Water quality lessons learned from Discovery Farms

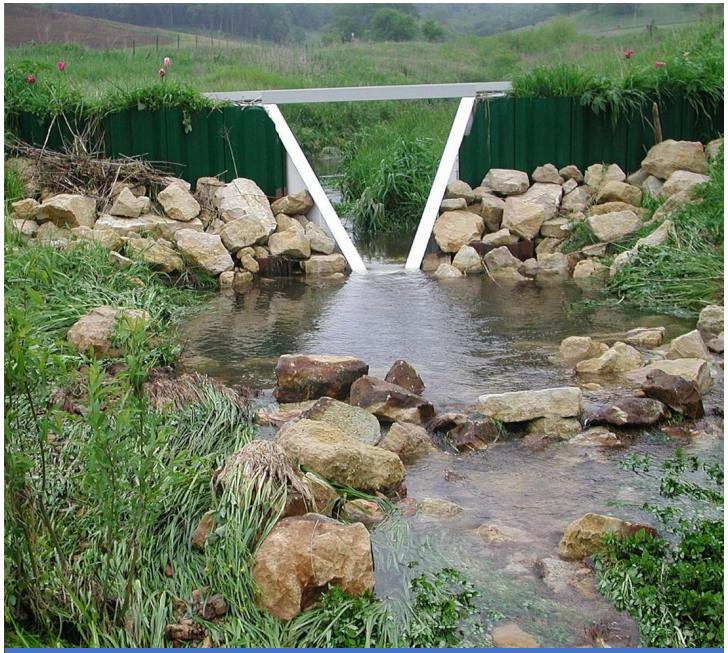
Matthew Ruark – Professor & Faculty Advisor
Amber Radatz & Eric Cooley – co-directors
Tim Radatz – Minnesota Discovery Farms
Anita Thompson, Qiang Li, Abigail Augarten – collaborating scientists

DISCOVERY FARMS WISCONSIN

DEPARTMENT OF SOIL SCIENCE
University of Wisconsin-Madison

Discovery Farms has played a role in positioning Wisconsin to understand and tackle water quality challenges.

First generation



Get research onto real farms

Get farmers a seat at the table

Discovery Farms has played a role in positioning Wisconsin to understand and tackle water quality challenges.

