

Nitrate Loss to Subsurface Drains from a Midwest Bioenergy Production System (RZWQM Simulations).

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Photo courtesy of USDA Natural Resources Conservation Service.

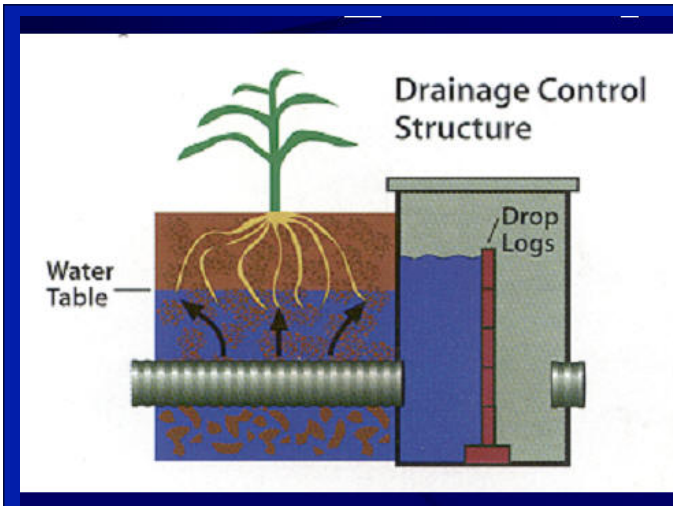
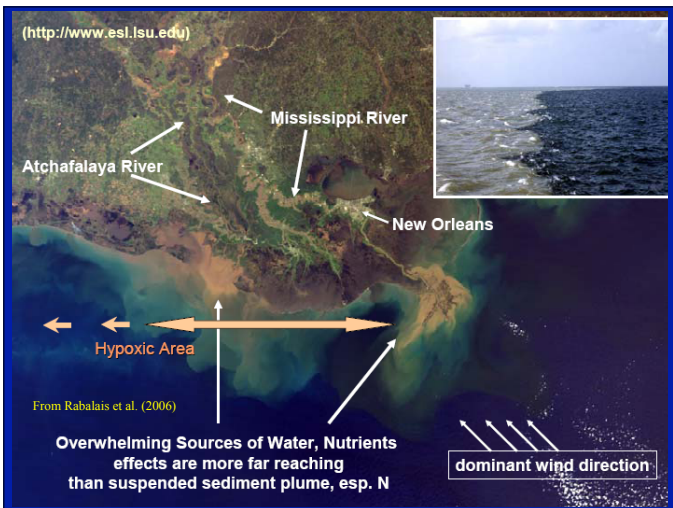


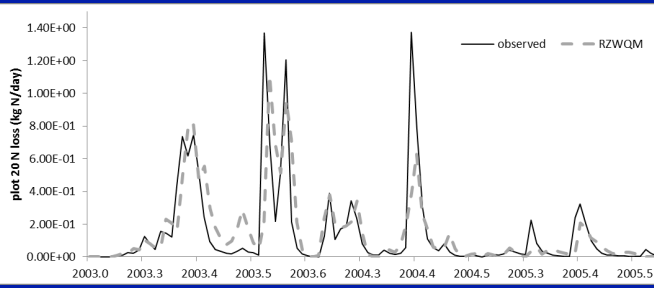
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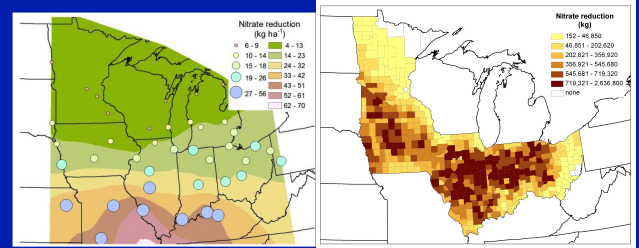
Kelly Farm Rye after Corn Planted 10-6-04
23 kg/ha reduction nitrate loss
2.7 Mg/ha rye shoot biomass

APR 19 2005

Weekly N loss from 2003-2005 on rye cover crop plot



Malone R.W. et al. 2014. Cover crops in the upper Midwest USA: simulated effect on nitrate leaching with artificial drainage. *Journal of Soil and Water Conservation* 69:292-305.



On average, RZWQM predicts that winter rye can reduce nitrate loss to tile drains more than 40% across the U.S. Midwest.

On average, RZWQM predicts that winter rye can reduce nitrate loss from Midwest tile drains to the Mississippi River by more than 150 million kg-N or about 20%.

