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Weed Management In Orchards

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Center for Sustaining Agriculture & Natural Resources

Outline

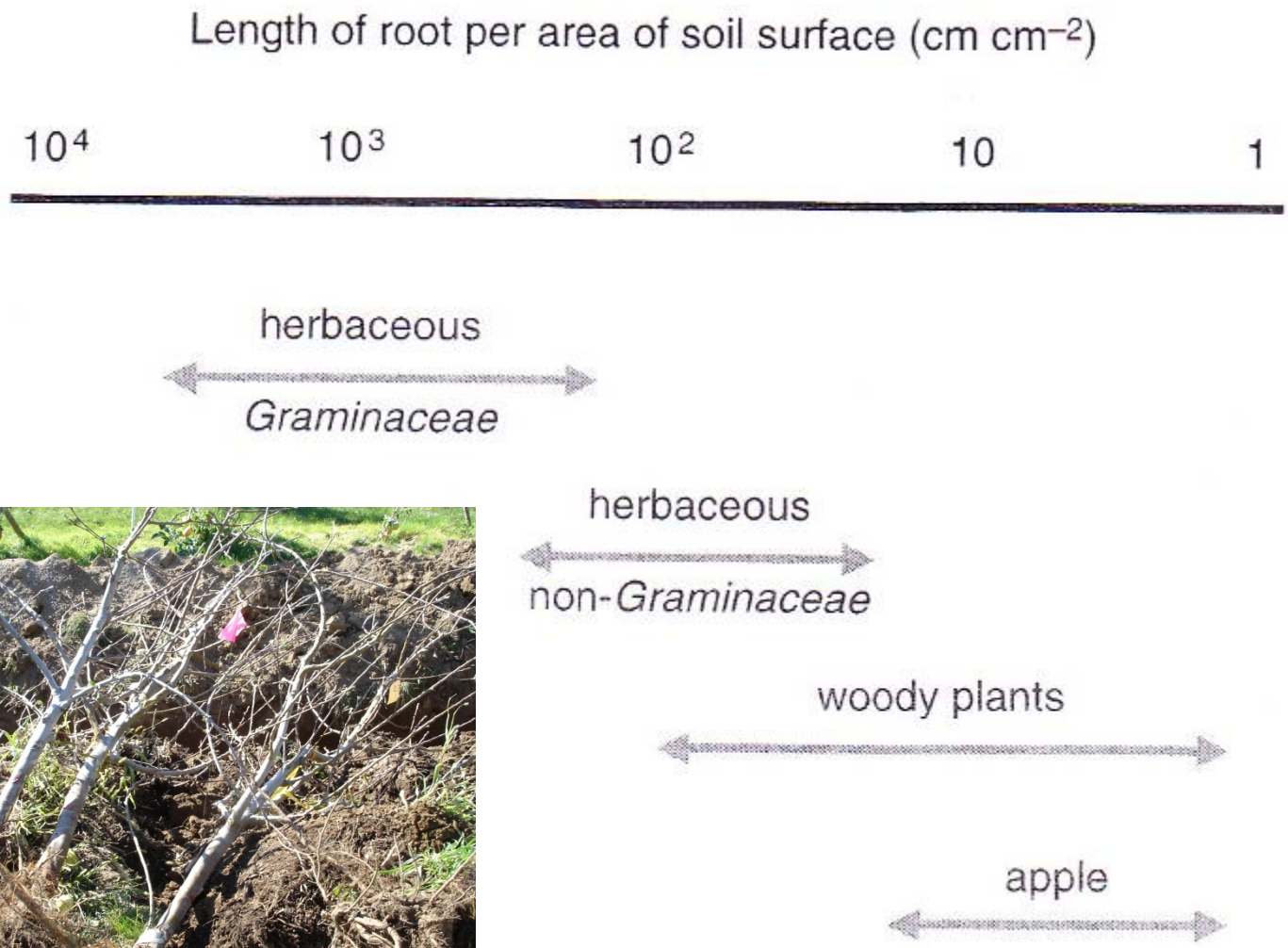
- Why weed control?
- Weed control options
- Results from non-chemical weed control
- Economics
- Conclusions

Weed Control

Why control weeds ?

- Limit competition with young trees – nutrients, water
- Minimize rodent habitat
- Weeds as hosts for pests, disease inoculum
- Avoid blocked sprinklers

Apple Root Density



(Neilsen and Neilsen, 2003)

