Harvesting and Feeding Drought-Stricken Corn Plants

2008 Corn Silage and Forage Field Day

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University of Florida
WEST PALM BEACH, Florida, January 8, 2008

- The past two years have been the driest back-to-back calendar years in South Florida since rainfall recordkeeping began in 1932, meteorologists at the South Florida Water Management District confirmed today.

The combined two-year total is nearly two feet less than the historical district-wide average of 104.5 inches for a typical two-year period.
Irrigation of Corn Plants
Scope of Presentation

Plant Development Affected by Drought

Harvesting and Ensiling Recommendations

Feeding Cautions
How Does Water Deficiency Influence Corn Plant Development?

Uptake of nutrients by plant is reduced

- Growth (yield) is reduced
- Loss of leaves due to wilting
How Does Water Deficiency Influence Corn Plant Development?

Uptake of nutrients by plant is reduced

- Growth (yield) is reduced
- Loss of leaves due to wilting
- Increased susceptibility to disease and insects
Common Corn Smut (*Ustilago maydis*)

www.ppdl.purdue.edu/PPDL/images/smut_ear.jpg
Eating Smut?

- Fungus (smut) does not produce toxins
- Sheep fed smut-infested corn silage ate more silage dry matter and had equal digestibility compared to sheep fed smut-free corn silage.
Huitlacoche; aka Corn Smut
aka Mexican Truffle
Influence of Water Deficiency on Corn Plant Development

When did drought stress occur?

- Prior to pollination of ear (tasseling and silking)
  - Reduced length of ear
  - Reduced # of rows of kernels (10-12 leaf stage)
  - Reduced # of kernels per row (12-17 leaf stage)
- During pollination, may eliminate ear development
- After pollination of the ear
  - Aborted kernels
  - Poor kernel fill
<table>
<thead>
<tr>
<th>Stage of development</th>
<th>% corn yield reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early vegetative</td>
<td>5 – 10</td>
</tr>
<tr>
<td>Tassel emergence</td>
<td>10 – 25</td>
</tr>
<tr>
<td>Silk emergence, pollen shedding</td>
<td>40 – 50</td>
</tr>
<tr>
<td>Blister</td>
<td>30 – 40</td>
</tr>
<tr>
<td>Dough</td>
<td>20 - 30</td>
</tr>
</tbody>
</table>

# Yield & Nutrient Content of Silage – Drought Prior to Pollination

<table>
<thead>
<tr>
<th>Measure</th>
<th>Drought year</th>
<th>Normal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM yield, tons/acre</td>
<td>7.7</td>
<td>8.1</td>
</tr>
<tr>
<td>NDF, % of DM</td>
<td>41</td>
<td>49</td>
</tr>
<tr>
<td>Starch, % of DM</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td>NDF digestibility, %</td>
<td>58</td>
<td>62</td>
</tr>
<tr>
<td>Milk (lb) per ton</td>
<td>3,400</td>
<td>3,280</td>
</tr>
<tr>
<td>Milk (lb) per acre</td>
<td>26,000</td>
<td>26,000</td>
</tr>
</tbody>
</table>

Lauer, Univ. of Wisconsin, 2003-06, Marshfield and Arlington growing sites (55 hybrids)
## Yield & Nutrient Content of Silage – Drought During Grain Filling

<table>
<thead>
<tr>
<th>Measure</th>
<th>Drought year</th>
<th>Normal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM yield, tons/acre</td>
<td>4.9</td>
<td>7.1</td>
</tr>
<tr>
<td>NDF, % of DM</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Starch, % of DM</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>NDF digestibility, %</td>
<td>60</td>
<td>64</td>
</tr>
<tr>
<td>Milk (lb) per ton</td>
<td>3,100</td>
<td>3,275</td>
</tr>
<tr>
<td>Milk (lb) per acre</td>
<td>14,750</td>
<td>23,250</td>
</tr>
</tbody>
</table>

Lauer, Univ. of Wisconsin, 2003-06, Chippewa Falls (50-53 hybrids) and Spooner (21-27 hybrids) growing sites
Yield and Quality of Drought Stressed Corn Plants

Silage

- If drought prevents pollination, expect to harvest 1 ton per foot of plant height, excluding the tassel, of 30% dry matter material
- Feed value is 65 to 95% of normal silage
Recommendations for Harvest of Corn Silage During a Drought

