

Orchard Mulching Trials

Wenatchee Valley College Auvil Teaching Orchard, E. Wenatchee, WA
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We are exploring the use of mulches in orchard systems to determine their potential for the multiple benefits of weed control, water conservation, nutrient cycling, and soil quality improvement. We are testing organic mulches that are available and inexpensive to obtain, as well as cover crops that can grow a mulch in place or serve as a “living mulch.”

The initial mulch trial was established in May 1999 on Red Delicious/M26 (planted 1995). Treatments include: Control (no mulch, Roundup for weed control); wood chip; shredded paper; and chopped alfalfa hay. Cover crops were established in late August 1999: dwarf white clover, oriental mustard, and winter rye. The clover is still growing, while the mustard and rye were only used for one season. One set of clover plots has been mowed 1-2 times per season, while the other set was suppressed with Roundup in 2000 and with flaming in 2001.

In the first season, the alfalfa mulch led to the greatest trunk growth. This effect was less pronounced in the second season, where the clover trees had growth similar to the alfalfa. There were no differences in fruit yield in 1999, while in 2000 yield was highest for alfalfa (61 lb/tree) and similar for all other treatments (33-42 lb/tree). There was small increase in fruit weight due to alfalfa in 1999. In 2000, only the alfalfa (highest) and rye (lowest) were statistically different for fruit weight. These differences are probably due to nitrogen. The alfalfa provided a large input of N in the year of application, but this faded with time. This was confirmed by the higher leaf N and leaf greenness measured.

Table 1. Tree growth.

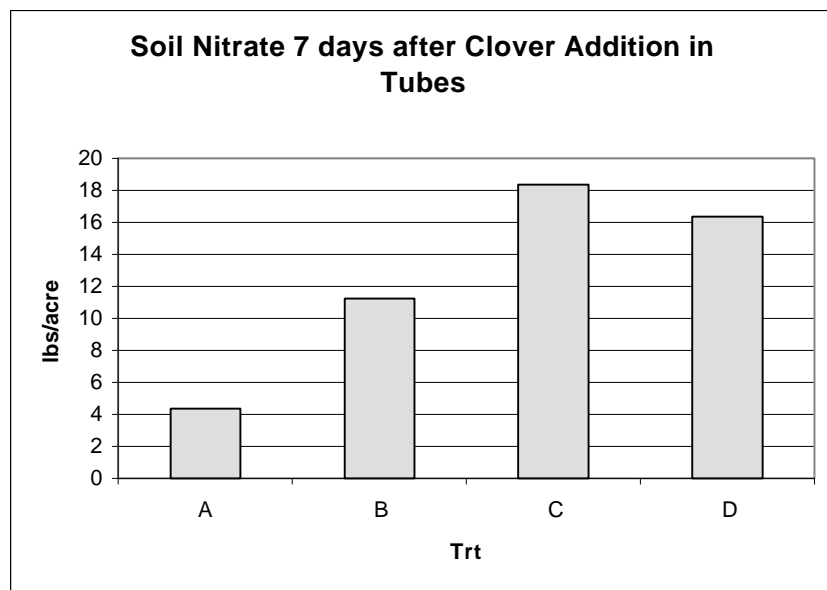
Code	Treatment	Trunk growth*		Leaf total N (%)		Fruit yield (lb/tree)		Fruit weight (g)	
		1999	2000	1999	2000	1999	2000	1999	2000
A	Control	19 b	10 bc	2.0 b	2.0 d	30	34 b	245 b	213
B	Wood chip	22 ab	11 bc	2.0 b	1.9 de	30	33 b	254 b	216
C	Paper	20 b	13 ab	2.0 b	2.0 de	34	38 b	254 b	229
D	Alfalfa	29 a	14 a	2.8 a	2.5 a	32	61 a	272 a	233
F	Rye		9 c		1.8 e		41 b		225
E	Mustard		12 abc		2.1 cd		37 b		207
G	Clover – mow		12 ab		2.2 bc		41 b		220
H	Clover – herb.		13 ab		2.3 b		42 b		220

*% increase in trunk cross-sectional area

Numbers within columns followed by the same letter are not statistically different.

Soil N was monitored at selected times. The alfalfa led to elevated soil N (50 ppm) compared to the control (4 ppm) in the first year, but this declined in the second and third year. Intensive monitoring of the clover plots has been done to determine whether the clover is adding N to the system that the trees benefit from. When tree roots were excluded, we did see a measurable release of N from the clover (Figure 1). The clover trees also have the highest leaf greenness and look to be the most vigorous in 2001.

Figure 1. Soil nitrate after addition of clover residues in root exclusion tubes.



A=control plots, - clover, + cover
 B=control plots, + clover, + cover
 C=clover plots, + clover, + cover
 D=clover plots, + clover, - cover

Fruit quality was assessed in both years, and the effect of high N from alfalfa was apparent. The clover plots appear to be having a trend similar to alfalfa, but more subdued. Otherwise, mulch treatment had minimal effect on fruit quality (Table 2).

Table 2. Effect of mulches on fruit quality.

