Proceedings of the 2nd Annual Nitrogen: Minnesota's' Grand Challenge & Compelling Opportunity Conference

Nitrogen Loss in Manured Systems

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Minnesota Nutrient Conference

February 23, 2016

Rochester, MN

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Discovery Farms is a Farmer Led Water Quality Research and Educational Program

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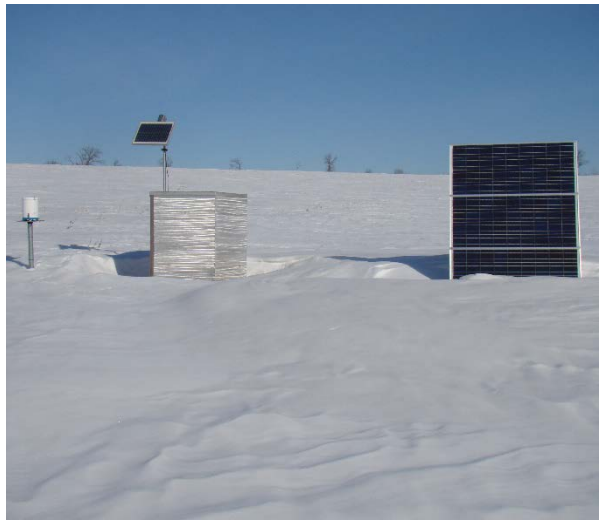
Discovery Farms provides credible edge-of-field research

Weather • Soil



Runoff • Sediment

Nitrogen • Phosphorus

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USGS
science for a changing world

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WISCONSIN

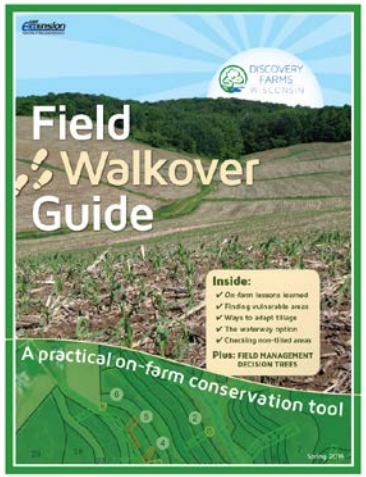
Discovery Farms communicates results

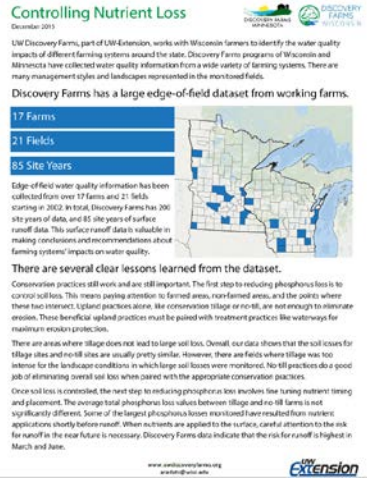
10 Events & Field Days

80 Presentations

Web:
uwdiscoveryfarms.org

Publications





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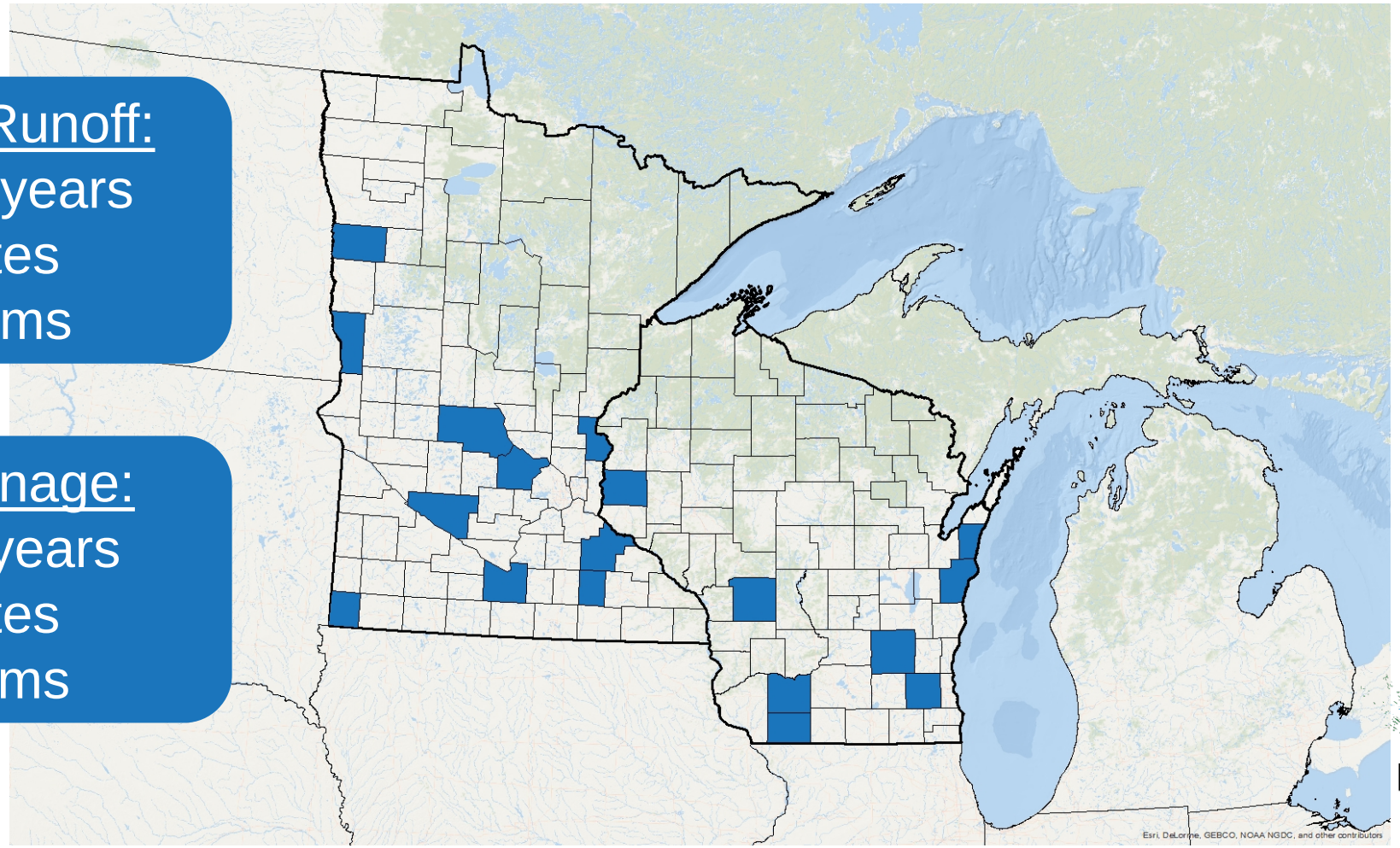
Discovery Farms has a large dataset with diverse farm systems and locations