Next generation

Support farmer-led watersheds in their efforts to implement practices locally

Verify effectiveness of suggested practices

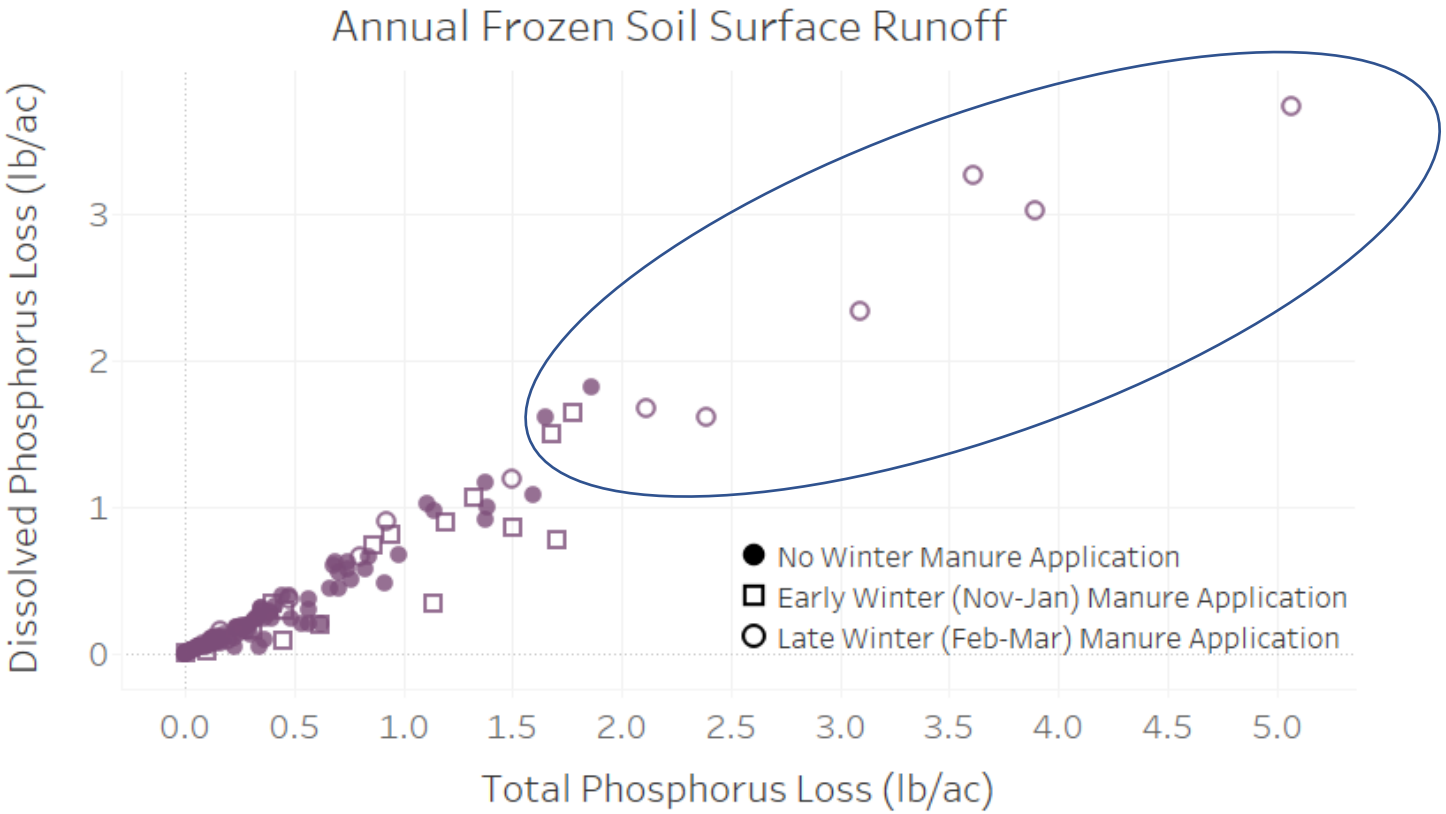
At our core Discovery Farms Programs are…

