A LOW COST TOOL FOR NITROGEN EVALUATION

Theo Gunther
How to evaluate your field at a low cost.
Assessment of Nitrogen Loss Reduction Practices rely on research studies or intensive sampling techniques

From Lawlor et al. 2008
Intensive water sampling is expensive, time consuming, and requires special equipment.
Nitrate Testing Cost Overview

**Water NO₃**
- ~$15+ per sample
  - Depends on Laboratory
- Test Strips
  - Pack of 50 is under $20

**Soil NO₃**
- ~$5+ per sample
  - Depends on sampling package
- Already relatively inexpensive to add if already soil sampling
360 Soilscan Cost

• Machine is Largest Cost
  • Available in many NRCS Offices statewide
  • Take advantage of these machines to get simple analysis

• Maintenance Cost
  • Standard Solution
  • Water Test Kit
  • Replacement Tips
  • ~$200-300 of supplies every 3 months depending on # of samples

Use the borrowed machine to conduct a low cost assessment
Want to test water but don’t have time to run to the office?

- Dozen 125 ml Nalgene bottles is ~$50

- Simply store enough water until analysis possible

- NO$_3$ stable if frozen

- Thaw and analyze
One-off water sampling can be helpful but difficult to detect changes

• Can show high or low concentration at one time

• No flow.

• No loss estimate.
Not all fields or tile systems are good candidates for assessment

One of 3 tile systems accessible for sampling

One tile shed accessible, one with single crop
Drawbacks and Gaps - Soil

• Nitrate level can change quickly

• Sampling labor intensive

• Other forms of N not measured

• THIS IS NOT A PERFECT APPROACH
Basic questions to ask:

• Does field have accessible tile outlet and known tile drainage area?

• Applying Nitrogen Above MRTN (Maximum Return To N)?
  • ~150 lb N after Soybean, ~200 lb N corn after corn

• Using a variable source of N?

• Major differences in soil types or top soil depth in the field?
1) What and why do you really want to know?

2) Is there a reasonable way to measure it?

• Examples:
  • Low soil nitrogen? Should I side dress N?
  • What is tile nitrate concentration? Use cover crops?
  • Is NO3 high enough for edge of field treatment to be worthwhile?
1) What and why do you really want to know?

2) Is there a reasonable way to measure?

• NO – Often the answer

• Maybe – not perfect doesn’t mean useless

• Yes – Focus on these opportunities
This is only one approach. Other Methods to estimate NO$_3$ concentrations work also

- Other methods can be more precise

- There is not always be a clear advantage to collecting the measurements

- Manage your expectations and put the results in context of larger production goals
Example 1:

• Corn-Soybean rotation

• Fall Anhydrous on soybeans

• Potential for Cover crop, saturated buffer, sidedress application?
**Example 1. Soil Sampling**

- **12” Soil at Point 1 over the growing season**

<table>
<thead>
<tr>
<th>Farm</th>
<th>Farmer</th>
<th>NO3-N</th>
<th>Sample Number</th>
<th>Sample Depth</th>
<th>Sample Core Length</th>
<th>Test Date</th>
<th>Notes</th>
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</table>

Slight Conversion in the across the row sample. 16 ppm in the inter row sample in June.
### Corresponding Water Samples

<table>
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<tr>
<th>Farm</th>
<th>Farmer</th>
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<th>Sample Number</th>
<th>Test Date</th>
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Steady Nitrate Concentrations in season. Compare with other fields in area.
Example 2: Continuous Corn with Manure and Commercial N

- Nitrate in top 24”
- Residual N after harvest?
Sampled three time per season. Pre-plant, Late spring (pre-side dress), post harvest

- Soil 12"
- Soil 24"

<table>
<thead>
<tr>
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<th>Sample Core Length</th>
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</table>

- Large amount of residual N after harvest
- Lot of N in soil.
- Test Tile for elevated concentration
So what to do next?

• Example 1

• Low soil N pre and post crop

• Test water in soybean phase

• Sample Collection
  • Soil 2.5 hours
  • Water 10 min per sample

• Soil Sample Analysis
  • 24 samples
  • ~3 hours total for season

• Water Sample Analysis
  • ~5 min each (x10)
So what to do next?

• Example 2

• High N in top 24”

• Test water, consider edge of field practice?

• Sample Collection
  • Soil 2.5 hours (Season)
  • Water 10 min per sample (not including travel)

• Soil Sample Analysis
  • 24 samples
  • ~3 hours total for season

• Water Sample Analysis
  • ~5 min each (x10)
Soil samples 0-18 inch depth comparison with lab

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>NO3-N</th>
<th>Lab</th>
<th>Sample #</th>
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<td>15_16</td>
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- Duplicate samples submitted
- Shaded samples in NH3 Band
- Values are near lab if maintained and calibrated
Compare to standard solutions with a known value
IC v. 360 Soil scan
Water Calibration Samples

R² = 0.8893
IC v. 360 Soil scan
Water Calibration Samples

\[ y = 1.0362x - 0.7097 \]
\[ R^2 = 0.8898 \]
IC v. Soilscan Tile Water

IC v. SS360

\[ y = 0.8504x + 0.7692 \]

\[ R^2 = 0.8034 \]
Water Sampling with the Soilscan

- Water samples <20 mg/l may test 3-5 mg/l higher than results using Ion Chromatography
- Standards of 5, 10, 30 mg/l helpful as comparison
- Good estimates but not as accurate as a laboratory
Evaluation Benefits

• May help adjust nutrient management
• Get an idea of your tile concentration.
• Group of growers can evaluate how specific practices work locally over time
Evaluation Drawbacks

- Time
  - Sample Collection
  - Analysis

- Convenient Analysis?
  - Few minutes/sample when calibrated
  - May be easier to send to lab, particularly for soil

- May not provide actionable information
Different management scenarios will test slightly different.
THANK YOU
-360 Soilscan machines are an option available to test soil and water nitrate concentrations.
- If considering edge of field practices or cover crops, measuring the status of nitrate in tiles can help prioritize which outlets and fields are best candidates for practices.
- Maintenance and use of calibration standards improves results interpretation.
- Rye cover crops create low soil nitrate conditions in early spring. Adjust fertilizer management to address this condition when planting corn.
- Assessment of nitrate in soil and water is not feasible or necessary for all fields but can provide feedback on the effect of some conservation practices.