How to No-Till using a Cover Crop-Based System

Erin Silva, Organic Production Specialist
University of Wisconsin, Dept of Agronomy
Benefits of No-Till Production

- Tillage can:
  - destroy soil structure
  - reduce SOM (C and N)
  - decrease microbial biomass
  - increase evaporation
Is it possible to develop a NT farming system based on cover crops?
No-till soybean seeded into rye killed without tillage

No-till corn at physiological maturity

Cover Crop Based ≠ Conventional no-till

- Confined to no-till crop *phases*: NOT continuous no-till

NT cover crop/grain or seed crop phase

followed by

Tilled grain/seed crop phase
Phases of Cover-Crop Based No-Till

1. Cover crops seeded the previous fall

2. Cover crops killed in June

3. Grain or seed crop no-till drilled into killed cover crop

4. Grain or seed crop is combined

Images courtesy of Kathleen Delate at Iowa State Univ., and Dale Mutch at Michigan State Univ.
Potential Benefits of Cover-Crop Based NT

- Weed management
- Reduced labor
- Ecosystem services of rye cover
  - Reduced runoff
  - Increased organic matter
  - Increased water infiltration
  - Trapping excess nitrogen
Potential Risks of Cover-Crop Based NT

- Mechanical methods of cover crop management
- Cash crop establishment
- Weed suppression by cover crop mulch
- Competition between cash crop and cover crop
- Delayed cash crop planting
Construction and design of the roller

- The blades are mounted in a chevron pattern, which prevents bouncing and helps guide the tractor in a straight line.
- Each blade is bolted on instead of being welded, so it can be replaced or adjusted if necessary.
Roller-Crimper

- ground-driven
- can be purchased from I and J Manufacturing
- plans on Rodale website (www.rodaleinstitute.org)
- front or rear mounted
Cover Crops killed by Roller/Crimper

Chevron-shaped blades crimp and kill effectively rye and hairy vetch

Mounting roller in front allows killing/crimping/seeding single-pass operation

Image on right provided by Dale Mutch at Michigan State University
Roller-Crimper Prices

I and J manufacturing: http://www.croproller.com/

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>8' Model</td>
<td>$2,950</td>
<td>1,400 lb</td>
</tr>
<tr>
<td>10 1/2' Model</td>
<td>$3,360</td>
<td>1,835 lb</td>
</tr>
<tr>
<td>15 1/2' Model</td>
<td>$4,200.00</td>
<td>2,400 lb</td>
</tr>
</tbody>
</table>
Videos

- http://www.youtube.com/watch?v=PW4mwVJPSS9A
- http://www.youtube.com/watch?v=JK1jCoxa5kw (cue at 4:55)
Early May Rye Crop (planted at 4 bu/ac in Sept.)
Conventional wisdom: CC biomass \( \geq 5000 \text{ lb/acre} \)

Hairy vetch cover crop just after being rolled in PA (> 6000 lb/acre)

Hairy vetch cover crop after rolling at Arlington in 2009 (> 8000 lb/acre)

Crimping must be performed at anthesis to ensure complete termination of crop with no regrowth
Rye height at crimping (late May) – over 5 ½ feet tall
Treatments

- Rye, triticale, and barley (4 bu/ac), Austrian Winter Pea (40 lbs/ac), or vetch (30 lbs/ac)
- Planted early-mid September
- Crimped late May-Mid June at maturity
  - Small grains – at anthesis
  - Legumes – 100% bloom
- Planted at time of crimping
  - Soybean – 200,000 plants per acre
Crimping Rye
Rolled-Crimped Rye
Soybean – one month after planting
View of Rye Mat – Mid-Summer
Soybean – end of July
Soybean - mid-September
Soybean – mid-September
Cover Crop biomass, weed biomass, and yield of cover-crop based no-till soybean

<table>
<thead>
<tr>
<th></th>
<th>Cover Crop Biomass Mg DM ha(^{-1})</th>
<th>Weed Biomass g m(^{-2})</th>
<th>Yield bu ac(^{1})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>2011</td>
<td>2010</td>
</tr>
<tr>
<td>Hairy Vetch</td>
<td>3.67b</td>
<td>5.00b</td>
<td>20.7ab</td>
</tr>
<tr>
<td>Winter Rye</td>
<td>10.17a</td>
<td>10.33a</td>
<td>38.8a</td>
</tr>
<tr>
<td>Winter Triticale</td>
<td>14.56a</td>
<td>6.38b</td>
<td>35.0a</td>
</tr>
<tr>
<td>Winter Peas</td>
<td>6.29b</td>
<td>0.0c</td>
<td>19.3ab</td>
</tr>
<tr>
<td>Winter Barley</td>
<td>11.71a</td>
<td>10.33a</td>
<td>25.0a</td>
</tr>
<tr>
<td>Control</td>
<td>--</td>
<td>--</td>
<td>1.6b</td>
</tr>
</tbody>
</table>
**Corn Silage, 2010 (tons/acre)**  
(mean at Arlington: 9.0 tons/ac)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Crimped</th>
<th>Mowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rye</td>
<td>4.08</td>
<td>6.6</td>
</tr>
<tr>
<td>Vetch</td>
<td>8.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Barley</td>
<td>4.6</td>
<td>6.5</td>
</tr>
<tr>
<td>Triticale</td>
<td>4.92</td>
<td>4.32</td>
</tr>
<tr>
<td>Austrian Winter Pea</td>
<td>9.6</td>
<td>10.9</td>
</tr>
</tbody>
</table>
## Examples of Soybean Yields across Experiments

<table>
<thead>
<tr>
<th>Year</th>
<th>Till (bu/ac)</th>
<th>Cover-Crop No-Till (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 (Silva)</td>
<td>47</td>
<td>30</td>
</tr>
<tr>
<td>2008/2009 (Bernstein)</td>
<td>54</td>
<td>43</td>
</tr>
<tr>
<td>2011 (Silva)</td>
<td>52</td>
<td>53</td>
</tr>
</tbody>
</table>
Labor Inputs (hours per acre)

Bernstein et al., 2011
Fuel Inputs ($/ac diesel fuel)

- Tilled: 30
- No-till Crimped Rye: 15

Fuel costs $0.6-0.9

Bernstein et al., 2011
Risks vs. Benefits

• NT rye risks
  • Less soybean yield
  • Tie-up of nutrients and water?

• NT rye benefits
  • More effective weed management
  • Less labor inputs
  • Less fuel inputs
  • Less soil loss (Bernstein et al. - 86-89% reduction in predicted soil loss under the rye mulch)
  • Greater accumulation of organic matter
Keys to Success?

- Adequate biomass
  - Plant early and adequate density
  - Quality seed?
- Success under different weed pressures
  - Perennials vs. annuals?
- Fertility?
Citation