Farmer-led

On-farm research

Outreach

Historically, we have focused on phosphorus and surface water quality

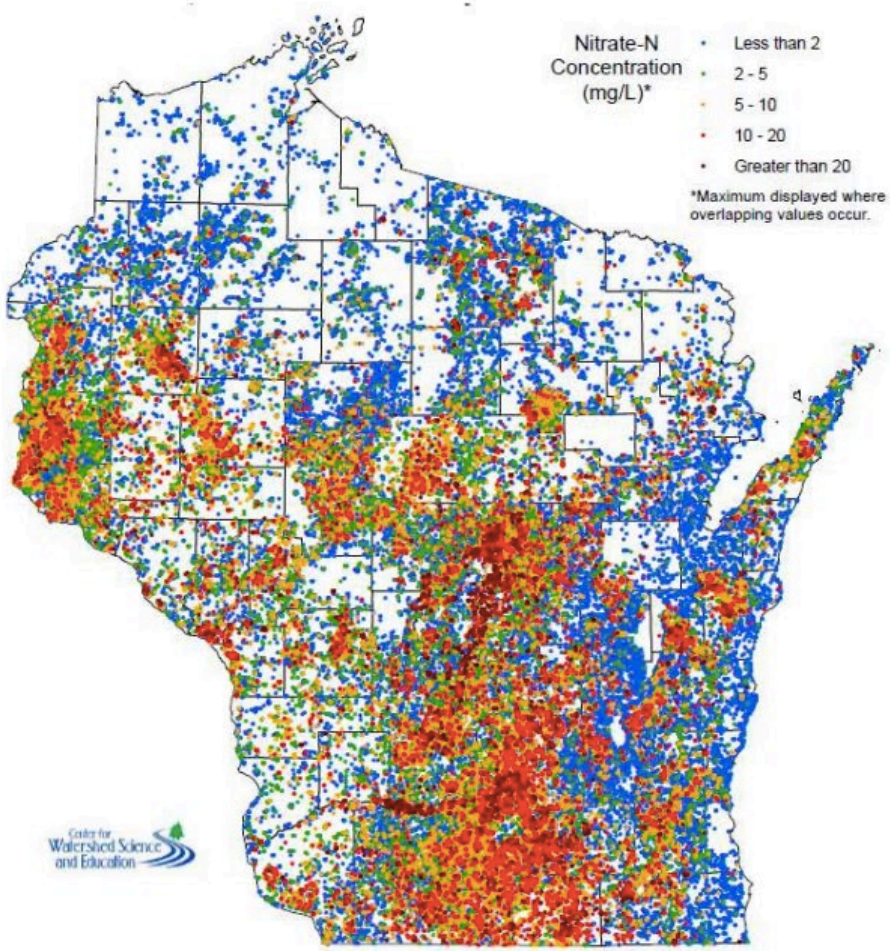


Private Well Nitrate Concentrations

Nitrate-N Concentration (mg/L)*

- Less than 2
- 2 - 5
- 5 - 10
- 10 - 20
- Greater than 20

*Maximum displayed where overlapping values occur.



Disclaimer: This map represents well water data in the Center for Watershed Science and Education database, WI DNR Groundwater Retrieval Network. It does not represent all known private wells.

The first step in knowing what to do is to know where you are starting from.

- How much corn are you growing per pound of N applied?
- What's the nitrogen balance of each field?

Measures of nitrogen use efficiency (NUE)

- Partial factor productivity (PFP)

  Yield / N applied

- Partial N balance

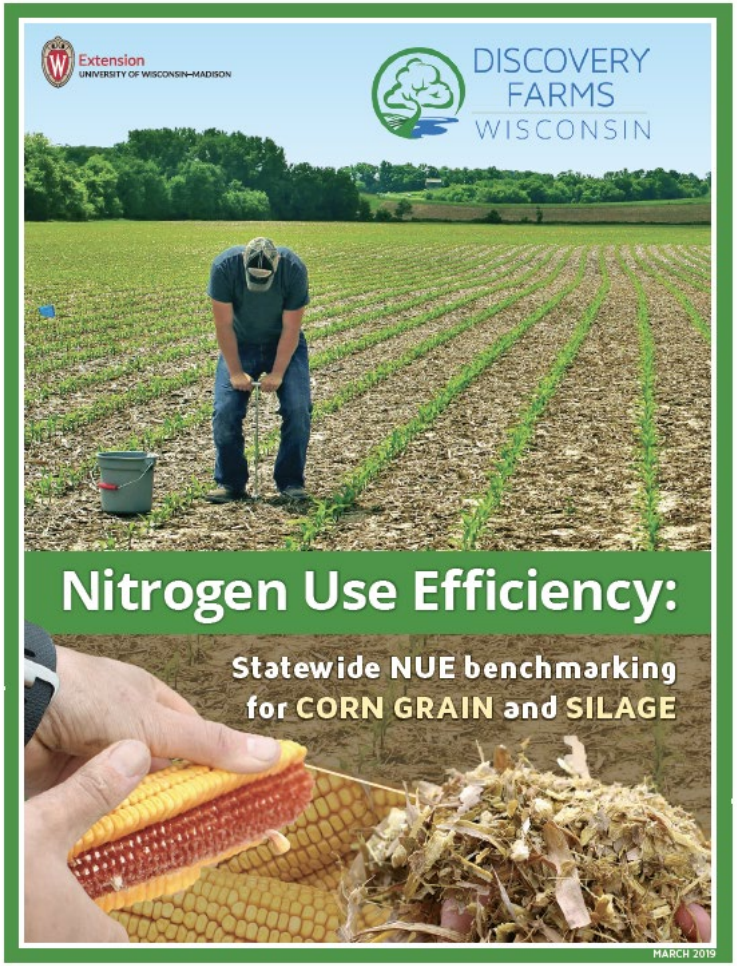
  N applied – N removed

+ = more N applied than removed
- = more N removed than applied

Our premise is that farmers need to “see” their N as measures of NUE to help with decision making

- And if they had a better sense of where they ranked relative to their peers, that would provide evidence that changes to the nitrogen management would be beneficial.

