Nitrogen Fertilization for First Leaf Almond Trees Following Orchard Recycling

Holtz, B.[1], Browne, G.[2], Doll, D.[3], Gaudin, A.[4], Culumber, M.[5], Yaghmour, M.[6], Gordon, P.[7], Niederholzer, F.[8], and Jahanzad, E.[4]

University of California Cooperative Extension, San Joaquin[1], Merced[3], Fresno[5], Kern[6], Madera[7] , and Colusa/Sutter/Yuba[8] Counties, USA

[2]USDA-ARS, University of California, Davis, USA

[4]Plant Science, University of California, Davis, USA

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University of California
Agriculture and Natural Resources

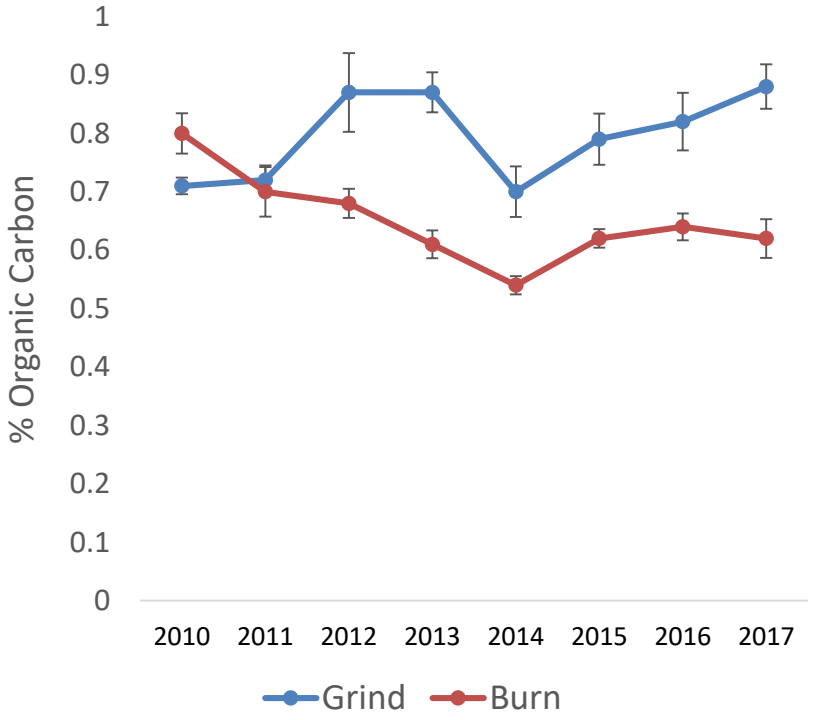
Burning before the clean air act of 2002

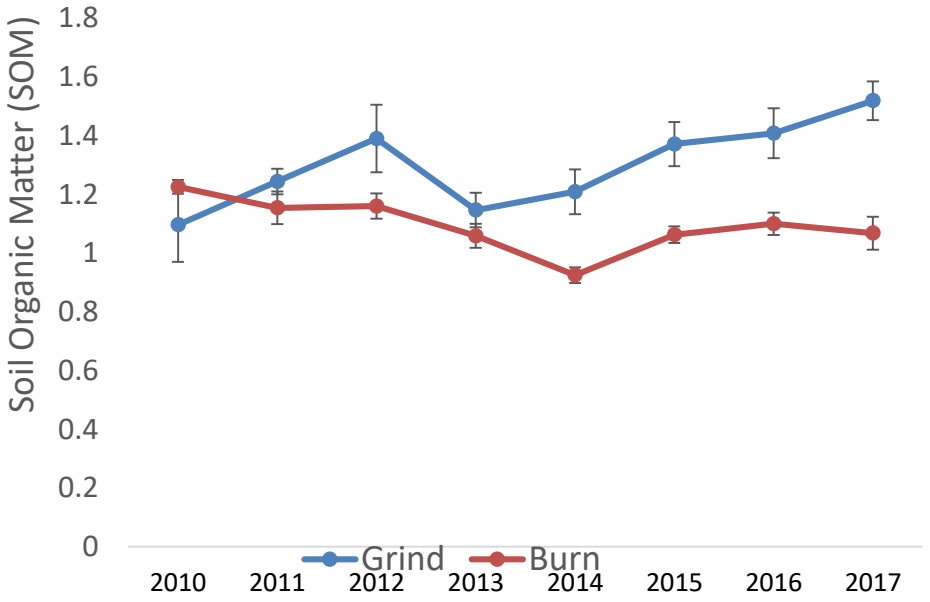
Grinding orchards for co-generation plants

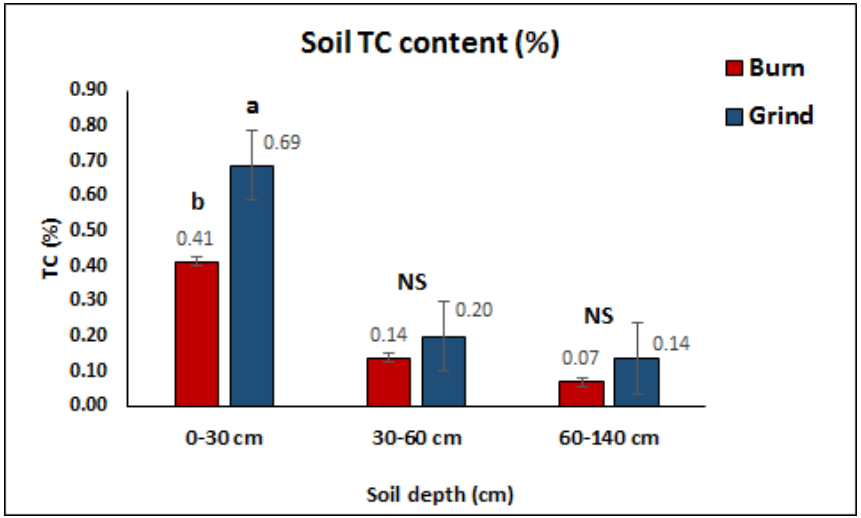
Can we return this organic matter to our orchard soils without negatively effecting the next orchard that will be planted?

