

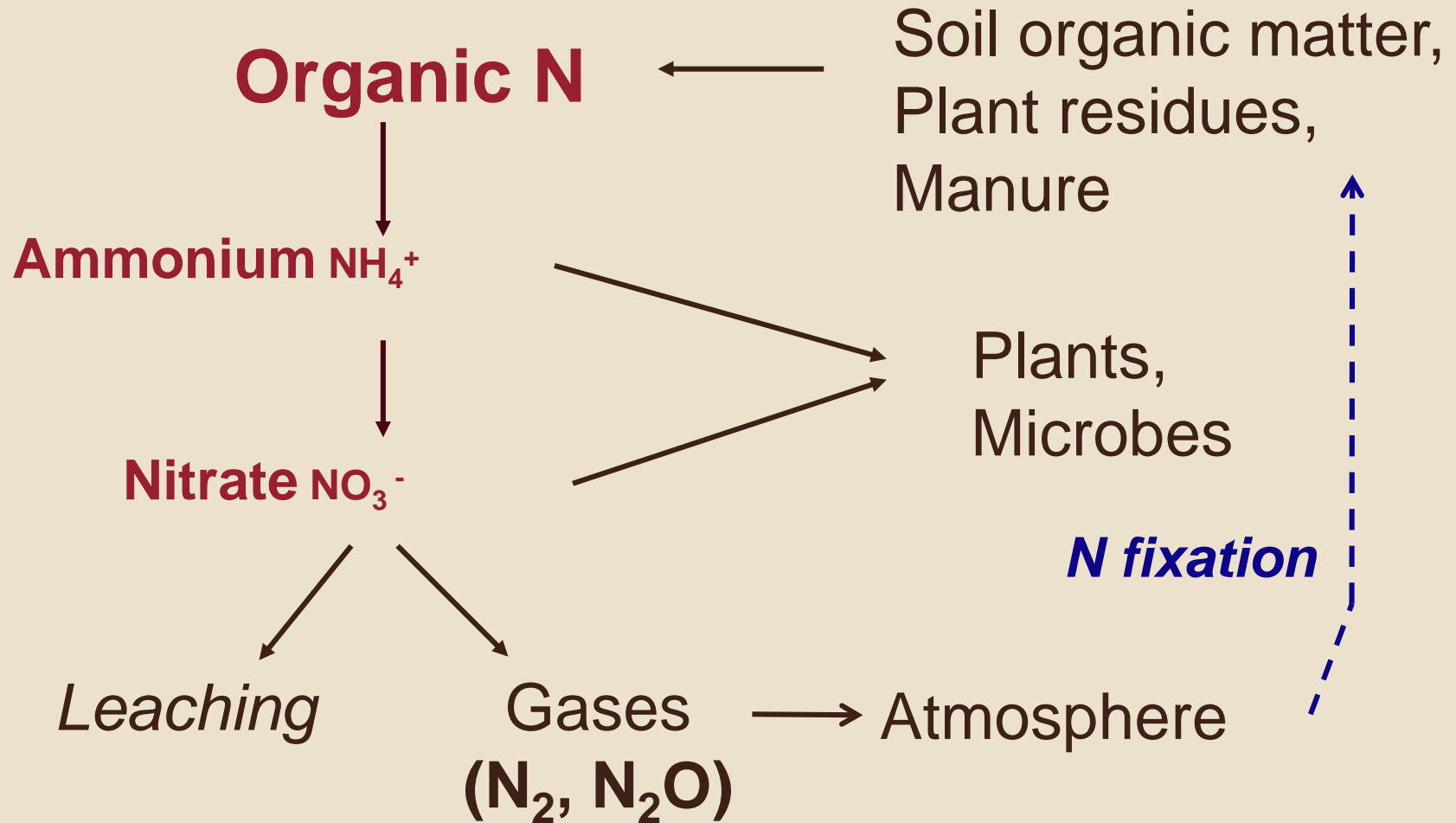


Organic materials as fertilizers and soil amendments

Andy Bary
WSU Puyallup



Nitrogen Cycle



Organic materials

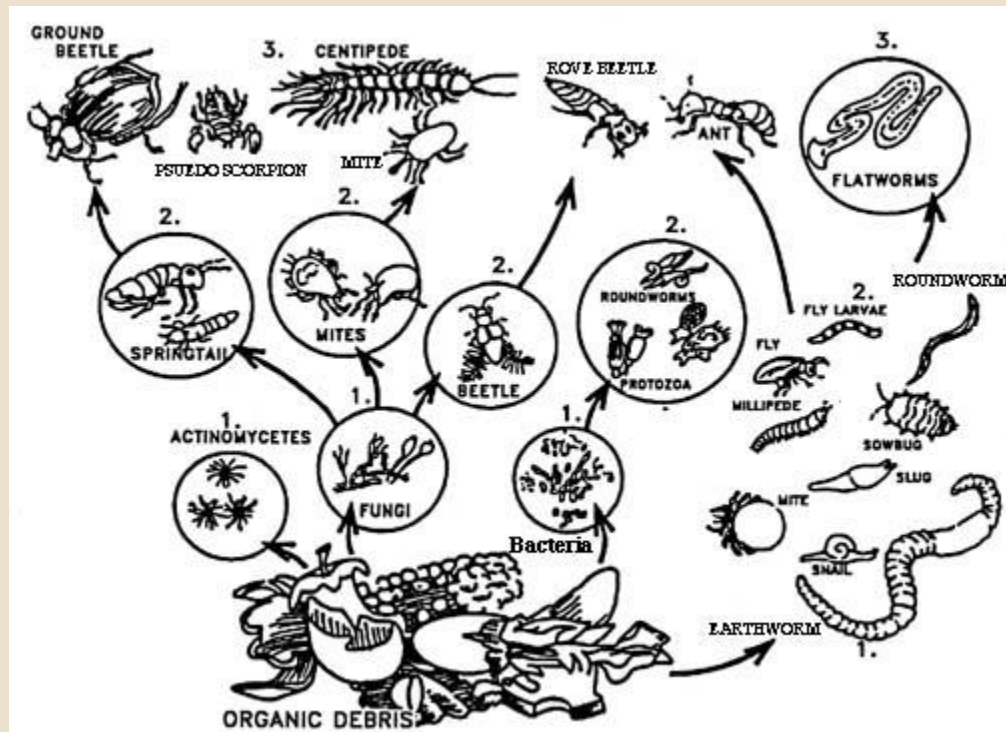
Management depends on:

- C:N ratio
- degree of decomposition



Carbon:Nitrogen ratio

- Ranges from **<5:1 to >500:1** in organic materials
- **Low C:N** supplies N to plants
- **High C:N** ties up N by biological immobilization





Predicting Nitrogen Availability from Organic Amendments

Field research in Puyallup, WA and Aurora, OR



- Jubilee sweet corn
- 8-11 materials/site/yr
- Control & 4 urea rates
- N recovery from crop and soil



