

# Does Organic Matter Matter?



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# Organic Matter benefits

- direct addition of nutrients
- improved soil structure (aggregation and aeration)
- improved nutrient and water retention (buffering)
- site of intense biological and biochemical activity

# CATION EXCHANGE CAPACITY

me 100g<sup>-1</sup> (cmol (+) kg<sup>-1</sup>)

Sandy Loam (Osoyoos)	4.8
Sandy Loam (Skaha)	12.5
Silt Loam (Penticton)	18.0
Ogogrow compost	89.7
Dairy solids (vermicompost)	175.3

Organic amendments can have very high cation exchange capacity (CEC) relative to soils and materially increase the CEC on low CEC soils.

# Compost Nutrients

- vegetation/poultry manure/straw
- aerated, turned, 65 C.
- C (39.3 % )
- 2.5% N, 2.3% P, 2.7% K,
- Ca (6.1%), Mg (0.9%),
- Zn (417ppm), Cu (7 ppm)
- Annual applications based on 50 lbs N/acre, assuming annual 30% N mineralization; requires 12 tons compost per acre.

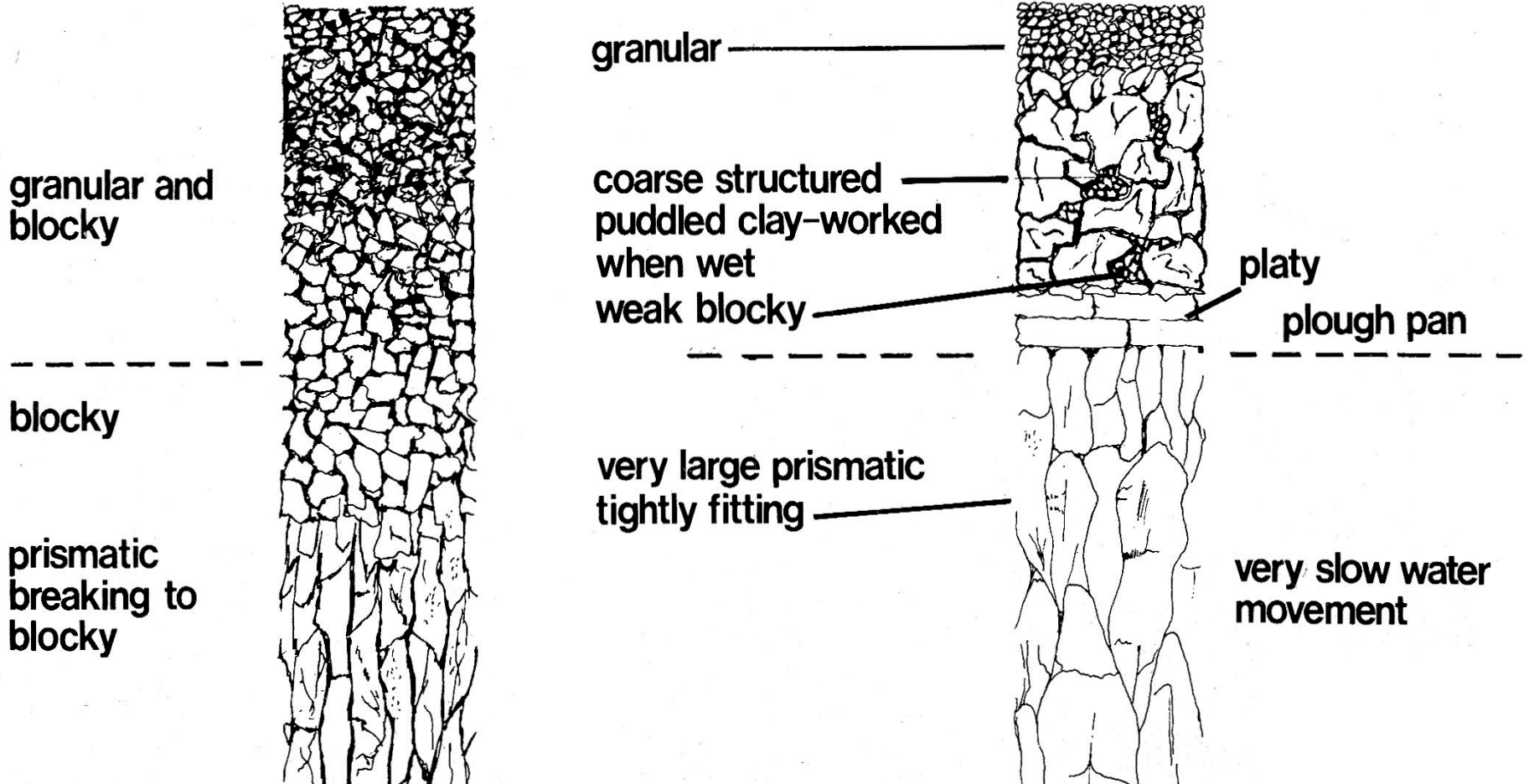


# Compost N availability

	N (%)	C/N	Available Yr 1 (%)
Broiler litter	3.84	9.5	42 (27-54)
Dairy solids	1.99	19.8	6 (-2-16)
Pelleted fish	9.40	4.5	77