Standard System

Herbicide strip, grass alley

Mini Tatura Trellis on M.9
Washington

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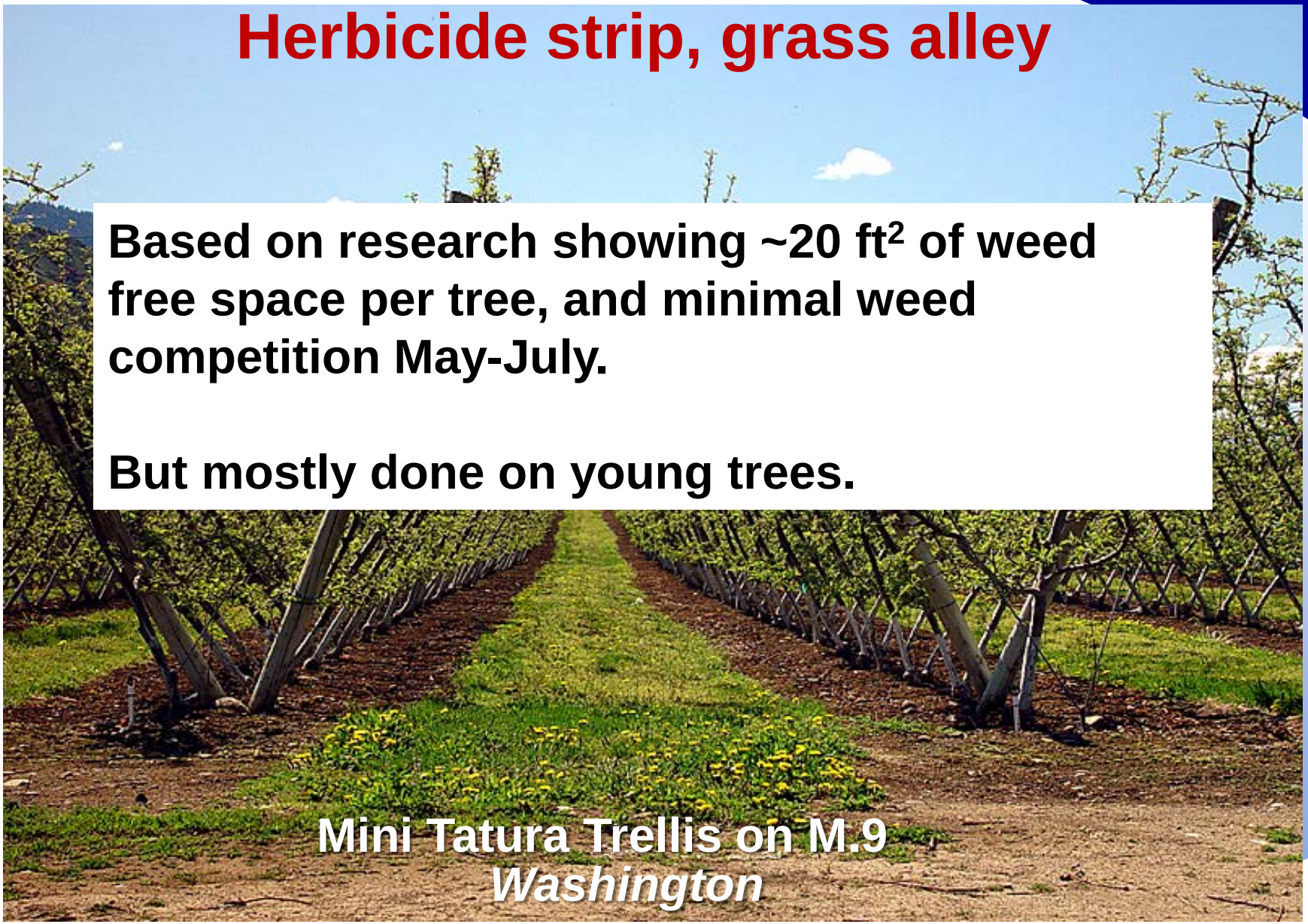
Herbicide strip, grass alley



Based on research showing ~20 ft² of weed free space per tree, and minimal weed competition May-July.

But mostly done on young trees.

Mini Tatura Trellis on M.9
Washington

Weed Control Options

Orchard Weed Control Options

	Pro	Con
Herbicides	Control weeds around trunk; rodents; no tree, root damage; low cost	Resistance, leaching, soil quality loss; effectiveness
Mowing	Fast, inexpensive	Short-term suppression; still have competition, habitat
Tillage	Effective; rodents; low cost	↓ tree growth, fruit size, soil quality; damage trees
Flaming	Control weeds around trunk; rodents; low cost	Tree injury, perennial weeds, fossil fuel
Inert mulches	Effective; soil quality; moisture	Costly; N tie up; soil quality
Living mulches	Add biodiversity; soil quality; fix N	Competition; rodents; persistence

(Granatstein & Mullinix, 2008)

How to combine strategies? Change system with age of orchard?

