Estimating the Nitrogen Supplying Power of Manitoba Soils

Don Flaten, Amy Mangin, Trevor Fraser, and Jeff Seward, University of Manitoba
John Heard, Manitoba Agriculture

AGVISE Seminar – March 14, 2018
Recommended Rate of Nutrient to Apply = Crop Nutrient Requirement - Soil Nutrient Supply

But how is the soil’s supply of N affected by:

– residual plant available N in soil
– N mineralization, immobilization, and losses
  • site and year
  • historical nutrient & crop mgmt. practices
  • current nutrient & crop mgmt. practices

And how do we predict those effects?
1. Accounting for the effect of residual plant available N in soil

Effect of Soil Test N on Yield Response of Barley to Fertilizer N (Soper & Huang 1963)

<table>
<thead>
<tr>
<th>Soil Test Method</th>
<th>R² *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil organic matter (0-6”)</td>
<td>0.06</td>
</tr>
<tr>
<td>Easily hydrolyzed organic N (0-6”)</td>
<td>0.70</td>
</tr>
<tr>
<td>N release during incubation (0-6”)</td>
<td>0.69</td>
</tr>
<tr>
<td>Water soluble nitrate-N (0-48”)</td>
<td>0.90</td>
</tr>
</tbody>
</table>

* Correlation between % of max. yield and log of soil test N for 9 experiments in 1960. Nitrate-N and incubation N were also significantly correlated with each other (R² = 0.38)
Effect of **Soil Organic Matter** on Relative Yield of Barley in Unfertilized vs. Fertilized Treatments (Soper & Huang 1963)

\[ y = 17.325 \ln(x) + 40.893 \]

\[ R^2 = 0.0565 \]
Effect of Easily Hydrolyzed Organic N on Relative Yield of Barley in Unfertilized vs. Fertilized Treatments (Soper & Huang 1963)

\[ y = 51.268 \ln(x) - 159.11 \]

\[ R^2 = 0.7338 \]
Effect of **Soil Nitrate-N** on Relative Yield of Barley in Unfertilized vs. Fertilized Treatments (Soper & Huang 1963)

\[ y = 25.249 \ln(x) - 22.401 \]

\[ R^2 = 0.9012 \]
Effect of Soil Nitrate-N + Easily Hydrolyzed N on Relative Yield of Barley in Unfertilized vs. Fertilized Treatments (adapted from Soper & Huang 1963)

\[ y = 42.819 \ln(x) - 138.4 \]

\[ R^2 = 0.9225 \]
Effect of Soil Nitrate-N on Uptake of N by Spring Wheat in Unfertilized Treatments (Unger and Flaten 1999-2000)*

\[ y = -0.0036x^2 + 0.9459x + 47.628 \]

\[ R^2 = 0.491 \]

* 10 site years in AB, SK, MB in 1999, 2000 (Unger and Flaten)
Effect of Phosphate-Borate Extractable N on Uptake of N by Spring Wheat in Unfertilized Treatments*

\[ y = 0.1861x + 68.726 \]

\[ R^2 = 0.0983 \]

* 10 site years in AB, SK, MB in 1999, 2000 (Unger and Flaten)
Effect of Nitrate plus Phosphate-Borate N on Uptake of N by Spring Wheat in Unfertilized Treatments*

\[ y = -0.0012x^2 + 0.7678x + 0.1219 \]

\[ R^2 = 0.6222 \]

* 10 site years in AB, SK, MB in 1999, 2000 (Unger and Flaten)
2. Accounting for the effect of historic and current nutrient and crop management on N mineralization from soil organic matter.

e.g. land fertilized with manure vs. synthetic fertilizer; perennial vs. annual cropping systems
NCLE Long Term Field Laboratory for Manure and Crop Management (U of MB Glenlea Research Station)

Photo: Matt Gervais
Phase 1 (2007-2015)

Four Types of Nutrients
- Liquid pig manure
- Solid pig manure
- Solid dairy manure
- Synthetic fertilizer

Two Manure Application Rates
- Yearly applications to meet crop N requirements
- Intermittent app’ns to meet crop N requirements

Two cropping systems
- Annual crops only
- Perennial
  - Grass forage (Fall 2008-2011, Fall 2014-present)

Measurements:
- Soil nutrients, pH & salinity
- Crop nutrient uptake & yield
Phase 2 (2015-2017)

