Nutrient Control BMPs:

Soil Testing
Plant Tissue Analysis
Fertilizer Application
Spill Prevention

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Soil Testing

**Importance**

- Part of the “Nutrient Control Practices” listed under approved BMPs for water quality improvement in the EAA.

- Soil testing is an essential tool to formulate a sound amendment and nutrient management program.

- With increased emphasis on environmental quality and rising cost of fertilizer materials, soil testing has become an important tool to identify areas where inadequate or excess fertilization has occurred.
Relationship Between Soil Test P, Crop Yield, and Potential for Environmental Problems due to Excessive Soil P

Soil Test P (Index Value)

Relative Crop Yield (%)

Potential Environmental Problems

Excessive

L  M  H

0 25 50 75 100 125 150
Soil Testing: 3-Step Process

1. Soil Sampling:
   a) Collection of Soil Samples
   b) Handling and Submitting

2. Laboratory Extraction and Analysis:
   a) Sample Preparation
   b) Extraction and Measurement of Nutrients.

3. Interpretation and Fertilizer Recommendation:
   Making sense of the results to make reasonable nutrient (fertilizer) application recommendations for a specific crop.
1. Soil Sampling: Collection

- Critical to the soil testing process
- High field variability
- Remember that a very small area is sampled
- 20-25 cores samples collected per 40-acre field
Soil-test Pw contour map
Okeelanta muck (EAA)
1. Soil Sampling: Handling and Submitting

Proper handling is also important:

- Thoroughly mix the composite; break up cores.
- Soil samples should be delivered as soon as possible after collection.
- Clearly label and identify sample.
- Include contact information.
2. Laboratory Analysis: Sample Preparation
2. Laboratory Analysis: Sample Preparation
2. Laboratory Analysis: Measurement
3. Interpretation and Recommendation

Response of Crisphead Lettuce to Soil-Test P Levels

\[ y = 96.8 \times (1 - 1.6e^{-0.17x}) \]

\[ r^2 = 0.66 \]
Proposed Revision of Sugarcane P Calibration

Mean Relative Sucrose

\[ y = 0.878(1 - \exp^{-0.242x}) \]

\[ R^2 = 0.55, \ P < 0.0001 \]
## Revised Sugarcane P Calibration

<table>
<thead>
<tr>
<th>Mehlich 3 Soil P</th>
<th>Plant Cane</th>
<th>Ratoon 1</th>
<th>Ratoon 2</th>
<th>Ratoon 3+</th>
</tr>
</thead>
<tbody>
<tr>
<td>g P/m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 8</td>
<td>75</td>
<td>75</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>9-15</td>
<td>60</td>
<td>60</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>16-20</td>
<td>50</td>
<td>50</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>21-25</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>26-30</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>31-35</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>36-40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Fertilizer Application

3 Goals of Fertilizer Application BMPs

- Fertilize to cover all crop needs
- Reduce over- or misapplication
- Eliminate spills, cleanup spills
Apply minimum amount of P fertilizer that is needed to produce optimum yields

- Increase fertilizer use efficiency
- Timing of fertilizer application/split applications
- Placement of fertilizer close to root zone
- Fertilizer sources: soluble/slow release fertilizers
Banding of P Fertilizers

- Places fertilizer close to the root zone; more efficient uptake by plant.
- Reduces the soil-fertilizer surface contact area, resulting in less P fixation.
- Reduces likelihood of overlapping application to same rows.
- The most important advantage of banding is the significant reduction of the overall amount of P applied especially to vegetables.
Banding increases P availability to plants by:

a. providing concentration of P in narrow band in root zone (most important in short-lived shallow rooted crops)

b. decreasing pH in that narrow application zone, which temporarily allows P availability by slowing P fixation
Fertilizer Misapplication Prevention

Misapplication of fertilizer P:

- Application of P fertilizer to soils with high P fertility levels.
- Application of P fertilizer to soils at higher than the recommended rates.
- Application of P fertilizer to non-target areas due to mechanical failures or lack of proper training.
Problems caused by increased P concentrations:

- Algal blooms
- Excessive aquatic weed growth
- Low dissolved oxygen levels
- Increased TP and TDP in drainage water
- Increased P loads off the farm
- Decreased drainage capacity of canals
Fertilizer Misapplication Prevention: Tune/Calibrate Equipment

- Before planting season starts
- Monitor actual application rates vs. calculated amounts
Fertilizer Misapplication Prevention: Reduce Turning Speed

Never broadcast fertilizer near canals. Use AIRMAX pneumatic controlled-edge applicator for those areas.
Fertilizer Misapplication Prevention:
Proper Training
Recommendations to Reduce Fertilizer Spills

- Park fertilizer hoppers/trailers and field application rigs far away from ditch/canal banks.

- Park fertilizer hoppers/trailers on level ground (avoid slopes leading to open water).

- Limit the number of loading sites … easier to “police”.

- Properly train all personnel involved in handling fertilizer material.