Surface Runoff:
110 site years
28 sites
21 farms

Tile Drainage:
50 site years
14 sites
11 farms



DISCOVERY FARMS MINNESOTA

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Nitrogen loss in manured systems is…complicated.

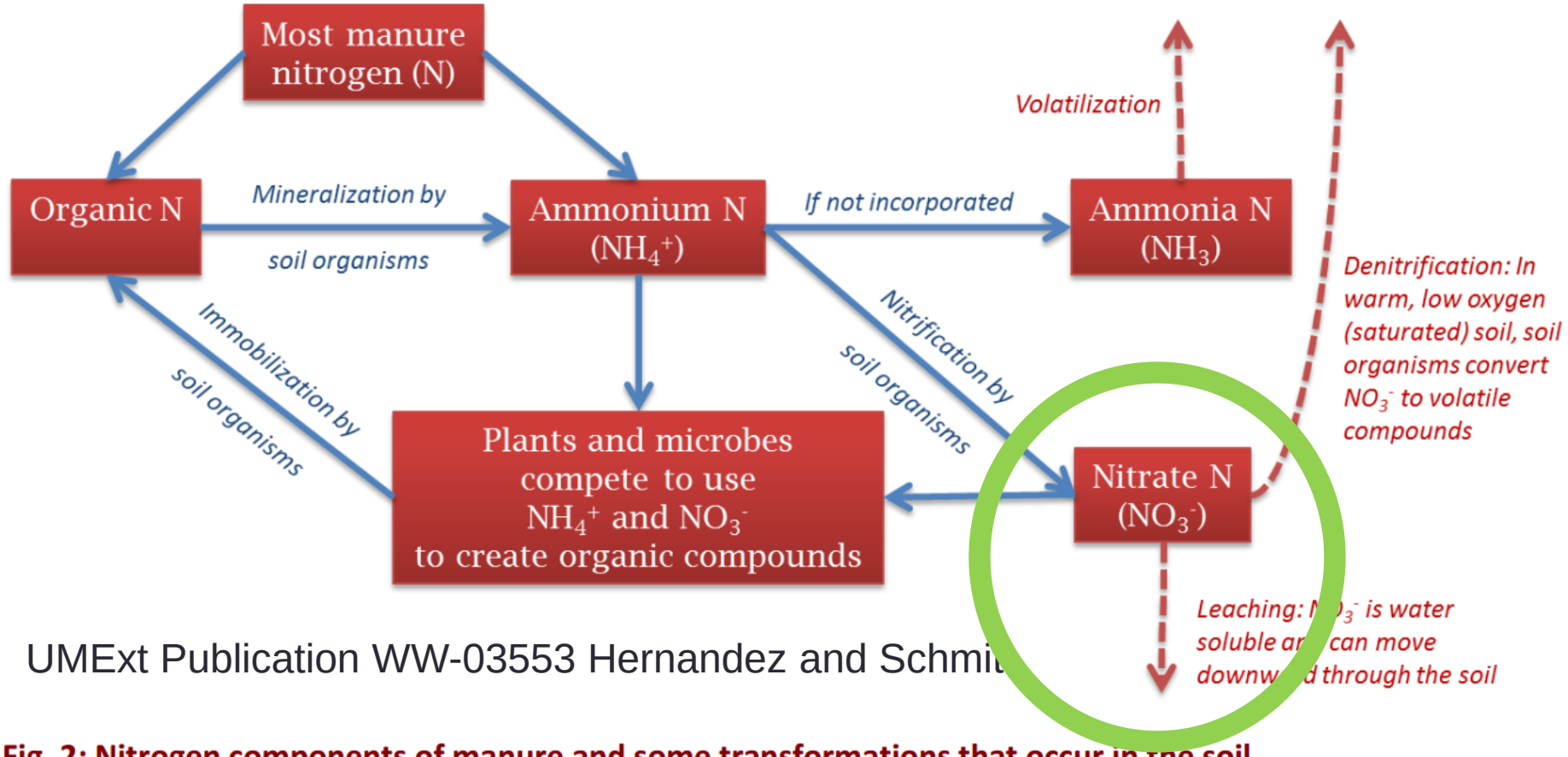
- Where does N go?
- When do we lose N from fields?
- The pool of nitrogen in livestock systems
- Can we improve our efficiency with nitrogen?

The chemistry of soil, nitrogen and phosphorus determines how each behaves.

