ILLINOIS NREC

From Peer-Reviewed Science to BMP's for On-Farm Adoption

NREC Refresher

- Created in 2012 through state statute
  - Pursue nutrient research & educational programs
  - Ensure adoption and implementation of practices that
    - Optimize nutrient use efficiency
    - Ensure soil fertility
    - Address Environmental concerns regarding fertilizer
- Funded by $.75/ton assessment on fertilizer sold in Illinois
- Collaboration between ag, environmental groups, and state agencies

NREC Refresher

- 13 Member Council (9 voting and 4 advisory)
- Voting Members
  - 3 Farmers (ILFB, ICGA, ISA)
  - 3 Members from Fertilizer Industry
  - CCA
  - Specialty Fertilizer
  - Illinois Department of Ag
- Advisory Members
  - 2 Environmental Organizations (Sierra Club & Environmental Law Policy Center)
  - State/Federal Ag Research Station Representative
  - Illinois EPA

NREC Refresher

- Solicit proposals that focus on
  - Improved nutrient efficiency
  - Enhanced crop production
  - Protect water quality
- Council, Research Committee, and Independent Peer Review Team review applications
- Projects are ranked on merit and availability of funds

2020 Projects

- Adjusting project timing to align with crop year
  - Will start in October versus January
  - Allow for projects with Fall treatments to start with funding
- No new projects in 2020
- New RFP will be available in late Spring 2020 for the 2021 Crop year

Funding and Progress to Date

- Since 2013
  - Approximately $19.8M invested in research projects
  - Four NREC publications: Turf Guide, Cover Crop Guide 1.0, Guide to MRTN, and Cover Crop 2.0
  - Annual Reports, Investment Insights, Field Notes, and videos
  - More than a dozen papers published in Professional Journals written by NREC-funded researchers
  - Many opportunities for collaboration on research and outreach projects

Funding Priorities

Maximize Efficiency

Minimize Losses

Mitigate Negative Impacts

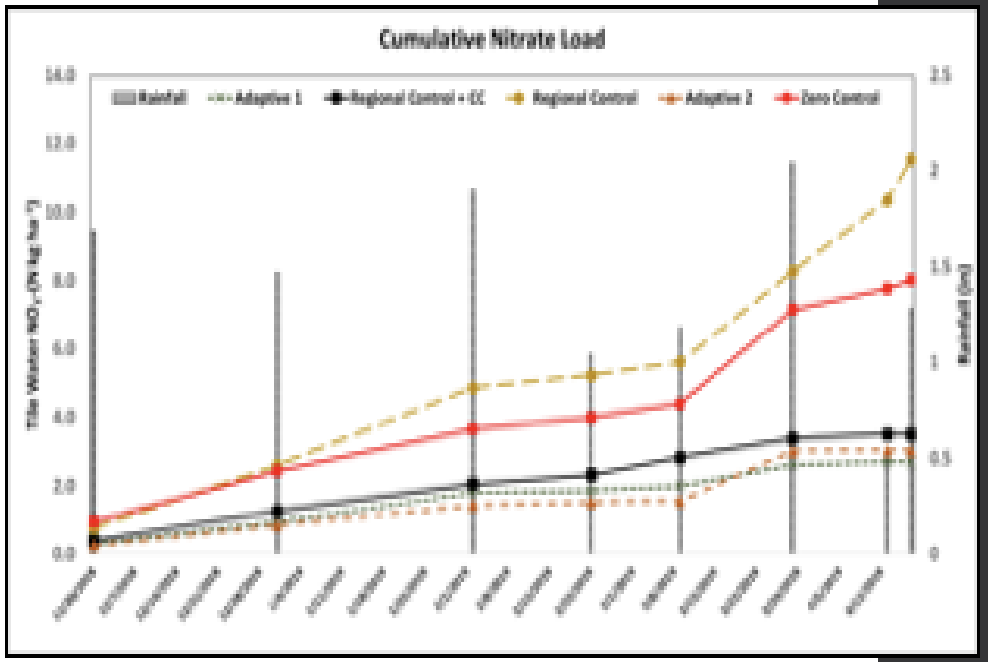
NREC 2019 Research Update

Dr. Shani Golovay

COVER CROP HIGHLIGHTS

Shalamar Armstrong

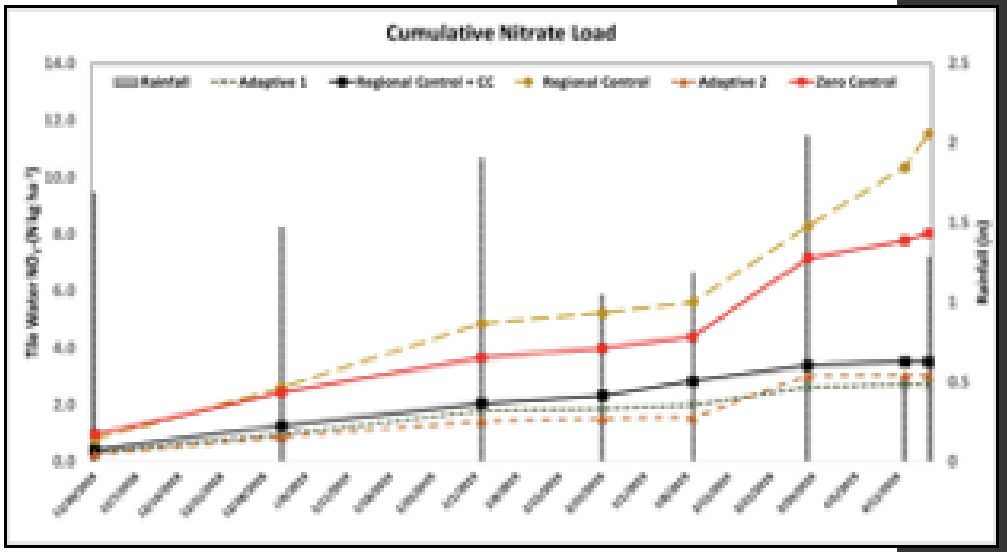
Cover crops resulted into a 72% reduction in nitrate nitrogen load within the tile drainage system relative to the Regional Control system where no cover crops were planted.



