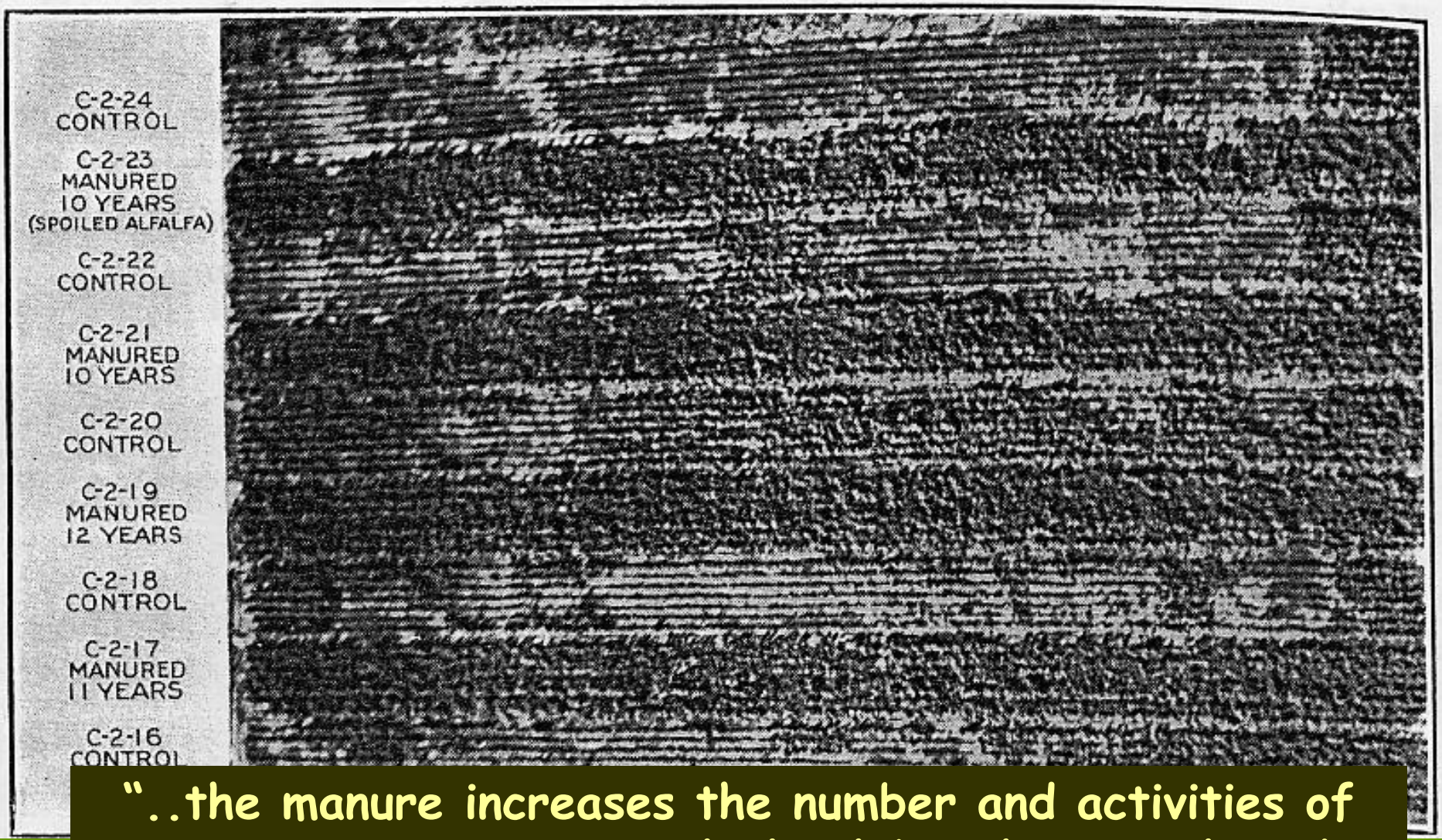
Organic Matter-Mediated General Suppression

Alex Stone, Dept. of Horticulture

OREGON STATE
University

King et al, 1934

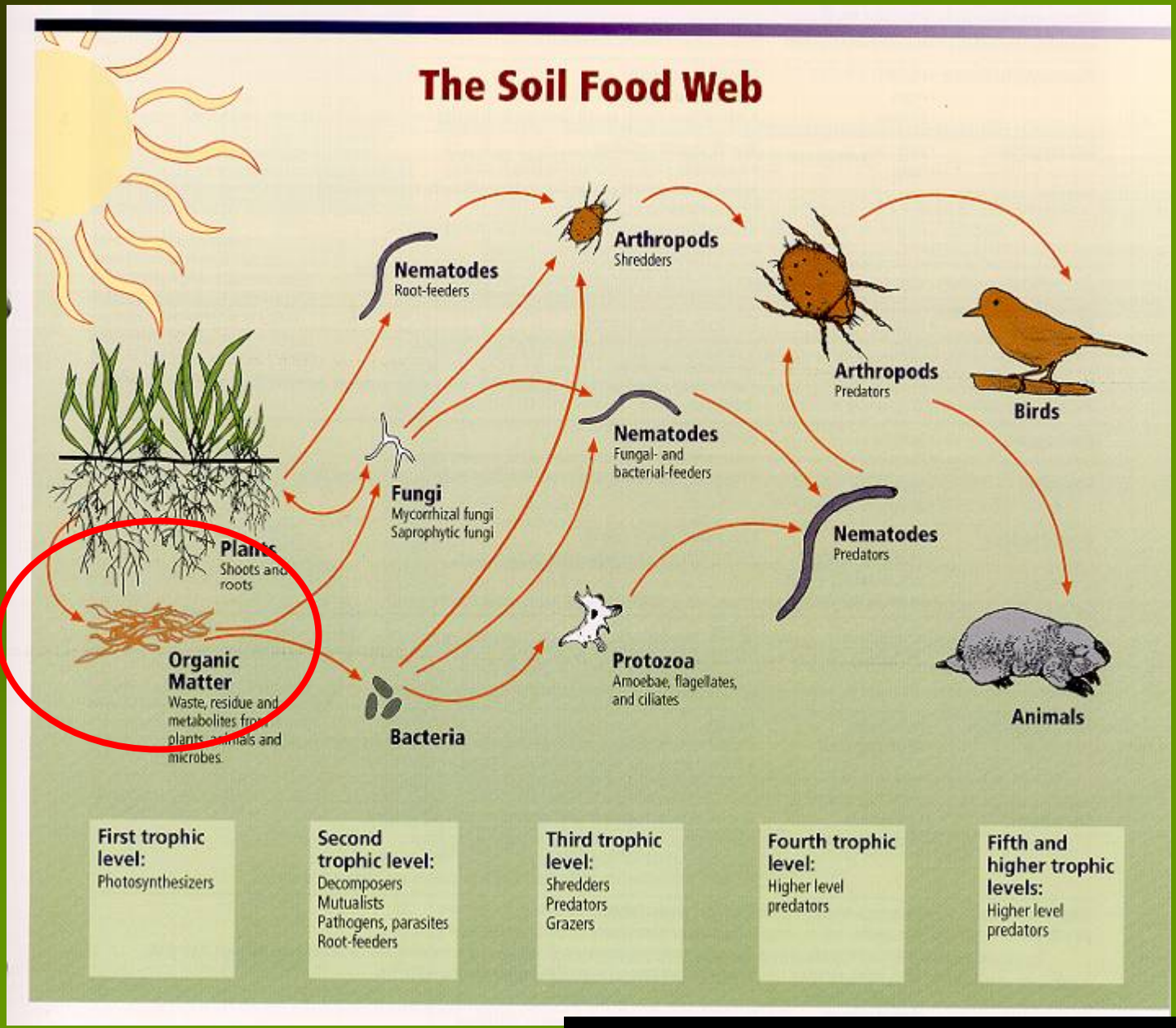


"..the manure increases the number and activities of competitive organisms which inhibit the growth and development of the root rot fungus."

