Proceedings of the 2007 CPM Short Course and MCPR Trade Show

December 4 – 6, 2007
Minneapolis Convention Center

Do not Reproduce or Redistribute Without Written Consent of the Author(s)
Conservation Tillage for Continuous Corn: Constraints and Opportunities

Tony J. Vyn
&
Students,
Colleagues,
Farmers
Does ethanol really change the conservation tillage decisions for corn production?

Picture courtesy of B. Moebius, Cornell University, 2007
4-State No-till Adoption in 2004

Acreage (%)

Ohio
Ind.
Ill.
Iowa

Corn
Soybean

Source: CTIC National Crop Residue Survey
Tillage Choices for Corn after Soybean versus Corn after Corn?

Photo credit: Greg Stewart
Answer: Depends on Soil Type, Erosion Risk, Technology Adoption and Crop Management

Picture courtesy of Jeff Vetsch
What Kind of Corn-Dominant Rotation?

- Continuous Corn
- Soybean-Corn-Corn
- Soybean-Corn-Corn-Corn
- Soybean-Corn-Corn-Soybean-Corn
- Soybean-Wheat-Corn-Corn-Corn
- Alfalfa-Alfalfa-Alfalfa-Corn-Corn-Corn
Ratio of Corn to Soybean Acres (2005)

Source: G. Shnitkey, Univ. of Illinois, Farm Economics Facts and Figures (Sept. 15, 2006)
Triplett - Van Doren
Tillage and Rotation Plots in Ohio
Corn Yield Response to Rotation/Tillage (Wooster, OH; 1963-2006)
Wooster Site

Organic Carbon (g kg\(^{-1}\))

Plow

No tillage

Purdue Agronomy
Tillage Effects on Organic C (Wooster) over 3 Decades

Source: Warren Dick, OSU
Corn Yield Response to Rotation/Tillage (Hoytville, OH; 1963-2006)
Tillage Effects on Organic C (Hoytville) (1980 to 2005)

Source: Warren Dick, OSU
Long-term Rotation and Tillage Plots
Silty clay loam, W. Lafayette, IN 1975-2006
Corn Yield Response to Tillage and Rotation, Silty Clay Loam, W. Lafayette, IN, 1975-2006.
Long-term Tillage Effects on Soil Organic Matter (1975-2003, West Lafayette, IN)

Source: Gal, Vyn et al., 2007, Soil Tillage Research

Source: Gál et al., 2007 Soil Tillage Research
Long-term Tillage and Rotation Effects on Total Soil Carbon to 1.0 m depth (1975-2003)

Source: gàl, Vyn et al., 2007, Soil Tillage Research
Continuous versus Short-term No-till Influence on Soil Carbon Weight

Source: Omonode, Gál, Stott, Abney & Vyn* 2006, SSSAJ 70:419-425
Successful Strip Tillage after Soybean and Reasonable Soil Moisture Conditions

Source: Norm Larson, Elburn Co-op, IL
Strip Tillage for Corn after Corn?
Surface Residue Cover (%) after Planting Loam Soil, Wanatah, IN, 2001-2005

![Surface Residue Cover Graph]

- Soy
- Corn

Previous Crop

Surface Residue Cover (%)

- Chisel
- Strip-till
- No-till
Strip Tillage for Corn after Soybean and Corn in N. Indiana, Loam Soil (2001-07)

Yield (bu./ac)

- **Soybean**
  - Fall Chisel: 207
  - Strip-till: 209
  - No-till: 201

- **Corn**
  - Fall Chisel: 193
  - Strip-till: 192
  - No-till: 180

Legend:
- Orange: Fall Chisel
- Blue: Strip-till
- Green: No-till

Previous Crop

- **a** indicates no significant difference.
- **b** indicates a significant difference.
Corn after Corn with Stover Removal?

Dr. Stuart Birrell, Ag and Biological Engineering, Iowa State
Questions about Corn Stover Removal

Feasibility for ethanol production?

Effects on soil properties?
Corn Yield Response to Residue Removal in Corn after Corn


Across 4 Mollisol Environments in Illinois

<table>
<thead>
<tr>
<th>Proportion of Above-ground Residue Removed</th>
<th>Yield (Mg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>13</td>
</tr>
<tr>
<td>Half</td>
<td>13</td>
</tr>
<tr>
<td>None</td>
<td>12</td>
</tr>
</tbody>
</table>

Yield response to residue removal by tillage method.
The rotation effect lasts two years increasing corn grain yield 19% for 1C and 7% for 2C …

Source: Lauer, unpublished

**Corn Yield Response Following Five Years of Soybean**

- **CS**: 178 (A), 18% increase
- **1C**: 179 (A), 19% increase
- **2C**: 162 (B), 7% increase
- **3C**: 155 (CD), 3% increase
- **4C**: 156 (C), 3% increase
- **5C**: 155 (CD), 3% increase
- **Cont.**: 151 (D)

Control treatments averaged across tillage treatments at Arlington, WI.

