Corn Stover Harvests: Soil, Nutrient and Costs considerations

Higher yields come with more residue

Stover: A challenge and an opportunity

Growers are spending time and money to manage residue

Corn yields have increased as new technologies are developed and used

Anticipated impact of improvements in agronomics, breeding and biotechnology on average corn yields in the United States

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Residue survey used to gauge farmer view of stover

Three geographies

Residue survey (Sept 2010)

- 528 farmers
- Are actively involved in farming
- Are primarily responsible for decisions concerning seed purchases
- Planted at least 100 corn acres in 2010

What is a typical crop rotation for the corn acres on your farming operation?

Farmers view residue management as a problem

Seriousness Of Corn Residue Management Over The Past Few Years

- South
- Central
- West
- Overall

Over the past few years, would you say that managing corn residue has become:

Residue management costs about $12/ac

Uncertainty and risks of corn stover harvests

Stover project structure and scope

Soil health: Manage to erosion and organic matter targets

Conservation planning tools (RUSLE2, WPPS, and SC) have been used to estimate field-specific stover retention targets

  Theoretical Implications
- University of Nebraska Extension: Harvesting Crop Residues
  http://www.ianrpubs.unl.edu/epublic/pages/index.jsp?what=publicationD&publicationId=1026
- USDA NRCS Conservation Practice Standard 344: Residue Management, Seasonal.

- Soil health: Manage to erosion and organic matter targets
Soil health: Manage to erosion and organic matter targets

- Residue requirements by field (average = 2.5 ±1.3 dry tons/ac, n = 144)

- Management targets:
  - Erosion < 2.5 tons/ac
  - Build organic matter (all SCI subfactors > 0)

- RUSLE2 and Soil Conditioning Index (SCI) used to estimate amount of stover needed to reach these targets on field-by-field basis.

- Field stover requirements depend on rotation, yield, slope, soil type and management.

Corn yield required to provide minimum amount of stover 132 ±66 bu/ac in Benton County, Iowa.

Fields most suitable for harvest are flatter, higher yielding (C-C preferred) and have less tillage.

Management targets can be used to estimate national stover supply

- Includes soil organic matter (SCI), water erosion (RUSLE2) and wind erosion (WEPS).
- Source: D. Muth

Harvest statistics – All near Cedar Rapids, IA

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large round bales</td>
<td>6468</td>
<td>5635</td>
<td>4460</td>
</tr>
<tr>
<td>Large square bales</td>
<td>0</td>
<td>409</td>
<td>1567</td>
</tr>
<tr>
<td>Total harvest (dry tons)</td>
<td>2980</td>
<td>2799</td>
<td>2645</td>
</tr>
<tr>
<td>Baling rate (dry tons/ac)</td>
<td>1.2 ±0.5</td>
<td>1.7 ±0.6</td>
<td>1.3 ±0.3</td>
</tr>
<tr>
<td>Enrolled fields</td>
<td>38</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>Harvested fields</td>
<td>25</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Average corn yields</td>
<td>194</td>
<td>191</td>
<td>182</td>
</tr>
</tbody>
</table>

18 Participating farmers over the three years

3 unusual years = “average” weather

2008 – Delayed crop, frequent light rains, stover harvest during 2 breaks in rainfall, 17 harvest days

2009 – Very delayed crop, frequent heavy rains, stover harvest during longer break in rainfall, 18 harvest days

2010 – Early crop, excellent weather, 22 harvest days

This is “average” weather

- Harvest day defined as 3rd dry day
- 3.2 ± 0.5 harvest days/yr (1988-2009)
- Assume 6 week harvest window
- “Average” is 19.2 harvest days
- 2008 – 2010 average = 19 harvest days/yr

Raking

- Kuhn SR112 Speedrake, 21-23’ rake – estimate 4.5% dirt in 2008 bales

Windrows at an oblique angle to corn rows
Three balers used in 2010 harvest

<table>
<thead>
<tr>
<th></th>
<th>John Deere 567/568</th>
<th>Case IH RB8564</th>
<th>New Holland BB9080</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bales made</td>
<td>4460</td>
<td>1567</td>
<td></td>
</tr>
<tr>
<td>Baling rate (bales/hr)</td>
<td>38.6 ± 9.2</td>
<td>42.6 ± 7.0</td>
<td></td>
</tr>
<tr>
<td>Bale weight (lbs fw/bale)</td>
<td>1050 ± 148</td>
<td>1044 ± 120</td>
<td>934 ± 137</td>
</tr>
<tr>
<td>Bale moisture (%)</td>
<td>9.8 ± 1.5</td>
<td>13.3 ± 4.4</td>
<td>14.9 ± 5.5</td>
</tr>
<tr>
<td>Bale density (lbs dw/ft³)*</td>
<td>7.9 ± 1.4</td>
<td>7.5 ± 2.4</td>
<td>9.1 ± 3.6</td>
</tr>
</tbody>
</table>

*Standard deviation includes variation in fresh weights, moisture content and volume

Bühler/Inland 2500 bale carrier

Huge improvement, staging 86 bales/hr in 2009 vs. 19 bales/hr in 2008

Large square system tested in 2010

New Holland BB9080 large square baler

Bühler/Inland 4480 bale carrier

New Holland H5980 Heavy Duty Wheel Rake

Care needs to be taken not to over harvest

Post harvest field

Measuring bales
Sloven moisture varies by field and by year

**Nutrient content varies by field and year**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>15.4</td>
<td>15.5</td>
<td>15.4</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>3.5</td>
<td>3.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Micronutrients in corn stalk bales**

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Com.</th>
<th>Day 1</th>
<th>Day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron (Fe)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Bale storage and testing**

Rapid post-harvest moisture increase

Tarped stacks were most effective at keeping bales dry [Western Ag]

**Nutrient replacement value**

*Replacement costs are estimated using fall prices

Fixing a bale price in the spring is pre-selling nutrients

**Rye cover crop before and after harvest**

Cover crops can enhance corn stover harvests
Cornrower – Chopping corn head with windrow former

Windrowed corn stover

Chopping behind the Cornrower

Chopped, treated stover packed into a bunker

Chopped, treated stover packed into a bunker

Corn stover harvests and uses: Summary

- Properly done, stover harvests can improve the value of an acre of corn
- Requires management to erosion and organic matter targets
- Nutrient (N, P, K) removal costs average about $10/bale
- Harvesting dry stover can be challenging
- Cattle feed application works with wet stover
- Lower cost, higher volume bulk harvest are possible