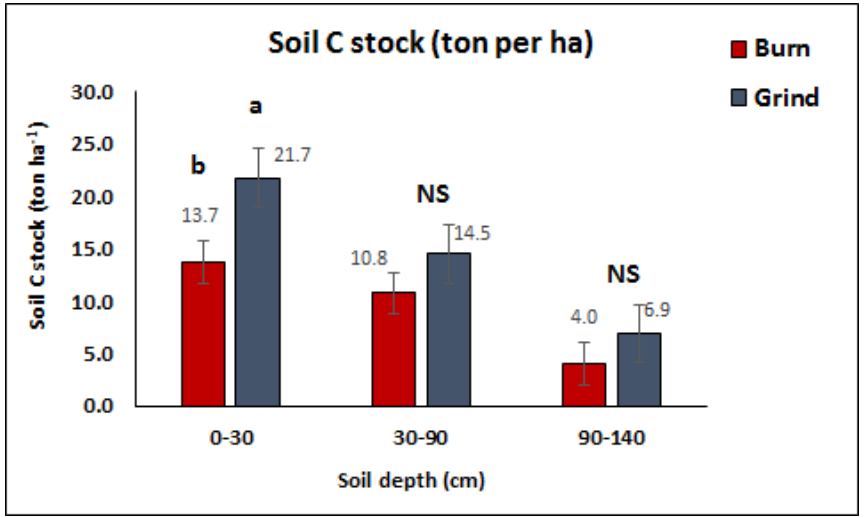
Can whole orchards be incorporated into the soil when they are removed and not burned in the field or in a co-generation plant?

The Iron Wolf


% Organic Carbon
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2010
2011
2012
2013
2014
2015
2016
2017
Grind
Burn


Soil Organic Matter (SOM)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Grind
Burn
2010
2011
2012
2013
2014
2015
2016
2017





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

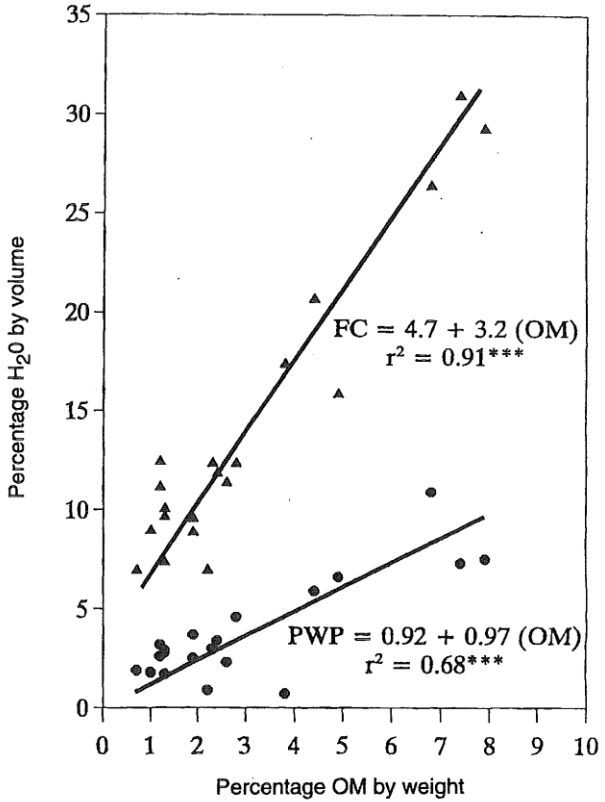


Figure 1. Water content at FC and PWP versus OM content of sand surface horizons.

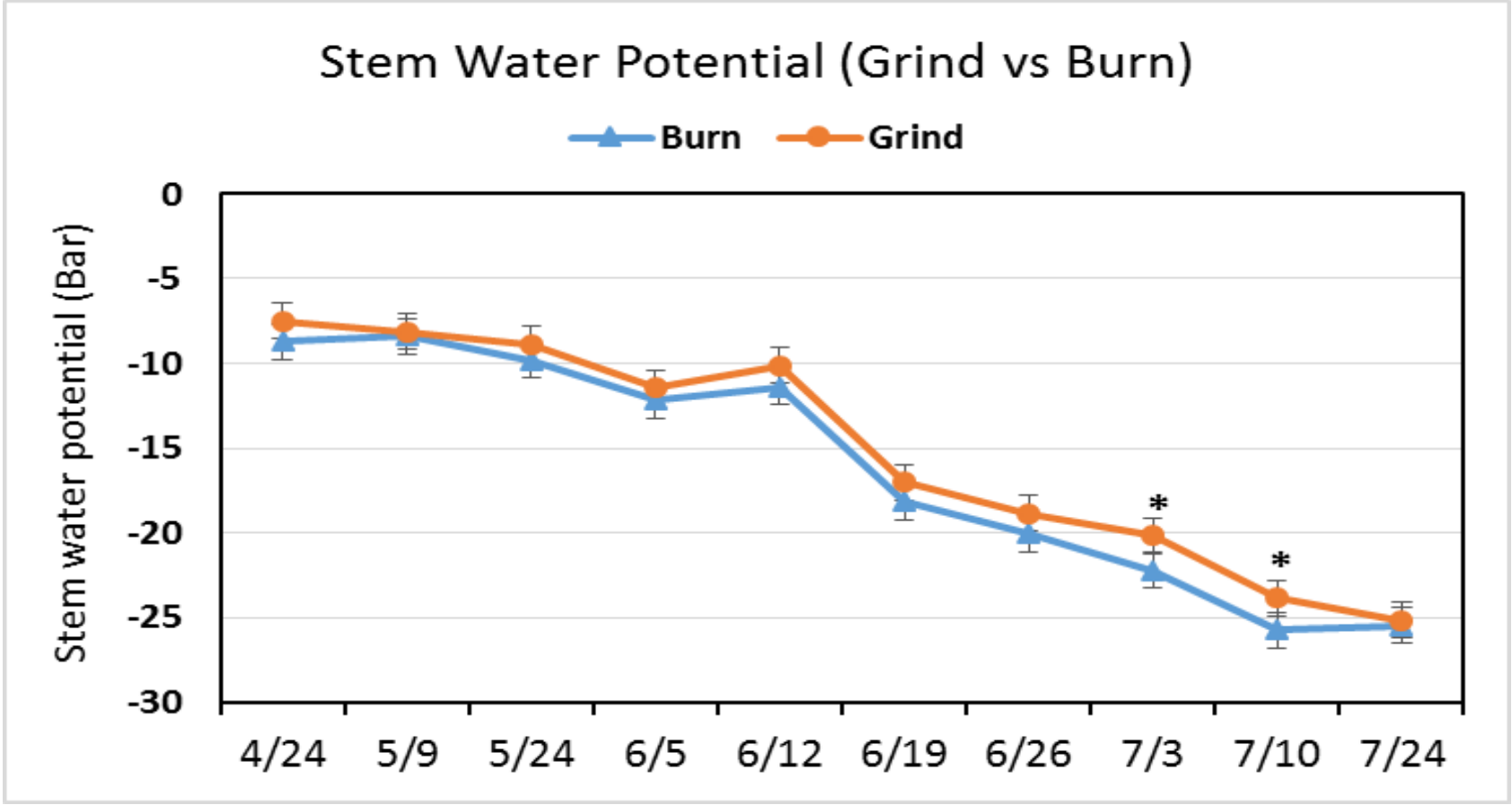
Soil Organic Matter and Available Water Capacity

