Orchard Understory Management Options

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Orchard Floor

Orchard floor management affects:

- Weed competition with trees
- Nutrient dynamics
- Water management
- Rodent habitat
- Insect habitat
Economic outcomes

• Impact production costs
• Impact fruit value
• Optimize both
• Maintain organic status
• Other values
# Organic Orchard Weed Control Options

<table>
<thead>
<tr>
<th>Method</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage</td>
<td>Effective; rodents; low cost</td>
<td>Reduced tree growth, fruit size, soil quality; tree damage</td>
</tr>
<tr>
<td>Flaming</td>
<td>Control weeds around trunk; rodents; low cost</td>
<td>Tree injury, perennial weeds, fossil fuel</td>
</tr>
<tr>
<td>Inert mulches</td>
<td>Effective; soil quality; moisture</td>
<td>Costly; N tie up; soil quality</td>
</tr>
<tr>
<td>Living mulches</td>
<td>Add biodiversity; soil quality; fix N</td>
<td>Competition; rodents; persistence</td>
</tr>
<tr>
<td>Organic herbicides</td>
<td>Control weeds around trunk; rodents; no tree, root damage</td>
<td>Effectiveness; multiple; applications; high cost</td>
</tr>
<tr>
<td>Mowing</td>
<td>Inexpensive; no root, soil disturbance</td>
<td>Not effective for young trees; poor weed control by trunks</td>
</tr>
</tbody>
</table>

*(Granatstein & Mullinix, 2008)*
## Alternative Weed Control Costs

<table>
<thead>
<tr>
<th>Method</th>
<th>Rate</th>
<th>Freq.</th>
<th>Cost/ac/yr ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ac)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyphos.</td>
<td>0.5 l</td>
<td>4/yr</td>
<td>24</td>
</tr>
<tr>
<td>Weed fabric</td>
<td>5’ x 3750’</td>
<td>1/6 yr</td>
<td>286</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>8.5 ton</td>
<td>1/2 yr</td>
<td>319</td>
</tr>
<tr>
<td>Wood chip</td>
<td>100 yd³</td>
<td>1/3 yr</td>
<td>200</td>
</tr>
<tr>
<td>Spray on</td>
<td>3.4 ton</td>
<td>1/1.5 yr</td>
<td>234</td>
</tr>
<tr>
<td>Flaming</td>
<td>48 lb</td>
<td>3/yr</td>
<td>36</td>
</tr>
<tr>
<td>Tillage (WW)</td>
<td>0.25 hr</td>
<td>4/yr</td>
<td>0</td>
</tr>
</tbody>
</table>

(adapted from Hogue et al., 2002)
CA Organic Pears

Economics
Total Costs/Acre/Year

$1,200
$1,000
$800
$600
$400
$200
$0

Mowing  Fabric  Chips  Herbicide  Manure Lo  Manure Hi  Feather

NOTE: Fabric cost does not include annual removal

Ingels et al., 2010

Weed Control Trial

• 3 commercial organic orchards, WSU Sunrise
• Large replicated plots
• Replicated bin harvest commercially packed
• Organic herbicide; $85/wk, frequent application needed
• Flaming - $100/ac for season; as effective as herbicide; no soil disturbance
• Mulching – increased fruit size, yield
GreenMatch® herbicide, mid-summer

Nightshade 3 DAT

Lambsquarters 3 DAT

Dandelion 3 DAT

Dandelion 7 DAT
Foxtail 3 DAT

GreenMatch® herbicide, mid-summer
Water

Tree Water Status

Sunrise Orchard 2010

- Stem Water Potential (Mpa)

- Herb/Burn
- Wood chip
- Fabric
- Tillage

Soil Water Status

2010, Tensiometer

- Soil Moisture (KPa)

- Volumetric Water Content (%)

- Herb/Burn
- Wood chip
- Fabric
- Tillage

2011, Hydrosense
Mature Gala apple – Returns to grower ($/ac)

