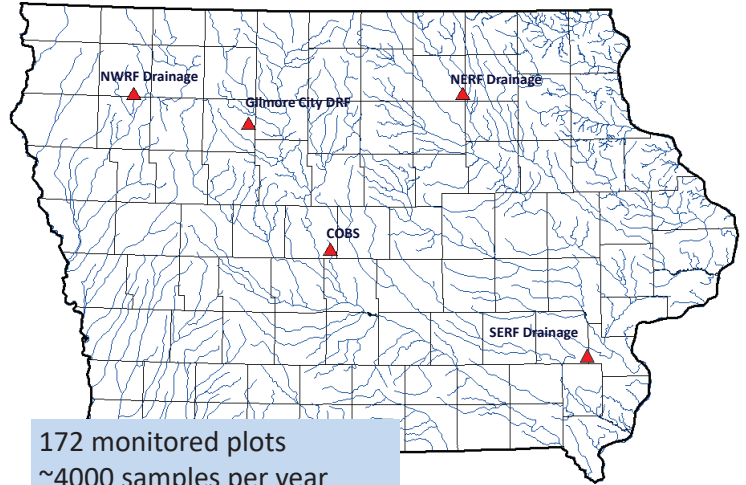


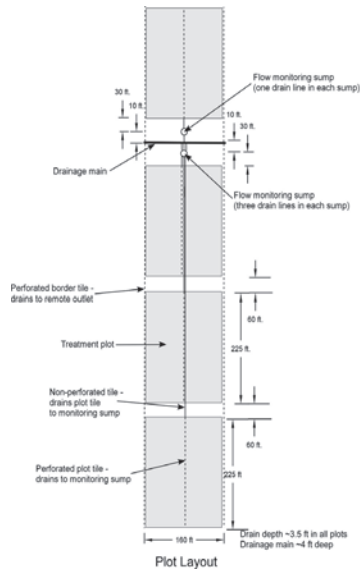
Impacts of 4R Management on Drainage Water Quality

Matt Helmers – Director of the Iowa Nutrient Research Center, Professor in Dept. of Ag. And Biosystems Engineering and Dean’s Professor in the College of Ag and Life Sciences

