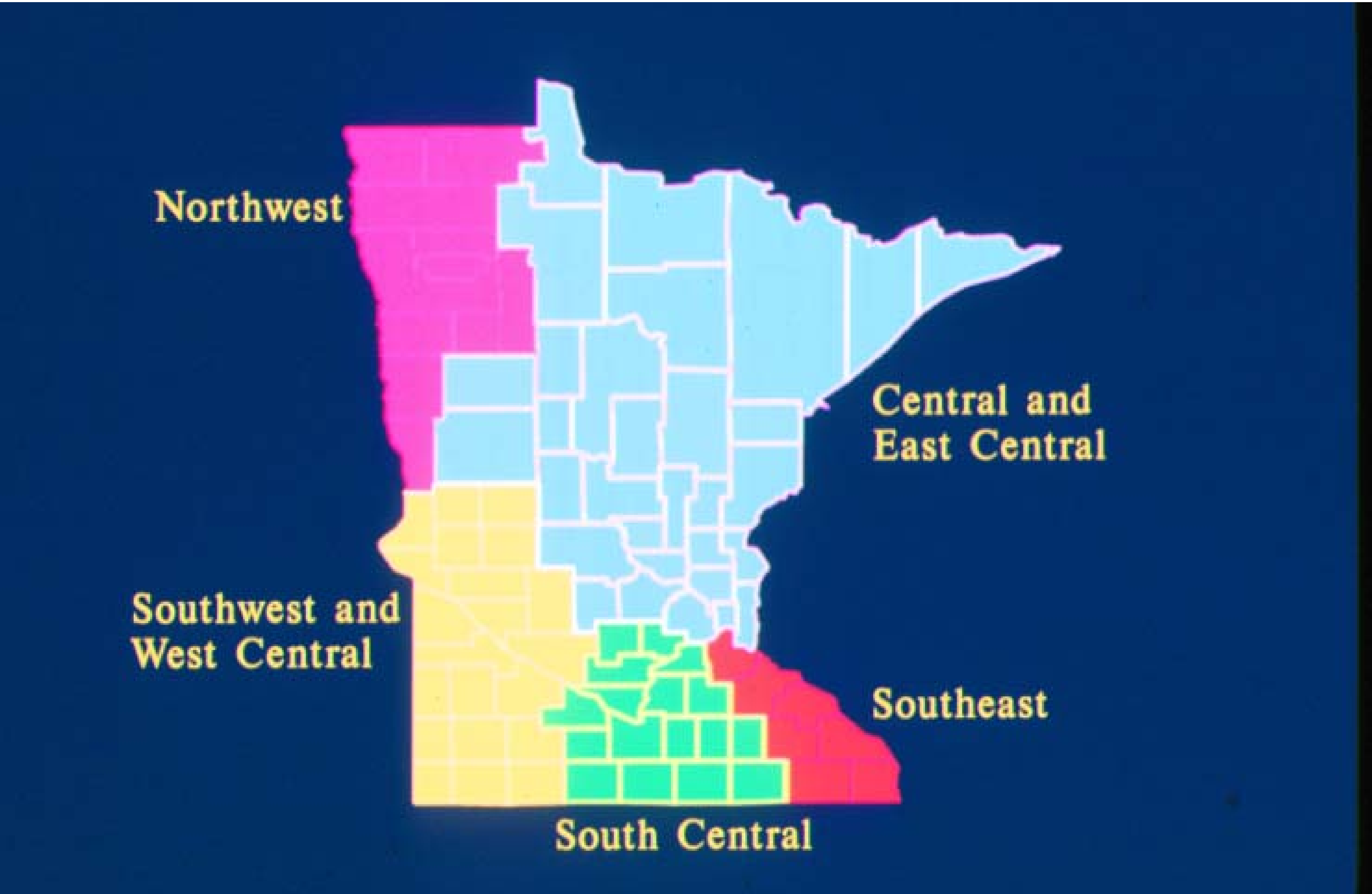
CHANGES

- Climate
- Nitrogen Sources
- Retailers
- Farm Size
- Technology
  - sensors
  - application equipment
- Farmer attitudes
- Tile Drainage
- Water quality concerns