by

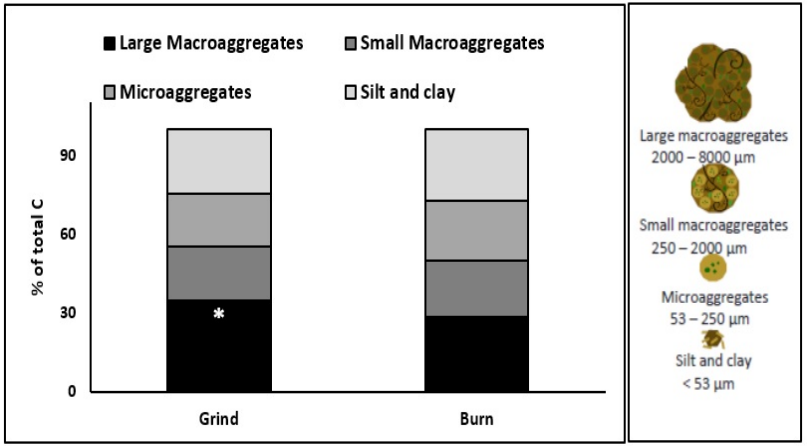
Berman D. Hudson

J. Soil and Water Cons. 49(2):189-194.

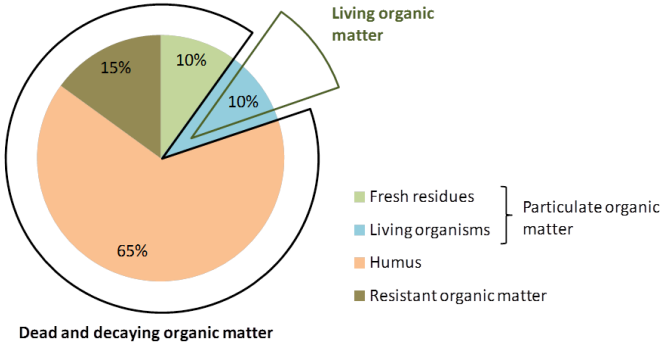
We estimate that Whole Orchard recycling has increased the water holding capacity of our soil by 15% based on this curve and that SOM has increased from in 1.07 (burn) to 1.52 (grind) (2017 results).


Stem Water Potential (Grind vs Burn)
Burn
Grind
Stem water potential (Bar)
0
-5
-10
-15
-20
-25
-30
4/24
5/9
5/24
6/5
6/12
6/19
6/26
7/3
7/10
7/24
*
*

Soil TC storage in soil aggregates



- 14% increase in large macroaggreagate TC storage in the Grind treatment compared to the Burn

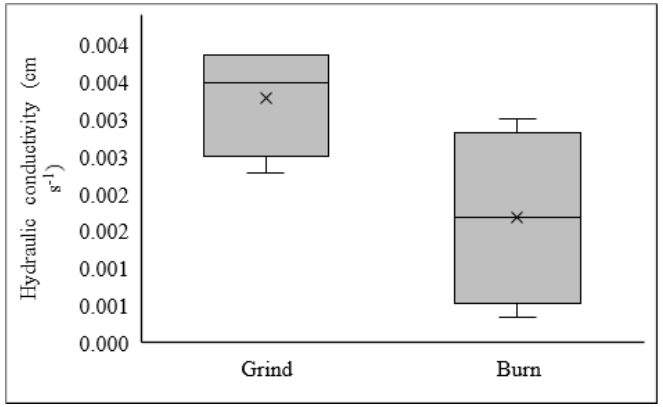


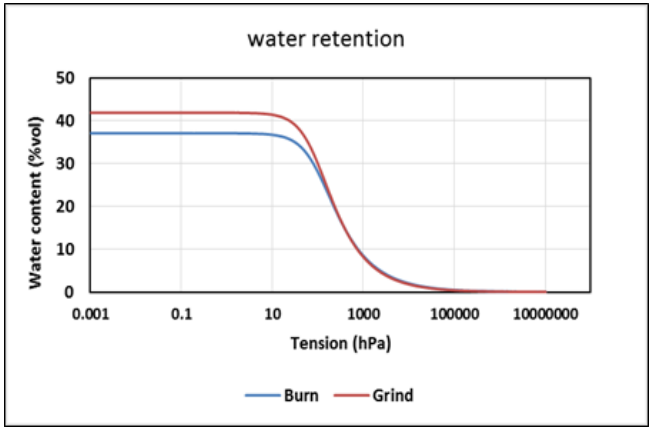
Soil organisms are more abundant and more active

- Soil microbial biomass carbon (MBC) increased (+ 47%)
- Soil microbial biomass nitrogen (MBN) was slightly higher
- Overall, higher N and C cycling enzyme activity rates in the Grind treatment compared to the Burn

Impacts on soil hydraulic properties?

- Improved soil aggregation (significant higher Mean Weight Diameter in the Grind treatment (610 vs 534)
- Compaction was reduced in the Grind plots (- 27%)
- Higher infiltration rate in the Grind treatment (0.003 vs 0.001 cm/s)
- Increased water retention (+ 13% at FC) in the Grind plots





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 up-rooted during planned orchard removals.

