

Whole orchard recycling to reduce organic residue while building soil organic matter, carbon, and fertility

by

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This project evolved from farming on the urban edge







Are these wood chips effecting soil nutrients and the microbial community of almond soils?

Wood chipped vs Non-chipped



Wood chipped almond orchard soils were sampled and compared to non-wood chipped orchards

Wood chipped vs Non-chipped Orchard



Wood chipped almond orchards:

- more wood rotting basidiomycetes
- more bacterial and fungal feeding nematodes
- Increased soil nutrient levels
- lower pH
- more organic matter, higher soil carbon



Can we return this organic matter to our orchard soils without negatively effecting the next orchard that will be planted?

Can whole orchards be incorporated into the soil when they are removed and not burned in the field or in a co-generation plant?



2000 barrel experiment:

Almond brush was
chipped up with a Brush
Bandit wood chipper





Uniform sandy loam soil
was mixed with wood
chips, 1/3 chips to 2/3
soil

I thought this rate would
be similar to whole
orchard recycling?

It turned out to be much
greater— a 300 tons
per acre rate

- 1/3 part wood chips were mixed with 2/3 parts soil
- Placed in 35 gallon containers



- One almond tree was planted per barrel



49 ppm Nitrate in irrigation water

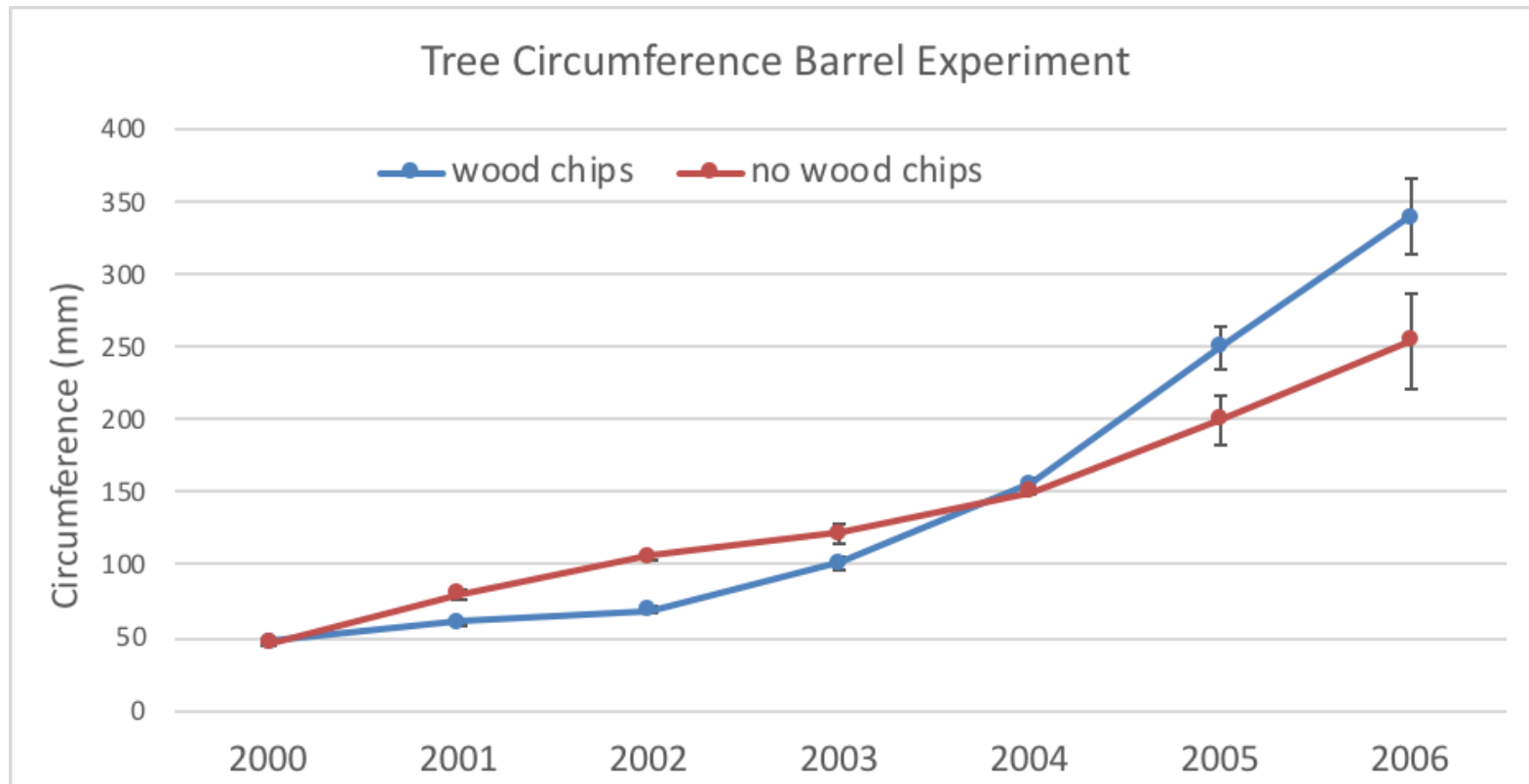


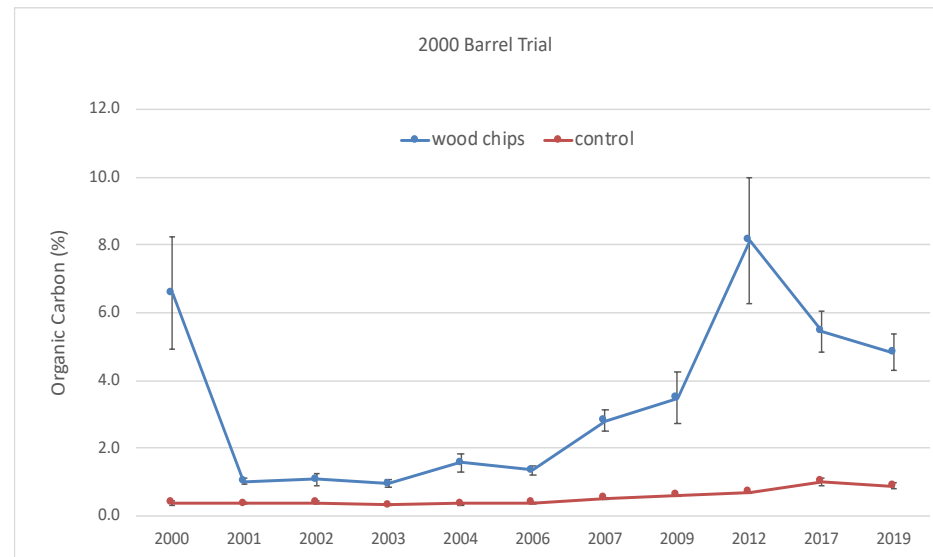
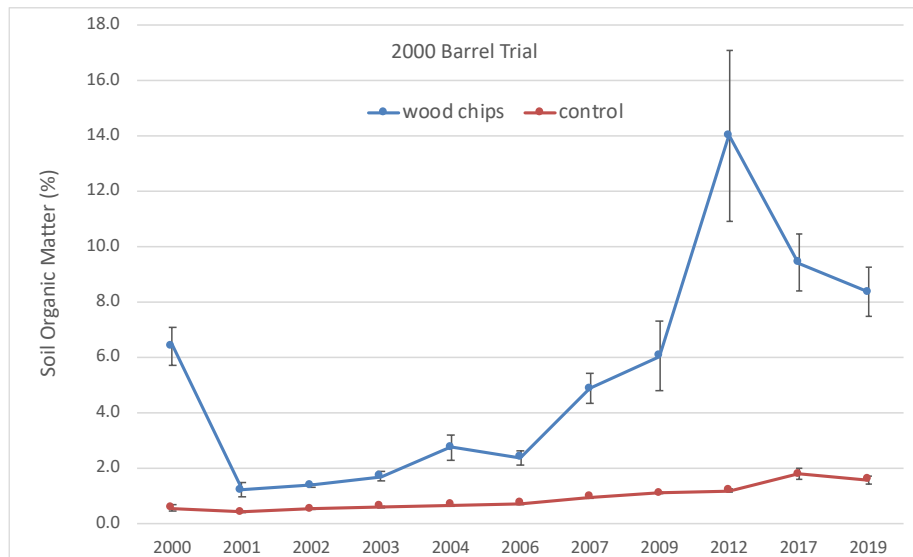
- Ten barrels received the wood chip and soil mixture while another 10 just received soil