Orchard Herbicide Guidance

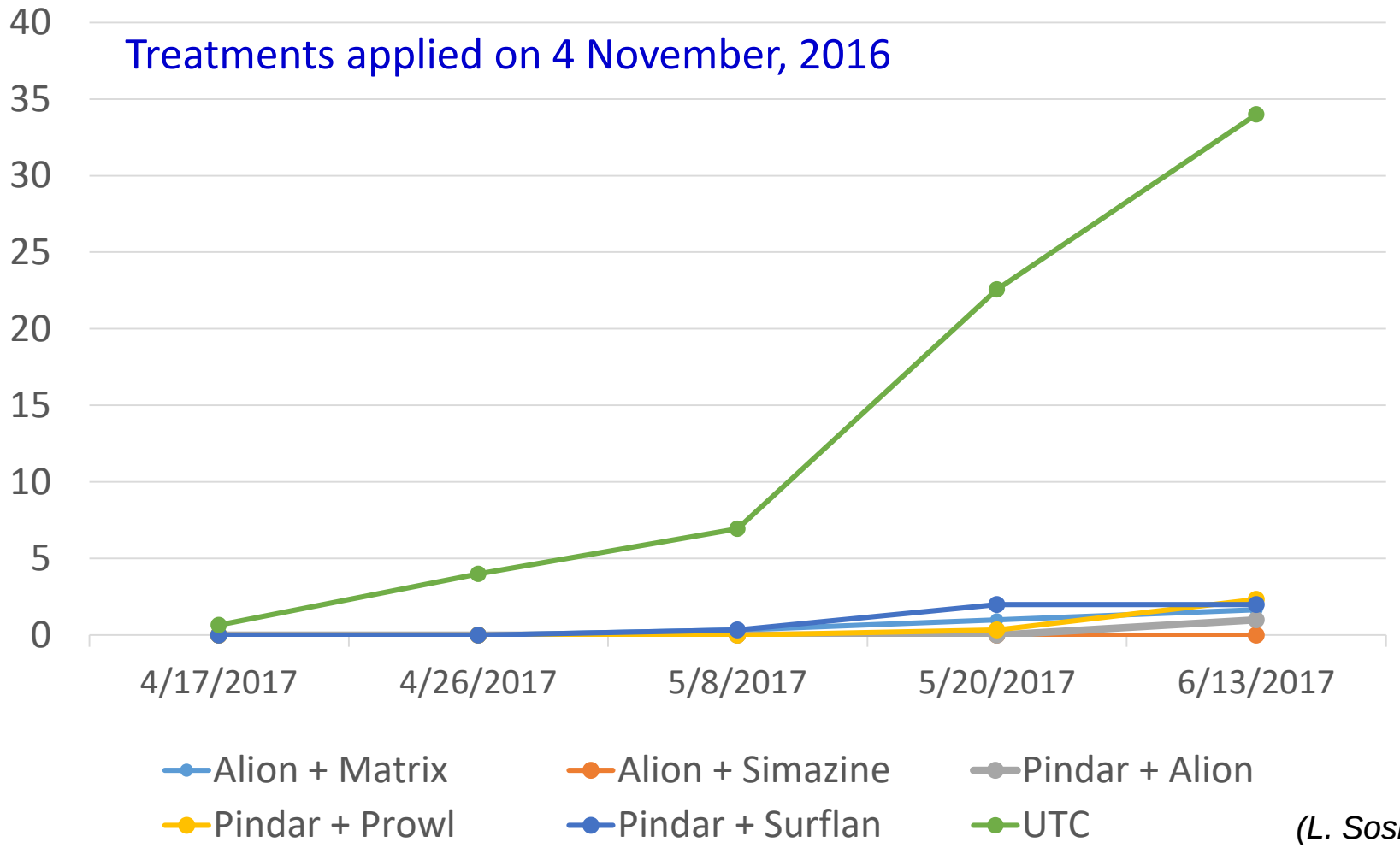
Tim Smith approach

1. Combination of two residual herbicides, fall apply; control emergence of winter annual, spring annual, summer annual
2. Systemic herbicide: mid-late summer; perennials, control escapes
3. Burndowns: small seedling weeds
4. “Mix it up”. Use different combinations, different modes of action for better control, resistance mgt.

(Fall control is best for perennials)

Percent (%) Weed Cover up to 7 Months after Herbicide Application

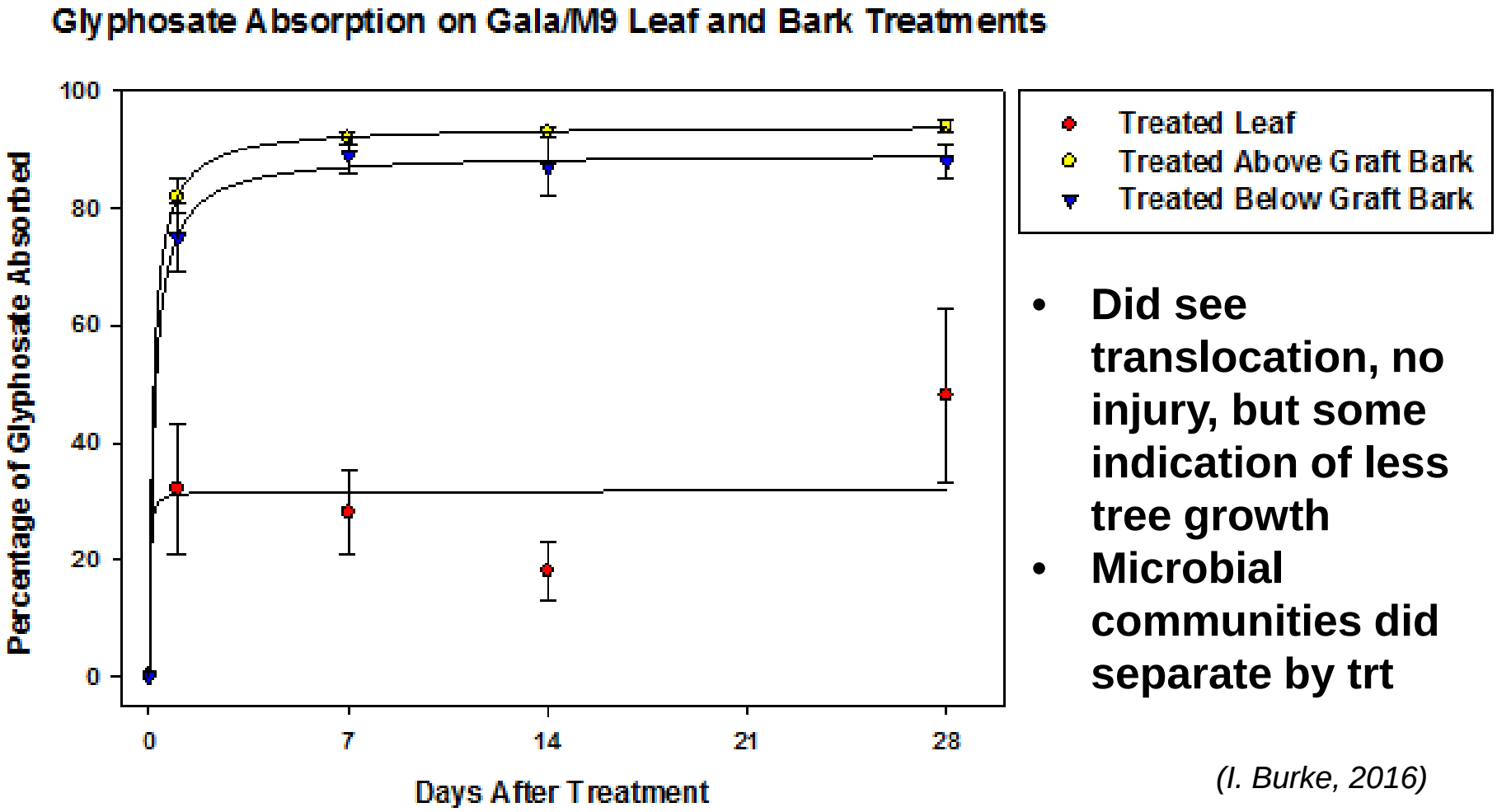
Wenatchee, WA



(L. Sosnoskie)

Glyphos Damage

Figure 1. The percentage of glyphosate absorbed by leaf, by the bark above graft, and by the bark below graft at 1, 7, 14, and 28 days after treatment (DAT).