"The last few projects that we've done,

AgAlert®

THE WEEKLY NEWSPAPER FOR CALIFORNIA AGRICULTURE

A few growers have used manure spreaders to spread wood chips back on the soil surface

Will Whole Orchard Recycling:

- Increase water holding capacity?
- Bind pesticides and fertilizers?
- Increase Nitrogen efficiency?
- Increase/decrease Green House Gas production?
- Provide carbon credits to farmers?

Whole Orchard Recycling

1 UC Kearney Research and Extension Center (KREC) 2008, Fresno County
2 UC Kearney (KREC) Micro-plot study 2016, Fresno County
3 Agriland Farming, Chowchilla, Madera County 2016
4 Wonderful Orchards, Ranch 3371, Kern County 2016
5 Wonderful Orchards, Ranch 3381, Kern County 2016
6 Tallerico Orchards, Manteca, San Joaquin County 2016
7 Warkentin Ranches, Parlier, Fresno County 2017
8 Fresno State, CSUF, Fresno County 2017
9 Nickels Estate, Arbuckle, Colusa County 2017
10 UC Kearney 2018 Experiment

G & F Ag Services orchard removal typically involves 5 machines and costs ~$600 acre

The Morbark horizontal chipper can chip up 15-20 acres per day.

Screens can be used to limit chip size to 2 inches or less.

The Iron Wolf is being compared to this Morbark Chipper at Agriland Farming in Chowchilla.

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

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

Wood chips are spread uniformly over entire field surface


FLAGLER'S
LAND LEVELING
New Holland
T9050

When 64 tons of wood chips are returned to the soil per acre:

N= 0.31 %, 396 lbs/ac
K= 0.20 %, 256 lbs/ac
Ca= 0.60 %, 768 lbs/ac
C= 50 %, 64,000 lbs/ac

The nutrients will be released gradually and naturally

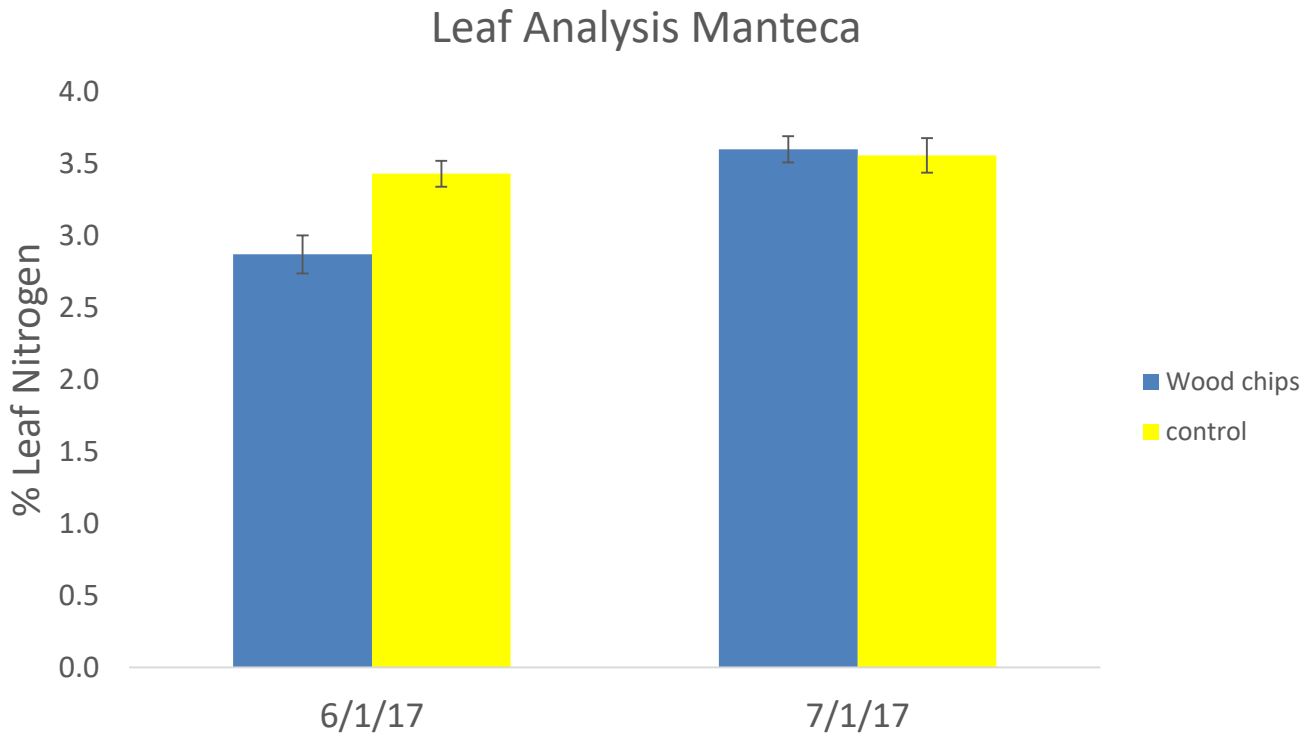
After spreading the woodchips growers can proceed with typical land preparation practices for the next orchard: ripping, disking, fumigation….

Tallerico Orchard in Manteca:

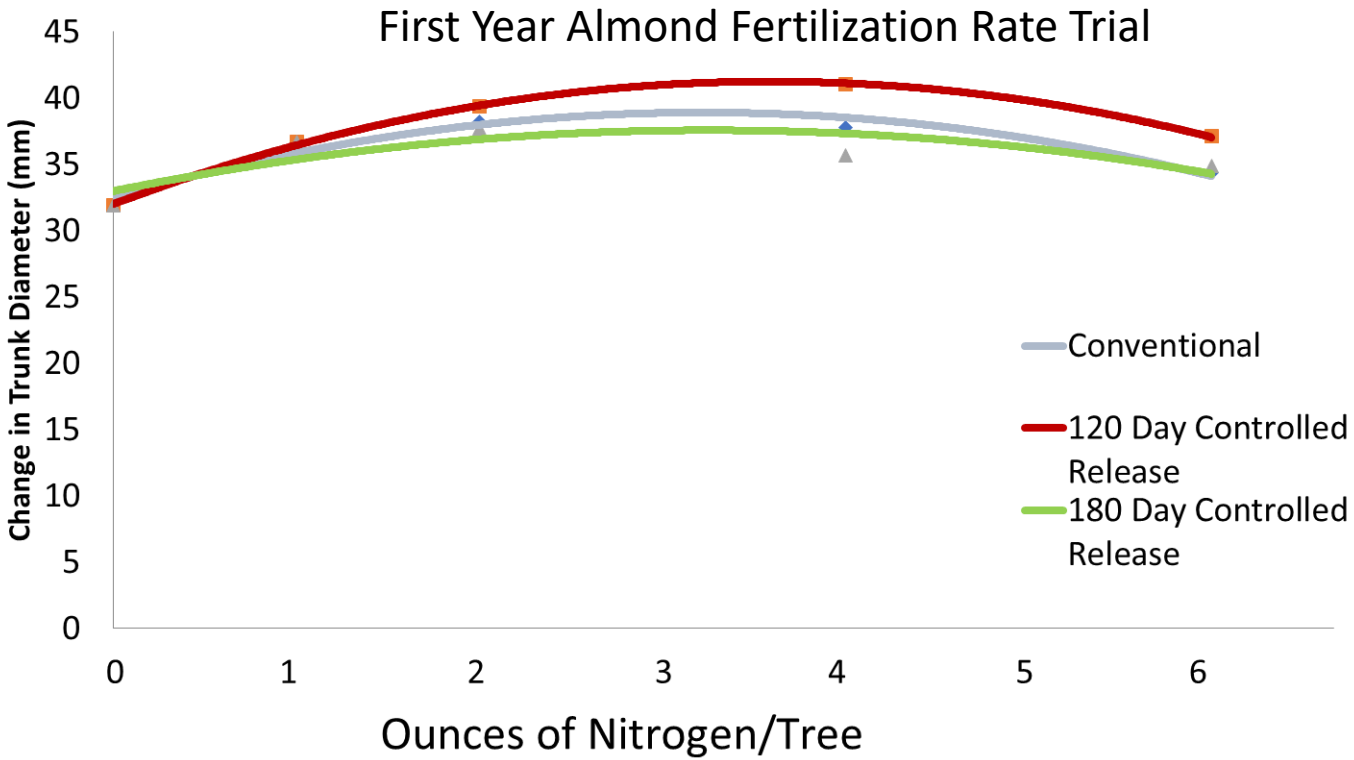
64 tons per acre

In the portion of the orchard where the wood chip piles were—there was total weed suppression.

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


Leaf Analysis Manteca
% Leaf Nitrogen
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
6/1/17
7/1/17
Wood chips
control

Current recommendations for newly planted almond trees



UCCE Merced David Doll

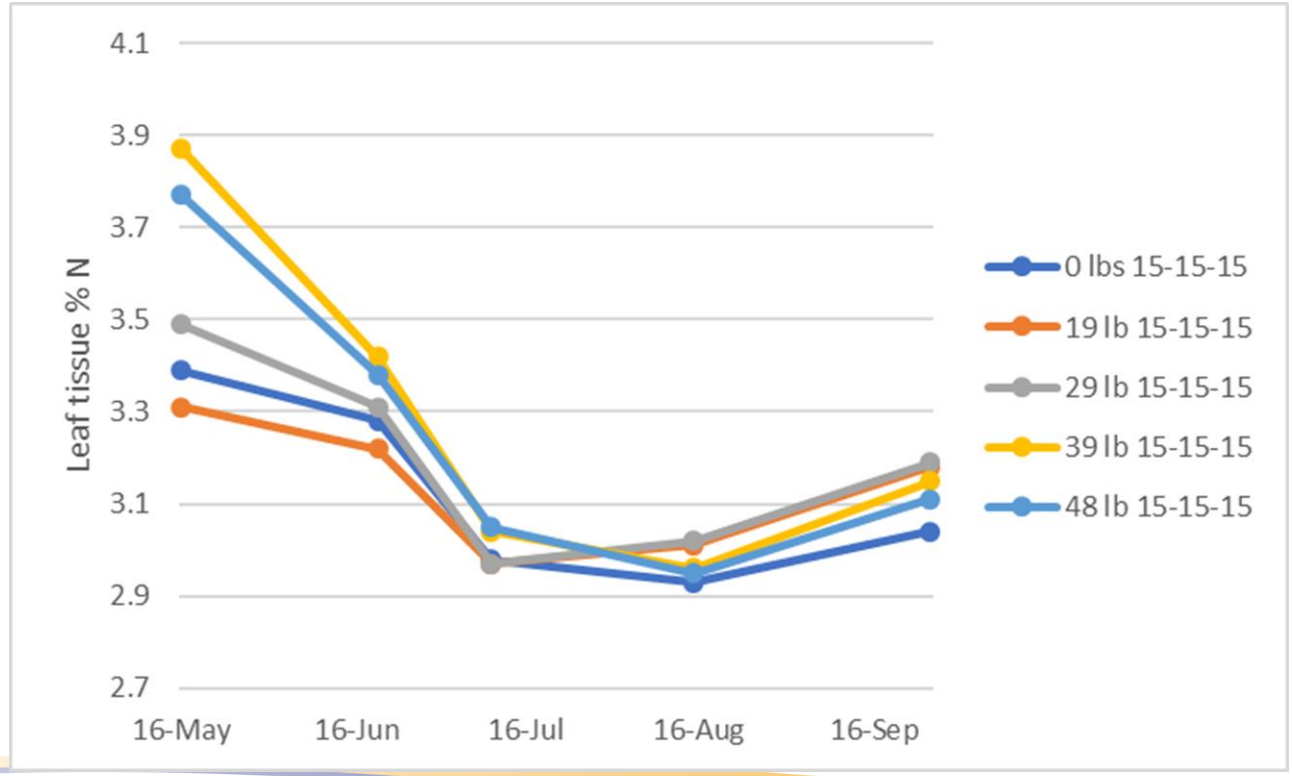
	100% efficiency total N oz/tree/year	22% efficiency of UAN 32 total N oz/tree/year
White	8.65	1.91
Blue	12.78	4.31
Yellow	13.98	5.51
Orange	15.18	6.71
Red	16.38	7.91

