Harvest Moisture Recommendations

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University of Wisconsin - Madison
Ensiled Feeds

- Corn Silage
- Hay-Crop Silage
- High-Moisture Shelled Corn
A Note

- % DM = 100% - Moisture%

- % Moisture = 100% - DM%
Whole-Plant Corn Silage

Grain ~40-45% of WPDM
- Avg. 30% starch in WPDM
- Variable grain:stover

Stover= ~55-60% of WPDM
Leaves = 15% of DM
Stem = 20-25% of DM
Cob+Shank+Husk= 20% of DM

80 to 98% starch digestibility
- Kernel maturity
- Kernel particle size
- Endosperm properties

40 to 70% IVNDFD
- Lignin/NDF
- Hybrid
- Maturity

Whole-Plant Corn Silage
- Avg. 30% starch in WPDM
- Variable grain:stover
Whole Plant

<table>
<thead>
<tr>
<th>Year</th>
<th>LSD(0.10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>1.0</td>
</tr>
<tr>
<td>1989</td>
<td>1.4</td>
</tr>
<tr>
<td>1990</td>
<td>0.6</td>
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</tbody>
</table>

DM%
Ton DM/acre

Wiersma et al., JPA, 1993
Wiersma et al., JPA, 1993

ivTDMD %
Whole-Plant Corn Silage

- Variable grain:stover
- Kernel maturity
### Maturity effects in corn silage

Bal & co-workers, JDS, 1997; UW Madison

<table>
<thead>
<tr>
<th></th>
<th>ED</th>
<th>¼ ML</th>
<th>2/3 ML</th>
<th>BL</th>
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<tbody>
<tr>
<td><strong>CS DM%</strong></td>
<td>30</td>
<td>32</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td><strong>CS Starch, %</strong></td>
<td>18</td>
<td>29</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td><strong>CS aTT StarchD, %</strong></td>
<td>90&lt;sup&gt;a&lt;/sup&gt;</td>
<td>88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>86&lt;sup&gt;b&lt;/sup&gt;</td>
<td>75&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Diet aTT StarchD, %</strong></td>
<td>94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>92&lt;sup&gt;b&lt;/sup&gt;</td>
<td>88&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Whole-Plant Corn Silage

- Kernel maturity
- Kernel particle size
Adapted from Schwab et al., 2003.
Target for Whole-Plant Corn Silage

- 35% DM (65% Moisture)
Concerns

- ≤30% DM (≥70% Moisture)
  - Reduced yield
  - Reduced starch content
  - Increased seepage
  - High acidity
  - Aerobic instability
Concerns

≥40% DM (≤60% Moisture)
- Reduced starch digestibility
- Reduced fiber digestibility
- Kernel & stover particle size
- Silo packing
- Silage fermentation
## DM Content of Corn Silages

<table>
<thead>
<tr>
<th></th>
<th>1 Std Dev</th>
<th><strong>Average</strong></th>
<th>1 Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dairyland</strong></td>
<td>29%</td>
<td>37%</td>
<td>45%</td>
</tr>
<tr>
<td>2002-2007</td>
<td>n=13k/yr.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dairy One</strong></td>
<td>23%</td>
<td>34%</td>
<td>45%</td>
</tr>
<tr>
<td>2002-2007</td>
<td>n=19k/yr.</td>
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</table>
Relationship Between Forage Moisture and Kernel Milk Stage

$R^2 = 0.42$

1990-2000
$n = 2245$

Whole plant moisture (%)

Kernel milk stage

Dent Black layer
Height of Cutting

Higher Cutting

- NDF, ADF, & lignin
- IVNDFD
- whole-plant moisture

DM yield loss of 5-8%
Relationship Between Forage Moisture and Kernel Milk Stage

$R^2 = 0.42$

Whole plant moisture (%) vs. Kernel milk stage

1990-2000

n = 2245

Dent Black layer

$R^2 = 0.42$
Table 1. High Moisture Corn Storage in Conventional, Bunker, Bag, and Oxygen Limiting Silos

