Making Dry Hay & Baleage

Aaron Gabriel, Cornell Cooperative Extension
Just Trying To Preserve Forage Quality

Leaf retention is critical for quality hay
Something Can Be Managed At Each Step

- Mowing
- Conditioning
- Tedding
- Raking
- Baling
- Wrapping for baleage
- Transporting
- Storage
Drying = Sunshine + Humidity + Temperature + Wind
Morning or Afternoon mowing makes no difference in the northeast 90% of the time
(Plant respiration stops at ~40% moisture)

Estimated gm sugar/Kg grass DM

Sugar Level

8:00 AM  Noon  7:00 PM  Midnight  8:00 AM
Discbines

- can travel 5 – 10 mph
- do not plug like sickle mowers
- Cut a lodged crop better

* easier to replace knives
Conditioning is essential for dry hay, but not for baleage
Rubbing wax off leaves vs crimping stems

- 2-4% more alfalfa leaf loss with tines, but can be adjusted
- Tines work best on grass
- Rolls are good for alfalfa, wear out in the middle fastest

http://www.uwex.edu/ces/forage/wfc/proceedings2002/mower_conditioner_files/image002.gif
Tine or Finger Conditioner
tines may swing on some brands
Macerator (ReCon 400) reduce drying time from 0 to 24 hours
Rubber rolls in front hold forage firmly.

Steel rolls behind spin at different speeds to nick and scrape wax off grass leaves and alfalfa stems.
Teddar

ted hay soon after mowing
Teddar with horizontal long & short tines
Hay Fluffer flips windrow in place (old Grimm tedder).
Hay Rakes

- rake at >35% moisture

Roping

Gentle, roping

Fluff for good drying,
Set PTO to wheel speed, high repairs

No roping, high repairs; need full windrows

http://www.dyersold.com/equipment_for_sale/New%20Holland%20hay%20rake%20$%201,850.00.jpg


http://www.progressivedairy.com/features/full_photos/2008/0108/0108hg_shinners_1_full.jpg

Keep Soil Out of Hay

< 10% ash on soil test

- Mow at a decent height (4” grass, 3” alfalfa)
- Properly adjust tedder
- Properly adjust the rake
- Properly adjust pick-up on baler
- Plow & fit fields well so they are smooth
Baler adjustments & tractor operation affect bale shape and density.
Moisture Testing

1) “Dish rag” test. – Wring out moisture when above the 65%
2) Commercially available testers poor at <40% moisture
3) Koster moisture testers - heated, forced-air dryers, takes longer than a microwave moisture test.
4) **Best Method** - *microwave moisture test*
   - Measure 100 grams forage, chopped 1”
   - Place a cup of water in the microwave
   - Microwave 1 minute at a time at first, weigh when it feels dry
   - Microwave 30 seconds or less and weigh each time (avoid burning it)
   - When it stops loosing weight, it is dry (~99% dry)
   - Starting weight – final weight = % moisture (water was removed)
<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Condition and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>No action needed.</td>
</tr>
<tr>
<td>150</td>
<td>Hay is entering the danger zone. Check temperature twice daily. Disassemble stacked hay bales to promote air circulation to cool the hay.</td>
</tr>
<tr>
<td>160</td>
<td>Hay has reached the danger zone. Check hay temperature every couple of hours. Disassemble stacked hay bales to promote air circulation to cool the hay.</td>
</tr>
<tr>
<td>175</td>
<td>Hot spots or fire pockets are likely. Alert fire services to the possible hay fire incident. Stop all air movement around the hay.</td>
</tr>
<tr>
<td>190</td>
<td>With the assistance of the fire service, remove hot hay. Be aware that hay could burst into flames.</td>
</tr>
<tr>
<td>200 or higher</td>
<td>Most likely, a fire will occur. Be aware that hay could burst into flames.</td>
</tr>
</tbody>
</table>

(Source: National Resource, Agriculture, and Engineering Service (NRAES))
Figure 1. Homemade hay temperature probe with thermometer.
Leaf loss in grass during round baling – moisture effect

Figure 1. Leaf loss during baler operation. Accumulation of data for several large round balers over a range of hay moisture contents in fields of mixed alfalfa, crested wheatgrass and bromegrass. Data source: Prairie Agricultural Machinery Institute.
Preservatives – liquid & granular propionate

