

Progress Report: Organic Cropping Research for the Northwest

TITLE: Understory Management in Organic Tree Fruits and Other Woody Perennials

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ABSTRACT: Weed control and fertility management have been identified as priority research needs by Washington organic orchardists. Mechanical weed control has been the standard practice, often with high cost and potential degradation of soil quality. Mulches, which may be expensive, can provide good weed control and increased tree growth and yield in some settings, and may provide an environment to enhance codling moth mortality with entomopathogenic nematodes. Living mulches show promise for weed control, soil quality, and fertility benefits, but can compete with trees and increase rodent populations. Initial studies with a new mechanical cultivator for orchards (Cultivator Z) in comparison with a control (mowed weeds), wood chip mulch, and a commonly used cultivator (Cultivator Y) show that Cultivator Z is as effective as Cultivator Y, with lower operating costs, but still has much more weed growth than the mulch. Water infiltration (an indicator of soil quality) was significantly lower in Cultivator Y plots than in Cultivator Z plots. Initial screening of 26 potential living mulch species showed white clover and colonial bentgrass to be the best species to establish ground cover under severe weed pressure with a spring planting. Weed pressure for a late summer planting was much lower. Wood chip mulch did enhance the mortality of codling moth larvae when treated with *Steinernema carpocapse* and *S. feltiae*.

OBJECTIVES:

1. Evaluate the effectiveness of various weed management strategies for organic orchards.
2. Evaluate 'living mulch' species for establishment, vigor and weed competitiveness.
3. Evaluate the potential for understory management to increase mortality of overwintering codling moth (*Cydia pomonella*) larvae.

PROCEDURES:

1. A new trial was set out in an 8-yr old block of Gala/M26 in transition to organic certification. Treatments included control (no tillage, mowing to keep weeds down), wood chip mulch (6" thick), Cultivator Y (3x), Cultivator Z (2x), Cultivator Z (3x), and Cultivator Z (4x), with 5 replicates. Cultivator Y is a hydraulically driven unit with a vertical axis cultivating head. Several companies make this type of machine. Cultivator Z is a ground-driven rolling cultivator with a spring blade that works in between the trees.

Data collected included weed cover, weed biomass, tractor time for operations, shoot extension, SPAD, and leaf samples. Also, infiltration and penetration resistance were measured to monitor soil quality, and soil samples were taken for pending organic matter tests.

2. A new trial was set out in an 8-yr old block of Gala/M26 in transition to organic certification, with 3 replicates. The weed strip was tilled in mid-April and living mulch species were planted in mid-May. Six perennial landscape species were planted (alyssum, native beach strawberry, native ginger, sweet woodruff, creeping thyme, and scotch moss). These species were selected as an alternative to legumes to avoid potential rodent problems. Twenty entries of annual and perennial legumes, and colonial bentgrass, were planted (white clover, strawberry clover, kura clover, subclovers, medics, trefoil) singly and in combination. Weeds were hand pulled during May, June, and July. Crop establishment and weed competitiveness were noted through the season, and select biomass samples were taken. A late summer planting of selected legumes was also done to test this timing for weed problems.

3. The nematode / mulch trial continued in the same location as last year (an 8-yr old block of Gala/M26 in transition to organic certification), with main plots of mulch or bare ground (tillage), and split plots of water, *Steinernema. carpocapsae*, and *S. feltiae*, with 5 replicates. Nematodes were applied at 0.4 billion nematodes/acre with a backpack sprayer to the weed strip on three different dates to try to coincide with a susceptible part of the life cycle of codling moth (*Cydia pomonella*) – spring, summer, fall. Sentinel CM larvae in cardboard strips were placed in the plots prior to application, recovered 2 days later, and then evaluated for infection by the respective nematodes. In addition, in the fall 2004 test, sheet metal arenas were placed in the plots to test for the persistence of the nematodes and their ability to infect mobile CM larvae.

PROGRESS TOWARDS OBJECTIVES:

1. Cultivator Z proved to be an effective mechanical device. It is much faster to operate than other mechanical weeders (e.g. 440 ft/min for Cultivator Z vs. 20 ft/min for Cultivator Y) and weed control results are comparable. The blade that sweeps weeds from between the trunks was less consistent in its weed control than the rolling spiders on each side of the tree row. The spiders were able to work in heavy weed pressure (e.g. weeds 10-12' tall) but did a better job if weeds were smaller. Cultivator Y is a more effective cultivator in grass sod.

Infiltration and penetrometer resistance were measured this year to help set a baseline for monitoring the soil quality impacts of repeated mechanical tillage compared to untilled or mulched soil. Cultivator Y had significantly slower infiltration than the other treatments.

Cultivator Z is similar in cost to other mechanical cultivators (about \$5,000). However, it is a very simple machine with no internal hydraulics and thus should have lower maintenance costs and down time. It can also be used with another operation such as spraying or mowing, and thus the tractor/operator cost is virtually zero. The machine manufacturer noted that he is able to cultivate 40 acres of orchard in about 8-10 hr of operation, which is supported by the ground speed measured in this trial. The cost of applying wood chip mulch was also calculated from this trial, and is estimated to be \$924/ac for this setting, using a tractor-pulled mulch spreader that was loaded with a tractor front-end loader. It took about 5 minutes to cover 40 lineal feet of row (the 5' weed strip only) with about 6" of mulch. Half of the total time was driving to and from the mulch stockpile, which was located a distance from the trial block. The mulch was delivered free to the orchard by tree removal services in the area.

