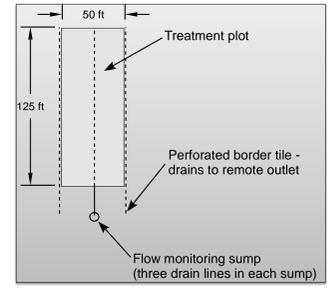


Effects of nitrogen application timing, tillage systems and winter cereal rye cover crop on corn and soybean yields and nitrate-nitrogen concentrations from a tile-drained field in Iowa

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Introduction and Rationale

In field practices including nutrient management, tillage and alternative cropping systems are a promising way to reduce nitrate-nitrogen (NO₃-N) export from tile drained agricultural fields.

The specific objectives of this study were to determine and compare crop yields and flow weighted NO₃-N concentrations under various experimental treatments:

- nitrogen fertilizer application timing (spring versus fall);
- tillage practices (conventional tillage versus no-till);
- cover cropping systems (winter cereal rye cover crop versus no cover crop).

Experimental Procedure

A field study was conducted at the ADW Research Facility near Gilmore City, Iowa, from 2011 to 2013. The treatments investigated consist of 8 plots with a corn-soybean rotation, where 4 plots are in corn and 4 in soybeans each year. In this study aqua-ammonia was applied to all corn treatments at the same nitrogen application rate of 150 lb-N/acre, while soybean treatments received no nitrogen. Continuous subsurface drain flow measurements and composite water samples were used to quantify drainage volumes and NO₃-N concentrations.

Table 1. Description of experimental treatments

Treatment	Tillage	Cover Crop	Nitrogen Application
CP-FA-150-S	Chisel plow	-	Fall
CP-FA-150-C	Chisel plow	-	Fall
CP-SP-150-S	Chisel plow	-	Spring
CP-SP-150-C	Chisel plow	-	Spring
CP-rye-150-S	Chisel plow	Winter rye	Spring
CP-rye-150-C	Chisel plow	Winter rye	Spring
NT-SP-150-S	No-till	-	Spring
NT-SP-150-C	No-till	-	Spring
NT-rye-150-S	No-till	Winter rye	Spring
NT-rye-150-C	No-till	Winter rye	Spring

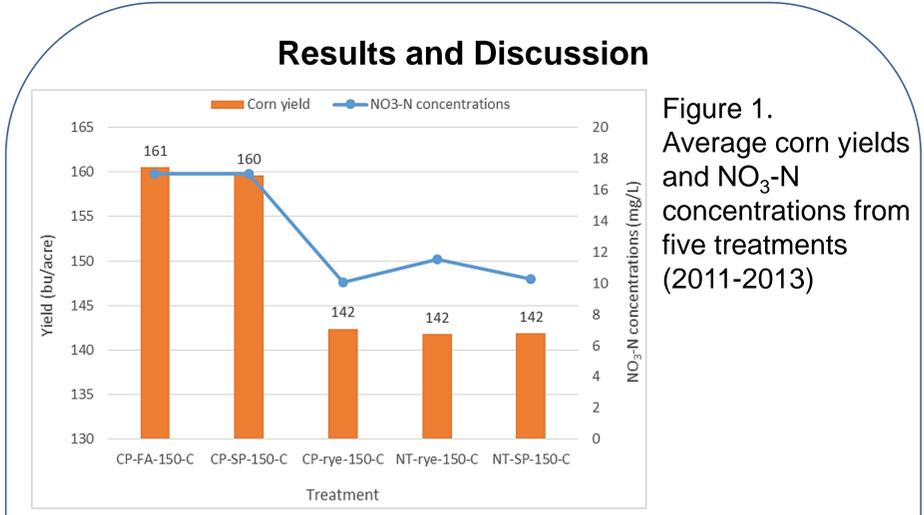


Figure 1. Average corn yields and NO₃-N concentrations from five treatments (2011-2013)

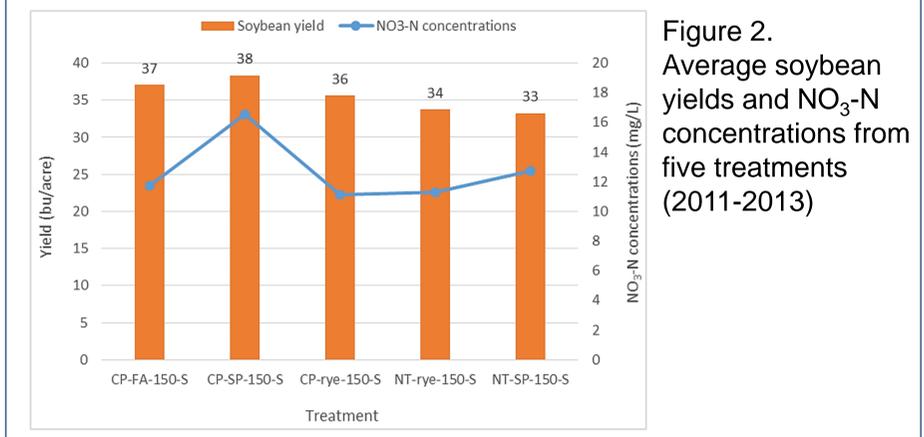


Figure 2. Average soybean yields and NO₃-N concentrations from five treatments (2011-2013)

Treatment	2011	2012	2013	Average
	----- inches -----			
CP-FA-150-C	6.8	0.4	8.3	5.2
CP-SP-150-C	10.1	1.2	10.5	7.3
CP-rye-150-C	9.6	0.7	7.6	6.0
NT-rye-150-C	10.8	0.9	10.0	7.2
NT-SP-150-C	8.4	2.0	9.5	6.7
CP-FA-150-S	8.4	0.8	5.6	5.0
CP-SP-150-S	10.3	1.8	9.1	7.1
CP-rye-150-S	12.3	1.6	7.7	7.2
NT-rye-150-S	10.5	0.6	7.8	6.3
NT-SP-150-S	8.4	1.1	9.9	6.5
Precipitation	22.3	20.8	26.6	23.2

Table 2. Annual and 3-yr average subsurface drainage volumes and precipitation (2011-2013)

Results and Discussion

- The highest corn yields during the study period was for the spring and fall application with conventional tillage treatments, while the lowest yields was for the rye cover crop and no-till treatments. However, treatments with high corn yields also had highest NO₃-N concentrations when compared with cover crop and no-till treatments.
- The conventional tillage with spring applied nitrogen to the previous corn crop treatment had highest soybean yield of 38 bu/ac and highest NO₃-N concentrations, while the no-till spring nitrogen application treatment had the lowest yield at 33 bu/ac.
- Overall, the lowest crop yields were observed in 2012 when plant growth was limited by severe drought.
- Fertilizer application timing had little impact on NO₃-N concentrations for corn treatments, in contrast for soybean treatments where the nitrogen was applied in the spring to the prior corn crop there tended to be increased NO₃-N concentration in water for the conventional till system.
- Averaged over 3 years, the no-till system showed potential to reduce NO₃-N concentrations in the subsurface drainage by 40% and 23% after corn and soybean, respectively.

Conclusions

The use of the winter cereal rye cover crop reduced NO₃-N concentrations in the subsurface drainage. The nitrate-nitrogen concentrations tended to be lower in the no-till systems when compared with the conventional tillage. Crop yields were generally better on the chisel plow treatments without winter cereal rye cover crop. This study highlighted possible impacts of droughts on crop yields, therefore, there is a need for further investigations to reduce climate related risks. In this case, implementation of drainage water management practices might be a possibility.

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