- Mushrooms were found frequently after rainfall and irrigations in the chipped plots









Can we return this organic matter to our orchard soils without negatively effecting the next orchard that will be planted?

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The Iron Wolf

[http://ucanr.edu/?blogpost=16603
&blogasset=74534](http://ucanr.edu/?blogpost=16603&blogasset=74534)



The Iron Wolf
a 100,000 lb (45,000 kg)
rototiller



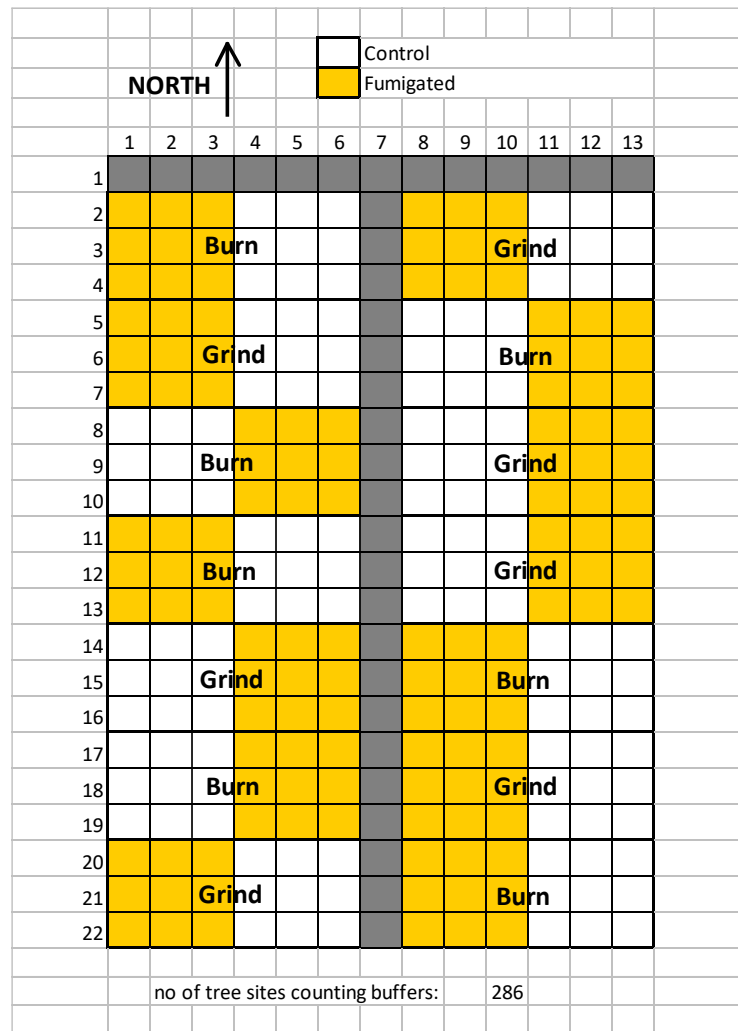
Two Treatments:
Orchard Grinding with Iron Wolf
Pushing and Burning Trees





In a natural forest system— Tree nutrients come from either decomposing logs or ashes from forest fires.







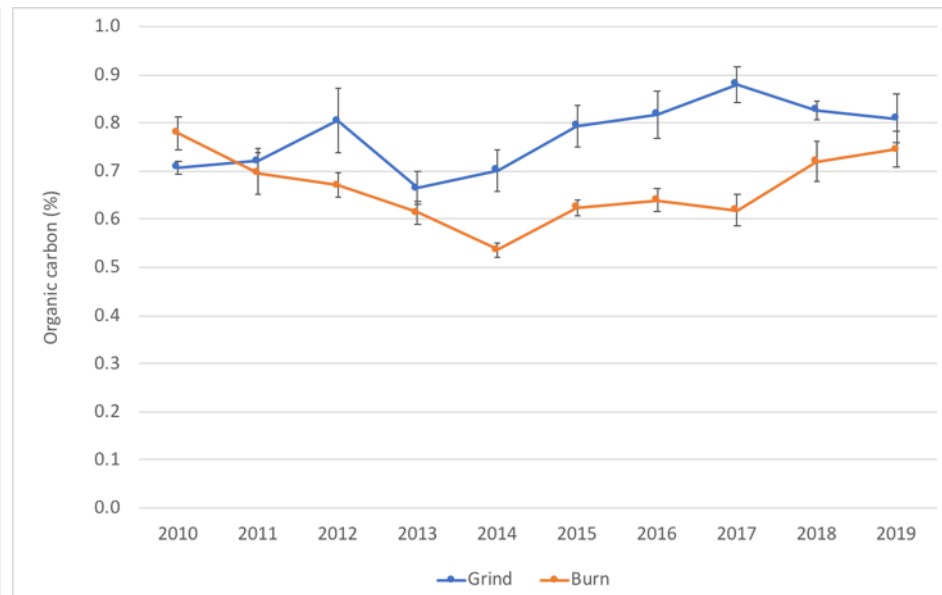
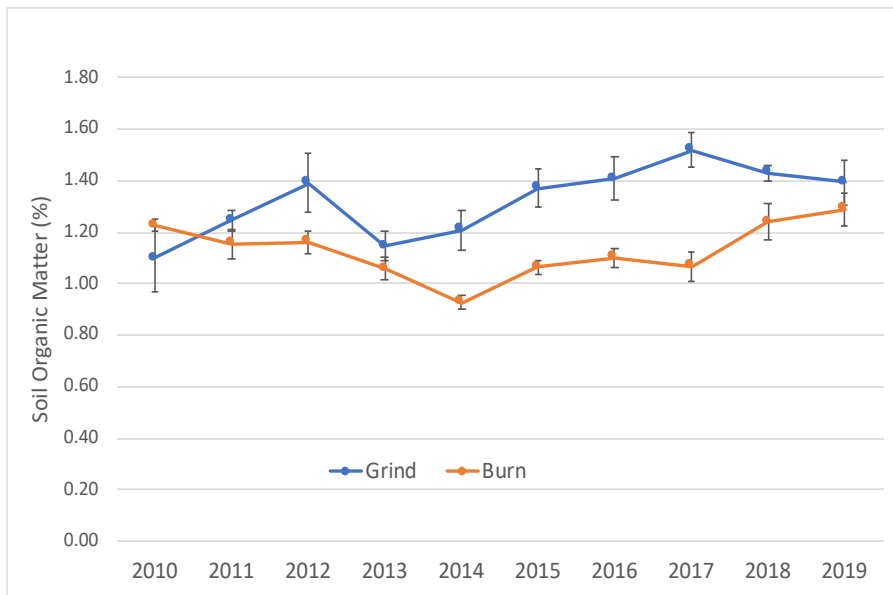
2009 First leaf trees growing in grinding plot