- Intermittent Manure Applications
- P Drawdown

- N Mineralization
  - measured as crop yield, N uptake, and changes in residual NO$_3$-N in plots where manure and/or synthetic fertilizer applications have been discontinued, as of fall 2015

- Project Sponsors:
  - University of Manitoba
  - Manitoba Pork Council
  - Dairy Farmers of Manitoba
  - Manitoba Livestock Manure Mgmt. Initiative
  - Canada/Manitoba Growing Forward 2 Program
Effect of discontinued yearly synthetic fertilizer nitrogen and discontinued yearly N-based applications of manure on seed yield for the annual cropping system

Fraser and Flaten 2018. Preliminary information; please do not reproduce without authors’ permission.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Harvested Seed Yield kg ha⁻¹</th>
<th>Cumulative Mean Yield %CONTᵃ</th>
<th>Cumulative Mean Yield Increase %FERTᵇ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HRS Wheat 2016</td>
<td>Canola 2017</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1010 C</td>
<td>770 C</td>
<td>100 C</td>
</tr>
<tr>
<td>Continuous Synthetic Fertilizer</td>
<td>3810 AB</td>
<td>3360 A</td>
<td>408 A</td>
</tr>
<tr>
<td>Discontinued Synthetic Fertilizer</td>
<td>2960 AB</td>
<td>2000 B</td>
<td>277 B</td>
</tr>
<tr>
<td>Discontinued Liquid Pig Manure</td>
<td>4090 A</td>
<td>2650 AB</td>
<td>375 AB</td>
</tr>
<tr>
<td>Discontinued Solid Pig Manure</td>
<td>3090 B</td>
<td>2810 AB</td>
<td>336 AB</td>
</tr>
<tr>
<td>Discontinued Solid Dairy Manure</td>
<td>4080 AB</td>
<td>3280 A</td>
<td>415 A</td>
</tr>
<tr>
<td>S.D.</td>
<td>1230</td>
<td>1190</td>
<td>129</td>
</tr>
<tr>
<td>C.V. (%)</td>
<td>37.4</td>
<td>47</td>
<td>39.4</td>
</tr>
<tr>
<td>ANOVA (p-value)</td>
<td>&lt;.0001 *</td>
<td>&lt;.0001 *</td>
<td>&lt;.0001 *</td>
</tr>
</tbody>
</table>

* Indicates significance at p<0.05. Within each column means followed by the same letter are not significantly different.

ᵃ Mean yield index value across all crop years and crop types. Yield index was calculated separately for each replicate and expressed as a percentage of the mean from the control treatment.
Effect of discontinued yearly synthetic fertilizer nitrogen and discontinued yearly N-based applications of manure on estimated N mineralization for the annual cropping system

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N Mineralization kg ha(^{-1})</th>
<th>Cumulative Mineralized N(^{a})</th>
<th>Cumulative Increase in Mineralized N(^{b})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HRS Wheat 2016</td>
<td>Canola 2017</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>25 D</td>
<td>36 B</td>
<td>60 D</td>
</tr>
<tr>
<td>Continuous Synthetic Fertilizer</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Discontinued Synthetic Fertilizer</td>
<td>76 C</td>
<td>73 AB</td>
<td>149 C</td>
</tr>
<tr>
<td>Discontinued Liquid Pig Manure</td>
<td>115 B</td>
<td>74 A</td>
<td>189 BC</td>
</tr>
<tr>
<td>Discontinued Solid Pig Manure</td>
<td>111 BC</td>
<td>95 A</td>
<td>207 AB</td>
</tr>
<tr>
<td>Discontinued Solid Dairy Manure</td>
<td>158 A</td>
<td>104 A</td>
<td>262 A</td>
</tr>
</tbody>
</table>

S.D. 51.8 32.6 79 79
C.V. (%) 51 41.4 43.8 65.8
ANOVA (p-value) <.0001 * 0.0004 * <.0001 * <.0001 *

* Indicates significance at p<0.05. Within each column means followed by the same letter are not signif. different.

\(^{a}\) The cumulative sum of mineralized nitrogen in 2016 and 2017.

\(^{b}\) The cumulative sum of mineralized nitrogen in 2016 and 2017 expressed as an increase from the site mean mineralized nitrogen from the control.

