No-Till

• Sections 8.9 through 8.12 in Blanco and Lal were used as reference
Benefits of No-till for Crop Production
(Table 8.3 page 203)

- Prevents crusting
- Reduces wind erosion and crop abrasion
- Reduces scour and burial from water erosion
- Reduces nutrient loss from erosion
- Increases soil organic matter
- Increased microbial activity
- Increases nutrient cycling through residue retention
- Reduces diurnal fluctuations in soil temperature
- Decreases rate of evaporation from soil surface
- Reduces surface soil moisture fluctuation
- Reduced tillage and labor costs
Benefits of No-till for the Environment

• Water Quality
  – Nutrient, and sediment loads are decreased
  – In regions where herbicides are used regardless of tillage, they too can be decreased in runoff

• Wild life habitat
  – Pheasant in the high plains provides an example

• Carbon sequestration

• Albedo (reflectivity) of the surface can be increased
  – MAY contribute to mitigation of climate change
Environmental Challenges in using No-till

- Increased herbicide use
- Stratification of nutrients resulting in increased risk of dissolved nutrient runoff.
- Improvements in macroporosity and water infiltration can cause increased leaching
  - Particularly concerning in systems with subsurface drainage
Challenges to No-Till

- Herbicide Resistance
- Increased management requirements
- Crop rotations must be developed
- Soil compaction
- Must be more selective with regard to planting conditions
  - For example should wait until residues are dry
  - “Dusting in” a crop is more challenging but can be done in no-till
Challenges to No-Till

• Grazing No-Till
  – Recent studies have shown that grazing can improve microbial activity and nutrient cycling
  – Dual purpose no-till has been shown to be equally successful as tillage systems
  – Fall forage production can be lower however, weight gains are generally similar because cattle don’t bog down during wet conditions
  – Earlier planting may also overcome cooler soil temps
    • However, this must be weighted against pest pressure that can occur in early planted wheat
Other challenges to No-till Grazing

• Must be careful not to over graze
  – Residue management is critical
  – Sufficient residue must be maintained to protect the soil surface
Grazing No-till

- Residue will prevent crusting and further deterioration of soil condition during fallow period
- Wetting and drying cycles will alleviate compaction
- Maintenance of residue or green growing plants also ensure active root growth which prevent compaction
Grazing No-till

• If severe compaction results from gazing deep tillage is not required
• Grazing generally will only compact soil at 0-4 inches
• Shallow ripping will break up compaction from grazing
Soil Structural Improvements

• Removal of tillage from the system allows soil structure to improve
• Macropores formed from shrink/swell, root growth, and worm borrowing can be maintained
• Surface residues are critical for maintaining this structure
  – Protect surface from crusting
  – Provide organic matter for biological activity and aggregate stability
Soil Structural Improvements

• Bare surface of a 15 year old no-till soil after cotton followed by sesame
Soil Structural Improvements

• Worm casts cover the soil surface
Soil Structural Improvements

• A high residue crop is needed to protect this soil from degradation
Surface Evidence of Soil Structure

- Worm casts under residue
Surface Evidence of Soil Structure

- 70 bushel double crop sorghum after 50 bushel wheat
Topsoil structure

• Granular or small blocky structure is preferred in surface soil

• Tillage temporarily improves soil tilth (section 8.2)
  – Reconsolidation results in massive structure
  – This is why residue maintenance is so important
    • Prevents crusting
    • Cover crops in the early years of adoption may also help by providing root growth during fallow period
Benefits of Structure

• Increased Macroporosity improves air, water and root movement in soils

• As structure improves so will:
  – Root respiration
  – Water availability
  – Nutrient uptake

• Runoff may also decrease
Influence of No-Till on Evaporation

• Maintenance of crop residues decreases the rate of evaporation
  – It does not eliminate it

• In environments like Oklahoma evaporation represents the largest loss of water from a summer fallow system

• No-till can decrease this loss and make double crops and summer more successful
Soil Water in 0-15 inch Depth at Lahoma (7/09-6/11)

- Surface soil moisture is generally higher in NT
  - Reduced Evaporative Water Loss
Soil Water in 4 ft Profile at Lahoma (7/09-6/11)

- Effect of tillage is reduced
July 2009

![Soil Depth Graph]

- **Soil Depth (inches)**
  - 90
  - 80
  - 70
  - 60
  - 50
  - 40
  - 30
  - 20
  - 10
  - 0

- **Water Content (Inches H₂O/Inch soil)**
  - 0
  - 0.1
  - 0.2
  - 0.3
  - 0.4

- **Soil Depth (inches) vs. Water Content**
  - Conv. Wheat
  - NT Wheat
## Wheat Yields at Lahoma