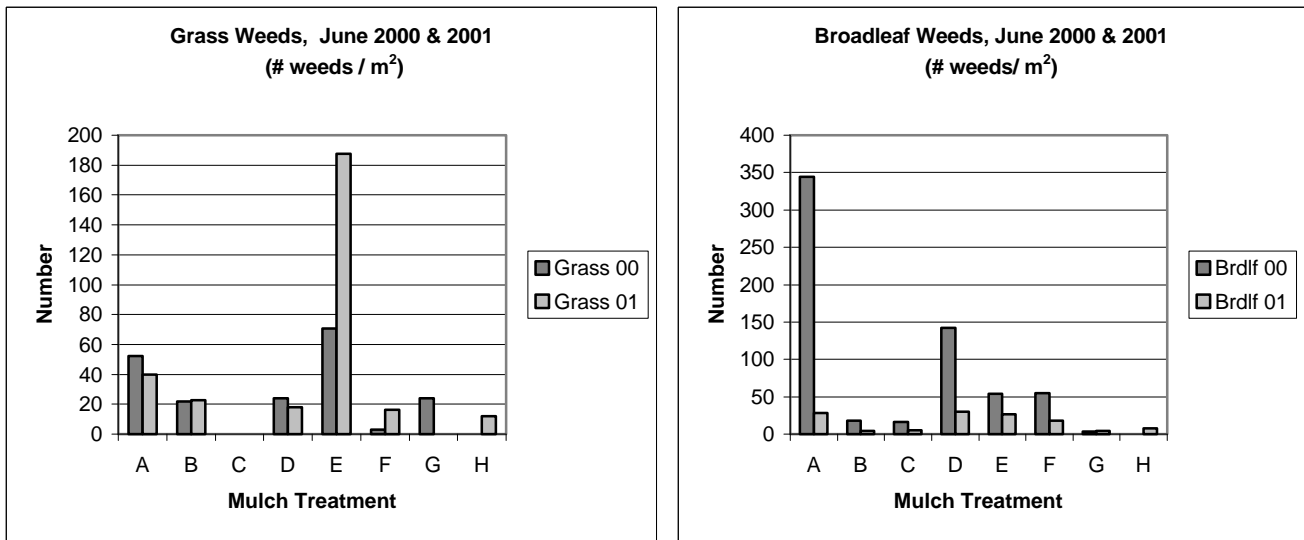
	Fruit Firmness (lb)		Color (% red)		Starch (0-6)		Soluble Solids (%)		Titratable Acidity (%)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Control	16.0 b	19.2 a	99.0	99.2 a	1.78 a	3.78	11.3	10.1	0.32	0.23
Wood chip	16.6 a	19.2 a	99.0	99.3 a	1.74 a	3.19	11.2	11.0	0.32	0.25
Paper	15.9 b	19.1 a	98.0	99.0 a	1.80 a	3.44	11.1	11.3	0.32	0.25
Alfalfa hay	15.3 c	17.5 b	96.2	91.9 b	1.98 b	4.14	10.9	10.7	0.33	0.23
Mustard		17.5 b		98.8 a		3.36		11.2		0.24
Rye		18.9 a		99.5 a		3.78		9.3		0.25
Clover (mow)		18.7 a		98.5 a		3.40		10.4		0.23
Clover (herb.)		18.3 ab		98.4 a		3.44		10.6		0.25

Numbers within columns followed by the same letter are not significantly different.

Soil temperature and bloom development were monitored in the spring. Mulches almost always led to cooler soil temperatures than the control, with the wood chip and clover often being the coolest. However, the soil temperature differences did not lead to any measurable differences in bloom development.

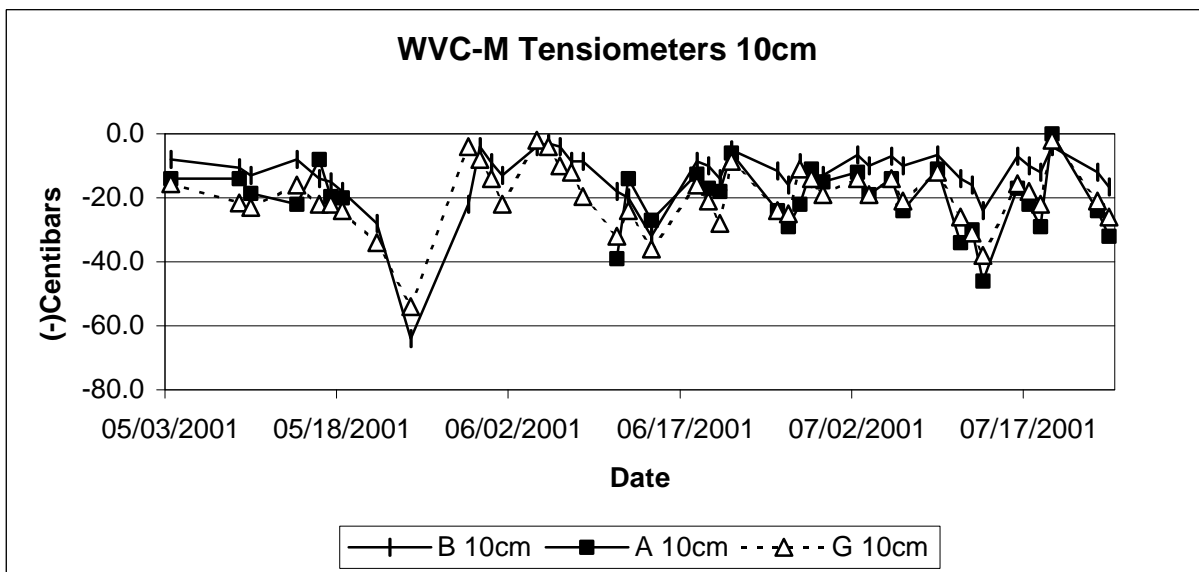
Weed pressure in the plots has not been severe. Overall, the paper, wood chip, and clover plots have provided good weed control. The alfalfa plots were often the most weedy, and the mustard led to an annual grass infestation. Rye was effective for one season, particularly for grassy weeds.