Materials

Primary Amendments

Broiler litter, raw &
composted

Dairy manure solids, raw &
composted

Yard trimmings, raw &
composted

Rabbit manure, raw &
composted

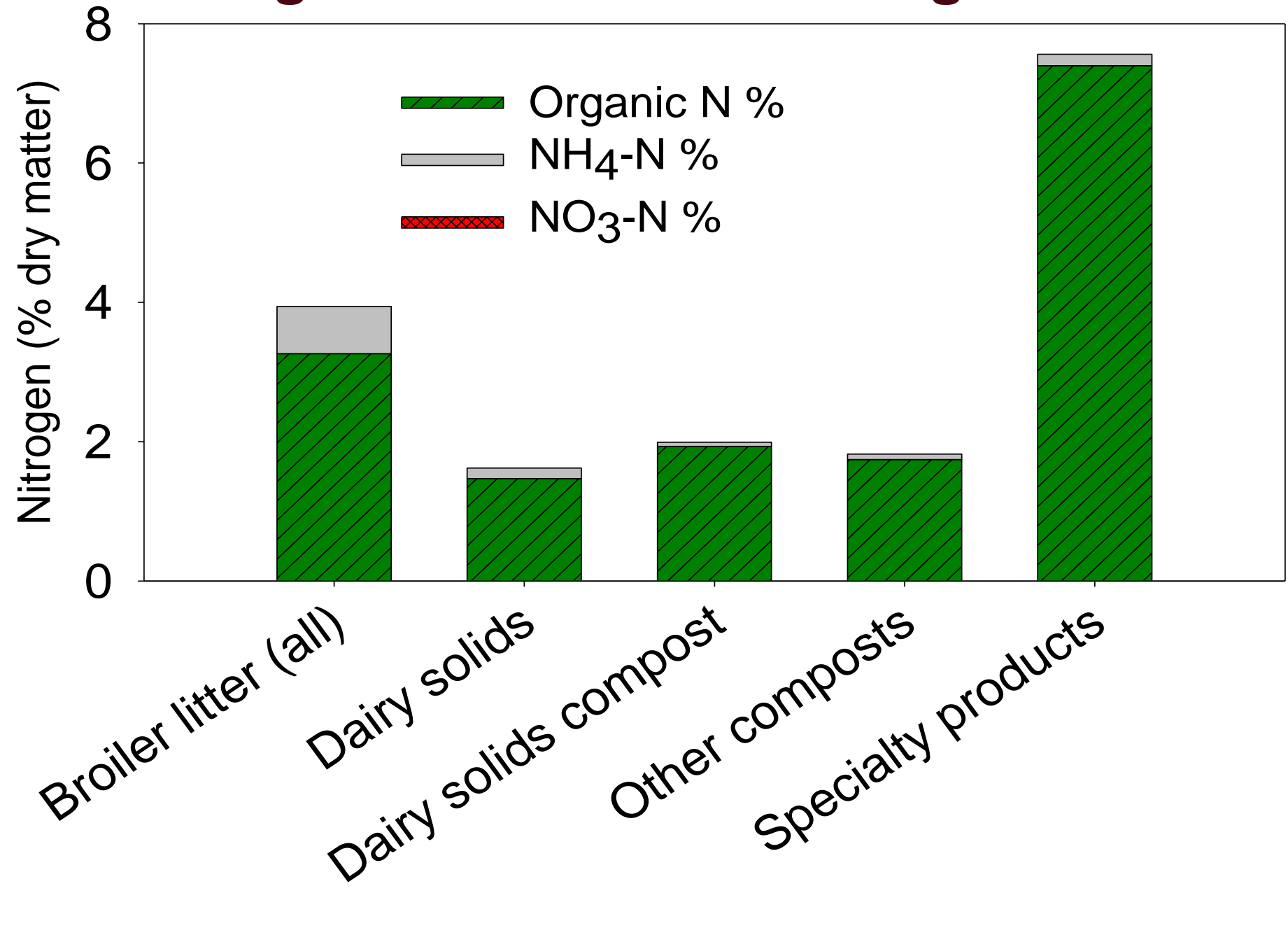