(Note: this data represents the sample analysis that we have completed at this point, but is not the full display of the total water quality analysis)

Shalamar Armstrong

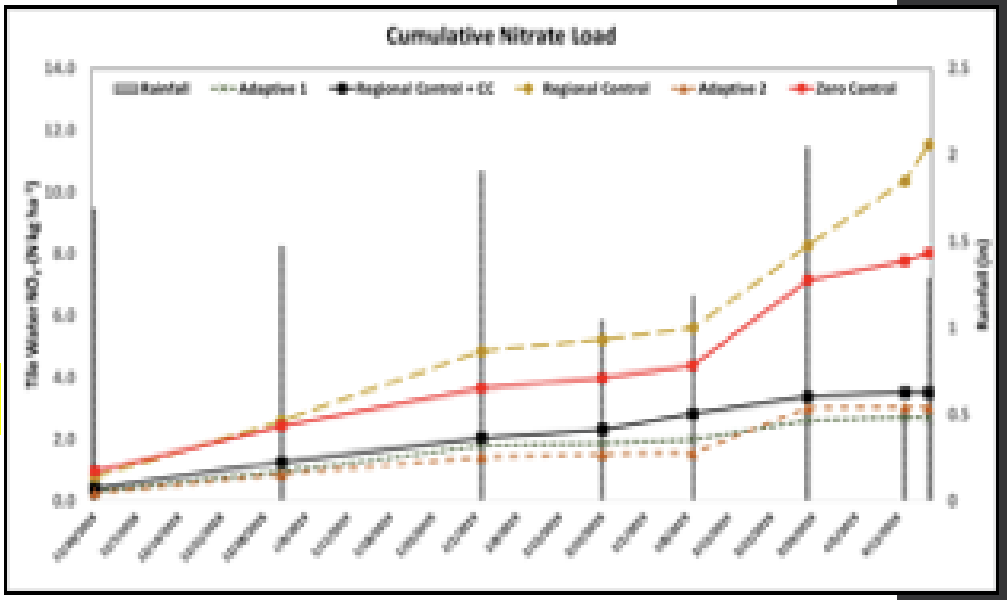
Between the dates 11/30/2018 and 4/16/2019 displayed in the figure above, no fertilizer nitrogen had been applied, thus the N reduction is coming from cover crops scavenging nitrate produced by the soil organic matter through mineralization.



(Note: this data represents the sample analysis that we have completed at this point, but is not the full display of the total water quality analysis)

Shalamar Armstrong

On average, cover crops reduced the nitrate nitrogen load by 62% when compared to the zero control.



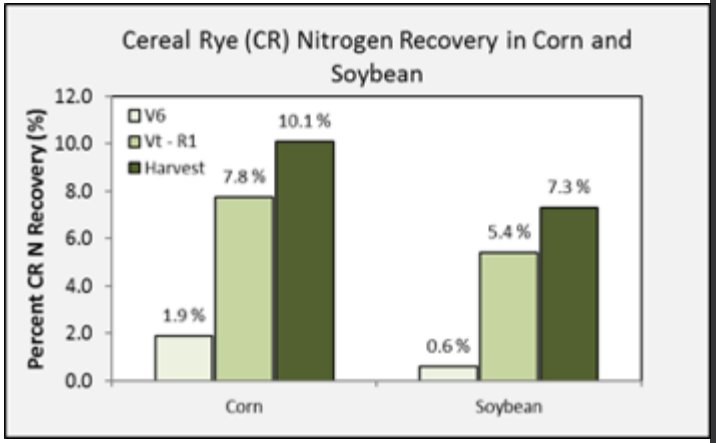
(Note: this data represents the sample analysis that we have completed at this point, but is not the full display of the total water quality analysis)

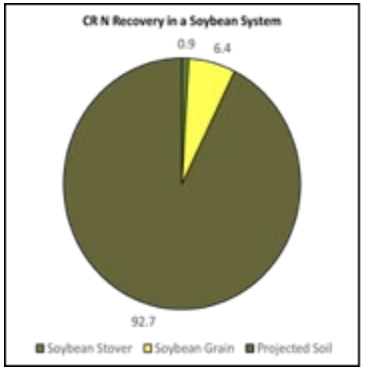
Shalamar Armstrong

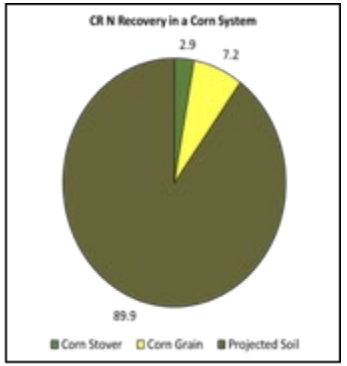
The percent of cereal rye scavenged N increased as the plants matured.

A similar trend was found for soybean.

^{15}N studies revealed that only 7.3-10% of cereal rye biomass N is recovered by the subsequent corn and soybean.







Shalamar Armstrong

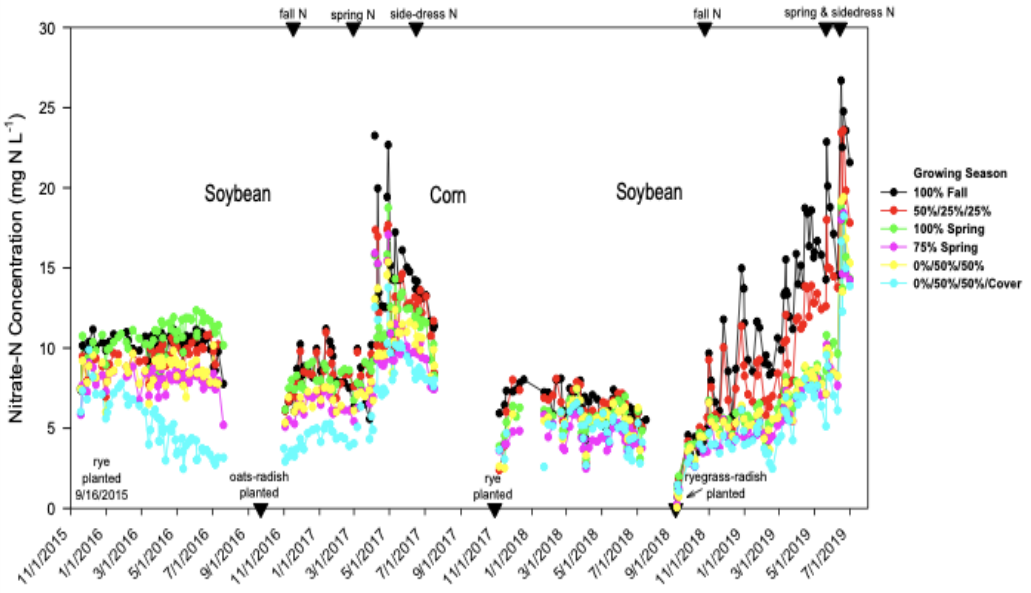
Cereal rye reacts more with soil mineralized N compared to fertilizer N, therefore corn yield reductions are being induced by cereal rye reducing the portion of nitrogen that the corn gets from soil mineralization.