OM-Mediated General Suppression

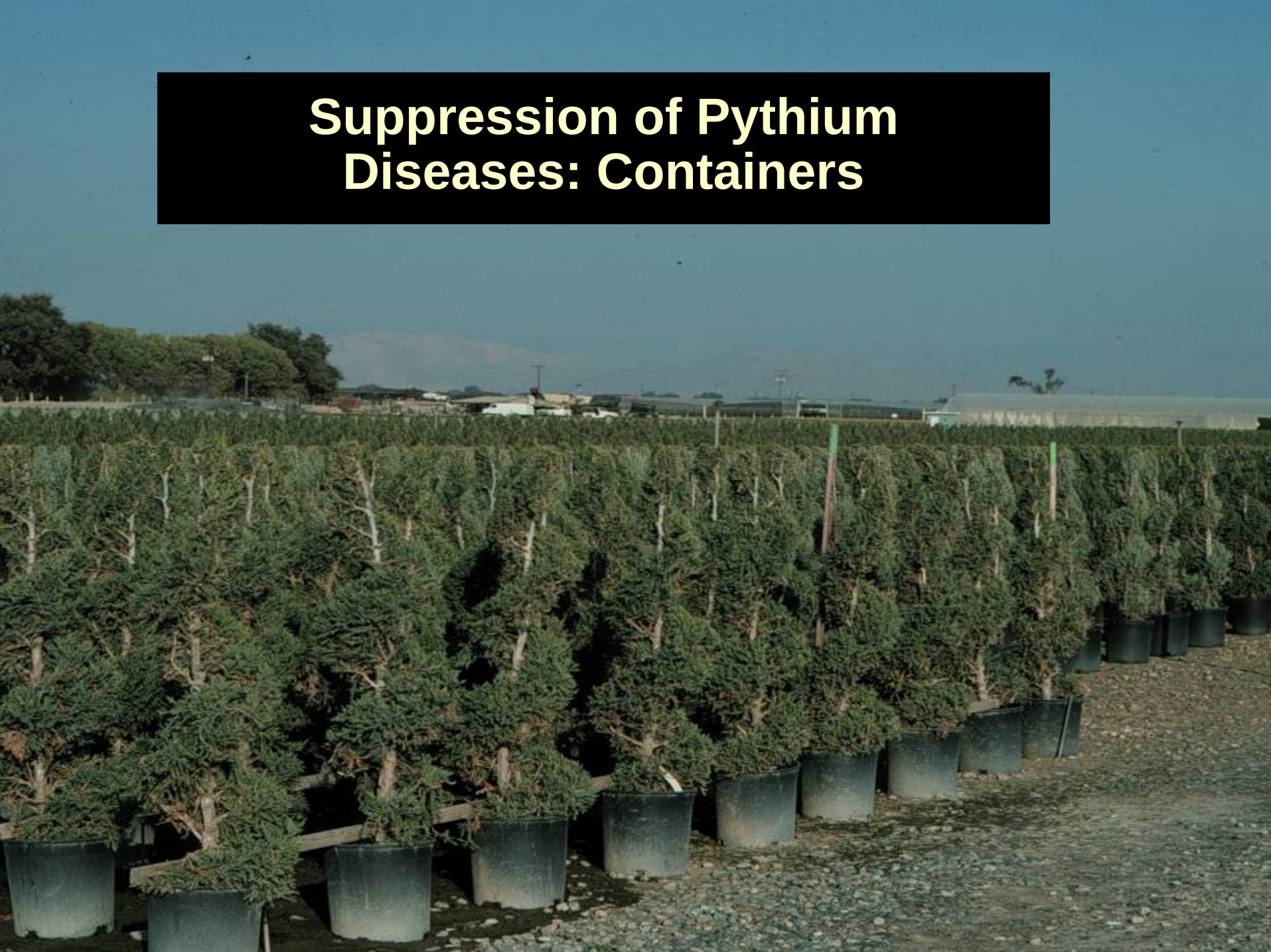
- ✓ is generated by many types of OM
- ✓ is generated immediately after high rate amendment
- ✓ is of fairly short duration
- ✓ is positively related to microbial (FDA) activity

Stone et al, 2004



from the USDA Soil Biology Primer

Suppression of Pythium Diseases: Containers



BIOLOGICAL CARRYING CAPACITY*

Relative to the biocontrol of Pythium root rot;
based on grower observations and laboratory measurements

Hardwood bark compost	2-3 yr
Sawdust-bedded cow manure compost	1 yr
Pine bark compost	6-12 mo
Light peat (H2 - H3 on the von Post decomposition scale)	2-10 mo
Dark peat (H4)	0-1 wk

*sensu Boehm et al, 1993

Peat System: Proportion of Culturable Community Engaged in Biocontrol

Boehm et al, 1997

- Suppressive peat: 10% of culturable species with activity against Pythium DO
- Conducive peat: <1%
- Composted hardwood bark - 25%