Background – Winter rye as a biofuel

(Shao et al., 2015, *Biotechnology for Biofuels*)

- “Planting winter rye as cover crop can add significantly to farmer’s income”
- Winter rye biomass value more than \$150/Mg
- Fertilizer added to rye increases biomass
- Rye biomass delivered to the farm gate costs perhaps \$45–\$75 per Mg DM (Baker and Griffis, 2009).
- These two studies suggest planting rye as a cover crop may add to farmer’s income
- Potential rye biomass harvest from U.S. corn/soybean-belt is 151 Tg (170 million U.S. tons) (Feyereisen et al., 2013)

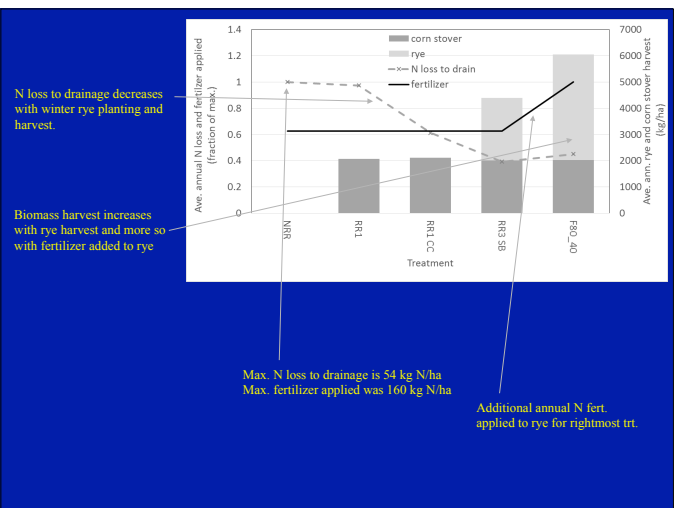
Background – Winter rye as a biofuel

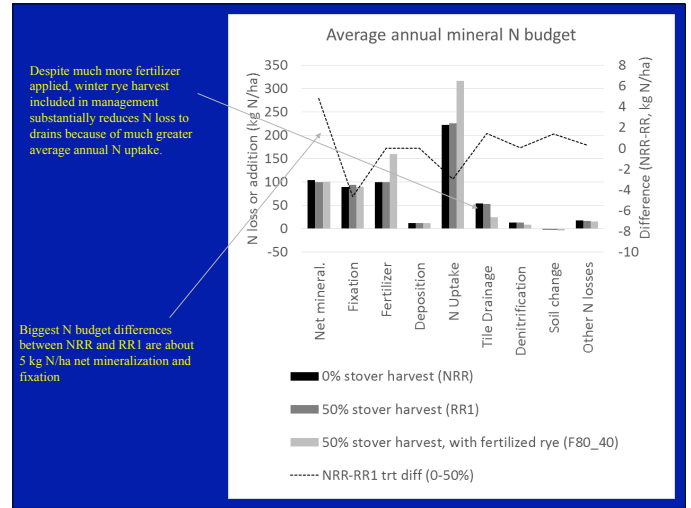
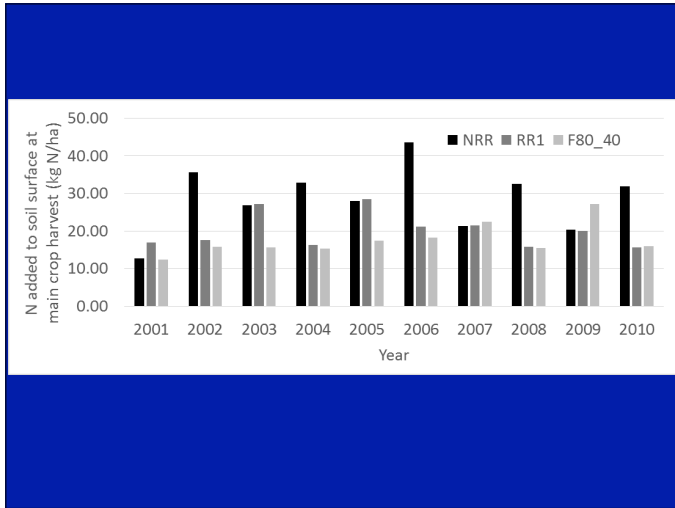
- Few studies have evaluated the effect of corn stover removal on nitrate loss to subsurface drainage (Daigh et al., 2015, *JEQ*)
- Evaluation of N loss in systems where winter cover crop was harvested is even more limited.
- Therefore, we used RZWQM to predict N loss to drainage in central Iowa corn/soybean rotations under
 - corn stover harvest
 - winter rye cover crop harvest

RZWQM simulated treatments (2001-2010).

Treatment	Fertilizer applied (kg N/ha)		Soybean planting date	Corn stover harvest	Rye biomass termination/harvest		
	Corn	Rye*			Amount	Amount	Prior to soybean
NRR	200	0	5-May	0%	0%	n/a	n/a
RR1	200	0	5-May	50%	0%	n/a	n/a
RR1 CC	200	0	5-May	50%	0%	20-Apr	20-Apr
RR3 SB	200	0	5-Jun	50%	90%	20-May	20-Apr
F80_40	200	80/40	5-Jun	50%	90%	20-May	20-Apr

* Fertilizer applied to rye March 9 → 80 kg N/ha prior to soybean planting and 40 prior to corn.





Summary and Conclusions

- Fertilized rye as a cover crop could provide 4.0 Mg/ha/year
- Literature suggests rye value more than \$150/Mg while cost to grow and harvest are less than \$75/Mg
- N loss to drainage in fertilized/harvested rye (F80_40) less than in conventional rye cover crop (RR1 CC).
- Rye as a bioenergy source could have economic and environmental benefits.