Fruit Tree Fertility Management

Stephen Bramwell

WSU Extension

Thurston County

May 1st, 2018

WASHINGTON STATE UNIVERSITY EXTENSION

Functions of healthy orchard soil

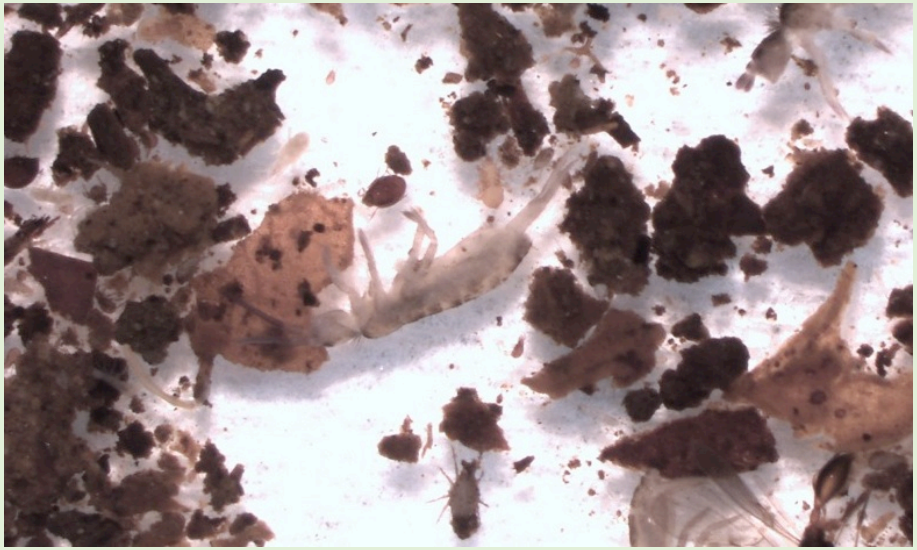
- Root health – aeration, access to nutrients, water holding capacity, drainage, water infiltration (antibiotics, predation, competition, paratization ie Trichoderma…replant dec.)
- Nutrient availability – OM release, cation exchange, microbial cycling (up to ¼ of available N from nematodes, mites, springtails)
- Water availability – storage and release (from 5-25% water capacity from 0.5 – 3% OM
- Disease resistance – Organisms responsible for suppressing replant disease

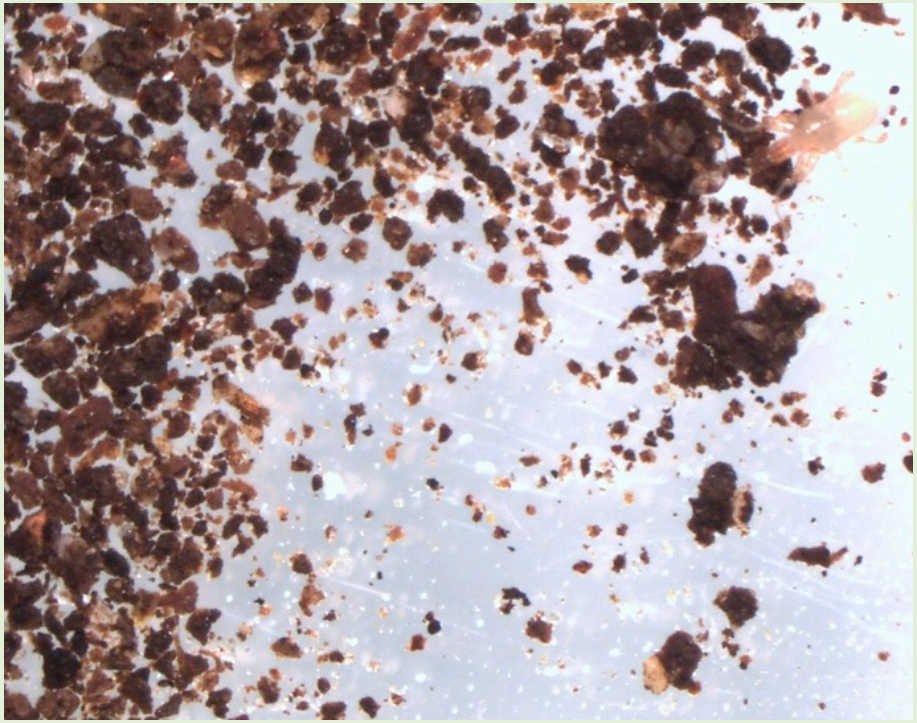
Orchard soil with high organic matter.
Photo credit: Tianna DuPont