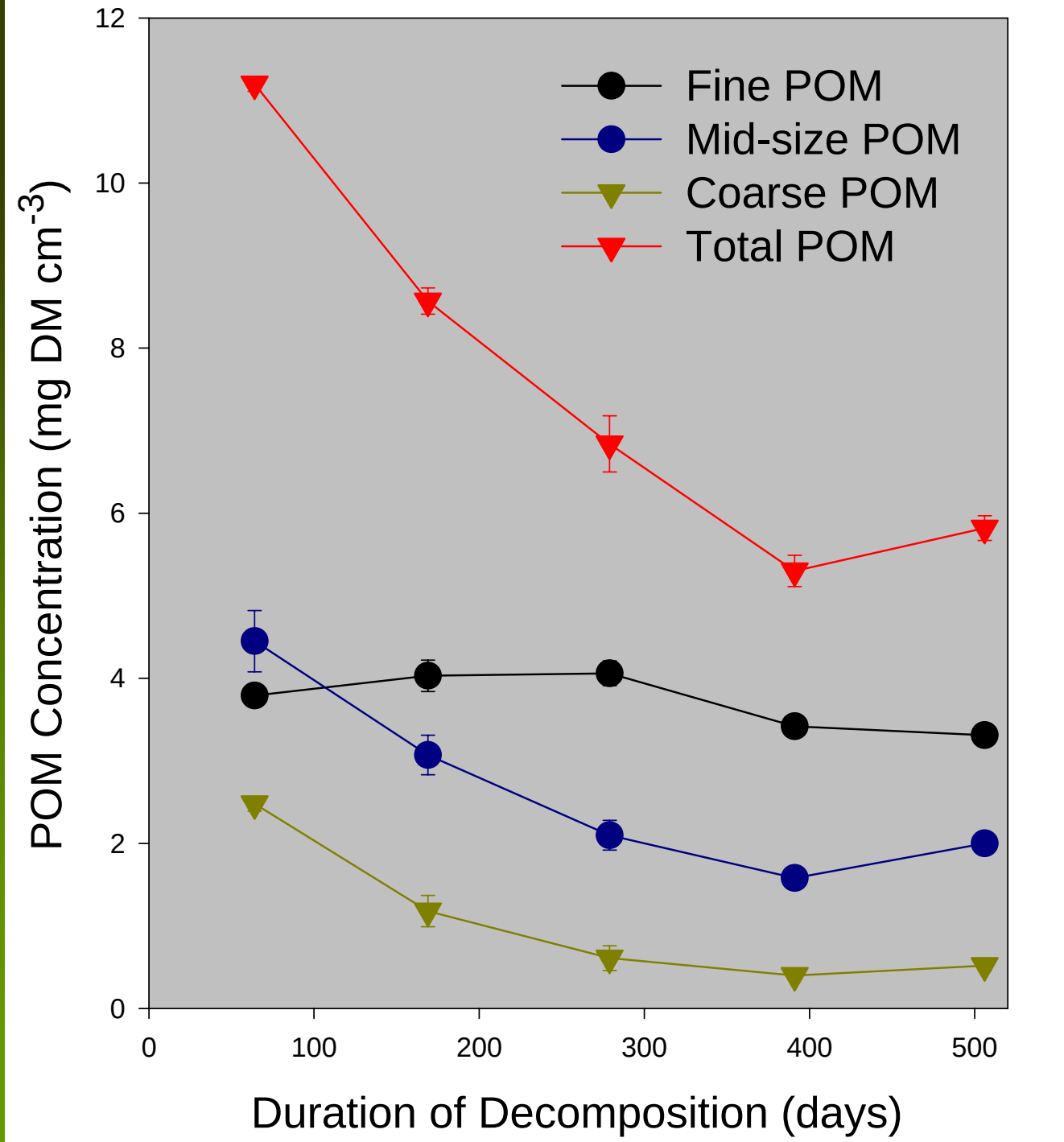
Suppression of Pythium DO in a Sawdust-Bedded Dairy Manure Compost

Compost System

Trends in suppressiveness to Pythium root rot of cucumber in a compost- and a peat-amended mix.

	Time after potting (days)				
	15	186	274	375	426
Compost	1.4[2,a]	1.4[a]	1.0[a]	1.5[a]	2.4[b]
Peat	2.4[b]	2.2[b]	3.8[d]	3.1[c]	2.5[bc]

$LSD_{0.05}$= 0.70


Fine POM
Mid-size POM
Coarse POM
Total POM
POM Concentration (mg DM cm-3)
Duration of Decomposition (days)
0
2
4
6
8
10
12
0
100
200
300
400
500

Compost Composition by ^{13}C CP-MAS NMR Spectroscopy: Relationship to Lit. Values

	160-200 ppm **carbonyl/ carboxyl**	110-160 ppm **aromatic**	45-110 ppm **O-alkyl**	10-45 ppm **alkyl**	as determined by proportion of 160-200 and 45-110 ppm spectral areas
compost day 4	**4**[1]	12	**70**	12	
compost LF day 83	**7**	**20**	**55**	**18**	**suppressive**
compost LF day 391	**7**	**20**	**54**	**19**	**suppressive**
compost LF day 506	**10**	23	**51**	16 ??	conducive
total soil LF[3]	**6-12**	16-28	**39-57**	16-26	**suppressive**/conducive?
free soil LF[2]	**5-7**	14-18	**55-63**	**18-25**	**suppressive?**
occluded soil LF[2]	**7-11**	15-20	**33-45**	28-45	conducive?
L horizon (forest soil)[4]	**5-8**	14-23	**54-58**	16-22	**suppressive?**
Of horizon (forest soil)[4]	**5-11**	15-22	**39-55**	23-28	**borderline?**
Oh horizon (forest soil)[4]	**7-11**	13-23	**44-48**	23-34	conducive?
Aeh horizon (forest soil)[4]	**7-11**	9-25	**39-42**	25-42	conducive?

[2]from Golchin et al, 1994; [3] from Baldock et al, 1992; [4] from Hempfling et al,1987 and Kögel-Knabner et al, 1988; forest soil horizons

Poinsettias are Nice, but Real Farmers Grow Snap Beans

Vegetable Rotation
potato/snap bean/cucumber

Hancock Amended-Sand Field Trial: Suppression of Diseases caused by *Pythium* spp.

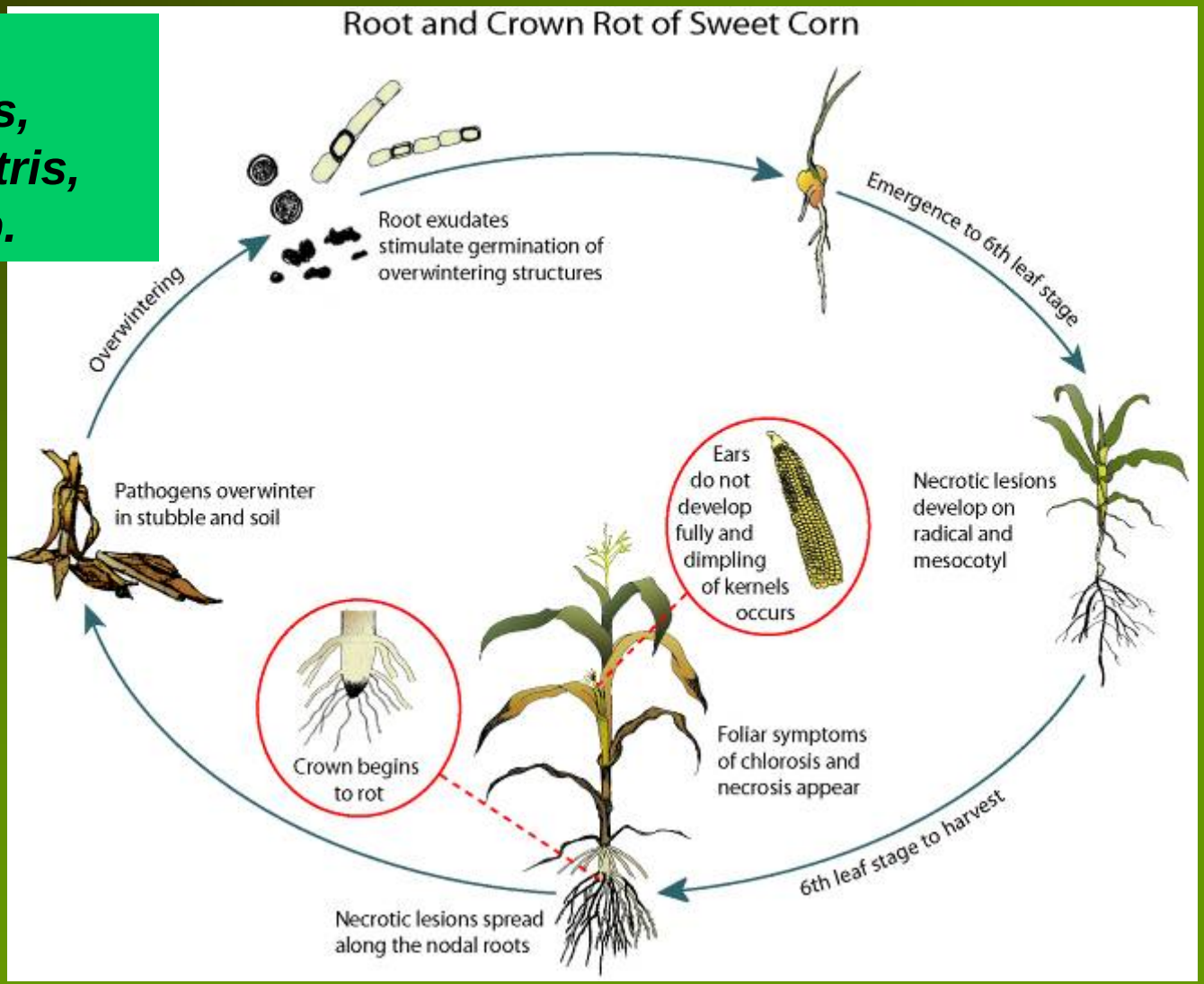
Treatment	Potato (98)	Cucumber (99)	Snap Bean (99)
	Pythium Leak Incidence	Pythium Damping-off index	Aerial Pythium Incidence
PS L	6.3 a	1.9 b	3.0 b
PS H	5.1 b[1]	1.4 b	1.7 b
PSC L	10.3 a	1.6 b	1.5 b
PSC H	4.8 b[1]	1.8 b	1.7 b
PSB L	4.1 b[1]	1.7 b	1.9 b
PSB H	8.7 a	1.7 b	1.7 b
Control	13.1 a	3.1 a	15.0 a
LSD (P=0.05)	9.7	0.7	6.6