2. Living mulch species performed variably in this initial season. Weed pressure was intense with the spring planting, dominated by annual cool season and warm season grasses. Only a few entries performed well without extensive hand weeding - the white clovers and the bentgrass.

Over time, the strawberry clover also established a cover. With weeding, the alyssum nearly reached 100% ground cover and provided flowers season long. The fall planting had much less weed pressure, as has been experienced in the past. All the species that were fall planted (trefoil, kura clover, medic) had excellent germination and growth with no weeding, compared to less effective stand establishment in the spring planting, when kura clover failed to establish. First year data are contained in the accompanying living mulch report.

3. The positive effect of the mulch on CM mortality was most evident in the spring and fall 2004 tests. In the spring, the mulch increased mortality from below 20% to 40-60%. In the fall, mulch had a bigger impact on the efficacy of *S. carpocapse* (20% CM mortality on bare ground vs. 90% under mulch) than of *S. feltiae* (60% bare ground vs. 85% under mulch). Research is needed to determine the spatial distribution of overwintering CM larvae in modern high density orchards and the relative attractiveness of various mulches as overwintering sites for these larvae. If a mulch proved attractive to the larvae, it could act as a “trap location” that could be treated with nematodes while the larvae are relatively immobile, leading to significant mortality and thus reductions in spring populations.

OUTPUTS:

1. A field demonstration was held to allow growers to see Cultivator Z in action. Five growers participated. A video of the machine was shown at the Ecological Weed Management workshop in Wilsonville, OR, in February 2004. The machine was lent to 2 growers to allow them to evaluate it under their differing orchard conditions.
2. A written report of the first year of evaluation of living mulches was produced and will be put on the Organic and Integrated Fruit Production web site.
3. A poster was developed and presented at the “Bugs Work for You” symposium in Portland, OR in November 2004. An abstract is included in the proceedings. The poster will be put on the Organic and Integrated Fruit Production web site.

<http://organic.tfrec.wsu.edu/OrganicIFP/Home/Index.html>

The poster was also presented at the Washington State Horticulture Association 2004 annual meeting in Yakima in December 2004.

IMPACT:

1. Both growers who tested Cultivator Z were favorably impressed, are considering a purchase, but see it as a complement to the tools they already have, not a total replacement. For perennial grasses, it may not be sufficient. And it may be too risky to use in a new planting or in cherries where bark wounds from the sweep blade could increase infection by *Pseudomonas*. The orchard manager at the experimental site is considering using Cultivator Z instead of glyphosate in the conventional blocks as he believes it is a less expensive option.
2. We have had 7 grower inquiries about the living mulch trial. Concerns about rodents remain unanswered.
3. We have had 15 grower inquiries about the entomopathogenic nematodes and mulch. Growers are awaiting more definitive results.

INSTITUTION: Washington State University, Wenatchee Valley College, USDA-ARS, Agriculture Canada

STATE: WA

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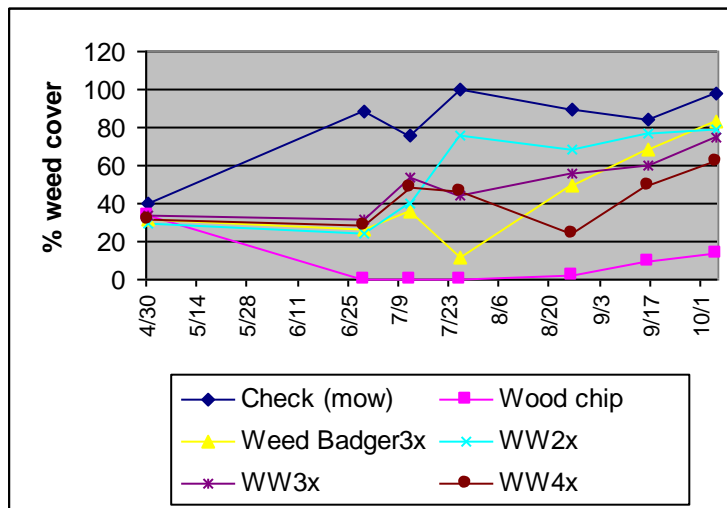
FUNDING AMOUNT(S): \$31,489 USDA, \$1,000 WTFRC

ORGANIC RESEARCH LAND (indicate number of acres on all that apply):

Station ___non-organic ___transitional ___certified
On-farm ___non-organic _1.0 transitional ___certified

FARMER COOPERATOR(S): Number_1___
Name(s): Amos Kukas

Percent weed cover in the tree row during the 2004 growing season.



Cultivator Z tillage dates: 5/26, 6/12, 7/13, 8/13

Cultivator Y tillage dates: 5/19, 6/17, 7/13

Water Infiltration as measured by single-ring method. August 2004.

TRT	T1 (min/1" water)	T2 (min/1" water)
A Mow	0.696b	3.56b
B Wood Chip	NA	NA
C Cultivator Y	2.328a	8.182a
D WW 2x	0.732b	2.138b
E WW 3x	1.188b	3.006b
p= 0.0007 0.0047		

T1= time at ambient soil moisture; T2=time at field capacity.