Northern San Joaquin Valley Almond Day

Orchard Carbon Recycling and Replant Disease

by

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San Joaquin County

With urban encroachment many growers could not burn their brush.

- Must be hand fed
- Will chip 9 inch diameter wood
- Handy for blow overs and broken limbs


Amanita


Amanita


Caprinus


Hygrophorus

Marasmius Fairy Ring

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

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

Wood chipped vs Non-chipped

Wood chipped vs Non-chipped

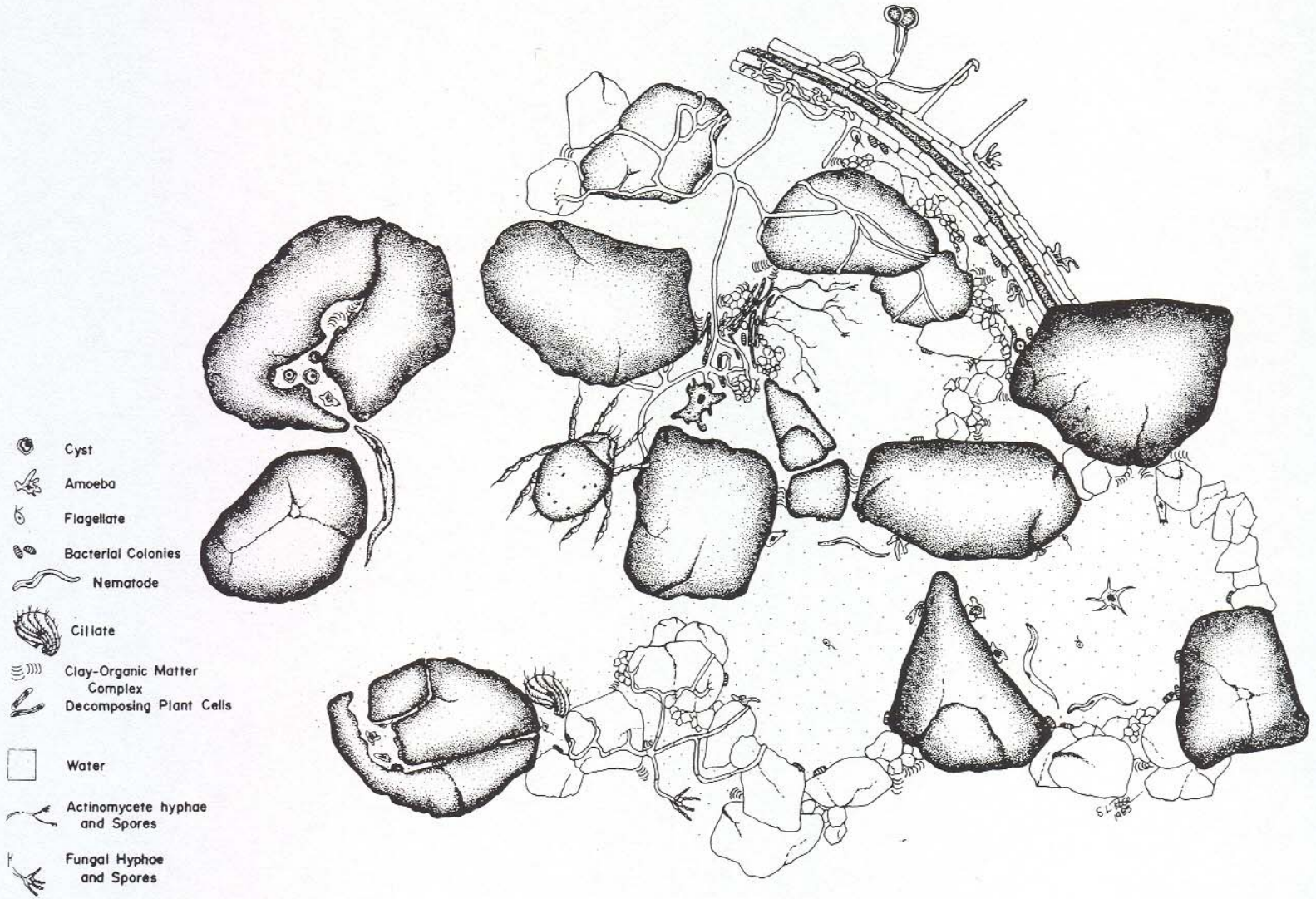
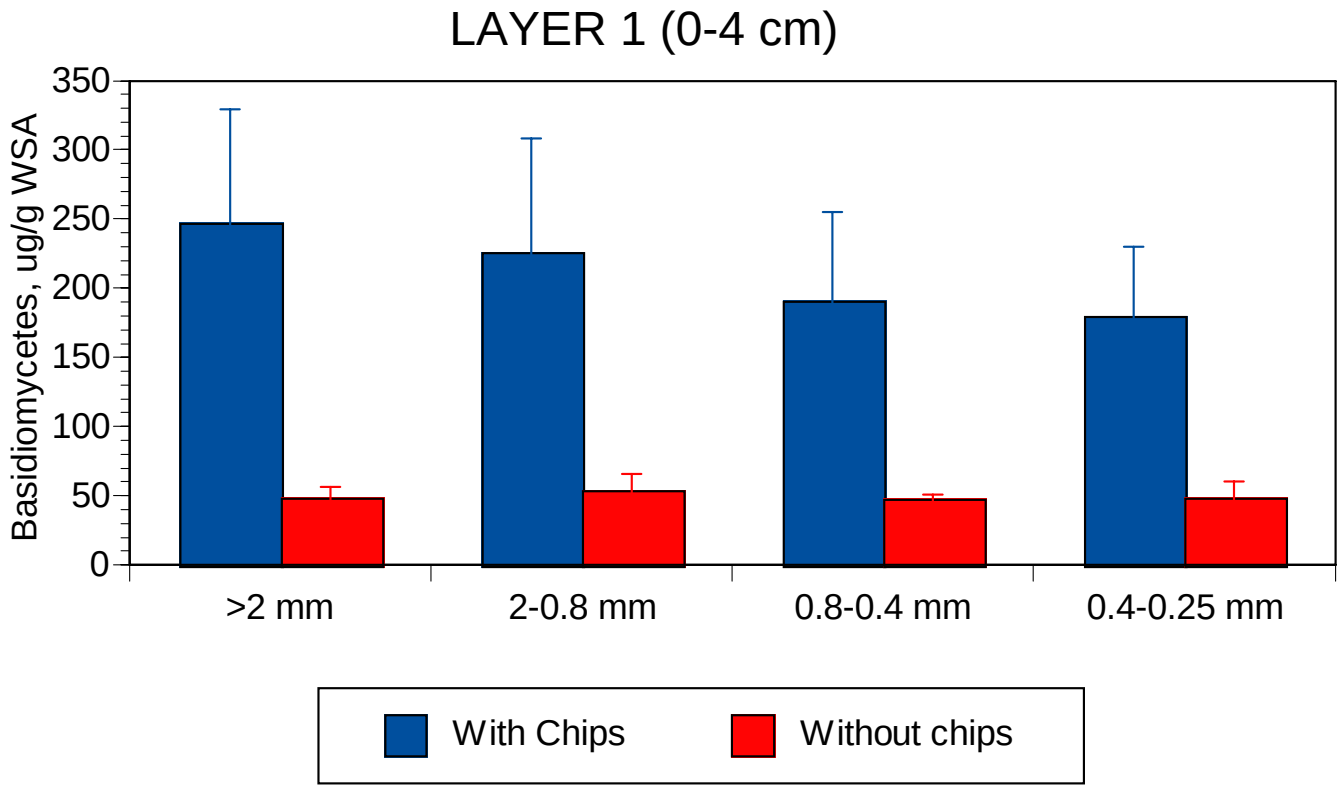


Figure 5.2. Trophic relationships among different groups of soil organisms are controlled by accessibility to their resources. This illustration represents approximately 1 cm^2 of a highly structured microzone in the surface horizon of a grassland soil. Courtesy of S. Rose and T. Elliott, personal communication.)

- wood debris in contact with soil stays moist and is rapidly colonized by fungal mycelium forming soil aggregates.

Experiment on field plots amended or not with wood chips.
Soil aggregating basidiomycete amount in water stable aggregates (WSA) retrieved from the top surface layer



How fast do woodchips or shreddings decompose? Can we speed up the rate of decomposition?

- In 1997 an experiment was initiated to determine how quickly woodchips and shreddings decomposed.
- 300 gram samples of wood chips and shreddings were weighed out. There were 11 replications per treatment.