- Mulch: $10,497
- Herb/flame: $8,434
- Tillage: $8,365
# Tillage Trial results

<table>
<thead>
<tr>
<th>TRT</th>
<th>2005</th>
<th></th>
<th>2006</th>
<th></th>
<th>TCSA increase</th>
<th>Canopy volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fruit yield</td>
<td>Fruit Size 80-88</td>
<td>Gross Fruit Value*</td>
<td>Fruit yield</td>
<td>Fruit Size 80-88</td>
<td>Gross Fruit Value*</td>
</tr>
<tr>
<td></td>
<td>kg/tree</td>
<td>%</td>
<td>$/ha</td>
<td>kg/tree</td>
<td>%</td>
<td>$/ha</td>
</tr>
<tr>
<td>Wood chip</td>
<td>22.4</td>
<td>15.5 a</td>
<td>35,454</td>
<td>14.7</td>
<td>39.0</td>
<td>27,249</td>
</tr>
<tr>
<td>Control mow</td>
<td>20.4</td>
<td>6.6 b</td>
<td>29,647</td>
<td>14.3</td>
<td>33.5</td>
<td>24,077</td>
</tr>
<tr>
<td>Cultivator Z 3x</td>
<td>17.6</td>
<td>7.0 b</td>
<td>23,603</td>
<td>13.3</td>
<td>22.0</td>
<td>25,100</td>
</tr>
<tr>
<td>p=</td>
<td>0.150</td>
<td>0.014</td>
<td>0.805</td>
<td>0.076</td>
<td>0.001</td>
<td>0.008</td>
</tr>
</tbody>
</table>
Total Biomass
3-yr Pinova/EMLA.7
E. Wenatchee, WA

Yield Efficiency
(g fruit/g tree DM)

LML  0.78
WCM  0.41
TILL 0.50

(D. TerAvest)
Soil Organic Matter

**Topsoil (0-6 in) – Yakima**

- **CA strawberries – paired fields**
  - Biological property
  - Total C (g C/kg soil): Con 8.25, Org 10.04 *
  - Total N (g N/kg soil): Con 0.666, Org 0.867 **
  - Organic matter (mg/kg soil): Con 1.46, Org 1.84 *
  - Microbial biomass (µg CO₂-C/g soil): Con 96, Org 249 ***

Tillage for weed control

0.4 t/ac compost

8-10 t/ac compost

Courtesy: P. Andrews
Weed Fabric in Sweet Cherry

OSU, Hood River, OR – 2001-2007

• Fabric groundcover vs. bare ground in tree row
• 2000-2003 – fabric $2124/acre increased costs
• 2004 – fabric trt net returns $2306/ac more than bare ground (1st yr of production)
• 2005 - $1633/ac more with fabric
• Fabric – trees produced more fruit at an earlier age, maintained higher yields

(Yin et al., 2007)
White clover living mulch

Pros

• N contribution (46% mineralized over 3 weeks); root N
• Recycles P, K
• Suppresses weeds
• Low cost
• Tree growth, fruit yield enhanced

Cons

• Rodent risk
• No control over N timing
• N fixation suppressed
Direct-seeded Alfalfa

June 23, 2010
Morgan Orchard

Cumulative Cover Crop Biomass

Cover Crop Biomass, 2008-10

Add 30-50 lb avail. N/ac

$0.65/ lb N

Biomass DM (kg/ha)

Alfalfa | Grass | Kura | Ladino | Trefoil

Spray | No spray

2008 | 2009 | 2010

Washington State University
World Class. Face to Face.
Sweeping flailed prunings onto the tree row as an internal source of mulch.
Summary

- Weed control systems vary greatly in cost, efficacy
- Systems differ in rodent control, tree performance
- Water looks to be more limiting than N
- Role of temperature, biology in mulch not clear

**Soil temperature (5 cm) Aug. 3**

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Till</td>
<td>31.3° C</td>
</tr>
<tr>
<td>Mulch</td>
<td>19.7° C</td>
</tr>
</tbody>
</table>

**Optimum for dwarfing rootstock 14° C**

(Skroch and Schribbs, 1986)

- Can affordably generate some mulch in orchard
- Potential biocontrol benefits
Questions?