Tillage & Conservation Tillage

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NREM 461
I. Conventional & Conservation Tillage

A. **Tillage**: mechanical manipulation of soil to modify conditions, manage crop residues & weeds, incorp. chemicals for crop prod.

1. Critical adaptation of early farmers;
2. With time & tech., tillage implements became bigger, more rugged; tractors became larger & more powerful

3. Double-edged sword: necessary at times but
B. Objectives of tillage:

1. Prepare seedbed

2. Control weeds

3. Incorp. residue
C. Undesirable effects occur

1. soil compaction

2. accelerated decomposition of OM

3. ↑ erosion

(Brady & Weil 2002)
D. Types of tillage implements

1. **Plow**: sharpened spike drawn thru soil
   a.
2. **Moldboard Plow**: specialized plow that lifts, turns soil in plow layer, depositing inverted soil in space occupied by adjacent furrow

   a. developed in England in 18th cent.

   b. modern moldboard plow

(Troeh et al. 2004)
3. **Disk Cultivator**: tillage implement w/ a number of saucer-shaped, steel components mounted on 1 or more axels
Figure 9-4  A tandem disk. The front disks turn the furrows out from the center, the rear disks toward the center. Such implements produce a relatively smooth surface and cover part of the crop residues. This unit is equipped with a “floating” central small disk that cuts the ridge left by the front disk gangs. (Courtesy Deere and Company, Moline, Illinois.)  (Troeh et al. 2004)
4. **Tine Cultivator**: implement w/ points/blades mounted on frame used after plowing, disking
   
   a. break clods, smooth soil surface, uproot & kill weeds
5. **Chisel Plow**: ripping implement w/ several tiers of shanks on a frame that penetrates 8-12 in

a.

(Troeh et al. 2004)
Figure 9-11  Skew treads attached behind a gang of chisel plows. The treads help to smooth the seedbed and to anchor the loose straw in the soil. A large amount of residue remains on the ground surface after this combined operation. (Courtesy Sunflower Manufacturing, Beloit, Kansas.)
E. **Conservation Tillage**: term applied to variety of systems that leave soil surface trashy, cloddy, & ridged (leave $\geq 30\%$ residue cover on soil surf. after planting, $\geq 1000$ lb/ac residue)

1. **Stubble mulch tillage (trashy fallow)**: farming w/ implements so that residues remain on soil surface at seeding to control erosion

   a.
2. **reduced tillage**: dispenses w/ some or all of pre- & post-plant tillage
   a. red. tillage ↓ fuel costs, conserves soil
   b. usu. requires use of chemical weed control
3. **no-till**: no tillage for seedbed preparation or weed control except for action of planter

a. George McKibbon (IL agronomist)

b. Leave preceding crop’s residue virtually undisturbed

c. Planter can be fitted w/ chisel or disk to open furrow for seed, extra hoppers for fertilizer, herbicide

d. *What are 2 most common no-till crops?*
Figure 9–17  A no-till row crop planter. The planter is equipped to open the furrow, push crop residue to the side, fertilize, and apply herbicides. This type of implement will work equally well in untilled wheat stubble or in clean-tilled land. (Courtesy Fleischer Manufacturing, Inc., Columbus, Nebraska.)
Figure 9-18 A no-till grain drill with rugged, high-clearance furrow openers and a combined air seeder/fertilizer applicator. This unit comes in widths from 27 to 57 ft (8.2 to 17.4 m) and is capable of seeding through dense residues on untilled small grain or row crop fields. An herbicide application attachment is available. (Courtesy CNH Global N.V., Saskatoon, Saskatchewan, Canada.)
Figure 2: Comparison of Various Operations Involved In Different Tillage Systems with Corn

<table>
<thead>
<tr>
<th>Tillage System</th>
<th>Plow</th>
<th>Chisel</th>
<th>Disk</th>
<th>Cultivator</th>
<th>Planter</th>
<th>Crop Residue Remaining</th>
<th>Water Erosion Reduction</th>
<th>Conservation Comments</th>
</tr>
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<tbody>
<tr>
<td>Moldboard Plow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 Pounds/Acre</td>
<td>0%</td>
<td>Least effective for erosion control.</td>
</tr>
<tr>
<td>Disk Harrow</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1500 Pounds/Acre</td>
<td>40%</td>
<td>May not leave sufficient surface residue. Buries approximately 50% of residue per trip over the field.</td>
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<tr>
<td>Chisel Plow (twisted shank)</td>
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<td></td>
<td></td>
<td>3000 Pounds/Acre</td>
<td>65%</td>
<td>Roughens surface, covers up to 75% of residue per trip over the field.</td>
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<tr>
<td>Chisel Plow (straight shank)</td>
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<td></td>
<td></td>
<td></td>
<td>4800 Pounds/Acre</td>
<td>75%</td>
<td>Roughens surface, covers about 20% of residue per trip over the field.</td>
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<tr>
<td>Ridge-Plant</td>
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<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>4800 Pounds/Acre</td>
<td>75%</td>
<td>Cultivator must be used for weed control and ridge forming.</td>
</tr>
<tr>
<td>No-Till</td>
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<td>*</td>
<td>*</td>
<td>6000 Pounds/Acre</td>
<td>95%</td>
<td>High dependency on herbicides for control of weeds—special cultivator capable of operating in heavy residue may be needed.</td>
</tr>
</tbody>
</table>

1/ Measured in pounds per acre based on 100-bushel per acre yield. Actual residue left will vary with tractor speed, machinery settings, and heanness of crop growth.

2/ Data are approximations. Figures will vary according to soil type, percent and length of slope, amount of rainfall, and cropping system.

Legend: o Indicates equipment ordinarily needed.

Legend: O Optional equipment that may be used.

Legend: * Specialized or modified equipment needed.

Source: Soil Conservation Service of Michigan.
<table>
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<th>Advantages to no-till</th>
<th>Disadvantages to no-till</th>
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F. Subsoiling & Deep Plowing

1. **Subsoiling**: practice of opening soil 12-24 in. or greater w/ chisel that penetrates soil *w/o inverting* ripped layer

   a.

2. **Deep plowing/ripping**: inverts cultivated layer by using large disks (up to 3 ft diameter) or w/ large moldboard plows

   a. used to bury infertile surface soil material &
G. Emergency tillage

1. 2 general methods of **Emergency tillage**:

   a. Spreading straw, manure, mulches, coarse sand, fine gravel on soil surface

   b. Roughen soil surface to reduce wind velocity, bring clods to surface,