Optimizing Understory Management in Northwest Orchards

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TOPICS

• Introduction
• Weed control
• Mulching
• Soil impacts
• Rodents, bugs
• Summary

Photo: B. Barritt
PNW Tree Fruit

• National leader in organic apple, pear, cherry
• Orchards reliant on irrigation water from snowpack; global warming influence
• Weed control, tree nutrition are costly in organic systems
• Downward pressure on price, need to cut costs
• Must maintain or improve soil quality – NOP
• Goals for understory management – control weeds, provide N, conserve water, improve soil, enhance biocontrol, reduce costs, ease of management
Orchard Floor Options

Tillage – costly in young orchards; can degrade soil quality

Flaming – uses fossil fuel; potential tree injury

Inert mulches (e.g. wood chips, fabric) – costly to apply; availability?

Living mulch, cover crops – competition with tree, rodents

Organic herbicides – e.g. acetic acid, clove oil, Brassica meal – marginal effectiveness; costly

How to combine strategies? Change system with the age of the orchard?
Weed control (WW) trial 2004-2005

• 6 treatments, 5 reps: control (mow), wood chip mulch, Weed Badger, Wonder Weeder (2x, 3x, 4x)

• Less tree growth with tillage; more tree leaning?

• No clear soil quality impacts

• Wood chip mulch increased fruit size, increased gross fruit value ~$600-3000/acre over WW 4x, cost ~$900/acre to apply

• Wonder Weeder 440’/min vs. Weed Badger 20’/min

• Tillage provides adequate weed control, but stimulates more seed germination
Wonder Weeder
440’/min

Weed Badger
20’/min
WVC Mulch Trial

Weed control by mulches – June 2000

Wood chip

Shredded paper
**Orchard Mulching Trials – Summerland, BC**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>TCSA (mm²)</th>
<th>Roots (g/0.018m³)</th>
<th>Yield (kg/tree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check (glyphosate)</td>
<td>1011 b</td>
<td>11.3 c</td>
<td>10.3 c</td>
</tr>
<tr>
<td>Biosolids (Vancouver)</td>
<td>1052 b</td>
<td>16.9 bc</td>
<td>11.2 bc</td>
</tr>
<tr>
<td>Paper mulch</td>
<td>1565 a</td>
<td>28.7 abc</td>
<td>13.0 ab</td>
</tr>
<tr>
<td>2 + 3</td>
<td>1490 a</td>
<td>41.8 a</td>
<td>13.9 a</td>
</tr>
<tr>
<td>Composted biosolids + 3</td>
<td>1406 a</td>
<td>38.7 a</td>
<td>14.9 a</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>1203 b</td>
<td>35.2 ab</td>
<td>14.0 a</td>
</tr>
<tr>
<td>Geotextile</td>
<td>1125 b</td>
<td>19.1 bc</td>
<td>12.7 abc</td>
</tr>
</tbody>
</table>

(Hogue et al., 2000)
Effect of Orchard Mulching on Soil Moisture Depletion

10 cm: WC < Clover = Bare
30 cm: WC = Clover < Bare
Integrated mulch (IMM) trial

New planting: Pinata/M7

Goal: optimize weed control, soil quality, tree health

CONTROL

WC mulch

Living mulch

Legume

Non-legume

COVER / RHIZOSPHERE

‘Sandwich’

Legume

Non-legume

DISTURBANCE

WW

WASHINGTON STATE UNIVERSITY
EXTENSION
World Class. Face to Face.
Integrated mulch (IMM) trial

New planting: Pinata/M7

Goal: optimize weed control, soil quality, tree health

- Control 0
- Control 1x
- Brassica 1x
- WC mulch 1x, 1.5x
- Living mulch
  - Legume 0.5x, 1x
  - Non-legume 0.5x, 1x, 1.5x
- WW 0.5x, 1x, 1.5x

'Disturbance'
- 'Sandwich'
  - Legume 1x
  - Non-legume 1x

Cover / Rhizosphere
‘Sandwich’ system

Living mulch non-legume

‘Green islands’ from fertilizer injection
Living Mulch (LM) trial

Perennials, biennials, annuals. 3 reps. Original trial: 26 entries New trial: 32 entries

• Better seed establishment in new planting
• Severe annual grass infestation in both trials
• Definite presence of voles; legumes, grass
• Bentgrass too competitive
• Adequate LM for weed control competes with young trees in Yr 1
Correlation of TCSA growth increment (cm²) and total understory competition (total % cover of weeds and cover crop).
2nd Leaf – TCSA vs. % cover

No correlation
IMM trunk % increase
end 05 - end 06, 1x fertility rate

IMM trunk % increase
end 05 - end 06, all treatments
IMM total biomass and trunk growth increment correlation

WW plots 7-12
05-06 trunk growth increment (cm²)
0 200 400 600 800 1000 1200 1400
total biomass g/m²
Living Mulch and Weed Dry Matter

~1.5T DM / ac; 55 lb N
Soil Nitrate

Nitrogen release over 2 weeks from ambient soil with and without clover, root exclusion tubes, and tube covers.

A – control plot; tube + cover; no clover
B – control plot; tube + cover; clover clippings added
C – clover plot; tube + cover, clover clippings added
D – clover plot; tube – cover, clover clippings added
E – control plot; no tube
F – clover plot, no tube

46% of clover N mineralized

Grow Your Own N
Soil Nitrate

(Courtesy L. Hoagland)
Wenatchee Valley College:
Alfalfa mulch and clover cover crop increased indicators of enhanced nutrient turnover

EO nemas/10 g soil
- Alfalfa hay
- Chips
- Paper
- Clover
- Rye
- Control

All bacterivores
- Control

(T. Forge, PARC)
Soil Quality

Soil Dehydrogenase 2005

CTL = control  
LML = living mulch legume  
WC = wood chip mulch  
WW = Wonder Weeder tillage  

(Courtesy: L. Hoagland)
Effect of Mulches on Nematodes in Orchard Soil - Summerland, BC

(Hogue et al., 1998)

- Bactiv. (x10)
- Omni/Pred
- Pratylenchus

Categories:
- Check
- VBio
- PM
- VBio+PM
- KBio+PM
- AlfM
- Geotex

(T. Forge, PARC)
Late summer 2000

Early spring 2002

Rodents – the weak link for clover.
Vole Activity
IMM Trial, 11/05 & 2/06

Trail length (cm/m²)

LML  a
LMNL b
SWL  ab
SWNL ab
WC  c
CTL d
WW  c

11/05 trails  2/06 trails
Nematode Trial

Hypothesis: wood chip mulch will enhance survival of EPNs and their predation of codling moth larvae (overwintering)

Two species – *Steinernema carpocapsae, S. feltiae*; with and without wood chip mulch; 5 reps
Effect of wood chip mulch and nematode species on codling moth larvae mortality - September 2004

Letters indicate differences between treatments; Fishers LSD at P < 0.05
Going Forward

Mulches show real promise – both living and inert can help soil quality

Herbicides an important alternative to tillage

Matching legume N to time of tree need

Will need multiple benefits for economics – e.g. clover for weed control, water conservation, nitrogen

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http://www.tfrec.wsu.edu/OrganicIFP
http://organicfarming.wsu.edu