Using Plant Analysis to Diagnose Nutrient Needs in Alfalfa

World Dairy Expo
Madison, WI
October 5, 2012

Carrie Laboski
Objectives

• To obtain info. on nutrition status of Wisconsin’s alfalfa crop
• To determine if K and S deficiency are becoming more common throughout Wisconsin or in certain regions
How did we do this?

• Alfalfa fields throughout Wisconsin
  – No manure or fertilizer S 18 months prior to sampling
  – Plant sample bud to 1st flower stage after 1st or 2nd cut
    • Top 6” from 30-40 plants
    • Analyzed to total N and total mineral content
  – 0-6” soil sample
    • 10 cores taken from same area as plant samples
    • Analyzed for P, K, pH, buffer pH, OM, S, and B
Field history

- County, nearest town, latitude & longitude (if known)
- Soil series
- Seeding date and variety
- Manure & fertilizer application history
- Previous crop history
- Number of cuttings in each year of the stand & annual yield (if available)
- Date of sampling, and general appearance (with photo if possible) at the time of sampling
What we learned in 2011

- Sampled by UWEX
  - 34 samples submitted
    - 29 normal appearing
    - 5 abnormal appearing
    - 2 fields had both normal & abnormal areas
- Sampled by consultants
  - 105 samples
    - All normal appearing
UWEX sampled normal appearing fields or portions of fields (n=29)

- **N**: 27 (27), 1 (1), 1 (1)
- **P**: 23 (23), 1 (1), 5 (5)
- **K**: 13 (13), 14 (14), 2 (2)
- **S**: 0 (0), 5 (5), 11 (11)
- **B**: 18 (18), 5 (5), 5 (5), 19 (19)

Legend:
- **Low**
- **Sufficiency**
- **High**
UWEX sampled abnormal appearing fields or portions of fields (n=5)

- **N**: 0, 5
- **P**: 0, 5
- **K**: 0, 3, 2
- **S**: 0, 2, 3
- **B**: 1, 1, 3

Legend:
- Low
- Sufficiency
- High
Normal appearing fields (n=105) samples by crop consultants in NE WI

- **N**
  - 99 (6% Low, 94% Sufficiency, 0% High)
  - 6 (1% Low, 99% Sufficiency, 0% High)

- **P**
  - 67 (6% Low, 94% Sufficiency, 0% High)
  - 38 (3% Low, 97% Sufficiency, 0% High)

- **K**
  - 89 (6% Low, 94% Sufficiency, 0% High)
  - 10 (1% Low, 99% Sufficiency, 0% High)

- **S**
  - 17 (1% Low, 99% Sufficiency, 0% High)
  - 0 (0% Low, 100% Sufficiency, 0% High)

- **B**
  - 105 (0% Low, 100% Sufficiency, 0% High)
  - 0 (0% Low, 100% Sufficiency, 0% High)
For all samples (normal & abnormal)

• UWEX sampled
  – 47% of all samples were low in K
  – 62% of all samples were low in S
  – 24% low in K and S
  – Similar results as 2010

• Consultant sampled
  – 10% low in K
  – 16% low in S
  – 2% low in K and S

Consultant sampled fields had more recent history of manure application than UWEX sampled fields.
Why are we seeing low S and K?
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

1987 1988 1989
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

1992 1993 1994
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005


Sulfate as $SO_4^2$ (kg/ha)

- $\leq 3$
- 3 - 6
- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- 21 - 24
- 24 - 27
- $> 27$
Sulfate Ion Wet Deposition
1985-2005

1997 1998 1999
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

Sulfate as $\text{SO}_4^{2-}$ (kg/ha)

- ≤ 3
- 3 - 6
- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- 21 - 24
- 24 - 27
- > 27

1999 2000 2001
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005
Sulfate Ion Wet Deposition
1985-2005

2002 2003 2004
Sulfate Ion Wet Deposition
1985-2005

2003 2004 2005
Sulfate ion wet deposition, 2006

Sites not pictured:
- AK01 1 kg/ha
- AK03 1 kg/ha
- PR20 31 kg/ha
- VI01 9 kg/ha

Sulfate as $\text{SO}_4^{2-}$ (kg/ha)

National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu
Sulfate ion wet deposition, 2007

Sulfate as $\text{SO}_4^{2-}$ (kg/ha)

Sites not pictured:
- AK01  1 kg/ha
- AK03  < 1 kg/ha
- PR20  19 kg/ha
- VI01  9 kg/ha

National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu
Sulfate ion wet deposition, 2008

Sites not pictured:
AK01 1 kg/ha
AK03 < 1 kg/ha
PR20 22 kg/ha
VI01 9 kg/ha

Sulfate as $\text{SO}_4^{2-}$ (kg/ha)

- ≤ 3
- 3 - 6
- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- 21 - 24
- 24 - 27
- > 27

National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu
What can we do about S deficiency?