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



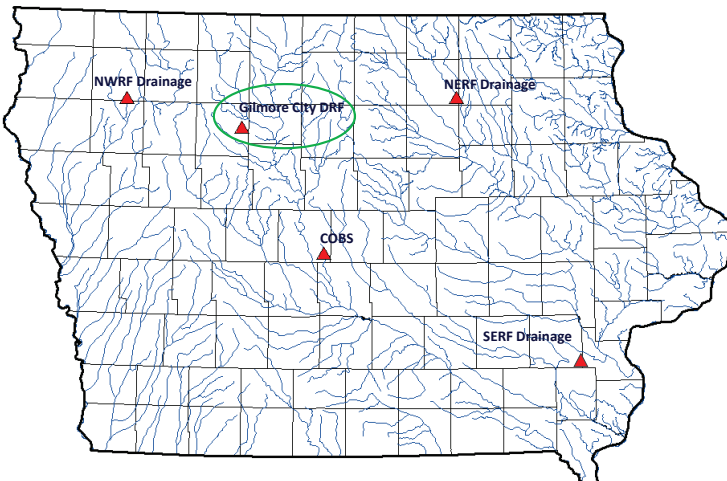
Subsurface Drainage Layout



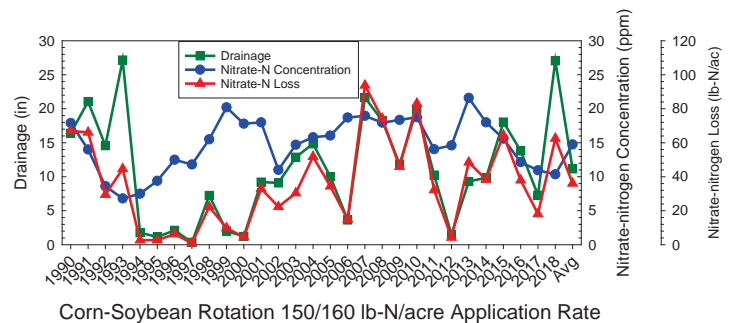
Flow Monitoring System



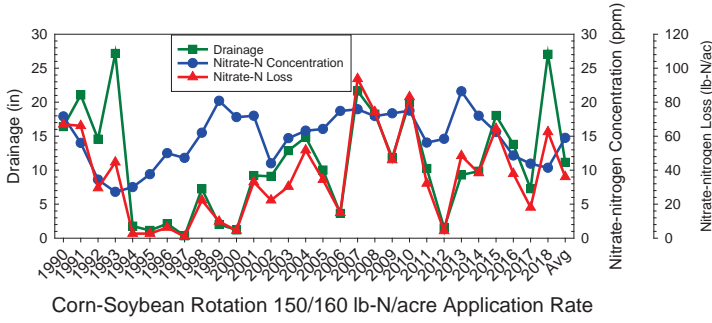
Replicated subsurface drainage plots to evaluate performance of various in-field management practices



Twenty-Nine Year Summary



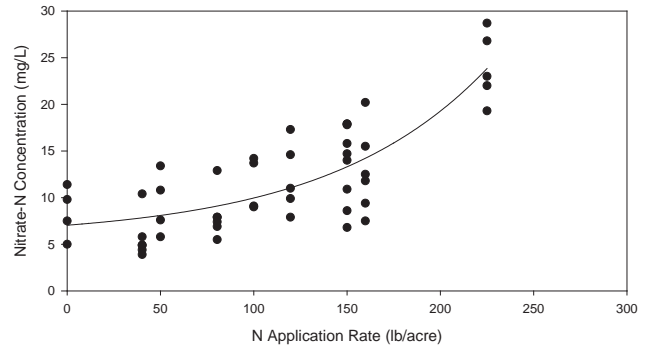
Twenty-Nine Year Summary



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

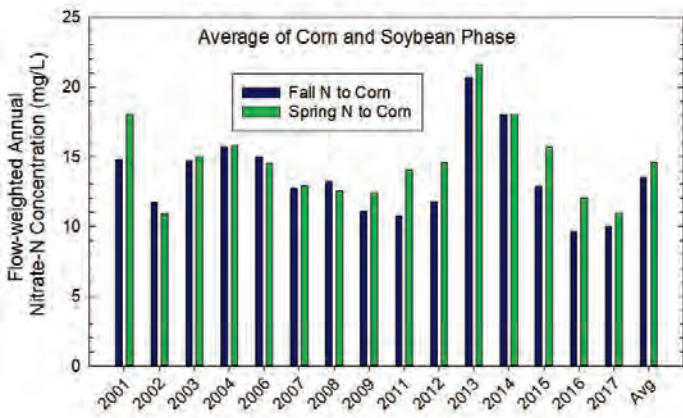
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N-Rate versus Concentration



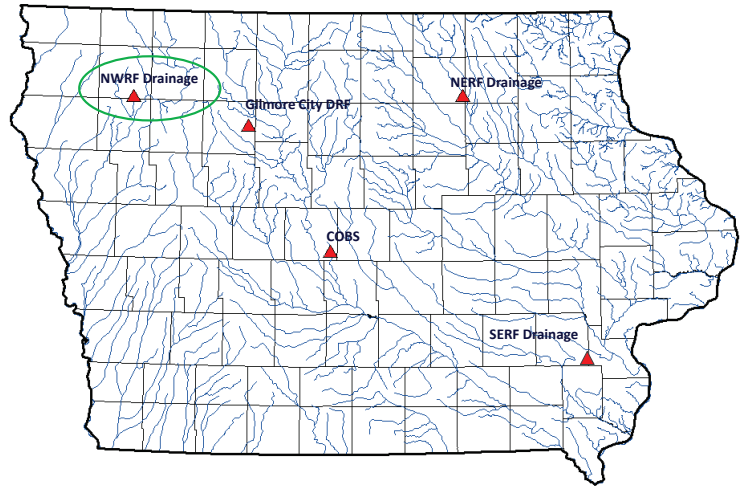
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Timing Study at ADW