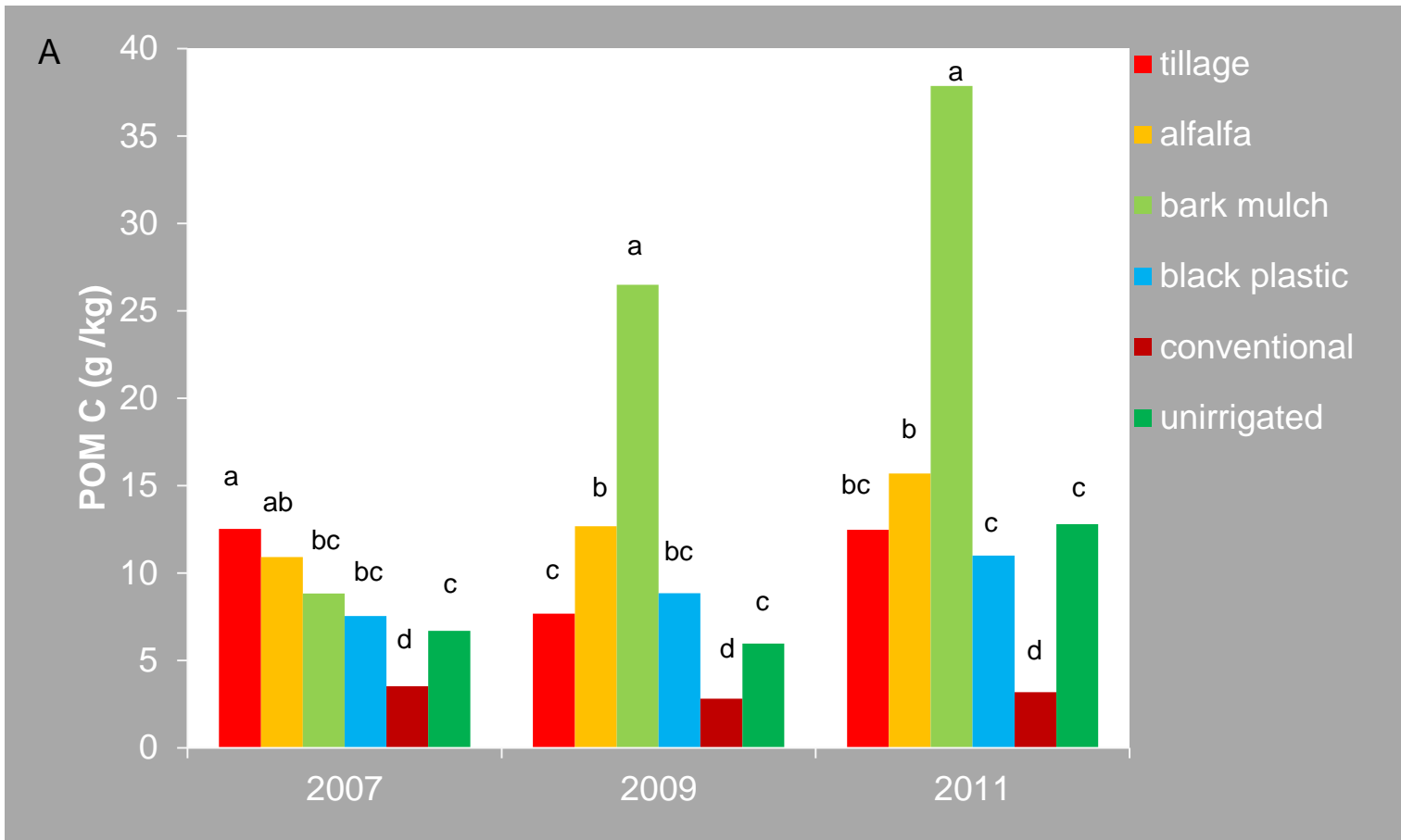
# Soil Structure

Plays a role in water infiltration, retention, and plant availability; aeration; ease of root extension