- **Did see translocation, no injury, but some indication of less tree growth**
- **Microbial communities did separate by trt**

(I. Burke, 2016)

Other Controls

Mowing

'Dyna-Trim' type
retractable mowing head

T. Pitts

String weeder

Tillage

T. Pitts

Flame Weeding

Brewster orchardist:

- **Burn 4-5 ac/hr**
- **10 gal propane/hr**
- **4x per season**
- **Cost $70-80/ac**

Dovex Orchard, June 2007

(T. Pitts)


Mulches
Chopped alfalfa hay mulch

Wood Chip Mulch

- can get excellent weed control
- increased fruit size & tree growth

Mow and Blow

- Reduced passes with mower
- Reduced passes with weed sprayer
- Reduced herbicide
- Reduced irrigation

(H. Huntley)


Shredded paper mulch


Spray-on
paper mulch

Spray-on Paper Mulch

Cost and longevity are key issues.


Weed fabric
Wenatchee orchard (2012):
Fabric $330-800/acre; lasts ~ 10 yr
Labor to apply $100-200/acre
Labor to open and close each year $200/acre
(T. Pitts)

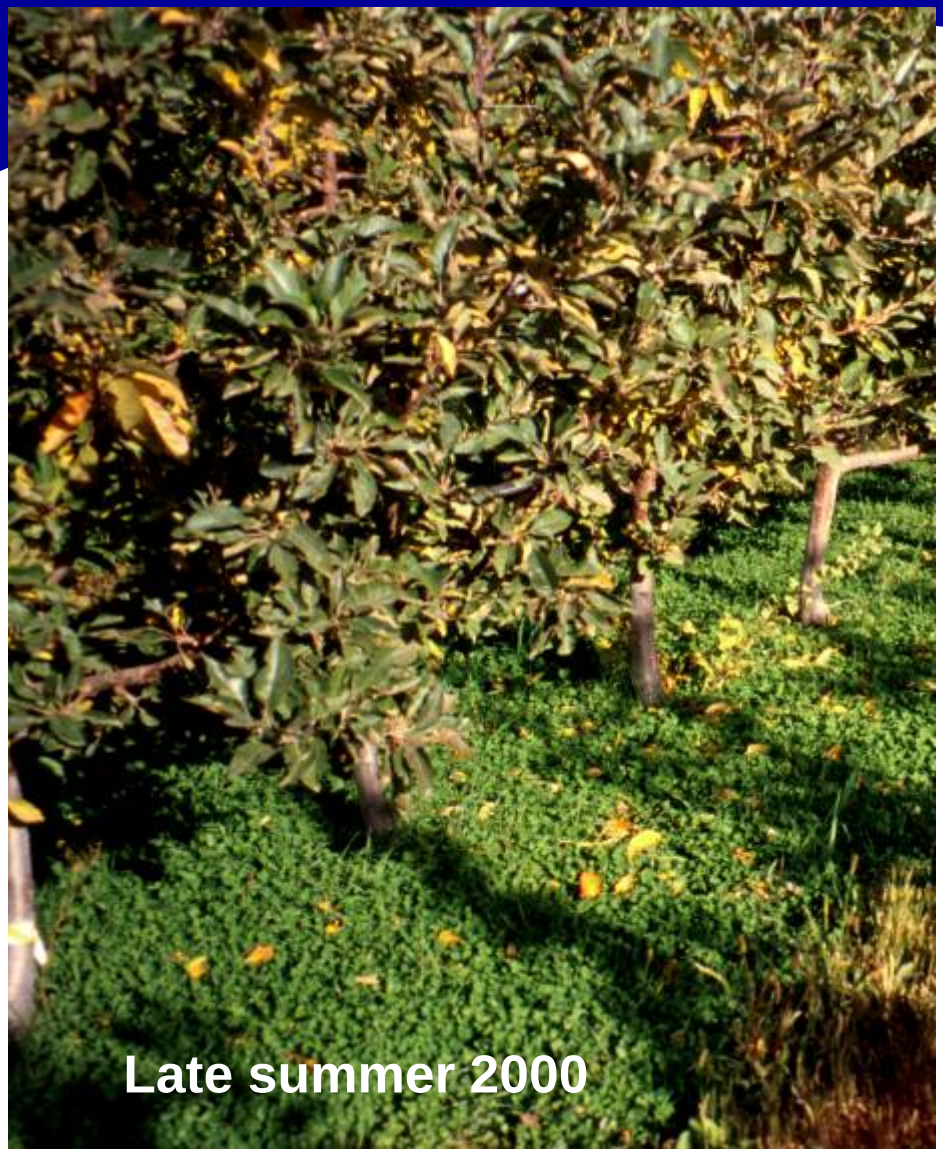

‘White on black’
fabric

‘Living’ mulches

Sweet woodruff

Thyme


White clover 'living' mulch



Rodents – the weak link for clover.