**new 2019 initial findings not yet published

Lowell Gentry:

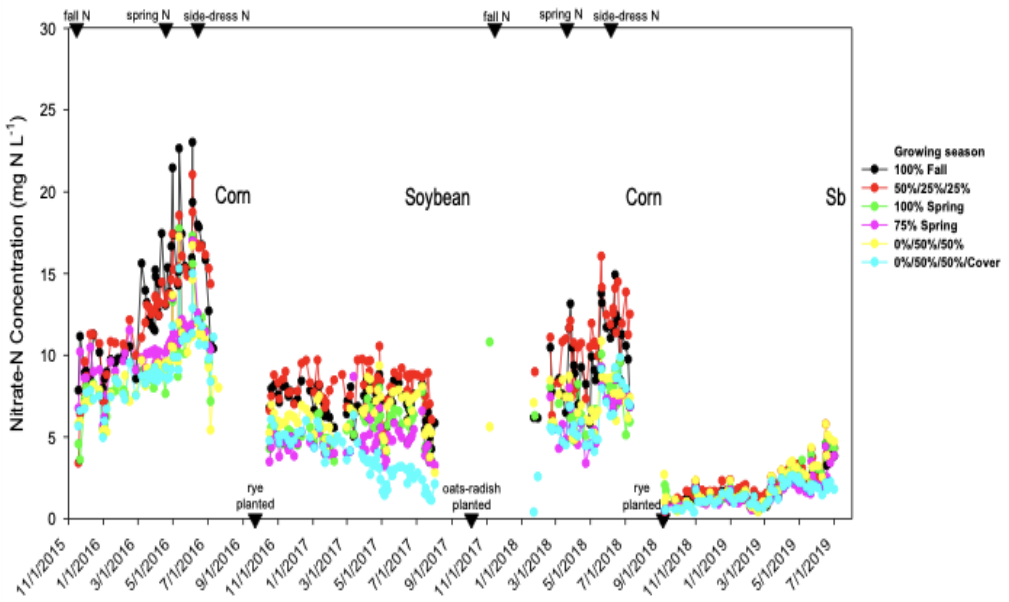
Cumulative tile nitrate loads had separated across treatments, demonstrating that timing of fertilizer N application does impact nitrate losses

The cover crop treatment has lost the least amount of tile nitrate.



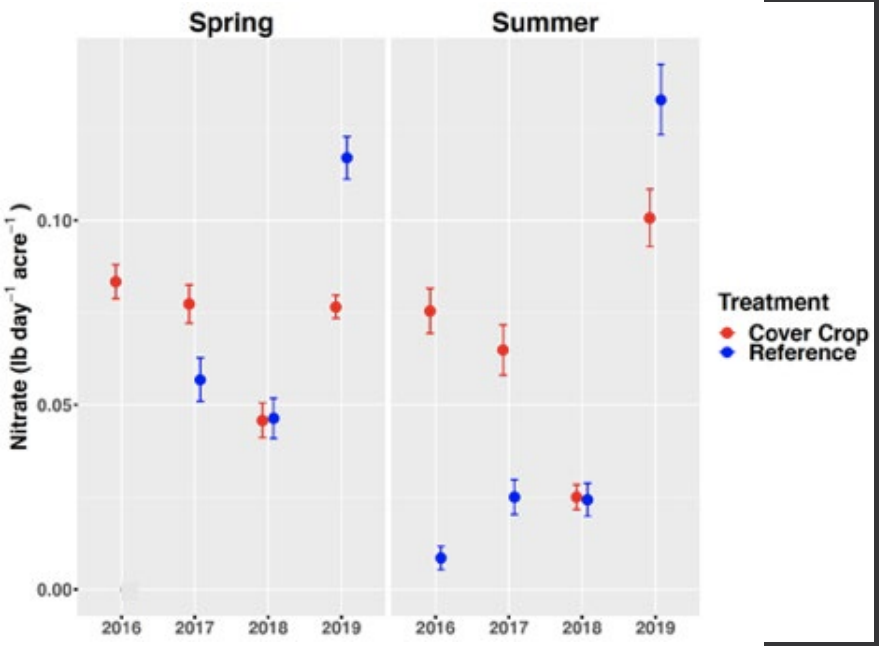
Lowell Gentry:

With the early tile flow and the late application of N, we saw the influence of N mineralization on tile nitrate loss from soybean residue without the complicating effects of early spring N application.



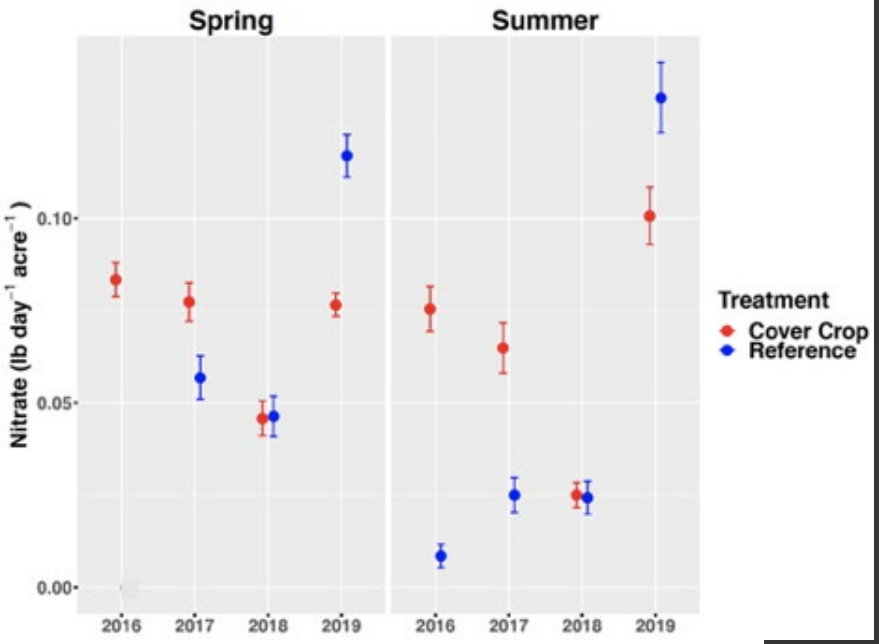
Catherine O'Reilly: The Effect of Cover Crops on surface water quality: A paired watershed

Their preliminary results so far suggest that even cover cropping as little as 60% of a watershed could be effective at reducing N loss, even without changing any other management



Catherine O'Reilly: The Effect of Cover Crops on surface water quality: A paired watershed

This spring, the cover cropped watershed lost 30% less N than the reference watershed.