Phosphorus and Soil

Nitrogen

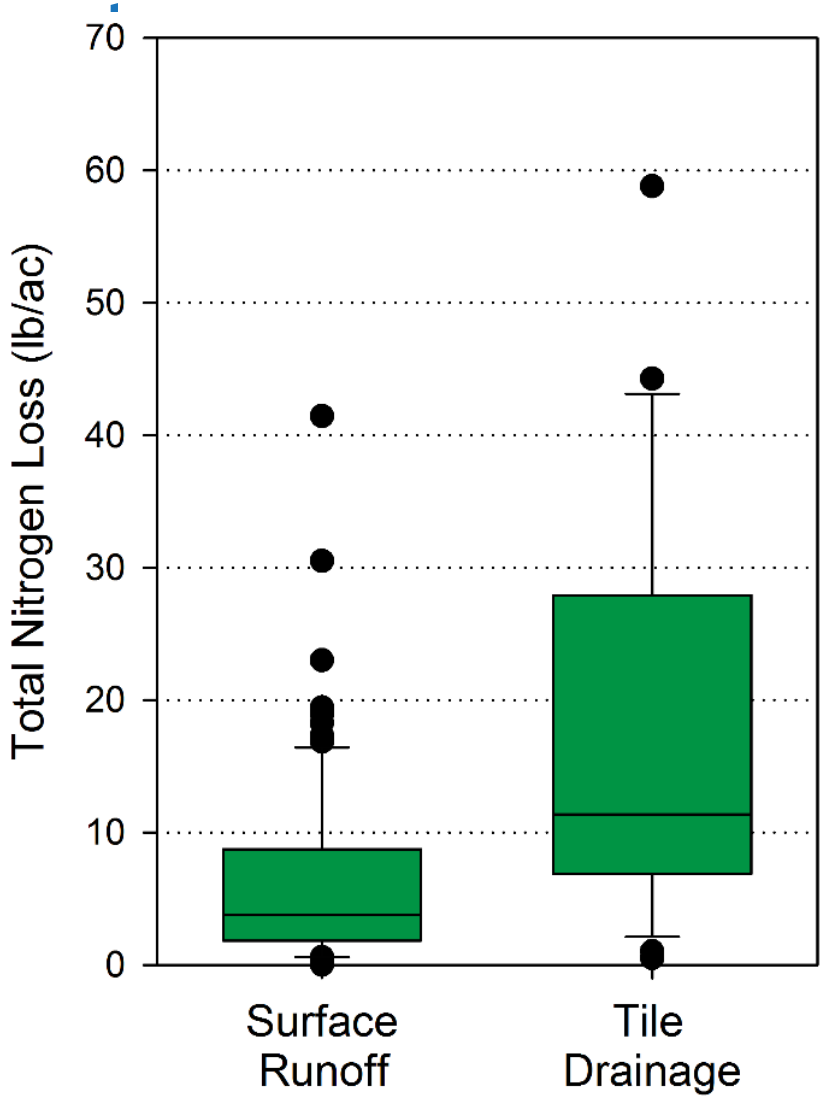
The major concern for nitrogen loss is conversion to nitrate. Nitrate in the soil profile moves easily with water.



UMExt Publication WW-03553 Hernandez and Schmit

Fig. 2: Nitrogen components of manure and some transformations that occur in the soil.

If you only look at surface runoff, you really don't see the whole picture of N movem



Surface median: 3.8 lb/ac (1.8 to 8.7)
Tile Median: 11.4 lb/ac (7.1 to 26.7)

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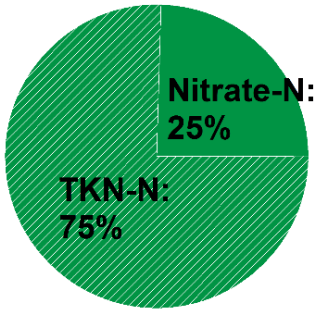
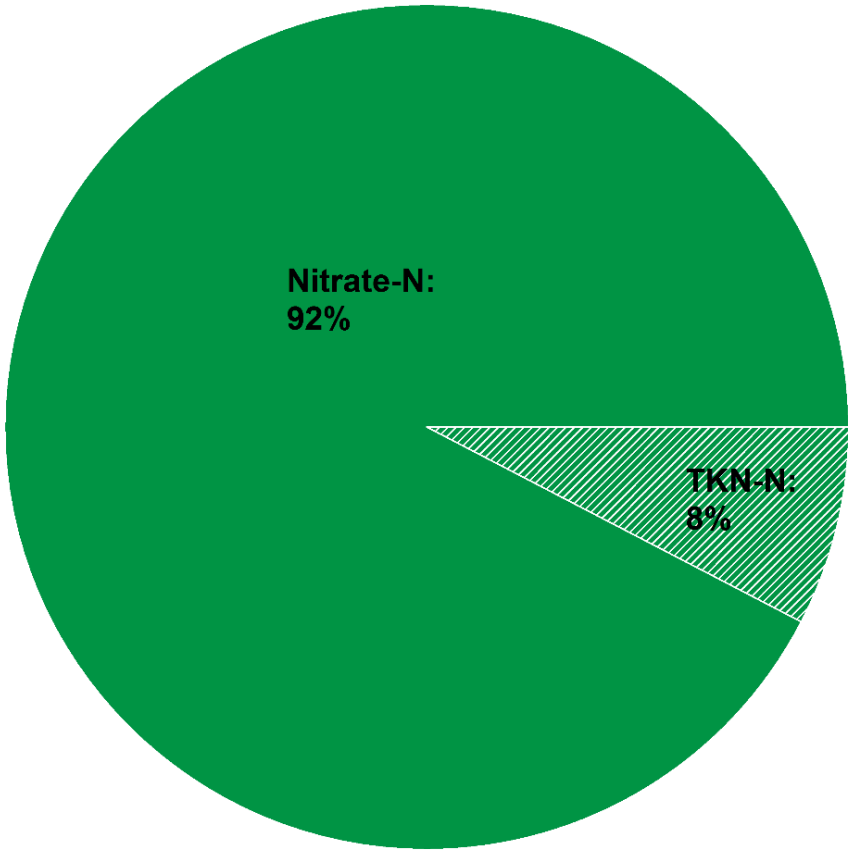
In surface runoff, nitrogen loss is mostly driven by **timing** of application and the amount of **erosion**.