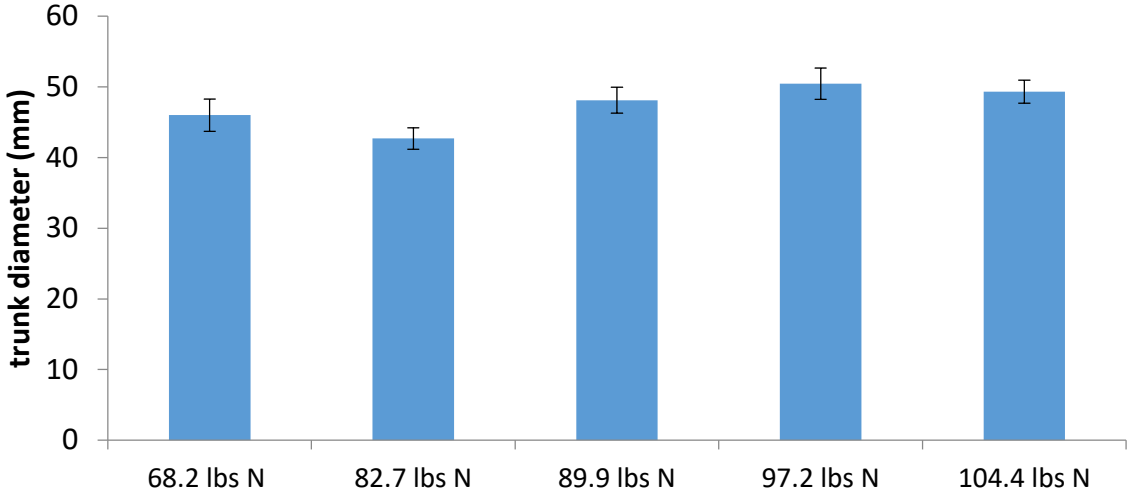
	100% efficiency total lbs N /acre	22% efficiency total lbs N /acre
White	62.70	13.84
Blue	92.60	31.24
Yellow	101.35	39.94
Orange	110.05	48.64
Red	118.75	57.34