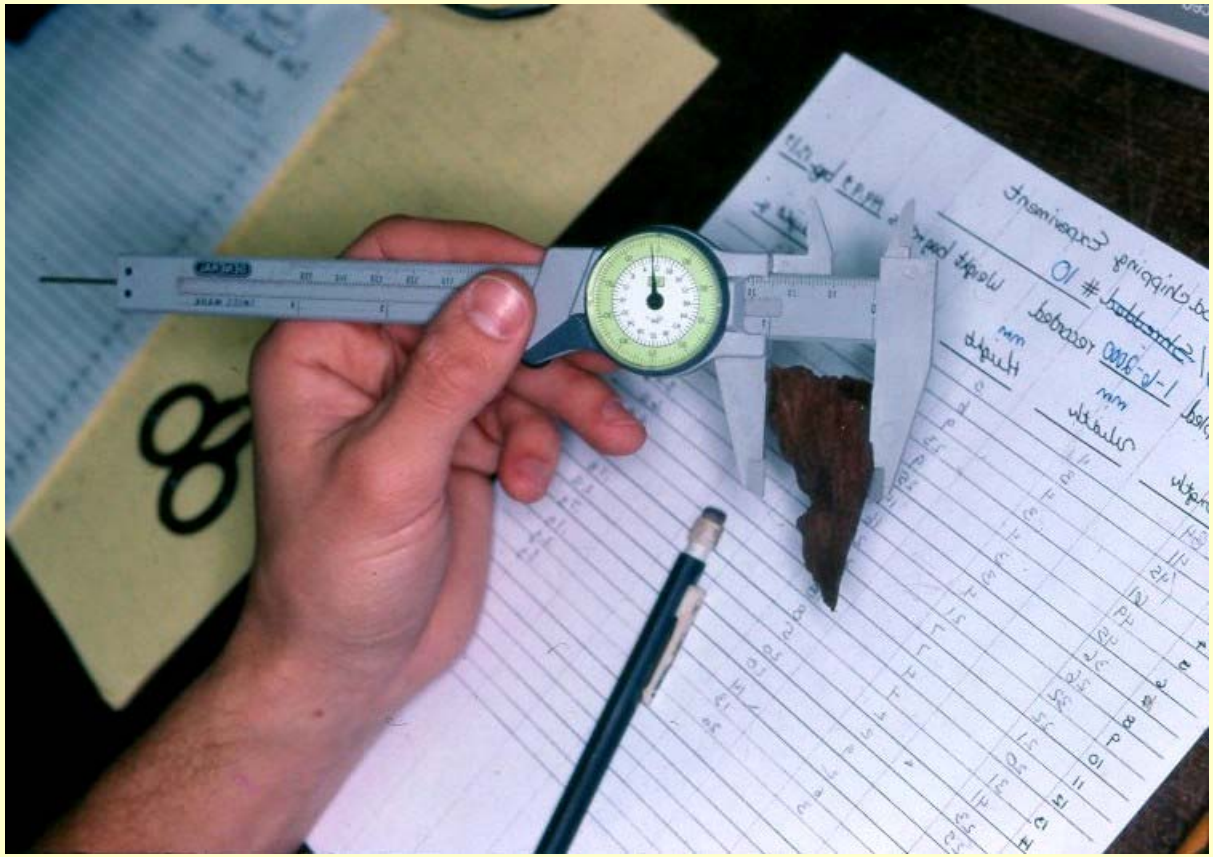
- 300 gram samples of woodchips and shreddings were placed into nylon mesh bags in contact with almond orchard soil.

- The nylon bags containing wood chips and shreddings were placed on the soil surface of an almond orchard

- The bags were sampled periodically. Wood decomposing fungi were often observed producing mushrooms in the nylon bags containing the woodchips and shreddings.

- Fungal mycelium was also observed colonizing and decomposing the wood debris in the nylon bags.

- The soil was washed through a ¼ inch screen. If wood debris passed through the screen it was considered decomposed. The remaining debris was weighed and measured.



- If wood debris did not pass through the screen the 25 largest woodchips or shreddings per bag were measured (length, width, height) to determine area (cubic mm), and individually weighed, then returned to the nylon sacks and soil and placed back on the orchard floor. Size, weight, and rate of decomposition (% reduction in weight) were examined. Over 12,000 individual measurements were made from 1997 to 2005.

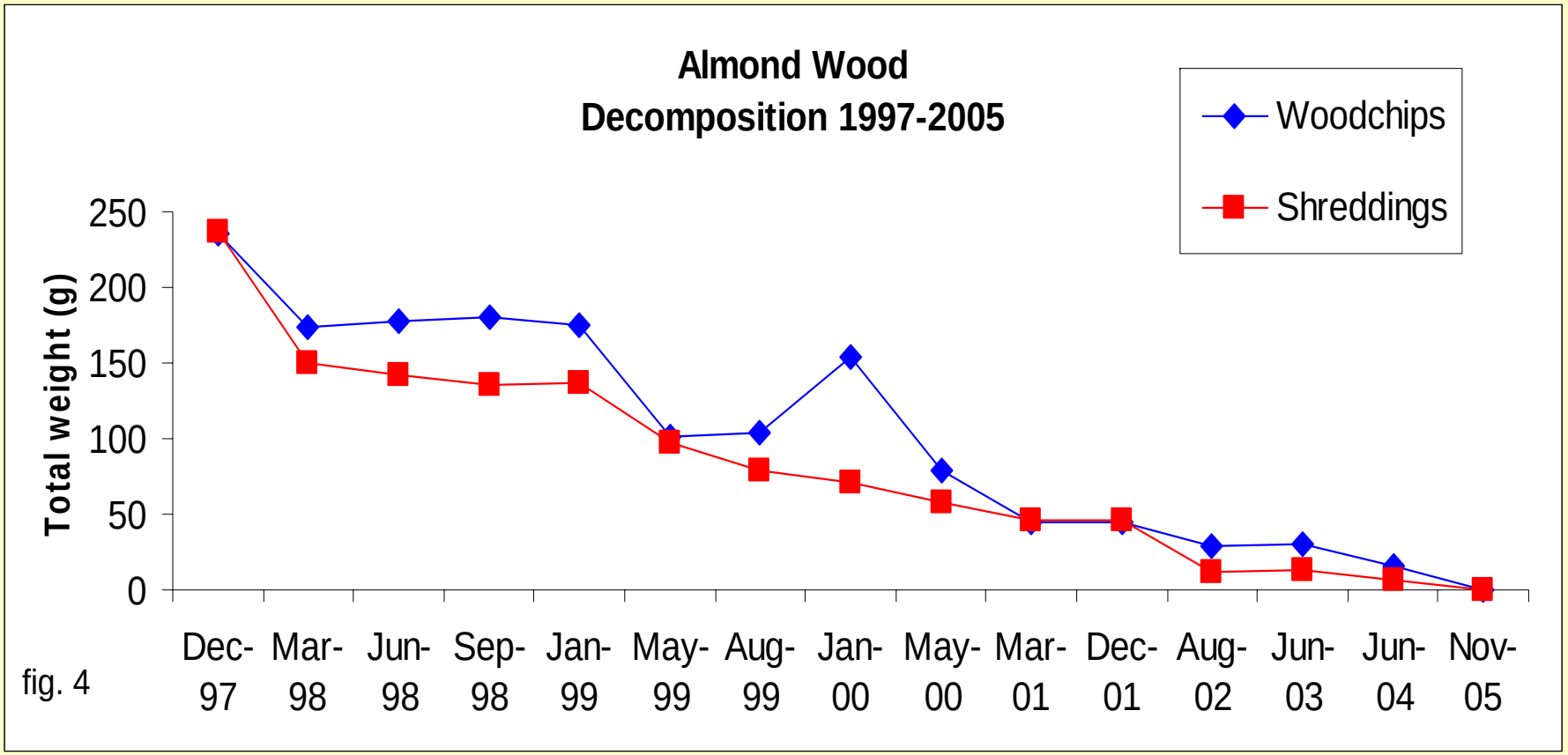


fig. 4

- If woodchips and shreddings did not pass through the screen they were weighed and returned to nylon sacks and the orchard floor. The percent decomposition (% reduction in weight) of the total 300 g sample was determined.

Wood chippers and shredders improved in their ability to produce smaller sizes of chips and cover more acreage without hand labor

Almond farmers lead as environmental stewards

by Christine Souza

To improve air quality, California almond growers are implementing a shredding technique shown above, to dispose of prunings and limit the amount of agricultural burning that takes place in the field. Shredded prunings, at right, are reduced to the size of a quarter.

As California's population continues to escalate and the number of vehicles on the state's roadways reaches an all-time high, concern about air quality increases with more pressure put on farmers and ranchers to make changes in their everyday operations.

Like their counterparts in other commodity groups, the state's almond growers, who produce almost all of the domestic supply in the nation and more than 75 percent of worldwide production, have done their part to improve air quality by reducing the amount of agricultural burning.

"Reducing agricultural burning is something we can work on to improve the air quality in the Central Valley and we are intent on doing that," said Chris Heintz, Almond Board of California director of production research and environmental affairs. "Of course our bottom line is selling almonds, but we have to do it within the framework of agricultural and urban dwellers in the valley. We want to do our part. It is about making this a better place to live. It is about being sensitive to our environment."

The almond sector has set air quality as a top priority and is looking at research projects that lead to viable alternatives for disposal of orchard prunings, other than burning. Since the 1980s, the Almond Board has funded various projects related to brush utilization.

"Our board several years ago designated the environ-

"The time will come when we won't be able to open-field burn brush anymore. A lot of growers have seen the writing on the wall and it is amazing as to how many are opting to have guys come in and shred now, even when they could burn if they wanted to," Holtz said. "I think a lot of the growers have always felt that it was a waste to put on water and fertilizer and then take all of the prunings and burn them. With the shredding technique, I think there is a feeling that not only are you not polluting the air, you are also putting fertilizer back into the ground."

Until now, growers have been reluctant to consider this technique an alternative to burning due to the cost of the equipment necessary to chip the prunings. They also found that the early chippers left pieces of wood in the orchard that were too large, resulting in slow decomposition and interference with pickup of nuts at harvest. However, with strict air pollution control standards on the horizon for the Central Valley and more efficient equipment now available, more growers are willing to chip or shred rather than burn. Growers are also pleased to discover the benefits of incorporating the organic matter into the soil.