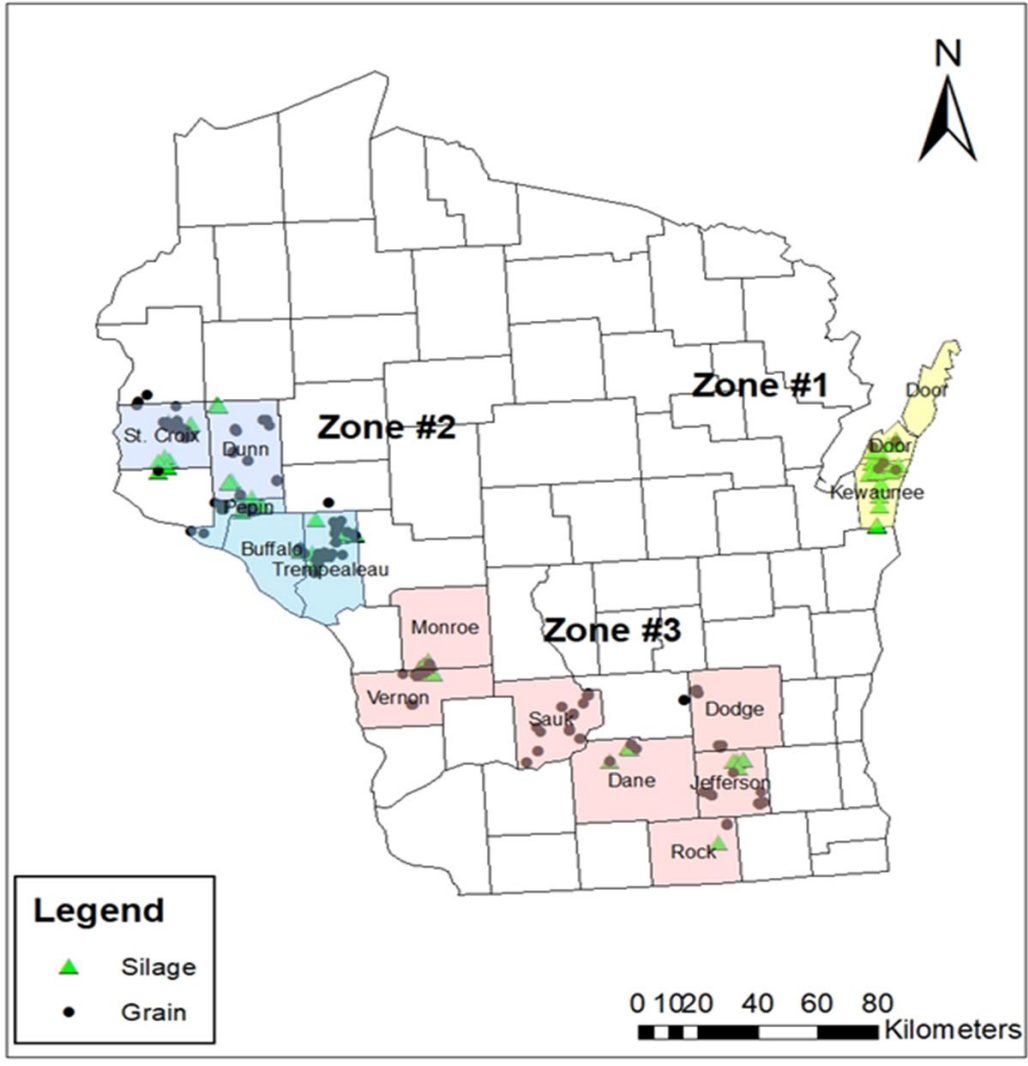
Thus, we set out to benchmark NUE metrics in Wisconsin for corn grain and corn silage



