Agricultural Management and Technology in the Saginaw Bay

Tim Boring
Michigan Soybean Checkoff
Farmer Stewardship
4R Nutrient Management

- Biodiversity
- Nutrient loss
- Water & air quality
- Affordable & accessible food
- Ecosystem services
- Farm income

Environmental Goals:
- Resource use efficiencies: Energy, Labor, Nutrient, Water
- Soil erosion
- Nutrient balance
- Yield
- Net profit

Economic Goals:
- Return on investment
- Quality
- Yield stability
- Working conditions

Social Goals:
- Educational opportunities
- Community engagement
- Sustainable livelihoods

Cropping System Goals:
- Source
- Rate
- Time
- Place
4R nutrient management
Right source. Right rate. Right time. Right place.

Right now.
Right Source

Dry and Liquid Blend List

**DRY BLENDS:**

<table>
<thead>
<tr>
<th>Standard Blends</th>
<th>Formulated with AVAIL® and/or NutriSphere-N®</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-14-42 + 0.25%B</td>
<td>11-52-0 MAP w/ AVAIL</td>
</tr>
<tr>
<td>5-10-10</td>
<td>18-46-0 DAP w/ AVAIL</td>
</tr>
<tr>
<td>5-14-42</td>
<td>46-0-0 UREA w/ NutriSphere-N</td>
</tr>
<tr>
<td>5-20-20</td>
<td>5-22-22 w/ AVAIL</td>
</tr>
<tr>
<td>6-24-24</td>
<td>17-17-17 w/ NutriSphere-N</td>
</tr>
<tr>
<td>8-32-16</td>
<td>23-0-0 +10%Ca +6%Mg (PL) &amp; NutriSphere-N</td>
</tr>
<tr>
<td>9-23-30</td>
<td>26-12-12 w/ NutriSphere-N</td>
</tr>
<tr>
<td>10-10-10</td>
<td>MAP/Potash Blends</td>
</tr>
<tr>
<td>10-30-10</td>
<td>3-14-42</td>
</tr>
<tr>
<td>10-20-20</td>
<td>4-18-39</td>
</tr>
<tr>
<td>12-12-12</td>
<td>5-24-24</td>
</tr>
<tr>
<td>12-24-24</td>
<td>5-26-30</td>
</tr>
<tr>
<td>15-15-15</td>
<td>Formulated with Ammonium Sulfate (AS),</td>
</tr>
<tr>
<td></td>
<td>Pelletized Lime (PL) or both</td>
</tr>
<tr>
<td>16-16-16</td>
<td>0-0-30 +10%Ca +6%Mg (PL)</td>
</tr>
<tr>
<td>19-19-19</td>
<td>4-8-40 + 3%S (AS)</td>
</tr>
<tr>
<td>19-19-19</td>
<td>12-12-12 +7%Ca +4%Mg (PL)</td>
</tr>
<tr>
<td>20-10-10</td>
<td>14-14-14 + 3%S (AS)</td>
</tr>
<tr>
<td>28-13-13</td>
<td>16-8-8 +15%S +1%Ca +0.8%Mg (PL &amp; AS)</td>
</tr>
</tbody>
</table>

*Dry blends are available in bulk or bag.

**LIQUID BLENDS:**

<table>
<thead>
<tr>
<th>Base Grades</th>
<th>lbs./gal</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-34-0</td>
<td>11.7</td>
</tr>
<tr>
<td>10-30-0 w/ 2%S &amp; 0.25%Zn (Chelated)</td>
<td>11.5</td>
</tr>
<tr>
<td>11-37-0</td>
<td>12.0</td>
</tr>
<tr>
<td>12-30-0 w/ 3% Sulfur</td>
<td>11.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clear Liquid Blends</th>
<th>lbs./gal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-4-12</td>
<td>9.9</td>
</tr>
<tr>
<td>2-6-12</td>
<td>10.0</td>
</tr>
<tr>
<td>4-10-10</td>
<td>10.3</td>
</tr>
<tr>
<td>6-18-6</td>
<td>10.8</td>
</tr>
<tr>
<td>7-22-5</td>
<td>10.9</td>
</tr>
<tr>
<td>8-25-3</td>
<td>11.0</td>
</tr>
<tr>
<td>15-15-3</td>
<td>11.0</td>
</tr>
<tr>
<td>17-17-0 w/ 2%Sulfur</td>
<td>11.1</td>
</tr>
<tr>
<td>18-18-0</td>
<td>11.2</td>
</tr>
<tr>
<td>18-18-0 w/ 2%Sulfur</td>
<td>11.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty Items</th>
<th>lbs./gal</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-0-0 UAN w/ NutriSphere-N</td>
<td>10.7</td>
</tr>
<tr>
<td>9-27-0 w/ 2% Sulfur &amp; AVAIL</td>
<td>11.2</td>
</tr>
<tr>
<td>Potassium Thio-Sulfate KTS Low Salt</td>
<td>12.2</td>
</tr>
</tbody>
</table>