Madera County Farm Bureau member Larry Lowder, of Andrews Farms, a multi-generational family farm in Madera, worked with Holtz and hired Joe DiAnna to break down and remove several thousand acres

is more cost involved
t we got out of it. I think
ther alternative," Lowder
urn days that we need to
are of, so I don't see any

to wood chipping, grow-

CONTINUED ON PAGE 26

Photos/Christine Souza

Almond grower Larry Lowder, top, implemented the shredding technique on several thousand acres at his orchard in Madera. Brent Holtz, University of California Cooperative Extension farm advisor in Madera County, above, researched the chipping and shredding of almond orchard prunings.

- Jack Rabbit wood chipper


FLORY
2004 11 10


2004 11 10

2003 Orchard Experiment

			2003 wood chipping experiment, Larry Lowder													
C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C
C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C
C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C
C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C
C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C	NP	M	NP	C
					NP= Nonpareil											
					C= carmel											
					M= Monterey											
					brush and wood chips											
					no brush and no wood chips											
			The Nonpareil rows will be the center rows of the two treatments													
			In the no brush NP rows, brush will be thrown into the adjacent M and C rows.													
			In the brush and wood chips NP rows, brush will be added from the no brush rows													

An average of 1,247 and 502 pounds per acre of wet weight prunings were pruned in the orchard trial in 2003 and 2004, respectively. Larry Lowder (Andrews Farms) considered this a light pruning.

- After the nuts had been shaken to the ground at harvest, dried, and wind rowed, the amount of wood debris were determined per 22 feet of wind-row by hand sorting and weighing.

Sticks at the Processor?

- The wood chipped or shredded treatments had significantly more wood debris in 22 feet of wind-row than the non wood chipped treatments in both 2004 and 2005 harvests

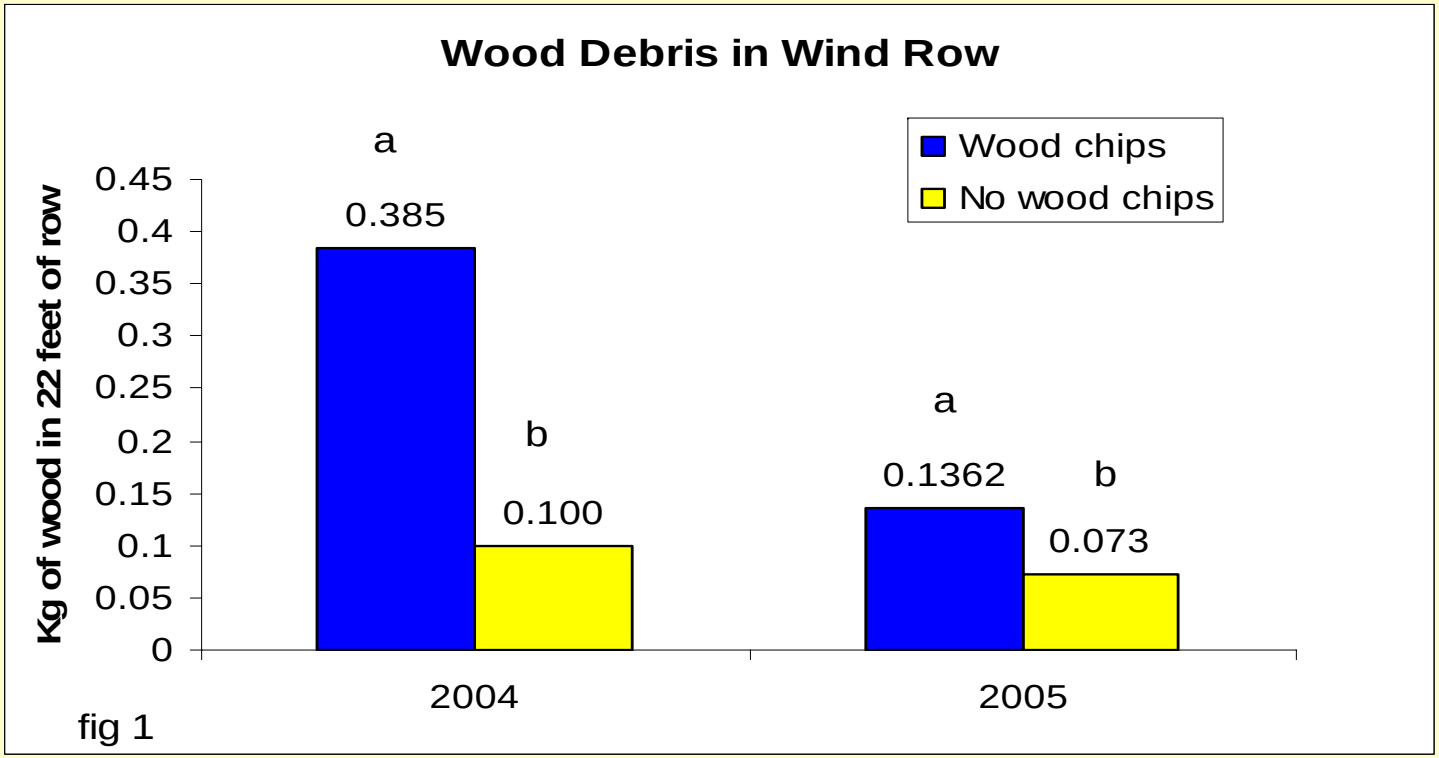
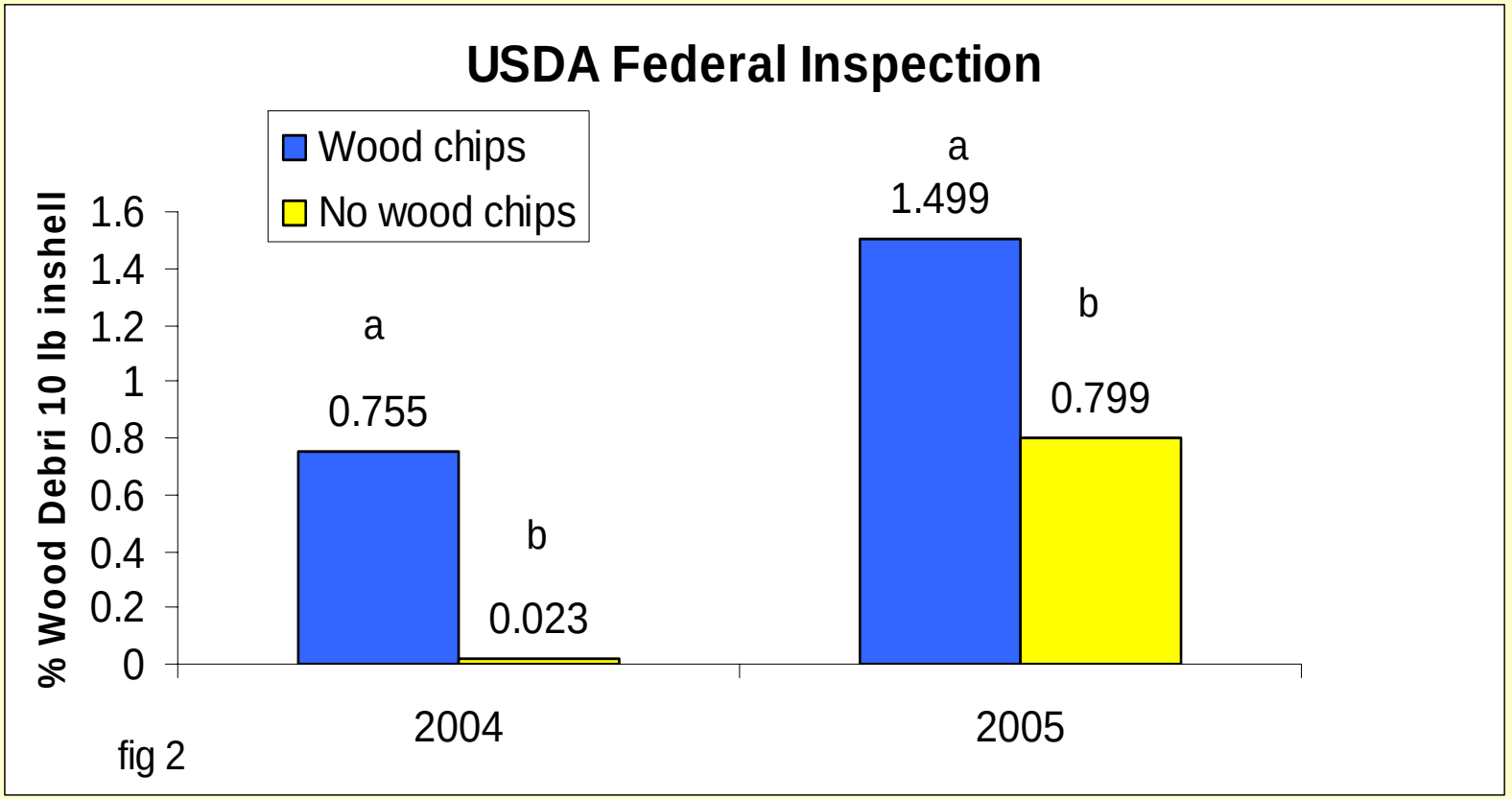


fig 1

USDA analysis for wood debris



- Ten pound bulk inshell almond samples taken from harvest carts from wood chipped treatments had significantly more wood debris when compared to samples from non wood chipped treatments in both 2004 and 2005

- I have advised many growers that after heavy pruning and shredding, that they till or disk the orchard floor to enhance soil contact.