Soil health

Healthy, high-quality soil has:

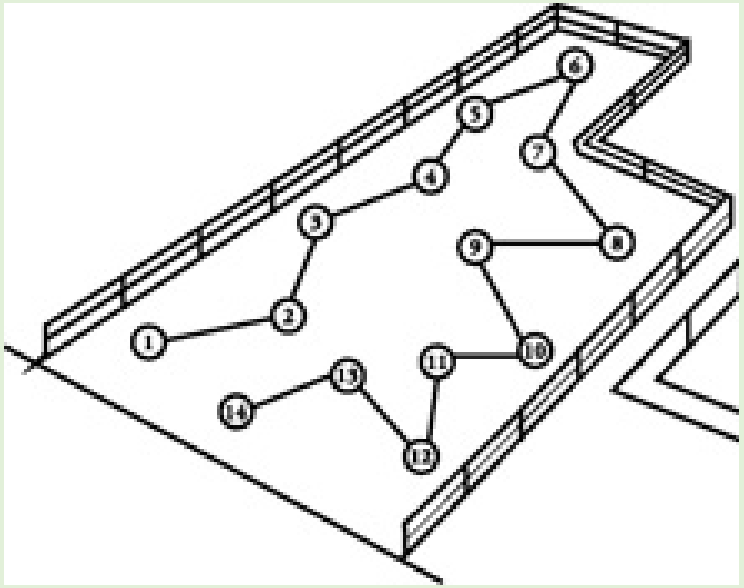
- Good soil tilth
- Sufficient depth
- Sufficient, but not excessive, nutrient supply
- Small population of plant pathogens and insect pests
- Good soil drainage
- Large population of beneficial organisms
- Low weed pressure
- No chemicals or toxins that may harm the crop
- Resilience to degradation and unfavorable conditions
- —from Soil Health Training Manual





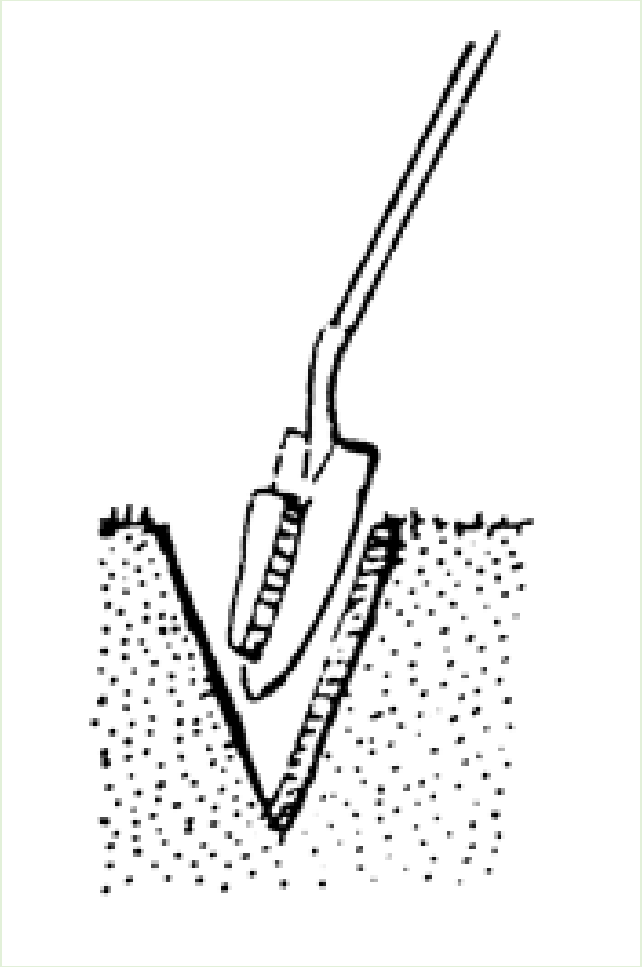
Soil sampling

- Divide orchard into units (based on soil type, unusual areas)
- Small diverse areas will need to group crops for sampling
- Take 10 to 20 cores per unit (0 to 12 inch depth)
- Avoid unusual areas