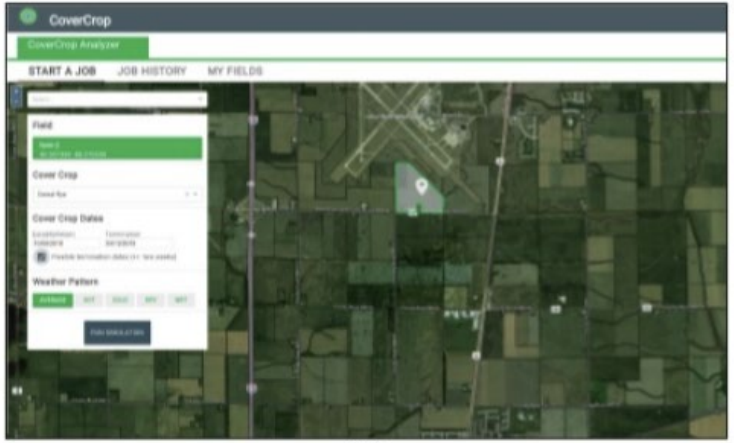
Nicholas Seiter UIUC: Insect Management in Cover Crop Systems

Fields in Effingham County suffered above average slug damage, but both the cover and no-cover fields were affected.

Ground beetles, slugs, and an earthworm collected from a pitfall trap. This trap is buried to ground level, and measures the activity-density of ground-dwelling insects

Coppess: Web based Decision Support Tool for Cover Crop Management

This project is an innovative effort at translating research into web-based decision support tools that will assist farmers in the management of cover crops in their fields,



(a)

(b)

Phosphorus Research

Andrew Margenot UIUC Evaluating Slow Release P Fertilizer

The greenhouse experiments indicate that struvite can be used to meet vegetative growth P needs of corn.

R. Christianson: Reducing P Loss in Southern Illinois

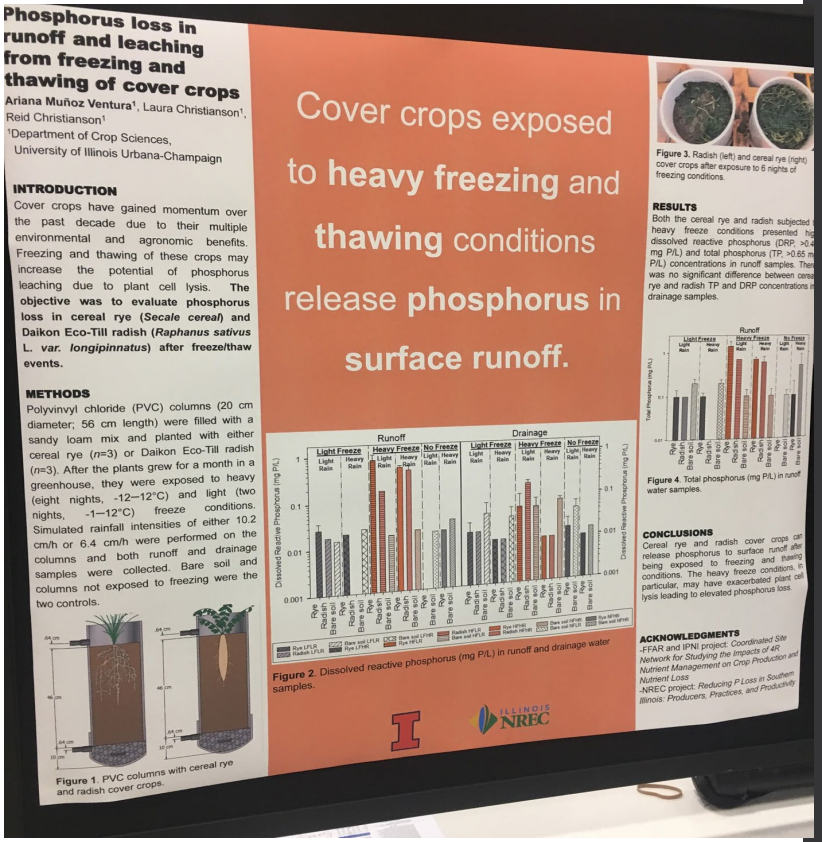
Answering the question “do cover crops increase dissolved P loss during freezing and thawing cycles?”
Rainfall simulation on frozen and unfrozen cover crops.-->

R. Christianson: Reducing P Loss in Southern Illinois

Initial results show increased dissolved reactive phosphorus loss in run-off for both cover crop types (cereal rye and radish) when subjected to heavy freeze.

R. Christianson: Reducing P Loss in Southern Illinois

The in-lab cover crop study has been completed with data presented at ASA meeting this November.



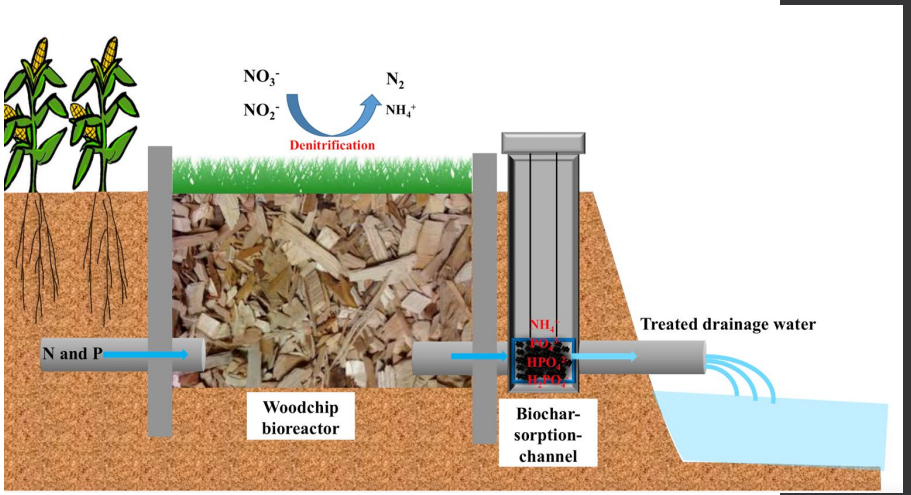
R. Christianson: Reducing P Loss in Southern Illinois