Drivers of Nitrogen Management

- Water
- Temperature
- Decision makers
  - retailer, consultant, farmer
  - making the RIGHT decision
  - lower the risk of loss

Region Specific BMPs for N

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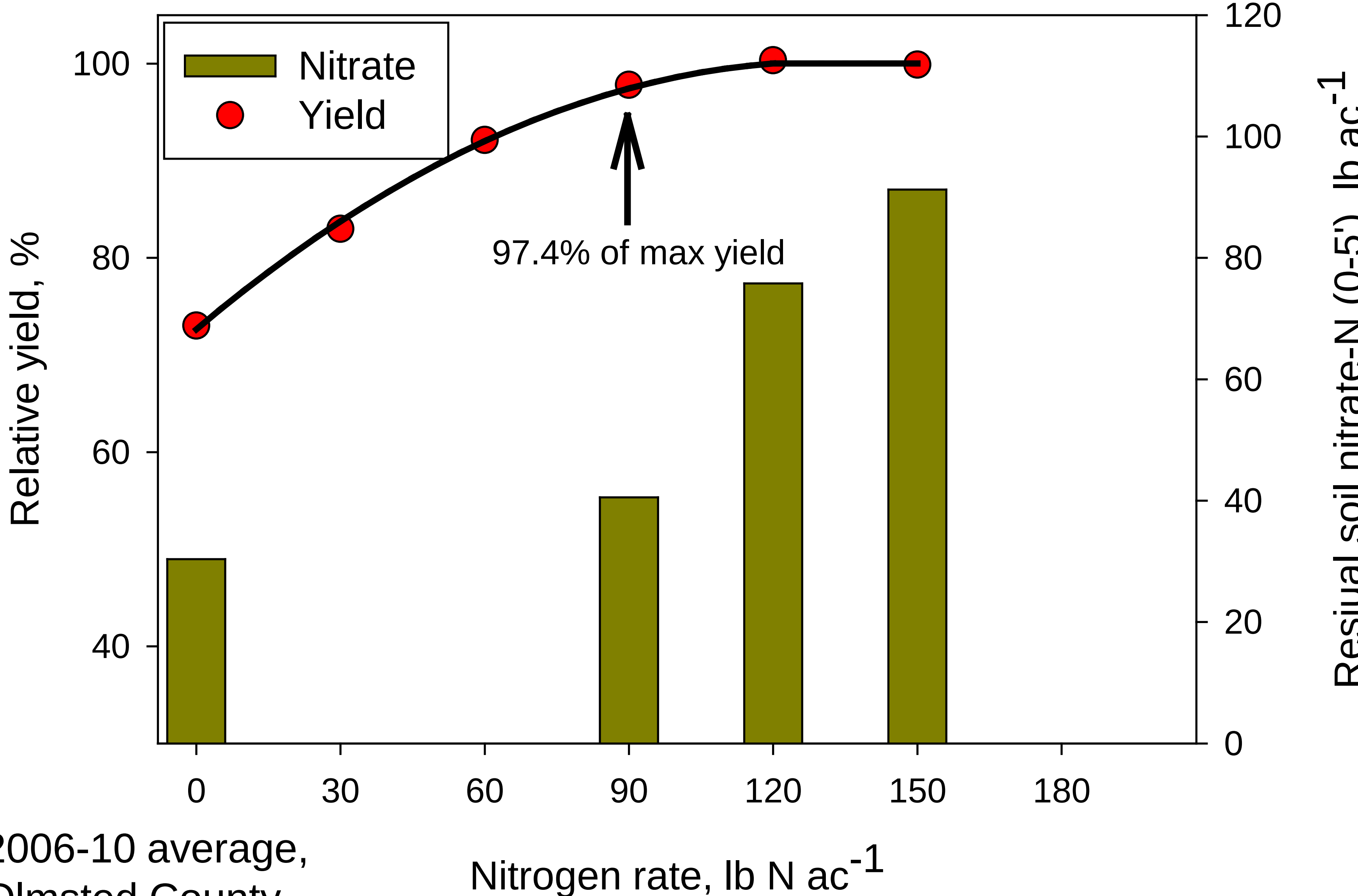
Management Practices