Soil sampling

- Keep moist samples cool during and after sampling
- Refrigerate, freeze, or bring directly to lab
- Same time year, same sampling depth
- Send about 1 pint to lab, carefully labeled



Fertility at planting

- Soil sample
- Follow liming recommendations (split app if > 140 lb/1,000 sf)
- 1-3 yrs cover crop in tree rows or field recommended
- Soil test will indicate lbs/ac applications rate (TCD)
- I like Bob Contisano's publication
- Phillips: 1 lbs rock phosphate, 1 lbs azomite, mycorrhizal root dip*
- Mound planting

Garden-scale example of soil change over 3-yr period. Micros typ applied more targeted at larger scale.

	Soil test results 2014	Recomm. (ppm)	Soil test results 2020
pH	4.8	6-6.8	6.5
P	27	35-40	90VH
K	86	200-300	178M
Ca	493	Follow lime rec.	~
Mg	91	150	222M
S	13	20	9L
B	0.1	1-2	0.3VL
Zn	0.5	3.5-7	1.8
Fe	30	20-50	61VH
Cu	0.5	1-3	1.0

Fertility regime: Winter rye-vetch cover crop, and per 1,000 sf annually: 1-yd compost, 75 lbs Microna lime, 3-5 lbs N (100-160 lbs 3-2-stutzmans), and 5-10 lbs kelp meal

Applying Lime to Raise Soil pH

"Lime to apply" values are based on application of 100-score lime and 6-inch soil sampling depth. For example, lime to apply = 78 lbs per 1,000 ft^2 when a desired soil pH is 5.6 and the lime requirement test (SMP) value is 6.0.

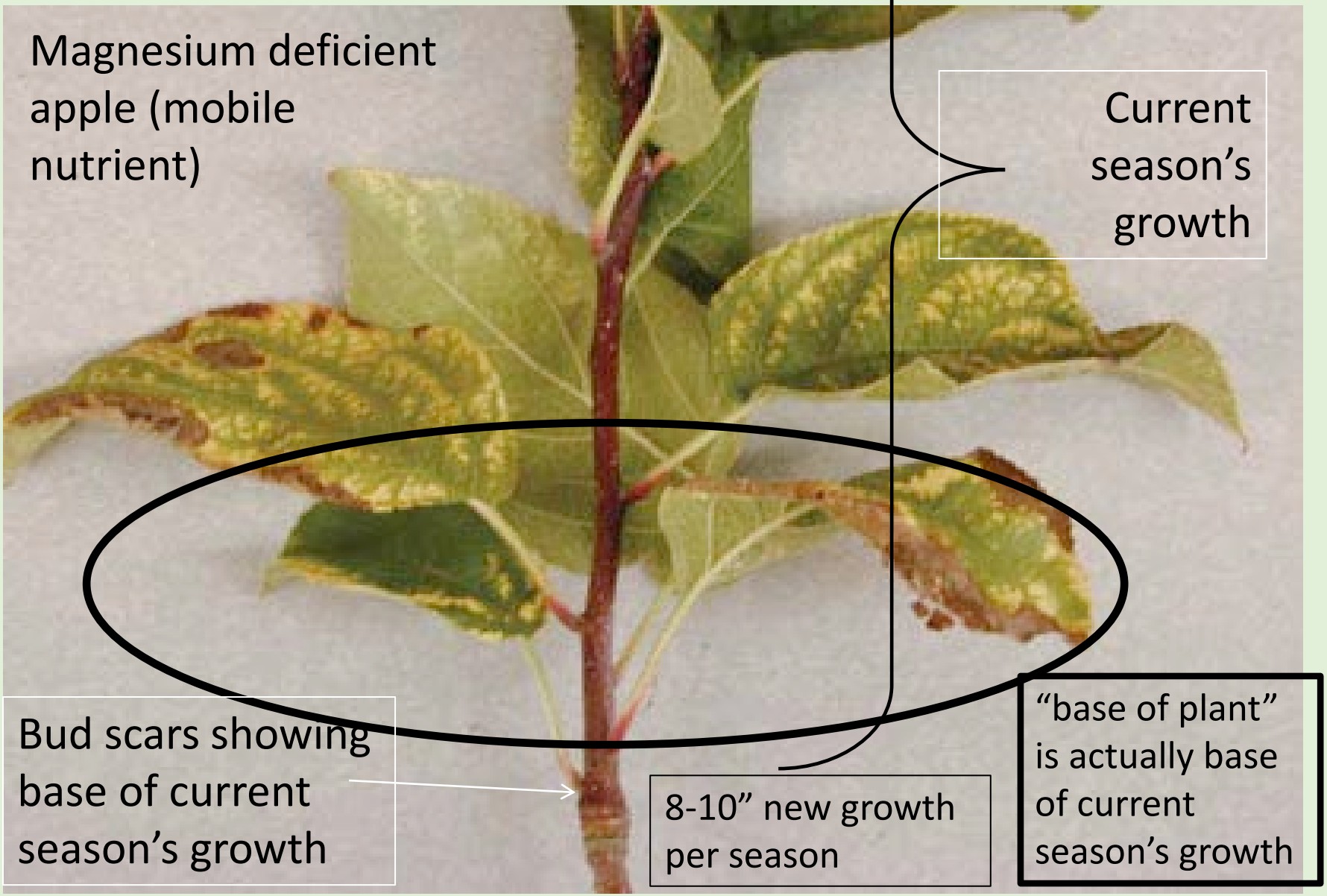
If the value is greater than 140 lbs per 1,000 ft², consider splitting the application.