DISCOVERY FARMS WISCONSIN

- 2015-2020
- 197 grain fields
- 97 corn silage fields

Hand harvest from 3 m of row (3 reps)



We used quartile ranges to benchmark NUE measures to define efficiency categories

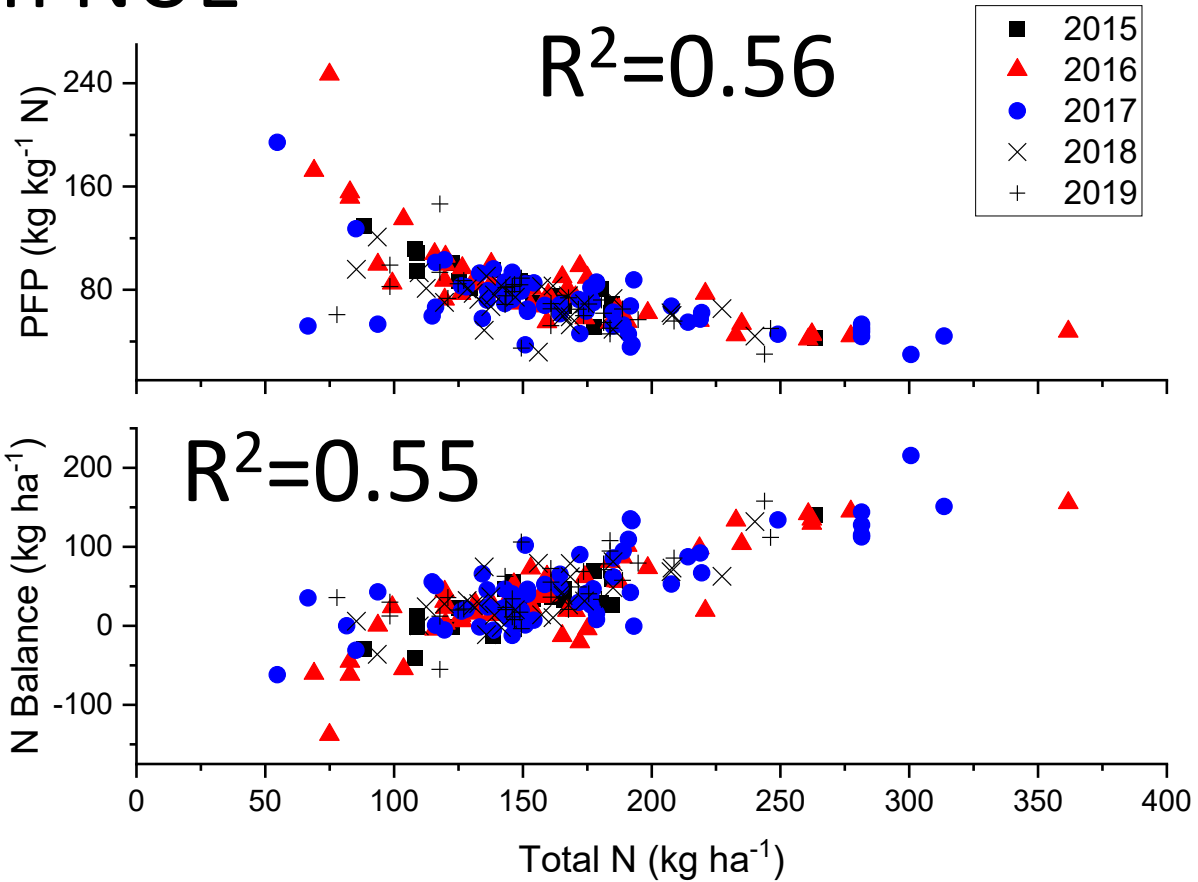
https://uwdiscoveryfarms.org/on-farm-projects/nitrogen-use-efficiency/