1. Cropping system
2. Rate of N application
3. Time of N application
4. Nitrification inhibitors
5. Source of N
6. Placement of N
7. Cover Crops

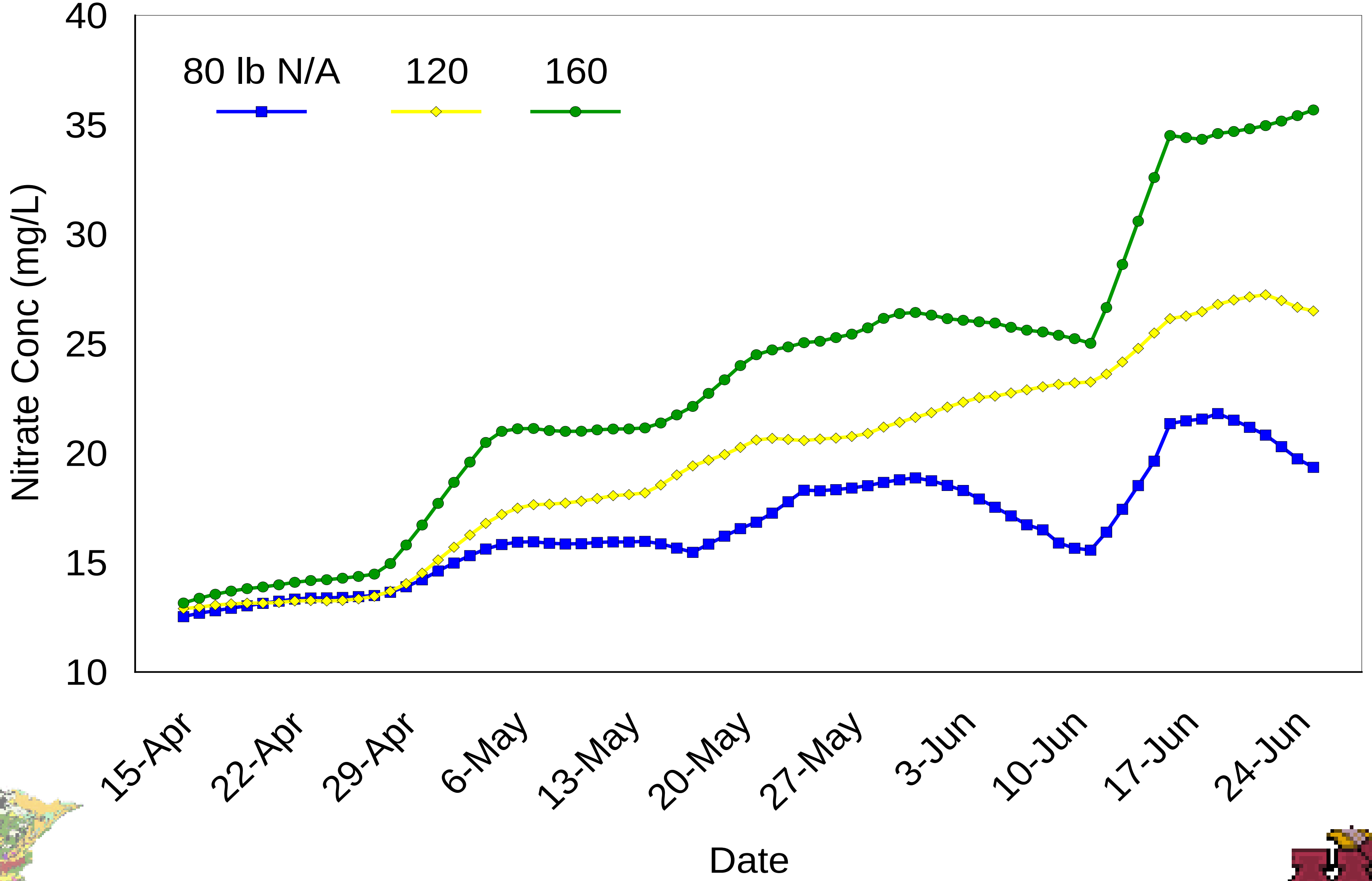
Rate of N Application

Relative corn yield following soybean & residual soil NO_3 (0-5' depth) as affected by N rate (Port Byron)



2006-10 average,
Olmsted County

Effect of N rate for corn after soybean on NO_3-N concentrations in tile drainage water in 2001.



