

lowa Farm Bureau's Margin Management Webinar Series presents:

Impacts of 4R Nitrogen Management on Water Quality

Thursday, March 29, 2018 1:00 pm

Sponsored by:



Speaker: Dr. Matthew Helmers,

Dean's Professor, College of Ag. & Life Sciences Professor, Dept. of Ag. & Biosystems Engineering, Iowa State University

IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering

Impacts of 4R Nitrogen Management on Water Quality

Matthew Helmers Dean's Professor, College of Ag. & Life Sciences Professor, Dept. of Ag. and Biosystems Eng. Iowa State University



Fig. 1. MANAGE Drain Load subsurface (a) vs. surface drainage site-years (b).

Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Flow Monitoring System



Drainage Monitoring System



Soil Nitrate Production vs. Crop Nitrate Uptake



In the shaded areas, the soil produces nitrate, but there is no crop to use it. As a result, <u>some</u> nitrate is lost to waterways.

IOWA STATE UNIVERSITY Extension and Outreach Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Twenty-Seven Year Summary



Twenty-Seven Year Summary



Combined Corn-Soybean System – Same N management – Early Spring Sidedress at 150-160 lb-N/acre

Nitrate Response to Nitrogen



IOWA STATE UNIVERSITY Extension and Outreach

Nitrate Response to Nitrogen



$\textbf{Results} \rightarrow \textbf{Nitrogen source}$

Averaged over the corn-soybean rotation











Impact of Application Timing: 2006-14



Impact of Application Timing: 2006-14





Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Treatments

Treatment Number	Tillage	Nitrogen Application Time	Nitrogen Application Rate (lb N/acre)*
1	Conventional tillage*	Fall (anhydrous ammonia with nitrapyrin)**	135
2	Conventional tillage	Spring (anhydrous ammonia)	135
3	Conventional tillage	Split with variable N at sidedress (40 lb/acre of urea 2x2 starter at planting plus in-season agrotain treated urea)	135
4	Conventional tillage	None	0

* Fall chisel corn stalks with spring disk/field cultivate, and spring disk/field cultivate soybean stubble.

**In fall of 2014 freezing conditions occurred early and prevented fall application. Application occurred in early spring 2015.

Flow-weighted Nitrate-N Concentration





*Means with the same letter in the same year are not significantly different, P=0.05.

Flow-weighted Nitrate-N Concentration





*Means with the same letter in the same year are not significantly different, *P*=0.05.

Soil Nitrate Production vs. Crop Nitrate Uptake Addition of a Cover Crop



In the shaded areas, the soil produces nitrate, but there is no crop to use it. As a result, <u>some</u> nitrate is lost to waterways.

Winter Cereal Rye Cover Crops



Gilmore City



Impacts of Cover Crops on Nitrate-N Load in Drainage Water – Gilmore City



Impacts of Cover Crops



Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Impact of Land Management



Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Management systems for 2016 - 2018 study

System	Application timing and N source	Сгор	Tillage	N rate (lb/ac)
1	Spring UAN -	Corn Soybean	Chisel plow Field cultivate	150 -
2	Early fall manure -	Corn Soybean	No-till No-till	150 -
За	Late fall manure + Instinct	Continuous corn	Chisel plow	200
3b	Spring manure	Continuous corn	Chisel plow	200
4a	Late fall manure	Continuous corn	Chisel plow	200
4b	Late fall manure + 1 ton/ac gypsum	Continuous corn	Chisel plow	200
5	Early fall manure -	Corn + Rye cover Soybean + Rye cover	No-till No-till	150 -
6	Late fall manure -	Corn Soybean	No-till No-till	150 -

Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Monthly nitrate-N levels in corn 2016-2017



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Monthly nitrate-N levels in soybeans 2016-2017



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Monthly nitrate-N levels in continuous corn 2016-2017



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Cereal rye cover crop N uptake



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Manure injection bands



Rye cover crop growth at NERF April 6, 2016

Corn phase yields



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Soybean phase yields



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Continuous corn yields



Research funded by Iowa Pork Producers Association and Calcium Products Inc.

Temporal Changes

Corn Yield



N Output with Grain



Edge-of-Field Practices

Drainage water management COCCCCC 100000 60000000 200000000000 USDA TRANSFORMING DRAINAGE. United States Department of Agriculture National Institute of Food and Agriculture

Subsurface Drainage Bioreactor



Saturated buffers

COCCOC



CCCCC .



United States Department of Agriculture National Institute of Food and Agriculture

Nitrate Removal Wetland





To Reach our Goals

• WE NEED IT ALL!!

- N Management
- Cropping practices/landuse
- Edge-of-Field Practices







IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering

Resources

- 10 Ways to Reduce Nitrate Loss -<u>http://draindrop.cropsci.illinois.edu/wp-</u> <u>content/uploads/2016/09/Ten-Ways-to-Reduce-</u> <u>Nitrate-Loads_IL-Extension-_2016.pdf</u>
 - Drainage Water Quality Impacts of Various In-Field Nutrient Management Practices
 - Agricultural Drainage Research and Demonstration Site Gilmore City – AE 3614
 - Comparison of Biofuel Systems Site AE 3615
 - Northeast Research and Demonstration Farm AE 3616
 - Northwest Research and Demonstration Farm AE 3617
 - Southeast Research and Demonstration Farm AE 3618

IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering

Discussion

mhelmers@iastate.edu

Twitter: @ISUAgWaterMgmt Website: http://agwatermgmt.ae.iastate.edu/ Iowa Farm Bureau's Margin Management Webinar Series:

Impacts of 4R Nitrogen Management on Water Quality

Thanks for your participation!

Please fill out a brief evaluation by clicking: https://tinyurl.com/fourRManage

Recordings of this webinar and materials will be available for Farm Bureau members at <u>www.iowafarmbureau.com</u>

Speaker: Dr. Matthew Helmers,

Dean's Professor, College of Ag. & Life Sciences Professor, Dept. of Ag. & Biosystems Engineering, Iowa State University