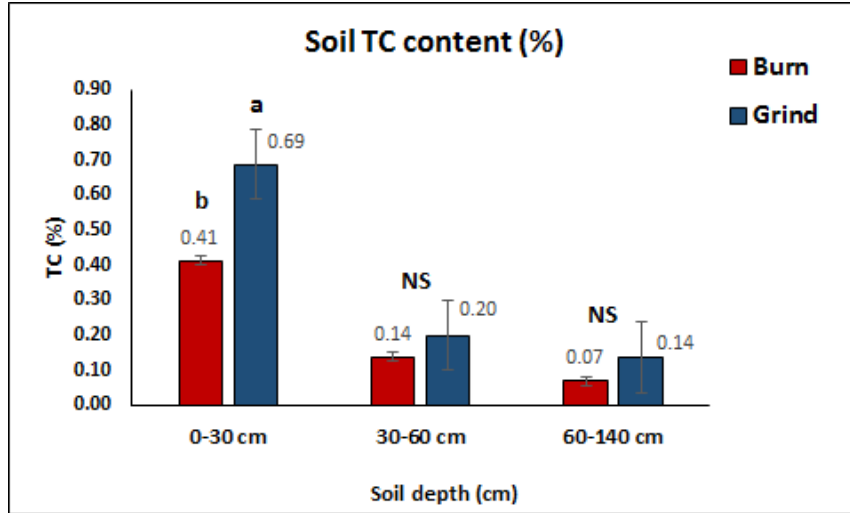
2010 Second leaf trees



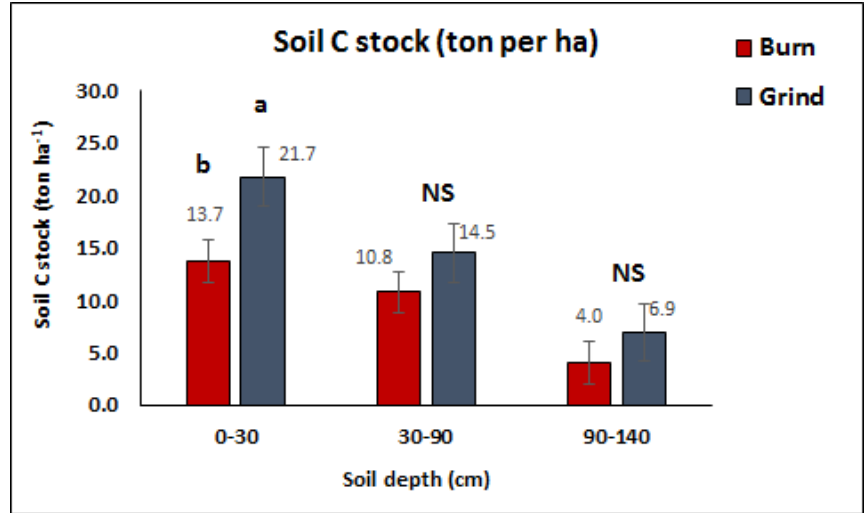
No difference in tree
circumference

The Grinding did not stunt the
second generation orchard

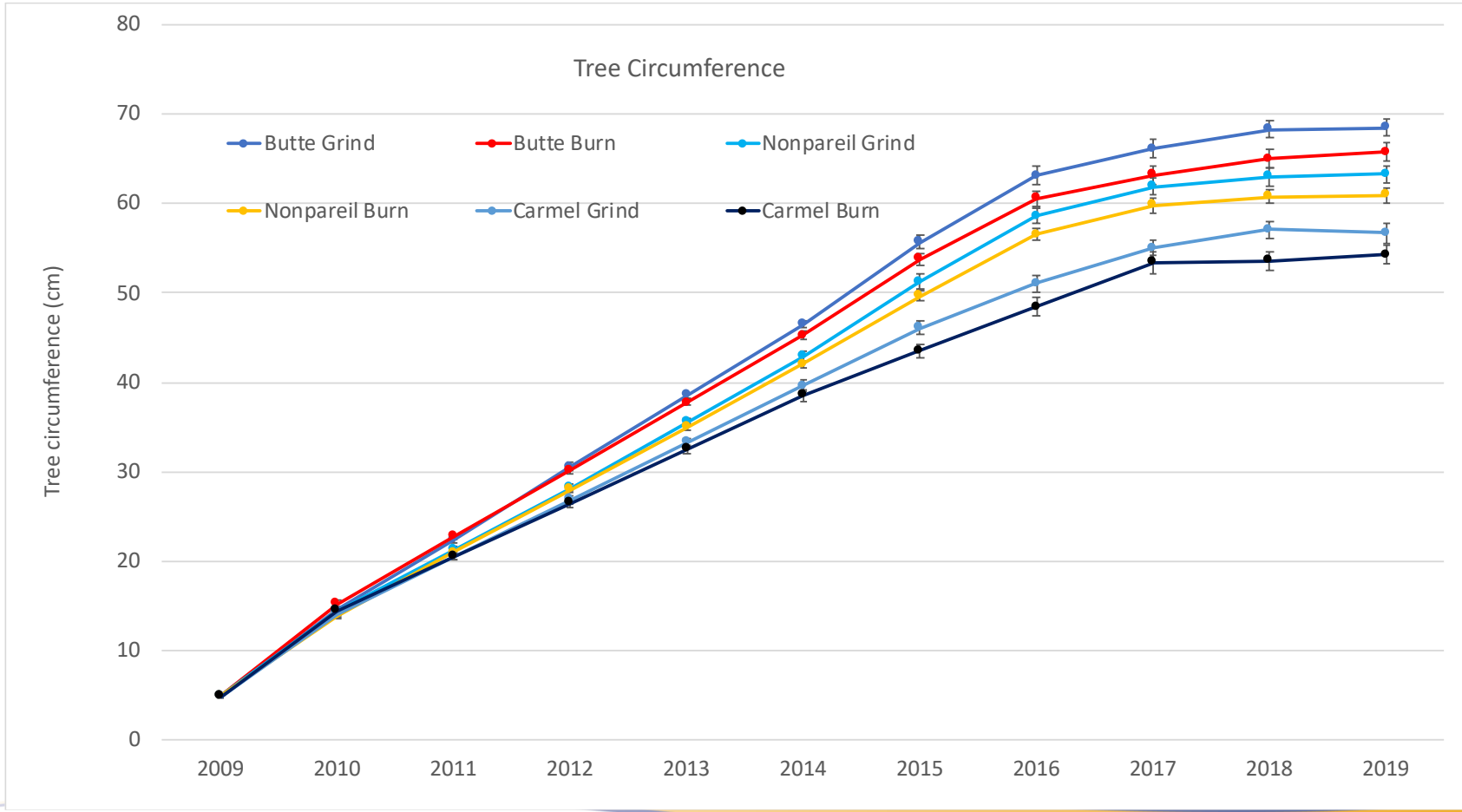




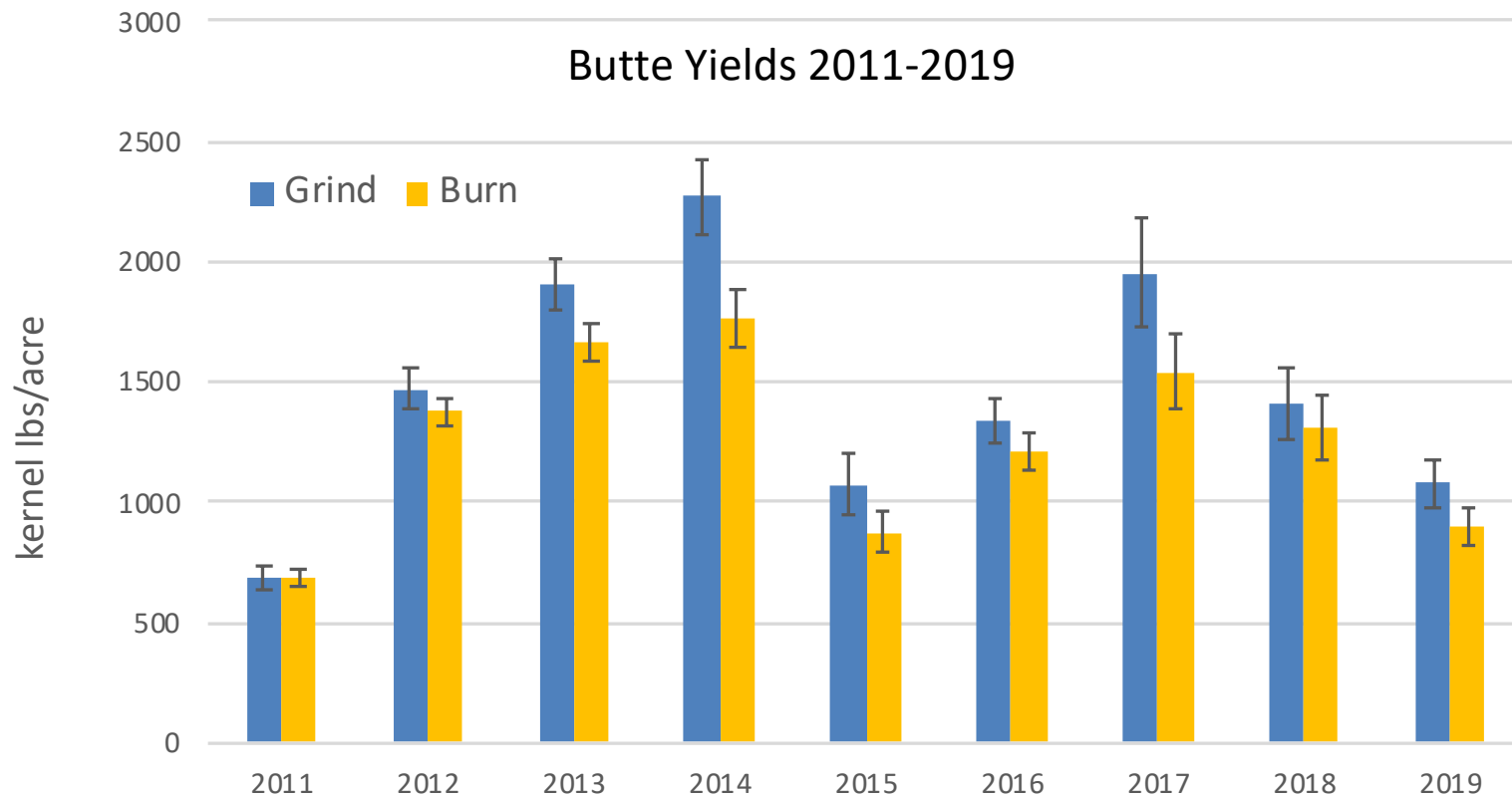
WOR increased soil C content by 68% (0-30 cm) compared to the Burn treatment

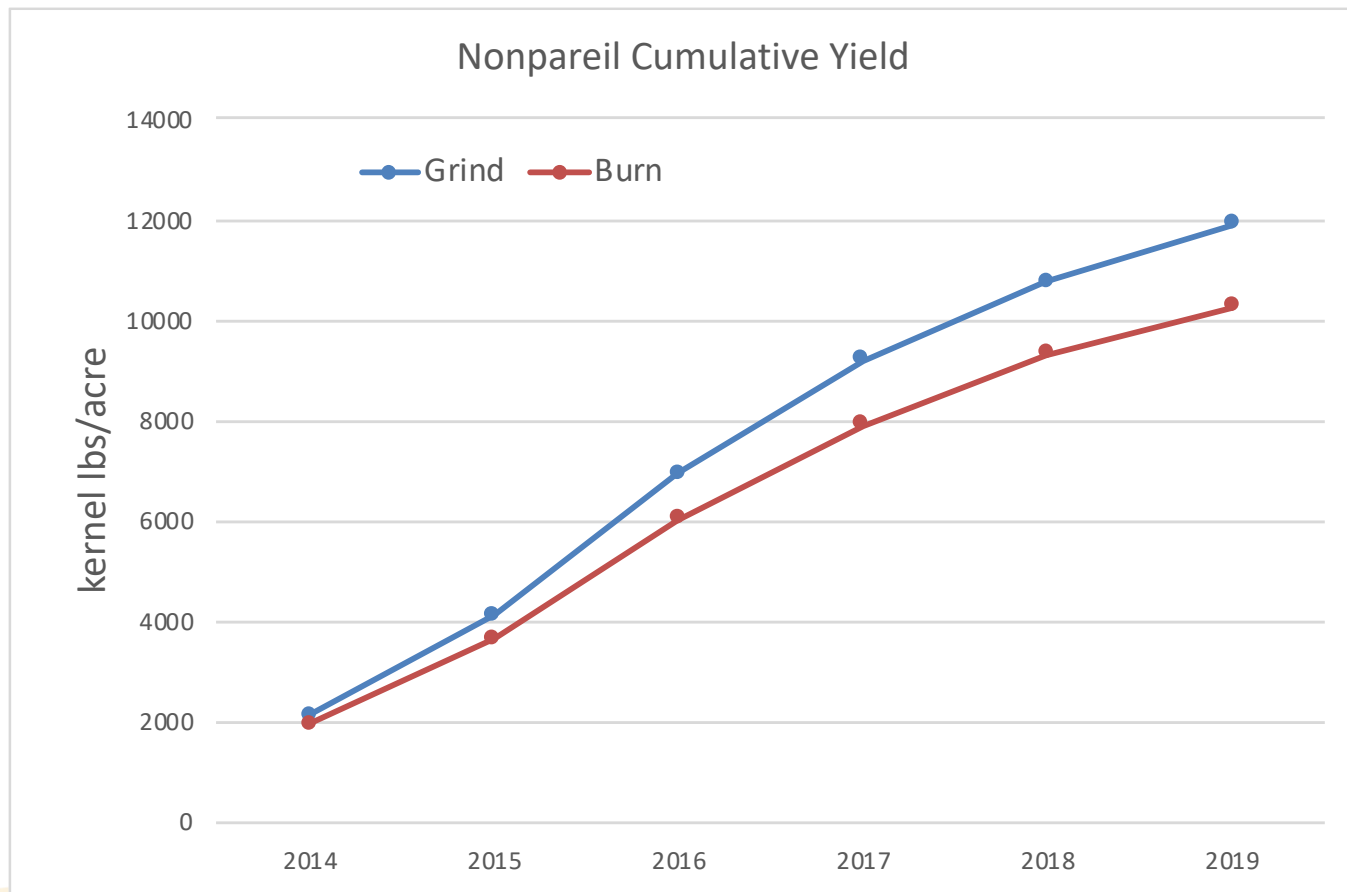


WOR lead to + 8 tons per ha of C sequestered compared to the burn treatment, 9 years after recycling



Butte Yields 2011-2019





Whole Orchard Recycling has:

- Increased soil organic matter
- Increased soil organic carbon
- Increased soil nutrients
- Increase soil microbial diversity
- Increased orchard productivity

Closure of more biomass plants reduces options

By Christine Souza

The closure or threatened closure of more California biomass power plants leaves farmers with fewer options for disposing of tree prunings or of trees uprooted during planned orchard removals. "The last few projects that we've done,



In 2015 growers started using manure spreaders to spread wood chips back on the soil surface







Orchard removal typically involves five machines and costs between \$600-700 acre. Horizontal grinders can chip up 15-20 acres per day. Two inch screen sizes are recommended rather than four inch screens to reduce chip size.