Table 2. Corn grain benchmark efficiency ranges

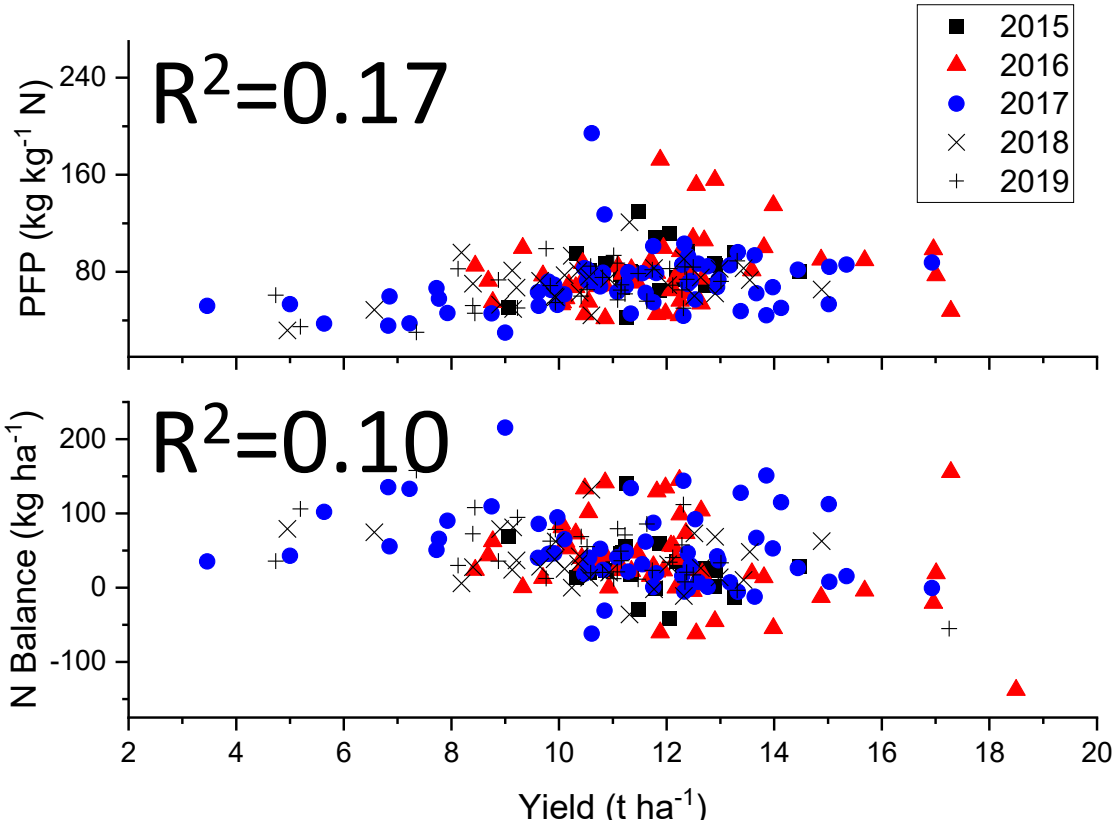
CORN GRAIN BENCHMARKS								
	LOW USE EFFICIENCY (DECISION TREE BOX 1)		LOW-MID USE EFFICIENCY (DECISION TREE BOX 2)		MID-HIGH USE EFFICIENCY (DECISION TREE BOX 3)		HIGH USE EFFICIENCY (DECISION TREE BOX 4)	
	PFP	PNB	PFP	PNB	PFP	PNB	PFP	PNB
lb grain/lb N at 15.5% moisture	0-58	0-0.60	59-72	0.61-0.77	73-85	0.78-0.88	>85	>0.88
bu grain/lb N at 15.5% moisture	0-1.04		1.05-1.29		1.30-1.52		>1.52	

Which is the bigger driver of NUE? Yield or N rate?

Nitrogen rate explains over 50% of the variability in NUE



While yield explains less than 17% of the variability



Improvements in efficiency (and thus to water quality) will occur through improved nitrogen management

Are there better on-farm measurements?

