Implementation of Strip Cultivation in Michigan Apple Orchards: First Year Results

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Introduction
Grower interest in alternatives to herbicide strips in perennial crops is increasing. The "Swiss Sandwich system" or strip cultivation, where growers cultivate within the drip line of trees is one such alternative. The potential advantages of this system include:
- Reduced herbicide application costs
- Reduced herbicide damage to crop plants
- Increased NPK availability within the tree rooting zone
- Increased soil organic matter within the tree rooting zone
- Increased habitat for beneficial insects and mites

Objectives:
- Demonstrate weed control efficacy using front mounted cultivation implements
- Determine impacts on soil nutrient levels, organic matter, tree growth (not presented), and beneficial arthropod communities
- Compare economic costs of floor management systems

Methods
Experiments were performed at 3 farm sites. Site one was near Flushing with mature trees where strip cultivation had been used for more than 5 years. Site two was outside of Pottersville with trees in their 5th leaf and ground cover management consisting of repeated applications of Roundup® and 2,4d. Six rows, three of which were cultivated once a month and three of which received the grower’s normal ground cover management practice, were selected at each site. At site’s one and three we used a Wonder Weeder® brand implement (Fig 1), while the implement at site two was fabricated by the grower (Fig 2). We measured: weed coverage, soil nutrition and organic matter, terminal growth measurements, and mite populations.

Weed Management
- Cultivation increased bare ground at the Flushing and Sparta sites but not at the Pottersville site (Fig 3)
- Cultivation significantly decreased end of season dry weed biomass at Flushing but slightly increased dry weed biomass at Pottersville and Sparta (Fig 4)

Beneficial Mite Counts
- Cultivation using either of cultivation tools was considerably less expensive than projected herbicide application costs (Table 1).
- Savings over herbicide applications (assuming $50 per herbicide application) ranged from $58.26 per acre where new Wonder Weeder® and 3 point hitch were purchased to $72.26 with the grower built implement. This translates to $5826 and $7226/100 acres/year.

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>
</tr>
<tr>
<td>Savings</td>
<td>NA</td>
<td>$50.26</td>
<td>$65.26</td>
<td>$72.26</td>
</tr>
</tbody>
</table>

Equipment cost estimated at: $2,500, $10,000, $6,500, and $3,000

Conclusions
- Cultivation had a definite impact on weed coverage and end of season dry biomass and did not result in as much bare ground as the two herbicide regimes. This was expected as the goal of strip cultivation is to set weeds back and maintain partial soil coverage.
- Numerical and significant increases in June soil ammonium and fall organic matter suggest that cultivation may help build soil and provide some “bonus” nitrogen to trees during a critical period of fruit growth and development. Increased organic matter leads to increased water holding capacity, increased nutrient cycling and improved plant health. However SOM changes slowly over time.
- Increased levels of beneficial mites in cultivated plots suggests that maintenance of some ground cover may provide biological control services for apple pests.
- The significant cost savings that may be expected with this system (over herbicide based programs) was the most exciting result, especially considering that costs might be further reduced for growers that integrate front mounted cultivation with rear mounted mowing or spraying operations. This would effectively halve tractor operation costs.