Troubleshooting Fields Using Plant Analysis, Including Stalk Nitrate Testing

Soil, Water, & Nutrient Management Meetings
November 30 – December 9, 2010

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STALK NITRATE TESTING

Photo: Sam Kweskin
Sampling guidelines

- Samples should be taken 1 to 3 weeks after black layer.
- An 8” segment of stalk should be taken from 6 to 14 inches above the soil surface, remove leaf sheaths.
- Stalk segments from 15 plants make one sample.
- A sample should not represent more than 20 acres.
- If soil characteristics or past management practices vary across the field, then separate samples should be collected for each area.
- Stalks severely damaged by insect or disease should not be used.
Sample handling

• Place sample in paper bags

• Samples should be refrigerated (not frozen) if they are to be stored for more than one day before shipping

• Contact your laboratory to confirm that they run the stalk nitrate test
## Interpretation

<table>
<thead>
<tr>
<th>Category</th>
<th>Nitrate-N concentration</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive</td>
<td>$&gt; 2000$ ppm</td>
<td>High probability that N availability was greater than if fertilized according to UW-Extension guidelines</td>
</tr>
<tr>
<td>Optimal</td>
<td>700–2000 ppm</td>
<td>High probability that N availability was within the range needed to maximize profitability</td>
</tr>
<tr>
<td>Low</td>
<td>$&lt; 700$ ppm</td>
<td>High probability that greater N availability would have resulted in increased yields</td>
</tr>
</tbody>
</table>
Limitations of stalk nitrate tests

- Identifies excessive and optimal N rates more accurately on medium yield potential soils compared to high yield potential soils.
- Test may occasionally incorrectly indicate that excess N was supplied to fields with:
  - Recent (within two years) history of manure application
  - Alfalfa in the rotation
  - Particularly on high yield potential soils
- Test does not provide an indication of the amount of N that was over or under supplied.
- Test can be impacted by weather:
  - In extremely dry years, values tend to be high
  - Values tend to be low in an extremely wet year
Accuracy of the end-of-season stalk nitrate test to categorize sites as having low, optimal, or excessive N rates on 49 medium and 49 high yield potential Wisconsin soils from 1992-1995

<table>
<thead>
<tr>
<th>Soil yield potential</th>
<th>Stalk nitrate test category</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Optimal</td>
<td>Excessive</td>
</tr>
<tr>
<td>Medium</td>
<td>60</td>
<td>92</td>
<td>71</td>
</tr>
<tr>
<td>High</td>
<td>75</td>
<td>56</td>
<td>63</td>
</tr>
</tbody>
</table>

% of sites correctly categorized
2006 Dodge Co. stalk nitrate at MRTN plots

![Graph showing the relationship between N fertilizer rate and End of Season Stalk Nitrate (ppm), with yield (bu/a) on the y-axis and N fertilizer rate on the x-axis. The graph includes lines for P Yield (SC), B Yield (CC), P stalk nitrate, and B stalk nitrate. EONR markers are indicated at specific nitrate levels.](image-url)
Influence of corn hybrid on late season stalk nitrate value for C-C at Arlington, 2010

- Too much fertilizer
- Too little fertilizer
- EONR 20 lb/a

Fertilizer N applied – EONR_{0.10} (lb N/a)

Stalk NO\textsubscript{3}-N (ppm)

Hybrid:
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
Stalk nitrate summary

• Adequacy of any given N rate on a field is dependent upon environmental conditions
  – Basing future N rate decisions solely on 1 year’s stalk nitrate values could result in poor decisions

• Stalk nitrate data collected over several years coupled with N management and growing season weather can be useful in determining if N fertilizer rates should be reduced to improve profitability
PLANT ANALYSIS

Photo credits: Todd Andraski
Plant analysis can:

• Confirm visual symptomology

• Assess a crop’s response to applied nutrients
  – Where different treatments applied in the same field
    • Eg. strips with and without fertilizer added

• Determine the availability of nutrients
  – When a reliable soil test does not exist
    – Soil test calibration has not been completed

• Reveal early stages of nutrient deficiencies
Plant analysis as a diagnostic tool

