Comparing Tillage Systems (conventional, minimum, no-till) with Overhead Irrigation Using a 3 Year Crop Rotation of Corn, Soybean, and Barley.

Tyler Tjelde
Masters of Agronomy
19 May 2010
**BACKGROUND**

- Cartwright, ND
BACKGROUND

Brandy, Jeffrey (4) and Macy (2)
BACKGROUND

Education
- B.S. in Crop and Weed Sciences (NDSU 2003)
- Started Master of Science Distance Education Program in spring 2008

Work Experience
- Irrigation Research Specialist - North Dakota State University – Williston Research Extension Center (2008-present)
- Ag Research Technician - USDA-ARS, Northern Plains Ag Research Laboratory – Sidney, MT (2005-2008)
- Farm and ranch with my dad
WHY DID I CHOOSE THIS PROJECT

- Northeast MT and Northwest ND (MonDak region)
- ~ 350,000 Irrigated acres in region
- Potential exists for 2x acres
- Current practices
- Input costs and labor shortages
- Understanding crop residues
**NESSON VALLEY**

- 28 miles east of Williston, ND
- Soil Type – Lihen sandy loam
- 128 day frost free period
- 13.7 inches avg. annual precip
- MonDak Region
Nesson Valley Research Irrigation Site
OBJECTIVES

- Evaluate the interaction between crop production and tillage when overhead irrigation is used
- Examine the influence of tillage systems on soil quality
- Identify suitable soil management options, for irrigated crops in the MonDak region.
Why is it important?

Tillage practices can influence crop yield and production by changing physical, chemical and hydraulic characteristics of soil (structure, aeration, aggregate stability, carbon content, nitrate movement and leaching, bulk density, compaction, water content, infiltration rate hydraulic conductivity) over the growing season. The combined effects of various long term tillage systems and crop rotations on soil characteristics are not well understood, and consequently their interrelationships have not yet been defined (Jabro et al., 2008).
Experimental Design
TILLAGE SYSTEMS

- Conventional tillage
  - <30% crop residue remaining on the soil surface

- Minimum tillage (reduced)
  - >30% crop residue remaining on soil surface

- No-till
  - Soil is left intact and crop residue is left on the soil surface
CONVENTIONAL TILLAGE

- System that mixes or disturbs the soil extensively, burying plant surface residue in the process.
  + i.e. moldboard plow, disk, chisel plow, ripper

  “Turn the soil black”
MINIMUM TILLAGE

- Leaving >30% crop residue
- Minor soil disturbance
  + Strip till
  + One pass system
  + Minimal soil disturbance
- Leaving the soil undisturbed from harvest to planting
- Residue (not trash!) is a resource
OVERVIEW OF CROP PRODUCTION

- Corn
- Soybean
- Barley
LINEAR OVERHEAD IRRIGATION
North Dakota Ag Weather Network (NDAWN)

http://ndawn.ndsu.nodak.edu

<table>
<thead>
<tr>
<th>Crop</th>
<th>Irrigation Amounts</th>
<th>Rainfall Amounts</th>
<th>Total Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>11.00</td>
<td>10.50</td>
<td>21.50</td>
</tr>
<tr>
<td>Soybean</td>
<td>10.70</td>
<td>10.14</td>
<td>20.84</td>
</tr>
<tr>
<td>Barley</td>
<td>7.95</td>
<td>8.48</td>
<td>16.43</td>
</tr>
</tbody>
</table>

Irrigation and Rainfall amounts from crop emergence to harvest
Conventional

- Provides seedlings with less resistance as they sprout upward
- Produce a fine seedbed
- Better mechanical weed control
- Increases nitrogen mineralization
- Vulnerable to erosion
No-till and minimum till
- Water infiltration
- Soil moisture
- Soil temperature
- Soil aeration
- Microbial populations and activity
- Erosion control
### 2009 Weather Conditions

#### Nesson Valley 2009 growing season (May-October)

<table>
<thead>
<tr>
<th>Month</th>
<th>09 Avg. Temp</th>
<th>Avg. Normal Temp</th>
<th>Dept. from Normal</th>
<th>09 Rainfall</th>
<th>Dept. from Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degrees F</td>
<td>Degrees F</td>
<td>Degrees F</td>
<td>inch</td>
<td>inch</td>
</tr>
<tr>
<td>May</td>
<td>67.1</td>
<td>67.3</td>
<td>-0.2</td>
<td>0.3</td>
<td>-1.9</td>
</tr>
<tr>
<td>June</td>
<td>73.0</td>
<td>75.8</td>
<td>-2.7</td>
<td>3.2</td>
<td>0.3</td>
</tr>
<tr>
<td>July</td>
<td>75.5</td>
<td>81.7</td>
<td>-6.3</td>
<td>4.6</td>
<td>2.3</td>
</tr>
<tr>
<td>August</td>
<td>77.5</td>
<td>81.6</td>
<td>-4.1</td>
<td>1.9</td>
<td>0.1</td>
</tr>
<tr>
<td>September</td>
<td>78.4</td>
<td>69.3</td>
<td>9.1</td>
<td>0.5</td>
<td>-1.2</td>
</tr>
<tr>
<td>October</td>
<td>44.6</td>
<td>55.9</td>
<td>-11.3</td>
<td>1.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Information obtained from NDAWN - Nesson Valley Hofflund Bay site