Time of N Application

Time of Ammonia Application for Corn after Soybean at Waseca

April – June Rainfall

30-yr normal =	10.7”
1997 =	8.5” (20% below)
1998 =	11.8” (10% above)
1999 =	15.8” (48% above)

Corn yield as affected by time of application.

	Years		
Time/Placement	1997-'98	1999	3-yr Avg.
	Yield (bu/A)[1/]		
Fall/under row	188	145	174
April/between rows	188	181	186

[1/] Across all four tillage systems.

Primary points

- There was no interaction between Time of N and Tillage

- Spring N in 1999 increased grain yield by 36 bu/A, silage yield by 1.3 T/A, and N recovery by 42% compared to a late October application.
  - fall N can be risky

Time of N Application and N-Serve

Corn grain yield after soybeans as affected by fall and spring application of anhydrous ammonia and N-Serve at Waseca, 1994-99.

Time of Application	N-Serve	
	No	Yes
	- - - 6-Yr Avg. Yield (bu/A) - - -	
Fall (late Oct.)	161	171
Spr. (April)*	172	176

* A yield response to spring-applied N-Serve occurred in years when June rainfall was excessive, but the 4 bu/A (6-yr avg.) increase was not statistically significant.

Corn yield, N recovery, and NUE as influenced by time of application and N source at Waseca.

N Management			3-Yr Avg.		
Time	**Source**	**N-Serve**	**Yield**	**N recovery**	**NUE**
			bu/A	%	bu/lb FN
Fall	Urea	No	152	43	0.36
“	“	Yes	158	47	0.42
“	AA	No	168	60	0.51
“	“	Yes	170	63	0.53
Spr. PP	Urea	No	185	76	0.66
“	AA	No	182	84	0.64
--	None	--	112	--	--

Nitrogen (NO_3) Loss from Tile Drainage

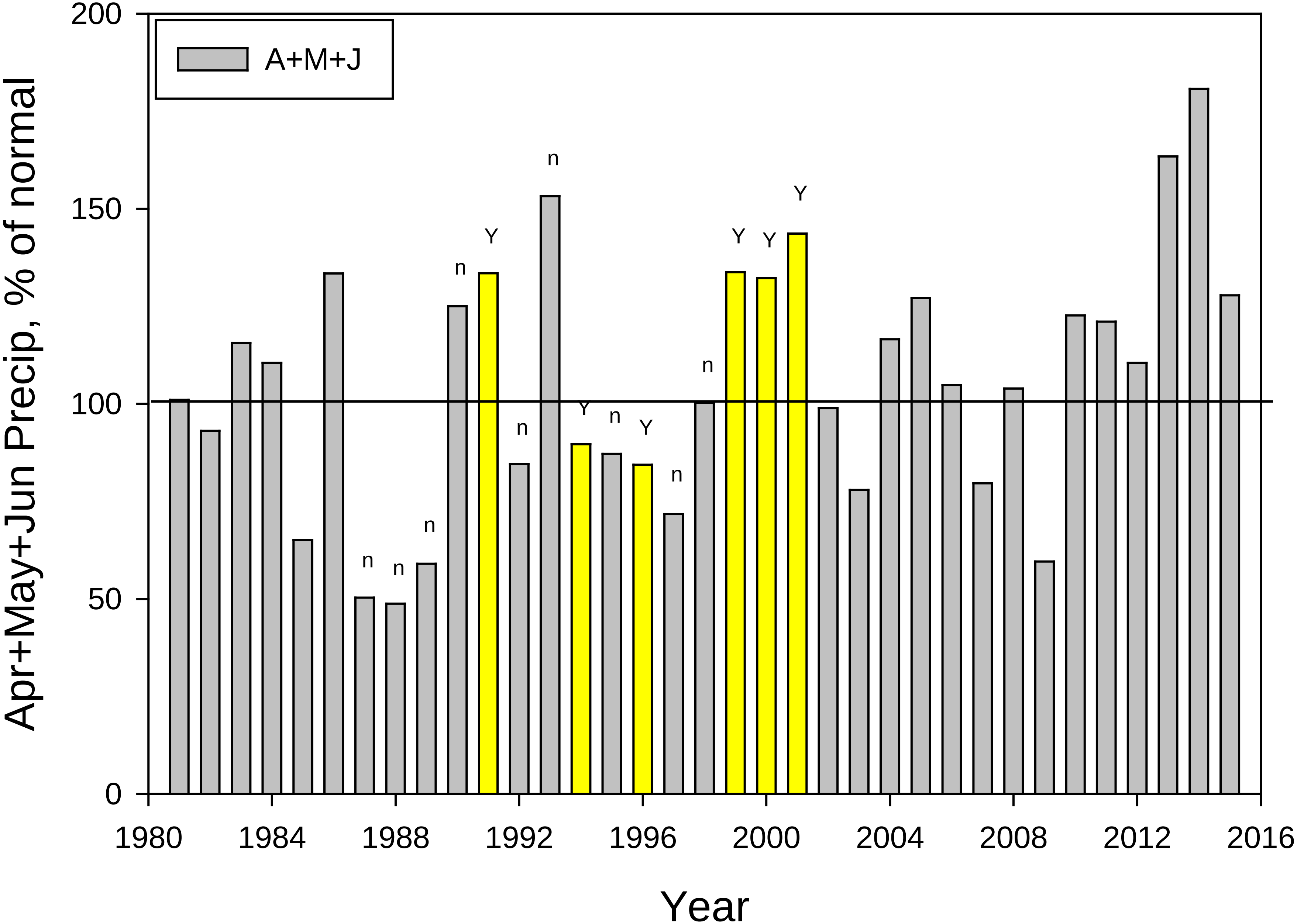
Time and Rate of N Application and Nitrification Inhibitors (N-Serve)