‘Living’ mulches

Fall-planted Oriental mustard


Annual grass weeds after mustard


Winter rye

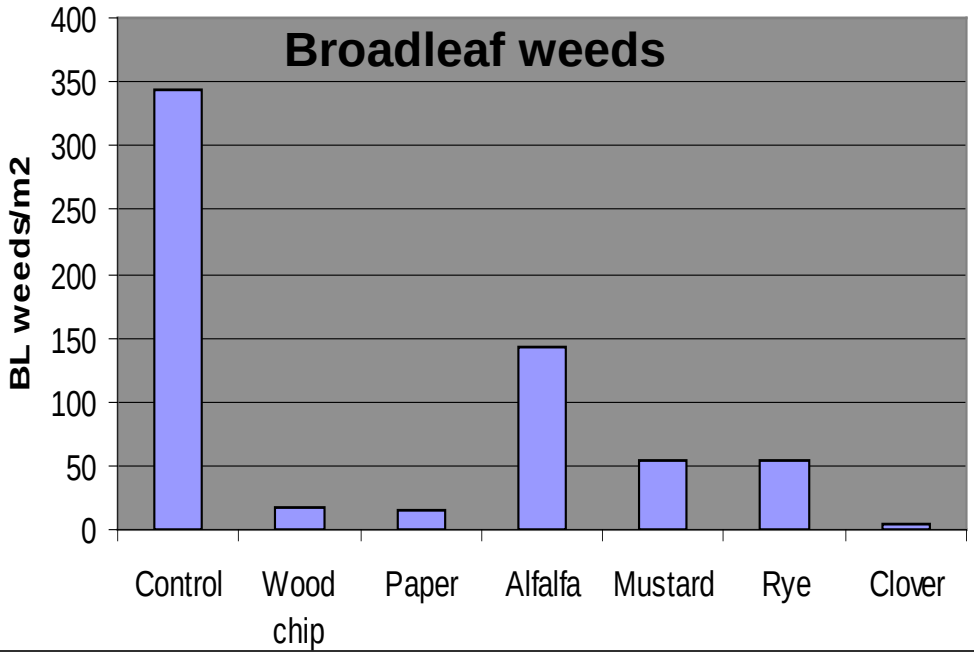

Winter rye in May

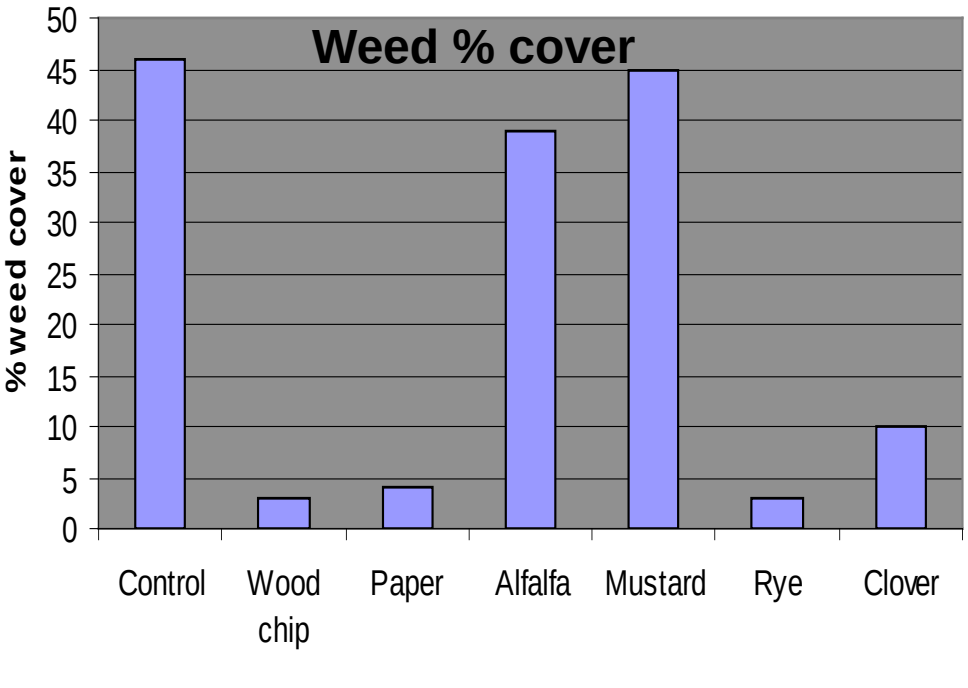
Results from Non-Chemical Weed Control Trials