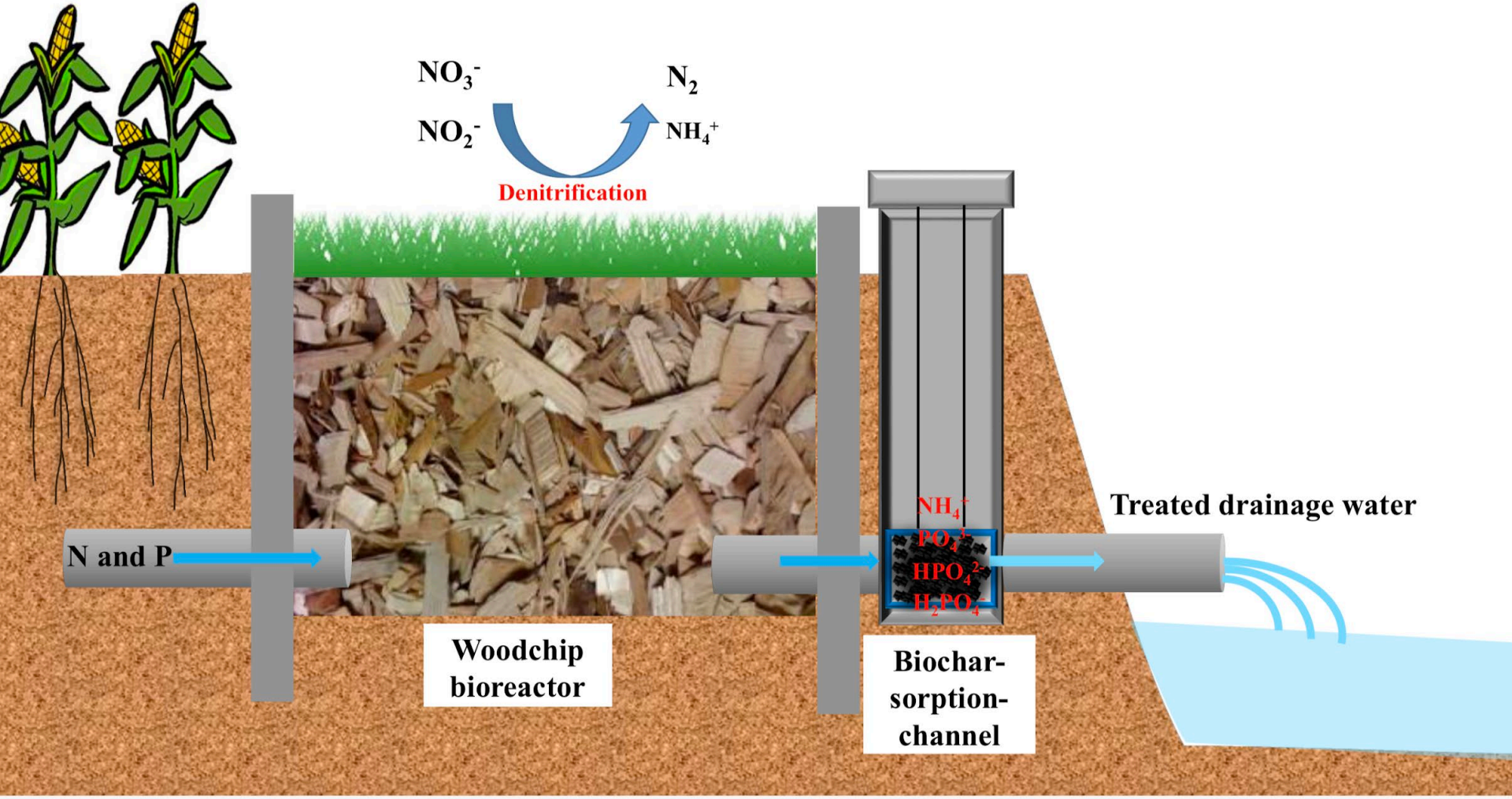
They have narrowed down the type of material (media) to include in the phosphorus plots.

Wei Zheng: Designer Biochar to Capture and Recycle Phosphorous from Tile Drainage System

Working to create designer biochars to effectively

- adsorb phosphorus
- recycle phosphorus-captured biochars as a slow-release fertilizer.
- construct refillable biochar-sorption-channels to capture phosphorus from subsurface tile drainage



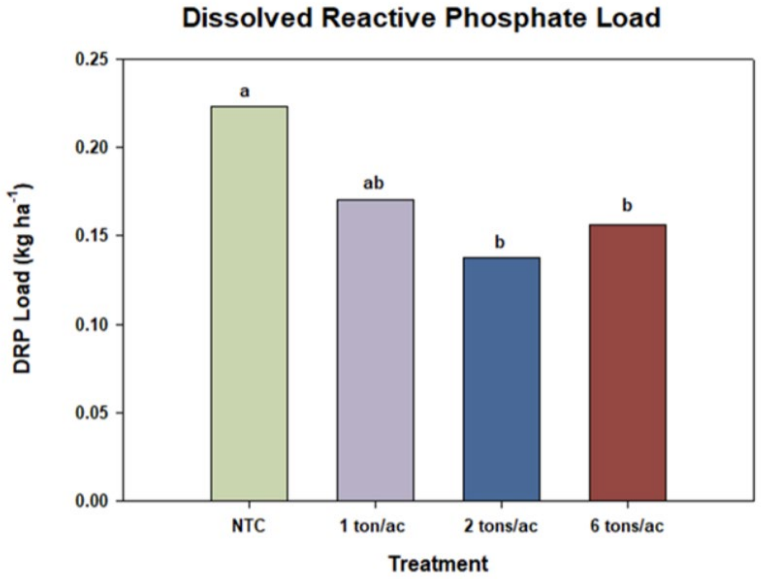

NO_3^-
N_2
NO_2^-
NH_4^+
Denitrification
N and P
Woodchip bioreactor
NH_4^+
PO_4^{3-}
HPO_4^{2-}
$H_2PO_4^-$
Biochar-sorption-channel
Treated drainage water

Williard and Schnoover SIUC Water Quality and Agronomic Impacts of Gypsum

- A significant decrease in TP load and DRP load in surface runoff water was observed following treatment application
- suggesting that the calcium in the applied gypsum is binding available phosphate in the upper soil horizon.