Total N uptake in fertilized plots

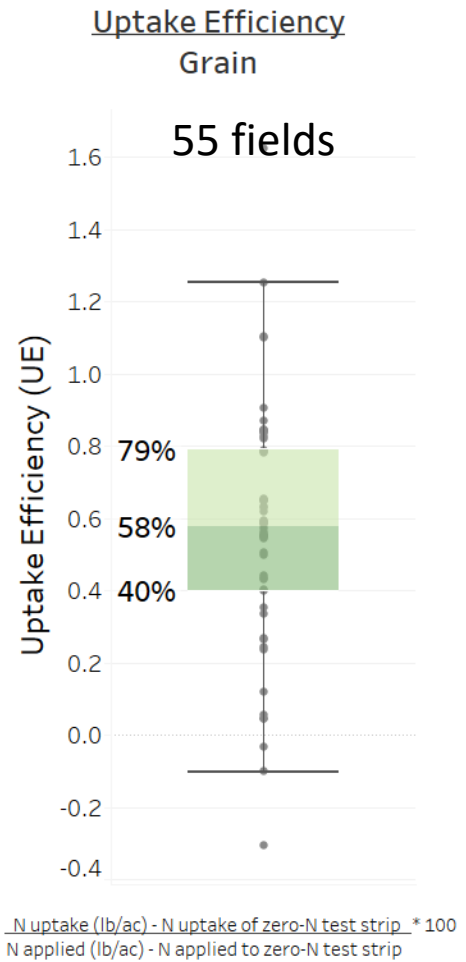
Fertilizer N actually used

Total N uptake from unfertilized plot (comes from decaying crop residues, SOM & residual soil nitrate)

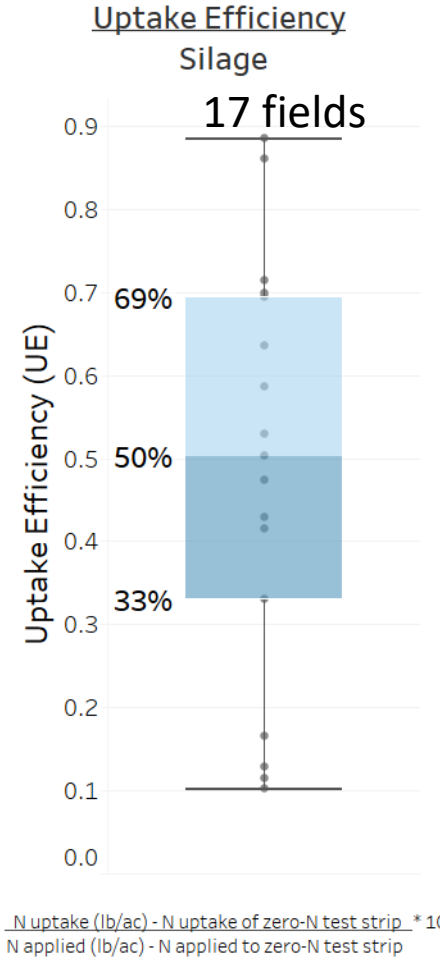
Uptake efficiency
[N uptake (F) –
N uptake (Non-F)]
÷
N applied

We observed a wide range of efficiencies across fields

The variability of the data suggests that every field's soils and systems are different and N management needs to be considered on a field by field basis