- If wood debris is in contact with soil it stays moist and is rapidly colonized by fungal mycelium that incorporates woody material into soil aggregates, holding debris in the orchard during harvest.

	2003	2003	2004	2004	2006	2006	2007	2007
	Wood chips	No-chips	Wood chips	No-chips	Wood chips	No-chips	Wood chips	No-chips
pH	6.53	6.80	6.80	7.03	6.97	7.13	6.87	7.37
EC dS/m	0.69	0.52	0.57	0.41	0.67	0.33	0.67	0.41
CEC meq/100g	7.03	4.05	10.75	4.77	8.98	3.93	14.27	4.23
N (Total) %	0.15	0.04	0.12	0.05	0.08	0.04	0.15	0.04
NH4-N ppm	3.40	1.90	5.07	3.43	3.95	2.25	14.55	2.12
N03-N ppm	1.35	0.70	2.47	0.50	2.45	1.10	0.83	1.02
Bray P ppm	21.27	19.97	35.03	25.40	24.20	22.48	18.65	11.77
X-K meq/100g	0.13	0.10	0.20	0.15	0.16	0.12	0.35	0.15
X-K ppm	56.17	47.83	79.17	55.50	62.83	45.67	136.67	58.17
TKN %	0.08	0.03	0.09	0.04	0.09	0.04	0.18	0.04
Zn (DPTA) ppm	9.55	4.62	10.73	4.37	20.07	10.07	20.43	11.15
Zn (Total) ppm	38.67	31.33	52.67	37.17	49.00	40.50	52.67	43.00
Ca (SP) meq/L	4.20	2.78	3.75	2.27	4.67	1.85	3.93	2.13
X-Ca meq/100g	4.02	1.97	5.33	2.28	5.62	2.52	7.26	2.70
Mg (SP) meq/L	2.78	1.93	2.42	1.55	3.00	1.25	2.45	1.57
X-Mg meq/100g	1.28	0.77	1.62	0.86	1.70	0.90	1.98	0.91
Na (SP) meq/L	1.67	1.12	0.82	0.60	0.95	0.58	0.88	0.68
X-Na meq/100g	0.10	0.10	0.06	0.04	0.07	0.04	0.08	0.04
X-Na ppm	21.83	11.83	14.50	8.17	16.00	9.33	18.67	9.17
Cl (SP) meq/L	1.40	0.90	1.22	0.83	1.22	0.67	1.52	1.03
B (SP) mg/L	0.12	0.10	0.22	0.15	0.13	0.10	0.13	0.10
Mn (DTPA) ppm	21.58	29.48	13.97	12.37	33.08	25.82	29.87	21.88
Mn (Total) ppm	129.17	141.00	146.50	135.50	136.67	130.50	134.67	137.17
Fe (DTPA) ppm	74.08	84.43	17.75	8.70	100.78	60.72	44.88	44.03
Fe (Total) ppm	5203.33	4840.00	6038.33	5311.67	6605.00	6306.67	6290.00	6250.00
Cu (DTPA) ppm	5.07	3.07	5.20	2.35	5.80	2.75	7.18	2.40
Cu (Total) ppm	17.00	11.67	61.83	20.33	18.17	11.50	25.00	11.67
C (Total) %	1.98	0.48	1.70	0.42	1.39	0.45	2.98	0.44
OM %	1.67	0.58	2.72	0.64	2.35	0.69	4.84	0.92
C-Org %	0.97	0.34	1.58	0.37	1.36	0.40	2.81	0.53
Sand %	92.25	92.40	89.25	90.50	87.00	89.00	88.33	89.33
Silt %	6.75	5.80	6.00	5.00	9.50	7.17	9.00	6.83
Clay %	1.00	1.80	4.75	4.50	3.50	3.83	2.67	3.83
CaCO3 %	1.02	0.93	0.20	0.20	0.32	0.28	0.22	0.20
HCO3 (SP) meq/L	3.45	2.80	3.62	2.10	3.33	1.55	3.80	3.30
5 ATM %	5.10	2.18	7.44	3.00	6.17	2.60	12.08	3.12
SP %	36.6	25	36.60	25.00	38.60	30.00	50.60	27.40

Wood chipped almond orchards:

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

- I would like to see whole orchards and vineyards incorporated back into the soil from where they were growing and not burned or removed and burned in a co-generation plant!

- Redwood forest nutrition comes from decomposing logs (carbon)
- These logs or stored carbon represent the productivity of a forest ecosystem over thousands of years.

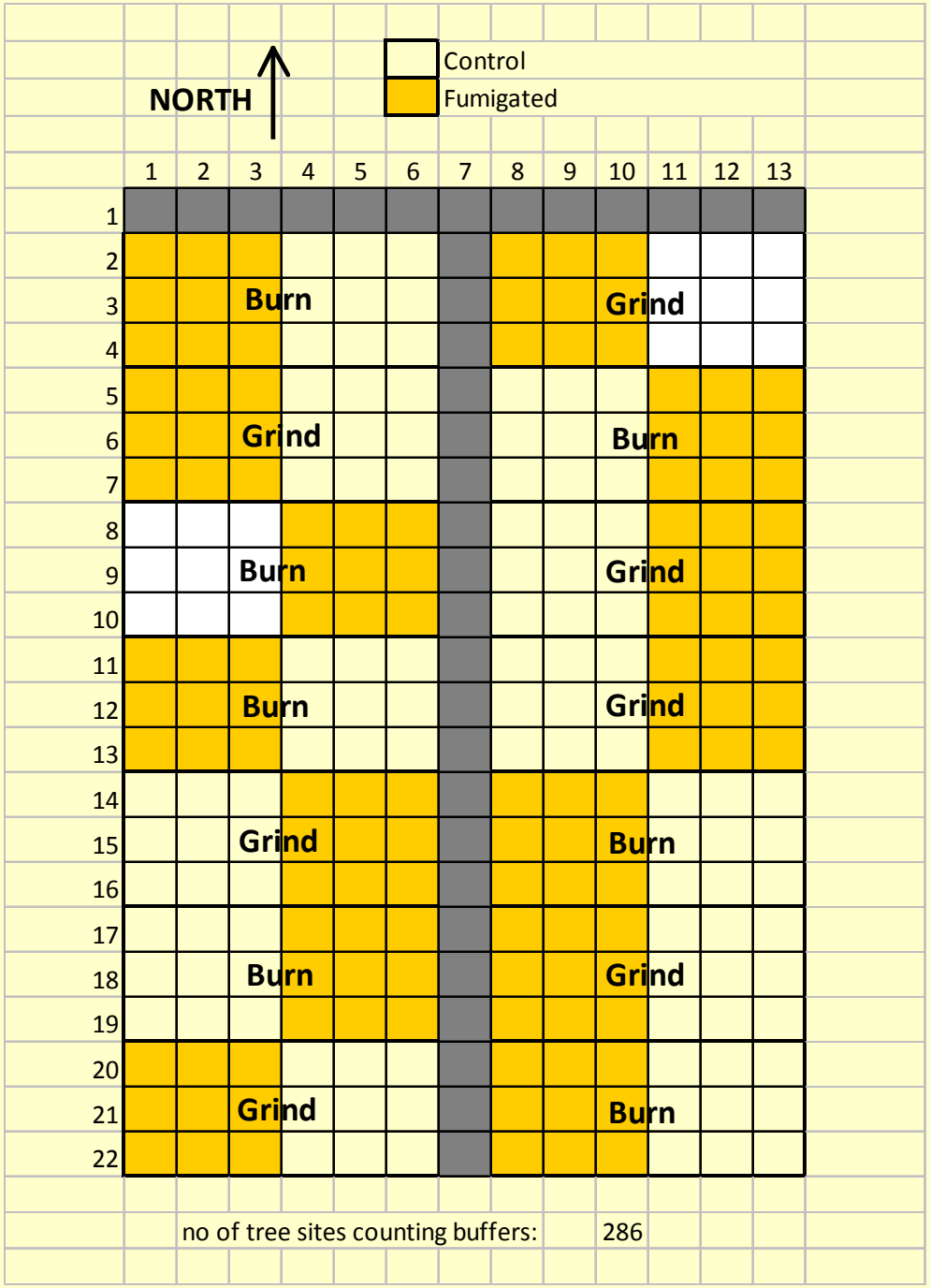
- When we remove an orchard we grind up 30 years worth of photosynthesis and carbon accumulation and we haul it out of the orchard to burn in co-generation plants. 30 years of organic matter is lost from our system, estimated at 30 tons per acre for almond.

- Can we return this organic matter to our orchard soils?