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



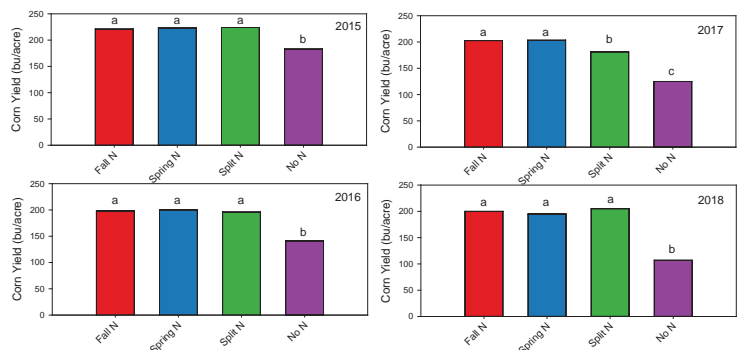
Treatments

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.

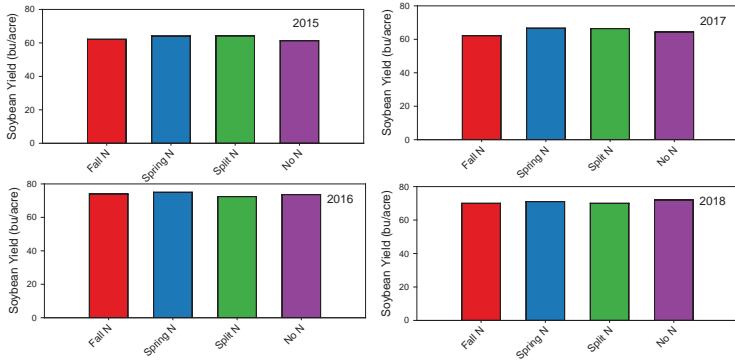
**In fall of 2014 freezing conditions occurred early and prevented fall application. Application occurred in early spring 2015.

Corn Yield



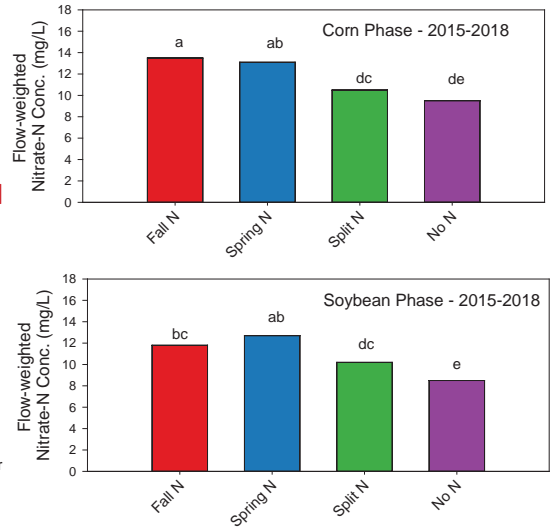
*Means with the same letter in the same year are not significantly different, $P=0.05$.

Soybean Yield



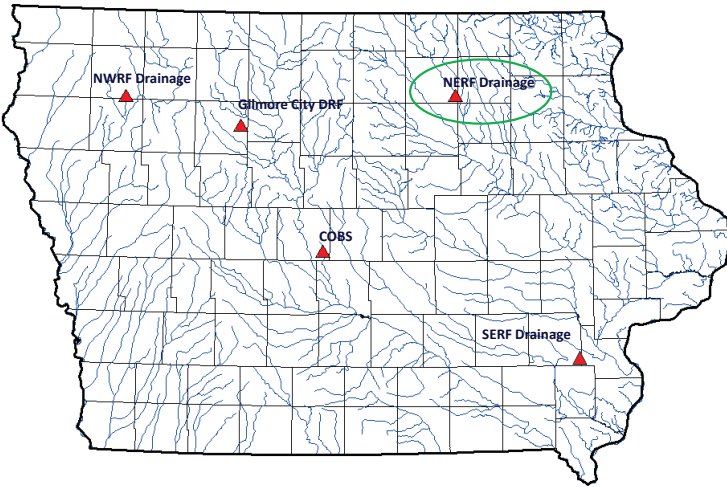
*Means with the same letter in the same year are not significantly different, $P=0.05$.