Effect of time of AA application and N-Serve on corn yields after soybean from 1987-2001 at Waseca

	Time of N Application		
Parameter	Fall	Fall+N-Serve	Spring
15-Yr Avg. Yield (bu/A)	144	153	156
15-Yr Avg. FW NO_3-N Conc. (mg/L)	14.1	12.2	12.0
15-Yr N recovery in grain (%)	38	46	47
*7-Yr Avg. Yield (bu/A)**	*131*	*146*	*158*

* Seven years when statistically significant differences occurred.

April + May + June Precipitation at Waseca



Effect of N rate on yield of corn after soybean, net return to fertilizer N, and nitrate-N concentration in tile drainage at Waseca (2000–2003).

N Treatment			4-Yr Yield	4-Yr FW
Time	Rate	N-Serve	Avg.	NO_3-N conc.
	lb /A		bu/A	mg/L
---	0	---	111	---
Fall	80	Yes	144	11.5
Fall	120	Yes	166	13.2
Fall	160	Yes	172	18.1
Spr.	120	No	180	13.7

Nitrate-N concentrations and losses in tile water as affected by rate and time of N application at Waseca.

N application			FW	2000-2003		
			NO_3-N	NO_3-N Lost		
Rate	Time	N-Serve	Conc.	C	Sb	Total
lb N/A			mg/L	-- lb/A/4 cycles - -		
80	Fall	Yes	11.5	115	90	205
120	Fall	Yes	13.2	121	99	220
160	Fall	Yes	18.1	142	139	281
120	Spr.	No	13.7	121	98	219