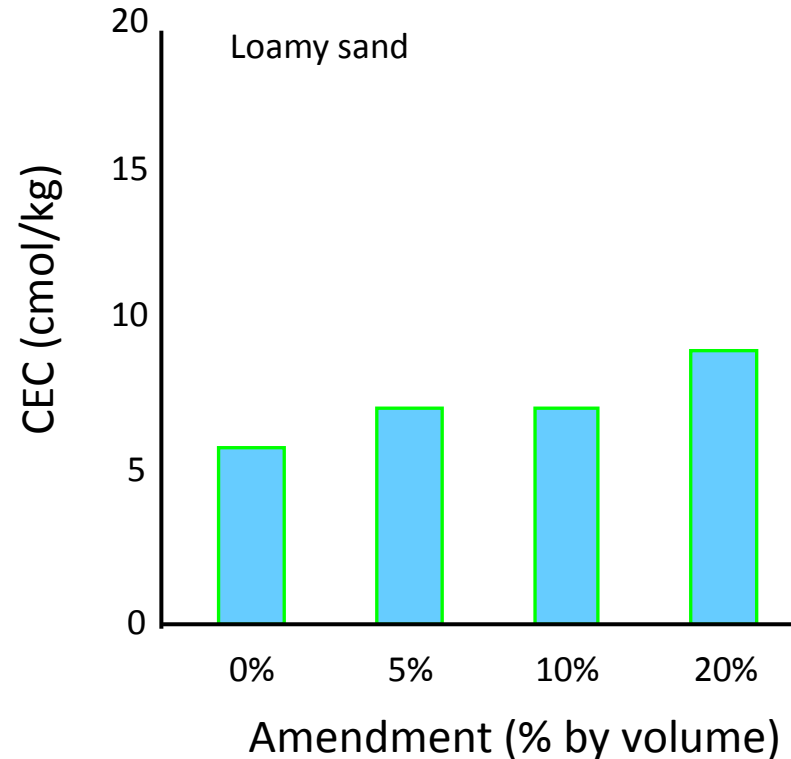
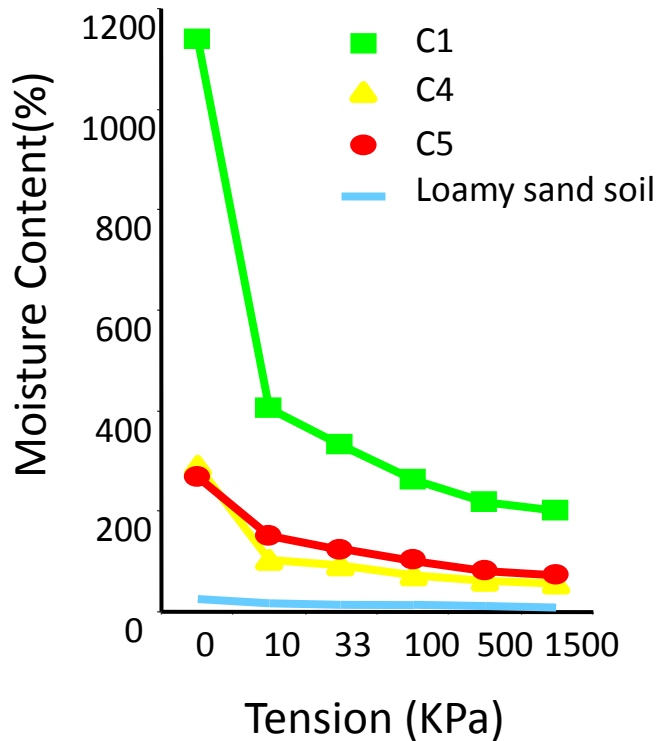


# Particulate soil carbon (>53 $\mu$ )

This measurement can change faster than total soil carbon and be an early indicator of increasing soil organic matter.