https://ir.library.oregonstate.edu/downloads/m613mx90d

Lime requirement test (SMP) interpretation

	Desired soil pH		
	Lime to apply to attain desired soil pH (lbs per 1,000 ft²)		
SMP value	pH 5.6	pH 6	pH 6.4
6.7	0	0	0
6.6	0	0	46
6.5	0	46	78
6.4	0	51	101
6.3	0	69	124
6.2	46	92	147
6.1	64	110	170
6	78	133	193
5.9	96	152	216
5.8	115	170	243
5.7	129	193	266
5.6	147	211	289
5.5	165	234	312
5.4	179	253	335
5.3	197	275	358
5.2	216	294	381
5.1	230	317	409
5	248	335	432
4.9	266	354	455
4.8	285	381	478

Does it need fertilizer? Plant observation



Annual Growth Rate

Nonbearing Trees	Last Year's Annual Growth Rate
Apple	12 to 36 inches
Pear	
Peach & Nectarine	
Tart Cherry	
Plum & Sweet Cherry	
Bearing Trees	
Apple Non-Spur	6 to 18 inches
Apple Spur-type	6 to 10 inches
Pear	12 to 16 inches
Peach & Nectarine	12 to 18 inches
Tart Cherry	~ 8 inches
Plum & Sweet Cherry	~ 8 inches

For example, if you need 1/2 pound of nitrogen for a given area and are using a product with 15 percent Nitrogen, divide .5 (one-half pound) by .15 (the percent of N in the product). This tells you 3.33 pounds of this product are needed to apply 1/2 pound of nitrogen.

Pome fruits: "1/10th pound of nitrogen per inch of trunk diameter (measured 1 foot above ground level). Apply this amount if growth the previous year was at the low end of the recommended rate."

http://extension.colostate.edu/topic-areas/yard-garden/fertilizing-fruit-trees-7-612/

Does it need fertilizer? Soil test

- Separate orchard into similar areas
- A soil core auger is best
- Obtain 15-20 cores from beneath trees in the sampling area (block) of interest
- Collect composite of 0-6” cores, and a composite of 6-18” cores
- Mix composite in clear plastic bucket (avoids zinc contamination)
- Place pint to 1-quart sub-sample in clean bag; follow lab instructions and complete paperwork

When?...