- Bale at 5% more moisture
- Better leaf retention
- Beat the weather
- May be necessary for large squares
- ~$15/ton
- Excellent coverage is necessary
Preservatives Can Maintain Quality

Table 1. Storage losses and composition of alfalfa hay baled at 32% moisture and treated with different rates of propionic acid at baling. 1 *Hay at harvest was 70.5% IVDDM (In vitro dry matter digestibility)*  

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Max. Storage Temperature, °F</th>
<th>Dry Weight Loss, %</th>
<th>Digestibility, %</th>
<th>Total Carbohydrates, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>124</td>
<td>15.1</td>
<td>60.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Propionic Acid Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.02%</td>
<td>127</td>
<td>16.7</td>
<td>61.8</td>
<td>3.1</td>
</tr>
<tr>
<td>0.2%</td>
<td>115</td>
<td>13.2</td>
<td>62.2</td>
<td>3.9</td>
</tr>
<tr>
<td>0.5%</td>
<td>104</td>
<td>11.7</td>
<td>61.0</td>
<td>4.1</td>
</tr>
<tr>
<td>1.0%</td>
<td>84</td>
<td>7.6</td>
<td>65.0</td>
<td>6.5</td>
</tr>
</tbody>
</table>
Recommended rates for applying organic preservatives to hay.

<table>
<thead>
<tr>
<th>Hay Moisture Level, %</th>
<th>Rate, % (dry wt basis)</th>
<th>lb/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-25</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>25-30</td>
<td>1.0</td>
<td>20</td>
</tr>
<tr>
<td>30-35</td>
<td>1.5</td>
<td>30</td>
</tr>
</tbody>
</table>
Variable Chamber Baler
Tractor should be heavier than the baler plus bale
Variable Chamber Round Baler
Fixed Chamber Baler
Less than perfect conditions for round baling

Baling short, dry and slick material such as straw from a rotary combine can be a challenge. The baler may continually plug or starting the bale may be difficult.

Make decent-sized windrows

Bale in late evening or early morning to take advantage of moisture

Reduce bale density settings

Make smaller bales

Decrease the PTO speed while maintaining normal ground speeds

If possible, adjust the distance from the twine to the end of the bales as wide as possible so the twine doesn't slip off the end of the bale

Use a close twine spacing across the bale
Round Baler Leaf Loss in Chamber

http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng3129
Round Baler Drive Pattern for Good Bale Shape

WEAVING PATTERNS

Expanding Chamber (Hard Core) Baler - Right

Fixed Chamber (Soft Core) Baler - Right

Wrong

http://www1.agric.gov.ab.ca/$department/deptdocs.ns?all/eng3129
Windrow Size – full or < ½ pick-up width for good bale shape
## Variable vs Fixed Chamber Round Balers

<table>
<thead>
<tr>
<th>COMPARISON</th>
<th>Variable</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Req.</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>Purchase Price</td>
<td>More</td>
<td>Less</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>More (belts)</td>
<td>Less</td>
</tr>
<tr>
<td>Bale Size</td>
<td>Adjustable</td>
<td>One size</td>
</tr>
<tr>
<td>Bale Pressure</td>
<td>Adjustable</td>
<td>Slightly adjustable</td>
</tr>
<tr>
<td>Leaf loss</td>
<td>2 – 4%</td>
<td>3 – 8%</td>
</tr>
<tr>
<td>Baleage</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Management Areas for Leaf Retention

- Ted and Rake at Proper moisture, no less than 35 or 40%
- Ted and Rake at a gentle speed
- Bale at proper moisture: 18-20% sm sq. / 16-18% Round / 15-16% lg sq
- Baler pick-up speed, same as forward speed.
- Baler forward speed, do not pull or push forage into the baler
- Windrows full of hay
- Round balers should turn no more than necessary to form the bale; square bale plunger should plunge a chamber full of hay
- Square bales partially on thrower belt lose leaves
- Handle bales as few times as possible
John Deere B-Wrap for Dry Hay

- Sheds rain and snow
- Lets moisture escape, so bales can cure
- Protects bales from ground moisture
Baleage balers

- heavy duty bearings & rollers
- scrapers to keep gum off belts and rollers
Table Wrapper