Fraser and Flaten 2018. Preliminary information; please do not reproduce without authors’ permission.
Immobilization ties up a large portion of fertilizer N and is reduced by in-soil banding

Fall recovery of $^{15}$N labelled fertilizer N in crop and soil

- Plant N
- Soil N

Recovery of fertilizer N %

- straw incorp N bcst: 72%
- straw on surface N bcst: 22%
- straw removed N bcst: 34%
- straw incorp N band: 53%
- straw on surface N band: 34%
- straw removed band: 53%

(Tomar and Soper, AJ 1981)
Effect of discontinued yearly synthetic fertilizer nitrogen and discontinued yearly N-based applications of manure on dry matter yield for the perennial cropping system

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Dry Matter Yield kg ha(^{-1})</th>
<th>Cumulative Mean Yield %CONT(^b)</th>
<th>Cumulative Mean Yield Increase %FERT(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forage Grasses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2016(^a)</td>
<td>2017(^a)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>3380 C</td>
<td>1050 D</td>
<td>100 C</td>
</tr>
<tr>
<td>Continuous Synthetic Fertilizer</td>
<td>8510 A</td>
<td>3710 A</td>
<td>302 A</td>
</tr>
<tr>
<td>Discontinued Synthetic Fertilizer</td>
<td>4610 C</td>
<td>1240 D</td>
<td>127 C</td>
</tr>
<tr>
<td>Discontinued Liquid Pig Manure</td>
<td>6540 B</td>
<td>1800 CD</td>
<td>182 B</td>
</tr>
<tr>
<td>Discontinued Solid Pig Manure</td>
<td>6370 B</td>
<td>2530 B</td>
<td>214 B</td>
</tr>
<tr>
<td>Discontinued Solid Dairy Manure</td>
<td>6720 AB</td>
<td>2460 BC</td>
<td>216 B</td>
</tr>
<tr>
<td>S.D.</td>
<td>2430</td>
<td>910</td>
<td>72.5</td>
</tr>
<tr>
<td>C.V. (%)</td>
<td>39.7</td>
<td>42.6</td>
<td>37.7</td>
</tr>
<tr>
<td>ANOVA (p-value)</td>
<td>&lt;.0001 *</td>
<td>&lt;.0001 *</td>
<td>&lt;.0001 *</td>
</tr>
</tbody>
</table>

\* Indicates significance at p<0.05. Within each column means followed by the same letter are not significantly different.
\(^a\) No second cut.
\(^b\) Mean yield index value across all crop years and crop types. Yield index was calculated separately for each replicate and expressed as a percentage of the mean from the control treatment.
\(^c\) Mean yield index value across all crop years and crop types. Yield index was calculated separately for each replicate and expressed as a percentage of the mean from the synthetic fertilizer treatment.

Fraser and Flaten 2018. Preliminary information; please do not reproduce without authors’ permission.
Effect of discontinued yearly synthetic fertilizer nitrogen and discontinued yearly N-based applications of manure on estimated N mineralization for the perennial cropping system

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N Mineralization kg ha(^{-1}) Forage Grasses</th>
<th>Cumulative Mineralized N(^{c})</th>
<th>Cumulative Increase in Mineralized N(^{d})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>24 D 13 B</td>
<td>37 D</td>
<td>0 D</td>
</tr>
<tr>
<td>Continuous Synthetic Fertilizer</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Discontinued Synthetic Fertilizer</td>
<td>32 CD 13 B</td>
<td>47 CD</td>
<td>10 CD</td>
</tr>
<tr>
<td>Discontinued Liquid Pig Manure</td>
<td>39 BC 25 A</td>
<td>64 BC</td>
<td>27 BC</td>
</tr>
<tr>
<td>Discontinued Solid Pig Manure</td>
<td>49 A 32 A</td>
<td>83 A</td>
<td>46 A</td>
</tr>
<tr>
<td>Discontinued Solid Dairy Manure</td>
<td>51 AB 29 A</td>
<td>82 AB</td>
<td>45 AB</td>
</tr>
<tr>
<td>S.D.</td>
<td>18.5</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>C.V. (%)</td>
<td>46</td>
<td>47.4</td>
<td>38</td>
</tr>
<tr>
<td>ANOVA (p-value)</td>
<td>&lt;.0001 *</td>
<td>0.0002 *</td>
<td>&lt;.0001 *</td>
</tr>
</tbody>
</table>

* Indicates significance at p<0.05. Within each column means followed by the same letter are not signific. different.