Specialty Products

Fish fertilizer, pelleted

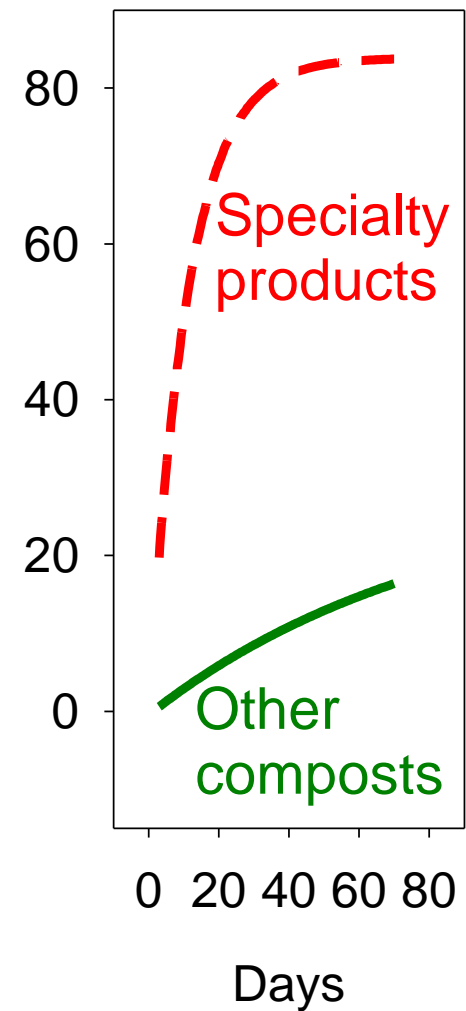
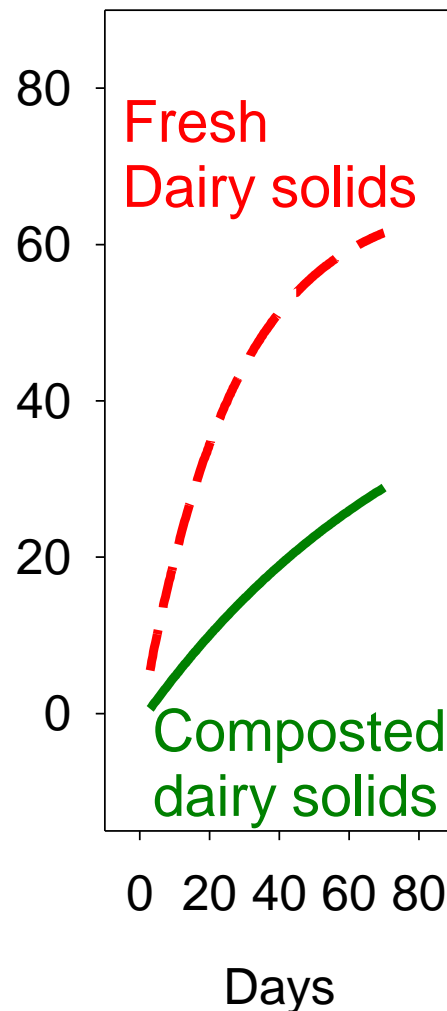
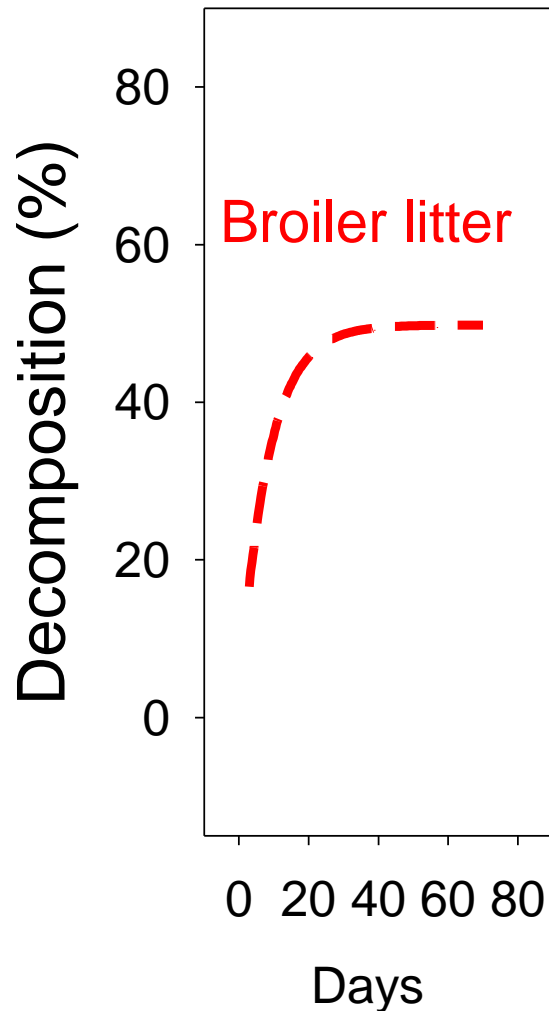
Canola meal

Feather meal, etc.