• To be useful, must follow some guidelines
1. Take good notes

• Written notes
  – Describe any visual symptomology
    • Where on the leaf and plant do symptoms occur?
    • Where in the field do symptoms occur?
    • How do the roots look?
      – Are nodules active?
      – Signs of compaction?
  – Weather conditions past & current
  – Crop management practices
    • Eg. planting date, hybrid/variety, tillage, pest management, etc.
  – Field history
    • Crop rotation, manure application, past problems, etc.
1. Take good notes

• Sketch a map of the affected area noting:
  – Drainage, topography, soil color, soil texture, and other features that might affect plant growth

• Photographs
  – Include close-ups and panoramas document a point in time
  – In panoramic photos, try to include a landmark

• Mark the affected areas
  – Flags or GPS boundaries
2. Obtain plant & soil samples from normal & abnormal areas

- Comparison may be more useful than using plant analysis sufficiency interpretation ranges alone
  - Hybrids/varieties may vary in their sufficient level

- Soil samples help determine if nutrient deficiency is a result of low soil nutrients or weather/field conditions
  - Eg. K deficiency caused by compaction

Photo credits: E. Birschbach
3. Sample appropriate plant part for given growth stage & adequate sample number

- Tissue nutrient concentration generally decreases as the crop matures
- Sufficiency ranges & DRIS indices (somewhat) developed for a specific plant part sampled at a specific growth stage
  - Sample incorrect part or incorrect stage can result in incorrect interpretation
- Collect adequate number of samples
  - Needs to be representative of area
  - Needs adequate tissue for lab to analyze
3. Sample appropriate plant part for given growth stage & adequate sample number

<table>
<thead>
<tr>
<th>Crop</th>
<th>Growth Stage</th>
<th>Plant Part Sampled</th>
<th># of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Bud to 1st flower</td>
<td>Top 6”</td>
<td>30-40</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Harvest</td>
<td>Whole plant</td>
<td>15-20</td>
</tr>
<tr>
<td>Corn</td>
<td>12 inches</td>
<td>Whole plant</td>
<td>10-15</td>
</tr>
<tr>
<td>Corn</td>
<td>Pre-tassel</td>
<td>Leaf below whorl</td>
<td>15-20</td>
</tr>
<tr>
<td>Corn</td>
<td>Tassel to silk</td>
<td>Ear leaf</td>
<td>15-20</td>
</tr>
<tr>
<td>Corn</td>
<td>Ensiled/chopped</td>
<td>Whole plant</td>
<td>10-15</td>
</tr>
<tr>
<td>Soybean</td>
<td>Prior to or at initial flower</td>
<td>4th petiole &amp; leaflet or 4th petiole only</td>
<td>20-25</td>
</tr>
<tr>
<td>Wheat</td>
<td>Tillering</td>
<td>Newest fully developed leaf</td>
<td>30-40</td>
</tr>
<tr>
<td>Wheat</td>
<td>Prior to heading</td>
<td>Newest fully developed leaf</td>
<td>30-40</td>
</tr>
</tbody>
</table>
4. Place sample in paper envelope & send to lab

- Plastic bags are not acceptable
- If soil has splashed onto plant bush it off
  - Do not wash
- Clearly lab sample
- Fill out sample submission form completely & accurately
  - Helps insure correct interpretations
- Contact lab in advance to obtain specific info.
5. Review plant & soil analysis results in conjunction with field notes

• Do the plant analysis results make sense based on field assessment?

• If no, or not sure
  – Call UWEX Co. Agent or a soil fertility specialist for assistance
Limitations of plant analysis

• Many of the previous guidelines developed because of limitations

• Remediation of nutrient deficiency not possible
  – Deficiency may have already caused yield loss
  – Crop may not respond
  – Crop may be too large
  – Unfavorable weather

• Sometimes, plant analysis can be a decision making guide for the next season’s crop
Areas for agronomists to improve when sampling for plant analysis

• Submit soil samples with plant samples
• Submit paired (normal and abnormal) samples
• Sample soybean at appropriate growth stage

Photo credits: T. Andraski
When using plant analysis to look for potential problems

• Don’t over interpret data
• Assess the bigger picture
  – Economics
  – Temporal/weather patterns effect on nutrient availability
Summary

• Plant analysis a helpful diagnostic tool if used properly
  — Follow sampling guidelines AND
  — Thoroughly research field history

• Remember plant analysis is NOT a substitute for a consistent soil sampling program

Photo credits: E. Sneller