Managing for 10 Tons Forage

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University of Wisconsin

Forage Harvest and Preservation Expectations

From the moment the crop is cut until it is fed to the animal, biological and mechanical changes occur that decrease quantity and nutritional quality of feed.

Goals:

✔ Conserve the protein and energy in the forage
✔ Maintain protein in a form that can be effectively utilized by the ruminant.

Common Forage Harvesting Losses

- Forage Harvesting: -14%
- Storage: -35%
- Feeding: -30%
- Field curing: -26%

- 29% Fed, 71% Lost

Optimum Management

- Forage Harvesting: -8%
- Storage: -5%
- Feeding: -8%
- Field curing: -10%

- 73% Fed, 27% Lost

Cost of Forage

Assuming hay at $100/ton

- 73% loss: $3401
- 27% loss: $1401

Top yield of Alfalfa varieties, UW Variety Trials Arlington, WI

Average 7.9 t/a
Top yield of Alfalfa Varieties, UW Variety Trials Marshfield, WI

Average 5.6 t/a

Getting high forage yield and quality Summary:
- Turn over thin stands
- Select a good variety
- Control diseases and insects
- Harvest at stage for high quality
- Condition properly and dry in wide swath
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- Fertilize to replace removed nutrients

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Plant density for high yield
- Plant density is not a good indicator of yield
- Stands should have at least 6 plants/ft²
- Stems are a good indicator of yield potential
- Need at least 55 stems/ft² for optimum yield

Rotational Benefit:
Alfalfa Legume Credits

Stand Density | Medium/Fine Soils | Sandy Soils
---|---|---
>8 inches | <8 inches | >8 inches | <8 inches
Good | 190 | 150 | 140 | 100
Fair | 160 | 120 | 110 | 60
Poor | 130 | 90 | 80 | 40

Rotational Benefit:
Corn silage and grain yields following alfalfa

<table>
<thead>
<tr>
<th>N Rate</th>
<th>Corn Silage Yield</th>
<th>Corn Grain Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lb N/a</td>
<td>T DM/ac</td>
<td>Bu/ac, 15.5%</td>
</tr>
<tr>
<td>0</td>
<td>9.77</td>
<td>228</td>
</tr>
<tr>
<td>20</td>
<td>9.75</td>
<td>226</td>
</tr>
<tr>
<td>40</td>
<td>9.81</td>
<td>228</td>
</tr>
<tr>
<td>80</td>
<td>9.78</td>
<td>229</td>
</tr>
<tr>
<td>160</td>
<td>9.88</td>
<td>229</td>
</tr>
<tr>
<td>LSD (0.10)</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Data are averages over 5 MN locations in 2009

Rotational benefit:
of alfalfa on corn yield

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Yield difference between top and bottom alfalfa entries in Wisconsin Alfalfa Trials, 1985 to 2015

- Average 2.23t/a DM
- Minimum 0.34t/a DM
- Maximum 6.18t/a DM
- Number trials 304

Winterhardiness
- Location
- Management
  - Soil fertility
  - Frequency of cutting
  - Late fall cutting
- Look for uneven spring greenup
  - If occurs - need more winterhardiness

Recommend both Apron & Stamina fungicides for Seed Treatment

No Stamina
Stamina Treated
Apron seed treatment still beneficial for pythium control

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Fungicide on Alfalfa Forage

Foliar diseases result in leaf drop
- Reduced yield
- Reduced forage quality

Treatment cost of $35/A (including the application fee of $8/A).

Is it economic?

Fungicide on alfalfa

- Applications limited to 3 cuttings per year
- Must apply before knowing if disease will be present
- Biggest benefit from using on first cutting

Alfalfa Weevil Damage

Potato Leafhopper

Potato leaf hopper scouting and economic thresholds

If the average Potato leaf hopper count exceeds the height of alfalfa in inches - spray
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Forage Quality Needs of Animals

- Stocker cattle
- Growing lambs & kids
- Nursing mare
- Hard working horse
- Beef cow & calf
- Ewe with lamb
- Doe with kid
- Ewe/doe, not lactating
- Idle horse
- Nursing mare
- Hard working horse
- Beef cow & calf
- Ewe with lamb
- Doe with kid
- Ewe/doe, not lactating
- Idle horse

Effect of forage quality on 4% fat-corrected milk production at four concentrate levels

From Kawasaki et al., 1989

Rate of Alfalfa Forage Quality Change per Day

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein, % DM</td>
<td>-0.25</td>
</tr>
<tr>
<td>Acid Detergent Fiber, % DM</td>
<td>0.36</td>
</tr>
<tr>
<td>Neutral Detergent Fiber, % DM</td>
<td>0.43</td>
</tr>
<tr>
<td>Neutral Detergent Fiber Digestibility, % NDF</td>
<td>-0.43</td>
</tr>
<tr>
<td>RFV, points</td>
<td>-2.9</td>
</tr>
<tr>
<td>RFQ, points</td>
<td>-3.6</td>
</tr>
</tbody>
</table>

Source: Undersander, 2009 unpublished
Measure to top of stem tip, not tip of highest leaflet.

Estimates are made at 4 to 5 locations in a field. The tallest stem may not be the most advanced in maturity.