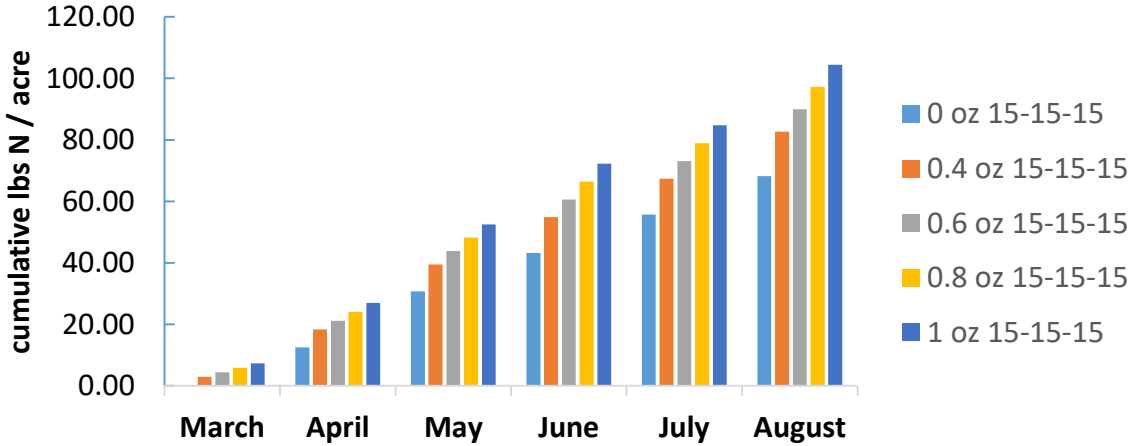
Control

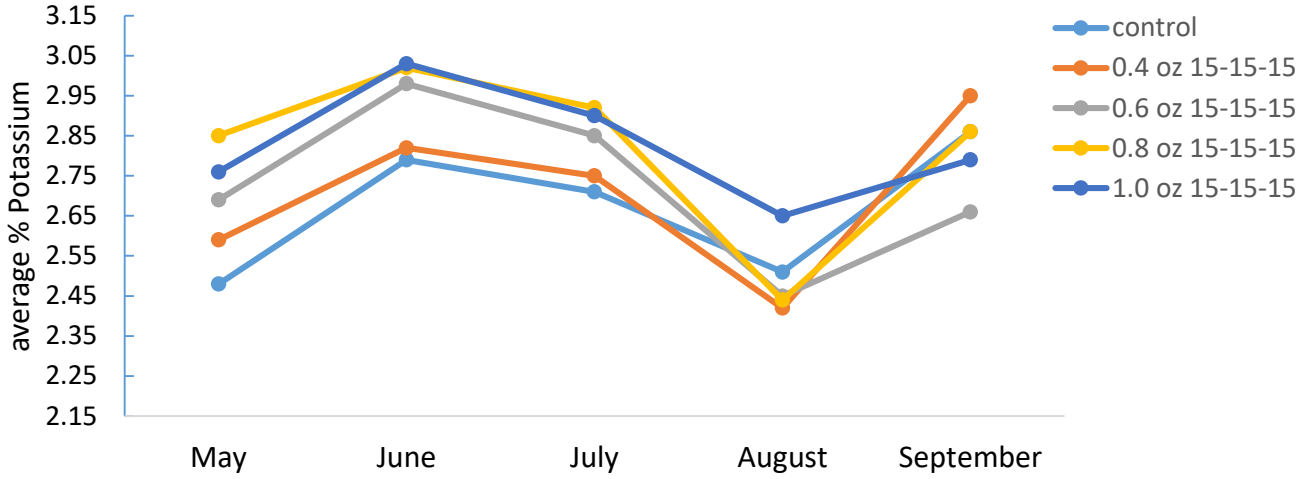
0.8 oz of N applied in March

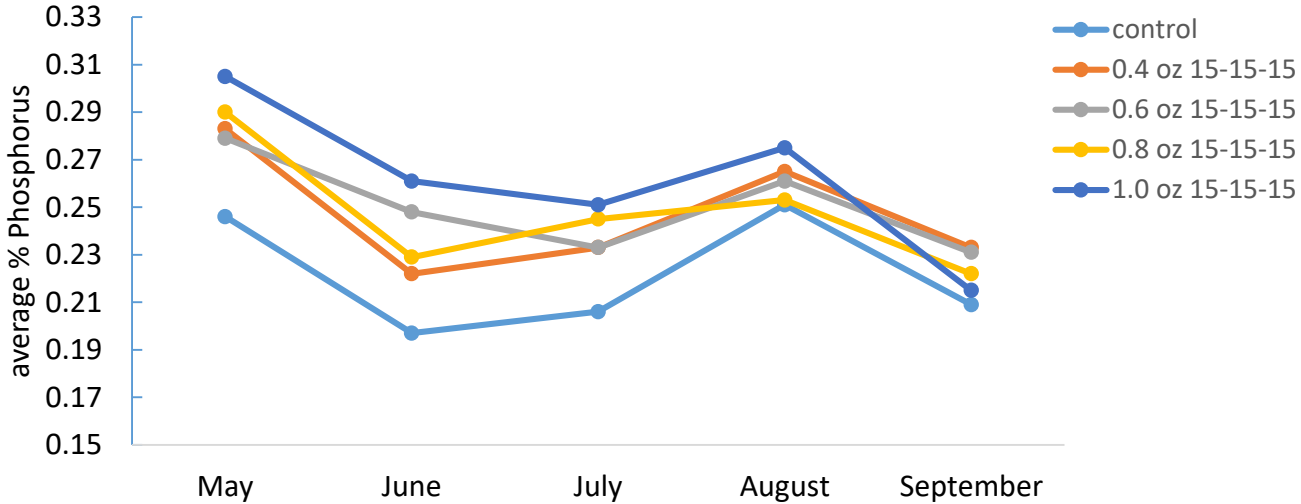
15-15-15 rates and leaf tissue %N



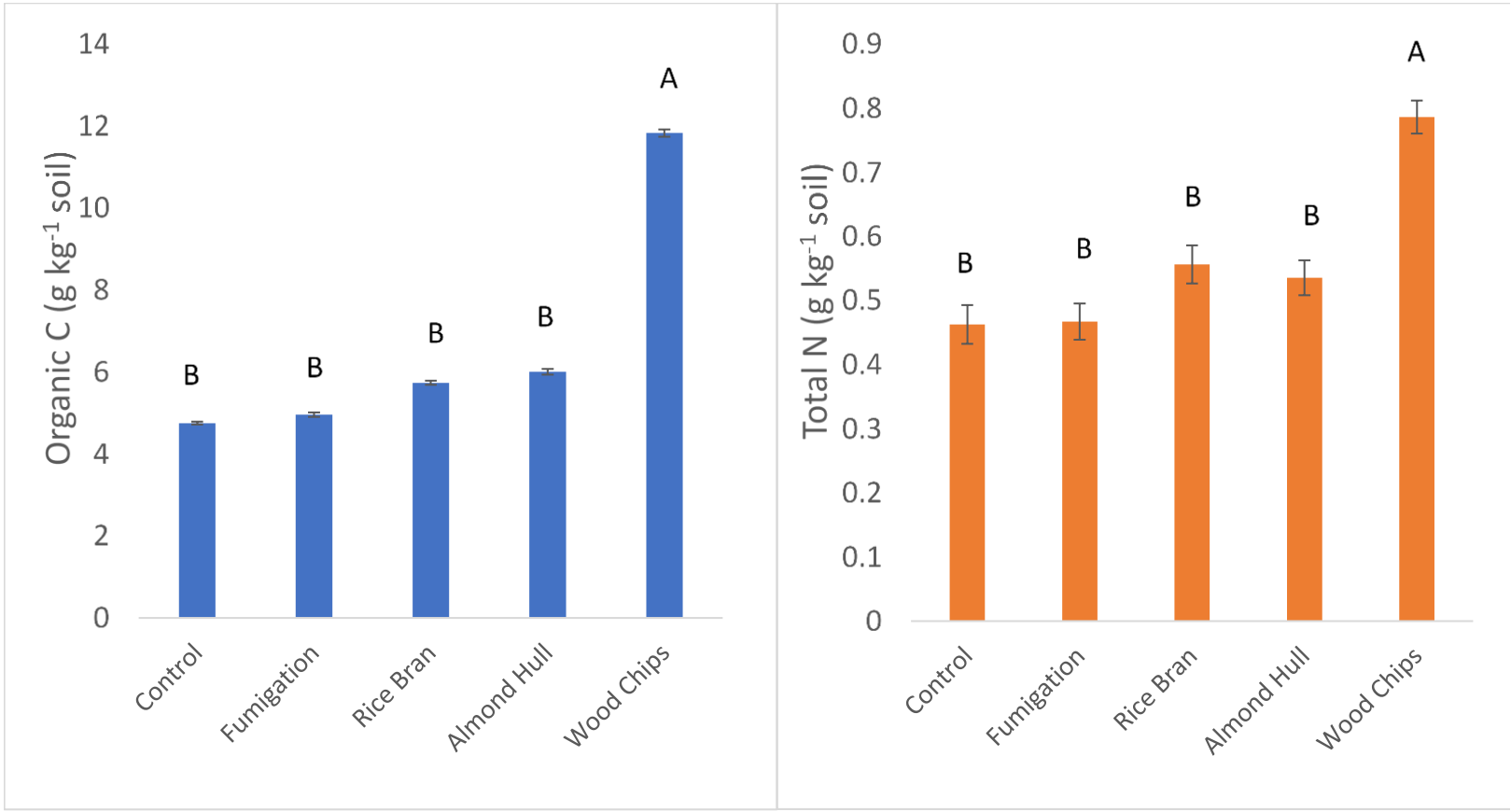

trunk diameter (mm)
60
50
40
30
20
10
0
68.2 lbs N
82.7 lbs N
89.9 lbs N
97.2 lbs N
104.4 lbs N


cumulative lbs N / acre
120.00
100.00
80.00
60.00
40.00
20.00
0.00
March
April
May
June
July
August
0 oz 15-15-15
0.4 oz 15-15-15
0.6 oz 15-15-15
0.8 oz 15-15-15
1 oz 15-15-15


average % Potassium
3.15
3.05
2.95
2.85
2.75
2.65
2.55
2.45
2.35
2.25
2.15
May
June
July
August
September
control
0.4 oz 15-15-15
0.6 oz 15-15-15
0.8 oz 15-15-15
1.0 oz 15-15-15


average % Phosphorus
0.33
0.31
0.29
0.27
0.25
0.23
0.21
0.19
0.17
0.15
May
June
July
August
September
control
0.4 oz 15-15-15
0.6 oz 15-15-15
0.8 oz 15-15-15
1.0 oz 15-15-15

