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 in 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)
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)
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.
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,
Phosphorus Research
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.
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
Denitrification

NO$_3^-$ → N$_2$ → NO$_2^-$ → NH$_4^+$

Woodchip bioreactor

Biochar-sorption-channel

N and P

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.
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”;

The in-ditch bioreactor is approximately 60 ft long x 7 feet wide x 4 inches deep and is preceded by a rock bed.
Laura Christianson

Bioreactors for Illinois

The ditch diversion bioreactor is 15 feet long x 30 feet wide x 2 feet deep. This low length to width ratio is meant to optimize flow capacity.
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.
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.
Both the saturated buffer and the pitchfork buffer were installed on March 19, 2019.
4R Nutrient Management
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$_2$O) 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$_2$O) 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.

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Amir Sadeghpour: Precision nitrogen management

24 unique total season nitrogen rates achieved from 30 unique treatment combinations of early and mid season nitrogen.
Emergence of each plot was assessed, but preplant fertilizer treatments did not affect the rate or percentage of plants emerged.
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
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Coming LIVE to Champaign, Illinois

NREC Investment Insight LIVE!

February 13, 2020

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