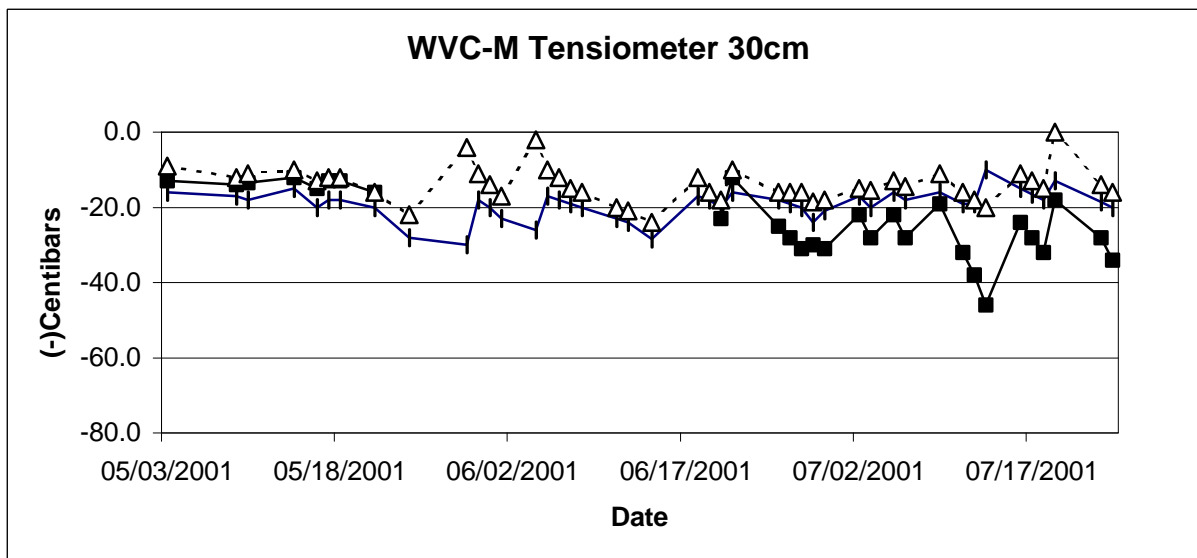
Figure 2. Weed control by mulches
 (A=control, B=wood chip, C=paper, D=alfalfa, E=mustard, F=rye, G=clover mow, H=clover herbicide)



Water use was monitored in selected mulch plots. In 2000, the clover consistently had the highest soil moisture in the top 20 cm using the Hydrosense TDR probe. In 2001, tensiometers were used at 10 and 30 cm in the control, wood chip, and clover plots (unreplicated). While the clover appeared to be similar to control at 10 cm, it consistently had greater soil moisture at 30 cm (Figure 3). Wood chip showed moisture conservation at both depths.

Figure 3. Soil moisture status in control (A), wood chip (B), and clover (G) plots. Readings are in centibars of tension, on a negative scale, with a lower number being a drier soil.





A second trial was started in 2000 (Gala/M26) to compare a wood chip mulch to no mulch for soil moisture status. An Enviroscan moisture monitoring probe was installed in each plot (4 replications). In 2000, all plots received the same irrigation, but the mulch plots consistently had 15-20% higher soil moisture at the end of each irrigation cycle. In 2001, the mulch plots and no mulch plots were watered independently, based on moisture need. Again, the mulch plots have required about 20% less irrigation as of mid-July. The Enviroscan system has provided very good data for monitoring soil moisture.

In 2001, rodent activity (both gophers and voles) in the trial was noticeably higher than before. Some digging in the tree row, particularly in clover plots, has damaged trees. The orchard manager reports a much higher frequency of coyotes as well, and the coyotes are damaging the plastic irrigation tubing. No vole damage has been observed in the wood chip or paper plots.

In a companion trial in Tonasket, wood chip, paper, and alfalfa mulches were applied to second leaf trees. The mulches did not lead to consistent growth differences as in the East Wenatchee trial, and leaf N was unchanged by mulch. The alfalfa mulch had the highest weed pressure, while the paper and wood chip had the best weed control.

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