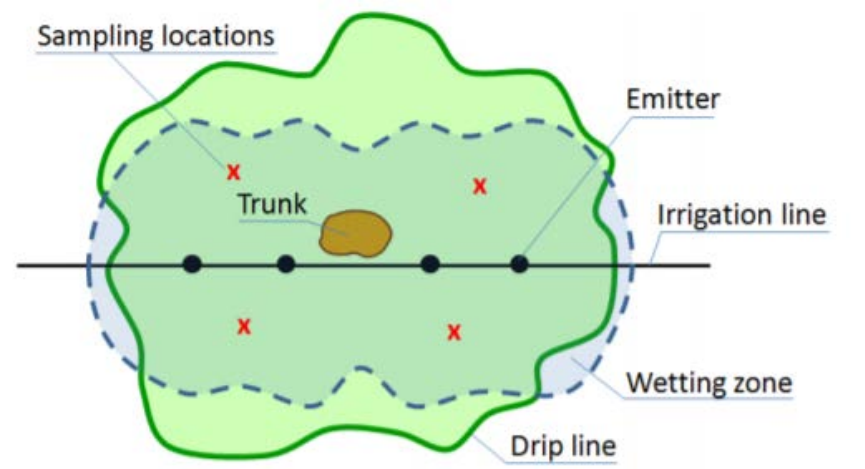


Figure 2: Bird’s view of the optimal sampling location under orchard trees. Soil samples are taken within the wetting zone halfway between the trunk and the drip line.

https://apps1.cdfa.ca.gov/fertilizerresearch/docs/Soil_Sampling_Orchards.pdf

Does it need fertilizer? Tissue analysis

- Sample between mid July and mid August (before apical bud set/summer vegetative dormancy)
- Several trees, 10-20 random leaves per tree at shoulder height, same variety at a time, avoid problem trees; 50-100 leaves per sample
- Middle of current season's growth
- Paired sampling helps data interpretation (healthy versus unhealthy tree); include multiple 'health' and 'unhealthy' trees in composite samples above
- Rinse leaves to remove dust, air dry, refrigerate if sample not immediately sent
- Analyze for: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn).

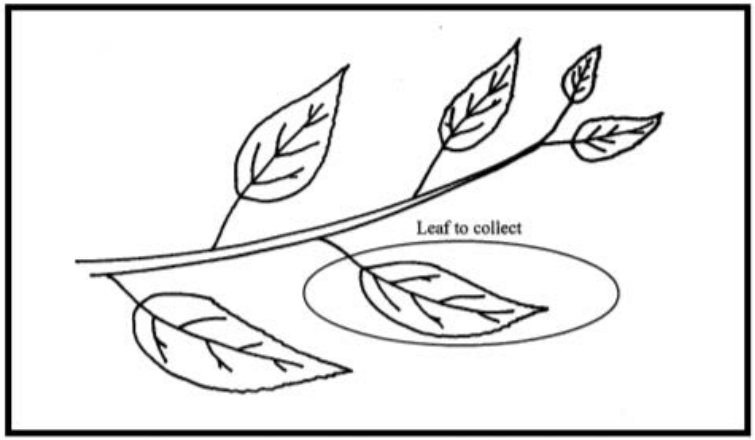


Figure 1. Photograph and diagram indicating the correct location to collect leaf samples.

https://extension.usu.edu/files/publications/publication/AG-FG-02.pdf

Fertilizing after planting

When?...

- Soil sample
- Follow liming recommendations (split app if > 140 lb/1,000 sf)
- Soil test will indicate lbs/ac applications rate (TCD)
- N fert: per table
- Other nutrients (N prob. Most important)
  - If def. by soil test: applications for lbs/tree, divide soil test lb/ac rec by estimated area of rooting zone
  - Monitor pH and P, others too
- But 1st, does it need it?

	lbs N/tree	lbs 3% chx manure*
1 yr	0.1	3.33
2 yrs	0.2	6.6
3-5 yrs	0.3	10
6-7 yrs	0.4	13.3

**lbs N needed / %N in fert, as fraction = lbs fert. e.g. 0.1/0.03 = 3.33 lbs fert*

Estimated rooting area & per acre N app (varies widely by rootstock)