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Conditioner types
- Flail/impellers
- Intermeshing Rolls

Wide swath benefits
- Faster drying
- Higher forage quality

Leaf Structure
- Legumes have 10 times more stomata than grasses
- Stomatal openings
- Upper and lower epidermis
- Palisade chlorenchyma
- Spongy mesophyll
- Stoma
- Water
- O₂, water vapor
- CO₂
- Synthesis products
- Protects surface cells
- Conserve water
**Drying Hay - Principles**

**Losses Due to Respiration**

<table>
<thead>
<tr>
<th>DM Loss</th>
<th>2%</th>
<th>4%</th>
<th>8%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Loss ($/t)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay value $200/t</td>
<td>$4</td>
<td>$8</td>
<td>$16</td>
</tr>
<tr>
<td>Hay value $300/t</td>
<td>$6</td>
<td>$12</td>
<td>$24</td>
</tr>
</tbody>
</table>

Minimize loss by drying to 60% moisture as quickly as possible

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**Summary**

- Lose first 15% water as quickly as possible
- Begin with wide swath (>70% of cut area).
- Conditioning necessary for hay not haylage.
- Condition alfalfa & alfalfa/grass mixtures with roller conditioner.
- Rake/merge with minimal ground contact to reduce dirt in forage.
- Additional tedding often necessary for grasses

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**Remove hay/haylage from field rapidly to minimize wheel traffic damage**

- Will lose 6% from next cutting for every day after cutting that field is driven over

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**TDN loss as result of heating**

- Above 86°F
Results of Malliard Reaction

\[ \text{TDN} = \text{dNFC} + \text{dCP} + 2.25 \times \text{FA} + \text{dNDF} - 7 \]

![Graph showing results of Malliard Reaction](image)

TDN losses of farmer submitted samples to forage testing laboratories

<table>
<thead>
<tr>
<th>TDN losses (% of DM)</th>
<th>Number of samples</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0</td>
<td>911</td>
<td>25</td>
</tr>
<tr>
<td>0-4.0</td>
<td>894</td>
<td>25</td>
</tr>
<tr>
<td>4.0-8.0</td>
<td>1221</td>
<td>34</td>
</tr>
<tr>
<td>8.0-12.0</td>
<td>517</td>
<td>14</td>
</tr>
<tr>
<td>&gt;12.0</td>
<td>69</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>3612</td>
<td></td>
</tr>
</tbody>
</table>

Moisture for baling to prevent mold

<table>
<thead>
<tr>
<th>Square Bale Size</th>
<th>Small</th>
<th>Medium (3’ x 3’)</th>
<th>Large (4’ x 4’)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>&lt;20%</td>
<td>&lt;16%</td>
<td>&lt;14%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Round Bale Size</th>
<th>Small (4’ w x 5’ h)</th>
<th>Medium (5’ w x 5’ h)</th>
<th>Large (5’ w x 6’ h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>&lt;18%</td>
<td>&lt;16%</td>
<td>&lt;15%</td>
</tr>
</tbody>
</table>

Amount of heating depends on heat transfer conditions.

Allowable moisture in hay without spoilage

- Depends on heat transfer conditions.
- Can bale without spoilage at higher moisture content if:
  - Cooler air temperatures (e.g. fall vs summer)
  - Smaller bale – less self insulation
  - Single bale vs stack – some growers let bales “sweat” for a couple weeks then stack.

Heating in bunker due to poor packing

Reducing heating damage loss

- For silage
  - Use inoculant
  - Pack well
  - Feed 1 ft/day from face
- For hay
  - Harvest sufficiently dry to prevent heating/mold
  - Use preservative/wrap in plastic
  - Make smaller bales
  - Don’t stack until finished ‘curing’
**Alfalfa Leaf Loss Effect on Forage Quality**

- Leaves higher in quality than stems
- Leaves 15 to 20% NDF
- Stems 60 to 70% NDF

\[ y = 0.52x - 28.32 \]

\[ R^2 = 0.71 \]

**Apply Hay Preservative**

**Use Preservative for wet hay**

*Hay preservative additives not needed for baleage*

**Possible Preservatives**
- Ammonia
- Urea
- Inoculants
- Propionic acid
- Acetic acid
- Buffered acids
- Acid salts
- Ethoxyquin

*Note: Ammonia recommended only for grass, not alfalfa*

**Wrap in plastic - baleage**

- Can wrap bales at any moisture between 20 and 70%
- Below 50% moisture - oxygen exclusion
- Above 50% moisture – both oxygen exclusion and fermentation with acid production
- Less spoilage on feedout

**Fermentation and moisture content**

- Increasing lactic acid fermentation
- Butyric acid fermentation

**Wrap in plastic**

- Preserves by excluding oxygen
- Need at least 6 wraps
How to make baleage:
Wrap Quickly after baling

Timing of Bale Wrapping effect on Internal Temperature of Bale over Time,

Lancaster, WI 1998 dry bales (36% moisture)

Baling
Cutting forage for hay/haylage
- Higher initial machinery cost
- Higher energy requirement
- Stones cause knife damage

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Tissue Test
- Sufficiency Levels of Nutrients

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>--% of DM--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>2.5 to 4.0</td>
</tr>
<tr>
<td>Phosphate (P₂O₅)</td>
<td>0.25 to 0.45</td>
</tr>
<tr>
<td>Potash (K₂O)</td>
<td>2.25 to 3.40</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.70 to 2.50</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.25 to 0.70</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.25 to 0.50</td>
</tr>
<tr>
<td>Boron</td>
<td>25 to 60</td>
</tr>
</tbody>
</table>

Sample top 6 inches of alfalfa at first flower

Alfalfa and Sulfur
- Alfalfa requires 5 lb sulfur/ton hay
- Deficiency
  - Reduces yield
  - Reduces stand life
  - Soil test not accurate
  - Tissue test at harvest
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