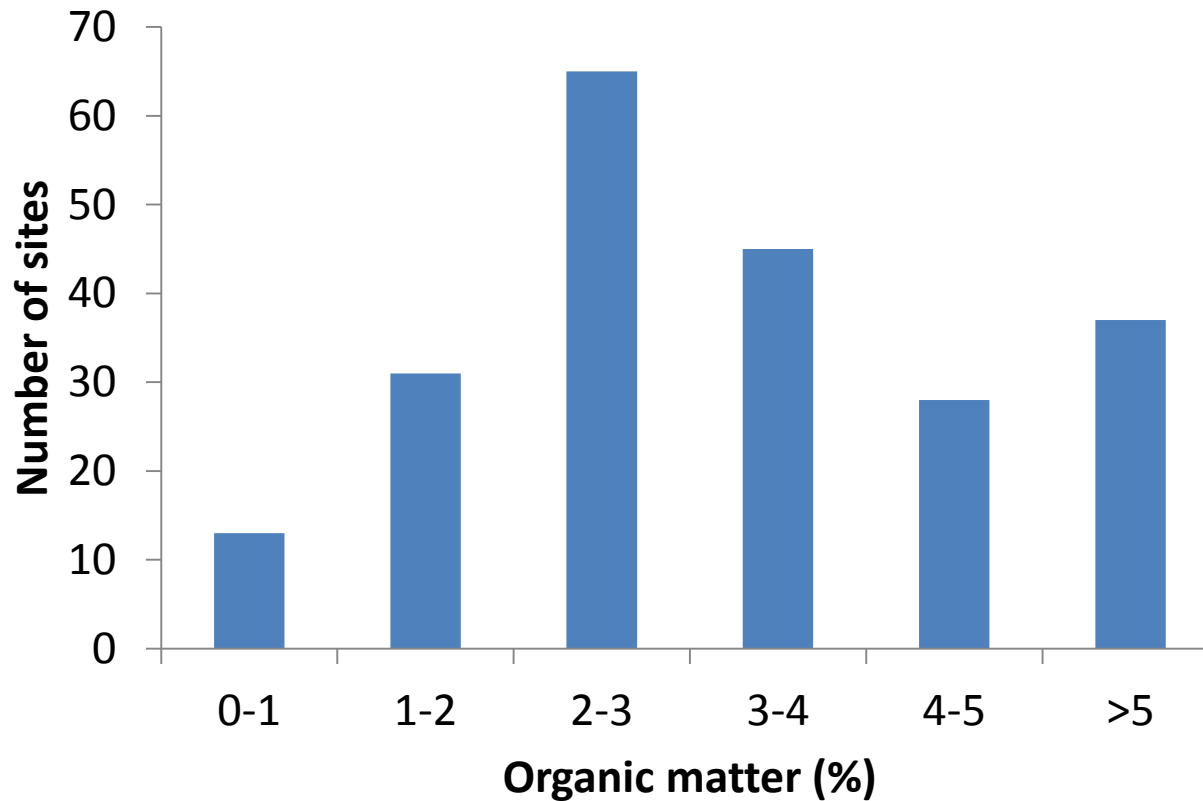
# Water and nutrient retention



Organic amendments such as compost can have beneficial effects on water relations and nutrient availability (CEC=cation exchange capacity).



