CROP RESIDUE MANAGEMENT AND SOILS

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DeAnn Pressley
Several cellulosic ethanol plants will start operations between 2012 and 2014.

Feedstocks: Corn stover and wheat straw

What are the effects of crop residue removal on soil quality?

It is possible to remove a fraction of crop residues without affecting soil and water quality, soil C sequestration, and crop yields for different soils and crops.
POSITIVE IMPACTS OF RESIDUE REMOVAL

• promote soil warming.
• increase seed germination.
• reduce pests.
• increase crop yields.

In some soils, residue removal may:

Improve farm economy (Marketing excess residue produced).

HOW ABOUT NEGATIVE IMPACTS OF RESIDUE REMOVAL?
CORN STOVER REMOVAL FROM IRRIGATED AND RAINFED NO-TILL SOILS IN KS: Experiment established in spring 2009

(Ian Kenney, DeAnn Presley, Humberto Blanco, Brian Olson, and Keith Janssen)
WHEAT AND SORGHUM RESIDUE REMOVAL IMPACTS ON SOIL AND CROP YIELDS IN KANSAS: ON-FARM AND PLOT RESEARCH

(Yuxin He, Humberto Blanco, John Tatarko, DeAnn Presley, Scott Sttagenborg, and Gerard Kluitenberg)
Soil slope 6%

WHEAT STRAW REMOVAL ON WATER EROSION: HAYS
RESIDUE REMOVAL VERSUS SOIL WATER USE

• Biofuels vs. the Great Plains.
• About 100 L irrigation water needed for 1 L corn ethanol.
WHEAT STRAW REMOVAL INCREASES SOIL’S SUSCEPTIBILITY TO WIND EROSION: Experiments in Hays and Colby: 2 years after removal

Wheat straw removal reduces the strength of soil aggregates and thus increases the soil’s susceptibility to wind erosion.

Hays, KS
Precipitation = 580 mm

$y = -0.48x + 134.8$
$R^2 = 0.65; P = 0.05$

Colby, KS
Precipitation = 525 mm

$y = -1.53x + 218.9$
$R^2 = 0.98; P < 0.01$
**RESIDUE REMOVAL EFFECTS ON SOIL ERODIBLE FRACTION**

- **Hays**
  - Wind Erosion = 0.002*Removal + 0.37
  - \( r^2 = 0.64 \)

- **Colby**
  - Wind Erosion = 0.001*Removal + 0.27
  - \( r^2 = 0.46 \)

- **Garden City**
  - Wind Erosion = 0.002*Removal + 0.26
  - \( r^2 = 0.96 \)

- **WINTER WHEAT**
  - Erodible fraction (<0.84 mm aggregates)

- **GRAIN SORGHUM**
  - Erodible fraction (<0.84 mm aggregates)
Wheat straw removal effects on soil organic C: Hays

**2009**

- **Organic C** = -0.002*Removal Rate + 1.07
- $r^2 = 0.74; P=0.07$

![Graph showing relationship between wheat residue removal rate and soil organic C for 2009](image)

**2010**

- **Organic C** = -0.004*Removal Rate + 1.75
- $r^2 = 0.78; P=0.04$

![Graph showing relationship between wheat residue removal rate and soil organic C for 2010](image)

**2009**

- **Total N** = -3E-05*Removal + 0.14
- $r^2 = 0.04$

![Graph showing relationship between wheat residue removal rate and soil total nitrogen for 2009](image)

**2010**

- **Total N** = -0.0003*Removal Rate + 1.74
- $r^2 = 0.80; P=0.02$

![Graph showing relationship between wheat residue removal rate and soil total nitrogen for 2010](image)
Wheat straw removal effects on grain and straw yield: Hays

Yield = -0.135*Removal + 46.67  
$r^2 = 0.76; P=0.06$

Yield = -0.07*Removal + 25.79  
$r^2 = 0.81; P=0.02$

Yield = -0.12*Removal + 25.54  
$r^2 = 0.98; P<0.01$

Yield = -0.01*Removal + 4.89  
$r^2 = 0.61; P>0.10$

Yield = -0.01*Removal + 4.11  
$r^2 = 0.86; P=0.02$

Yield = -0.01*Removal + 2.99  
$r^2 = 0.90; P=0.01$
Runoff and Sediment Losses from No-Till Corn on a Barnes loam (Morris, MN; Lindstrom, 1986) Residue Treatments: 0.5Y, Y, 2Y

Loam (6% slope)

Runoff (mm)

Rate of Stover Cover (%)

\[ y = 398.8x^{-0.62} \]
\[ R^2 = 1; P < 0.01 \]

Soil Erosion (Mg ha\(^{-1}\))

Rate of Stover Cover (%)

\[ y = 22.8e^{-0.01x} \]
\[ R^2 = 0.99; P < 0.01 \]
THANKS FOR YOUR ATTENTION
Table 1. List of crop residue index values. Multiply index by bushels of grain produced per acre for an estimate of available residue.

<table>
<thead>
<tr>
<th>Residue</th>
<th>Crop Index*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>100</td>
</tr>
<tr>
<td>Corn</td>
<td>60</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>60</td>
</tr>
<tr>
<td>Oats</td>
<td>55</td>
</tr>
<tr>
<td>Soybeans</td>
<td>45</td>
</tr>
<tr>
<td>Sunflower</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* Residue index = pounds of residue produced/bushel of grain produced
• An easy way to estimate pounds of residue is to
• make a template from pliable rod or material that is 132
• inches long and can be bent to form a circle. The circular
• template will have a diameter of 42 inches. The area
• within the circle is a unique size because the weight of
• the dry matter residue within this circle, weighed in
• grams and multiplied by 10, will equal pounds per
• acre. For example, if 800 grams of residue dry matter
• are collected from within the circle, there are approximately
• 8,000 pounds of residue dry matter per acre
• available for grazing.