The Iron Wolf

The Iron Wolf


The Iron Wolf


NORTH
Control
Fumigated
1 2 3 4 5 6 7 8 9 10 11 12 13
1
2
3
4
5
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7
8
9
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11
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20
21
22
Burn
Grind
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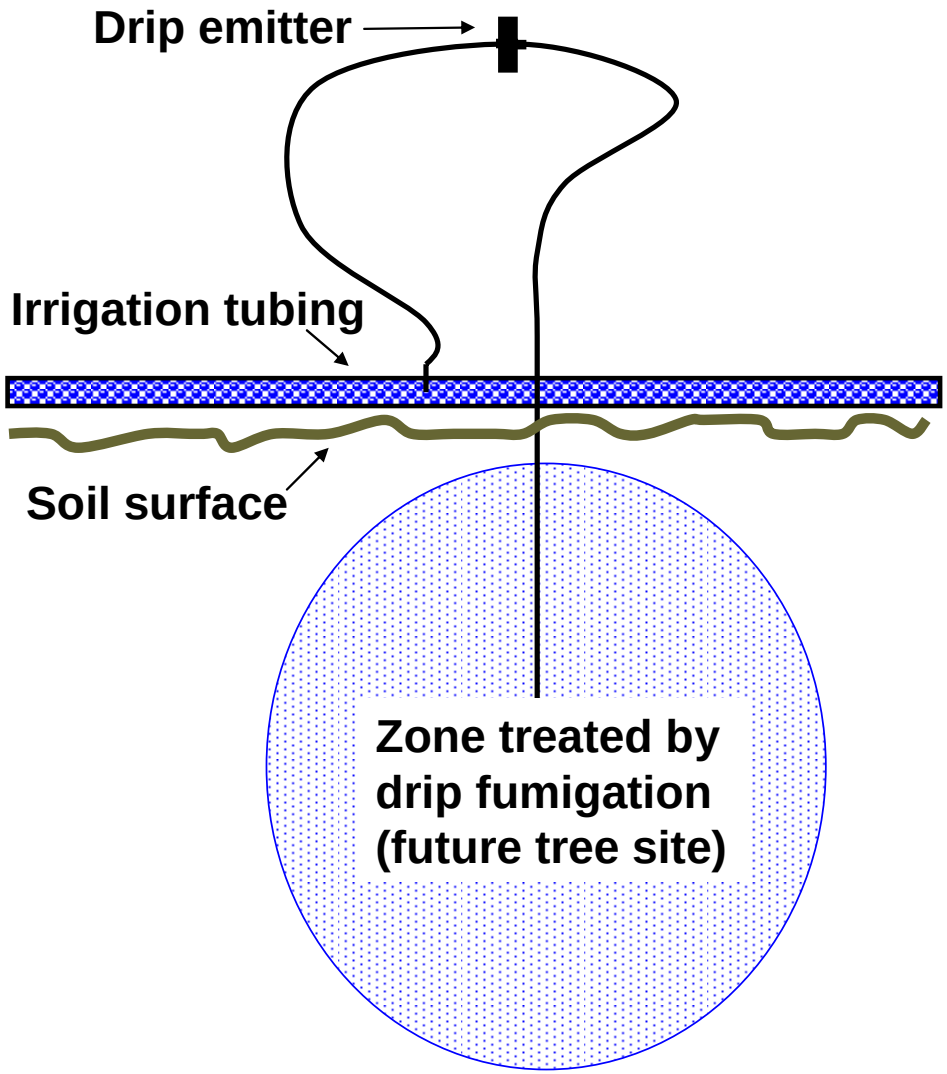
Burn
Grind
no of tree sites counting buffers:
286

Drip spot fumigation

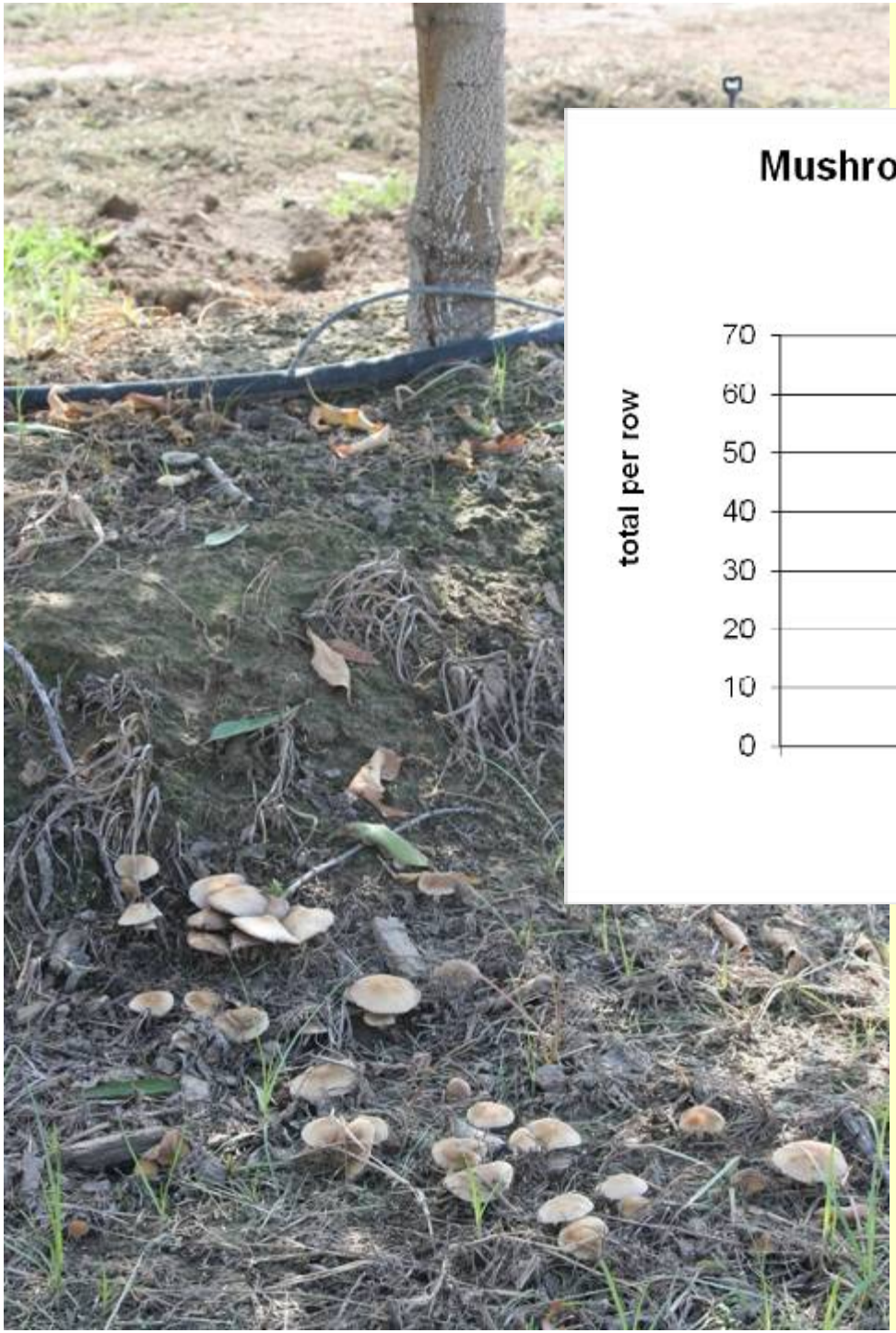


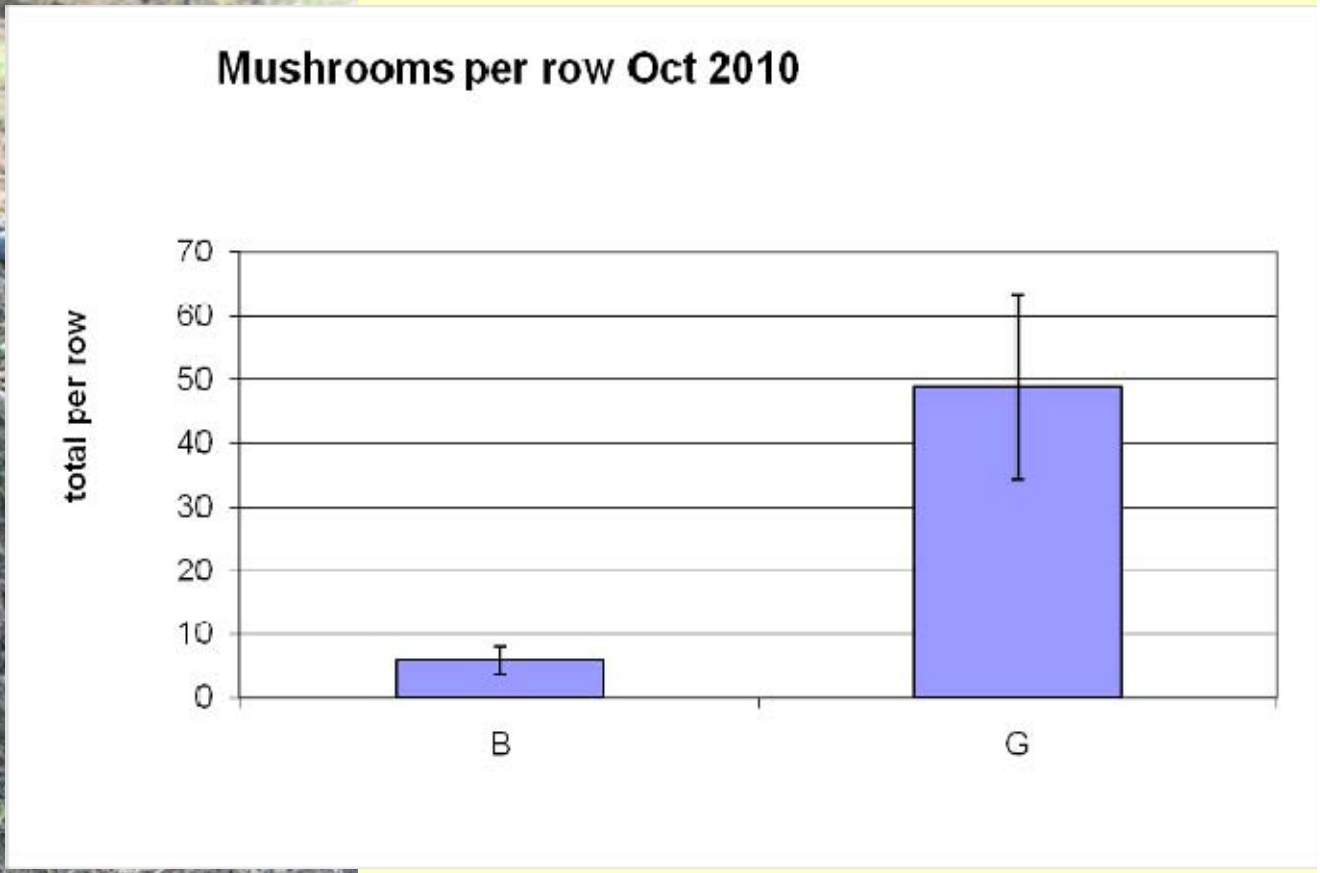
2007: 1 gph, 22” depth, 7.5 h, 0.2 lb Inline per tree site