# Soil Organic Matter (%) in Orchards and Vineyards; Okanagan BC, 2007



- Average = 3.4%
- Range = 0.35% - 11.5%
- Samples from 228 sites

Typical low organic matter  
soil in Okanagan Valley, BC



# Method: Incorporated amendment

Compost banded in the tree planting row



# Method: Surface mulch

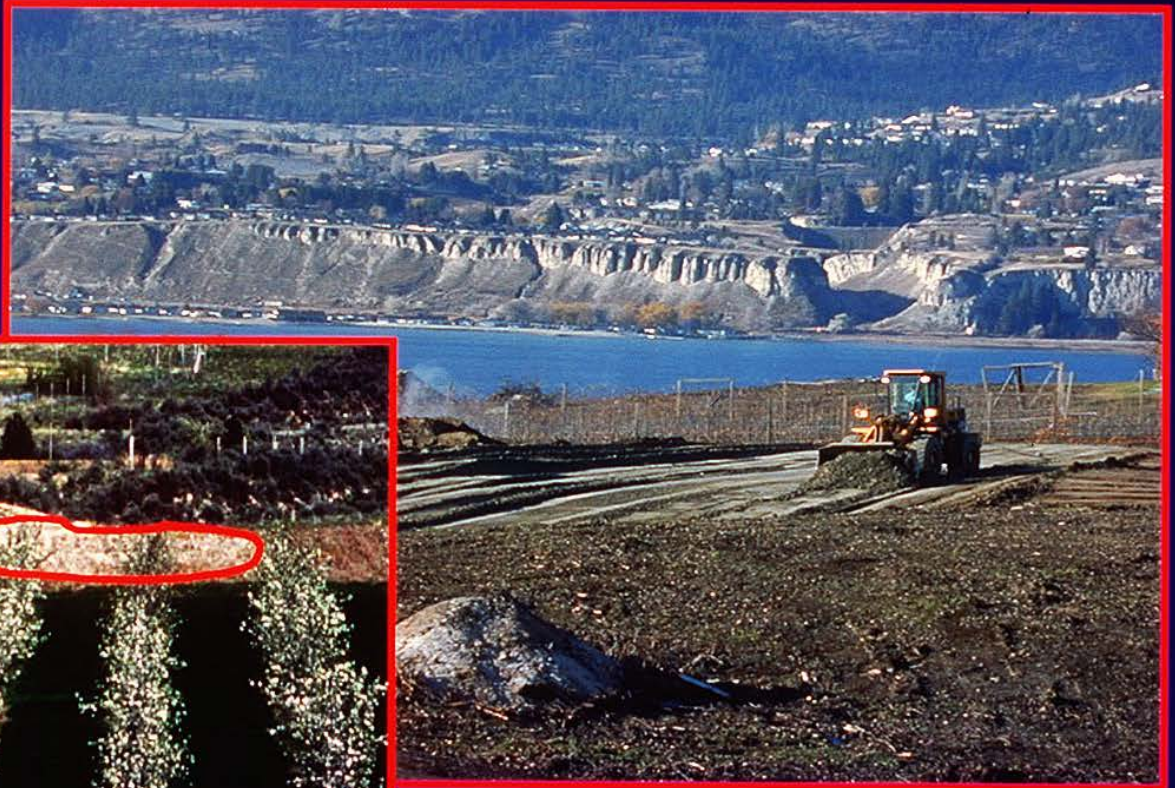


- Ambrosia/M.9
- Paper + 2 wood wastes
- Photo June 13, 2003

# Method: Localized application

Treating known problem areas

## Imposed variation



# Effect of land leveling on soil properties

	O/M	pH	EC	N	P	K	Ca	Mg
	%			lb/acre				
Undisturbed	3.6	6.3	0.38	40	99	1000	3418	484
Disturbed	1.1	8.3	5.2	57	9	467	8150	1000

Disturbed areas can benefit greatly from organic soil amendments

# Amendment experiment

- 'Braeburn' / M.26
- planted 1998
- Pre-plant amendment of sandy soil to 0.3 m depth
- N, P fertigation

# Effects of composted biosolids, clay minerals and mulch on 'Braeburn'/M.9

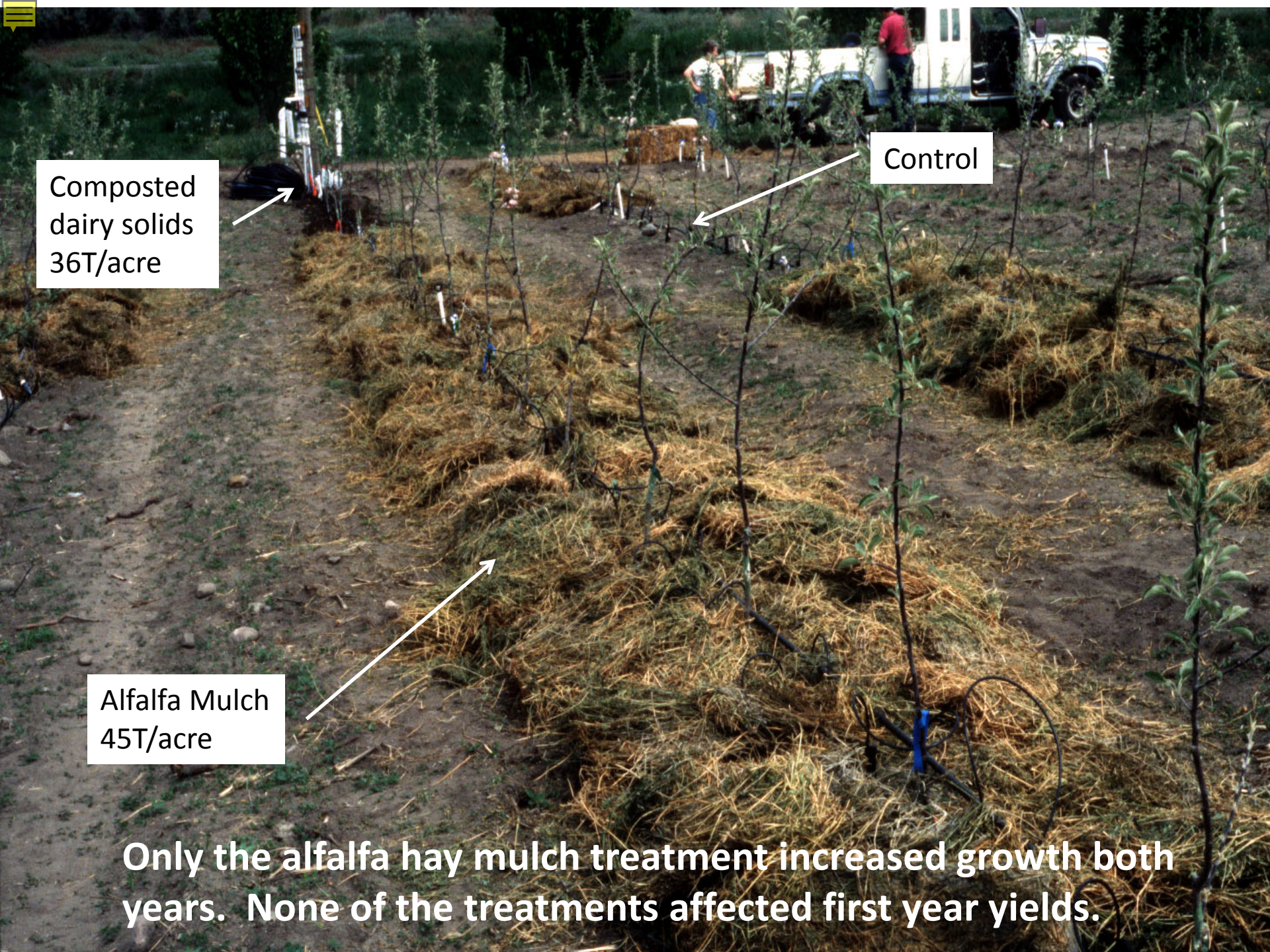
	Total shoot growth (m)	Leaf P (% DW)
<b>Check</b>	7.1c	0.24c
<b>Ogogrow (O)</b>	9.2a	0.32ab
<b>Vermiculite (V)</b>	7.2c	0.23c
<b>O + Zeolite</b>	8.5ab	0.34a
<b>O + Bentonite</b>	7.8bc	0.30b
<b>O + V</b>	8.9a	0.30b