Raw and composted paper mill residual amended field soils, Wisconsin
Common root rot of snap bean (*Aphanomyces euteiches* and *Pythium* spp).
Control
PMR-amended

Root rot of sweet corn

A Complex of Soilborne Microorganisms Causes Root Rot

Pythium arrhenomanes, Phoma terrestris, Drechslera sp.

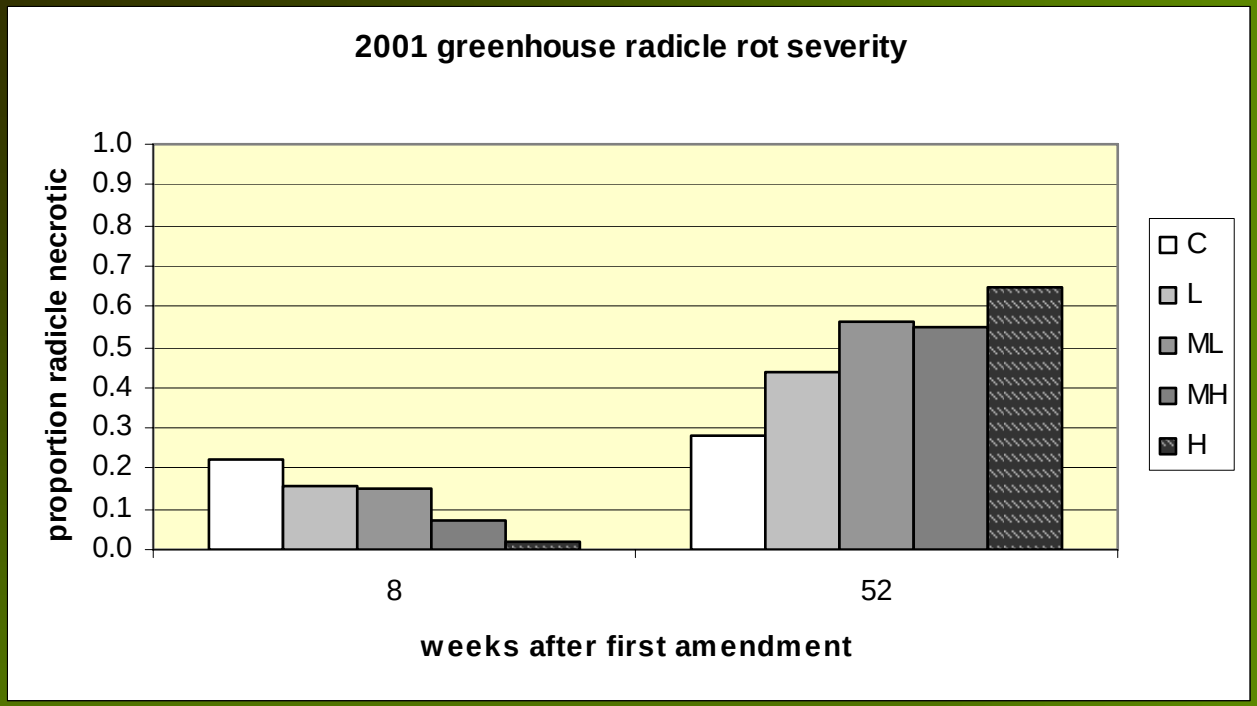


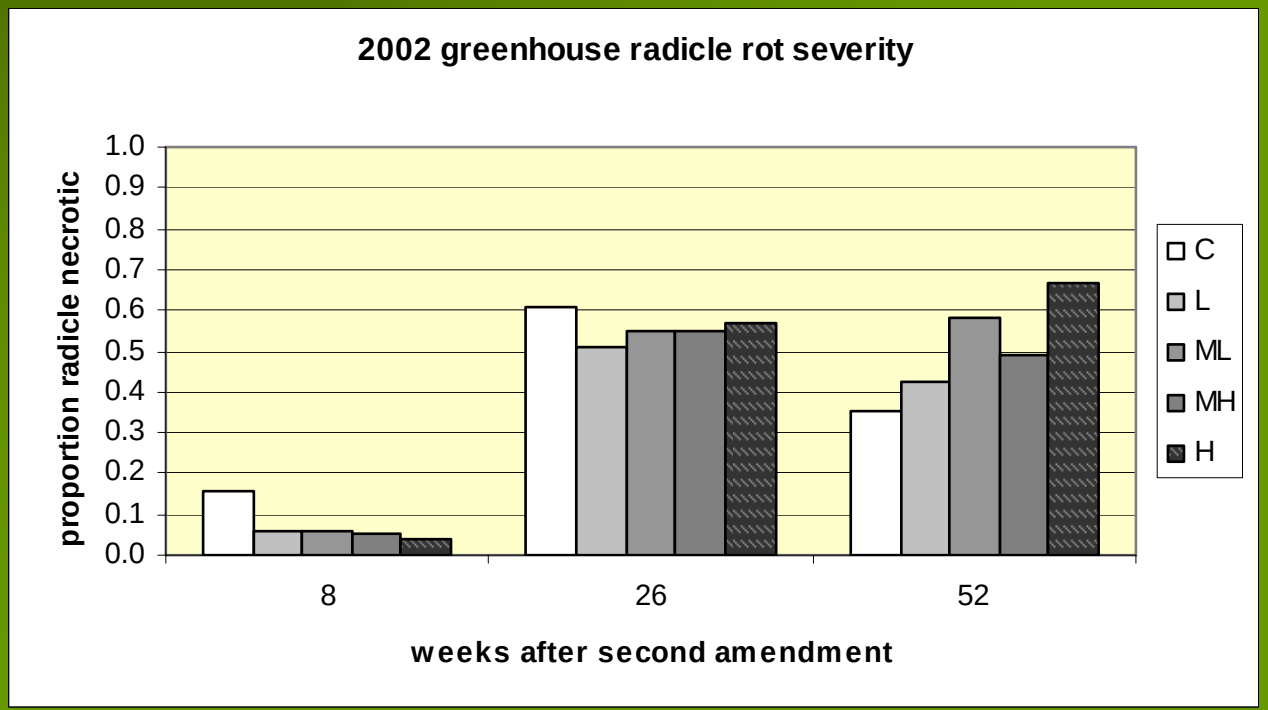
Hoinacki et al, 2004

Field Trial
Oregon State University
Research Farm

H.R. Darby, A.G. Stone, M.M. Wander, and R.P. Dick

- **Can we suppress sweet corn root rot through raw and composted manure amendments?**