Flow-weighted Nitrate-N Concentration



*Means with the same letter in the same year are not significantly different, $P=0.05$. Analyzed across corn and soybean phase

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

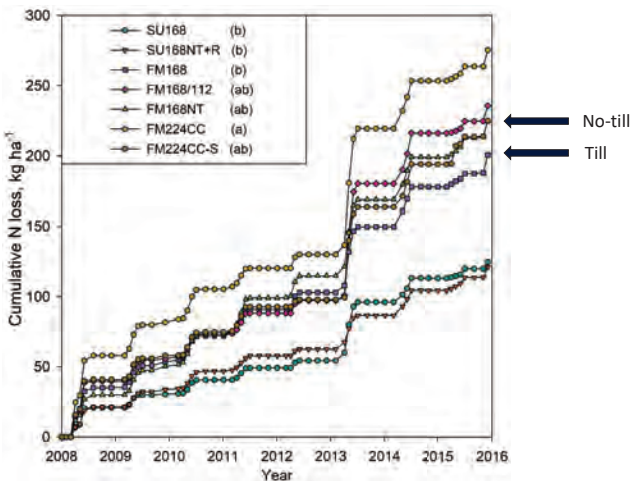


Management Systems for 2008-2015 Study

Treatment	Timing and source of N	Target N Rate kg ha ⁻¹	Crop rotation	Tillage
SU168	Spring UAN	168	Corn Soybean	Chisel plow corn fall Field cultivate spring
SU168NT+R	Spring UAN	168	Corn + Rye cover crop Soybean + Rye cover crop	No-Till No-Till
FM168	Fall Manure	168	Corn Soybean	Chisel plow corn fall Field cultivate spring
FM168/112	Fall Manure	168 112	Corn Soybean	Chisel plow corn fall Field cultivate spring
FM168NT	Fall Manure	168	Corn Soybean	No-Till No-Till
FM224CC	Fall Manure	224	Continuous Corn	Chisel plow fall Field cultivate spring
FM224CC-S	Fall Manure	224	Continuous Corn with Stover removal	Chisel plow fall Field cultivate spring

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Nitrate-N Loss from 2008-2015



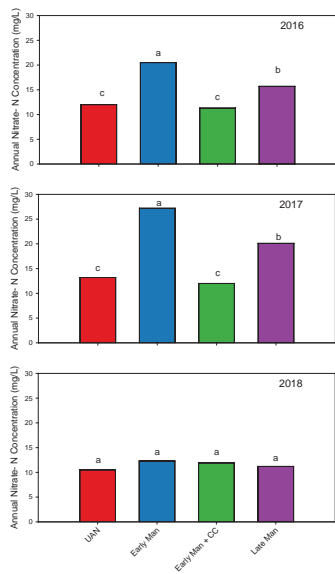
Management systems for 2016 - 2018 study

System	Application timing and N source	Crop	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
3a	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

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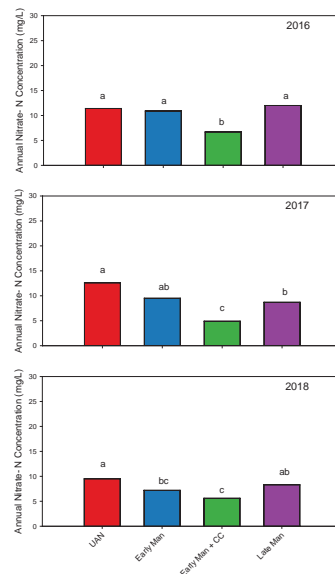
Research funded by Iowa Pork Producers Association and Calcium Products Inc

Corn phase: Flow-weighted Nitrate-N Concentration



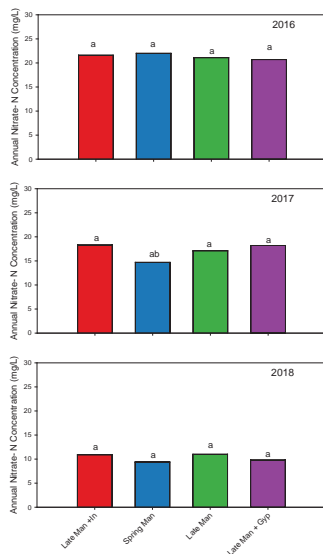
*Means with the same letter in the same year are not significantly different, P=0.05.

