WHY PERFORM TILLAGE

- THE PHYSICAL MANIPULATION OF THE SOIL FOR THE PURPOSES OF:
  - Management of previous crop residues
  - Control of competing vegetation
  - Incorporation of amendments
  - Preparation of a seedbed

- CONSERVATION TILLAGE LEAVES >30% RESIDUE
Tillage intensity in Wisconsin varies by crop.
INTENSIVE TILLAGE PROMOTES SOIL EROSION

DETACHMENT

DEPOSITION

Detachment

Sediment Load

Sediment Transport

Soil

Sediment Load

Deposition

Soil
CROP RESIDUE IS STILL THE BEST EROSION PREVENTION TOOL

- Reduced Detachment
- Hinders Overland Flow
- Improved Infiltration
- Rotations Maintain Soil Structure
- 30% Residue Reduces Erosion 60%
CONSERVATION TILLAGE REQUIRES ADAPTABILITY TO CONDITIONS

SKI IOWA !!
SELECT SITUATIONS TO REDUCE TILLAGE INTENSITY

- EVERY FIELD DOES NOT HAVE TO BE PLOWED
- NO-TILL OR MINIMUM TILL INTO FALL KILLED ALFALFA OR SOYBEAN STUBBLE
- PLANTER ATTACHMENTS BECOMING POPULAR
- WILL REQUIRE MORE ATTENTION TO PLANTER SETUP AND OPERATION
- OFTEN ECONOMICALLY JUSTIFIED
SOIL PROPERTIES AFFECTED BY TILLAGE

- Crop residue cover
- Soil test measurements
- Nutrient availability
- Structure and aggregate stability
- Water relationships
- Temperature
- Soil biology
- Strength
TILLAGE EFFECT ON SOIL TEST

ISSUES

- Nutrient stratification
  - Surface applied nutrients
  - Crop residues
  - Vertical and horizontal
- How to collect a representative sample
- Fertilizer placement considerations
SOIL TEST STRATIFICATION FOLLOWING FIVE YEARS OF TILLAGE MANAGEMENT, ARLINGTON, WIS.

Wolkowski, 2003 (Corn/soybean rotation)
TILLAGE HAS A PROFOUND EFFECT ON THE SOIL PHYSICAL CONDITION

TEN BOTTOM MOLDBOARD PLOW SET AT 11”, WOOD CO., WIS.
PROPER TILLAGE MANAGEMENT, ROTATION, AND ORGANIC ADDITIONS MAINTAIN AGGREGATE STABILITY
### TILLAGE EFFECTS ON SOIL (0-2 IN.) PROPERTIES AT LANCASTER, WIS.

<table>
<thead>
<tr>
<th>TILLAGE</th>
<th>STAB. AGGR.</th>
<th>TOTAL C</th>
<th>EARTH WORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>g/kg</td>
<td>No./m²</td>
</tr>
<tr>
<td>No-till</td>
<td>46</td>
<td>24</td>
<td>78</td>
</tr>
<tr>
<td>Chisel</td>
<td>34</td>
<td>16</td>
<td>52</td>
</tr>
<tr>
<td>Plow</td>
<td>36</td>
<td>11</td>
<td>53</td>
</tr>
</tbody>
</table>

*Karlen et al., 1994*
STRIP-TILLAGE CAN OFFER A COMPROMISE
STRIP TILLAGE EXPANDS CROP RESIDUE MANAGEMENT

Three categories

- **ROW OR RESIDUE CLEARING**
  - REMOVE RESIDUE
  - FINGER COULTERS, BRUSHES, SWEEPS

- **STRIP TILLAGE (SHALLOW: < 6 in.)**
  - MOVE RESIDUE, SEEDBED PREP., ROW FERTILIZER
  - FLUTED COULTERS, DISCS

- **STRIP TILLAGE (DEEP: > 6 in.)**
  - DISRUPT COMPACTION, DEEP-PLACE FERTILIZER
  - KNIVES
  - SOME WITH COULTERS TO MOVE RESIDUE OR CREATE MINI-RIDGES
SOIL TEMPERATURE AFFECTED BY TILLAGE AND CROP RESIDUE

Effect on crop residue, Arlington, 1994

Effect on in-row soil temperature, Arlington, 1994

Wolkowski, 2000
## EFFECT OF TILLAGE ON THE EARLY GROWTH OF CORN, ARLINGTON, WIS.