2001 greenhouse radicle rot severity
proportion radicle necrotic
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
8
52
weeks after first amendment
C
L
ML
MH
H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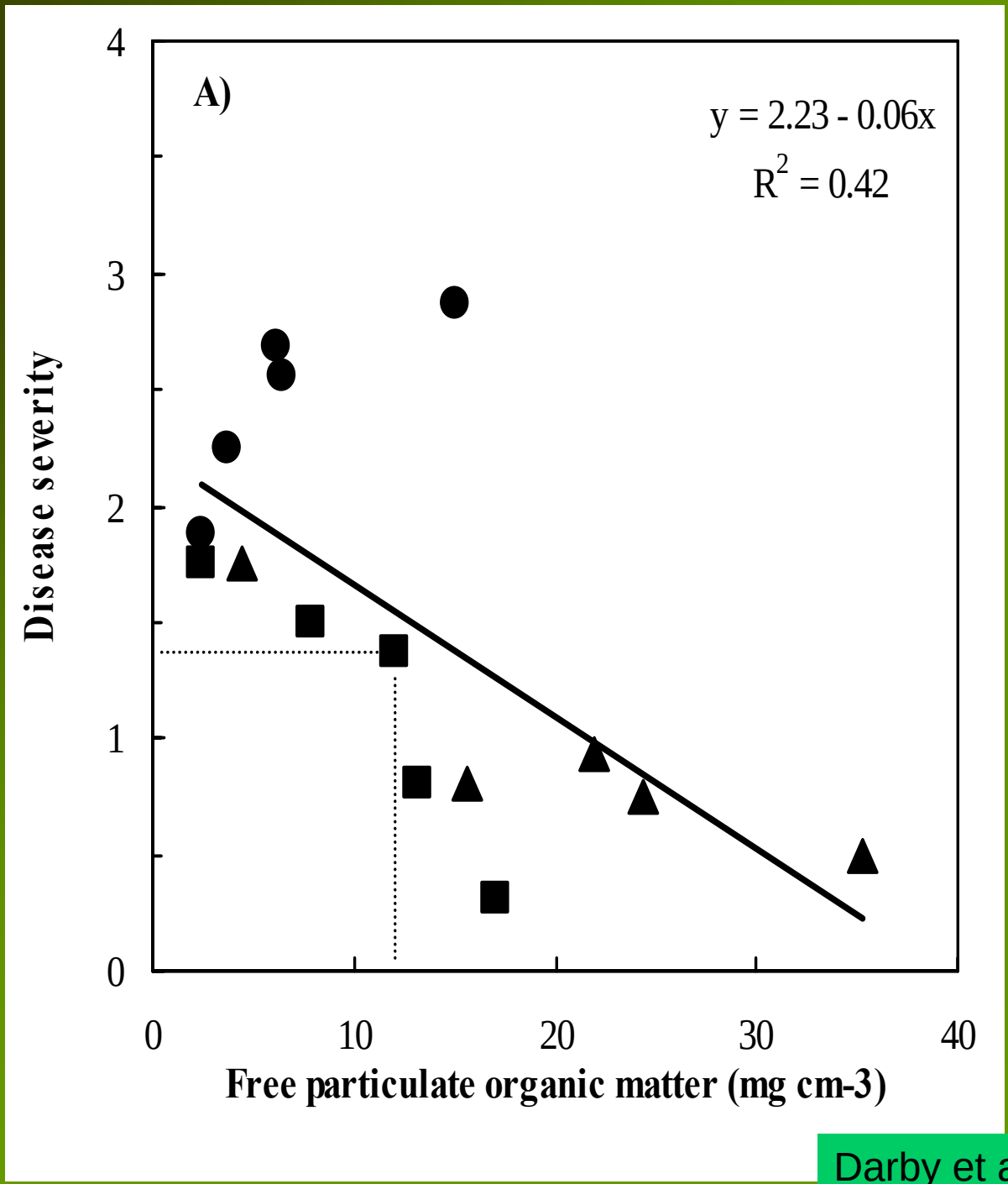
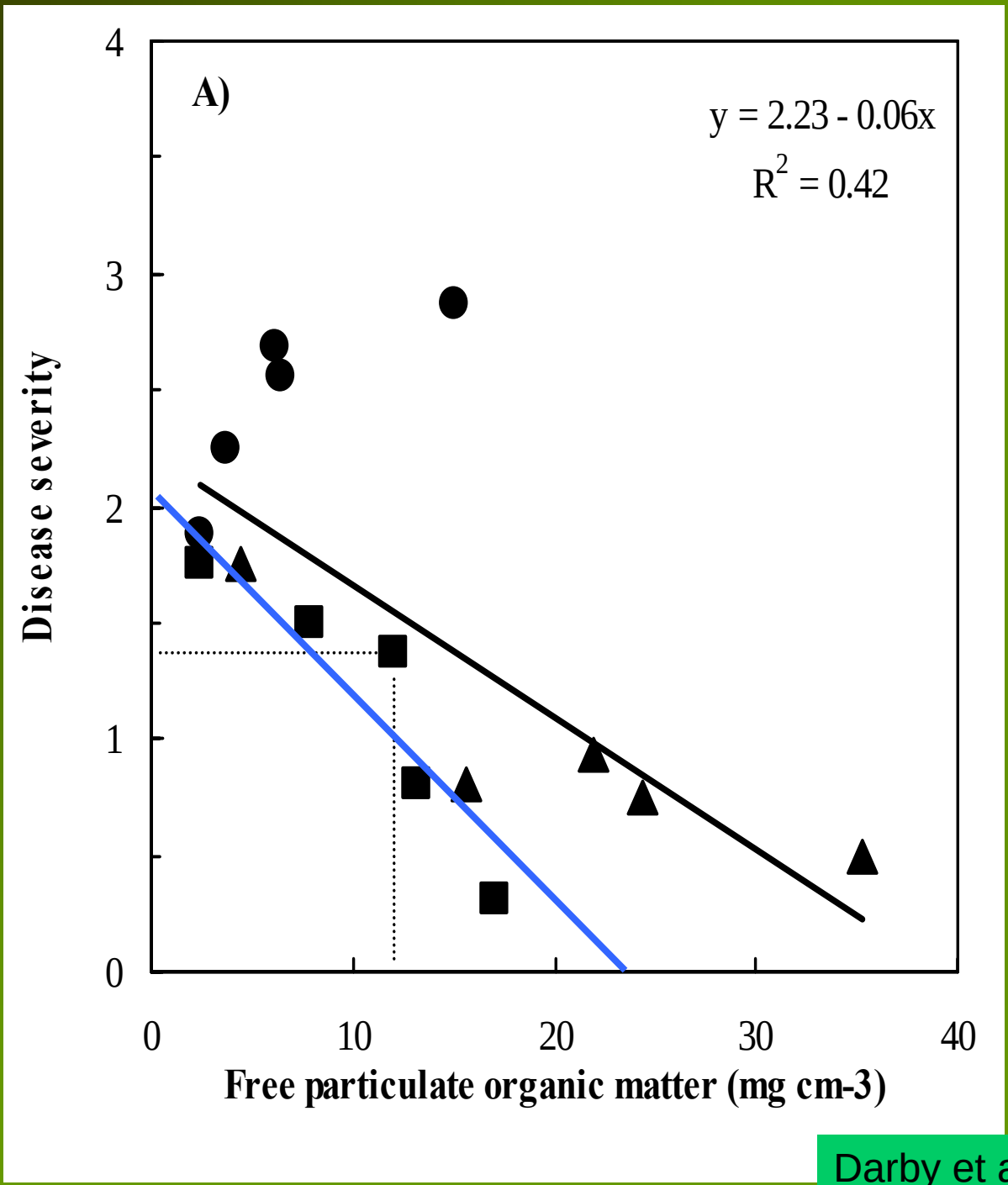
0.2
0.1
0.0
8
26
52
weeks after second amendment
C
L
ML
MH
H