Soybean phase: Flow-weighted Nitrate-N Concentration



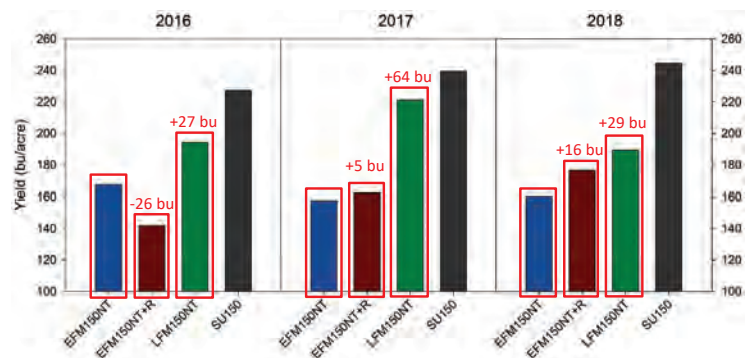
*Means with the same letter in the same year are not significantly different, P=0.05.

Continuous Corn: Flow-weighted Nitrate-N Concentration



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

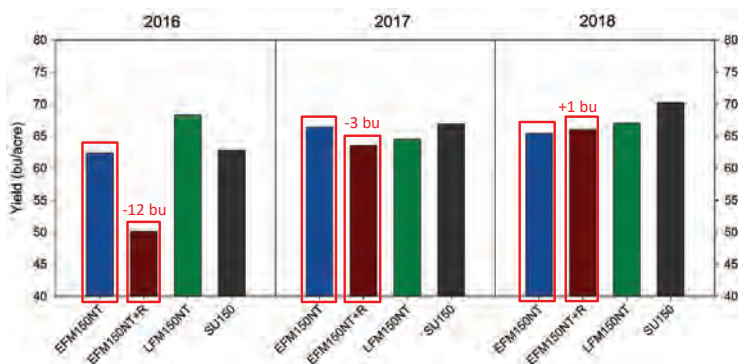
Corn phase yields



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

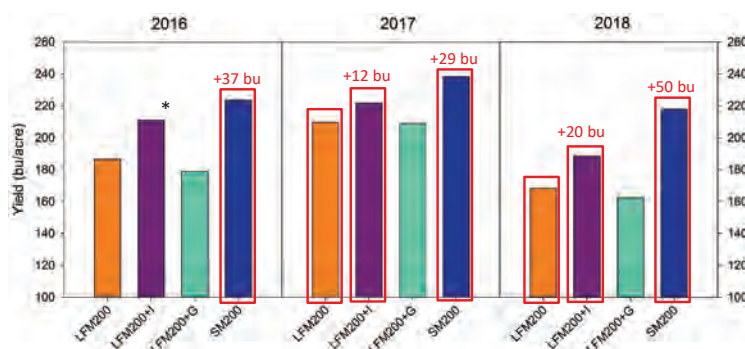
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Soybean phase yields