Drip spot fumigation

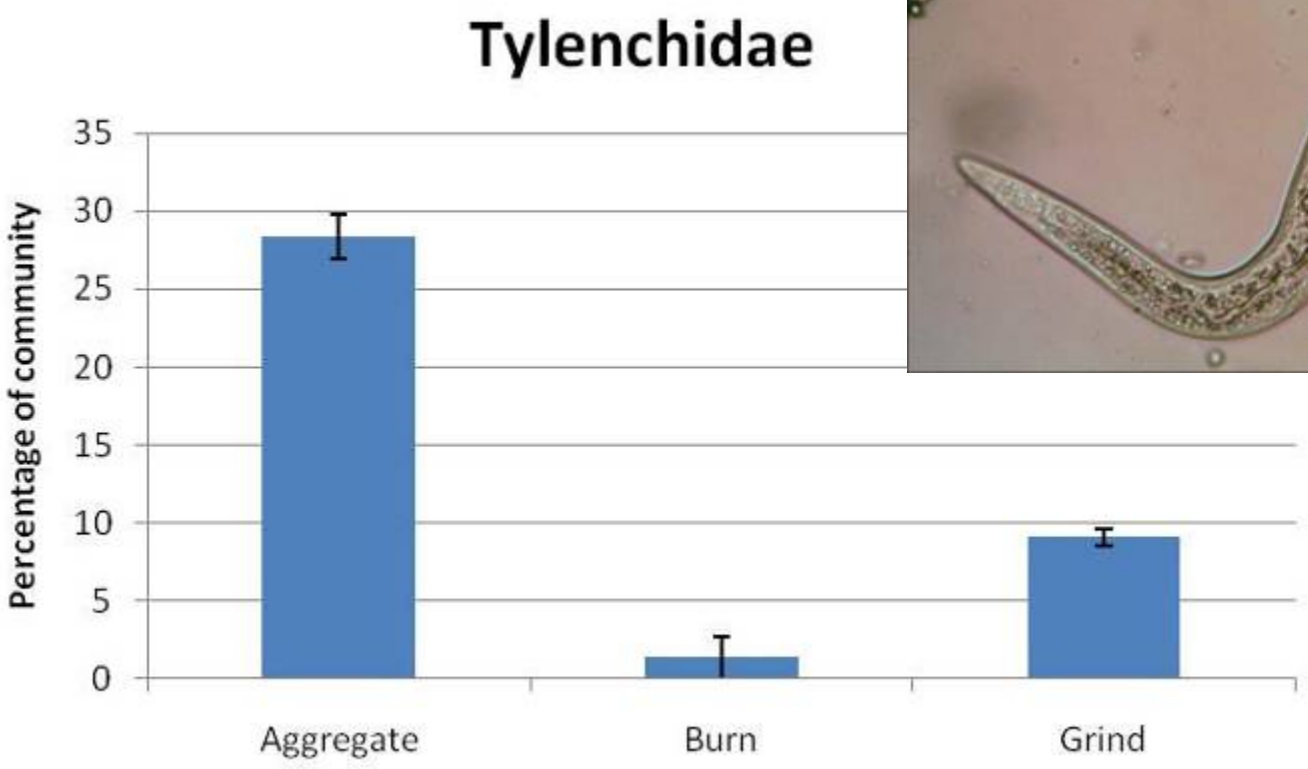
2009 First leaf trees growing in grinding plot

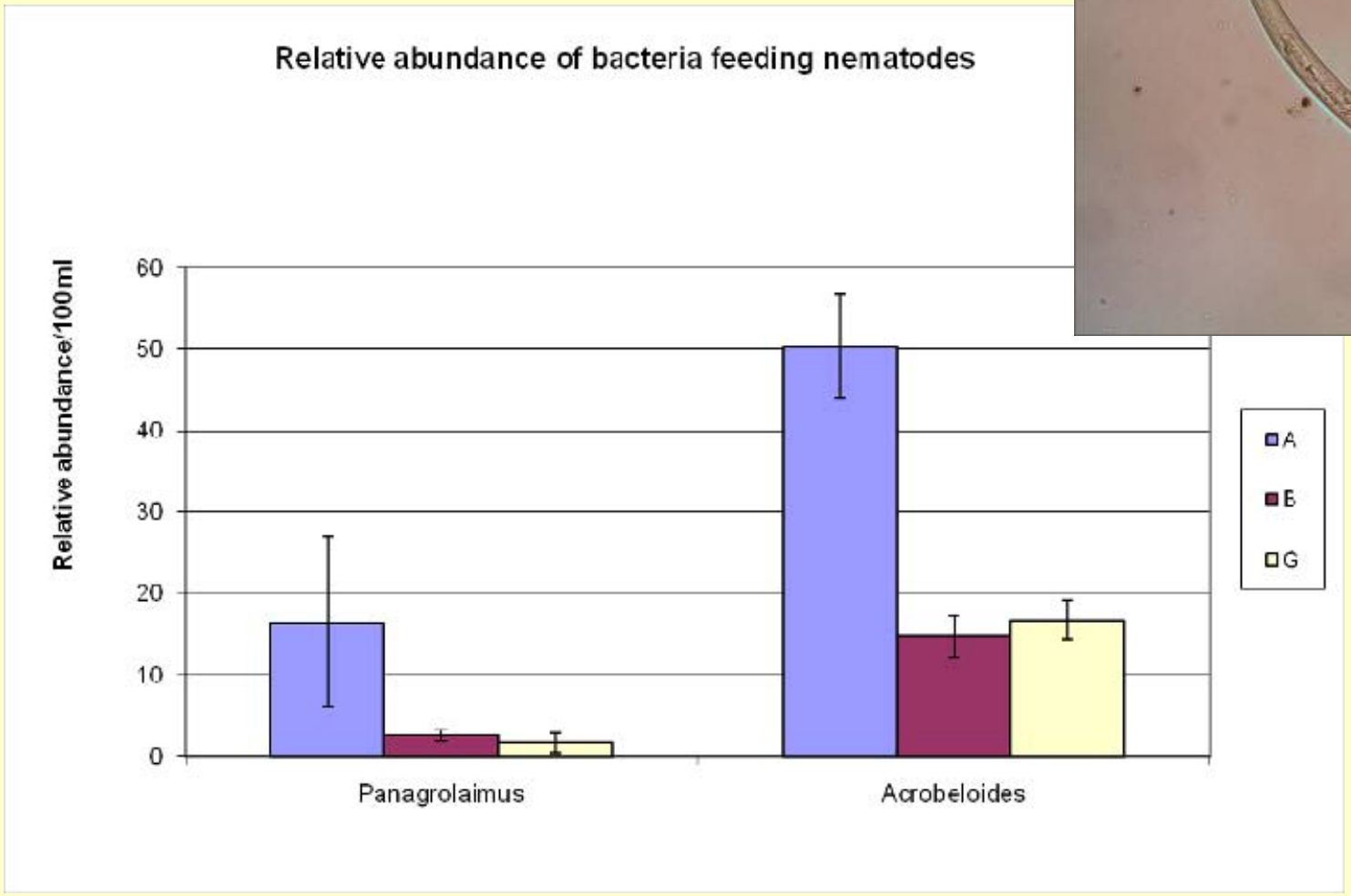
2010 Second leaf trees growing in grinding plot




