Reducing Tillage in Organic Grain Systems

Erin Silva
Associate Professor
State Extension Specialist, Organic Agriculture
University of Wisconsin-Madison
Resources

• emsilva@wisc.edu

• OGRAIN – Organic Grain Resources and Information Network
  • https://ograin.cals.wisc.edu/
  • YouTube videos, fact sheets, research reports
  • Join our listserv! join-ograin@lists.wisc.edu
The elephant in the organic room: Tillage
5 Soil Health Principles

• Principle 1: Soil Armor
• Principle 2: Minimizing Soil Disturbance
• Principle 3: Plant Diversity
• Principle 4: Continual Live Plant/Root
• Principle 5: Livestock Integration
Ecological intensification and arbuscular mycorrhizas: a meta-analysis of tillage and cover crop effects

“But importantly, cover crops increased AM formation similarly whether tillage was used or not, suggesting that the continuity of root associations with cover crops is at least as important for AM formation as decreasing disturbance. This is a significant finding, especially for agricultural systems that may rely more heavily on services provided by AM, for instance organic management or low input systems used by most of the world’s farmers.”

Timothy M. Bowles, Louise E. Jackson, Malina Loeher, and Timothy R. Cavagnaro
“When a cover crop, especially a legume, is used in these systems, then AM formation in the cash crop apparently can withstand some tillage.”
“System approaches that combine cover cropping and reduced tillage with other AM promoting practices like crop diversification and organic management may offer the most promise for enhancing AM communities, while also increasing soil C storage and nutrient cycling, and reducing nutrient losses and soil erosion.”
Cover Crop-based No-Tillage – A Systems approach

• Requires greater attention
  • Advanced planning
  • Adaptive management

• New equipment for rolling and no-till planting

• Different pests
  • Perennial and early weeds (e.g. common ragweed)
  • Seed corn maggot, true army worm, black cutworm
I & J Roller-Crimper (3 m wide cylinder, 1200 kg water-filled weight)

Ryan 2020
Cover crop compatibility with cash crops

Soybean into winter cereal

• Creates mulch preventing weeds from germinating
• Allelopathy
• Depletes soil N levels to starve weeds

Ryan 2020
Cover crop compatibility with cash crops

Corn into hairy vetch

• Supplement manure or compost prior to vetch
• Mixtures of hairy vetch and rye will suppress more weeds

Ryan 2020
Cereal rye is seeded in late summer.

Cereal rye protects the soil over winter.

Cereal rye grows rapidly in the spring and can reach six feet tall.

Cereal rye is terminated with a roller at 50% anthesis.

Soybeans are no-till planted into the residue.

Soybean seedlings emerge and grow through the residue.

Mulch suppresses weed emergence until soybean canopy shades out weeds.

Soybeans are harvested in the early fall.
Figure: Ground cover on April 1 in plots where cereal rye was seeded on six dates in the fall as part of an experiment conducted in central Pennsylvania. Photo credit Steven Mirsky and Bill Curran.
Adaptive Management

Spring is a critical time for organic no-till soybean production. Scouting fields both early in the spring and tracking soil moisture and weather conditions closer to soybean planting can help farmers identify and avoid problems.

Prior to seeding:
Does the field have a relatively low population of perennial weeds?

Yes
Proceed with seeding cereal rye in early September.

No
Work on reducing weed populations.

Yes
At greenup in spring:
Is the cereal rye stand uniform, dense, and weed-free?

No
Terminate the cereal rye with tillage prior to jointing and plant soybeans into tilled soil.

A few days before planting:
Is there adequate soil moisture and/or rain in the forecast?

Yes
Proceed with monitoring growth of cereal rye.

No
Harvest cereal rye for grain.

Yes
Proceed with rolling cover crop at anthesis and no-till planting soybeans.

Ryan, 2020
Liz Pickard, Sandra Wayman, Chris Pelzer, and Jeff Liebert
Basing termination date on cover crop phenology

Mirsky et al. (2009)
Rolled too early

Effective termination

Early Planting Approach

• Plant into standing rye 2-3 weeks prior to anthesis
  • Just past boot stage
• Soybeans emerge
• At anthesis – soybeans will be approximately at V2-V3
  • Crimp or mow over emerged soybeans
Crimping Aroostock – May 28
Crimping Spooner Rye – June 5
<table>
<thead>
<tr>
<th>Soybean Variety</th>
<th>Rye Variety</th>
<th>Planting Date</th>
<th>Plant Population</th>
<th>Yield</th>
<th>Tilled Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aroostook</td>
<td>May 18</td>
<td>115,667</td>
<td>66.4</td>
<td>78.8</td>
</tr>
<tr>
<td>1</td>
<td>Spooner</td>
<td>May 18</td>
<td>103,222</td>
<td>67.2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Aroostook</td>
<td>May 28</td>
<td>95,889</td>
<td>52.0</td>
<td>53.2</td>
</tr>
<tr>
<td>1</td>
<td>Spooner</td>
<td>June 5</td>
<td>100,778</td>
<td>58.8</td>
<td>43.3</td>
</tr>
<tr>
<td>2</td>
<td>Aroostook</td>
<td>May 18</td>
<td>90,444</td>
<td>63.2</td>
<td>57.7</td>
</tr>
<tr>
<td>2</td>
<td>Spooner</td>
<td>May 18</td>
<td>119,333</td>
<td>66.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Aroostook</td>
<td>May 28</td>
<td>141,222</td>
<td>56.3</td>
<td>56.7</td>
</tr>
<tr>
<td>2</td>
<td>Spooner</td>
<td>June 5</td>
<td>108,111</td>
<td>54.1</td>
<td>54.6</td>
</tr>
</tbody>
</table>
Soybean Seeding Rates – 225,000 seeds/ac
<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</td>
<td>47</td>
<td>30</td>
</tr>
<tr>
<td>2008/2009</td>
<td>54</td>
<td>43</td>
</tr>
<tr>
<td>(Bernstein)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>52</td>
<td>53</td>
</tr>
<tr>
<td>2013</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>2014</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>2015</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>2016</td>
<td>57</td>
<td>61</td>
</tr>
<tr>
<td>2017</td>
<td>48</td>
<td>47</td>
</tr>
<tr>
<td>2018</td>
<td>57</td>
<td>54</td>
</tr>
</tbody>
</table>