#### 2009 Corn GDD

<table>
<thead>
<tr>
<th>Month</th>
<th>09 GDD</th>
<th>Normal GDD</th>
<th>Dept. from Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degrees F</td>
<td>Degrees F</td>
<td>Degrees F</td>
</tr>
<tr>
<td>May</td>
<td>267</td>
<td>262</td>
<td>5</td>
</tr>
<tr>
<td>June</td>
<td>637</td>
<td>659</td>
<td>-22</td>
</tr>
<tr>
<td>July</td>
<td>1078</td>
<td>1211</td>
<td>-133</td>
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<tr>
<td>August</td>
<td>1533</td>
<td>1742</td>
<td>-209</td>
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<td>September</td>
<td>1974</td>
<td>2037</td>
<td>-63</td>
</tr>
<tr>
<td>October</td>
<td>2000</td>
<td>2141</td>
<td>-141</td>
</tr>
</tbody>
</table>

Information obtained from NDAWN
RESULTS

- Soil Temperatures
- Surface Residue
- Emergence
- Plant Populations

4 June 2010
# RESULTS (CONT.)

<table>
<thead>
<tr>
<th>Corn</th>
<th>Yield</th>
<th>Test weight</th>
<th>Protein</th>
<th>Starch</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bu/A</td>
<td>Lb/bu</td>
<td>%</td>
<td>%</td>
<td>Plant/A</td>
</tr>
<tr>
<td>Tillage treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional till</td>
<td>228.5 a</td>
<td>53.9 a</td>
<td>11.3 a</td>
<td>68.8 a</td>
<td>36880 a</td>
</tr>
<tr>
<td>Minimum till</td>
<td>157.1 b</td>
<td>51.3 b</td>
<td>10.9 a</td>
<td>68.7 a</td>
<td>34702 b</td>
</tr>
<tr>
<td>No - till</td>
<td>126.0 b</td>
<td>49.9 b</td>
<td>10.4 a</td>
<td>68.6 a</td>
<td>36445 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>14.1</td>
<td>2.7</td>
<td>8.2</td>
<td>0.9</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Previous crop: barley

Numbers followed by the same letter within a column are not significantly different (0.05)
RESULTS (CONT.)

<table>
<thead>
<tr>
<th>Soybean</th>
<th>Yield</th>
<th>Test weight</th>
<th>Protein</th>
<th>Oil</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tillage treatment</strong></td>
<td><strong>Bu/A</strong></td>
<td><strong>Lb/bu</strong></td>
<td><strong>%</strong></td>
<td><strong>%</strong></td>
<td><strong>X 1,000</strong></td>
</tr>
<tr>
<td>Conventional till</td>
<td>44.4 a</td>
<td>57.0 a</td>
<td>36.7 a</td>
<td>20.3 a</td>
<td>167.5 a</td>
</tr>
<tr>
<td>Minimum till</td>
<td>41.4 a</td>
<td>57.1 a</td>
<td>36.9 a</td>
<td>20.4 a</td>
<td>171.0 a</td>
</tr>
<tr>
<td>No - till</td>
<td>42.9 a</td>
<td>57.5 a</td>
<td>37.4 a</td>
<td>20.5 a</td>
<td>171.3 a</td>
</tr>
<tr>
<td><strong>CV (%)</strong></td>
<td>8.8</td>
<td>0.7</td>
<td>6.1</td>
<td>2.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Previous crop: corn

Numbers followed by the same letter within a column are not significantly different (0.05)
### RESULTS (CONT.)

<table>
<thead>
<tr>
<th>Barley</th>
<th>Yield</th>
<th>Test weight</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tillage treatment</strong></td>
<td><strong>Bu/A</strong></td>
<td><strong>Lb/bu</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Conventional till</td>
<td>118.9 a</td>
<td>52.7 a</td>
<td>9.8 a</td>
</tr>
<tr>
<td>Minimum till</td>
<td>106.3 ab</td>
<td>52.6 a</td>
<td>9.8 a</td>
</tr>
<tr>
<td>No - till</td>
<td>97.1 b</td>
<td>52.5 a</td>
<td>9.7 a</td>
</tr>
<tr>
<td><strong>CV (%)</strong></td>
<td>9.4</td>
<td>0.4</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Previous crop: soybean

Numbers followed by the same letter within a column are not significantly different (0.05)
SUMMARY AND CONCLUSIONS

- Significant differences
- 2009 weather
- Maintain yields
- Managing residue
- Additional Information


Thank You

Contributors
Jim Staricka
Jim Jenks
Cameron Wahlstrom
Why do we need to upset 500 to 1,000 tons of soil per acre with a moldboard plow when in reality we will use only about 8 percent of it for a seedbed (Ganzel, 2007)?

New World Encyclopedia