Kuhn & Knight manure spreaders were modified to spread wood chips.

Keeping the chips and having them spread back onto your orchard floor will cost an additional \$400 acre.

Wood chips are spread uniformly over entire field surface



64 tons per acre
caused initial tree
stunting and total
weed suppression.
The C:N ratio was
out of balance.

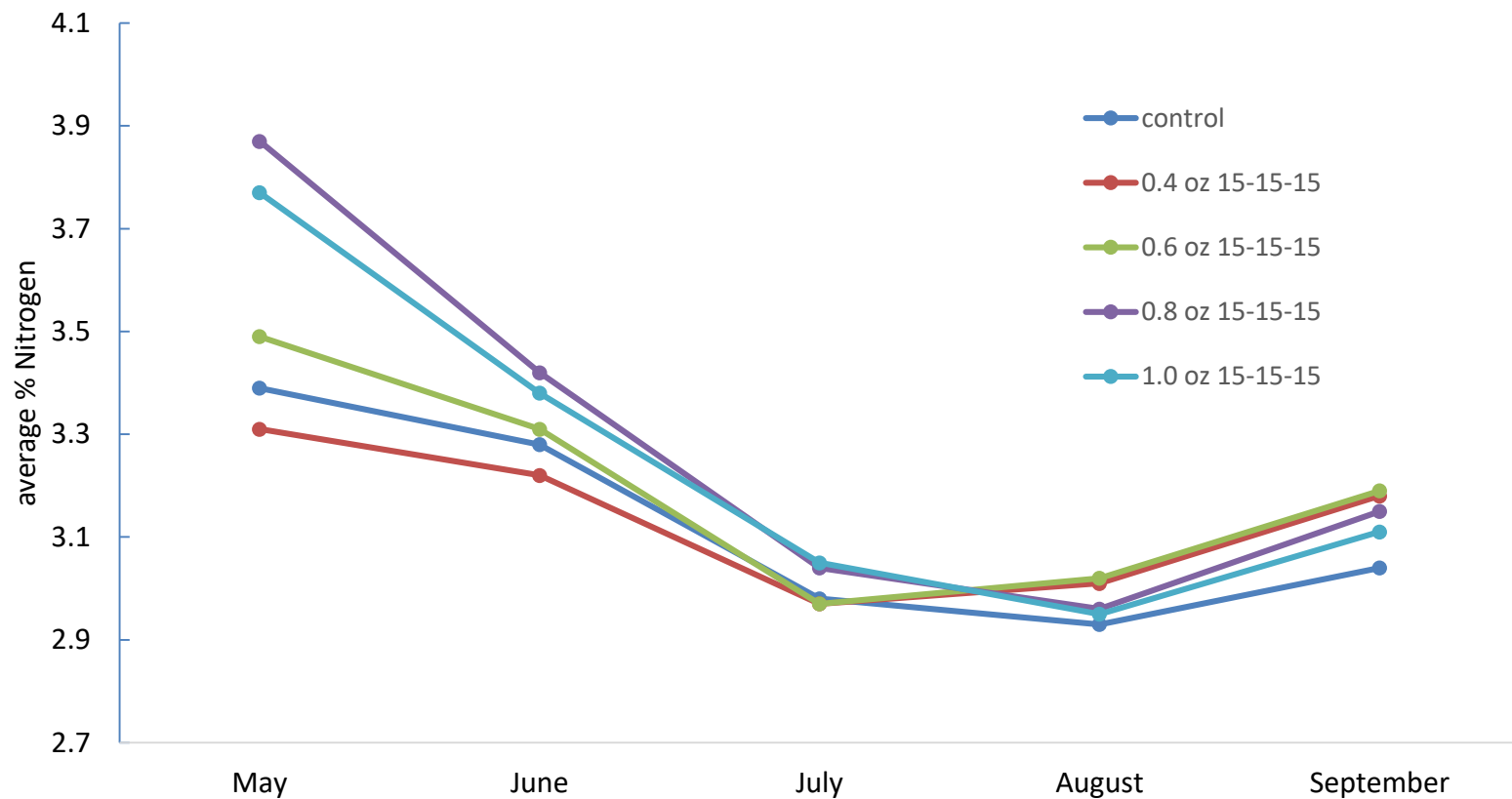
We doubled our
nitrogen applications
through fertigation in
order to get the
desired growth.



