Alfalfa - Getting 10 Ton Yields
March 2011

Craig Saxe
Juneau County UW-Extension

Special Thanks to:
Dr. Dan Undersander
University of Wisconsin
For providing many of these slides

Alfalfa - Getting 10 Ton Yields
“The good is the enemy of the best”
“Attention to detail makes the difference”

2009-2010 Experimental Variety Trial Results
(Sown April 2008)

Yield difference between top and bottom entries of WI Alfalfa Variety Trials, 1985 to 2010

Average 2.26t/a DM
Minimum 0.34t/a DM
Maximum 6.18t/a DM
Number trials 279

Additional yield of top alfalfa varieties
Wisconsin Alfalfa Yield and Persistence Project

2007 - 2010 Summary

1. Maintain Proper Soil pH and Fertility

- Proper fertilization:
  - Allows for good stand establishment
  - Promotes growth
  - Increases yield and quality
  - Improves winter hardiness and stand persistence
  - Improves alfalfa’s ability to compete with weeds
  - Strengthens disease and insect resistance

Soil pH and Fertility

- Have soils tested
- Lime fields to at least pH 6.7-6.9
- Apply lime at least 12 months before seeding
  - Best timing is as field is coming out of alfalfa

Figure 3. Average dry matter yield by cutting and for the total season. Data is segregated by calendar year.
Pounds of nutrients removed per ton of alfalfa produced

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Dry Matter Removed (lbs/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphate (P₂O₅)</td>
<td>14</td>
</tr>
<tr>
<td>Potash (K₂O)</td>
<td>58</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>30</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>6</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>6</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

2. Select the Best Alfalfa Varieties

- Cheap seed will not pay off in the long run
- Look over University Trials
- Compare new varieties with ones you’ve grown
- Select high-yielding varieties with adequate winter survival and disease resistance.

Winterhardiness Test of Alfalfa

Procedure
- Space plant alfalfa (1 ft apart) in rows 1 ft apart
- Clip frequently during seeding year
- Cut on Sept 20 in seeding year
- Rate individual plants in spring for injury and kill
- Report results relative to check varieties

Select Varieties with Increased Winterhardiness

- Less winterkill
- Less winter injury – more yield
Recommendations

- Very Winterhardy, Winterhardy, Moderately Winterhardy alfalfa varieties recommended for Wisconsin
- Plant more winterhardy type if:
  - Uneven greenup in spring frequently occurs
  - Cutting schedule always less than 35 days
  - Harvest late fall cutting

Selecting Grass varieties -
Yield difference among varieties in UW Trials

Effect of Verticillium Resistance on Alfalfa Persistence

Selecting Grasses

- Orchardgrass and tall fescue
- Want winterhardy types

Select Grass Varieties for

- Yield
- Winterhardiness
- Late maturing varieties
- Consistent yield throughout season (β)
- Rust resistance (orchardgrass, tall fescue, ryegrass, festolium)
3. Proper Seed Bed Preparation and Planting

Causes of Seeding Failure:

- Low Soil pH

Effect of Seeding Depth on Alfalfa Emergence

Choose Best Establishment Method

- Direct Seeding
- Oats with Poast Plus or Roundup
- With Companion crop
  - Oats
  - Ryegrass

4. Scout Fields and Spray as Needed

Two Major Pests

1. Potato Leafhopper
2. Alfalfa Weevil
Potato Leafhoppers
- Adults
  - 1/8 inch long
  - wedge shape
  - fluorescent green
- Nymphs
  - much smaller
  - yellowish green to fluorescent green
  - no wings

Damage
- Larva chew and skeletonize leaves
- Severe damage gives the field a grayish cast
- Most damage occurs on spring growth
- Feeding can continue on second crop new growth
- Some fields may not green up

Symptoms
- Hopper burn
- Distinct V-shape discoloration

Caused by
- Sucking plant sap and injecting toxin which inhibits water and nutrient transport

Alfalfa Weevil
- Larva
  - Slate-colored when small
  - Bright green when full grown (3/8”)
  - White stripe down the back, black head
- Adult
  - Dark gray to brown snout beetle (3/16”)
  - Distinct dark shield-like mark on the back