Williard and Schnoover SIUC Water Quality and Agronomic Impacts of Gypsum

- To date, gypsum application has resulted in lower total phosphorus (P) and dissolved reactive phosphate (DRP) loads in surface runoff compared to control.

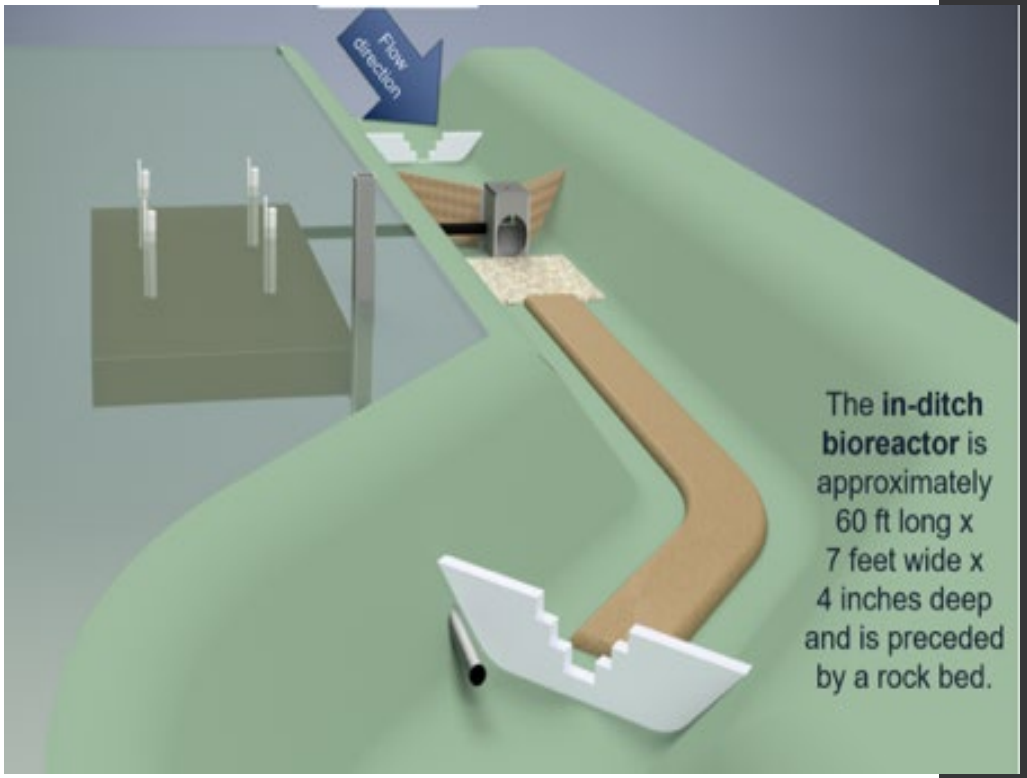


Edge of Field Practices

Laura Christianson

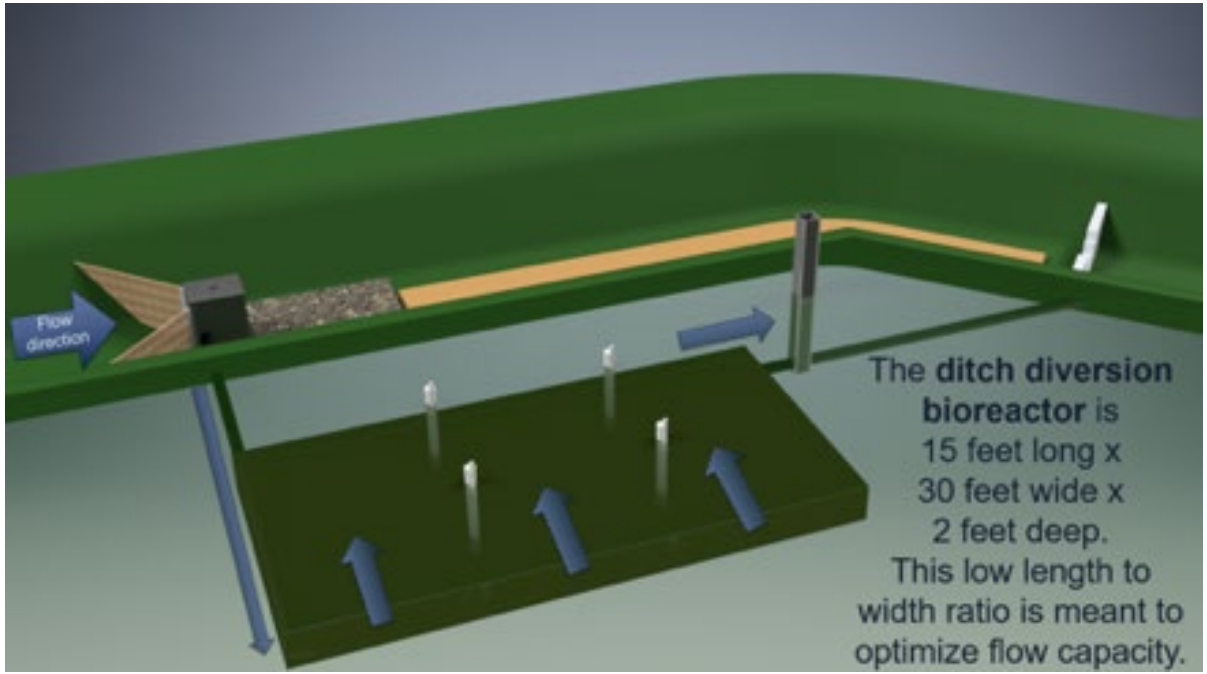
Bioreactors for Illinois

An innovative idea is using ditches for bioreactor placement or “double duty ditches”;



Laura Christianson

Bioreactors for Illinois



Laura Christianson and Richard Cooke

Drainage water management (DWM) and saturated buffers

The practice of drainage water management is working as expected to reduce nitrogen loss.

The practice is primarily reducing nitrate loss by reducing the volume of drainage water leaving through the tile outlet.