SOM is Compositionally and Functionally Heterogeneous

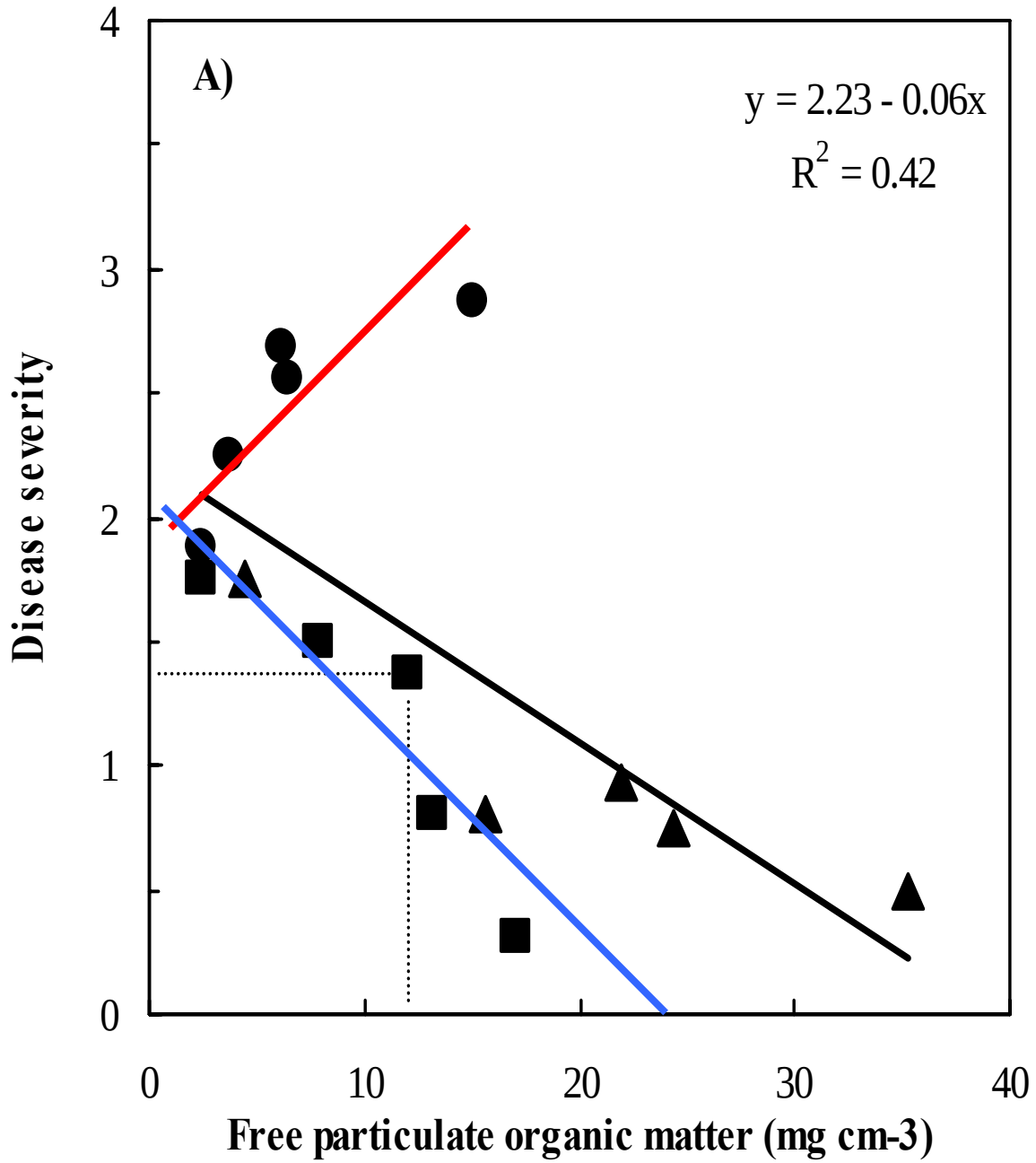
Pool	*Size/Age (yrs)*	*Functions*
Biologically Active	Small/1-5	The Meat: nutrient mineralization, macro-aggregation, disease suppression
Protected	intermediate/ 5-30	The Bones: soil structure, porosity, water relations
Stable	Large/ 50-10,000	Micro-aggregation, CEC, fate of ionic and non-ionic compounds, color