WVC Mulch Trial

Weed Control – 6/1/2000

8-yr ‘Red Delicious’/M.26
Wenatchee, WA





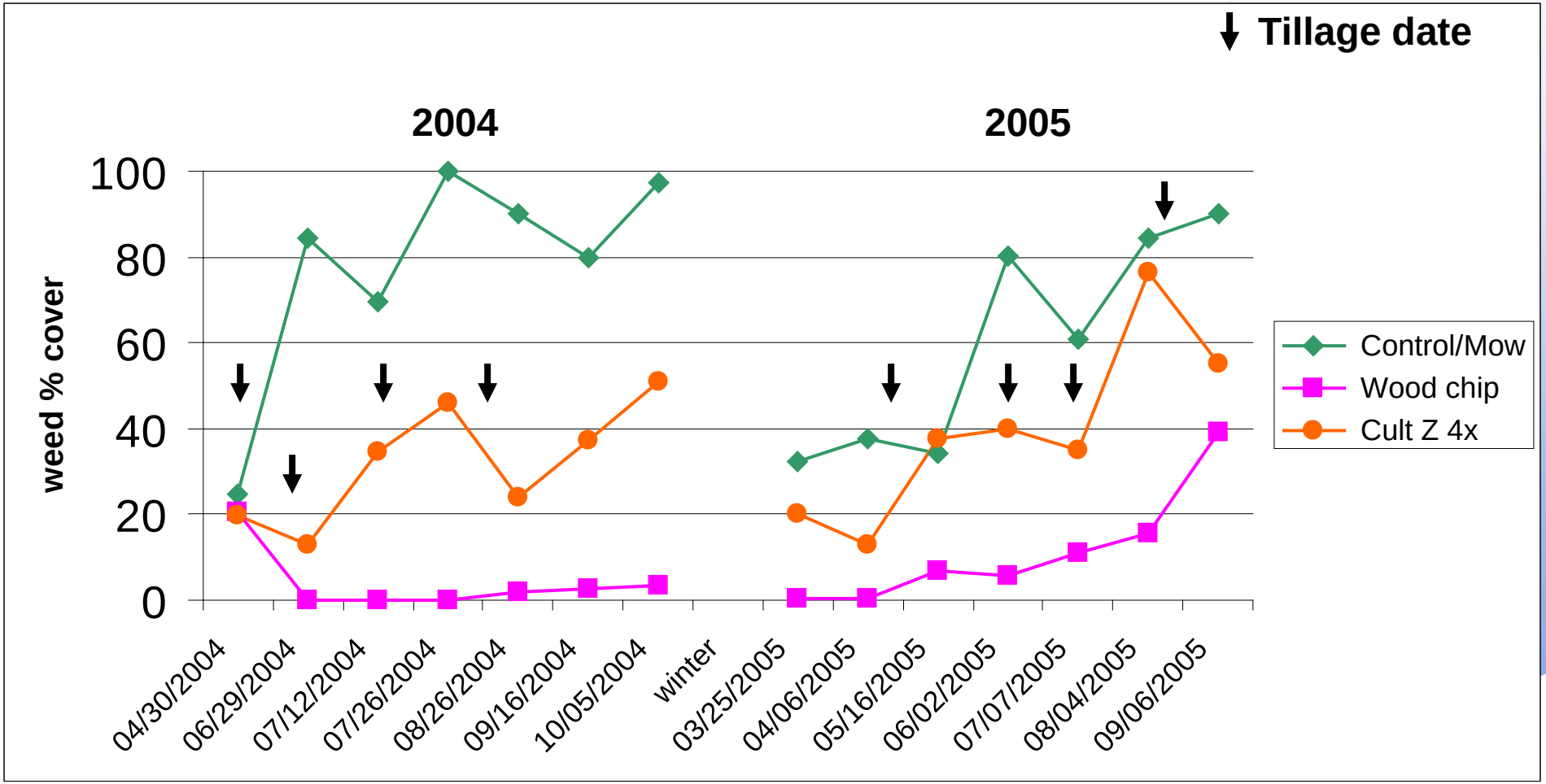
Weed Control

Tillage Comparison Trial, 2004-2006

- Control (mow), wood chip mulch, Weed Badger, Wonder Weeder at tillage frequencies (2x, 3x, 4x)
- Wood chip layer 15 cm thick

Tillage Comparison Trial

‘Gala’/M.26, E. Wenatchee, WA



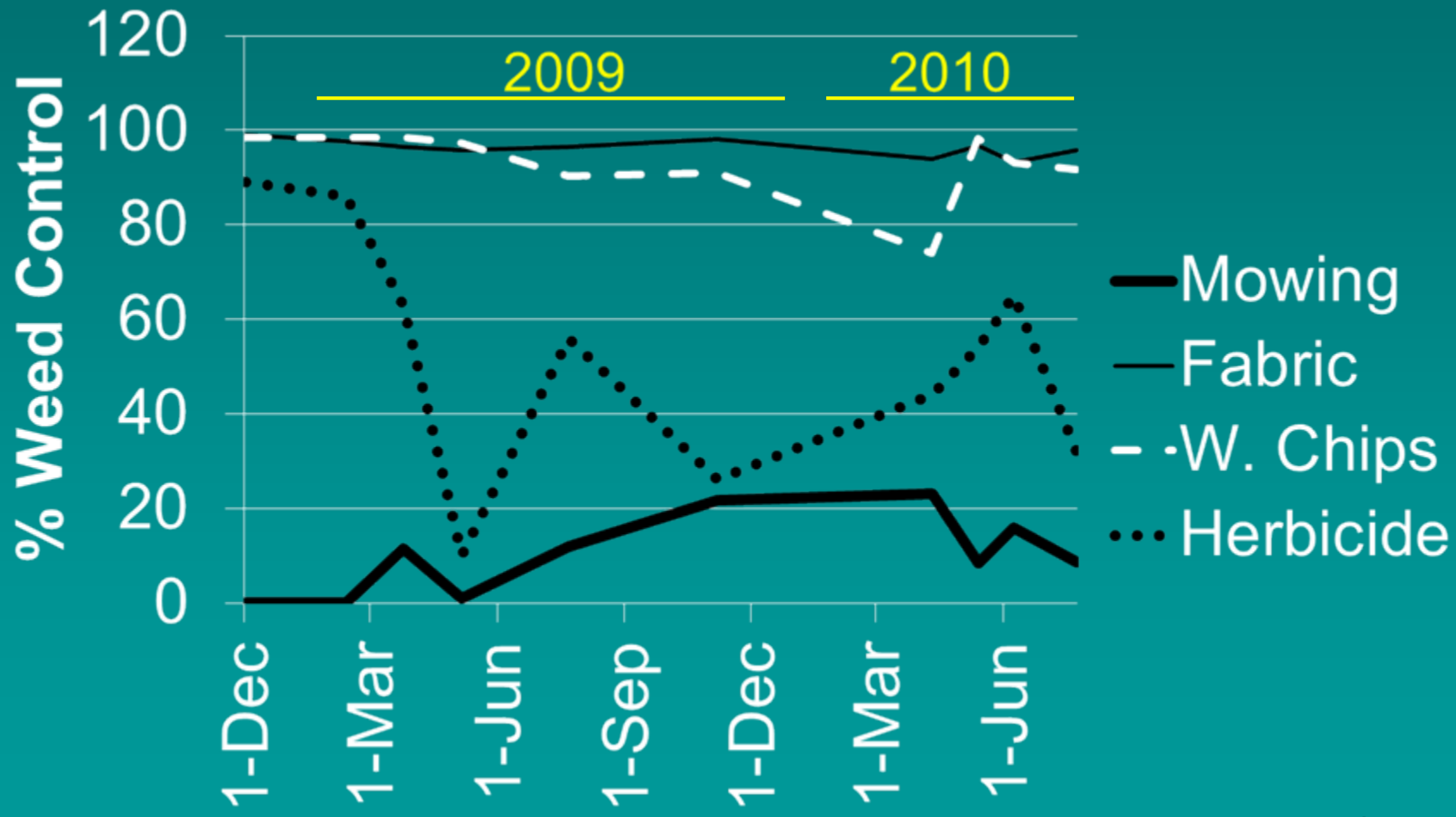
Tillage Trial

2004-2006

TRT	2005			2006				
	Fruit yield	Fruit Size 80-88	Gross Fruit Value	Fruit Yield	Fruit Size 80-88	Gross Fruit Value	TCSA increase	Canopy volume
	lb/tree	%	$/ac	lb/tree	%	$/ac	cm^2	m^3 /5 trees
Wood chip	49.3	15.5 a	14,354	32.3	39.0	11,032	3.7 a	56.7 a
Control mow	44.9	6.6 b	12,003	31.5	33.5	9,748	3.0 b	47.6 ab
Cultivator Z 3x	38.7	7.0 b	9,556	29.3	22.0	10,162	2.3 c	39.2 b
p=	0.150	0.014		0.805	0.076		0.001	0.008