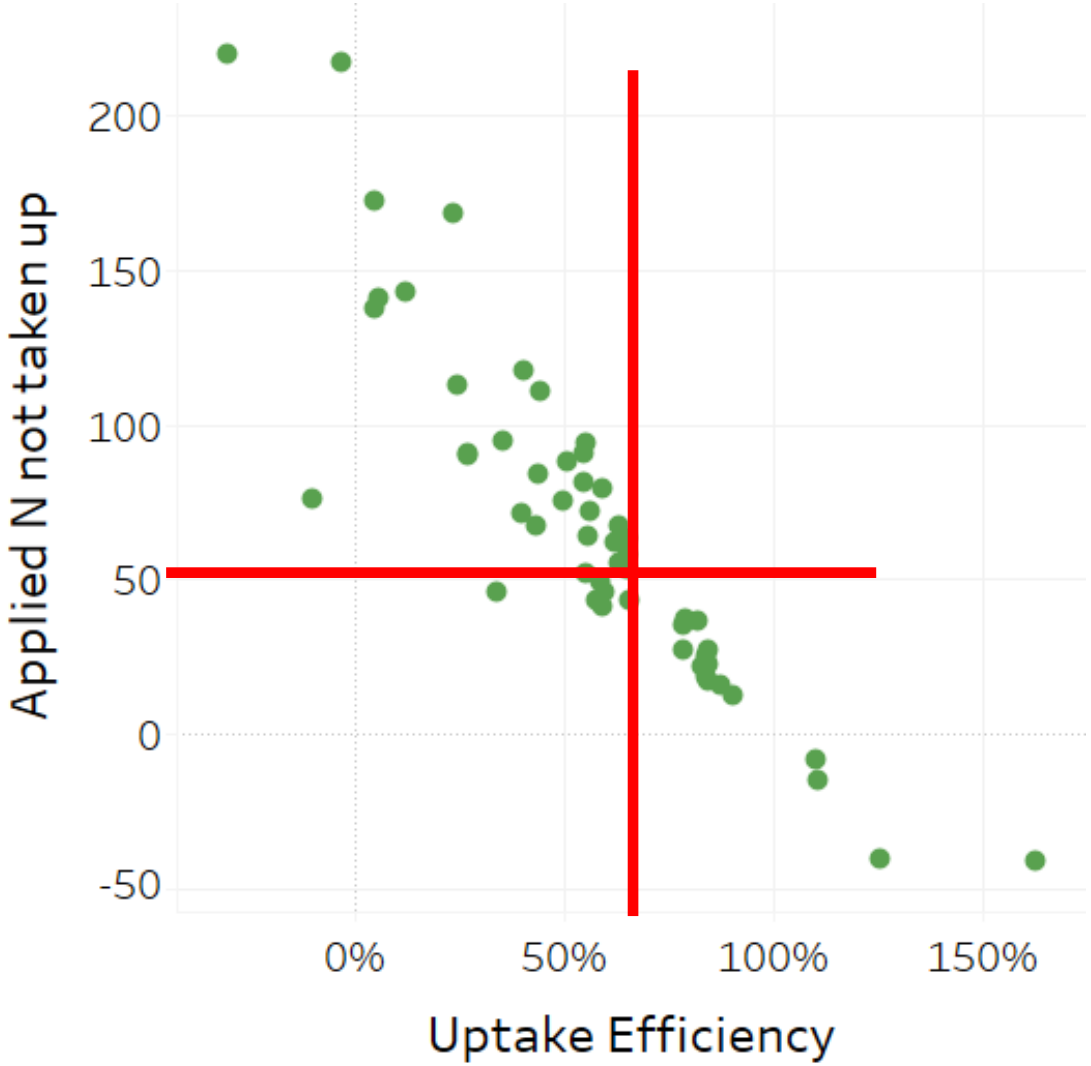
UE= N uptake (lb/ac) - N uptake of zero-N test strip * 100
N applied (lb/ac) - N applied to zero-N test strip



UE= N uptake (lb/ac) - N uptake of zero-N test strip * 100
N applied (lb/ac) - N applied to zero-N test strip

A lower UE means greater amounts of unused N.

Less than 60% efficiency typically led to more than 50 lb/ac of unused N



We have a lot more work to do in promoting nutrient management

We need more on-farm assessments to fully assess the effects of other management practices and soil properties

We are looking to build our dataset through farmer-consultant-agency collaborations

Nitrogen Use Efficiency:
A guide to conducting your own assessment

What's inside:

Extension
UNIVERSITY OF WISCONSIN–MADISON

DISCOVERY FARMS
WISCONSIN