Conclusions

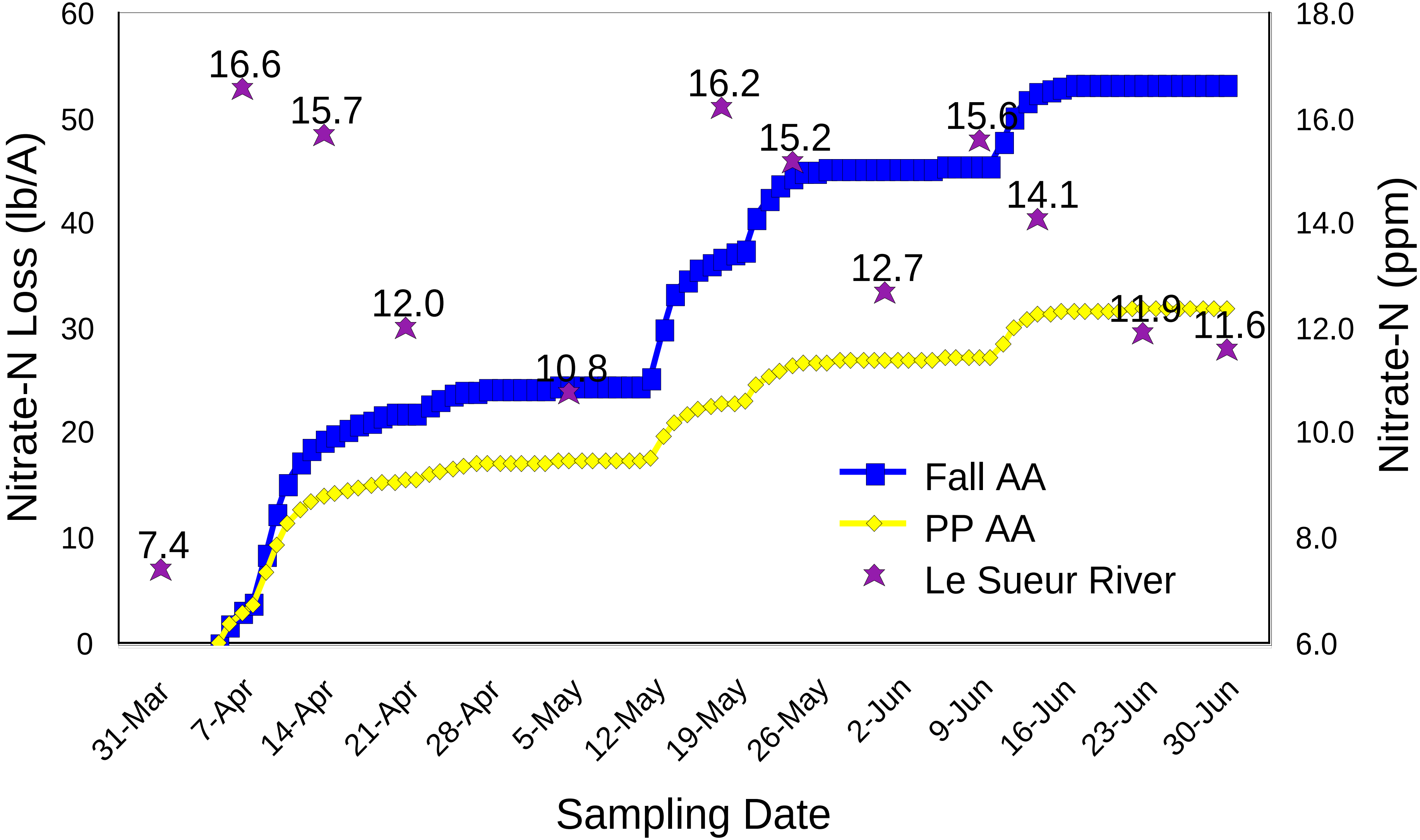
- Nitrate losses were increased 37% by increasing the application rate to 160 lb N/A from the recommended rate of 120 lb N/A for corn after soybean, but yields were increased only 4%.
- Nitrate losses were reduced 14% by decreasing the application rate to 80 lb N/A from the recommended 120-lb rate, BUT yields were reduced by 17%!!

Fall vs. Spring N Summary

Corn Yield: often higher with Spring N!!!

Nitrate-N: Little difference in concentration or loss between Fall and Spring application, if proper/right N rate and a nitrification inhibitor (N-Serve) is used.

1999 tile water NO_3-N loading at Waseca vs. NO_3-N concentrations in the Le Sueur River 2.3 miles from Mankato.



