Using Small-Plot Research Information to Guide Development of Conservation Practice Research at the Watershed Scale

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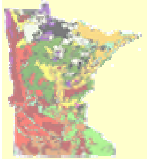
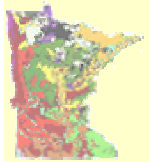


Goals

- Briefly share the results of 30+ years of field research investigating the effect of agricultural management practices on nitrate loss to surface water via sub-surface tile drainage.
- Rank these agricultural management practices as to their potential effectiveness for reducing nitrate losses to surface water.
- Assist scientists developing objectives and protocol for watershed scale research.

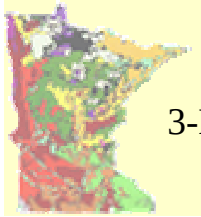


3-Nov-06

Management Practices

- Cropping system
- Rate of N application
- Time of N application
- Nitrification inhibitors
- Source of N (Fert. & Manure)
- Tillage
- Cover crops

CROPPING SYSTEMS

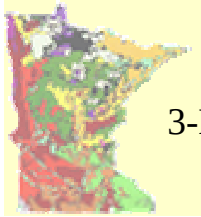


Effect of CROPPING SYSTEM on drainage volume, NO_3-N concentration, and N loss in subsurface tile drainage during a 4-yr period (1990-93) in MN.

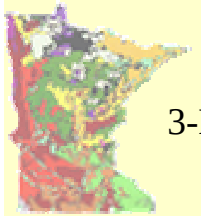
Cropping System	Total discharge	Nitrate-N	
		Conc.	Loss
	Inches	ppm	lb/A
Cont. Corn	30.4	28	194
Corn – Soybean	35.5	23	182
Soybean – C	35.4	22	180
Alfalfa	16.4	1.6	6
CRP	25.2	0.7	4

Conclusions

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



RATE OF N APPLICATION

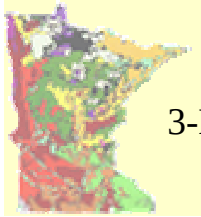


Effect of N rate on yield of corn after soybean, net return to fertilizer N, and nitrate-N concentration in tile drainage at Waseca (2000–2003).

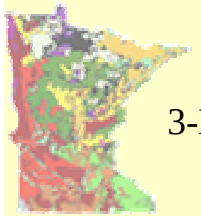
N Treatment			4-Yr Yield	Net	4-Yr FW
Time	Rate	N-Serve	Avg.	Return	NO_3-N conc.
	lb /A		bu/A	$/A/Yr	mg/L
---	0	---	111	---	---
Fall	80	Yes	144	30	12
"	120	"	166	70	13
"	160	"	172	78	18
Spr.	120	No	180	105	14

Conclusions

- Nitrate losses were reduced 27% by decreasing the application rate from 160 lb N/A to the recommended rate of 120 lb N/A for corn after soybean without reducing yield or profit.
- Nitrate losses were reduced 14% by decreasing the application rate to 80 lb N/A from the recommended 120-lb rate BUT yields and profit were reduced by 17% and 57%, respectively.



TIME OF N APPLICATION and Nitrification Inhibitors "N–Serve"



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

Parameter	Time of N Application		
	Fall	Fall+N-Serve	Spring
15-Yr Avg. Yield (bu/A)	144	153	156
15-Yr Avg. Economic return over fall N ($/A/yr) *	---	$9.30	$18.80
15-Yr Avg. FW NO_3-N Conc. (mg/L)	14.1	12.2	12.0
7-Yr Avg. Yield (bu/A) **	131	146	158
7-Yr Avg. Economic return over fall N ($/A/yr) *	---	$22.50	$51.00

* Corn = $2.00/bu; N = $0.25/lb N (fall) & $0.275/lb (spring).

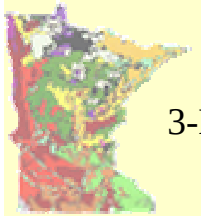
** Seven years when statistically significant differences occurred.

Conclusions

- Nitrate losses were reduced 14% by adding N-Serve to late fall-applied ammonia or by spring applying ammonia compared to a late fall application without N-Serve.
- Corn yields and profit were greatest for spring, preplant-applied ammonia.

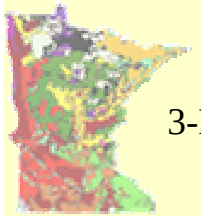
SOURCE OF N

- Fertilizer N vs. dairy and hog manure
  - –8-yr study at Waseca
  - –Continuous corn

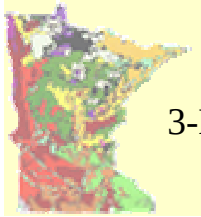


Conclusions

- Nitrate losses were not different between spring, preplant-applied urea and late, fall-applied liquid dairy or hog (finishing) manure provided the manure was applied at the same “available” N rate as urea.



TILLAGE



Effect of tillage on nitrate-N losses in subsurface drainage.

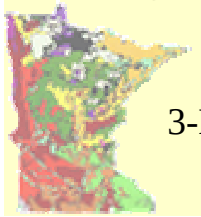
Parameter	Time of N Application	
	Mold. plow	No-till
Drainage volume (inches)	11.0	12.4
Nitrate-N conc. (mg/L)	15	13
Nitrate-N lost (lb/A)	38	37
N lost as a % of applied N	21	20

* Eleven year (1982-92) average.

Minnesota

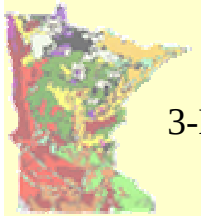
Conclusions

- Depends on climate
  - Tillage systems for row crops in northern US generally do not affect nitrate losses in drainage.
  - Fall tillage in warmer latitudes likely will increase nitrate losses due to enhanced mineralization.
- Dependent on crop rotation/system



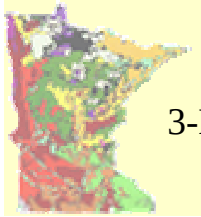
COVER CROPS

- 3-yr study at Lamberton
- Corn-soybean rotation with rye



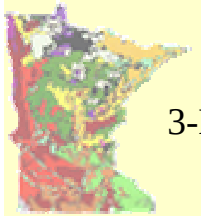
Conclusions

- Drainage volume and nitrate losses were reduced 11 and 13%, respectively when rye was planted following corn.
- Cover crop establishment and growth in the northern Corn Belt can be problematic.
  - estimated to be successful in 1 of 4 years in SW MN.



OVERALL SUMMARY

- Address goal # 2



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

Practice	Tile Drainage		Ground water
	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)

THANKS

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http://sroc.cfans.umn.edu