Control



0.8 oz of N applied in March





Control



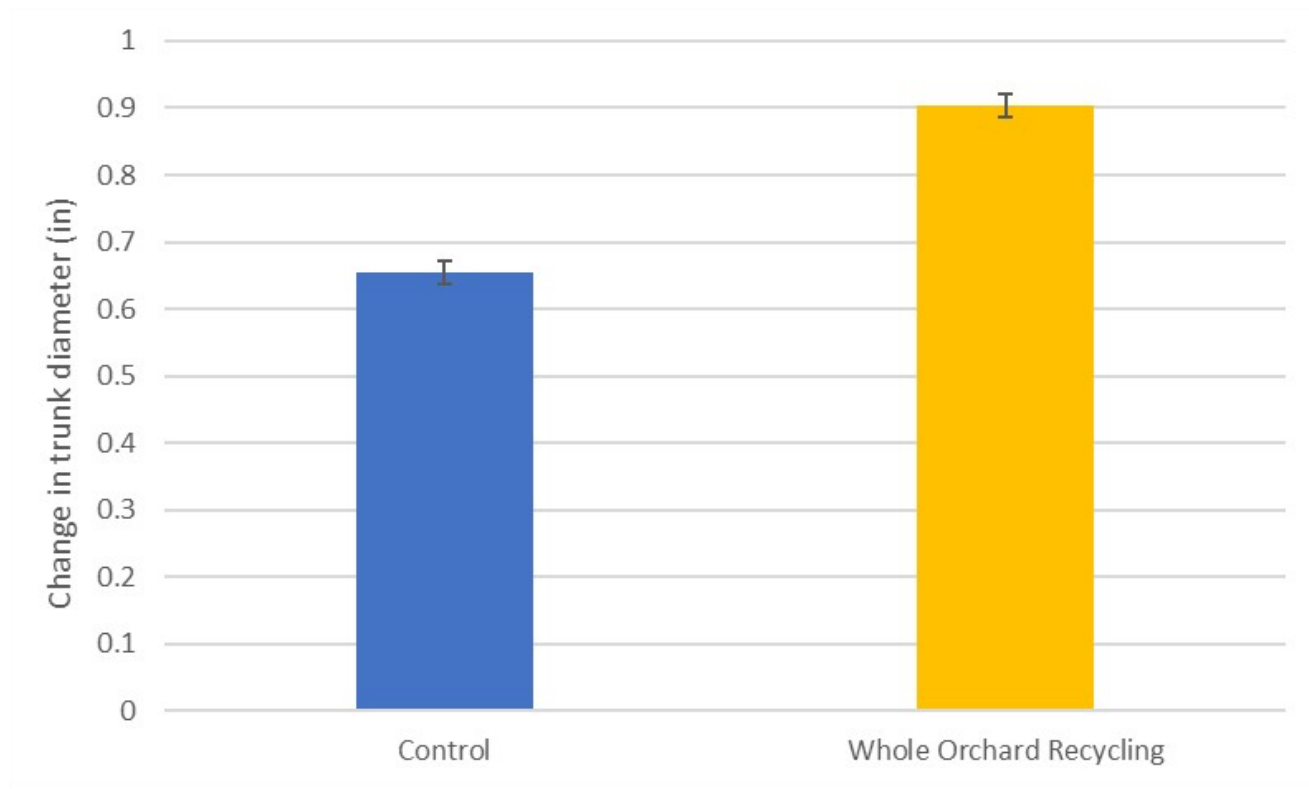
70 tons per acre rate



Control



70 tons per acre rate



Both treatments received 45 lbs N/acre (5 oz N per tree)

Leaf Petiole Analysis

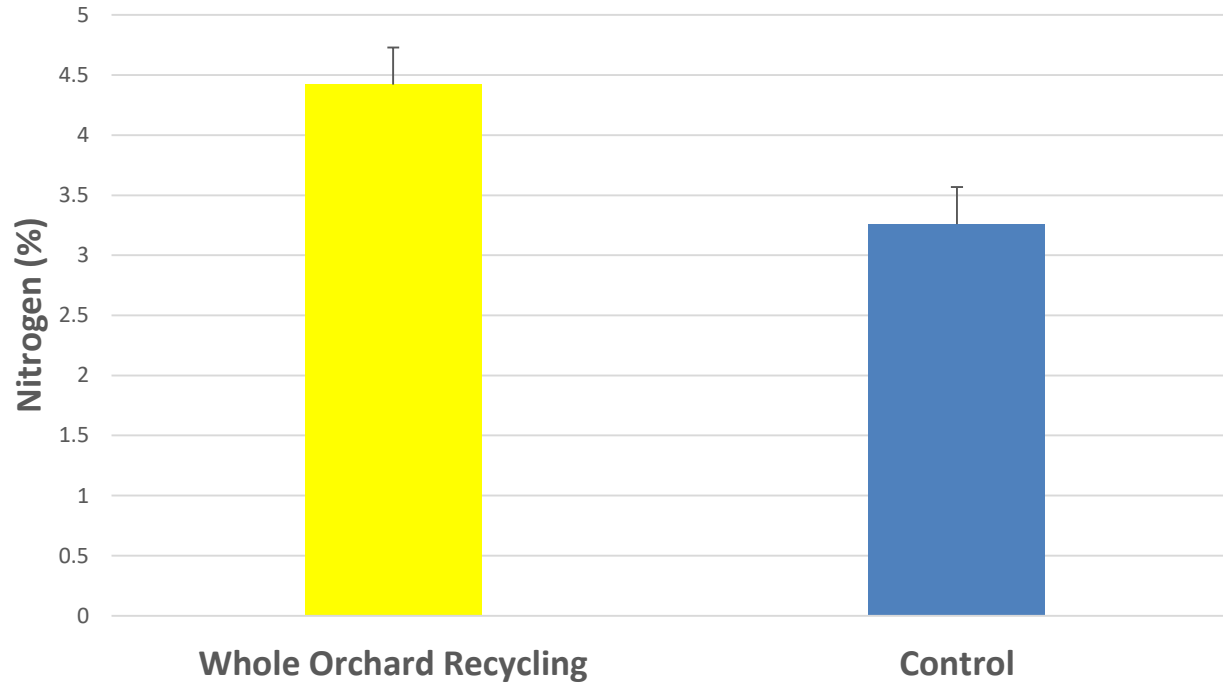


Table 1 Nitrogen fertility recommendations for the first two seasons after conventional planting and WOR replanting.

	1 st leaf	2 nd leaf
	Ounces N per tree	
Conventional planting	3	4
WOR replant	5	4-5