Sources of Nitrogen

Spring Nitrogen Source (2007-2010)

N	N Management		Grain	NUE
Source	Time	N-Inhibitor	Yield	Fert. N
			bu/A	bushel/lb N
Check	None	No	117 d	
AA	PP	No	170 ab	0.59
AA	PP	N-Serve	176 ab	0.60
Urea	PPI	No	182 a	0.66
UAN	PPI	No	171 bc	0.55
UAN	**Pre**	**No**	**166 c**	**0.49**

4-Yr Corn Yield Results

Crop Rotation	N Rate	N Time	Grain Yield	Total N uptake	NUE
	lb N/A		bu/A	lb N/A	bu/lb N
C-S-Corn	0	--	113	72	--
"	60 + 40	SPL	182	141	0.69
"	120	PP	186	142	0.61
	Significance:		NS	NS	--
S-C-Corn	0	--	66	45	
"	60 + 80	SP	172	135	0.76
"	160	PP	165	137	0.62
	Significance:		NS	NS	--

Funding provided by AFREC

4-Yr Corn Yield Summary

1) Corn yields were 15 bu/A (9%) greater for C-S-Corn than for S-C-Corn.
2) Corn grain yield and total N uptake were similar between the 100% preplant N rate and the 85% N rate split-applied.
3) NUE (bu/lb N) was consistently greater for the split-applied 85% N rate. (Need to consider economics).

Funding provided by AFREC

Acknowledgement

- The authors are most grateful to the Agricultural Fertilizer Research and Education Council (AFREC) and Minnesota Corn Growers for financial assistance for this research project.

CROPPING SYSTEMS

Effect of CROPPING SYSTEM on drainage volume, NO_3-N concentration, and N loss in subsurface tile drainage during a 4-yr period (1990-93) in MN.

Cropping System	Total discharge	Nitrate-N Conc.	Nitrate-N Loss
	Inches	ppm	lb/A
Continuous corn	30.4	28	194
Corn – soybean	35.5	23	182
Soybean – corn	35.4	22	180
Alfalfa	16.4	1.6	6
CRP	25.2	0.7	4