Surface Runoff



Tile Drainage



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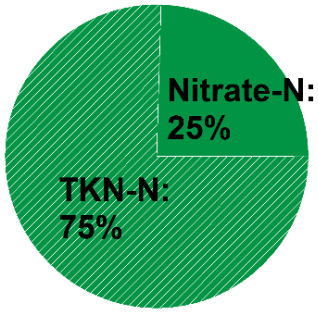
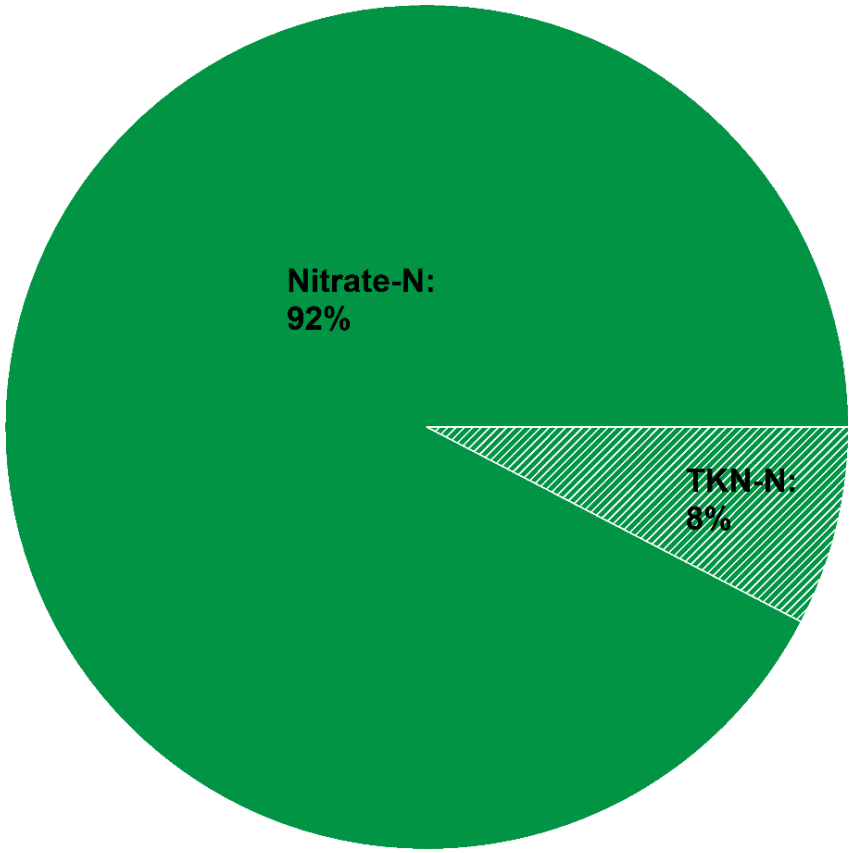
Three times more nitrogen is lost through tile than surface.

Surface Runoff



Tile Drainage



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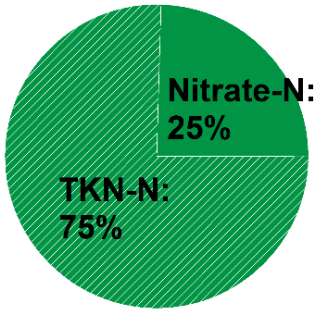
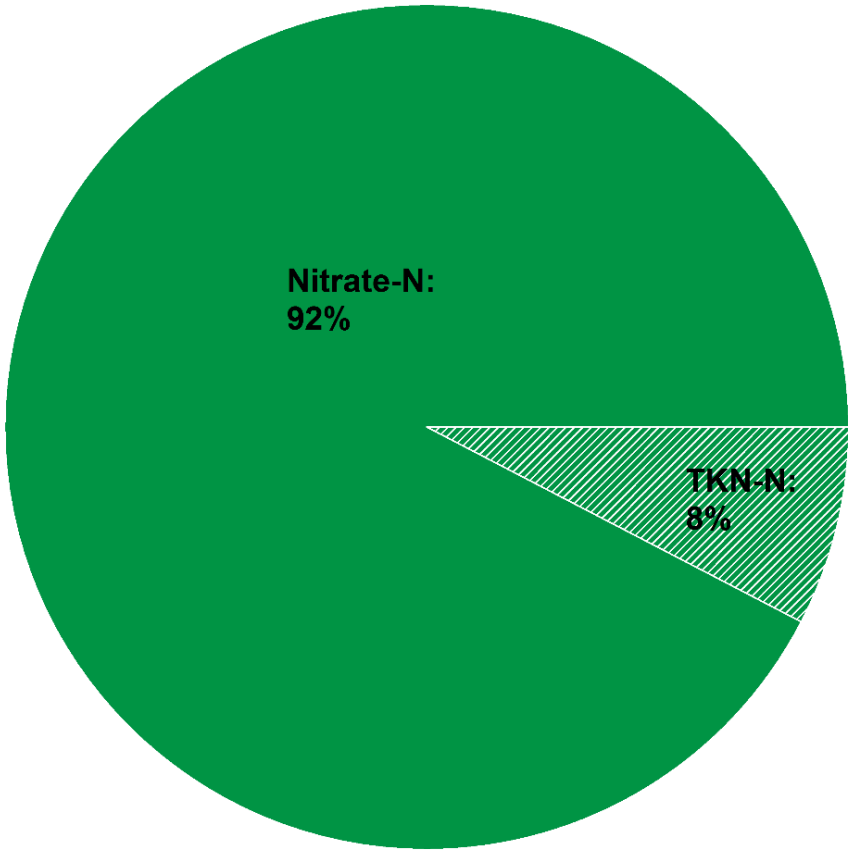
In tile, nitrate is the dominant form of loss.

Rate and **timing** of application and **weather** have the most impact on nitrogen loss in tile.

