Hay Storage Systems

Southeast Hay Convention
John W. Worley

It’s not unusual to see total losses of 70% or greater.

Loss accumulates with each step:
- Field curing: 10-25% loss
- Harvesting: 7-15% loss
- Storage: 5-45% loss
- Feeding: 10-30% loss

Storage Alternatives

- Curing
  - Field Dry
  - Baleage
- Packaging
  - Round Bales
    - Twine
    - Bale Wrap
  - Square Bales
    - Small
    - Large

Alternatives

- Storage
  - Square Bales - Barn
  - Round Bales
    - Field
    - Tarp
    - Barn

Baleage

- Greater control over harvesting time
- Excellent quality if moisture level right and no leaks
- Reduces Nitrate Levels

Baleage

- Costs more
- Can get spoilage if ensiling isn’t successful
- Disposal of Plastic

Dr. John Worley
Extension Engineer
**2014 Southeast Hay Convention**

**Hay Storage Systems**

---

**Square vs. Round Bales**

---

**Twine vs. Hay Wrap**

---

### Hay Storage Research

(Kentucky)

<table>
<thead>
<tr>
<th>Storage Method</th>
<th>Weathered Depth (in.)</th>
<th>DM Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twine</td>
<td>4.4</td>
<td>18.2</td>
</tr>
<tr>
<td>Netwrap</td>
<td>2.1</td>
<td>10.6</td>
</tr>
<tr>
<td>Solid plastic</td>
<td>0.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Shed</td>
<td>&lt;0.5</td>
<td>5.7</td>
</tr>
</tbody>
</table>

---

### Hay Storage – Preserving Quality

- Why build it?
- How to build it
- How to use it

---

**Hay Barn**

- Enclosed sides –
  - Better Protection (sun and rain)
  - Costs about twice as much
  - Ventilation
  - High-end hay storage

---

Dr. John Worley

Extension Engineer
2014 Southeast Hay Convention
Hay Storage Systems

Dr. John Worley
Extension Engineer

Tarp
- Low-cost alternative
- More Labor
- Decreased losses in case of fire

Uncovered
- Lowest Cost - Greatest Losses - Poorest Quality

Storage Options
- Tarped Stacks
- Hay Sheds
- Hoop Structures

Bale Storage Comparisons
- $0.75 + 30-70% Loss
- $3.50 + 5-10% Loss
- $1.50 + 20-40% Loss
- $5.00 + 5-10% Loss

Benefits of Covered Storage
- Reduced Dry Matter Loss
- Improved Nutritional Value
- Reduced animal refusal
- Barn can be used for other things when not used for hay (equipment storage)

Cost of Owning a Building
- 50 by 100 ft building at $5.00/ square foot ($25,000) (Roof only)
  - Depreciation $1250
  - Interest $1000
  - Tax & Ins. $750
  - Annual Repairs $125
- Total Annual Cost $3125

Slide courtesy of Dennis Hancock
2014 Southeast Hay Convention
Hay Storage Systems

**Dry Matter Losses (%)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Ground Stored</th>
<th>Elevated on Pallets</th>
<th>Elevated &amp; Tarped</th>
<th>Tarped Only</th>
<th>Barn Stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>38</td>
<td>14</td>
<td>na</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>32</td>
<td>14</td>
<td>na</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>na</td>
<td>na</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

**Size of Bale Affects Losses**

- Outer 4 to 6 inches is lost
- Higher percentage of a small bale

**Dry Matter Losses (%) As Affected by Bale Size**

<table>
<thead>
<tr>
<th>Bale Diam. (ft.)</th>
<th>Ground Stored</th>
<th>Elevated on Pallets</th>
<th>Elevated &amp; Wrapped</th>
<th>Barn Stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>32.4</td>
<td>26.2</td>
<td>14.6</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>23.8</td>
<td>17.4</td>
<td>11.4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>19.6</td>
<td>13.4</td>
<td>10.0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Digestibility and Palatability Also Affected**