• Either place bale on table with tractor or it will have an arm to lift bales onto table
• 20 – 30 bales / hour
In-line (tootsie roll) bale wrapper
40 – 50 bales/hr
Inline Wrapper
Silage Fermentation
wilt forage to 40 – 60% moisture

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Day 2</td>
<td>Day 3 to 6</td>
<td>Day 7 to 21</td>
<td>After Day 21</td>
</tr>
</tbody>
</table>

**Chemical Changes**
- Oxygen + Sugar → CO₂
  - Heat Water
  - Proteins Degraded
  - Sugar → Acetic Acid
  - Lactic Acid
  - Acetic Acid
  - Ethanol
  - Mannitol
  - CO₂

**Oxygen**
- Day 1: 80 to 100°F
- Day 2 to 6: 70°F
- Day 7 to 21: 70°F
- After Day 21: 70°F

**Microbial Growth**
- Day 1: Aerobic Bacteria
- Day 2: Acetic Acid Bacteria
- Day 3 to 6: Acetic Acid Bacteria
- Day 7 to 21: Lactic Acid Bacteria
- After Day 21: Stable state until silage is exposed to oxygen

**pH**
- Day 1: 6.0
- Day 2 to 6: 5.0
- Day 7 to 21: 4.2
- After Day 21: 4.0

Source: [http://www.liquidfeeds.com/assets/Uploads/Products/Sileage/Sileage-Fermentation/_resampled/resizedimage552423-Silage-Fermentation-Chart.jpg](http://www.liquidfeeds.com/assets/Uploads/Products/Sileage/Sileage-Fermentation/_resampled/resizedimage552423-Silage-Fermentation-Chart.jpg)
Baleage Tips

1. Use good quality forage, no rain damage
2. Make dense bales: driving slowly; full windrow
3. Wilt to 40-60% moisture
4. Wrap with 6 mil (6 layers) of plastic. Do not stretch plastic too much.
5. Wrap ASAP, w/in 2 hr on a hot day, w/in 12 hr on cool days
6. Wrap in a area free of puncture hazards
7. Store in area of low temperature fluctuation
8. Check bales weekly, repair with polyethylene tape
Table 1. Temperature (°F) in silage bales bagged immediately, after 8 hours, and after 24 hours.

<table>
<thead>
<tr>
<th>Days After Ensiling</th>
<th>Interval Between Baling and Bagging (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
<tr>
<td>1</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>129</td>
</tr>
<tr>
<td></td>
<td>125</td>
</tr>
<tr>
<td>2</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>135</td>
</tr>
<tr>
<td>3</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>132</td>
</tr>
</tbody>
</table>

Source: University of Missouri, 1983 Research Reports.
Bale Grabber
handle bales as little as possible to keep sealed

http://kts.se/NT/images/multigrip7.jpg
Any questions so far about making hay or baleage?

???

Labor Saving Machinery

- There is a lot of different bale handling equipment
- Youtube has many videos
Bale throwers are safer than kickers
Bale table accumulates bales, places them on the field for later pickup by a grabber.
Very few moving parts
Works on hills according to the dealer
Bale grabber has hydraulically operated hooks

http://www.hoelscherinc.com/g/fork3.jpg
Tractor pulled bale wagon

http://roederimp.com/specks/1003.jpg
Bale wagons work well when you stack bales in sheds

There are many types of bale accumulators. Youtube has lots of videos.
This accumulator picks up bales in the field. Some are designed to not tear baleage plastic.

Round Bale Unroller

http://www.ibiblio.org/farming-connection/grazing/forgey/images/unroll.gif
Questions?

http://i.dailymail.co.uk/i/pix/2011/06/15/article-0-0C92DC0E00000578-144_634x579.jpg
Storing hay

Lessons from a hay grower

By: Kevin Ganoe, CCE – Central NY Dairy & Field Crops Team
Horse customers want dust free hay
Keep hay off the floor to prevent moisture from contacting the bale

Use chaff to build a layer
Even the tightest buildings seem to allow snow through
Dealers want bales stacked cut side up
Lessons from a hay grower

• When baling don’t allow bales to spend any time on the ground to draw moisture

• If you have hay that is not fully dry:
  – Do not put damp bales on the bottom; moisture works its way up and ruins more bales
  – Don’t stack damp bales tight against the next bale

• Don’t allow bales to set on a wagon over night
  – Will draw moisture
  – If not stacked will be misshapen by the next day
Lessons from a hay grower

• Pest problems:
  – Rodents
  – Hay mites
• Know what your customer wants
Table 2: Typical ranges in storage losses for various hay storage methods.

