Baleage Systems -- Planning for Success

Bob Schultheis
Natural Resource Engineering Specialist
Silage Producers' Short Course
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Key Factors

- Quality at time of harvest
  - Baleage only preserves -- does not enhance forage quality
- Suitability of forage for ensiling
- Harvest and preservation techniques
- Storage methods

Best Forage Cutting Stage

- Tall fescue / Native WSG = boot
- Orchardgrass = blooms emerged
- Bermudagrass = every 28 days
- Caucasian bluestem = late boot
- Red clover = 1/4 to 1/2 bloom
- Alfalfa = 1/10 bloom, then every 28 days
- Lespedeza = 30% bloom
- Cereal crops = boot to milk

Stage of Growth Affect Intake

The leaves contain about 2/3rds of the plant nutrients

Crops to Wrap

- Legumes
  - Alfalfa
  - Red clover
  - Soybean
- Cool Season Grasses
  - Tall fescue
  - Wheat / Triticale / Rye
  - Annual Ryegrass
- Warm Season Grasses
  - Forage sorghum
  - Sudangrass
  - Pearl millet
  - Immature corn

Grasses vs. Legumes

- Grasses tend to ferment better than do legumes
  - More water-soluble carbohydrates
- pH near 4 for all grass treatments
- Much more acid production than in alfalfa silage
Forage Moisture Affects Dry Matter Harvest & Storage Losses

- Forage Moisture Testing
  - Heater/fan dryer (Koster® unit)
  - Electrical conductance moisture meter
  - Microwave + scale

Harvest Moisture Content Depends on Silo Type

- Conventional tower silos = 63–68% M.C.
- Silage bales = 50-60% M.C.
- Horizontal silos = 65–70% M.C.
- Limited-oxygen silos = 55–60% M.C.
- Silo bags = 65% M.C.

Silage Biology

- Baled silage
  - Flexible harvest options
  - Less field drying time
  - Greater harvest window
  - Less weather risk
  - Lower losses
  - Harvest & storage
  - More uniform product
  - No taxable structure

- Baled Hay
  - More marketable
  - Horses
  - Lower trucking costs
  - No fermentation
  - Less equipment
  - Less plastic disposal issues

Source: Dr. Kevin Shinners, University of Wisconsin, 2010
### Baleage vs. Chopped Silage

<table>
<thead>
<tr>
<th>Baleage</th>
<th>Chopped Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Baled silage</td>
<td></td>
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<tr>
<td>– Less expensive equipment</td>
<td></td>
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<tr>
<td>– Wider moisture range</td>
<td></td>
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<tr>
<td>– Targeted feeding</td>
<td></td>
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<tr>
<td>– No taxable structure</td>
<td></td>
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<tr>
<td>– Ideal for small operator</td>
<td></td>
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<tr>
<td>– Easier to market</td>
<td></td>
</tr>
<tr>
<td>• Chopped silage</td>
<td></td>
</tr>
<tr>
<td>– Better fermentation</td>
<td></td>
</tr>
<tr>
<td>– More versatile</td>
<td></td>
</tr>
<tr>
<td>– High capacity</td>
<td></td>
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<tr>
<td>– Easier TMR mixing</td>
<td></td>
</tr>
<tr>
<td>– Less sorting</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Dr. Kevin Shinners, University of Wisconsin, 2010*

### Tube vs. Individual Wrapping

<table>
<thead>
<tr>
<th>Tubes</th>
<th>Chopped Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tubes</td>
<td></td>
</tr>
<tr>
<td>– Less plastic used</td>
<td></td>
</tr>
<tr>
<td>– Greater productivity</td>
<td></td>
</tr>
<tr>
<td>– Less labor</td>
<td></td>
</tr>
<tr>
<td>• Chopped silage</td>
<td></td>
</tr>
<tr>
<td>– Targeted feeding</td>
<td></td>
</tr>
<tr>
<td>– Marketable product</td>
<td></td>
</tr>
<tr>
<td>– Occupies less area</td>
<td></td>
</tr>
<tr>
<td>– Less aerobic loss at feedout</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Dr. Kevin Shinners, University of Wisconsin, 2010*

### Equipment Needed for Baleage

- Mower
- Rake
- Baler capable of baling wet forage
- Tractor of sufficient horsepower to carry bales safely
- Bale spear or grapple
- Bale wrapper

### Making Good Baleage

- **Equipment Needed for Baleage**
  - Mower
  - Rake
  - Baler capable of baling wet forage
  - Tractor of sufficient horsepower to carry bales safely
  - Bale spear or grapple
  - Bale wrapper