Mushrooms per row Oct 2010
total per row
70
60
50
40
30
20
10
0
B
G

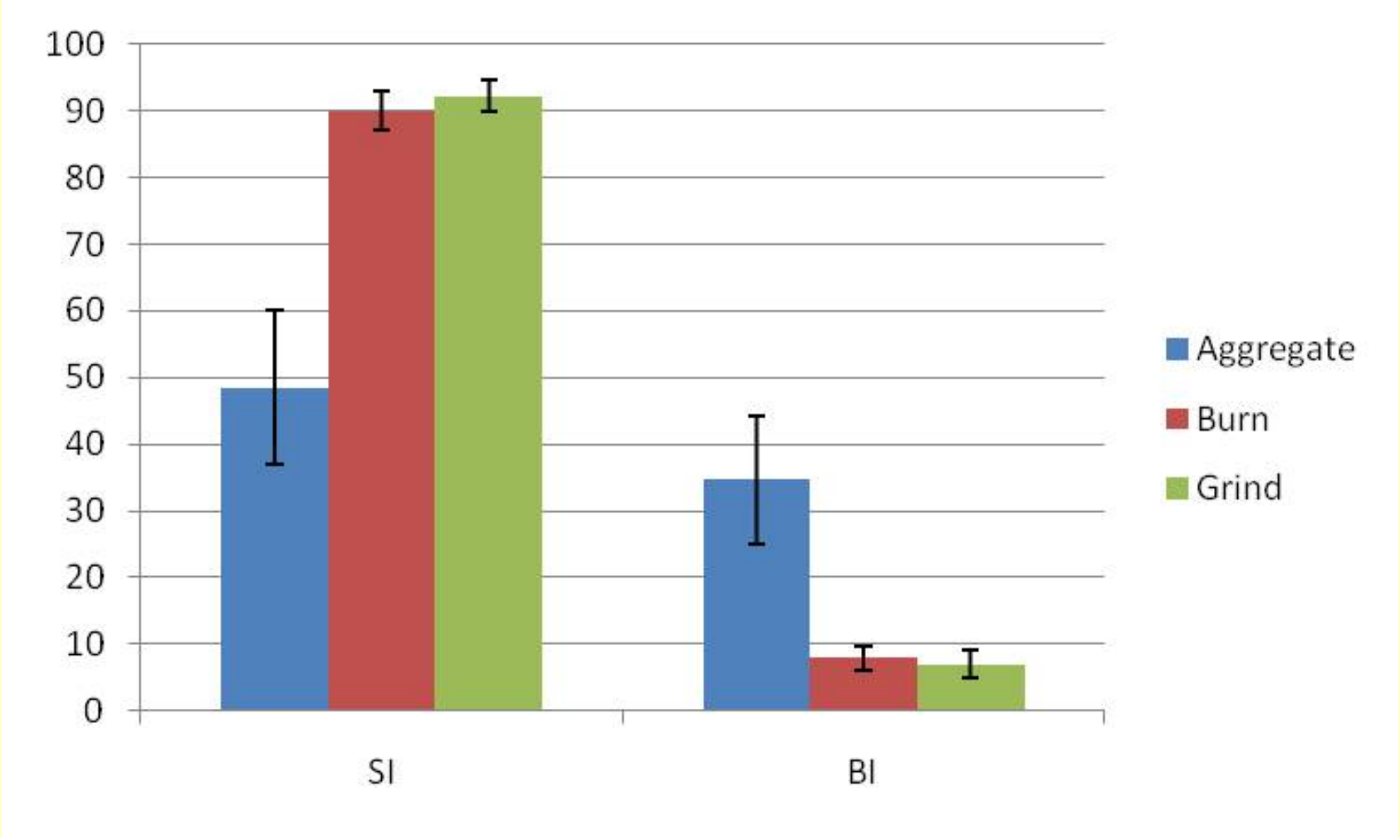
Nematode species of the family Tylenchidae feed on algae and fungi and are not parasitic. Significantly greater Tylenchidae were observed in the grind plots, especially next to woody pieces (aggregates).



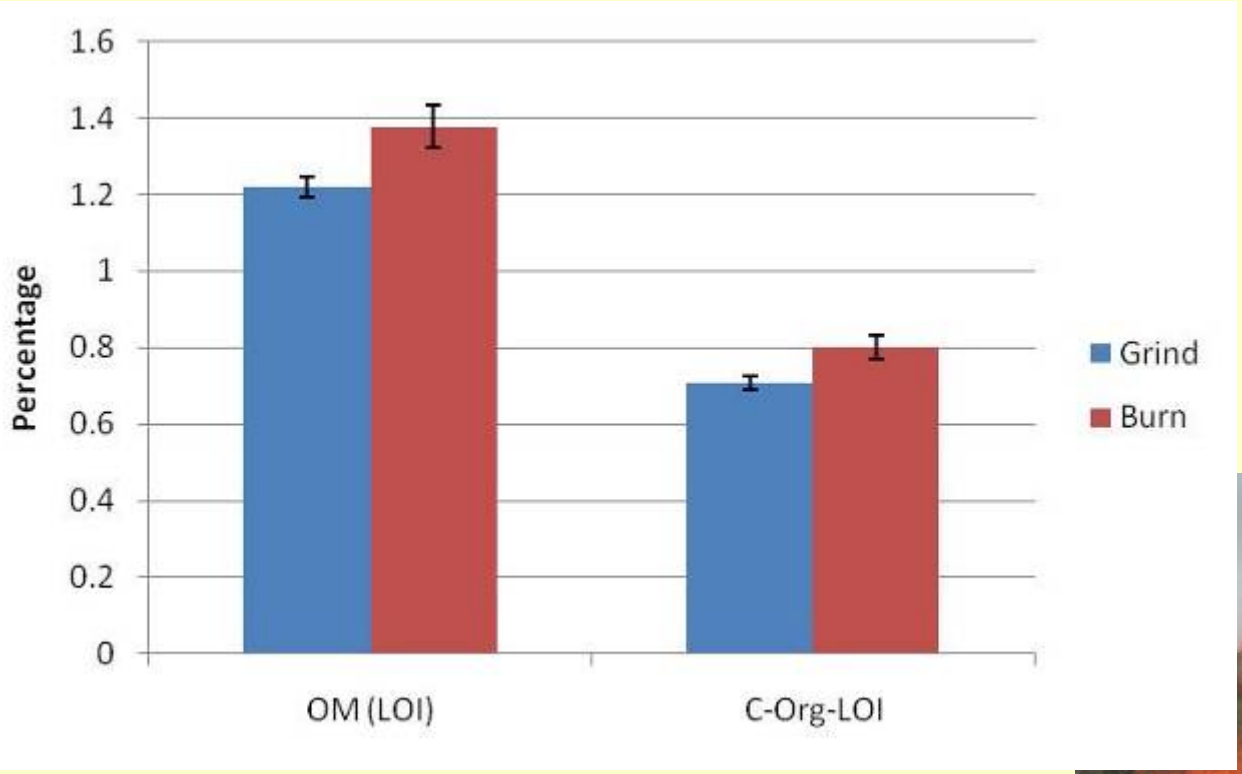


Panagrolaimus and Acrobeloides are bacterial feeding nematodes (not parasitic), and their populations were significantly greater on soil aggregates (wood).

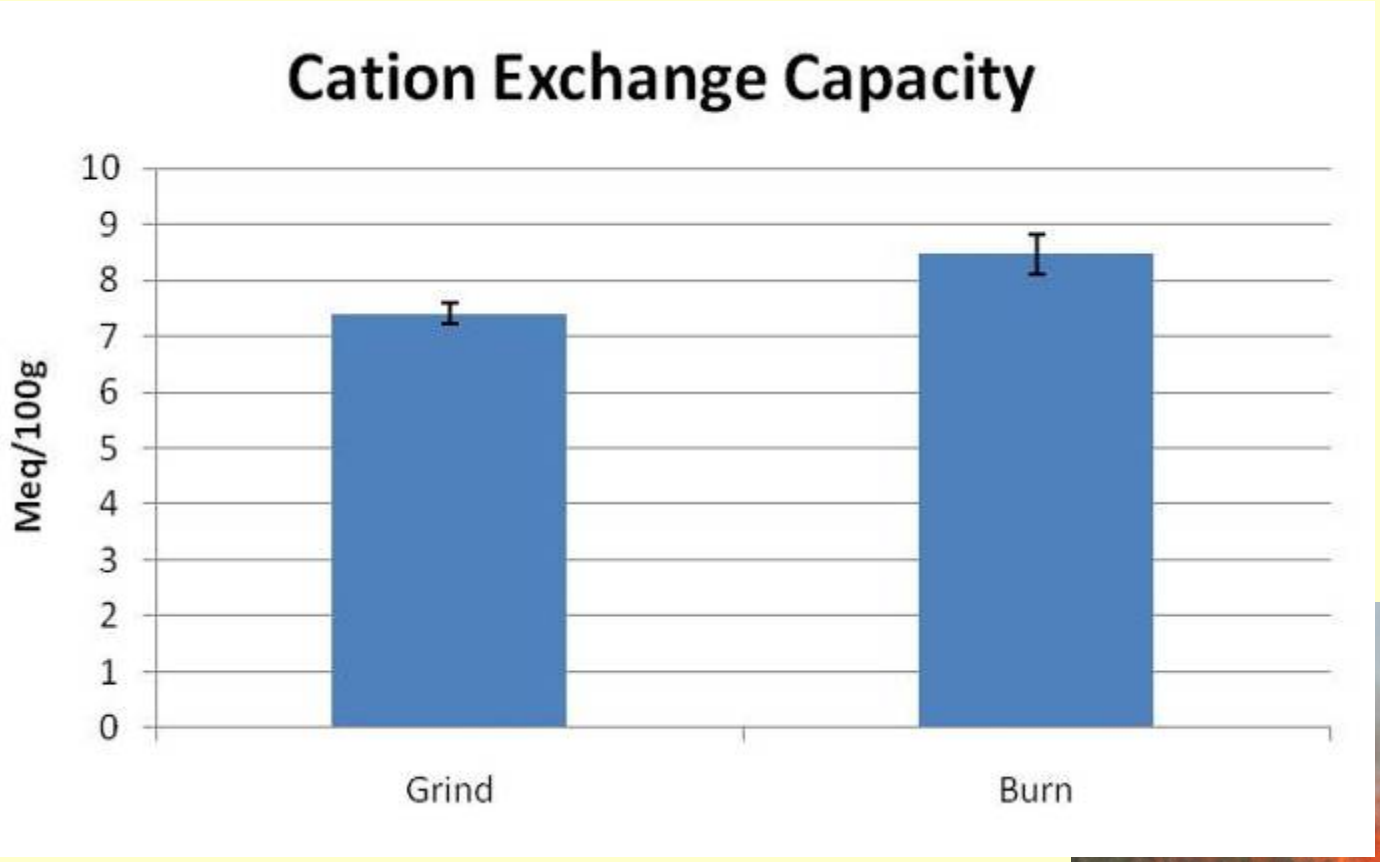
Aggregates had less complex food webs (low SI values) and more microbial feeding opportunistic nematodes (high BI values). This indicates that the aggregate's resources are being assimilated and colonized by nematodes.