Northwest Tiller
till, level, and roll in one pass


Organic C (g kg-1 soil)
14
12
10
8
6
4
2
0
A
B
B
B
B
Control
Fumigation
Rice Bran
Almond Hull
Wood Chips
Total N (g kg-1 soil)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
A
B
B
B
B
Control
Fumigation
Rice Bran
Almond Hull
Wood Chips

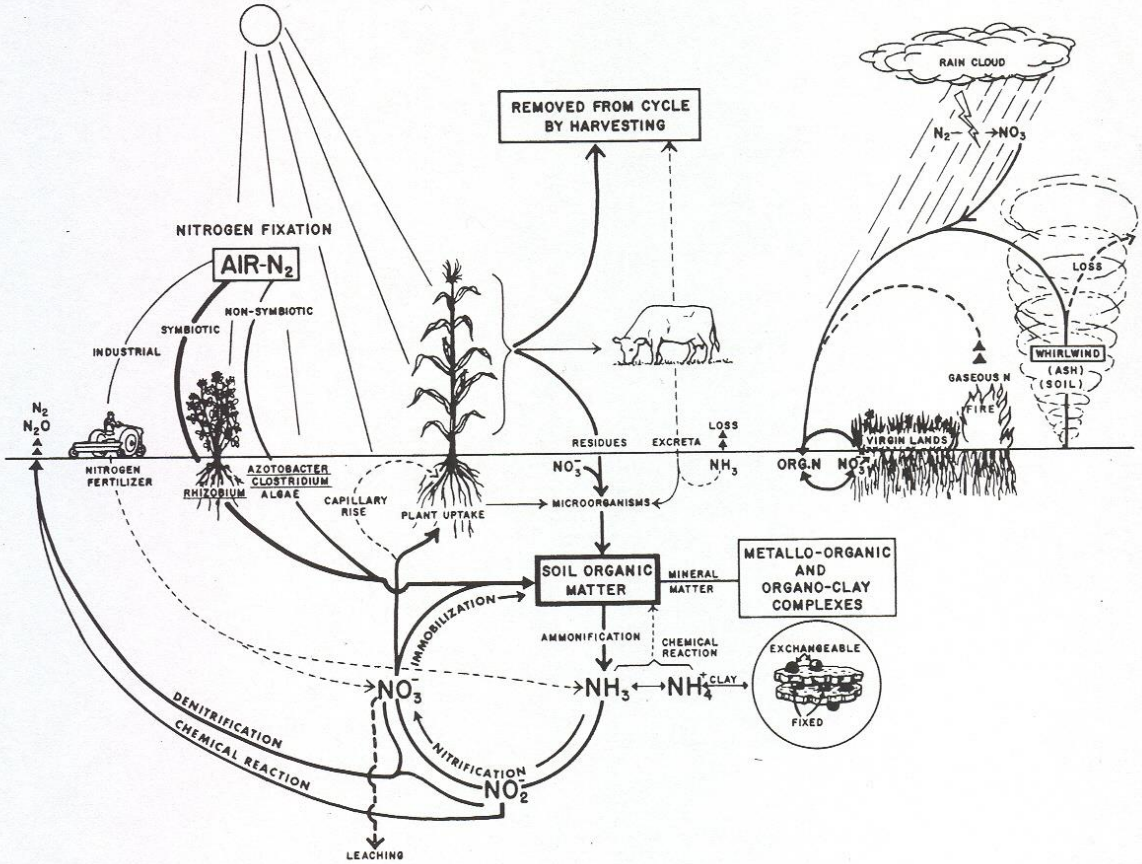


Figure 8.1. Nitrogen cycle in soil. (From Stevenson, 1982.)

This Duratech grinder is mobile and spreads the wood chips evenly as it grinds.

Efficiencies are improved every year that whole orchard recycling is performed.


MORBARK
50/48
DRUM CHIPPER
MORBARK

San Joaquin Valley Air Pollution Control District

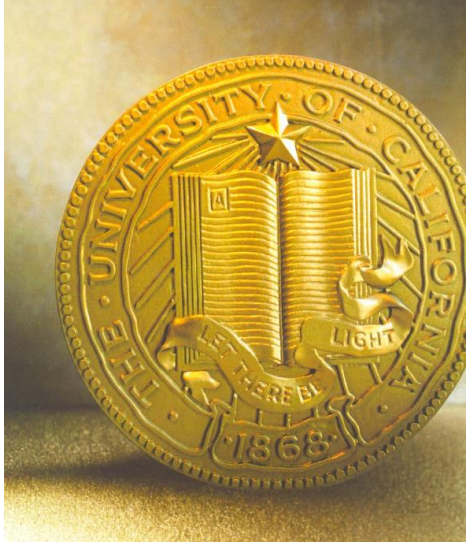
The San Joaquin Valley Air Pollution Control District (SJVAD) has recently approved a program that will reward growers with funding from $300-600 per acre up to $60,000 per year to implement whole orchard recycling.

For more information on these incentive programs, contact Jacob Whitson with SJVAD at 559-230-5800 or at Jacob.Whitson@ValleyAir.org.

Conclusions:

- Wood chip amendments can delay tree growth in newly planted orchards
- Whole Orchard Recycling may require early supplemental N to offset amending the soil with high C containing woodchips
- Applications of N after June didn’t seem to effect leaf N content
- We believe that N efficiency will ultimately be improved with the whole orchard recycling
- We believe that additional rates of N will not be necessary the second year after whole orchard recycling

Thank You!



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