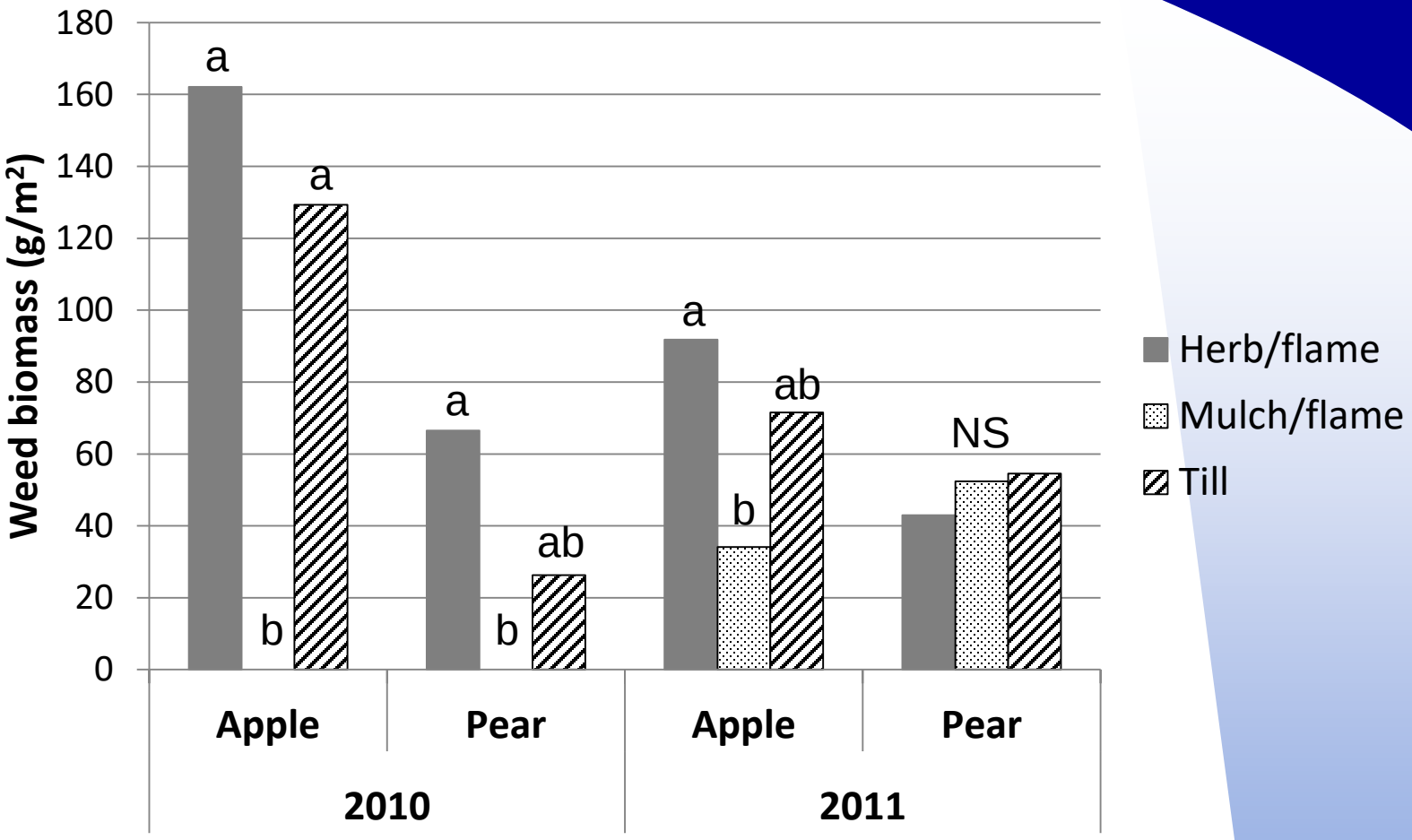
UC Davis Trial – Pears, Sacramento Delta

% Control of Weeds



(C. Ingels)

Weed Biomass



Weed biomass (dry matter) in the tree row. Columns with the same letter are not significantly different ($p<0.05$) for that orchard.

Sunrise Fabric Trial

- 2010-2012
- 6 yr old ‘Gala’/M.9

	3 Yr Increase TCSA	3 Yr Fruit Yield	Fruit size 2011*	Yield Eff.
	(%)	(kg/tree)	(g)	(kg/cm^2)
Black	113	39.6	211	1.79
White-on-black	129	47.1	219	2.16
p=	0.13	0.08	0.05	0.005
*no fruit size difference in 2010, 2012				

Makus 2007. White-on-black provided excellent weed control and raised anti-oxidant levels in blackberry.

Economics

Alternative Weed Control Costs

British Columbia, 2002

Method	Rate	Freq.	Relative Cost $/ac/yr
	(ac)		
Glyphos.	0.5 l	4/yr	1.0*
Weed fabric	5' x 3750'	1/6 yr	3.2
Alfalfa hay	8.5 ton	1/2 yr	3.9
Wood chip	100 yd^3	1/3 yr	3.4
Spray on	3.4 ton	1/1.5 yr	4.3
Flaming	48 lb	3/yr	1.2
Tillage (*Wonder Weeder*™)		3/yr	0.5-0.6