	Area (sf)	lbs N/ac
1 yr	<25	~174
2 yrs	25-50 +/-	~174
3-5 yrs	50-250	~90
6-7 yrs	250-300 +/-	~70

https://catalog.extension.oregonstate.edu/ec1503

Fertilizing examples and ideas

- Compost. 1 ton/1,000 sf = ~0.1-0.3 lb N per 100 sf area
  - Equiv. to 200 lbs compost per 10x10 rooting zone, or ¼ - ½ inch depth (N release dep on min. rate and % N in compost)
- Chicken feeding and grazing under fruit trees
  - 20 birds feeding on half acre ~ 145 lbs N per acre (18% N feed, 0.25 lbs feed per bird per day, 75 days on orchard site). More than sufficient.
- Soil organic matter N
  - Soil OM is 5% N. Soil with 3% OM, 2-4% mineralization/yr. = 60 lbs N/ac/yr, or ~0.13 lbs N per 100 sf area (a 1-yr old tree in 10'x10').

Handy N Fert trick

Age of tree x 5
% N (not fraction) = lbs fert

http://aces.nmsu.edu/pubs/_h/H319/welcome.html

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Alley Vegetation

Legumes for N Fixation

39 days after mowing; initially direct seeded

Add 30- 80 lb avail. N/ac/yr;
US$0.70/lb N

'Mow & Blow' Mulch Trial

Quincy, WA

- 'Fuji/M.9' 2nd and 3rd leaf
- Tall fescue forage grass mix, mowed weekly
- 1x rate = 0.5-1.0 lb/ft^2 DM
- About 10% of clippings retained after 2 yr
- 2x rate led to 20% increase in tree growth
- Clippings add 25-50 lb K/ac; 50 bin/ac apple crop removes 56 lb

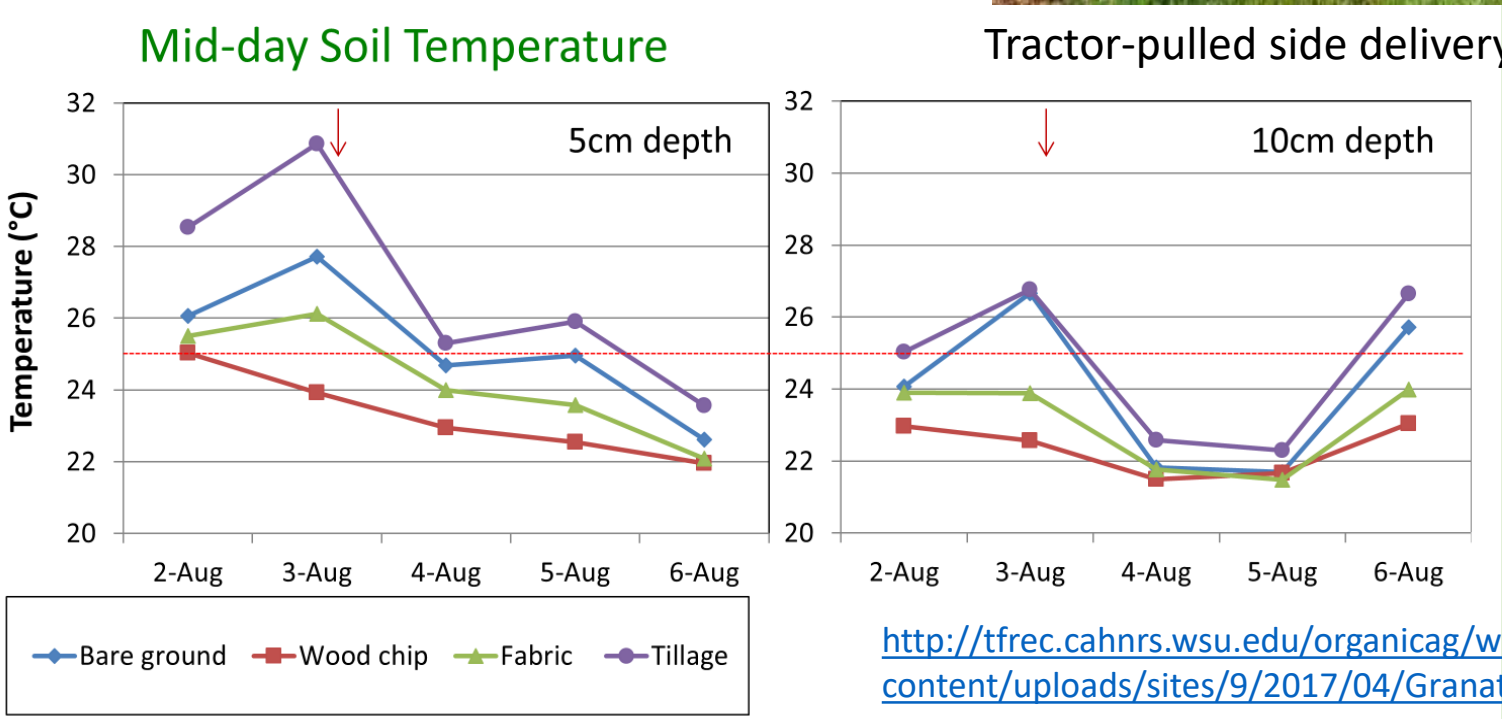
Deep-rooted perennials for soil minerals, less competitive ground cover (water, nutrients), and eventual chicken forage