Surface Runoff



Tile Drainage



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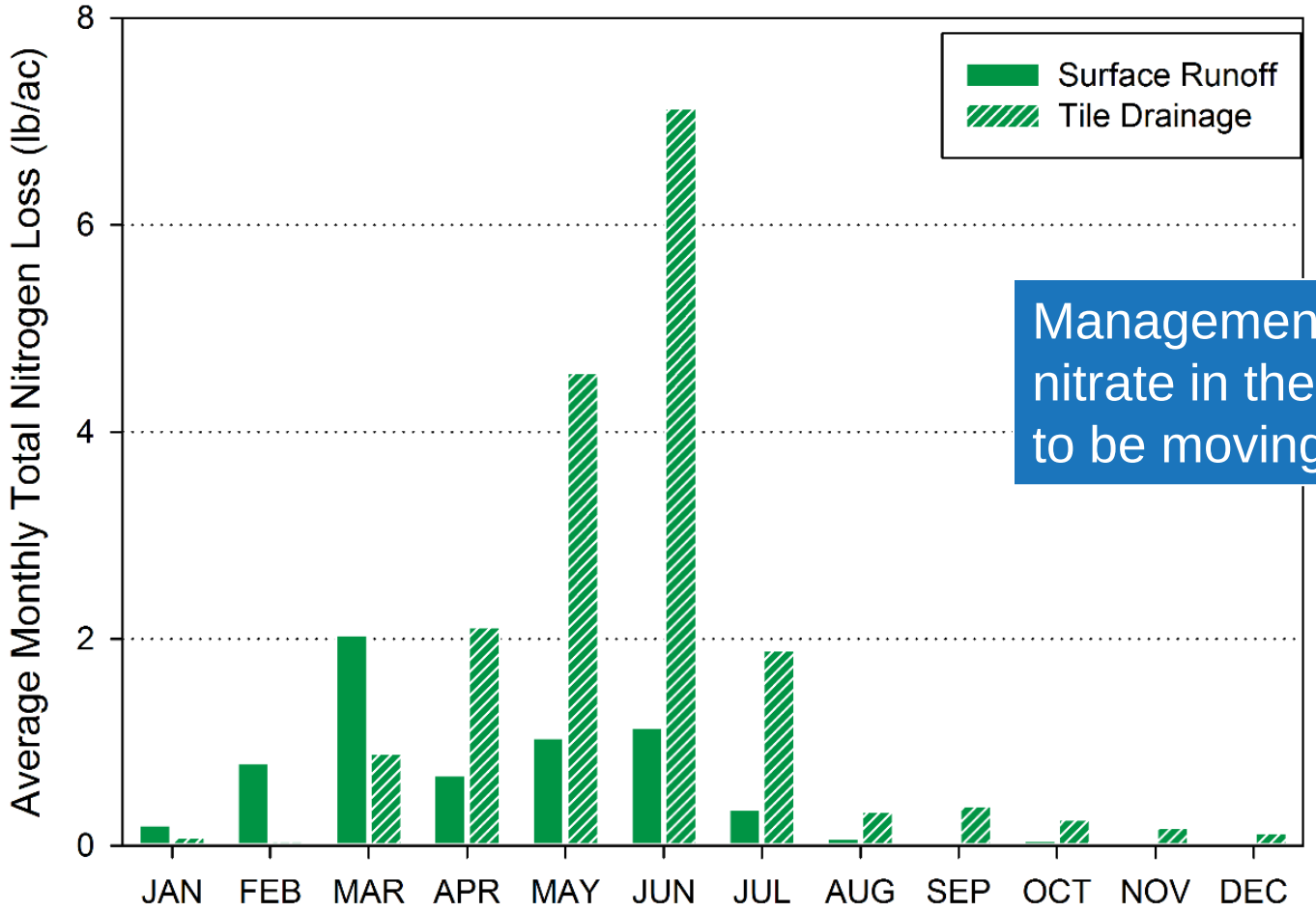
The timing of nitrogen loss closely resembles the runoff timing for surface and tile.

More



Management key: Work to limit the pool of nitrate in the soil at times when water is going to be moving through…March through June

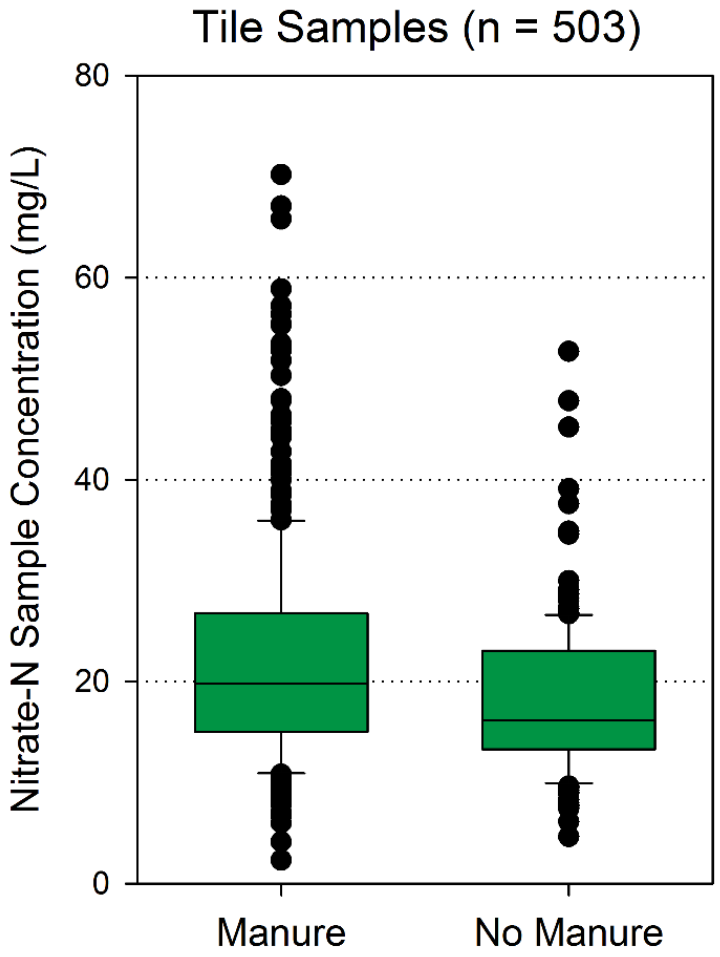
There is definitely no zero. How do we compare to other land uses?