# Amendment/mulching Naches, WA

- 'Braeburn'/M.9
- 4' x 8.5' spacing
- Replant site
- Planted 2000
- 2 levels of N
- 2 levels of irrigation (drip)
- Control vs organic soil amendment vs surface mulch.



A photograph of a field experiment. In the foreground, there are several young trees planted in rows. The ground around the trees is covered with a thick layer of yellowish-brown mulch. In the background, a white pickup truck is parked, and two people are standing near it. The trees are supported by stakes. The overall scene is outdoors with green foliage in the background.

Composted  
dairy solids  
36T/acre

Control

Alfalfa Mulch  
45T/acre

**Only the alfalfa hay mulch treatment increased growth both years. None of the treatments affected first year yields.**

# Naches Experiment results (5 yr)

- **Mulch**

  - Increased tree size, cumulative yield, fruit size (3 yr)

  - Decreased fruit firmness (1 yr)

- **'Amendment'**

  - Minor growth and yield effects

- **Over-riding replant effect**

  - Mulch or amendment did not control replant disease

# Long Term Mulching and Amendment Trial, PARC-Summerland, 1994-2003



# Experimental design

'Spartan' \* M.9 (1994)

1.25m x 3.5m spacing

7 treatments, RCB, 5 replicates

4 tree plots

Daily drip irrigation

N fertigation (70 – 100 kg N/ha/yr)

Gravelly sandy loam

# Plant and Soil Response to Mulches

Treatment	TCSA		Yield		Soil properties			
	(cm <sup>2</sup> )		(kg/tree)		Total C (%)	Total N (%)	Extract. P (ppm)	Infiltr' (L/hr)
	1997	2001	1997	2001	2001			
Check	4.6c <sup>z</sup>	11.5d	3.2c	14.7b	1.0c	0.10bc	40b	5.50b
GVRD	4.5c	11.6d	4.5bc	14.7b	1.9a	0.18a	205a	14.6ab
Paper mulch (PM)	7.4a	17.4a	6.5a	20.4a	1.3bc	0.12b	26b	10.0b
Geotextile	5.8bc	12.4d	5.2ab	16.0b	0.9c	0.09c	29b	3.40c

<sup>z</sup>Means with a column followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

GVRD=Vancouver composted biosolids; Paper mulch=shredded white office paper; Geotextile=black woven polypropylene 'weed fabric'

TCSA=trunk cross sectional area

# Spray-on Paper Mulch

- Based on positive results with shredded paper
- Used non-recyclable fibers
- Was meant to be more automated application



# Grower spray-on mulch experiments

- Apples on M.9; 4 sites
- Sandy loam soil
- 5 yr trials

Results: Improved performance (yield, growth) relative to herbicide control in 3 orchards.

Exception (yr 4-8), Ambrosia site



# Spray-on Mulch at a K-deficient site

- Gala/M.9, 6 yrs

## Results:

- SM had bigger trees but similar yield to herbicide controls
- None of the amendments prevented K deficiency (1.1%)

# Experimental organic block

PARC, Summerland, BC



- 'Ambrosia' / B.9, planted Apr 2006, 1 x 4m spacing
- Orthic Brown silt loam
- Experiment designed to compare common in-row management used by organic growers, as well as a conventional treatment and an unirrigated treatment