**Nutritional Losses**

Start with 1,000-lb bale at 15% moisture

<table>
<thead>
<tr>
<th>850 lb DM before storage</th>
<th>Ground Stored</th>
<th>Elevated on Pallets</th>
<th>Elevated &amp; Tarped</th>
<th>Barn Stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Loss</td>
<td>65</td>
<td>38</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Digestibility (%)</td>
<td>45</td>
<td>49</td>
<td>52</td>
<td>54</td>
</tr>
<tr>
<td>Digestible Matter After Storage</td>
<td>172</td>
<td>258</td>
<td>380</td>
<td>441</td>
</tr>
</tbody>
</table>

**Digestible Matter After Storage (1,000-lb Bale)**

Dr. John Worley
Extension Engineer
Dr. John Worley  
Extension Engineer

2014 Southeast Hay Convention  
Hay Storage Systems

Annual Savings on Hay Storage

- Assumptions
  - Hay valued at $75/ton (dry matter)
  - Hay losses reduced by 30%
  - 50 x 100 building (annual cost - $3125)
  - Storage Capacity - 250 tons (wet basis)
  - Hay stored at 15% moisture

- Annual Savings on Hay Storage
  - Dry matter saved - 64 tons - $4800
  - Net Savings - $1675

- What if?
  - If Digestibility Improved by 5% (Total of 42% savings) Net Savings - $3553
  - If Hay worth $90/ton, Net Savings - $4889
  - If dry matter loss improved by 50%, (106 tons) Net Savings - $4825

If You Build A Barn

How Much Should You Store in the Barn?

- All that you can fit in existing barns
- All square bales
- 50 to 75% of crop (feed last cutting first and store outside)

Barn Recommendations

- Build to meet Southern Building code (80 mph wind)
- If possible, orient the long axis east and west on open-sided barns
- Hay storage should be open, especially at the gable end for ventilation
- Stack bales on end to increase capacity
- Make sure the eave height (vertical clearance) of barn is sufficient

Rot and Rust on Inside Roof?

The University of Georgia  
College of Agricultural & Environmental Sciences
Dr. John Worley
Extension Engineer

2014 Southeast Hay Convention
Hay Storage Systems

Enclosed Gable

Water Loss from Curing Hay
- 100 tons of hay stored at 16% moisture
- Dries to 13% moisture
- 3% of 100 tons = 3 tons of water
- = 722 gallons
- Must be removed by ventilation

How much Ventilation?
(Enclosed Barn)
- Larger of the following 2 options:
  - 6” continuous ridge vent
  - 2”/10 ft of width
- For a 50-ft wide building -10” Ridge vent (83 sq. ft of ridge/gable opening for 100-ft long building)
- Equal area of opening near bottom of walls (Door can serve as part of vent)

Flooring for Square Bales
- Anything that promotes ventilation under the hay is good (Large rock, pallets, etc.
- Ideal is a raised floor with air underneath (not always practical)
- Bottom layer on edge – primarily to keep twine from rotting, but also helps promote ventilation
- Concrete with vapor barrier underneath and well-drained

If You Store In the Field

Field Storage Recommendations
- Store on high, well-drained ground
- Store in open, sunny area
- Store in rows with flat edges touching and round edges separated (unless tarped)
- Orient rows North and South
- Orient rows down slope, not across slope

THE UNIVERSITY OF GEORGIA
College of Agricultural & Environmental Sciences
What’s Right?  What’s Wrong?

2014 Southeast Hay Convention
Hay Storage Systems

What’s Right?  What’s Wrong?

2nd Year Outside Hay

Controlling Feeding Waste

Dr. John Worley
Extension Engineer

Feeding Losses

Method       1 day                    7 day
---- % Waste----
Unrolled     12.3                     43.0
Ring         4.9                       5.4

Slide courtesy of Dennis Hancock
### Feeding Losses

<table>
<thead>
<tr>
<th>Item</th>
<th>% Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone</td>
<td>2 - 5</td>
</tr>
<tr>
<td>Ring</td>
<td>4 - 7</td>
</tr>
<tr>
<td>Trailer</td>
<td>10 - 13</td>
</tr>
<tr>
<td>Cradle</td>
<td>15 - 20</td>
</tr>
</tbody>
</table>