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

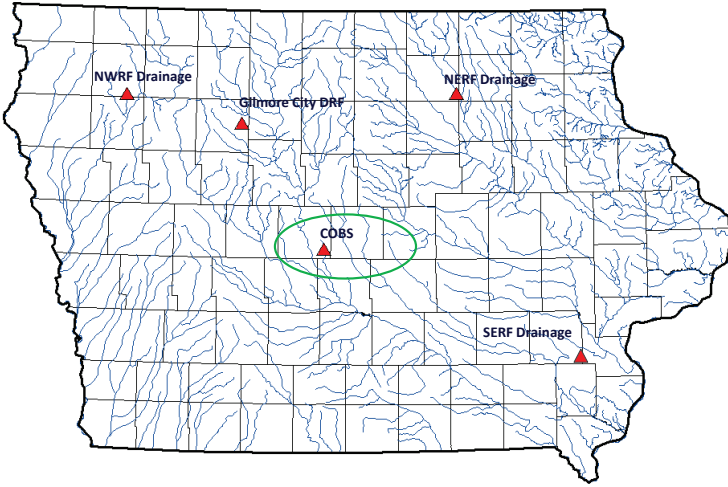
Continuous corn yields



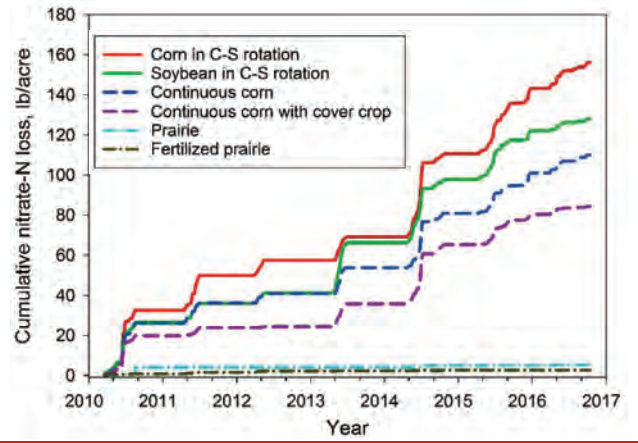
* LFM200+H was planted to soybeans in 2015

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

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

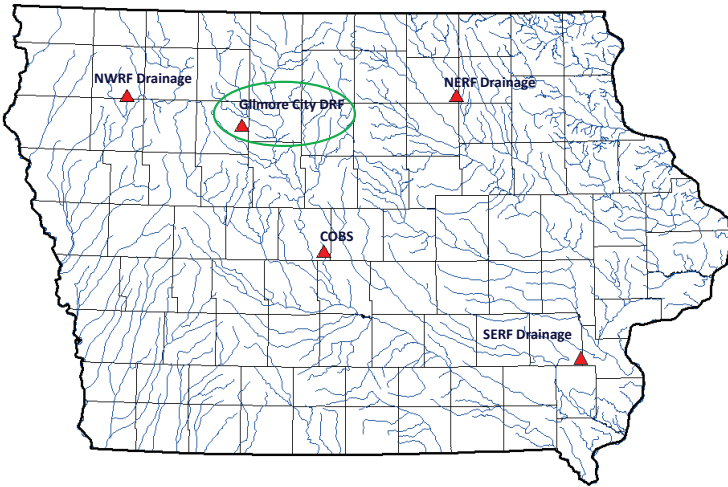


Impact of Land Management



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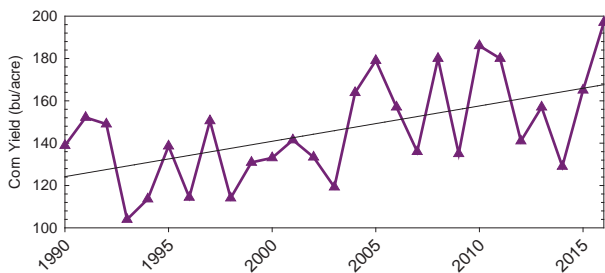
Replicated subsurface drainage plots to evaluate performance of various in-field management practices



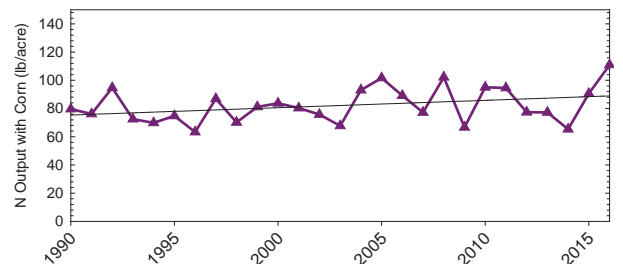
Temporal Changes

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Corn Yield



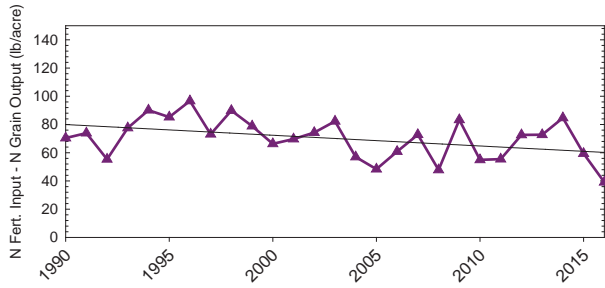
N Output with Grain



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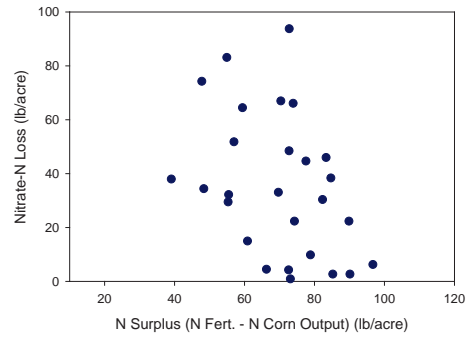
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N Surplus (N Fertilizer Input – N Corn Output)