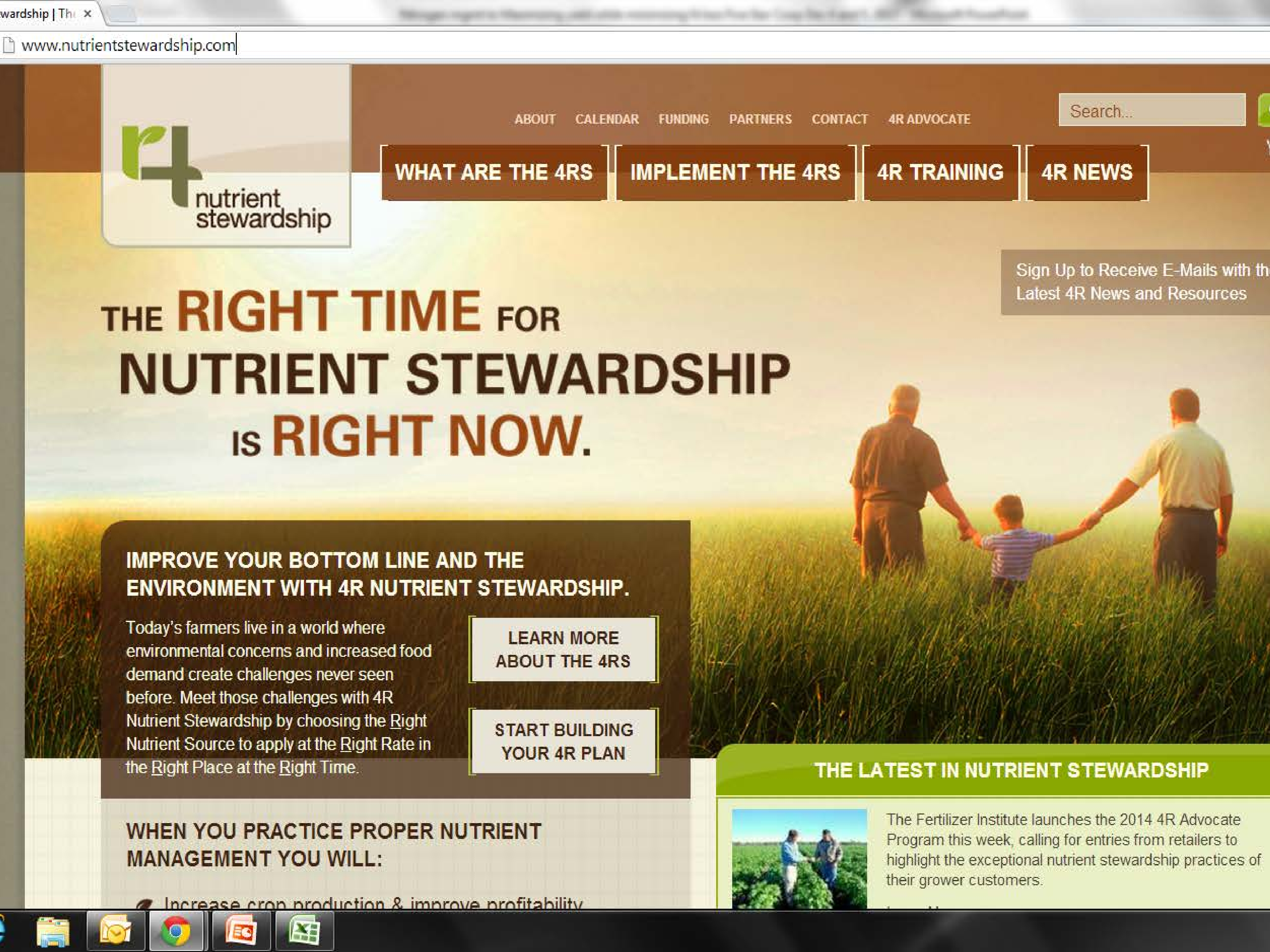
Conclusions

- Cropping system has greater effect on hydrology and nitrate losses than any other management factor! (RISK)
- Perennial crops (alfalfa and grasses) compared to row crops (corn and soybean) reduce
  - Drainage volume by 25 to 50%
  - Nitrate loss by > 95%

Relative effectiveness of management practices to reduce nitrate losses in ….

	Tile Drainage		Ground water
Practice	N. Corn Belt	S.&C. Corn Belt	N. Corn Belt
Cropping system	VH (100)*	VH	VH (100)*
Rate of N	L–H (10-40)	M-H	L-H (10-50)
Time of N	L (5-20)	M	M-H (20-50)
Source of N	VL (0-10)	VL	L (0-15)
Man. vs. Fert.			
Tillage	VL (0-10)	L	VL (0-10)
Cover crop	L (5-20)	M	L (5-20)

* Scale of effectiveness (0 – 100)



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The Fertilizer Institute launches the 2014 4R Advocate Program this week, calling for entries from retailers to highlight the exceptional nutrient stewardship practices of their grower customers.

4 R's

- RATE of application
- TIME of application
- SOURCE of Nitrogen
- PLACEMENT

Will the 4R approach to N management be successful in reducing nitrate-N losses to surface and ground water to meet the goals of Nitrogen Loss Reduction Strategies being established??

- They are directionally correct but will NOT accomplish the goals themselves.
- The role of the decision makers (retailers, consultants, farmers and farm organizations) will be critical to the 4R success.
- Shifting acreage away from corn to other cropping systems is the most effective strategy as it decreases N inputs to the landscape and consequently reduces N losses to water significantly.

Summary and Recommendation

- Environmental scrutiny of nitrogen use in agriculture will continue and likely intensify.
- What is your role? What can you do?
  - Follow nitrogen BMP's for Rate, Time of Application, Inhibitors (EEF's) and Source.
  - DON'T apply insurance N, instead apply rescue N only when needed.
  - Reduce acres that receive fall N application. OR, Use a nitrification inhibitor with fall N and delay application until early November.

FUTURE

- New inhibitors or EEF's
  - Nitrification
  - Urease (volatilization)
    - ✓ Agrotain, Limus, etc.
- Improved diagnostics?
- Improved N efficiency genetics?
- Cover crops???
- Engineered tile systems

FUTURE

- Challenges
  - increased tile drainage
  - long-term over-application of N
    - ✓ Provides greater amounts of available soil N, which affects the EONR and increases the nitrate-N concentration in drainage water.

FUTURE

- Greater societal concern and pressures
  - Environmental quality (water & air)
- Development of science-based policies
  - Rules & regulations
  - Examples:
    1) NO fall application of N on all well-drained soils
    2) Limited fall application (only AA with a NI) on the remaining soils
    3) Record keeping by retailers and farmers
       - fall N, manure applied, other N sources
- Adapt to change!

Thanks

Questions?

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