Table 1. *General guidelines for interpreting NO_3-N concentrations in tile drainage water. The interpretation is derived from numerous studies conducted throughout the cornbelt and highlights land management strategies commonly found in association with a concentration measured in tile as the tile leaves the edge of the field.*

NO_3-N Concentration (ppm)	Interpretation
≤ 5	Native grassland, CRP land, alfalfa, managed pastures
5 – 10	Row crop production on a mineral soil without N fertilizer Row crop production with N applied at 45 lbs./acre below the economically optimum N rate† Row crop production with successful winter crop to "trap" N
10 - 20	Row crop production with N applied at optimum N rate Soybeans
≥ 20	Row crop production where: • N applied exceeds crop need • N applied not synchronized with crop need • Environmental conditions limit crop production and N fertilizer use efficiency • Environmental conditions favor greater than normal mineralization of soil organic matter

Source: Interpreting Nitrate Concentration in Tile Drainage Water, Purdue Extension, Purdue University

The median and range of tile concentration values are slightly higher for manured compared to non-manured fields.



There may be opportunities to bring this range down with a greater focus on manure crediting and application timing.

Is this a consequence of more mineralizable N in the soil?

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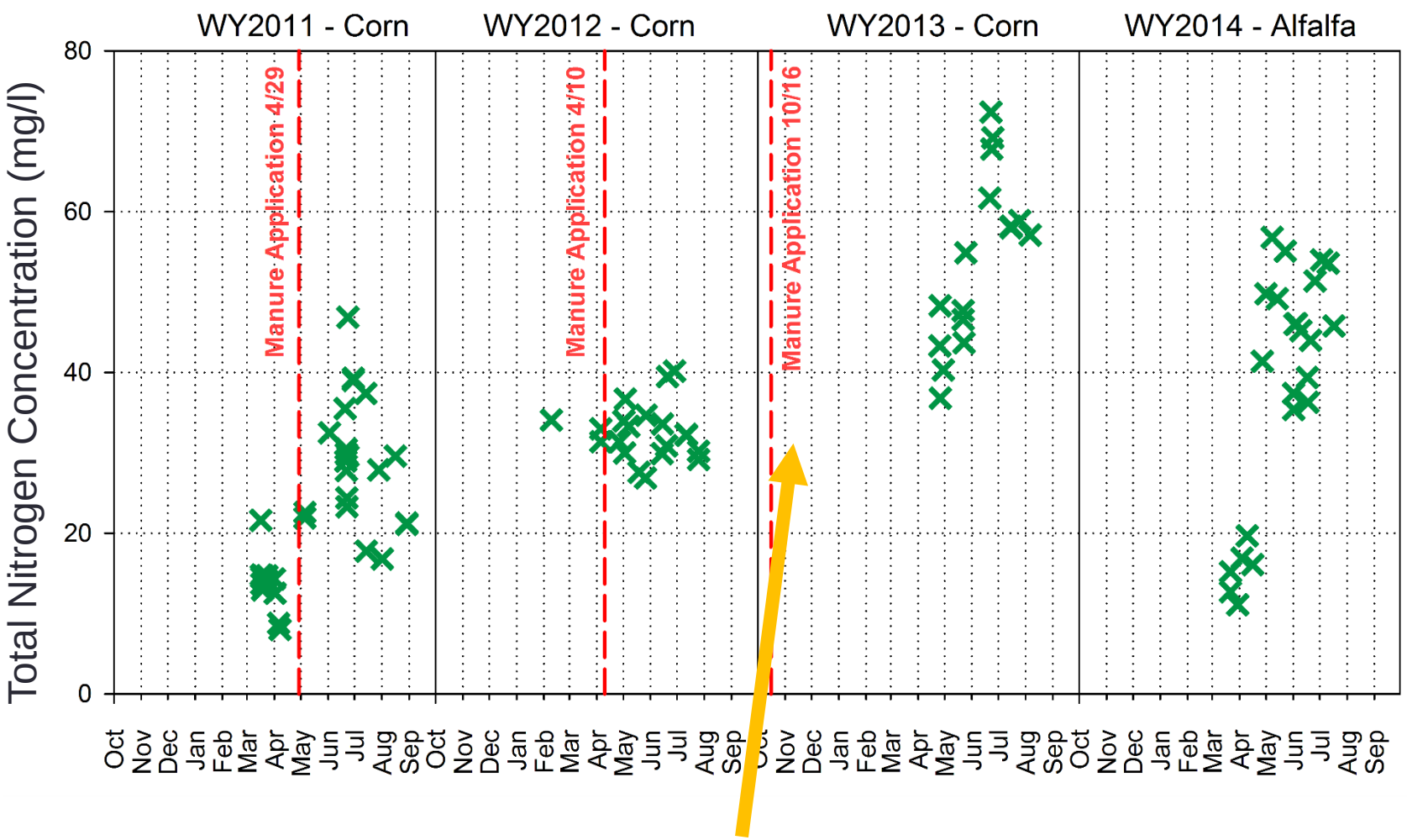
In the fall, manure applied when the soil is too warm can increase nitrogen loss.

When manure is applied too early in the fall, nitrogen concentration in tile increases.

If you must apply before soil temperatures cool down, use a nitrogen inhibitor or cover crops.



Oct 16, 2012:

Soil Temperature 50 degrees F

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Can we be more efficient with our nitrogen?

Discovery Farms is looking to outline a process that is easy to CUSTOMIZE, ADAPT and APPLY

It **is not** about a perfect rate, a lower rate or a higher rate

It **is** about giving farmers and consultants the tools to have a solid roadmap that supports how and why you apply N

Was this cropping system productive compared to its N application?