\(^{a}\) No second cut.

\(^{b}\) Data were log-normally distributed. Statistical analysis was performed on natural log transformed data.

Back-transformed geometric means are reported.

\(^{c}\) The cumulative sum of mineralized nitrogen in 2016 and 2017.

\(^{d}\) The cumulative sum of mineralized nitrogen in 2016 and 2017 expressed as an increase from the site mean mineralized nitrogen from the control.

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Predicting N Mineralization from Manured Soils in a Growth Room Environment

Jeff Seward, B.Sc.Agroecology Project April 2016
Treatments Selected from the Long Term Manure Mgmt. Trial for Growth Room Experiment

Soil was collected from 8 nutrient treatments:
- Solid Dairy N-Based Annual Applications
- Solid Pig N-Based Annual Applications
- Liquid Pig N-Based Annual Applications
- Solid Dairy Intermittent (1x in fall 2007)
- Solid Pig Intermittent (1x in fall 2007)
- Liquid Pig Intermittent (1x in fall 2007)
- Synthetic Fertilizer annual to match MSFG rec.
- Control - without any nutrient app’n since spring 2007

for 2 cropping systems (annual and perennial) ... which totals up to 16 treatments
Methods for Growth Room Experiment

• Grew wheat in growth room in pots for 7 weeks.
  – 8 nutrient treatments x 2 cropping systems x 2 duplicates = 32 pots in total
  – No additional N added as manure or fertilizer

• Measured above ground plant biomass and determined plant nitrogen uptake

• Evaluated the Les Henry Soil N Test, among others
  – Zip-lock bags filled with field moist soil and stored 4 weeks at room temperature
  – Measured soil test nitrate-N before (pre-plant NO$_3$-N) and after incubation (gross incubated N); N mineralization estimated by difference between these two (net mineralized N)
Preplant Soil Nitrate vs Wheat Dry Matter Yield

\[ y = 0.5986x + 5.8973 \]

\[ R^2 = 0.8512 \]

Perennial cropping system samples ... very low NO$_3$-N
Nitrogen mineralized during wheat growth in growth room experiment

Solid manures and perennial cropping system generally had the greatest potential for N mineralization.
Les Henry's Gross Incubated N vs Wheat Dry Matter Yield

\[ y = 0.3909x + 4.2268 \]

\[ R^2 = 0.957 \]
Les Henry’s Incubation Test for N Mineralization vs. N Mineralization for Wheat Grown in Growth Chamber

\[ y = 1.43x + 42.1 \]
\[ R^2 = 0.83 \]

\[ y = 0.81x + 12.8 \]
\[ R^2 = 0.70 \]
Les Henry’s N Mineralization Test vs. N Mineralization in NCLE Long Term Annual Crop Field Plots

\[ y = 0.0793x + 80.848 \]

\[ R^2 = 0.0081 \]
2. Accounting for the effect of historic and current nutrient and crop management on N mineralization from soil organic matter. eg. row crops
Nitrogen Fertilization for Corn

John Heard, Manitoba Agriculture
MERN@ $4/bu corn and $0.40/lb N

Yield bu/ac vs. Total N/ac (soil & fertilizer) for various locations:
- Winkler
- Carman
- Letellier
- Melita
- Portage
- Arborg
- Melita
- Winkler
- Kelburn
- Carberry

University of Manitoba
MERN@ $4/bu corn and $0.40/lb N

\[ y = -0.0006x^2 + 0.3199x + 155.64 \]

\[ R^2 = 0.1747 \]

\[ y = -0.001x^2 + 0.4023x + 75.337 \]

\[ R^2 = 0.4225 \]
MERN@ $4/bu corn and $0.40/lb N

\[ y = -0.0006x^2 + 0.3199x + 155.64 \]
\[ R^2 = 0.1747 \]

\[ y = -0.001x^2 + 0.4023x + 75.337 \]
\[ R^2 = 0.4225 \]
MERN@ $4/bu corn and $0.40/lb N

y = -0.0006x^2 + 0.3199x + 155.64
R^2 = 0.1747

y = -0.001x^2 + 0.4023x + 75.337
R^2 = 0.4225

Optimum Total N/bu
- Winkler: 0.56
- Carman: 0.51
- Letellier: 0.92
- Melita: 1.13
- Portage: 1.31
- Arborg: 1.17
- Melita: 1.05
- Winkler: 0.40
- Kelburn: 0.71
- Carberry: 0.46
- Average: 0.82
# Preliminary Estimates of N Mineralization