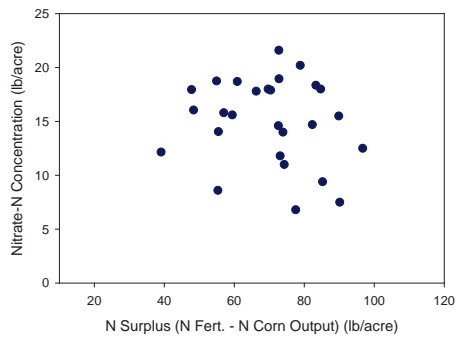
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N Loss versus Surplus



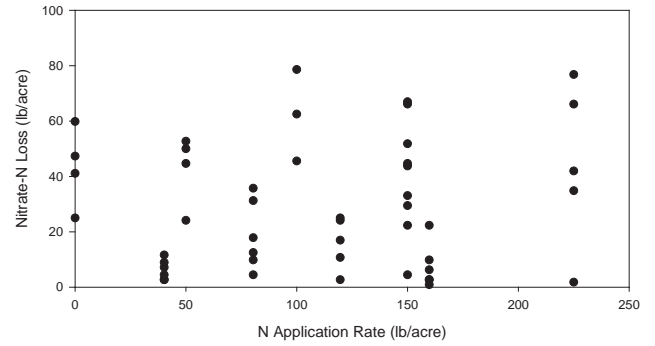
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N Concentration versus Surplus



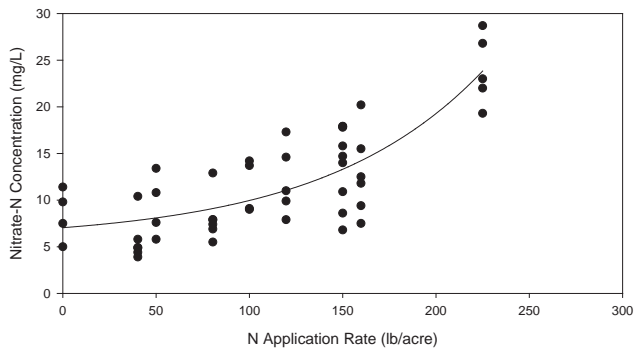
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N Rate versus Load



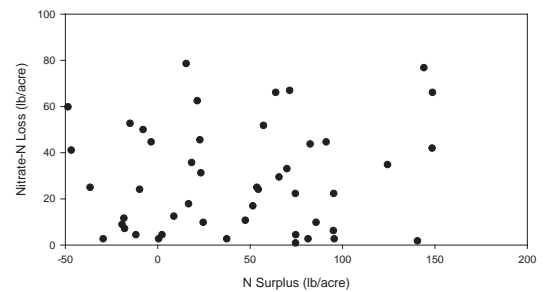
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N-Rate versus Concentration



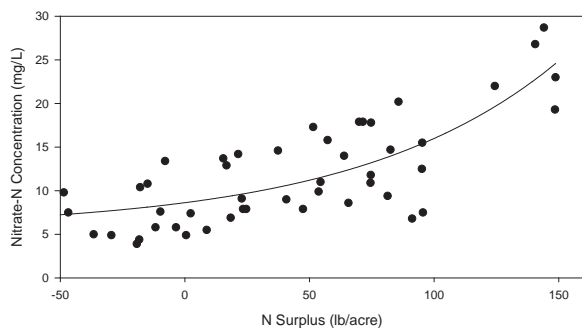
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N Surplus versus Load



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N Surplus versus Concentration



Summary

- Limited nitrate-N differences in drainage between fall ammonia and spring ammonia application
- Split application showing trends for reduced nitrate-N concentrations in drainage compared to fall or spring pre-plant
- Even when no nitrogen is applied in a corn- soybean rotation the nitrate-N concentrations are about 7-10 mg/L for conditions studied
- Early fall manure application increased risk of nitrate-N loss and yield reduction for corn
- Use of a cover crop with early fall manure application reduces risk of nitrate-N loss

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Discussion

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