5. Harvest Management
- Forage Yield Relative to Quality
  - Damage
    - Larva chew and skeletonize leaves
    - Severe damage gives the field a grayish cast
    - Most damage occurs on spring growth
    - Feeding can continue on second crop new growth
    - Some fields may not green up
  - Symptoms
    - Hopper burn
    - Distinct V-shape discoloration
  - Caused by
    - Sucking plant sap and injecting toxin which inhibits water and nutrient transport
  - Larva
    - Slate-colored when small
    - Bright green when full grown (3/8”)
    - White stripe down the back, black head
  - Adult
    - Dark gray to brown snout beetle (3/16”)
    - Distinct dark shield-like mark on the back

Forage Yield Relative to Quality
- Harvest Management
  - Damage
    - Larva chew and skeletonize leaves
    - Severe damage gives the field a grayish cast
    - Most damage occurs on spring growth
    - Feeding can continue on second crop new growth
    - Some fields may not green up
  - Symptoms
    - Hopper burn
    - Distinct V-shape discoloration
  - Caused by
    - Sucking plant sap and injecting toxin which inhibits water and nutrient transport
  - Larva
    - Slate-colored when small
    - Bright green when full grown (3/8”)
    - White stripe down the back, black head
  - Adult
    - Dark gray to brown snout beetle (3/16”)
    - Distinct dark shield-like mark on the back
Cutting Schedules for Different Management Goals

Risk of alfalfa harvest at Marshfield, 1970-2000

Date of Last Cutting

Effect of late fall cutting on next year’s yield (data from 2006)

1. What is your stand age?
   - > 3 years
   - 2 to 3 years
   - < 1 year

2. Describe your alfalfa variety:
   A. What is the winterhardiness?
      - Moderately winterhardy (ws score 4)
      - Winterhardy (ws score 3)
      - Very Winterhardy (ws score 2)
   B. What is the disease resistance?
      - Moderate resistance to only bacterial wilt
      - Moderate resistance to bacterial wilt plus either Anthracnose, Fusarium wilt, phytophthora root rot, or Verticillium wilt
      - Moderate resistance to all above mentioned diseases

Alfalfa variety total score (multiply two)
### 3. What is your soil pH?

<table>
<thead>
<tr>
<th>pH Range</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6.0</td>
<td>4</td>
</tr>
<tr>
<td>6.1 to 6.5</td>
<td>2</td>
</tr>
<tr>
<td>≥ 6.6</td>
<td>0</td>
</tr>
</tbody>
</table>

### 4. What is your soil exchangeable K Level?

<table>
<thead>
<tr>
<th>K Level</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt; 80 ppm)</td>
<td>4</td>
</tr>
<tr>
<td>Medium (80 to 120 ppm)</td>
<td>3</td>
</tr>
<tr>
<td>Optimum (120 to 160 ppm)</td>
<td>1</td>
</tr>
<tr>
<td>High (&gt; 161 ppm)</td>
<td>0</td>
</tr>
</tbody>
</table>

### 5. What is your soil drainage?

<table>
<thead>
<tr>
<th>Drainage Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor (somewhat poorly drained)</td>
<td>3</td>
</tr>
<tr>
<td>Medium (well to moderately drained)</td>
<td>2</td>
</tr>
<tr>
<td>Excellent (sandy soils)</td>
<td>1</td>
</tr>
</tbody>
</table>

### 6. What is soil moisture during fall/winter?

<table>
<thead>
<tr>
<th>Moisture Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>5</td>
</tr>
<tr>
<td>Medium to dry</td>
<td>0</td>
</tr>
</tbody>
</table>

### 7. Describe your harvest frequency:

<table>
<thead>
<tr>
<th>Cut interval</th>
<th>Last Harvest</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30 days</td>
<td>Sept. 1 to Oct. 15</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>After Oct. 15</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Before Sept. 1</td>
<td>3</td>
</tr>
<tr>
<td>30 to 35 days</td>
<td>Sept. 1 to Oct. 15</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>After Oct. 15</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Before Sept. 1</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 30 days</td>
<td>Sept. 1 to Oct. 15</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>After Oct. 15</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Before Sept. 1</td>
<td>0</td>
</tr>
</tbody>
</table>

### 8. For a mid to late October cut, do you leave more than 6 inches of stubble?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>
6. Maintain Short Rotations

- Increased alfalfa yield from younger stands
- Less weed problems in younger stands
- Increased corn silage yield following alfalfa
- 10 to 15% higher corn yields following alfalfa
- More legume credits
- Less rootworm insecticide needed following alfalfa
Alfalfa Legume Credits

