Comparing tillage and mulching for organic orchard performance

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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), Wonder Weeder® and Weed Badger® (WC), three tillage frequencies using the Wonder Weeder (WW), and a mowed weed control. Tillage frequencies using the Wonder Weeder® and Weed Badger® were Simplified traditional tillage frequencies using the Wonder Weeder® and Weed Badger®.

Trial 2. A new PotatoKEM® 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 (CTU); and an unfertilized, undisturbed, weed-free treatment (CTU). All treatments received the same rate of chicken compost each year (except CTL). Vole presence was measured by a grid intersect method, but voles were not controlled in the trial.

Table 1. Trial 2 treatments.

Table 2. Trial 1 yield results.

Results

Trial 1:
- Each tillage pass controlled existing weeds, but stimulated a flush of new weeds.
- Based on weed biomass data, living mulch reduced weed emergence over the 3-yr trial.
- Wonder Weeder® was faster, but shear bar on tool cannot be used on young trees.
- Improved tree performance in both trials.
- Clearly suppressed weeds, but competed with trees.

Trial 2:
- Wood chip mulch did not provide acceptable weed control; increased tree growth and yield (Figure 3).
- Living mulch provided excellent weed control (Figures 6 & 10), but competed with trees.
- Living mulch had greater vole presence, except Galium (SWNL, Figures 4 & 10).
- High vole presence in Yrs 1-2, but voles were nearly absent by Yr 3 due to natural decline.
- Living mulch had greater vole presence, except Galium (SWNL, Figures 4 & 10).

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.
- Wonderland provided less competition with trees than full living mulch, with less tree leaning than full tillage.
- More effective and longer-lasting weed control in established orchard than in new trees.
- Improved tree performance in both trials.
- Clear suppression of weeds, but competed with trees.
- Galium 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.

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