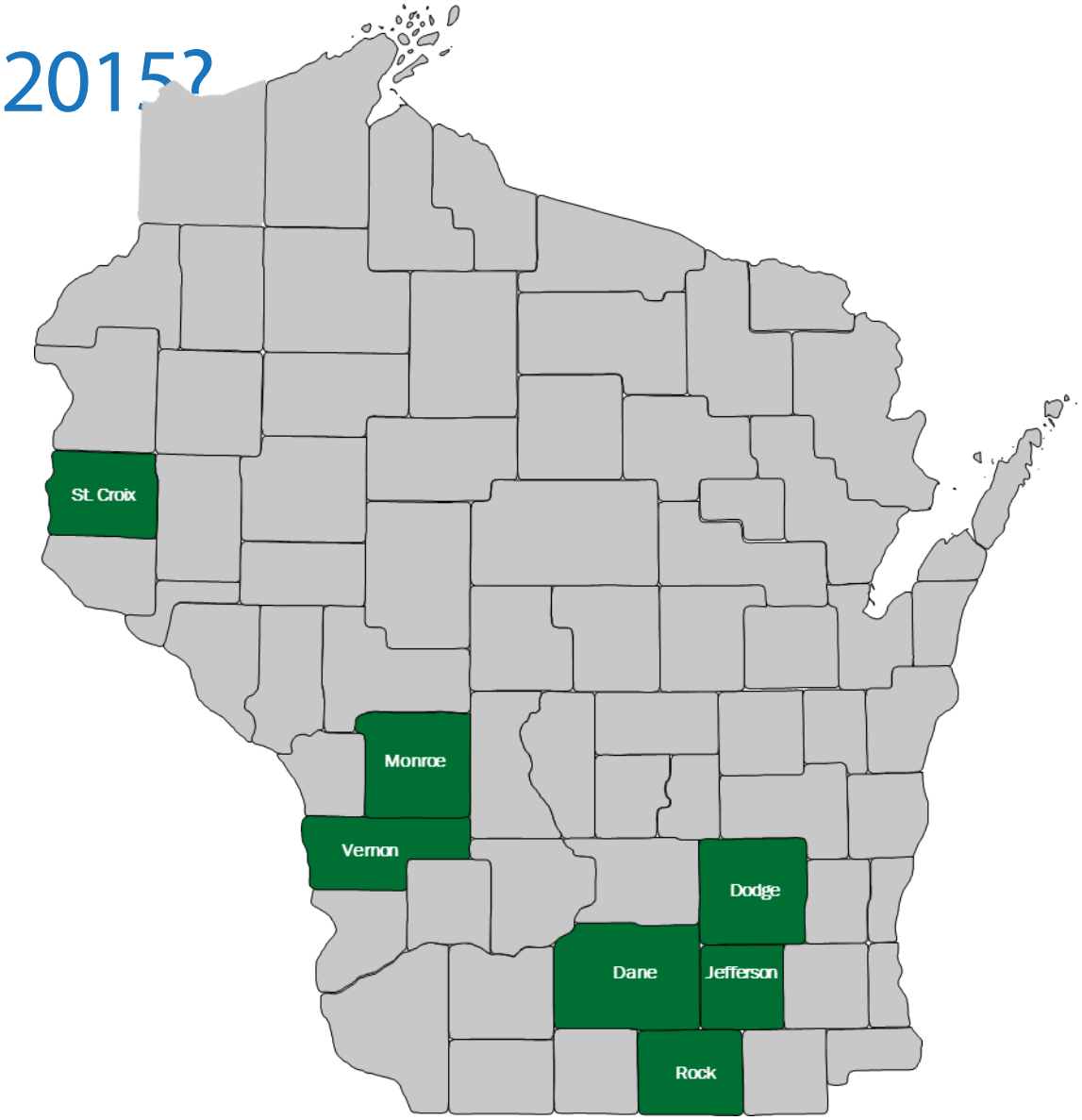
How efficient were you at removing applied nitrogen?

Did the fertilizer improve productivity?

How much of the N applied was taken up by the plant?

What was done in 2015?

- 4 Regions
- 22 Farms
- 51 Fields



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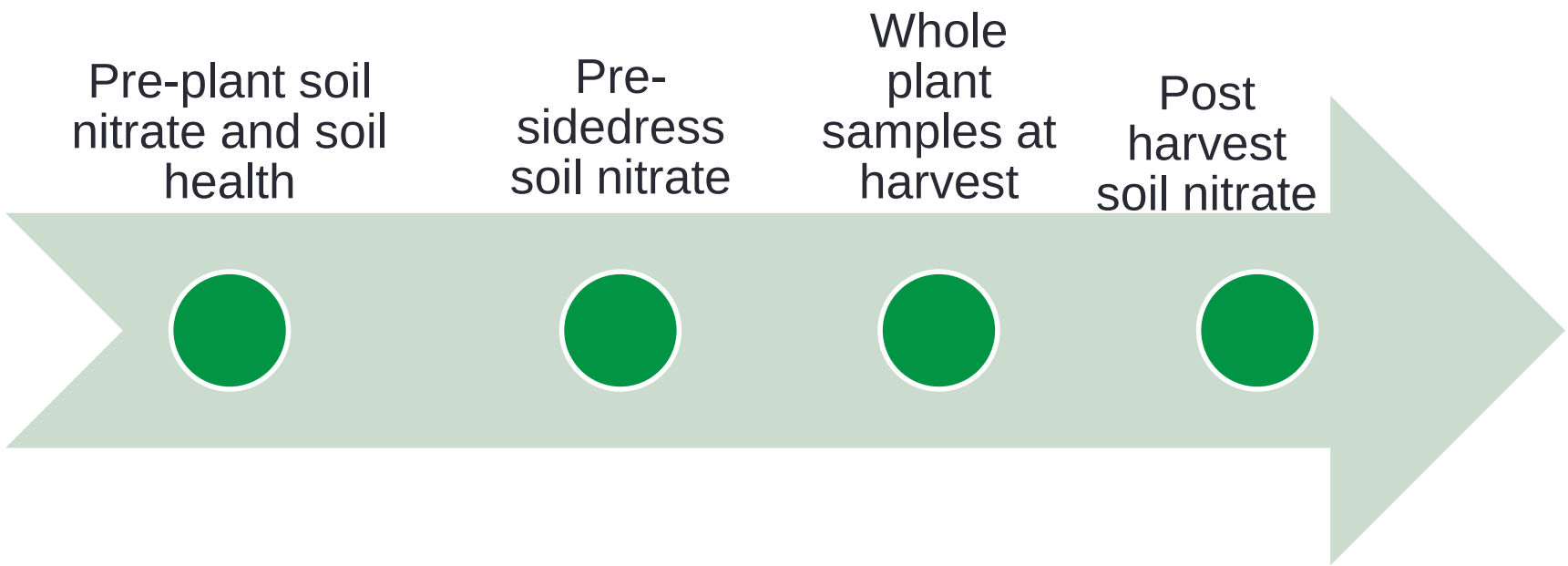
Measurements of Nitrogen Use Efficiency and Soil Health