Mulching for soil and orchard health

Preferred soil temperatures:

- apples (64-77 deg F)
- plums (deg F)
- pears (deg F)

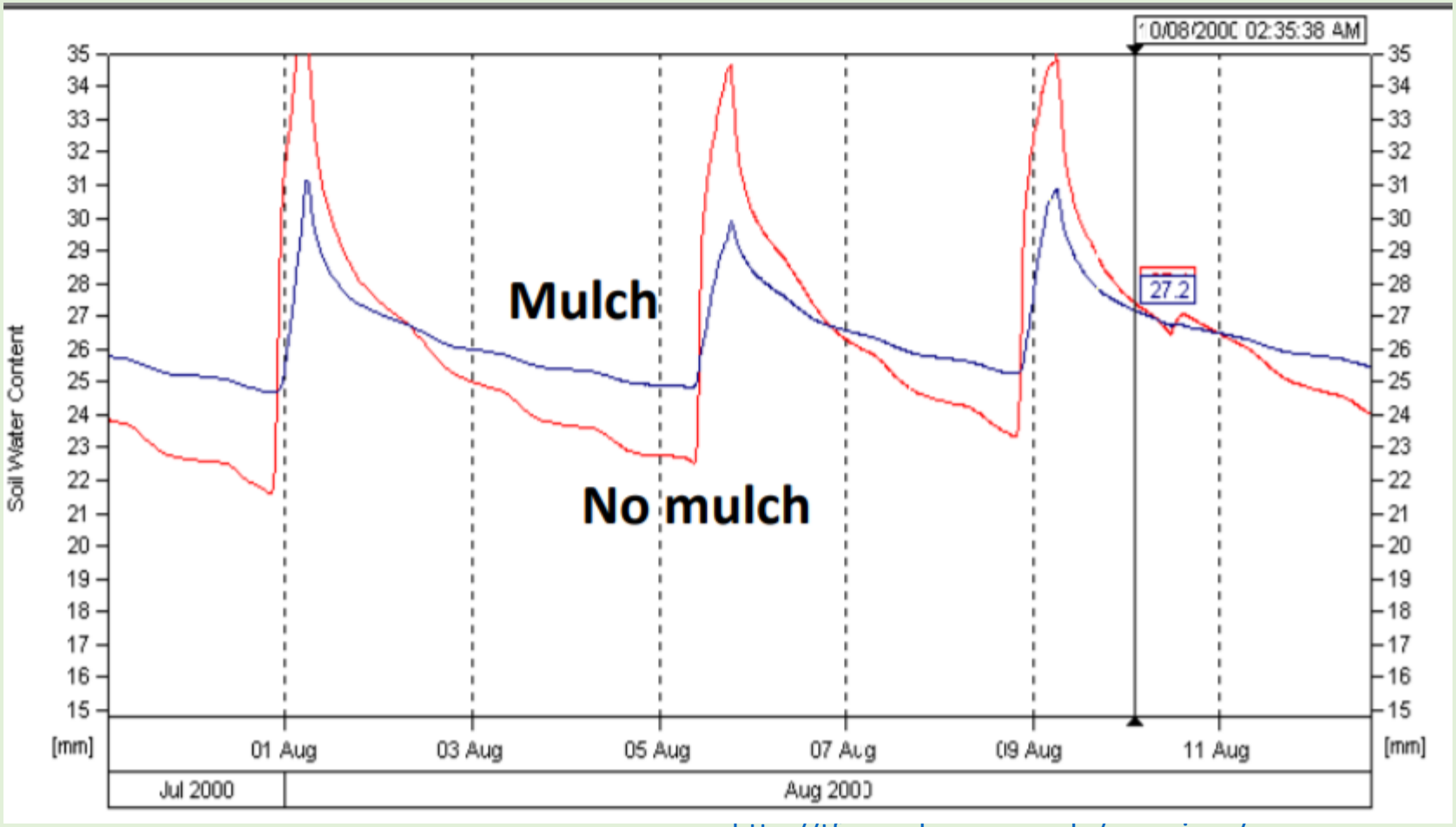
Tractor-pulled side delivery mulch spreader