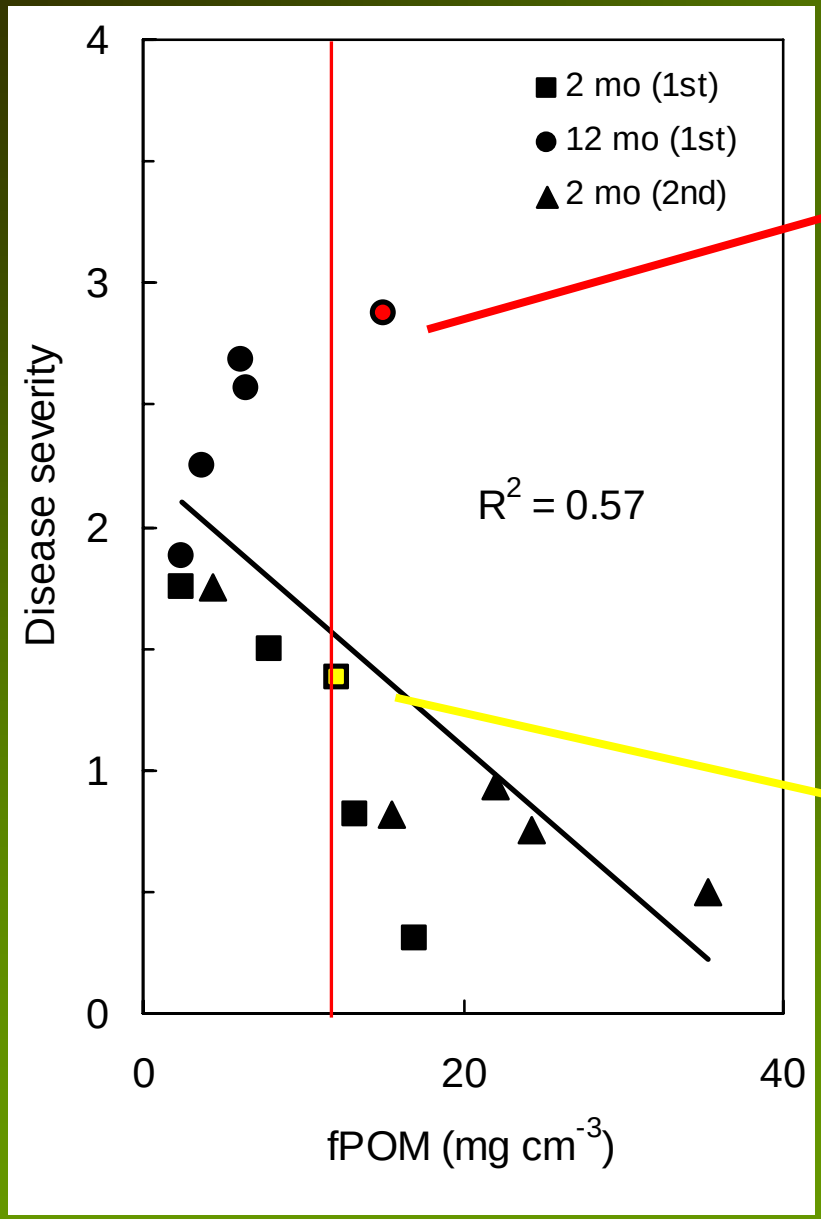
Darby et al, 2006



Darby et al, 2006



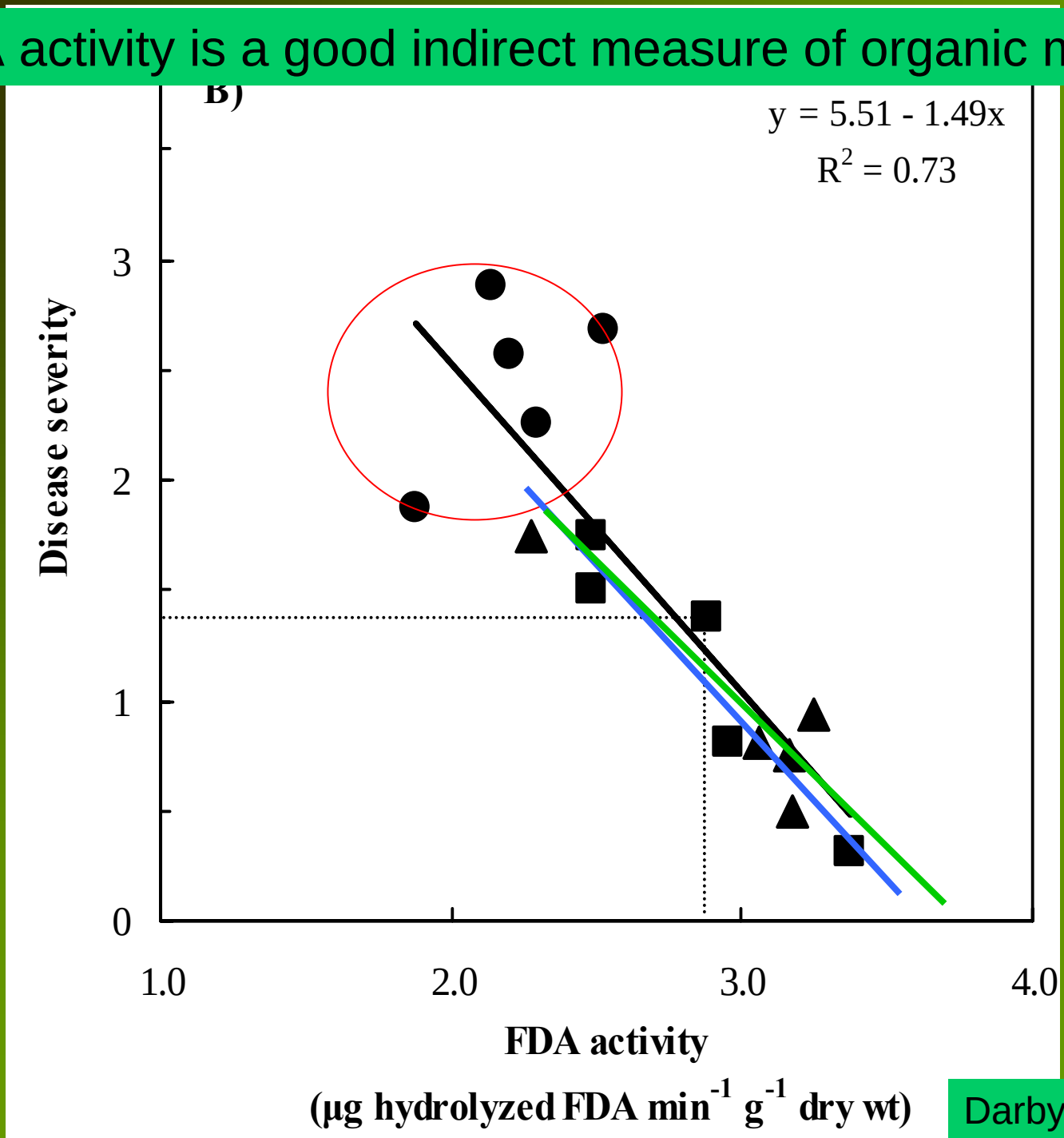
Darby et al, 2006



Relationship between fPOM and severity of root rot of sweet corn.