<table>
<thead>
<tr>
<th>Site</th>
<th>Check Yield</th>
<th>Est .N uptake</th>
<th>ΔSoil nitrate</th>
<th>Starter fertilizer N</th>
<th>Mineralized N est.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bu/ac</td>
<td></td>
<td>lb N/ac</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St Adolphe</td>
<td>202</td>
<td>226</td>
<td>-71**</td>
<td>4</td>
<td>151+</td>
</tr>
<tr>
<td>Carberry</td>
<td>120</td>
<td>134</td>
<td>-55**</td>
<td>6</td>
<td>73+</td>
</tr>
<tr>
<td>Arborg</td>
<td>154</td>
<td>172</td>
<td>-106**</td>
<td>10</td>
<td>56+</td>
</tr>
<tr>
<td>Morden</td>
<td>178</td>
<td>199</td>
<td>-38**</td>
<td>4</td>
<td>157+</td>
</tr>
<tr>
<td>Melita</td>
<td>187</td>
<td>209</td>
<td>-57**</td>
<td>4</td>
<td>148+</td>
</tr>
<tr>
<td>Winkler</td>
<td>173</td>
<td>194</td>
<td>-47</td>
<td>-</td>
<td>147</td>
</tr>
<tr>
<td>Carman</td>
<td>143</td>
<td>160</td>
<td>-12</td>
<td>-</td>
<td>148</td>
</tr>
<tr>
<td>Letellier</td>
<td>146</td>
<td>164</td>
<td>-15</td>
<td>-</td>
<td>139</td>
</tr>
<tr>
<td>Melita</td>
<td>69</td>
<td>77</td>
<td>-74**</td>
<td>-</td>
<td>3+</td>
</tr>
<tr>
<td>Portage</td>
<td>86</td>
<td>96</td>
<td>-61**</td>
<td>-</td>
<td>35+</td>
</tr>
</tbody>
</table>

*Estimate is based on using a 1.12 lb whole plant N uptake/bu less soil nitrate depletion, less starter fertilizer N. **No fall NO₃ samples, so spring NO₃ was assumed to be fully depleted.
What happens to organic matter in row cropped soils?
Historical & Current Nutrient & Crop Management Practices

- Regular applications of synthetic fertilizer and livestock manure build substantial reserves of soil organic N that can mineralize in later years
- N mineralization rates vary greatly with:
  - nutrient management history (eg. rate & frequency of manure and fertilizer application)
  - current and historical cropping management practices (eg. land historically in perennial forage may have more potentially mineralizable N than annual crop land, but land currently in perennial forage mineralizes N more slowly than annual crop land)
- N mineralization rates are probably greater for row crops than solid seeded crops
3. Accounting for the effect of site and year on N mineralization from soil organic matter

eg. Amy Mangin’s studies on optimizing nitrogen fertilizer management strategies for high-yielding spring wheat
Optimum N Rate for Spring Wheat: Gold Level Sites
(Mangin et al. 2018)

<table>
<thead>
<tr>
<th>Site-year</th>
<th>Spring NO$_3$-N (0-60cm)</th>
<th>Economic Optimum N Rate*</th>
<th>Yield at Economic Optimum N Rate</th>
<th>N Supply per Bushel (Spring NO$_3$-N + Fert N)</th>
<th>Estimated N Min’n During Growing Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs. N/ac</td>
<td>lbs. N/ac</td>
<td>bu/ac</td>
<td>lbs. N/bu</td>
<td>lbs. N/ac</td>
</tr>
<tr>
<td>Carman 2016</td>
<td>47</td>
<td>140</td>
<td>62</td>
<td>3.0</td>
<td>67</td>
</tr>
<tr>
<td>Brunkild 2016</td>
<td>40</td>
<td>140</td>
<td>75</td>
<td>2.4</td>
<td>35</td>
</tr>
<tr>
<td>Carman 2017</td>
<td>43</td>
<td>140</td>
<td>96</td>
<td>1.9</td>
<td>73</td>
</tr>
<tr>
<td>Brunkild 2017</td>
<td>43</td>
<td>140</td>
<td>110</td>
<td>1.7</td>
<td>45</td>
</tr>
</tbody>
</table>

