Strip Cultivation as an Alternative to Herbicides

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Rationale

- Over the last three decades the herbicide strip has become a popular horticultural practice in MI apples
  - **Benefits:** reduces/eliminates weed competition with trees, improves sanitation
  - **Costs:** chemical $$, bare soil prone to erosion and nutrient loss, reduction in habitat for beneficial insects, damage to tree?
- Cultivation within the drip line and tree row is another approach to weed management.
  - But what are the benefits and costs?

Objectives

- **Objective 1:** Demonstrate a cultivation system for on MI commercial orchards and determine impacts on weeds, nutrients and tree growth.
- **Objective 2:** Determine how cultivation impacts apple insect pests and beneficials
- **Objective 3:** Determine the relative cost of cultivation systems

Methods

- Three orchards were selected for the study: Flushing, Pottersville, and Sparta
- Flushing: Mature trees under strip cultivation for 5+ years
- Pottersville: 5th leaf trees under dormant herbicide
- Sparta: 5th leaf trees under burn down herbicide
Methods

- Sites cultivated once per month May-August
- **Sparta** and **Flushing** sites cultivated with a Wonder Weeder implement
- **Potterville** site cultivated with a grower built implement
- Monthly weed measurements on 3 rows cultivated & 3 rows grower standard practice
- Also collected soil samples in June and August, leaf nutrient samples in June, mite counts in July and terminal growth of trees

Wonder Weeder®

Grower Built Implement

Freshly Cultivated Soil
Results: Weed Coverage

• Cultivation greatly reduced ground cover compared to no treatment
• Cultivation was comparable to burn down herbicides
• Pre-emergent herbicides had less ground cover

% Bare Ground

05/12/10 05/28/10 06/10/10 08/06/10 09/06/10


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Herbicides Applied
Results: Weed Biomass

- Biomass significantly reduced compared to no herbicides
- Biomass comparable to herbicide treatments

Results: June Ammonium

- Significantly higher levels of ammonium at 2/3 sites in mid June
- Suggests that cultivated weeds are breaking down
- Free Nitrogen!!

Results: August Ammonium

- Mixed results in late August soil samples
- High levels of ammonium in the Fall are less desirable.
**Results: August SOM**

- Slightly increased Soil Organic Matter at all three sites
- SOM responds slowly
- Increased SOM will reduce nutrient leaching and increase water holding capacity

**Results: Tree Growth**

- Cultivation may impact young trees more than adult trees
- No significant impact at 2/3 sites
- All plots demonstrated acceptable growth.

**Results: Beneficial Mites**

- Predaceous Mites more abundant at 2/3 sites
- Sparta had the highest bare ground
- Increased plant material may have increased beneficial mites
- Fruit set was very low at all 2/3 sites

**Results: Economics**

<table>
<thead>
<tr>
<th>$$/Acre</th>
<th>Herbicide¹</th>
<th>Wonder Weeder® + 3 Point²</th>
<th>Wonder Weeder®³</th>
<th>Grower Built Cultivator⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>$2.50</td>
<td>$5.00</td>
<td>$3.25</td>
<td>$1.50</td>
</tr>
<tr>
<td>Herbicide</td>
<td>$50</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td># Applications</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>$131.74</td>
<td>$73.48</td>
<td>$66.48</td>
<td>$59.48</td>
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<tr>
<td>Savings</td>
<td>NA</td>
<td>$58.26</td>
<td>$65.26</td>
<td>$72.26</td>
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</table>

Estimated floor management costs based on 10 yr cost of ownership for a 100 acre orchard assuming: a 75 hp tractor, 10% yearly equipment maintenance and application time of 4 acres/hour.

*Equipment cost estimated at: ¹$2,500, ²$10,000, ³$6,500, and ⁴$3000*
Conclusions

- Cultivation provides a largely comparable level of weed management:
  - Strip cultivation reduced weed coverage comparably to burn down herbicides but not pre-emergents
  - Strip cultivation reduced weed biomass comparably to both herbicide tactics
- Cultivation increased June Ammonium levels: Free N!!
- Cultivation may increase SOM over time

Conclusions

- Cultivation may have slightly reduced terminal growth on young trees
- Growth still within acceptable range
- Cultivation may increase beneficial populations
- Cultivation is potentially much less expensive compared to tractor applied herbicides
- Front mounted implements may also be used to “multiply” tractor operations

Next Steps

- Continue soil, tree, and fruit measurements
- Determine impacts on yield
- Assess potential of combining orchard operations (i.e. cultivating + mowing)
- Assess impacts on rodent populations?
- Identify additional implements?

Alternative Implements

Hillside Cultivator
- Rear dragged Lilliston style cultivator for narrow spaced crops
- http://www.hillsidecultivator.com/
Alternative Implements

**Spin Weeder**
- Horizontal disk weeder
- Front or rear mount and can be combined with other cultivators

**Tiller Weeder**
- Standalone rototiller type cultivator for smaller scale production
- Self-powered weeder mulcher
- Adjustable depth 1”-10”
- Built in Michigan
- [http://www.tillerweeder.com/](http://www.tillerweeder.com/)

Acknowledgements

- Krista Buehrer
- Anne Nielsen
- Michael Kelleher
- Grower Collaborators
- Michigan Apple Committee

[MSU OPM Lab]