- **Making Good Baleage**
  - Make bales as dense as possible
  - Drive slowly with high PTO speed for tight, dense bales
  - Longer fiber slows fermentation
  - Don’t wrap in the rain
  - Make uniform bale shape and size
  - Inoculants (*Lactobacillus buchneri*) may help if the moisture isn’t right – speeds up lactic acid formation

- **Making Good Baleage**
  - Tie with plastic twine, net-wrap or untreated sisal twine
  - Avoid treated sisal twine, which degrades the plastic film
  - Bales 4 ft. wide x 4-5 ft. diameter = 900-1300 lbs.
  - Larger bales use relatively less film but are harder to handle
  - Wrap close to storage site = less handling
  - How to wrap
    - Stretch to 70-80% of original width
    - Recommed 5 layers (high moisture) to 8 layers (low moisture)
    - Avoid wet conditions (film loses tackiness)

**KEEP THE OXYGEN OUT!**
**Baleage - Wrapping**

- Wrap as soon as possible after baling
  - Makes aerobic phase shorter, temperature lower
  - Hot, summer day: < 2 hours
  - Cool, fall day: < 8 hours
    - Depends on weather and type of forage
  - Not more than 12 hours
- Delayed wrapping prevents adequate fermentation as reflected in the higher pH value

**Wrap Timing**

- Wrap as soon as possible after baling
  - Makes aerobic phase shorter, temperature lower
  - Hot, summer day: < 2 hours
  - Cool, fall day: < 8 hours
  - Depends on weather and type of forage
  - Not more than 12 hours

**Use High Quality Plastic**

- Plastic wrap is ~1-mil low-density polyethylene
- Stretching increases cling and makes tight seal
  - Stretching also reduces thickness by up to 25%
  - Tear strength and tack (or “stickiness”) may vary among brands of wrap
- More layers increases distance O₂ must travel
  - High temps makes film more permeable
- White film better than black for Missouri climate
  - Reflects sunlight better and reduces radiational heating

**Number of Wraps**

- Lots of variables
  - Film quality, thickness, material density
  - Generally minimum of 4 layers (2 turns at 50% overlap)
  - More layers needed as:
    - Moisture decreases
    - Maturity increases
    - Baling crops with sharp stems
- New trends in film wrap
  - Higher density resins = better O₂ barrier
  - More pre-stretching
  - Thinner, narrower but longer = about same weight

**Storage Treatment & Consumption**

<table>
<thead>
<tr>
<th>Storage Treatment</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 layers</td>
<td>53%</td>
</tr>
<tr>
<td>4 layers</td>
<td>84%</td>
</tr>
<tr>
<td>6 layers</td>
<td>88%</td>
</tr>
<tr>
<td>Hay</td>
<td>64%</td>
</tr>
</tbody>
</table>
Making Good Baleage

- Fermentation process complete within 6-8 weeks (often 4 weeks)
  - Fermentation conditions can vary due to forage maturity, temperature and bale moisture differences
- Bales should be fed within one year of wrapping
  - Depends on forage moisture and maturity
    - If > 60% M.C., feed within 3 months
    - If 30-40% M.C., feed within 6 months
    - If 40-60% M.C. feed within 12 months as long as plastic integrity is maintained (9 months preferred)

Crude Protein of Alfalfa Baleage

<table>
<thead>
<tr>
<th>Moisture Content at Baling (%)</th>
<th>Pre-Storage</th>
<th>Post-Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>25</td>
<td>23</td>
</tr>
<tr>
<td>49</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>43</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>22</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>

Digestibility of Alfalfa Baleage

<table>
<thead>
<tr>
<th>Moisture Content at Baling (%)</th>
<th>IVDMD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>65</td>
</tr>
<tr>
<td>49</td>
<td>60</td>
</tr>
<tr>
<td>43</td>
<td>55</td>
</tr>
<tr>
<td>22</td>
<td>50</td>
</tr>
</tbody>
</table>

Red Clover Baleage

<table>
<thead>
<tr>
<th>Treatment</th>
<th>CP (%)</th>
<th>NDF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC baleage</td>
<td>21.1</td>
<td>35.7</td>
</tr>
<tr>
<td>RC hay</td>
<td>16.3</td>
<td>49.8</td>
</tr>
</tbody>
</table>

(60% moisture at baling)