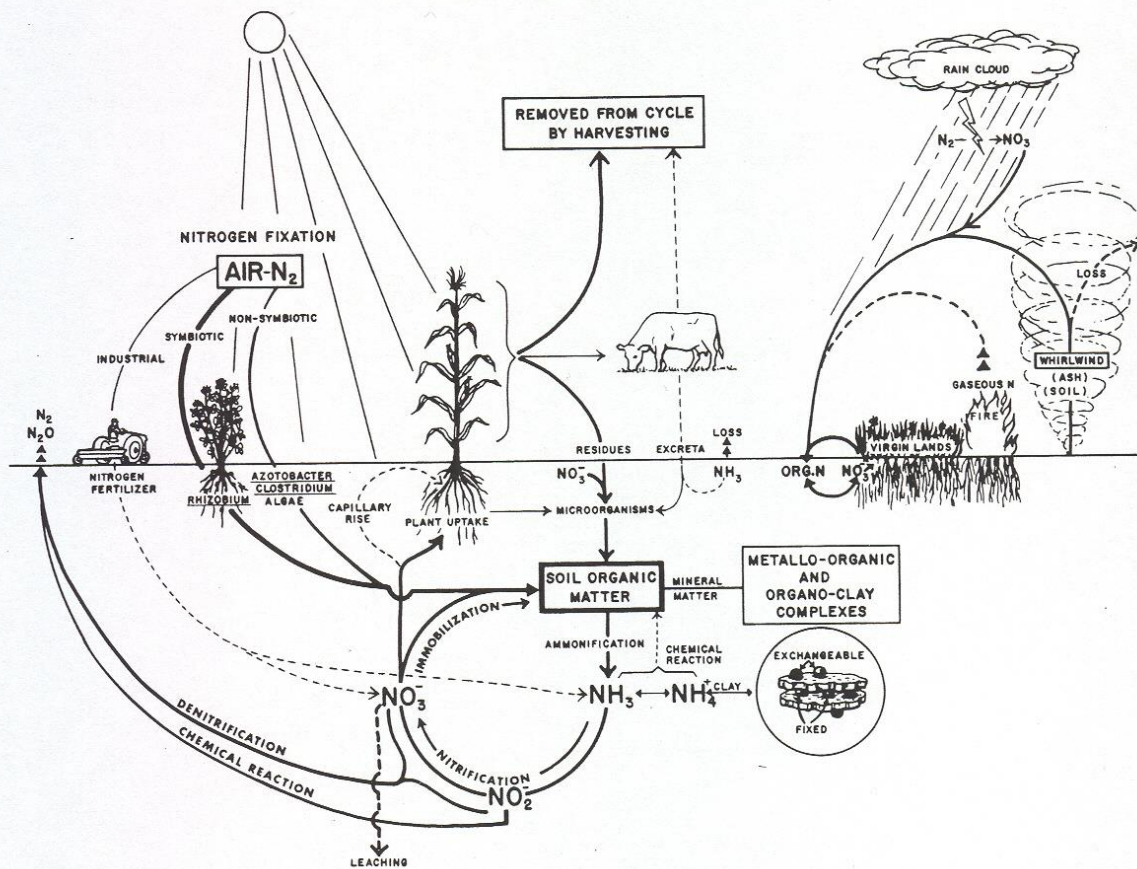
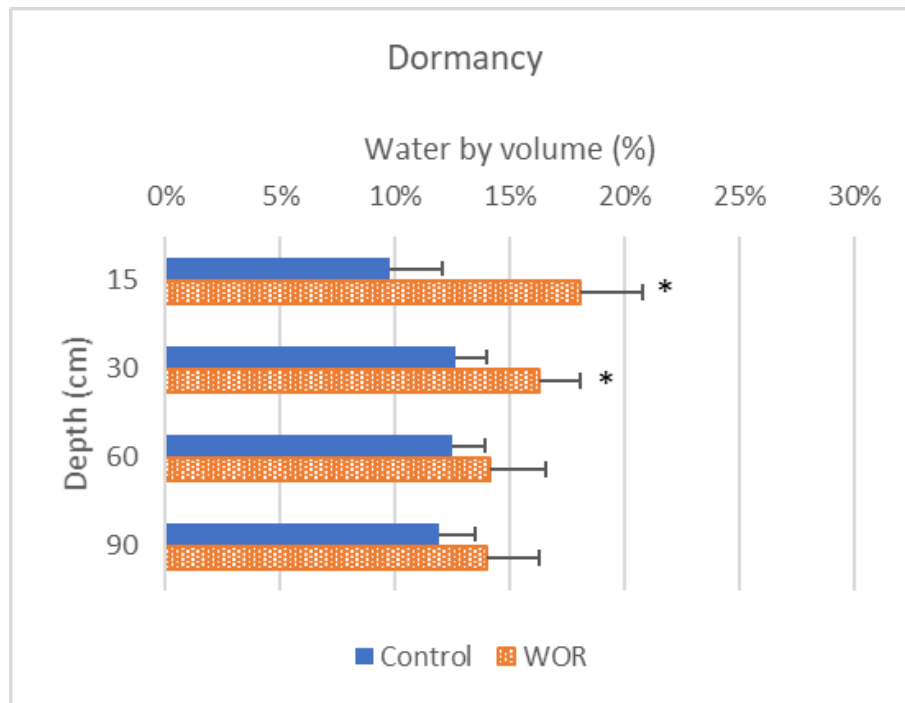
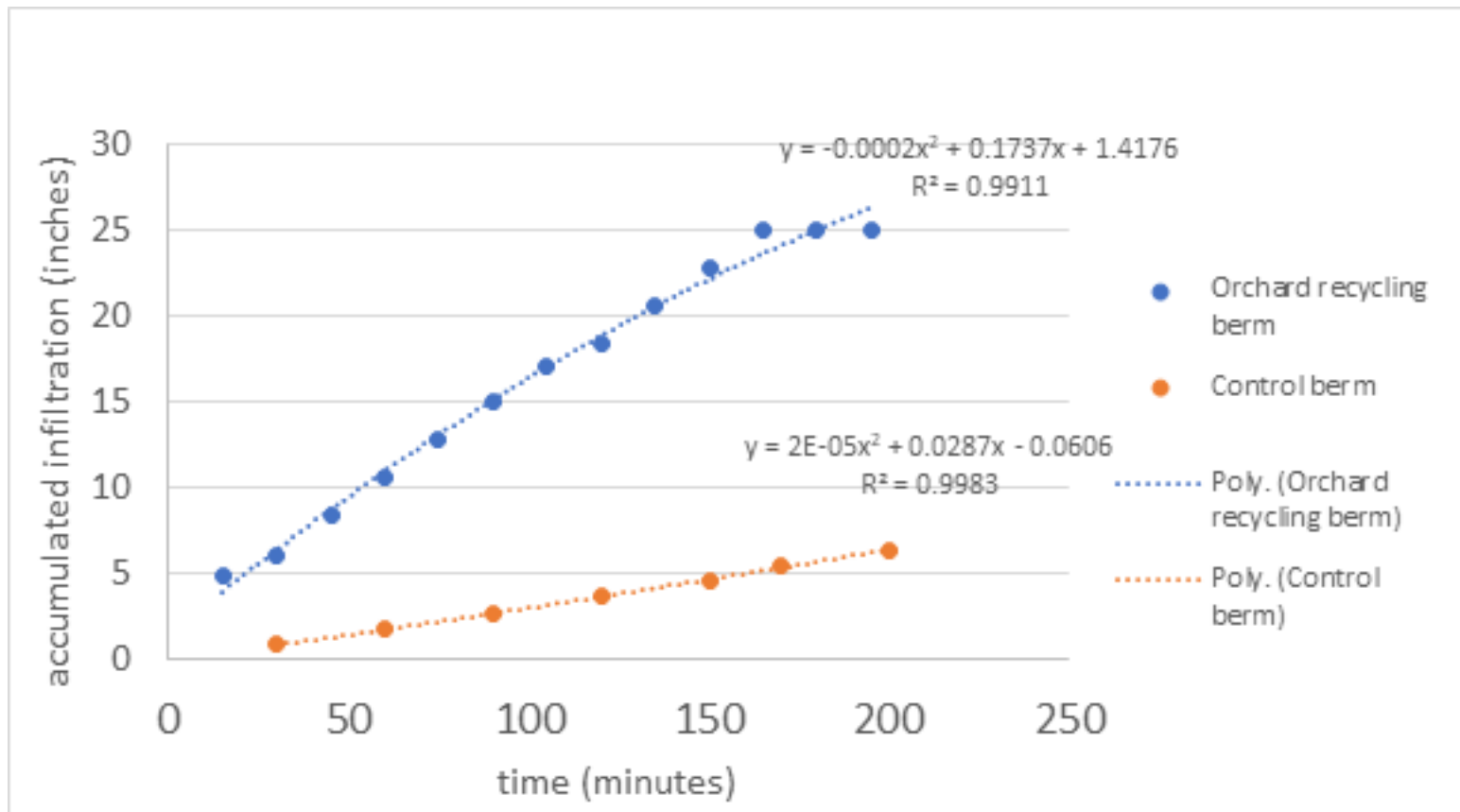
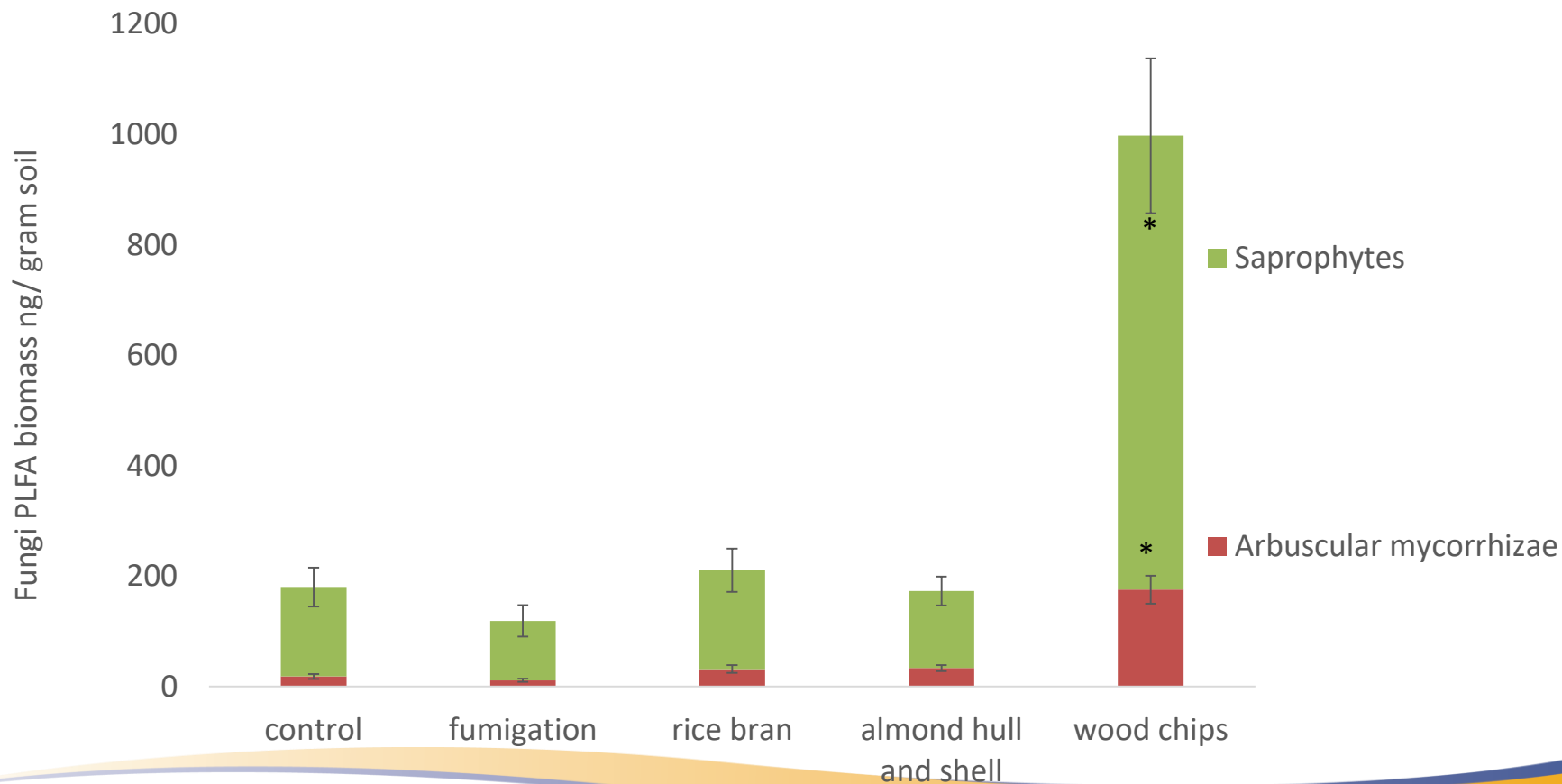