<table>
<thead>
<tr>
<th>TILLAGE</th>
<th>EMERGENCE</th>
<th>V6</th>
<th>V12</th>
<th>SILKING</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>plt/ft</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Strip-till</td>
<td>1.6</td>
<td>1.1</td>
<td>28</td>
<td>62</td>
</tr>
<tr>
<td>Chisel</td>
<td>1.8</td>
<td>1.1</td>
<td>29</td>
<td>80</td>
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<tr>
<td>No-till</td>
<td>0.7</td>
<td>0.7</td>
<td>18</td>
<td>36</td>
</tr>
</tbody>
</table>

*Wolkowski, 2000*
INTERACTIVE EFFECT OF TILLAGE AND ROW FERTILIZER, ARLINGTON, 1994-1996

Wolkowski, 2000
LANCASTER TILLAGE STUDY, 2004

Strip-tilling

Planted strip-till trmt.

Runoff collector in strip-till

Collector in chisel
LANCASTER TILLAGE STUDY, 2004

Chisel

Strip-till

Chisel

Strip-till
ESTIMATED SEDIMENT LOSS FROM FIRST-YEAR CORN AS AFFECTED BY TILLAGE

<table>
<thead>
<tr>
<th>Event Date</th>
<th>Amt.</th>
<th>Date sampled</th>
<th>Chisel</th>
<th>Strip-till</th>
</tr>
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<tbody>
<tr>
<td>13 May</td>
<td>0.95</td>
<td>14 May</td>
<td>0.117</td>
<td>0.006</td>
</tr>
<tr>
<td>21 May</td>
<td>0.5</td>
<td>24 May</td>
<td>2.82</td>
<td>0.225</td>
</tr>
<tr>
<td>22 May</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 May</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 May</td>
<td>1.17</td>
<td>1 June</td>
<td>0.39</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>1.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 July</td>
<td>0.73</td>
<td>12 July</td>
<td>0.27</td>
<td>0.009</td>
</tr>
<tr>
<td>12 July</td>
<td>0.41</td>
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</tbody>
</table>

Lancaster, 2004
Average of two collectors
YIELD RESPONSE TO TILLAGE AND K FERTILIZATION, LANCASTER, 2004

Avg. of two K rates
CHISEL PLOWING IS A VERSATILE CONSERVATION TILLAGE METHOD

- Reasonable progression from moldboard plowing
- Faster and consumes less fuel than moldboard plowing
- Many are adjustable for soil and residue conditions
- Point selected affects remaining residue and surface roughness
COMPARISON OF CHISEL POINTS

Twisted shovel

35 % Residue
COMPARISON OF CHISEL POINTS

Sweep

54 % Residue
CONTROLLED TRAFFIC IS A KEY TO MAKING REDUCED TILLAGE WORK

- Soil compaction robs yield
- Controlled traffic research, Australia
- Practiced on 2.5 million acres
- 500 GPS guided tractors
- Research shows 10-15% yield increase from controlled traffic management
HEAVY VEHICLES INDUCES SUBSOIL COMPACTION
SOIL ABUSE THAT CAUSES COMPACTION IS ALL TOO COMMON
TILLAGE INFLUENCES RESISTANCE TO PENETRATION

- Greater penetration resistance in no-till in top 6” compared to chisel when not compacted
- Compacted chiseled soil has greater resistance than no-till
- Greater penetration resistance when soil is dry
- Compaction effects more distinct in dryer soil
  dry (36 % vs. 27 %)

Arlington, Plano silt loam
DETERMINING THE NEED FOR SUBSOILING

- Evaluate depth and severity of compaction
- Check with penetrometer, probe, shovel
- Dig plants to examine roots
- Leave untreated strips for comparison
- Subsoiling is an expensive operation
- Subsoiling is not a cure-all, address compaction
ARE ALL SITUATIONS RESPONSIVE TO DEEP TILLAGE?
(SOIL BULK DENSITY PROFILE, ARLINGTON, WIS., 1998)

Depth (in)

0

8

16

Not subsoiled

Subsoiled

Bulk Density (g/cc)

0.8 - 0.9
0.9 - 1
1 - 1.1
1.1 - 1.2
1.2 - 1.3
1.3 - 1.4

PLANO SILT LOAM
EFFECT OF TILLAGE AND K FERTILIZATION ON FIRST-YEAR CORN YIELD AFTER SOYBEAN (2 yr. avg.)

Arlington, Wis.
THERE ARE DIFFERENCES BETWEEN SUBSOILERS

“V-Ripper”
- Leading disks
- Parabolic shanks
- Winged points

“Conservation”
- Cutting coulters
- Straight shanks
- Horizontal points
EFFECT OF SUBSOILER TYPE ON SOYBEAN AND CORN YIELD ON A SILTY CLAY LOAM SOIL

**Manitowoc, Wis.**
CONSERVATION TILLAGE IS NOT A “GIMME”
SUMMARY

- Tillage greatly modifies soil properties related to soil quality and crop growth.
- Intense tillage impacts residue management and soil consolidation, and can promote erosion.
- Improve traffic and tillage management to enhance soil quality and maintain productivity.
- Look for opportunities to reduce tillage intensity.
- High residue systems need “tweaking” in northern Wisconsin.