http://tfrec.cahnrs.wsu.edu/organicag/wp-content/uploads/sites/9/2017/04/Granatstein_OFMr2.pdf

Mulching for water conservation

Woodchip mulch led to 20-25% less moisture depletion between irrigations



http://ttrec.cahnrs.wsu.edu/organicag/wp-content/uploads/sites/9/2017/04/Granatstein_OFMr2.pdf

Soil health studies at Wenatchee tree fruit station

- OM additions, SOM and yield relations
- Manure, biosolids, compost, crop residue, hay additions
- “Mow and blow” mulching systems
- Potential to increase SOM, total C.
- Yield increases in 7 of 13 reviewed studies
- Woodchips increased tree growth Red Delicious/M.26 (Granatstein et al., 2010)
- Tree growth and yield in Gala/M.26 (2014)

Italian Nobili side-discharge flail mower

https://www.youtube.com/watch?v=w8uNQqUhtso

WASHINGTON STATE UNIVERSITY EXTENSION

Grass/weed mulch and woodchip mulch

Other orchard matters:
Crabapple rootstock experiment inspired by Jeb Thurrow

- Plants intended for low spot in landscape on Skipopa silt-loam
- Long-term hay field
- Perched water-table, surface ponding in winter
- Enthusiastic crabapple volunteer growth


cider

Orchard fertility calendar

- Fall prior: taking soil test, apply amendments (Phillips)
- Winter: dormant season pruning
  - Grazing chickens
  - Weed, apply compost & lime, mulch trees (my timing
- Early bloom (1/4” green/pink): holistic sprays (Phillips)
- Pink: second holistic sprays
- Petal fall: apply fertilizers; Phillips @ pre-bloom); 3rd holistic spray
- 1st cover: 4th spray. Kaolin, thin, other (see Phillips)
- Summer: prune water sprouts, kaolin

WASHINGTON STATE UNIVERSITY EXTENSION

- https://www.groworganicapples.com/organic-orcharding-articles/holistic-orchard-seasonal-checklist.php
- http://extension.oregonstate.edu/gardening/node/568

Resources

- Orchard tissue testing: https://extension.usu.edu/files/publications/publication/AG-FG-02.pdf
- Orchard Establishment: http://treefruit.wsu.edu/orchard-management/orchard-establishment/
- Orchard Soils and Nutrition: http://treefruit.wsu.edu/orchard-management/soils-nutrition/
- Below the Canopy: http://treefruit.wsu.edu/article/below-the-canopy/
- Fertilizing Fruit Trees: http://extension.colostate.edu/topic-areas/yard-garden/fertilizing-fruit-trees-7-612/
- OSU Tree Fruit and Vegetable Fertilizer Guide: https://catalog.extension.oregonstate.edu/ec1503