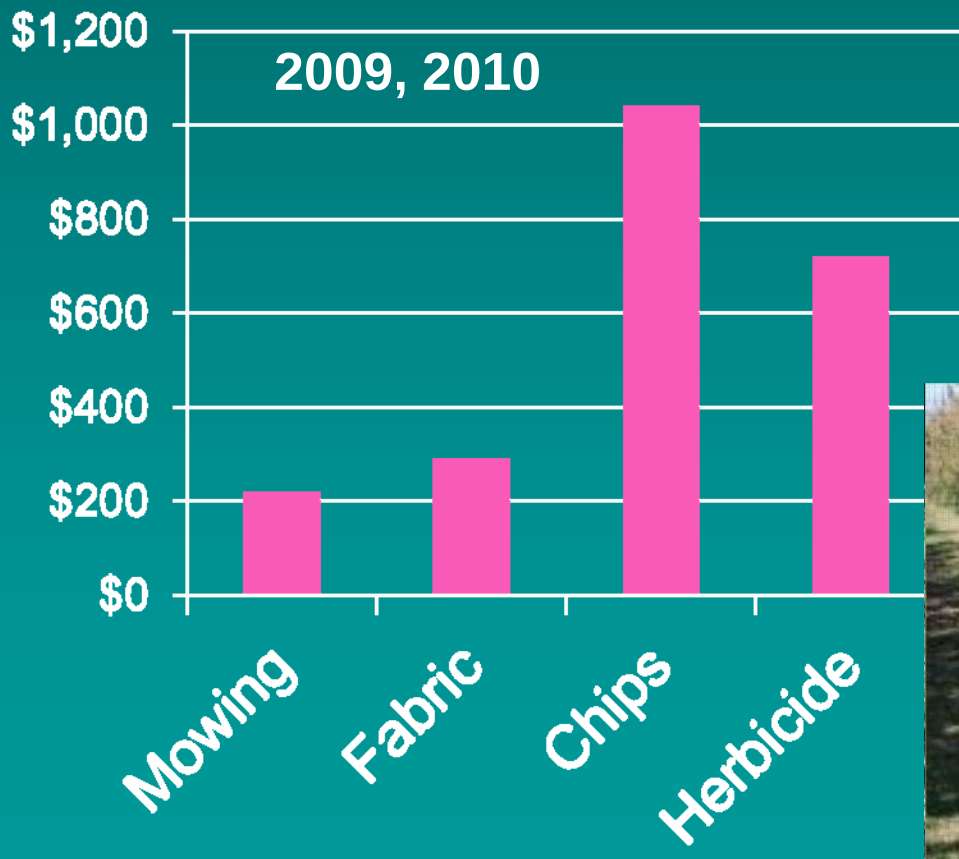
*Actual cost $104/ac in 2002 dollars

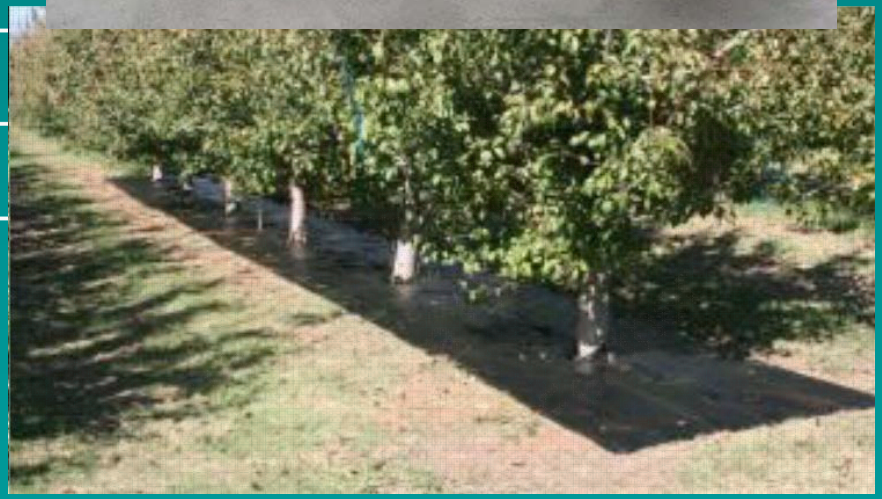
(Hogue et al., 2002)

UC Davis Trial – Pears, Sacramento Delta

Economics

Total Costs/Acre/Year





(C. Ingels)

Weed Fabric in Sweet Cherry

OSU, Hood River, OR – 2001-2007

- **Fabric groundcover vs. bare ground in tree row (herb.)**
- **2001-2004 – fabric $2125/acre increased costs**
- **2004 – fabric trt. gross returns $3240/ac more than bare ground (1st yr of production)**
- **2005 - $1633/ac more with fabric**
- **Fabric – trees produced more fruit at an earlier age, maintained higher yields**

(Yin et al., 2007)

(H. Ostenson)

Weed Control Costs

2011 Dollars

TRT	$/ac/trip	Trips/yr	$/ac/yr
Tillage	21.23	5	106
Herbicide	124.60	4	498
Flaming	20.64	5	113
Mulch*	1,202.00	1	--
Mulch over 3 yr			401
Mulch over 3 yr plus flaming			514

* Wood chip mulch applied to tree row, 3’ wide, 4” thick

(Granatstein et al., 2014)

Grower Returns

8+ yr ‘Gala’/M.26, sandy soil

	2009	2010	2011	3-Yr Rel to Till
	Apple - Returns* ($/ac)			
Mulch	2,320	8,440	12,764	+4,777
Herb/flame	1,971	6,193	9,638	-946
Tillage	2,942	6,843	8,963	0

Mature Anjou pears, good soil

	2009	2010	2011	3-Yr Rel to Till
	Pear - Returns* ($/ac)			
Mulch	9,580	12,636	9,377	+1,432
Herb/flame	10,274	10,621	8,141	-1,125
Tillage	10,676	11,182	8,302	0

*Gross bin returns minus weed control costs and picking costs *(Granatstein et al. 2014)*

Future Options ?

http://www.unibots.com/Agricultural_Robot_Designs.htm

http://articles.extension.org/pages/74528/abrasive-weeding:-a-new-tool-for-weed-management-in-organic-agriculture

Going Forward

- **Year-round bare ground probably not optimal (soil structure and biology, nutrient scavenging)**
- **Many herbicide options for weed control – resistance mgt.**
- **Mulches have other system benefits; may need supplemental weed control; mow & blow**
- **Living mulches – too competitive, rodent habitat; ways to manage around? habitat benefits?**

Orchard Floor Management

http://tfrec.cahnrs.wsu.edu/organicag/tree-fruit/orchard-floor-management/

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