<table>
<thead>
<tr>
<th>Storage methods</th>
<th>Twine</th>
<th>Net wrap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole barn</td>
<td>2-5%</td>
<td>2-5%</td>
</tr>
<tr>
<td>Hoop structure</td>
<td>2-5%</td>
<td>2-5%</td>
</tr>
<tr>
<td>Tarp</td>
<td>5-10%</td>
<td>5-8%</td>
</tr>
<tr>
<td>Stack pad,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>covered stack</td>
<td>5-10%</td>
<td>5-8%</td>
</tr>
<tr>
<td>uncovered stack</td>
<td>15-40%</td>
<td>10-30%</td>
</tr>
<tr>
<td>Plastic wrap</td>
<td>5-10%</td>
<td>N/A</td>
</tr>
<tr>
<td>Outside on ground,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>well-drained</td>
<td>20-40%</td>
<td>15-40%</td>
</tr>
<tr>
<td>poor drainage/shaded</td>
<td>30-60%</td>
<td>30-45%</td>
</tr>
</tbody>
</table>
### Table 3: Value of hay lost

<table>
<thead>
<tr>
<th>% Loss</th>
<th>$75</th>
<th>$100</th>
<th>$125</th>
<th>$150</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$8</td>
<td>$10</td>
<td>$13</td>
<td>$15</td>
</tr>
<tr>
<td>20</td>
<td>$15</td>
<td>$20</td>
<td>$25</td>
<td>$30</td>
</tr>
<tr>
<td>30</td>
<td>$23</td>
<td>$30</td>
<td>$38</td>
<td>$45</td>
</tr>
<tr>
<td>40</td>
<td>$30</td>
<td>$40</td>
<td>$50</td>
<td>$60</td>
</tr>
<tr>
<td>50</td>
<td>$38</td>
<td>$50</td>
<td>$63</td>
<td>$75</td>
</tr>
<tr>
<td>60</td>
<td>$45</td>
<td>$60</td>
<td>$75</td>
<td>$90</td>
</tr>
</tbody>
</table>
“Hay storage is not cheap, regardless of the method used. However, I often remind folks that if you are storing hay outside on the ground, you likely are paying for a barn whether you want to or not.”
When you are producing feed, whether for sale or for on-farm consumption, you need to know what it costs you.
Do you receive top price for your forage?

• If Yes – Great!!

• You can afford to invest in your land and equipment which will help you improve yield, quality and long term profit.
If No – you are not receiving top dollar.

• Then what is holding you back?
  – Poor Quality
  – Inconsistent quality
  – Too little of the good stuff
  – Inability to harvest on time
  – Inability to invest money into fields/equipment
  – Too many break downs
  – Bad weather slows down harvest
How to Figure Costs?

• Enterprise budgeting
  – Variable costs
  – Fixed costs
  – Breakeven cost
  – Breakeven yield
Crop cycle length

- Remember the impact a crop cycle can have on your needed returns.

- Total Cost to establish Hay ground $411.80/ac

- Crop length    Needed return
  - 3 years       $137.27
  - 4 years       $102.95
  - 5 years       $  82.36

At some point, you will need to add value again.
Break Even Price

– Production

• @ 1.5 T/ac  
  Orchardgrass: $417.77  
  Timothy: $332.69

• @ 3.0 T/ac  
  Orchardgrass: $208.90  
  Timothy: $166.34

• @ 4.5 T/ac  
  Orchardgrass: $156.67  
  Timothy: $124.76

• What price could you get? Or afford to pay?
Breakeven Yield

- Price/T
  - Orchardgrass
    - @ $200/T: 3.1 T/ac
    - @$240/T: 2.6 T/ac
  - Timothy
    - @ $200/T: 2.5 T/ac
    - @$240/T: 2.1 T/ac

- Lower yields result in greater expense amounts being spread across fewer tons.
Andrew’s Article

• $150/T cost equals $3/small square bale before storage and handling.

• Think about and track YOUR numbers.

• They may look more like these than you can imagine!
Questions?