Darby et al, 2006

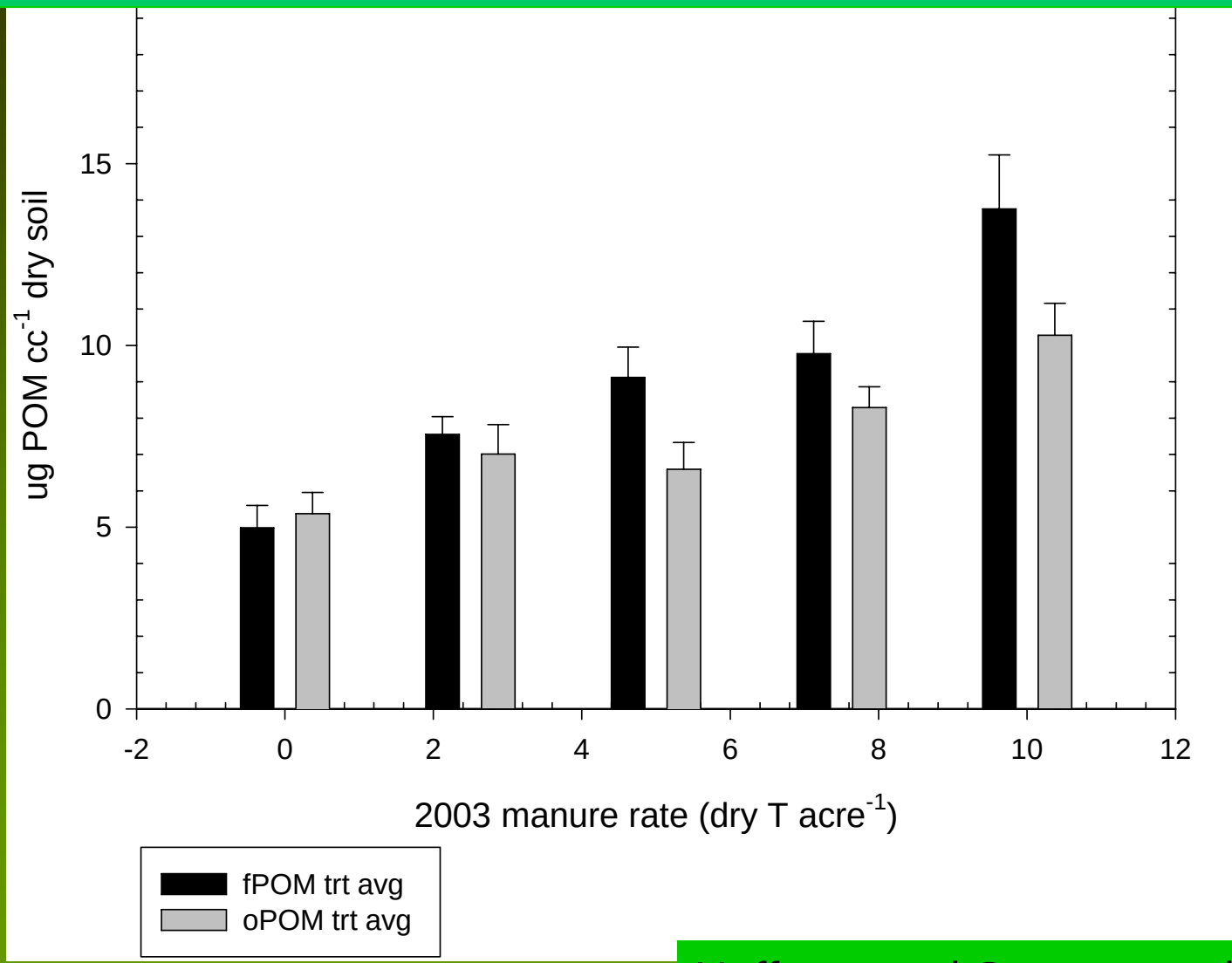
FDA activity is a good indirect measure of organic matter quality



Darby et al, 2006

Free and occluded POM pre-amendment in 2004 (4th year of serial amendment)

FDA activity and other general microbial indicators increase with the increase in POM



Hoffman and Stone, unpublished data

Review Chapter

- Stone, Scheuerell and Darby, 2004
- Chapter 5: Suppression of soilborne diseases in field agricultural systems.
- In: Soil Organic Matter in Sustainable Agriculture. CRC Press.

www.ecofarmer.us (go to publications)

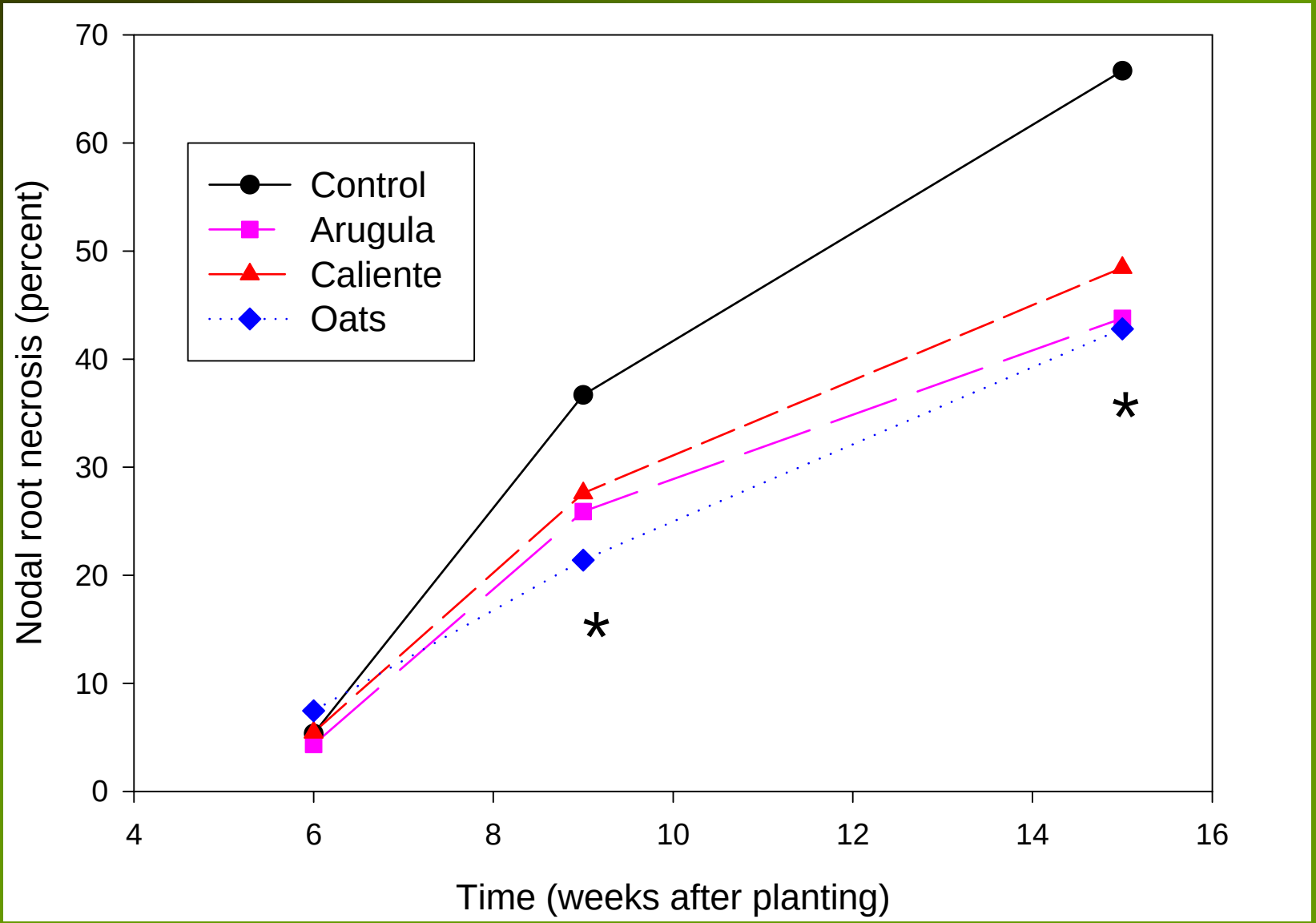
Cover Crops: A Tool to Improve Soil and Plant Health

Kenagy On-Farm Trial

- Winter cover crops planted Sept 15-16, 2004
- One approx. 60 ft. wide swath per treatment across pivot
  - Oats “Saia” (40 lbs/A)
  - Arugula (3.5 lbs/A)
  - Mustard mix “Caliente” (6 lbs/A)

  The cover crop biomass averaged 3.5 dry tons per acre with no differences among treatments.
- Flailed March 25, 2005
- Sweet corn SSJ+ planted June 23, 2005

Kenagy Corn Root Rot



Kenagy Corn Biomass