No-Till and Strip-Till: A Closer Look From Both Sides

Tony J. Vyn,
with assistance from farmers, graduate students, technicians, and colleagues

PURDUE UNIVERSITY
Indiana Tillage Data, 1990-2003

(percent of total cropland for specific crop in a no-till system)

Source: Purdue University-Transect Data
2002 Indiana Cropland Tillage Map

Percent of all Corn Fields planted using No-till

2002 Indiana Average is 21%

Source: Purdue University-Transect Data
So What is Problem?

- Planting Date?
- Nutrient Availability?
- Pests?
- Yields?
- Maturity?
Poor Stand Establishment?
## Corn Response to Tillage and Rotation
West Lafayette, IN, (1975-2003)

<table>
<thead>
<tr>
<th>Tillage</th>
<th>Corn/Soybean</th>
<th>Continuous Corn</th>
<th>Yield Gain for Rotation</th>
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<tbody>
<tr>
<td></td>
<td>Bu/ac</td>
<td>% of plow yield</td>
<td>Bu/ac</td>
</tr>
<tr>
<td>Plow</td>
<td>176</td>
<td>- - -</td>
<td>169</td>
</tr>
<tr>
<td>Chisel</td>
<td>177</td>
<td>100</td>
<td>164</td>
</tr>
<tr>
<td>Ridge*</td>
<td>182</td>
<td>103</td>
<td>167</td>
</tr>
<tr>
<td>No-till</td>
<td>173</td>
<td>98</td>
<td>146</td>
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Soybean Response to Tillage and Rotation, West Lafayette, IN (1975-2003)

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<td></td>
<td>Bu/ac</td>
<td>% of plow yield</td>
<td>Bu/ac</td>
</tr>
<tr>
<td>Plow</td>
<td>53</td>
<td>- - -</td>
<td>48</td>
</tr>
<tr>
<td>Chisel</td>
<td>52</td>
<td>97</td>
<td>46</td>
</tr>
<tr>
<td>Ridge *</td>
<td>51</td>
<td>96</td>
<td>45</td>
</tr>
<tr>
<td>No-till</td>
<td>50</td>
<td>95</td>
<td>46</td>
</tr>
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</table>

Narrow row production started.

- **Chisel**
- **No-till**

**5 per. Mov. Avg.**
- (Chisel)
- (No-till)
Population densities of Soy. Cyst Nematode under different crop sequences and tillage

(Westphal and Yyn)
Potassium Stratification
Long-Term Tillage (IN, 1975-94)

Source: Holanda et al. (1998)
Conservation Tillage Doesn’t Alter K distribution appreciably
Vertical soil K stratification averaged over years (1998-2000) at Strathroy

Soil Depth (in)

<table>
<thead>
<tr>
<th>Depth</th>
<th>Soil Exchangeable K (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2”</td>
<td>170</td>
</tr>
<tr>
<td>2-4”</td>
<td>100</td>
</tr>
<tr>
<td>4-8”</td>
<td>120</td>
</tr>
<tr>
<td>8-12”</td>
<td>90</td>
</tr>
</tbody>
</table>

Soil Exchangeable K (ppm)
Vertical soil K stratification averaged over years (1998-2000) at Kirkton
Planter Setup and Nutrient Banding?
Mean Soil-test K Stratification at Davis, EC Indiana

Source: Vyn et al., Better Crops #4, 2002
Soil K variability
High oil corn yields in response to K placement (EC Indiana, 2000-01)

Source: Vyn et al., Better Crops #4, 2002
RESPONSE OF CORN TO ROW-APPLIED K ON A SILTY CLAY LOAM SOIL (3 yr. avg.)

Dr. Wolkowski, UW, Oshkosh, Wis. (45 lb K\textsubscript{2}O/a)
Corn Yield Response to K Fertilizer Placement at Kirkton, Ontario (1996-98)

Starte K rate:
- Low 0-9 lb/ac
- High 45-54 lb/ac

Hybrid and Seasonal Effects on K Response to Banding

Most response to K banding with dry June and avg. soil K below 150 ppm.
No-till Yield Reductions in Corn?
Soil temperature versus soil moisture?
Tillage Effects on Corn Yield Response to Average Soil Moisture Contents During Early Growth

Source: Dave Hooker 2000
Short-term vs. Long-term No-till?

Woodstock Corn Yields 2001-2003 (Bill Deen)
Polymer Seed Coatings for Early Planting of No-till Corn in Indiana?
Early Plant™ Technology

It knows when to grow!

Below 55°F
- Coating Barrier
- Water is Repelled
- Seed

Above 55°F
- Coating Changes
- Water is Allowed to Permeate
- Seed Absorbs the Water
Emergence Profile (2000)

Planting Date: March 28
Coatings and Emergence Time in 2003 (average of 3 hybrids at West Lafayette)
Coating Effects on Corn Yield in 2003 (mean of 3 hybrids at West Lafayette)
Maximum and minimum soil temperatures after planting,
Polymer Corn Study, Wanatah, 2003

First planting April 3
Second planting April 15
Third planting April 28

Temperature (F)
Going Deeper??
Strip Tillage for Corn
Fall Strip-till Option?
Strip Tillage with Fertilizer Banding
What are we after with strip-till?