• Tissue test to confirm deficiency
  – If tissue S is < 0.25, then apply S

• Apply S
  – 25 lb S/a on established stands
    • Shortly after cutting before regrowth
    • Use a soluble source
  – 25 – 50 lb/a S at establishment
Sources of S

• Apply a soluble source of S to correct known deficiency
  – Potassium sulfate, calcium sulfate, ammonium sulfate
  – Elemental S will take too long to react

• Gypsoil or other FGD gypsum
  – 1 T/a application supplies 340 lb S/a
    • More S than needed;
    • Unsure over how many years this will be available
  – Unknown for how long S is available from a 1 T/a
Alfalfa field with patchy areas of yellow

Photo courtesy of Ted Bay, UWEX Grant/Lafayette Cos.
Alfalfa response to 25 lb S/a applied after 1\textsuperscript{st} cutting in 2010, Lafayette Co., WI

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Calcium Sulfate</th>
<th>Ammonium Sulfate</th>
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<tbody>
<tr>
<td></td>
<td>Dry Matter T/a</td>
<td></td>
<td></td>
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<tr>
<td>2nd cut</td>
<td>Normal</td>
<td>1.23</td>
<td>1.29</td>
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<tr>
<td></td>
<td>Abnormal</td>
<td>0.95</td>
<td>1.66</td>
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<tr>
<td>3rd cut</td>
<td>Normal</td>
<td>1.21</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>0.90</td>
<td>1.49</td>
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<tr>
<td>2nd + 3rd</td>
<td>Normal</td>
<td>2.44</td>
<td>2.51</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>1.85</td>
<td>3.15</td>
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<table>
<thead>
<tr>
<th></th>
<th>Tissue S</th>
<th>Tissue K</th>
<th>Soil Test K</th>
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<tbody>
<tr>
<td></td>
<td>%</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>0.24</td>
<td>1.79 (L)</td>
<td>67 (VL)</td>
</tr>
<tr>
<td>Abnormal</td>
<td>0.14</td>
<td>2.46 (S)</td>
<td>117 (O)</td>
</tr>
</tbody>
</table>

Data courtesy of Ted Bay, UWEX Grant/Lafayette Cos.
Potassium applications fall short on UWEX sampled normal appearing fields

<table>
<thead>
<tr>
<th>STK category (n)</th>
<th>Stand age †</th>
<th>2011 K₂O rec. (A2809)</th>
<th>2011 K₂O appl. rate</th>
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</thead>
<tbody>
<tr>
<td>VL (5)</td>
<td>5.0 ± 2.2</td>
<td>338 ± 27</td>
<td>21 ± 49</td>
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<tr>
<td>L (10)</td>
<td>3.9 ± 1.0</td>
<td>322 ± 57</td>
<td>28 ± 59</td>
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<tr>
<td>O (4)</td>
<td>3.0 ± 0.8</td>
<td>300 ± 85</td>
<td>3 ± 6</td>
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<td>H (4)</td>
<td>3.5 ± 1.7</td>
<td>135 ± 17</td>
<td>17 ± 29</td>
</tr>
<tr>
<td>VH (4)</td>
<td>3.3 ± 1.3</td>
<td>71 ± 19</td>
<td>7 ± 13</td>
</tr>
<tr>
<td>EH (2)</td>
<td>2.5 ± 0.7</td>
<td>0 ± 0</td>
<td>29 ± 3</td>
</tr>
</tbody>
</table>

† Includes establishment year to 2011.
Thanks for your support

- Midwest Forage Association
- Everyone that collected samples and took the time to complete the field historical info.
  - UWEX staff
  - Polenske Agronomic Consulting

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