- **Policy:** Park fertilizer hopper/trailers ONLY at sugarcane loading ramp sites.
Loading Site on Level Ground
Inspection of Fertilizer Loading Site
Recommendations to Reduce the Impact of Fertilizer Spills

- Contain spills on tarps placed under/between trailer and application rigs.
- Have buckets/shovels available for immediate clean-up.
- Sweep “mini-spills” off trailer/hopper onto tarp and apply soil/dirt/fertilizer clean-up mix in target field.
- **Policy:** All personnel involved in handling and spreading fertilizer should have a copy of the Standard Operating Procedures (SOP) on handling fertilizer spills.
Plant Tissue Analysis
## Sugarcane Leaf Nutrient Optimum Ranges

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Optimum Range</th>
<th>Est. 5-10% Loss</th>
<th>Est. 25% Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2.0-2.6</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>P</td>
<td>0.22-0.30</td>
<td>0.19</td>
<td>0.17</td>
</tr>
<tr>
<td>K</td>
<td>1.0-1.6</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Ca</td>
<td>0.22-0.45</td>
<td>0.20</td>
<td>0.18</td>
</tr>
<tr>
<td>Mg</td>
<td>0.15-0.32</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>Si</td>
<td>≥0.60</td>
<td>0.50</td>
<td>0.20</td>
</tr>
<tr>
<td>Fe</td>
<td>55-105</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Mn</td>
<td>20-100</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Zn</td>
<td>17-32</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Cu</td>
<td>4-8</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

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Nutrient Optimum Range Est. 5-10% Loss Est. 25% Loss

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Fe 55-105 50 40
Mn 20-100 16 12
Zn 17-32 15 13
Cu 4-8 3 2

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mg/kg
Additional Leaf Analysis Information


Excel Spreadsheet to calculate DRIS indices for Sugarcane http://erec.ifas.ufl.edu/DRIS/DRISCalculator.zip
Proposed Elemental Sulfur Recommendations for Sugarcane on Organic Soil
Purpose of Elemental Sulfur

- In high pH soils, micronutrients are less available to the crop.
- Elemental sulfur reduces pH as certain soil bacteria oxidize the sulfur to sulfate.
- By banding the sulfur under the row, it can have the maximum benefit, and limit the volume of soil you are treating.
- As soils get shallower with subsidence there are more situations with high pH and potential micronutrient deficiencies.
Sugarcane Yield and Soil pH

Relative sucrose yield vs. Negative soil pH (in-row 0-12 in)

- Site 5
- Site 6

Equation:

\[ y = -31.16 - (9.09x) - (0.64x^2) \]

If \( x < -7.06 \)

\[ r^2 = 0.60 \]
Leaf and Soil Manganese

Mehlich 3-extractable Soil Mn (g m$^{-3}$) vs. Leaf Mn Concentration (mg kg$^{-1}$)

- Site 1
- Site 2
- Site 3
- Site 4

$y = 19.4 \ln(x) - 9.7$

$r^2 = 0.81$
# Preliminary Proposed Sulfur Recommendations for Sugarcane on Organic Soils

<table>
<thead>
<tr>
<th>Soil pH</th>
<th>Elemental S (lb/ac preplant in furrow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥7.5</td>
<td>250 – 500</td>
</tr>
<tr>
<td>7.2-7.4</td>
<td>100 – 250</td>
</tr>
</tbody>
</table>
| 6.6-7.1   | 100 (STM5) if Mehlich 3 extractable Mn < 5.0  
This could be combined with another source of Mn |

Elemental S application would likely work well as a variable rate application because of the variable nature of pH as soils become shallower.
Proposed Nitrogen Fertilizer Recommendations for Sandland Sugarcane
Plant Cane Yield Response to Nitrogen

![Graph showing the relationship between nitrogen rate and relative sucrose yield across different sites. The graph includes data points for Site 1 (closed circles), Site 2 (open circles), Site 3 (downward-pointing triangles), and Site 4 (upward-pointing triangles). The nitrogen rate is shown on the x-axis (kg N ha⁻¹) ranging from 0 to 350, and the relative sucrose yield is shown on the y-axis ranging from 0.3 to 1.0.]

- **Site 1**
  - 180 lb N/ac
- **Site 2**
  - 225 lb N/ac

The graph indicates an increasing trend in relative sucrose yield with higher nitrogen rates. The 180 lb N/ac rate is marked by a dashed line, and the 225 lb N/ac rate is also marked with a dashed line, showing the nitrogen requirements for optimal yield across different sites.
Stubble Cane Yield Response to Nitrogen

![Graph showing the relationship between nitrogen rate (kg N ha⁻¹) and relative sucrose yield.](image-url)
Proposed Nitrogen Recommendations

- Plant Cane: 180-225 lb N/acre in 4-5 split applications
- Stubble cane: 150-200 lb N/acre in 3-4 split applications
- The recommendations may also include an exception for excessive rainfall
Nutrient BMPs very successful and economical
Requires proper annual training of personnel
Research on fertilizer use efficiency invaluable:
  - Fertilizer sources – slow release, micros, etc.
  - Soil fertility – pH effects, cycling, soil extractants, etc.
  - Crop nutrition – leaf analysis, supplementals, etc.