Ryegrass Baleage Comparison to Hay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>CP %</th>
<th>TDN %</th>
<th>RFQ</th>
<th>ADG lbs/hd/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryegrass Hay</td>
<td>14.7 b</td>
<td>62.4 c</td>
<td>133 b</td>
<td>1.26 b</td>
</tr>
<tr>
<td>Ryegrass Baleage</td>
<td>16.3 a</td>
<td>65.9 a</td>
<td>174 a</td>
<td>1.94 a</td>
</tr>
<tr>
<td>Bermuda Hay</td>
<td>16.1 a</td>
<td>62.9 b</td>
<td>116 c</td>
<td>1.56 b</td>
</tr>
</tbody>
</table>

Replacement Heifers Gain – No additional supplementation
Ryegrass hay received a light rain shower on it
Unpublished data, Calhoun, GA, 2009, Dennis Hancock
P<0.10

Four Types of Wrappers are Available

- Platform
- In-line
- Swinging arm
- Bale spear
Platform Wrappers

• Features
  – Trailer or 3-point hitch
  – Round or square bales
  – Tractor hydraulics or gas engine
  – Plastic $3.50 - $4.50/bale for 4 layers
  – Some have a loader arm; most can be loaded with a front-end loader

Platform Wrappers

• Concerns
  – Plastic cost
  – Labor per bale
  – Most only accommodate 4 ft. wide bales

Square Bale Platform Wrappers

In-Line Wrappers

• Features
  – Bales end-to-end
  – Less labor for wrapping
  – Lower plastic cost (1/2 or less)

In-Line Wrappers

• Concerns
  – Uniformity of adjacent bales (both size and density)
  – End of rows need to be sealed by hand
  – A hole in the plastic can spoil a large area
  – Feedout rate (need to feed 2 or 3 bales per day to keep ahead of spoilage)

Other Wrappers

End-to-End Individual Wrap

• Concerns
  – Labor-intensive
  – Plastic on bottoms of bales
Baler-Wrapper Combination

Wrapping Efficiency

- Individual bale wrapper
  - 25-30+ bales per hour with experienced workers
  - About the same number of bales covered by a 20 in. x 6,000 ft. or 30 in. x 5,000 ft. roll of stretch-wrap plastic
- In-line wrapper
  - 40-50 bales per hour with experienced workers

In-Line Wrapper Example
Successful Round Bale Silage
(Tips from Windmill Cattle Co., LLC)

- Never mow more hay than you can easily bale and wrap the next day
- Set the mower conditioner for a narrow windrow
- Before baling, run several microwave oven moisture tests
- Use baler net wrap instead of twine to tie silage bales
- Keep the baler close behind the rakes
- Wrap silage bales as soon after baling as possible

Baleage - Transport

- Handle minimum possible  
  - Avoid moving after 12 hours
- If bales must be moved, use a grapple to avoid puncturing plastic
- Keep loader low to prevent tractor overturn

Successful Round Bale Silage
(Tips from Windmill Cattle Co., LLC)

- Start a new line of bales by pushing against a stationary object
- Never position the wrapper on a side slope
- Put six layers of stretch wrap on the silage bales
- Adjust wrapper so that extra wrap is added where bales join
- When wrapping, alternate higher and lower moisture content bales (those baled earlier, with those baled later in the day)
- Have someone watch the operation of the wrapper

Baleage - Storage

- Store in a well-drained site
- Avoid woods, sharp stubble, wildlife  
  - Mowing weeds discourages rodents
- Stack where possible, saves room
- Store round bales on flat end  
  = more plastic, less “squish”
- Avoid stacking at high moisture
- Patch holes promptly
Baleage - Troubleshooting

• Caramelized or tobacco smell:
  – Heat damage – long delay from baling to wrapping
• Molds
  – O2, insufficient wraps, low moisture, low density, inoculation
• Rancid odor:
  – High moisture, clostridia, low sugar, insufficient LAB
• Heating, mold at feedout
  – Low moisture, high pH, feedout rate too slow

Film Recycling

• Unlawful to open-burn plastic in Missouri
  – Open, low-temp burning a bad idea
  – Dioxins released are toxic and potential carcinogens
  – Department of Natural Resources: 1-800-361-4827
  – http://dnr.mo.gov/pubs/pub2047.htm

Plastic Recycling

• Try to keep clean until removal
• May need to separate plastic types
• Store plastic indoors, under cover, or in special container
• Keep plastic clean and dry
• Increase density prior to shipping

Questions??

Program Complaint Information
To file a program complaint you may contact any of the following:

University of Missouri
• MU Extension AA/EEO Office
  109 F. Whitten Hall, Columbia, MO 65211

MU Human Resources Office
• 130 Heinkel Bldg, Columbia, MO 65211

USDA
• Office of Civil Rights, Director
  Room 326-W, Whitten Building
  14th and Independence Ave., 3SW
  Washington, DC 20250-9410

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