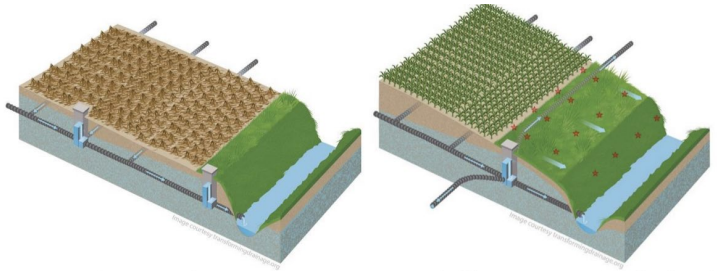


Figure 1. Illustration of drainage water management (left) and a saturated buffer (right) (credit: TransformingDrainage.org). Example proposed monitoring wells (four transects) shown with red stars.

Laura Christianson and Richard Cooke

Drainage water management (DWM) and saturated buffers

The saturated buffer monitoring sites also continue to reduce nitrogen loss from the tile drainage outlets.

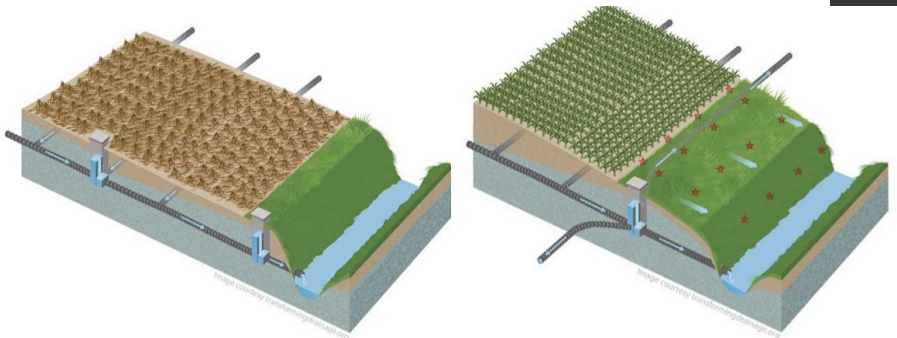
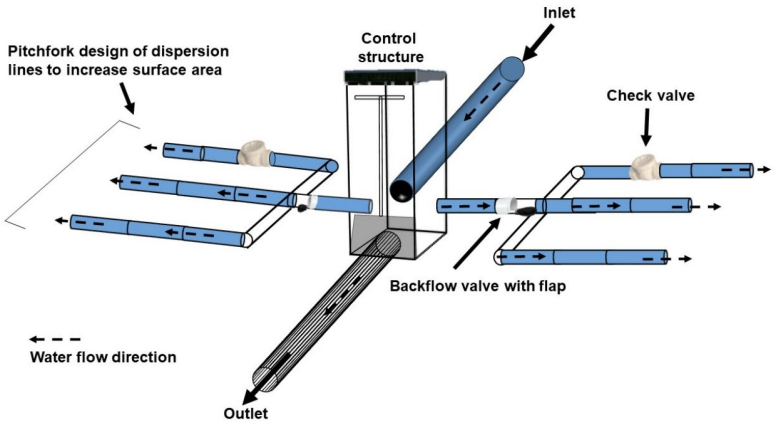
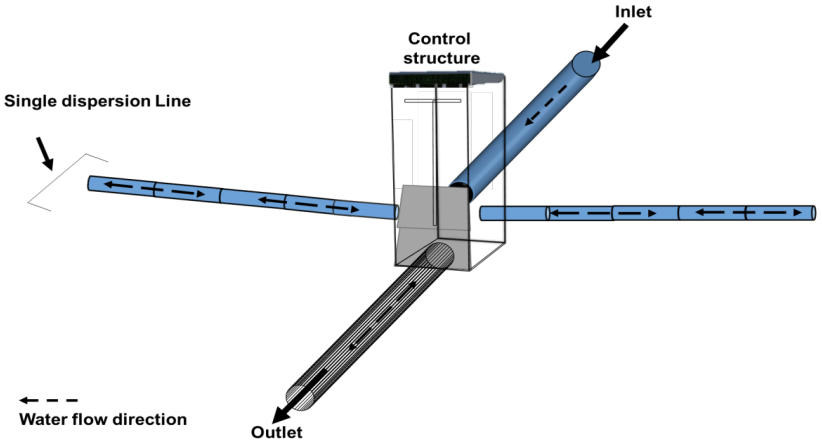


Figure 1. Illustration of drainage water management (left) and a saturated buffer (right) (credit: TransformingDrainage.org). Example proposed monitoring wells (four transects) shown with red stars.

Jon Schoonover and Karl Williard: Modelling and Designing Saturated Buffers



Both the saturated buffer and the pitchfork buffer were installed on March 19, 2019.



4R Nutrient Management

Angela Kent: Towards Management of Dissimilatory Nitrate Reduction to Ammonium

DNRA may act as an alternative nitrate reduction pathway when reduction via denitrification has been inhibited by the presence of oxygen.

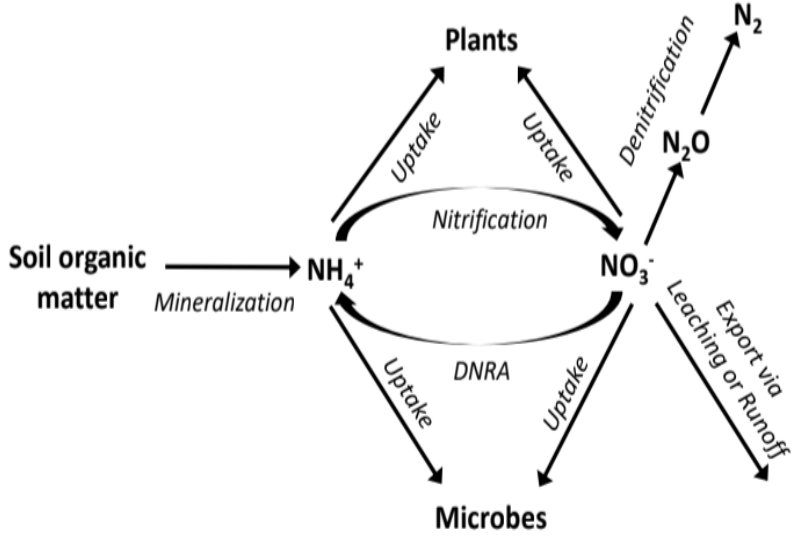


Figure 1. Schematic of the soil nitrogen cycle. Notably, dissimilatory nitrate (NO_3^-) reduction to ammonium (NH_4^+) (DNRA) leads to NO_3^- retention rather than gaseous loss to nitrous oxide (N_2O) or dinitrogen (N_2) via denitrification or export to waterways via leaching or runoff.