Average soil test N + Fertilizer N per bushel:
1.7 – 3.0 lbs N/bu

*Wheat prices from Jan 5, 2018, Nitrogen prices based off 5-years AVG urea price ($0.43/lbs N)
**Optimum N Rate for Spring Wheat: Silver Level Sites**  
(Mangin et al. 2018)

<table>
<thead>
<tr>
<th>Site-year</th>
<th>Spring NO₃-N (0-60cm)</th>
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<th>Yield at Economic Optimum N Rate</th>
<th>N Supply per Bushel (Spring NO₃-N + Fert N)</th>
<th>Estimated N Min’n During Growing Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs. N/ac</td>
<td>lbs. N/ac</td>
<td>bu/ac</td>
<td>lbs. N/bu</td>
<td>lbs. N/ac</td>
</tr>
<tr>
<td>Melita 2016</td>
<td>43</td>
<td>80</td>
<td>60</td>
<td>2.1</td>
<td>47</td>
</tr>
<tr>
<td>Carberry 2016</td>
<td>89 (red)</td>
<td>50</td>
<td>95</td>
<td>1.5 (red)</td>
<td>130 (red)</td>
</tr>
<tr>
<td>Melita 2017</td>
<td>11</td>
<td>140</td>
<td>74</td>
<td>2.0</td>
<td>85</td>
</tr>
<tr>
<td>Grosse Isle 2017</td>
<td>65</td>
<td>110</td>
<td>75</td>
<td>2.3</td>
<td>46</td>
</tr>
</tbody>
</table>

**Range of soil test N + Fertilizer N per bushel:**  
1.5 – 2.3 lbs N/bu

*Wheat prices from Jan 5, 2018, Nitrogen prices based off 5-years AVG urea price ($0.43/lbs N)
Predicting N Mineralization in Wheat N Study Using % Soil Organic Matter

\[ y = 0.4813x + 63.527 \]

\( R^2 = 0.0007 \) NS

Mangin et al. 2018
Predicting N Mineralization in Wheat N Study Using Spring Residual N (0-24”) 

Mangin et al. 2018
Predicting N Mineralization in Wheat N Study Using Les Henry Incubation Test

\[ y = 0.6177x + 47.989 \]
\[ R^2 = 0.0841 \text{ NS} \]

Mangin et al. 2018
Predicting N Mineralization in Wheat N Study Using NaHCO₃ Extraction Absorbance at 205 nm

\[ y = 0.1695x + 45.759 \]

\[ R^2 = 0.0505 \text{ NS} \]

Mangin et al. 2018
Predicting N Mineralization in Wheat N Study Using NaHCO₃ Extraction Absorbance at 260 nm

$y = 0.1357x + 40.86$

$R^2 = 0.0619$ NS

Estimated N Min'n (lb N/ac)

NaHCO₃ extraction absorbance @ 260 nm

Mangin et al. 2018
Predicting N Mineralization in Wheat N Study Using Solvita CO₂ Burst After Rewetting

\[ y = -0.1565x + 89.856 \]

\[ R^2 = 0.0986 \text{ NS} \]

Mangin et al. 2018
Site and Year Effects on N Mineralization

- N mineralization varies substantially from one field to another and one year to the next
- Current tools for estimating N mineralization in fields are not reliable
Summary Thoughts ...

• Applying synthetic fertilizer & livestock manure builds reserves of organic N that release large amounts of mineralized N in later years.

• The rate and amount of N mineralized varies with nutrient management history, current and historical cropping management practices.

• Temporal & spatial variability (e.g. site & year) will probably mess up any lab-based methods for estimating N mineralization for next year’s crop in a field.

• Many of these factors will also vary the amount of N mineralized within different areas of fields as a function of landscape position, etc.
Summary Thoughts, cont’d.

- We need better tools and strategies to apply the right rate of N, eg:
  - Apply decent base rates of N at or near planting; then use on-the-go, real time leaf reflectance measurements and other agronomic measurements that account for spatial and temporal variability in N supply/demand to determine midseason N applications
  - Validate N “budgets” for individual fields and management zones, with end of season “audits” using residual NO$_3$-N immediately after harvest (ie. a validated “virtual soil test”)
- In the meantime, use and follow annual fall residual NO$_3$ tests, to keep from getting too far off track
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