Comparing tillage and mulching for organic orchard performance

M. Wiman1, E. Kirby1, D. Granatstein1, K. Mullinix2
1- WSU Center for Sustaining Agriculture and Natural Resources, Wenatchee, WA
2- Institute for Sustainable Horticulture, Kwantlen University College, Surrey, BC

Introduction

Weed control and nitrogen nutrition remain two major challenges for the rapidly expanding organic tree fruit sector in the state. Tillage has been the most common weed control practice, often with significant financial cost, and with potential soil quality degradation that conflicts with the National Organic Standards. We compared novel tillage, mulch, and cover crop techniques in two trials to examine their economic and environmental trade-offs. The first trial compared two tillage implements, tillage frequency, a wood chip mulch, and a mowed control in an established orchard. Because weed control is crucial for young tree establishment, a second trial tested the tillage and wood chip techniques, along with a "living mulch" cover crop with legume and nonlegume species, in a newly planted orchard.

Methods

Trial 1. This trial was initiated in April 2004 in an 8-yr old block of Gala/M26. Treatments included wood chip mulch (applied 6" thick, Figure 1), two cultivation implements (Wonder Weeder® and Weed Badger®), three tillage frequencies using the Wonder Weeder (Figure 2), and a mowed weed control. In Yr 3, tillage was simplified to 2 passes, as greater frequency did not significantly reduce weeds.

Trial 2. A new Piñata®/M7 block was planted in April 2005 with two tillage techniques: clean cultivation (using Wonder Weeder) and Sandwich system (tillage on each side of the tree line with living mulch in the tree row, Figure 4). Living Mulch (LM) cover crops were planted in the entire 150-cm weed strip; Sandwich cover crops were planted in the 45-cm tree row only (Figure 4, Table 1). Tillage treatment plots (WW and SW) received four passes each season, and wood chips were applied yearly to a 6" depth. Two controls included a fertilized, undisturbed, weed-free treatment (CTL); and an unfertilized, undisturbed, weed-free treatment (CTLO), using manual weed control and organic herbicides. All treatments received the same rate of chicken compost each year (except CTLO). Vole presence was measured by a grid intersect method, but voles were not controlled in the trial.

Results

Table 2. Trial 1 yield results.

<table>
<thead>
<tr>
<th>Year 2005</th>
<th>Year 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit yield (kg/tree)</td>
<td>Fruit yield (kg/tree)</td>
</tr>
<tr>
<td>20.4</td>
<td>19.5</td>
</tr>
<tr>
<td>WW</td>
<td>CTL</td>
</tr>
<tr>
<td>14.35</td>
<td>14.7</td>
</tr>
<tr>
<td>SW</td>
<td>CTL</td>
</tr>
<tr>
<td>13.9</td>
<td>11.03</td>
</tr>
<tr>
<td>SWNL</td>
<td>LMNL</td>
</tr>
<tr>
<td>3.7 a</td>
<td>3.7 a</td>
</tr>
<tr>
<td>SWL</td>
<td>LMNL</td>
</tr>
<tr>
<td>1.05 b</td>
<td>1.05 b</td>
</tr>
</tbody>
</table>

Figure 6. Trial 2 biomass Yrs 1 and 2. WCK=Weedy check.

Figure 7. Trial 2 trunk growth. Letters a-c refer to Yr 3, x-z refer to Yr 2 data.

Figure 8. Trial 2 fruit yield and TCSA (normalized). Letters a-c refer to trunk growth, x-z to fruit yield.

Conclusions

Tillage:
- No clear effect on soil quality in Trial 1; Trial 2 tillage may have pruned roots.
- Wonder Weeder is faster, but shear bar on tool cannot be used on young trees.
- Sandwich system provided less competition with trees than full living mulch, with less tree leaning than full tillage.

Wood Chips:
- More effective and longer-lasting weed control in established orchard than in new trees.
- Improved tree performance in both trials.

Living Mulch:
- Clearly suppressed weeds, but competed with trees.
- Gallium was found to be less attractive to voles.
- Techniques to suppress competition still needed (e.g. organic herbicides, mowing).

Understory management had a major influence on tree growth, illustrating the trade-offs between tree performance and soil quality improvement. While wood chip mulch enhances tree growth, and living mulch enhances weed control, no treatment yet provides the optimum in tree performance, weed control, soil quality, and nutrient management.

Acknowledgements
- WSU-CSANR Organic Cropping Research Grant.
- Dr. Lynne Carpenter-Boggs, Dr. Lori Hoagland, Dr. Frank Peryea, Dr. Jeff Smith.
- Tyler Johnston, Jessica Jones, Kaz Lorenz, Dan TerAvest, Joyce Thompson.
- Ernie Cazares, Amos Kukas, and Wenatchee Valley College Orchard and crew.

More information at our website: http://organic.tfrec.wsu.edu/OrganicIFP/OrchardFloorManagement/Index.html