**Compost/Tillage**



**Alfalfa mulch**



**Black plastic  
mulch**



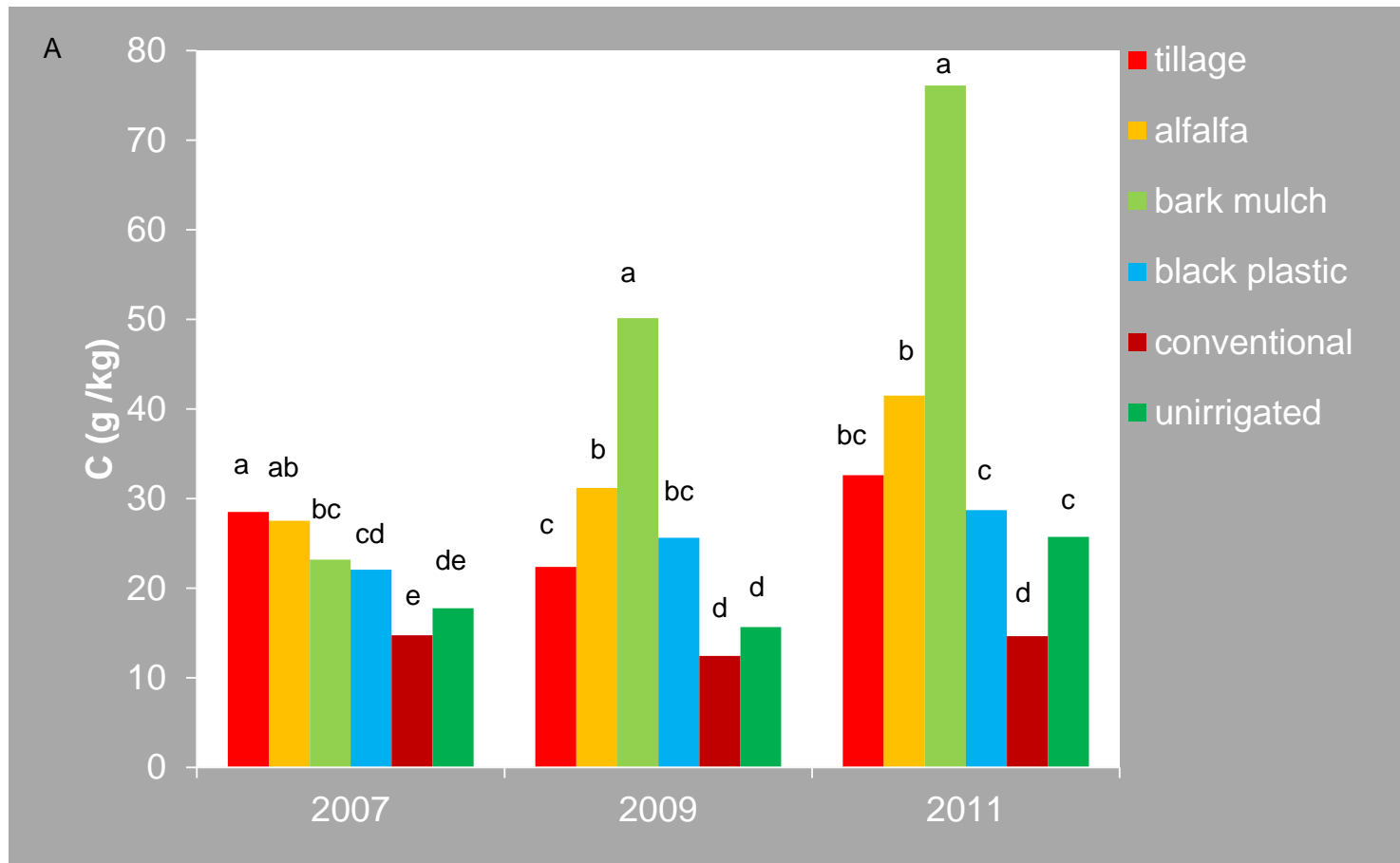
**Bark mulch**

# Soil Analysis

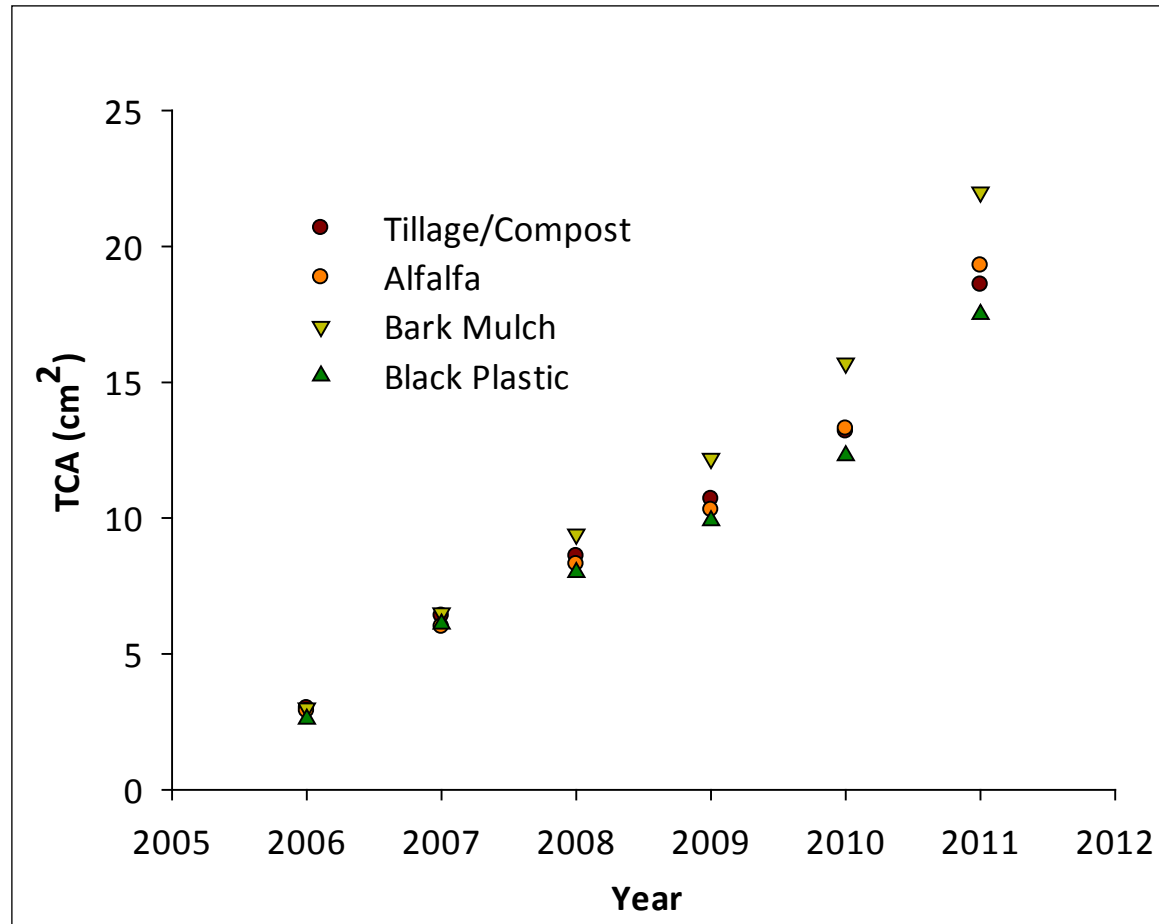
- 0-10cm
  - Total & Particulate [ $>53\mu\text{m}$ ] C, N. (LECO-CNS)
  - Microbial C [fumigation]. (Wu et al. 1990)
  - Bray P & Phosphatase activity. (Tabataba 1994)
  - OAc-Exchangeable K
- 0-30cm

Nematode (genus) community. (Forge and Kimpinski 2007)

# Soil carbon



# Tree vigor



Measured as trunk cross sectional area at end of each growing season. Bark mulch trees showed greater growth., while black plastic weed fabric had the least.

# Organic Trial Leaf Nutrients (2006-2011)

<b>Treatment</b>	<b>Leaf N (% dw)</b>	<b>Leaf K (% dw)</b>
Compost/ Tillage	<b>2.44ab</b>	<b>1.97b</b>
Alfalfa Mulch	<b>2.50a</b>	<b>1.98b</b>
Bark Mulch	<b>2.38b</b>	<b>2.10a</b>
Black Plastic	<b>2.46a</b>	<b>1.91c</b>
Significance	<b>*</b>	<b>****</b>

# Organic Trial Fruit Yields

<b>Treatment</b>	<b>2011</b>	<b>2012</b>	<b>2011-12</b>
Compost/ Tillage	<b>6.9a</b>	<b>4.6</b>	<b>11.5</b>
Alfalfa Mulch	<b>5.9ab</b>	<b>6.1</b>	<b>12.0</b>
Bark Mulch	<b>5.3b</b>	<b>6.8</b>	<b>12.1</b>
Black Plastic	<b>7.4a</b>	<b>4.9</b>	<b>12.4</b>
Significance	<b>*</b>	<b>NS</b>	<b>NS</b>



# Improved Performance Final Report Card

- High density apple on dwarfing rootstock
- Randomized, replicated trials
- Multi-year studies

	Sites	Success	Batting average
Surface Mulch	12	8	.667
Incorporated amendment	16	5	.313

# Other practical points

- Mulch/amendment buffered against accidental water stress (reduced fruit size)
- Mulch or amendment were ineffective on fertile sites, with strong fertigation programs, with high frequency irrigation, or even excessive irrigation (N leaching)
- Mulch or amendment were ineffective when an important limitation was not affected by treatment (e.g. replant disease, K deficiency)

By late summer, tree roots grew to the very surface of the soil and sometimes into the mulches.



# Thank you