Custom blends are available for both dry and liquid.
Right Time

Fall pre-plant

Spring in-crop
Right Place
Right Rate

Prescription Map
283.01 acres

Recommendation N 46-0-0

- 42 (4.8 ac.)
- 42 (16.6 ac.)
- 58 (29.6 ac.)
- 90 (68.6 ac.)
- 125 (90.2 ac.)
- 130 (73.3 ac.)

(283.0 ac.) Field Boundary
Basis of P and K Recommendations

Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat & Alfalfa

Extension Bulletin E-2567 (New), July 1995

Michigan State University
The Ohio State University
Purdue University
Fertilizer Recommendation Scheme

- Critical Level
- Maintenance limit

95% Yield

- Buildup range
- Maintenance range
- Drawdown range

Soil test level

Fertilizer rate
Fertilizer Recommendation Scheme

Critical Level                Maintenance limit
Soil test level

Fertilizer rate

95 % Yield

% Yield

↑

↑

Response Zone
Buildup Range

Adequate Zone
Maintenance Range

Drawdown Range

Soil test level

↓

↓
<table>
<thead>
<tr>
<th>Crop**</th>
<th>Unit</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa (DM)</td>
<td>ton</td>
<td>51</td>
<td>12</td>
<td>49</td>
<td>5.4</td>
</tr>
<tr>
<td>Barley grain</td>
<td>bu</td>
<td>0.99</td>
<td>0.40</td>
<td>0.32</td>
<td>0.09</td>
</tr>
<tr>
<td>Beans (dry)</td>
<td>bu</td>
<td>3.0</td>
<td>0.79</td>
<td>0.92</td>
<td>0.52</td>
</tr>
<tr>
<td>Bromegrass (DM)</td>
<td>ton</td>
<td>32</td>
<td>10</td>
<td>46</td>
<td>5.0</td>
</tr>
<tr>
<td>Canola grain</td>
<td>bu</td>
<td>1.9</td>
<td>1.2</td>
<td>2.0</td>
<td>0.34</td>
</tr>
<tr>
<td>Corn grain</td>
<td>bu</td>
<td>0.67</td>
<td>0.35</td>
<td>0.25</td>
<td>–</td>
</tr>
<tr>
<td>Cotton (lint)</td>
<td>bale</td>
<td>32</td>
<td>14</td>
<td>19</td>
<td>–</td>
</tr>
<tr>
<td>Flax grain</td>
<td>bu</td>
<td>2.5</td>
<td>0.70</td>
<td>0.60</td>
<td>0.19</td>
</tr>
<tr>
<td>Millet grain</td>
<td>bu</td>
<td>1.4</td>
<td>0.40</td>
<td>0.40</td>
<td>0.08</td>
</tr>
<tr>
<td>Oat grain</td>
<td>bu</td>
<td>0.77</td>
<td>0.28</td>
<td>0.19</td>
<td>0.07</td>
</tr>
<tr>
<td>Peanut nuts</td>
<td>ton</td>
<td>70</td>
<td>11</td>
<td>17</td>
<td>–</td>
</tr>
<tr>
<td>Potato tuber</td>
<td>cwt</td>
<td>0.32</td>
<td>0.12</td>
<td>0.55</td>
<td>0.03</td>
</tr>
<tr>
<td>Red clover (DM)</td>
<td>ton</td>
<td>45</td>
<td>12</td>
<td>42</td>
<td>3.0</td>
</tr>
<tr>
<td>Rice grain</td>
<td>bu</td>
<td>0.57</td>
<td>0.30</td>
<td>0.16</td>
<td>–</td>
</tr>
<tr>
<td>Rye grain</td>
<td>bu</td>
<td>1.4</td>
<td>0.46</td>
<td>0.31</td>
<td>0.10</td>
</tr>
<tr>
<td>Sorghum grain</td>
<td>bu</td>
<td>0.66</td>
<td>0.39</td>
<td>0.27</td>
<td>0.06</td>
</tr>
<tr>
<td>Soybean grain</td>
<td>bu</td>
<td>3.25</td>
<td>0.73</td>
<td>1.18</td>
<td>–</td>
</tr>
<tr>
<td>Sugarbeet root</td>
<td>ton</td>
<td>3.7</td>
<td>2.2</td>
<td>7.3</td>
<td>0.45</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>ton</td>
<td>2.0</td>
<td>1.25</td>
<td>3.5</td>
<td>–</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>ton</td>
<td>2.5</td>
<td>0.92</td>
<td>5.7</td>
<td>–</td>
</tr>
<tr>
<td>Wheat straw</td>
<td>bu</td>
<td>0.7</td>
<td>0.16</td>
<td>1.2</td>
<td>0.14</td>
</tr>
<tr>
<td>Wheat (spring)</td>
<td>bu</td>
<td>1.49</td>
<td>0.57</td>
<td>0.33</td>
<td>–</td>
</tr>
<tr>
<td>Wheat (winter)</td>
<td>bu</td>
<td>1.16</td>
<td>0.48</td>
<td>0.29</td>
<td>–</td>
</tr>
</tbody>
</table>