C = Corn, S = Soybean, Number = consecutive year of corn
Corn Yield Response to Tillage After 5 Years of Soybean
(Arlington, WI; 1987 to 2006; Control Treatments)

Corn Yield Response Following Five Years of Soybean

<table>
<thead>
<tr>
<th>Cropping Sequence</th>
<th>Conventional tillage</th>
<th>No tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>178</td>
<td>194</td>
</tr>
<tr>
<td>1C</td>
<td>179</td>
<td>194</td>
</tr>
<tr>
<td>2C</td>
<td>166</td>
<td>A</td>
</tr>
<tr>
<td>3C</td>
<td>158</td>
<td>152</td>
</tr>
<tr>
<td>4C</td>
<td>162</td>
<td>148</td>
</tr>
<tr>
<td>5C</td>
<td>163</td>
<td>147</td>
</tr>
<tr>
<td>Cont.</td>
<td>163</td>
<td>143</td>
</tr>
</tbody>
</table>

Control treatments during 1987-2006 at Arlington, WI.

Source: Lauer, unpublished
Soybean Yield Response to Tillage After 5 Years of Corn (Arlington, WI; 1987 to 2006; Control Treatments)

Source: Lauer, unpublished

C= Corn, S= Soybean, Number = consecutive year of corn

Control treatments during 1987-2006 at Arlington, WI

Grain Yield (bushels/acre)

Soybean Yield Response Following Five Years of Corn

Conventional tillage
No tillage

Cropping Sequence

Source: Lauer, unpublished
Deep zone-till
15"+ depth
## Continuous corn yield as affected by tillage at Rochester, MN

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>160</td>
<td>162</td>
<td>151</td>
<td>148</td>
<td>155</td>
</tr>
<tr>
<td>Rawson zone-till</td>
<td>166</td>
<td>171</td>
<td>159</td>
<td>156</td>
<td>163</td>
</tr>
<tr>
<td>Strip-till</td>
<td>152</td>
<td>172</td>
<td>164</td>
<td>158</td>
<td>162</td>
</tr>
<tr>
<td>Chisel plow +</td>
<td>161</td>
<td>170</td>
<td>171</td>
<td>163</td>
<td>166</td>
</tr>
<tr>
<td>LSD (0.10):</td>
<td></td>
<td>5</td>
<td>NS</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: J. Vetsch and G. Randall, Univ. of Minnesota

LSD (0.10) = 6

Grain Yield (Bu/A)

Tillage for 2nd year corn

Source: J. Vetsch and G. Randall, Univ. of Minnesota
Residue cover after planting as affected by tillage at Waseca in 2005-6.

LSD (0.10) = 4

Residue cover (%)

<table>
<thead>
<tr>
<th>Tillage</th>
<th>Residue Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep-till</td>
<td>51</td>
</tr>
<tr>
<td>Strip-till</td>
<td>56</td>
</tr>
<tr>
<td>Spring disk</td>
<td>39</td>
</tr>
<tr>
<td>Chisel +</td>
<td>25</td>
</tr>
<tr>
<td>Moldboard</td>
<td>8</td>
</tr>
</tbody>
</table>

Tillage for 2nd year corn

Source: J. Vetsch and G. Randall, Univ. of Minnesota
Management Issues Include Prior Compaction, Fertility, Automatic Guidance and Seed Row Uniformity
Strip-Till Corn after Corn

Source: Norm Larson, Elburn Co-op, IL

Split the middle w/o guidance
Average Maximum Soil Temperatures in First 4 Weeks after Planting (1997-2002)

- Corn after soybean
- Continuous Corn

- Fall chisel, disk, field cultivate
- No-till
Uniformity More Difficult to Achieve in Corn after Corn
No-till Corn Yields - Continuous as % Of Rotation - Loam Soil, Wanatah, IN (1997-2007)
Tony’s Top Seven for Continuous, Conservation-till Corn

1. Be realistic about costs before switching to Continuous Corn.
2. Pick your best drained and most productive fields.
3. Consider the advantages of strip tillage as an alternative to no-till or conventional tillage.
Tony’s Top Seven (continued)

4. Optimize conservation-till corn performance with superior management (e.g. hybrids, fertilizer, pest).

5. Avoid long-term continuous corn on most soils.

6. Aim for controlled traffic systems in future
7. Invest in Research!
Acknowledgments

Funding:
- USDA-CASMGS
- Purdue University (Mary S. Rice & Mission Oriented Funds)
- Foundation for Agronomic Research (PPI or INPI)
- Fluid Fertilizer Foundation
- John Deere & Co.

Equipment:
- John Deere Cropping Systems Unit
- Case-DMI (Goodfield, IL)
- Remlinger (Kalida, OH)

Seed:
- Pioneer Hi-Bred, Int.
- Beck’s Hybrids
Thanks!

tvyn@purdue.edu
home page:
//www.agry.purdue.edu/staffbio/vyn