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Regrowth after last cutting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Med, Fine Soils</td>
<td>&gt;8 inches &lt;8 inches &lt;8 inches &lt;8 inches</td>
</tr>
<tr>
<td>Sandy Soils</td>
<td>&gt;8 inches &lt;8 inches &lt;8 inches &lt;8 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stand Density</th>
<th>Good, &gt; 4 plt/ft²</th>
<th>Fair, 1.5 to 4 plt/ft²</th>
<th>Poor, &lt; 1.5 plt/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen/lb/acre</td>
<td>190</td>
<td>160</td>
<td>130</td>
</tr>
<tr>
<td>Nitrogen/lb/acre</td>
<td>150</td>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td>Nitrogen/lb/acre</td>
<td>140</td>
<td>110</td>
<td>80</td>
</tr>
<tr>
<td>Nitrogen/lb/acre</td>
<td>100</td>
<td>70</td>
<td>40</td>
</tr>
</tbody>
</table>

Effect of Wheel Traffic

- Soil compaction
  - Surface: related to contact weight
  - Subsoil: related to axel weight
- Physical damage to plant
  - Crown Damage
  - Broken Stems

7. Minimize Wheel Traffic Damage

- Minimize driving on field
- Use smallest tractor when possible
- Merge windrows where possible
- Go to larger equipment
- Take most direct route to edge of field
- Make road to drive on

Reducing Wheel Traffic Damage

- Do driving on field soon after harvest
- Manage to dry forage quickly
- Harvest for haylage or baleage
- Use preservative and harvest wet hay
- Use of duals not recommended
- Apply manure quickly after cutting
8. Avoid Autotoxicity

- Alfalfa plants produce toxins that can reduce germination and growth of new alfalfa seedings
- Toxins influence increases with age and density of stand
- Water soluble compounds impair seedling tap root development by causing root tips to swell and reduce root hair numbers

Autotoxicity reduces future yield

- Smaller plants, misshapen roots
- 20 to 30% reduced yield in production years

Autotoxicity

- reduces germination if severe
- reduces yield for life of stand
- Effect most severe on light soils
- Effect most prolonged on heavy soils
- Area of influence around living plant is 16" radius
- Irrigation/rains can wash autotoxic factor from soil
Autotoxicity Recommendations

- Wait at least one year before reseeding alfalfa if stand in for two or more years
- Can reseed new seeding failures anytime

Harvest First Cutting of New Seeding Early

- Take first cutting at 60 days after planting
- More additional cuttings – higher tonnage
- Less weed problems

Recommendations for Emergencies

- Accept some yield loss
- Remove topgrowth before plowing to reduce effect
- Tillage can reduce effect
- Irrigation/rains can wash toxic factor from soil
- Select fields with lightest soils

Effect of Cover Crop Competition on Alfalfa Yield

- Conventional oat nurse crop
- Roundup oat takeout

9. Importance of Seeding Year

- Too much competition to the young alfalfa seedlings can stunt their growth and or kill them.
- Alfalfa stressed in the seeding year will never yield as well in future years
- Higher than necessary plant populations of the cover crop add to establishment cost without producing additional return.

Alfalfa yield in year following seeding with Italian ryegrass cover crop at different rates

- High ryegrass seeding rates reduce alfalfa stand and yield in future years
Seeding year stress reduces yield of alfalfa in future years

- Autotoxicity
- Potato Leaf hopper
- Cover Crop
- Drought?
- Other?

Seeding year stress reduces yield of alfalfa for all years of stand

- Consider
  - Low yielding stands because of seeding year stress will not recover
- Recommendation
  - Determine if low production year yield is due to nutrient stress
    - If so, treat
    - If not, consider turning over stand

Alfalfa Seeding Trial - Forage Yields

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Arlington, WI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003</td>
</tr>
<tr>
<td>(1) Alfalfa seeded direct</td>
<td>2.8</td>
</tr>
<tr>
<td>(2) Oats sprayed at 6 inches</td>
<td>3.0</td>
</tr>
<tr>
<td>(3) Alfalfa + Oat haylage</td>
<td>2.7</td>
</tr>
<tr>
<td>Oat</td>
<td>2.0</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>0.7</td>
</tr>
</tbody>
</table>