*Reported nutrient removal coefficients may vary regionally depending on growing conditions. Use locally available data whenever possible.

**DM = dry matter basis; otherwise moisture content is standard marketing convention or at the stated moisture content.

Example: Using Table A, an example of nutrient balancing would be a 200 bu/A corn crop removes 70 lb P₂O₅ from the soil (200 x 0.35 = 70). So, the maintenance P₂O₅ application will be 70 lb/A.
Nutrient Uptake x Time

Diagram showing cumulative % of total N for different stages: V, E, 1, 3, 5, 8, 11, 14, 17, 20, 6, 7, 8. Days after emergence: 0, 20, 40, 60, 80, 100, 120. Dates: May, June, July, August, September.
Nitrogen

The Nitrogen Cycle

- Atmospheric nitrogen
- Crop harvest
- Industrial fixation (commercial fertilizers)
- Volatilization
- Runoff and erosion
- Denitrification
- Leaching

- Atmospheric fixation and deposition
- Animal manures and biosolids
- Biological fixation by legume plants
- Plant residues
- Plant uptake

- Organic nitrogen
- Ammonium ($NH_4^+$)
- Nitrate ($NO_3^-$)

Mineralization
Immobilization
Nitrogen

Corn Nitrogen Rate Calculator
Finding the Maximum Return To N and Most Profitable N Rate
A Regional (Corn Belt) Approach to Nitrogen Rate Guidelines

This web site provides a process to calculate economic return to N application with different nitrogen and corn prices and to find profitable N rates directly from recent N rate research data. The method used follows a newly developed regional approach for determining corn N rate guidelines that is being implemented in several Corn Belt states.

Regional Corn N Rate Publication

Choose state
- Illinois - North
- Illinois - Central
- Illinois - South
- Indiana - West & Northwest
- Indiana - East & Central
- Indiana - Remainder
- Michigan
- Minnesota
- Ohio
- Wisconsin - HYP Soils
- Wisconsin - MYP Soils
- Wisconsin - Irr. Sands
- Wisconsin - Non-Irr. Sands

Choose rotation pattern(s)
- Corn following soybean
- Corn following corn

Set corn and nitrogen prices
- UAN (28% N) 280 ($/ton)
- Nitrogen price 0.50 ($/lb N)
- Corn price 5.00 ($/bu)

Calculate  Reset

Illinois Map  Indiana Map  How to Use  More Info
Maximum Return on Nitrogen

Yield (bu/acre)

N rate (lb/acre)

Maximum return to nitrogen occurs at the optimum nitrogen rate (lb/acre).
Most profitable N rate is at the maximum return to N (MRTN). Profitable N rate range provides economic return within $1/acre of the MRTN.
N Price ($/lb N): $0.30 $0.50 $0.75 $0.90
Corn Price ($/bu): $5.00 $5.00 $5.00 $5.00
Price Ratio: 0.06 0.10 0.15 0.18
MRTN Rate (lb N/acre): 141 127 122 117

Return to N

N Rate, lb N/acre

Return to N, $/acre
Michigan sites

Relationship Between Economic Optimum N and Yield

- Optimum Yield, bu/acre
- Optimum N Rate, lb N/acre
Iowa sites

Relationship Between Economic Optimum N and Yield

Optimum Yield, bu/acre

Optimum N Rate, lb N/acre
Landscape variability
Fertilizer prescriptions

Variable rate planting