Total plant available N

Total plant uptake

Potentially mineralizable N

Efficiency calculations

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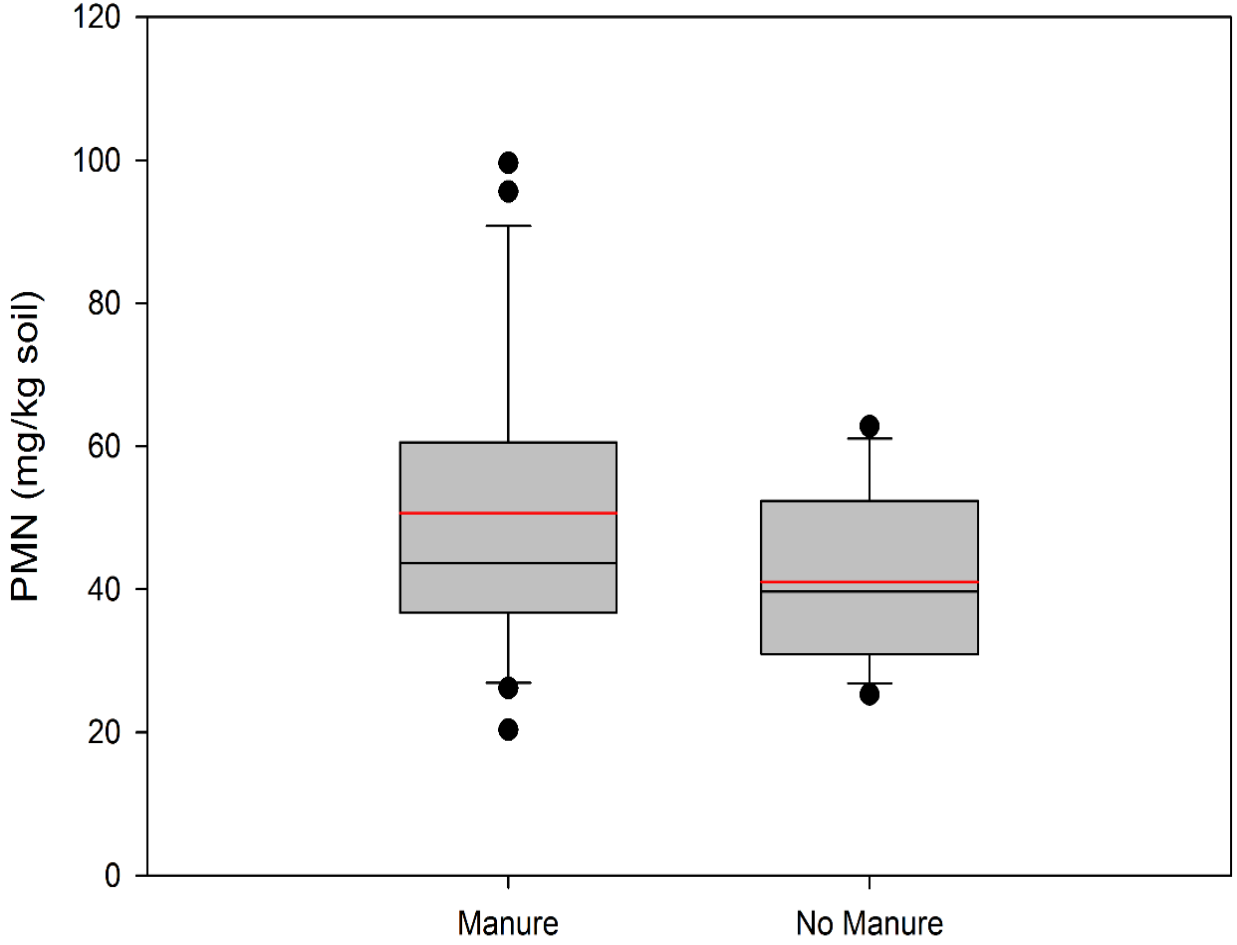
Soil health measurement shows that manure seems to impact mineralizable nitrogen



How does the pool of mineralizable nitrogen impact crop productivity or nitrogen use efficiency? Not sure yet.

It could influence nitrogen loss.

Points to drive home with…

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Leaching is the most significant pathway for nitrogen loss.

Measures should be taken to control erosion and avoid nitrogen application shortly before runoff to reduce nitrogen loss in surface runoff.

Timing and rate are the most controllable factors for limiting leaching loss, and we have more to understand about them.

Manure systems have more mineralizable N, which can affect losses.

Nitrogen Use Efficiency may be one way to try and more accurately credit nutrients and soil nitrogen contribution from manured areas.

www.uwdiscoveryfarms.org www.discoveryfarmsmn.org

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