<table>
<thead>
<tr>
<th></th>
<th>Corn Kernel Moisture, %</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>Ear Corn</td>
<td>26</td>
</tr>
<tr>
<td>Shelled Corn</td>
<td>26</td>
</tr>
<tr>
<td>Bottom Unloading Oxygen Limiting Silos</td>
<td></td>
</tr>
<tr>
<td>Corn Kernel Moisture, %</td>
<td></td>
</tr>
<tr>
<td>Ear corn-rolled*</td>
<td>26</td>
</tr>
<tr>
<td>Shelled corn</td>
<td>24</td>
</tr>
</tbody>
</table>

*OL Silo with Forage Unloader

Source: Rankin, 2009
Concerns

- **Dry HMC** (<26% kernel moisture)
  - Reduced ruminal & total tract starch digestion
    - Especially if mean particle size >1,000 microns
  - Fermentation
Concerns

- **Wet HMC** (≥35% kernel moisture)
  - Fast rate & high extent of ruminal starch digestion
    • Especially if mean particle size < 2,500 microns
  - Yeast/ethanol fermentation
**Concerns**

- **Snaplage** (40% - 45% moisture)
  - Reduced starch content
  - Increased NDF content
  - Increased variability in starch, NDF & energy contents
  - Fast rate & high extent of ruminal starch digestion
  - Particle size
  - Yeast/ethanol fermentation
Figure 5. The effect of DM on legume silage fermentations

Data courtesy of Cumberland Valley Analytical Services, Hagerstown, MD.

Source: B. Stone, 2009 VPI Cow College
Figure 2. The pH at which the growth of *Clostridium tyrobutyricum* ceases as a function of the DM content.

Source: Muck, JDS, 1988
Temperature Rise vs Bulk Density

Source: Muck & Holmes, 2006, NRAES-181 from Pitt, 1983, Trans ASAE

\[
x = 14 \text{ lb. DM} / \text{cu. ft.}
\]
Figure 1. Graph of porosity (decimal) vs. dry matter content (decimal) for various bulk densities.

Source: Holmes & Muck, www.uwex.edu/ces/crops/uwforage/Porosity-FOF.pdf
Target for Haycrop Silage

- 40% DM (60% Moisture)
Concerns

- **<35% DM (>65% Moisture)**
  - Increased risk of clostridial spoilage
  - Increased NPN
  - Increased RDP
  - Increased seepage
  - Particle size
Concerns

- ≥50% DM (≤50% Moisture)
  - Greater risk of weather damage
  - Greater harvest losses
  - Silo packing
  - Silage fermentation
  - Particle size
<table>
<thead>
<tr>
<th>Dairyland</th>
<th>1 Std Dev</th>
<th>Average</th>
<th>1 Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2007</td>
<td>34%</td>
<td>44%</td>
<td>54%</td>
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<tr>
<td>n=16k/yr.</td>
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<tr>
<td>Dairy One</td>
<td>29%</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>2002-2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=10k/yr.</td>
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Welcome to Dairy Cattle Nutrition UW-Extension

The Dairy Cattle Nutrition UW-Extension site is designed to provide research-based information for the public seeking resources on all aspects of the nutrition of dairy cattle.

Web Site Highlights

- Dairy Team News from the University of Wisconsin
- 2009 Four State Dairy Nutrition & Management Conference Proceedings
- UW Feed Grain Evaluation System
  - Technical note: A method to quantify prolamin proteins in corn that are not negatively related to starch digestibility in ruminants (Seth Lutson and Pat Hoffman - JSS paper)
  - Corn Biochemical Factors related to starch digestibility in ruminants (Pat Hoffman and Randy Shaver - conference paper)
  - Corn Biochemical Factors related to starch digestibility in ruminants (Pat Hoffman and Randy Shaver - soyde)
  - A guide to understanding prolamin (Pat Hoffman and Randy Shaver)
  - UW Feed Grain Evaluation System (Pat Hoffman and Randy Shaver)
  - Relative Grain Quality - RGD (Pat Hoffman and Randy Shaver)

Spreadsheets

- UWU2008 Corn Silage: Calculates TDF, NEL, NEL per ton, and NEL per acre

Publications

- Benchmarking for age nutrient composition and digestibility
- Feeding Programs in High Producing Dairy Herds

Presentations

- Benchmarking for age nutrient composition and digestibility
- Diets fed in selected WI high producing dairy herds

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Visit UW Extension Dairy Cattle Nutrition Website
http://www.uwex.edu/ces/dairynutrition/