Figure 8.1. Nitrogen cycle in soil. (From Stevenson, 1982.)



A 42% increase in soil moisture by volume was observed in WOR treatments (17% VWC) compared to the control (11% VWC) during the 2019-2020 dormant period in the top 30 cm





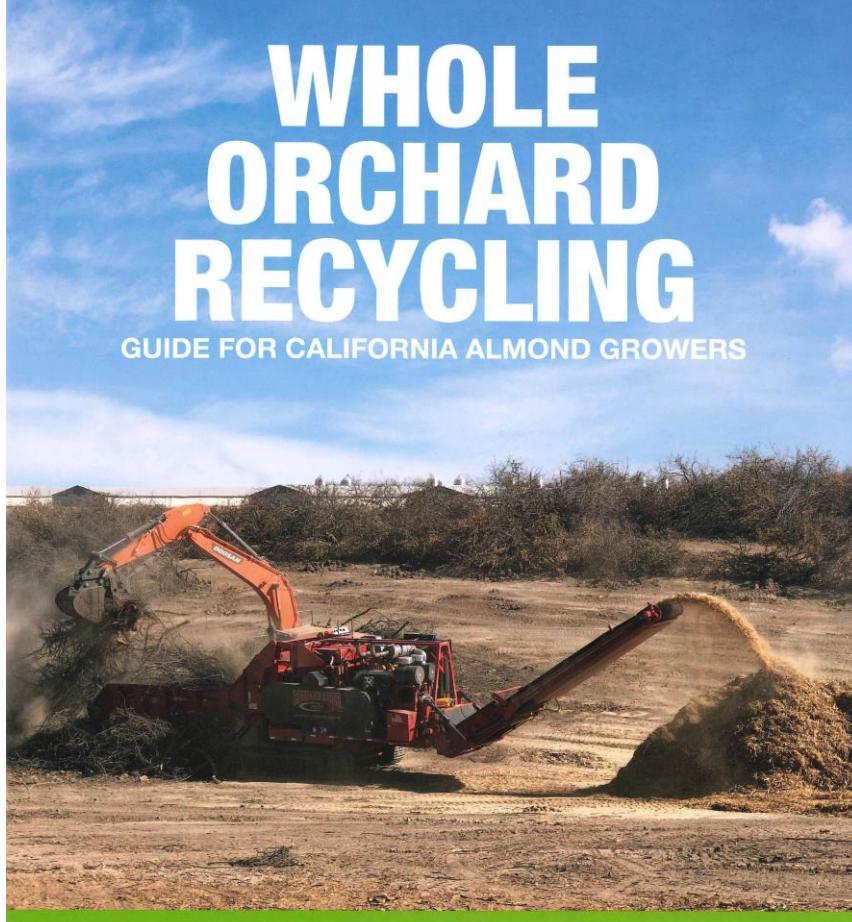


Annual applications:
15 tons per acre/annually
Hope to see similar benefits to cover cropping



WHOLE ORCHARD RECYCLING

GUIDE FOR CALIFORNIA ALMOND GROWERS



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San Joaquin Valley
Air Pollution
Control District

The San Joaquin Valley Air Pollution Control District (SJVAD) has a program that will reward growers with \$300-600 per acre per year (up to \$60,000 per grower) to implement whole orchard recycling. Since November 2018, 539 growers received awards totaling \$18.1 M, recycling 25,934 acres, diverting 727,980 tons of woody biomass from being burned.



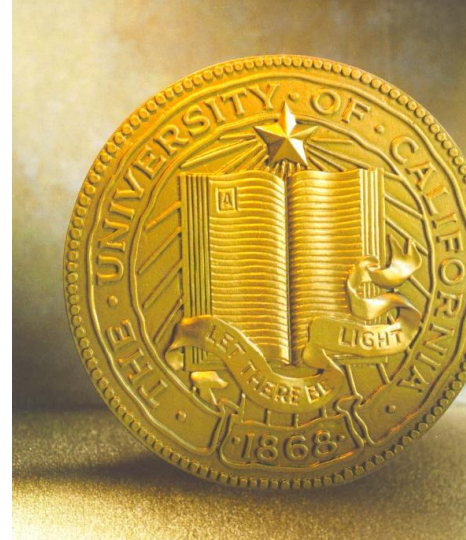
CDFA's Healthy Soils Program has approved Whole Orchard Recycling as a practice that growers can receive incentives for practicing. In its first year, 14 growers were awarded \$680,342 to practice whole orchard recycling.

www.cdfa.ca.gov



NRCS has just implemented a program to help growers implement whole orchard recycling.

Since 2015 over 40,000 acres have been recycled!



Thank You!