Angela Kent: Towards Management of Dissimilatory Nitrate Reduction to Ammonium

While the genetic potential for DNRA exists regardless of rainfall conditions, relevant functional genes are being “activated” at certain times.

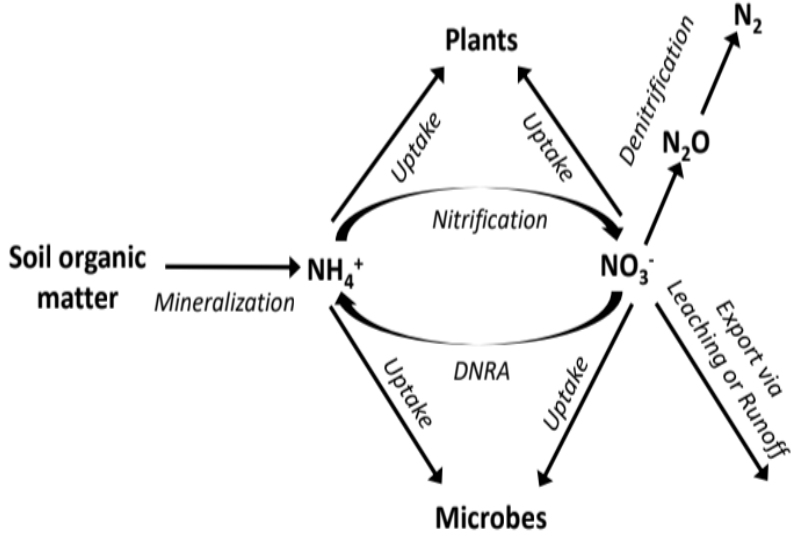


Figure 1. Schematic of the soil nitrogen cycle. Notably, dissimilatory nitrate (NO_3^-) reduction to ammonium (NH_4^+) (DNRA) leads to NO_3^- retention rather than gaseous loss to nitrous oxide (N_2O) or dinitrogen (N_2) via denitrification or export to waterways via leaching or runoff.

Amir Sadeghpour: Precision nitrogen management

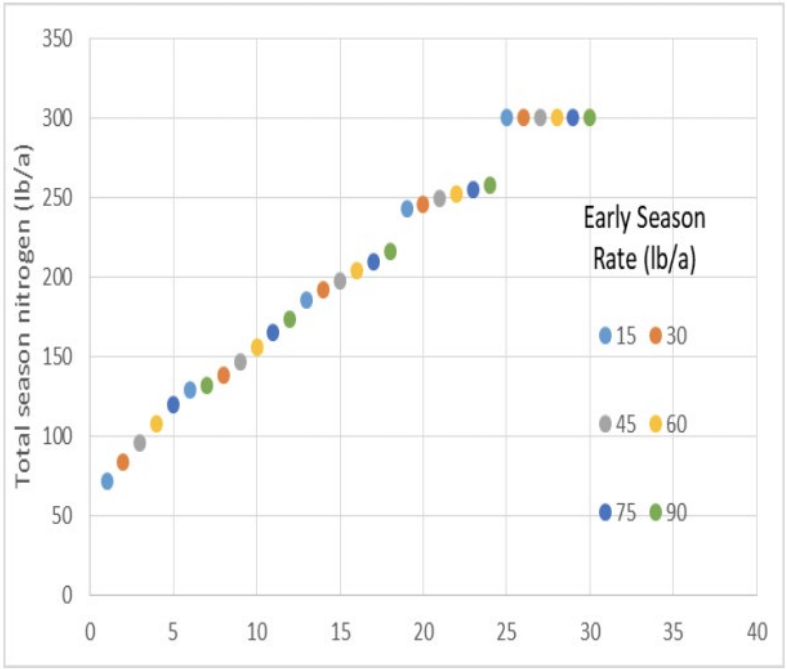
In spring 2019, they established N rate trials at three sites, two in Illinois (Carbondale, ARC; Belleville, BRC) and one in cooperation with a local farmer in Logan County, Kentucky.

Table 1. Early season, sidedress, and resulting total nitrogen rates applied with the 30 treatment combinations.

Early nitrogen rate					
----------lb-N/a----------					
15	30	45	60	75	90
Sidedress nitrogen rate					
----------lb-N/a----------					
57	54	51	48	45	42
114	108	102	96	90	84
171	162	153	144	135	126
228	216	204	192	180	168
285	270	255	240	225	210
Total final rate					
----------lb-N/a----------					
72	84	96	108	120	132
129	138	147	156	165	174
186	192	198	204	210	216
243	246	249	252	255	258
300	300	300	300	300	300

Amir Sadeghpour: Precision nitrogen management

24 unique total season nitrogen rates achieved from 30 unique treatment combinations of early and mid season nitrogen.



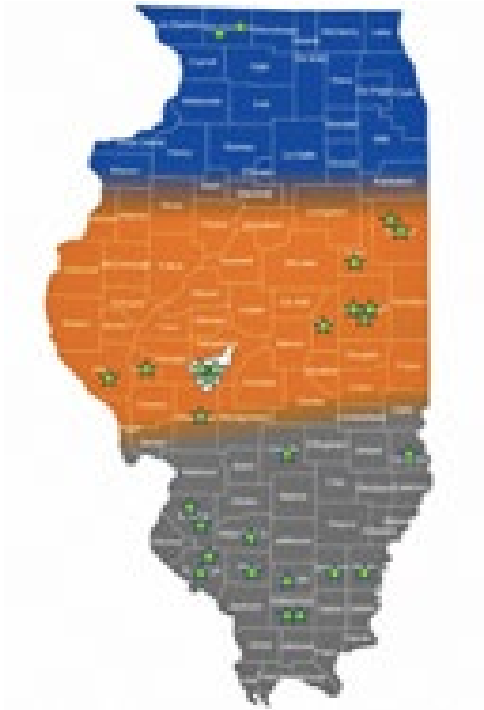
Below: Nitrogen Placement and Application Timing

Emergence of each plot was assessed, but preplant fertilizer treatments did not affect the rate or percentage of plants emerged.

Figure 1. Corn planted at Ewing, IL in 2019 with 180 lbs N/acre broadcasted before planting (left) compared to 0 lbs of N (right).

IFCA: Nitrogen Rate Research & NREC Project Partnership

- Long-term N rate trials to support MRTN calibration
- Publication of MRTN guide
- Support of field scale N rate trials throughout Illinois



Where can I get more info?

- **Website**: illinoisnrec.org
- **Twitter**: @IllinoisNREC
- **Facebook**: @IllinoisNREC
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