- Yields
  (relative to no-till; stability)

- Planting Timeliness
  (pre-plant soil conditions)

- Fertilizer Placement Efficiencies
  (systems approach)
Soil Drying Pattern (0-6") after Wheat (ON, 1999)
2002 Soil Moisture
In-row, pre-plant measurements

Soil Moisture

No Till  Strip Till

Winger
Weber
McLagan
Perth
Eastep
Comley
Blythe Brae
Strip-till versus No-till Corn after Wheat (Belmont, ON)

Strip-till on left, no-till on right
Tillage Effects on Corn Yield After Wheat

Centralia and Wyoming, ON (1994-96)

Yield (bu/ac)

- Moldboard: 153
- Chisel: 148
- Fall Disk: 149
- Strip-till: 149
- No-Till (baled): 142

Legend:
- Moldboard
- Chisel
- Fall Disk
- Strip-till
- No-Till (baled)
Wheat Residue Effect on No-till Corn Yields

Centralia & Wyoming (1994-96)

Yield (bu/ac)

- Fall Strip-till: 149
- No-till (not baled): 135
- No-till (baled): 142
- No-till (bare): 149

Opoku, Vyn & Swanton (Agron. J. 89:549)
Tillage Effects on Corn Yields After Soybeans
(Hooker, Avg. of Alvinston and Fingal, ON, 1994-96)

Yield (bu/ac)

<table>
<thead>
<tr>
<th></th>
<th>Plow</th>
<th>Chisel</th>
<th>Strip-till</th>
<th>No-Till</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>127</td>
<td>120</td>
<td>127</td>
<td>120</td>
</tr>
</tbody>
</table>

Source: Dave Hooker, 2000
Fall tillage effects on corn yield after soybeans (averaged 1998-00) in Ontario.
Fall tillage effects on corn yield after wheat (averaged over 98-00) in Ontario.

![Bar chart showing yield (bu/ac) for different tillage treatments.]

- Moldboard: 151
- Strip-till 12": 150
- Strip-till 6": 146
- Strip-till 3": 140.5
- No-till: 148.5

Tillage Treatments

Yield (bu/ac)
Corn yields in Indiana following soybeans in Indiana (1999-2001)

Yield (bu/ac)

Moldboard: 197
Strip-till 13": 185
Strip-till 8": 185
No-till: 186
# 2001-2003 Ontario Yield Summary
(courtesy of Greg Stewart, 2004)

<table>
<thead>
<tr>
<th>Year</th>
<th>PLOW</th>
<th>FALL STRIP</th>
<th>NO-TILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>100</td>
<td>101</td>
<td>100</td>
</tr>
<tr>
<td>2002</td>
<td>105</td>
<td>102</td>
<td>100</td>
</tr>
<tr>
<td>2003</td>
<td>103</td>
<td>103</td>
<td>100</td>
</tr>
<tr>
<td><strong>AVE.</strong></td>
<td><strong>103</strong></td>
<td><strong>102</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
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Represents 38 site/year comparisons over the three years.
Strip Tillage for Corn after Corn?
Strip Tillage for Corn in N. Indiana, Loam (2001-03)

Yield (bu/ac)

Soybean
- Fall Chisel: 193 (A)
- Strip-till: 196 (A)
- No-till: 192 (A)

Corn
- Fall Chisel: 180 (a)
- Strip-till: 177 (a)
- No-till: 169 (b)

Previous Crop

Legend:
- Fall Chisel
- Strip-till
- No-till
Planting Date Effects in 2003

W. Lafayette, IN

Wanatah, N. IN

Strip-Till
No-Till
Chisel

Early Optimum? Early Optimum?
Fall Strip-till 8” depth

DMI 2500
with Mole Knife
Recent Strip Tillage Options
Impact of P & K placement in corn?
Soybean Harvest and No-till Double-crop Corn: Brazil Style
Conclusions

1. No-till corn adoption higher in Indiana, but reservations on increased adoption are the same.

2. Technology changes have improved success rate.

3. Strip tillage for increased planting flexibility and opportunity for fertility placement.

4. Nutrient management needs more attention in no-till and strip-till corn.
Thanks!

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Soybean K Fertility Issues?
Aerial accumulation of N, P, and K by soybean (80 bu/A)

1. Does K placement Matter?
2. Implications for Row Width?
Narrow-Row Soybeans Following Corn with Alternate K Placement

1. Extent of vertical and horizontal soil exchangeable K distribution
2. Actual soybean row widths
3. Environment and genetic impacts on root system distribution
Growth of Vegetative and Reproductive Tissue

Impedance to Root Growth

Oxygen Availability

Herbicide Injury

Disease

Temperature Stress

Respiration

Potential Daily Growth

Water + Nutrient Stress
Soybean Yield Responses to K fertilizer Placement in Ontario (1998 to 2000)

<table>
<thead>
<tr>
<th>Location</th>
<th>Initial Soil K mg L⁻¹</th>
<th>Zero K bu ac⁻¹</th>
<th>Broadcast bu ac⁻¹</th>
<th>Band bu ac⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>42</td>
<td>35.6b</td>
<td>36.2b</td>
<td>39.2a</td>
</tr>
<tr>
<td>Kirkton</td>
<td>85</td>
<td>43.5a</td>
<td>43.7a</td>
<td>43.6a</td>
</tr>
<tr>
<td>Strathroy</td>
<td>128</td>
<td>47.2b</td>
<td>48.6ab</td>
<td>49.8a</td>
</tr>
</tbody>
</table>

K fertilizer rate: 89 lb a⁻¹

Tillage: no-till for Paris,
: no-till, fall zone-till, and fall disk for Kirkton and Strathroy

Source: Yin and Vyn, 2002
Comparison of no-till with zone-till and fall disk systems

No-till
Narrow row (15”)
Fall broadcast
(no incorporation)

Zone-till
Wide row (30”)
Fall band
(6” deep)

Fall disk
Narrow row (15”)
Fall broadcast
(incorporation)

49.1
40.7

49.5

Yin and Vyn, Agron. J.. 2002
Soybean Trifoliate Leaf K at R1?

Y = 55.7 + 3.1X - 0.06X^2  
P < 0.05  
R^2 = 0.33

Source: Yin and Vyn, 2003