<table>
<thead>
<tr>
<th>Cropping System</th>
<th>Yield Bu/acre</th>
</tr>
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<tbody>
<tr>
<td><strong>2008</strong></td>
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<tr>
<td>Conv. Wheat</td>
<td>36</td>
</tr>
<tr>
<td>NT Wheat</td>
<td>38</td>
</tr>
<tr>
<td>NT Wheat After Canola</td>
<td>41</td>
</tr>
<tr>
<td><strong>2009</strong></td>
<td></td>
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<tr>
<td>Conv. Wheat</td>
<td>43</td>
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<tr>
<td>NT Wheat</td>
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<td>NT Wheat After Summer Crops</td>
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<td><strong>2010</strong></td>
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</tr>
<tr>
<td>Conv. Wheat</td>
<td>37</td>
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<tr>
<td>NT Wheat</td>
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</tr>
<tr>
<td>NT Wheat Second Year After Summer Crops</td>
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<tr>
<td><strong>2011</strong></td>
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<tr>
<td>CT Wheat</td>
<td>64</td>
</tr>
<tr>
<td>NT Wheat</td>
<td>65</td>
</tr>
<tr>
<td>NT Wheat After Canola</td>
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<tr>
<td>NT Wheat After Summer Crops</td>
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</table>
# Average Yields at Lahoma

<table>
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<th>Cropping System</th>
<th>Yield Bu/acre</th>
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<td>NT Wheat After Canola</td>
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<tr>
<td>NT Wheat After Summer Crops</td>
<td>46</td>
</tr>
</tbody>
</table>
Long-Term Wheat Yields in Goodwell
Long-Term Sorghum Yields in Goodwell
Soil Temperature under No-till

- Crop residues decrease soil temperature in summer months
- Can increase soil temps in winter due to insulation
Soil Temperature under No-till

• Decreased summer soil temps can benefit late spring planted crops
  – Soybeans

• Decreased temps can be a challenge for early planted crops:
  – corn
Soil Compaction

- All soils managed using modern mechanical agricultural practices are compact
- The extent of compaction and its impact on productivity is dependent on soil type and management
- Surface compaction is of specific concern for no-till soils
  - Cannot be tilled away
Soil Compaction

• Greater efforts to limit traffic during wet periods are needed in No-till

• Controlled traffic becomes a more attractive management option for no-till systems
  – Prevents whole field compaction
  – Compacted traffic lanes allow for more rapid entry into field after rainfall events
An Example of a Controlled Traffic Program

• The key is to minimize the annual footprint.
  – Wide traffic lanes increase the area that could be negatively impacted by traffic
  – The system would be best served by not utilizing duals and eliminating field activities during wet conditions.
An Example of a Controlled Traffic Program

• Precision driving would help in row crops.
  – Will keep tracks in the inter-row space
  – Would not be as effective in the wheat crop

• Tram lines would provide for precision driving in a wheat system
A Brief History of No-Till

• The Earliest forms of No-till were adopted during the 1960 in the U.S.
• No-till adoption was made possible by:
  – Development of Herbicides
  – Demonstration sites
  – Introduction of fluted coulter planters
• However, adoption was limited to a small portion of cropland until the 1990s
• 30 years for a significant change in cultural practices!!!
An OSU Extension Survey found that No-till practices were implemented on 28% of Oklahoma Cropland in 2008
No-Till in South America

• South America has experienced the most impressive rate of no-till adoption
• Increased from 0.7 to 40.6 Mha between 1987 to 2004
• Paraguay has the largest percentage of No-till cropland in the world,
  – Nearly 70% of the cropland is in no-till
No-Till in Europe

- Efforts to establish no-till were initiated in the 1950s.
- Adoption was limited because of problems with weed control.
- Similar story to the U.S.
  - The first experience producers had were negative.
  - This appears to have delayed adoption even after technologies were improved.
No-till in Africa

• In general, adoption is very limited
• In Africa, adoption is limited by
  – Cost of mechanized no-till equipment
  – Land tenure
  – Harsh climate conditions
  – Lack of knowledge
  – Lack of crop residues (cultural practices associated with animal production and fuel)
No-Till in Asia

• Generally represents a small faction of total cropland management

• India provides for some optimism:
  – No till wheat acres increased from 400 ha in 1998 to 2.2 Mha in 2005.
No-till in Australia

• No-till is expanding rapidly
• In Western Australia 85% of cropland is no-till
• Nationally only 40% of cropland is under no-till
My thoughts on Why No-Till Adoption has been Slow

• Reinvestment costs for older producers
  – 65 year old farmers are generally not interested in borrowing money and changing their business model

• Knowledge gaps must be filled
  – This takes time and effort

• Early efforts had limited success
  – We have better equipment and technologies

• Perception that no-till can not be grazed
  – It can be successfully grazed but changes are required