- Harvest at proper moisture (30 to 35% DM)
- If too dry, need to increase packing in silo
  - shorter TLC, possibly 0.5 inch w/o processor
  - add water (~6 gallons/TON per 1% increase in DM) - difficult to do
- Sugars stored in stalk instead of grain so silage may be more susceptible to aerobic spoilage upon opening if unused sugars are present.
Plants Can Accumulate Nitrates

- Plants accumulate N in NO\textsubscript{3} (Nitrate) form rather than convert it to a protein form

- Environmental conditions conducive to nitrate formation
  - Rain after a period of drought
  - Cloudy weather
  - Heavy N fertilization
Plant Nitrates Pose Toxicity Risk to Cows

In the cow, $\text{NO}_3$ (nitrate) $\rightarrow \text{NO}_2$ (nitrite) $\rightarrow \text{NH}_3$ (ammonia)

- Reduces oxygen-carrying capacity of blood
- Rapid or difficult breathing
- Staggering, weakness, death
- Chocolate-colored blood
- Abortion
Reducing Risk of Nitrate Toxicity

- Bacterial fermentation during ensiling converts 25 to 50% of nitrates to bacterial protein so risk is reduced.
- Don’t green-chop or graze droughty corn plants.
- Analyze for nitrates at commercial lab ~$6-9.
# Nitrates and Feeding Recommendations

<table>
<thead>
<tr>
<th>Nitrate, ppm</th>
<th>Feeding recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4,400</td>
<td>Safe</td>
</tr>
<tr>
<td>4,400 – 8,800</td>
<td>Limit to 50% of diet DM</td>
</tr>
<tr>
<td>8,800 to 17,600</td>
<td>Limit to 25% of diet DM</td>
</tr>
<tr>
<td>More than 17,600</td>
<td>Do not Feed!</td>
</tr>
</tbody>
</table>

To convert ppm to %, divide by 10,000

To convert nitrate to nitrate-Nitrogen, multiply nitrate value by 0.227
Reducing Risk of Nitrate Toxicity

- Bacterial fermentation during ensiling converts ~50% of nitrates to bacterial protein so risk is reduced

- Don’t green-chop or graze droughty corn plants

- Analyze for nitrates at commercial lab ~$6-9

- Consider harvesting higher on stalk? Nitrates accumulate in lower stalk and leaf portion of the plants
Stalk NO$_3$, ppm

- Upper 1/3 = 678
- Middle 1/3 = 3,557
- Lower 1/3 = 24,471

Whole Plant = 4,333

NO$_3$, ppm

- Leaf: 284
- Ear: 75

Michigan State Univ, 2007
Effect of Cutting Height of Corn Plants on Silage Yield and Quality

![Bar chart showing the effect of cutting height on silage yield and milk production. The chart indicates that higher cutting heights result in lower silage yield and milk per ton, but higher milk per acre.]

- **Silage yield**
- **Milk per ton**
- **Milk per acre**

**Stubble height after cutting, inches:**
- 6
- 12
- 18

**Lauer, Wisconsin**
# Nitrates and Diphenylamine Test

<table>
<thead>
<tr>
<th>Nitrate, ppm</th>
<th>% of stalks turning blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 2,500</td>
<td>46%</td>
</tr>
<tr>
<td>2,500 – 6,000</td>
<td>67%</td>
</tr>
<tr>
<td>6,000 to 10,000</td>
<td>86%</td>
</tr>
<tr>
<td>10,000 to 15,000</td>
<td>95%</td>
</tr>
<tr>
<td>&gt; 15,000</td>
<td>100%</td>
</tr>
</tbody>
</table>

61% false positives
11% false negatives

Selk et al., PAS 8:41-45.
Feeding Precautions

- Plants with few ears have a greater portion of N in ruminally soluble form
  - Keep diet N at ~50% ruminally degradable N
Feeding Precautions

- Plants with few ears have a greater portion of N in ruminally soluble form
  - Keep diet N at ~50% ruminally degradable N

- Don’t overfeed nitrates (less than 0.44% of dietary DM)

- Don’t underfeed starch (24-26% of diet DM)

- Have NDF tested for digestibility to better estimate NEL
Summary

- Effect of drought on corn plant development is most negative at pollination and during grain filling.

- Smut probably does not pose a health problem to cows.
Summary

- Ensile corn plants at 30 to 35% DM
- Analyze silage before feeding for
  - Nitrates
  - Protein and soluble protein
  - Starch
  - Digestible NDF