In July 2010, Burn treatments had significantly more organic matter (OM) and carbon (C) in the top 5 inches of soil.



In July 2010, the cation exchange capacity was significantly greater in the burn treatment



Burning appears to release nutrients back into the orchard soil more rapidly than decomposition.


FOLIAR PRIDE

I believe orchard recycling will:

- Increase organic matter
- Increase soil carbon, nutrients
- Increase water holding capacity
- Increase soil microbial diversity
- Increase orchard productivity
- Bind pesticides and fertilizers

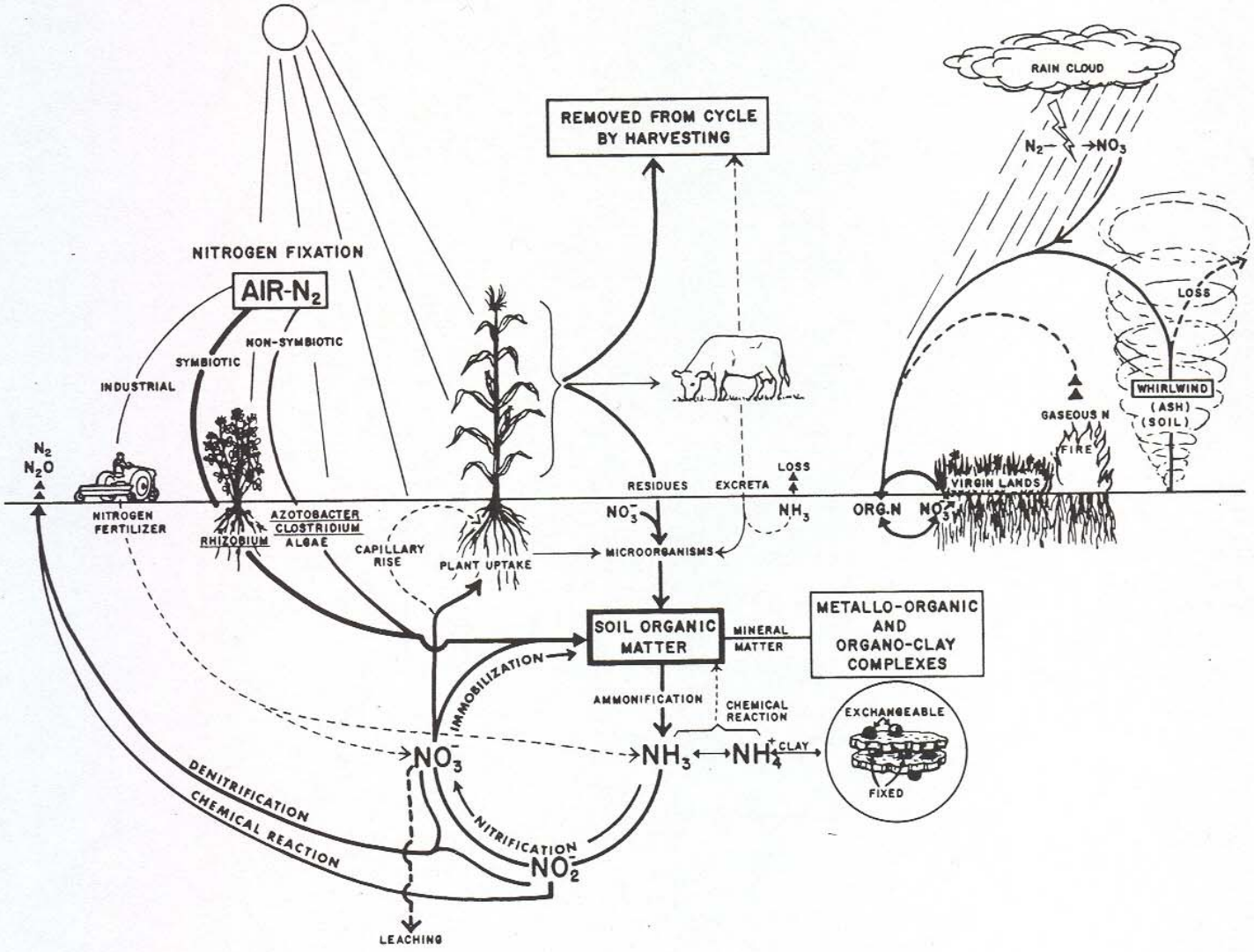
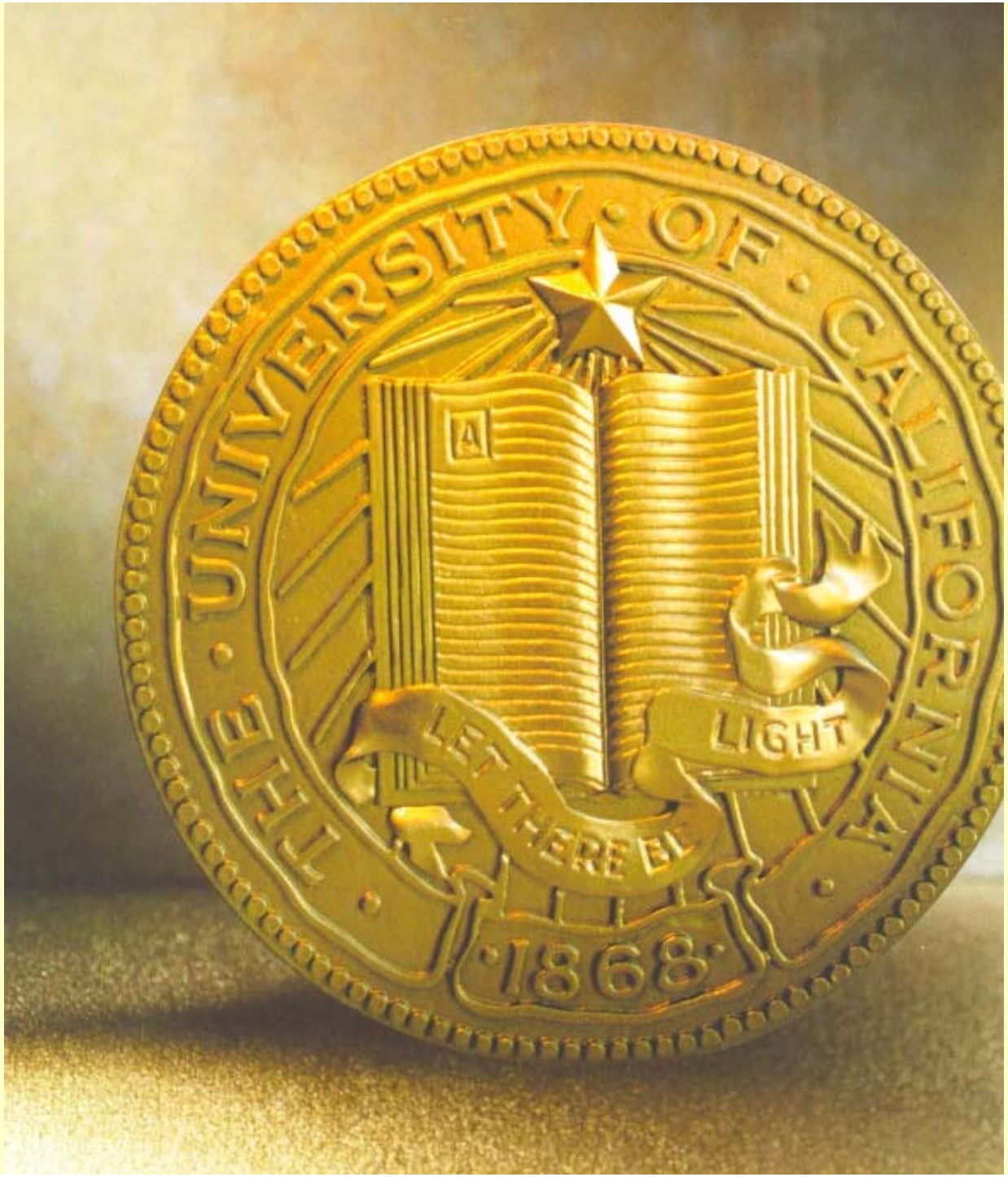


Figure 8.1. Nitrogen cycle in soil. (From Stevenson, 1982.)

Future Directions with the first whole tree grinding trial

- Pesticide binding
- Nitrogen binding
- Economic analysis of grinding
- Carbon sequestration
- Carbon budget and marketing



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