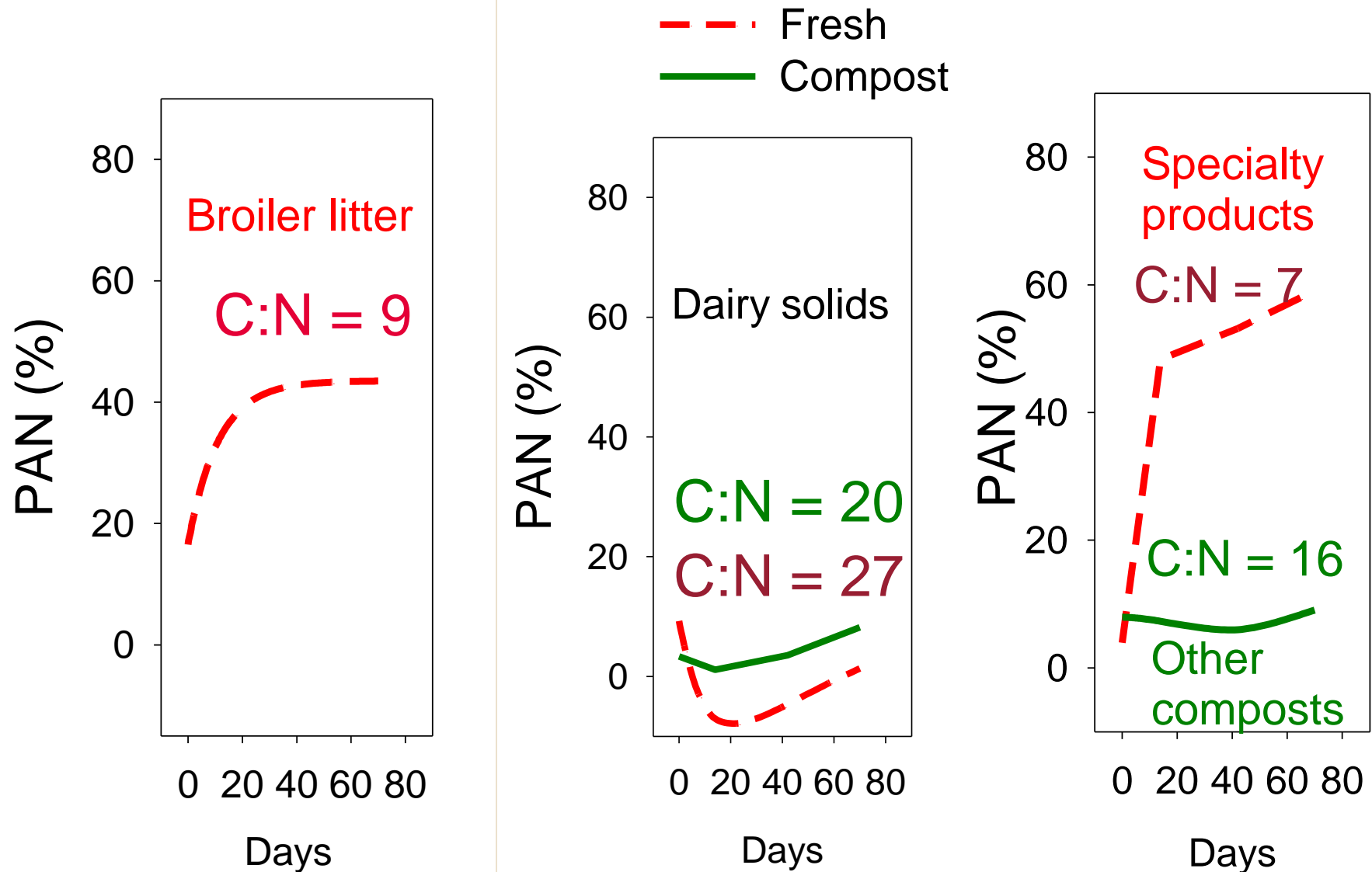
Organic amendment nitrogen data



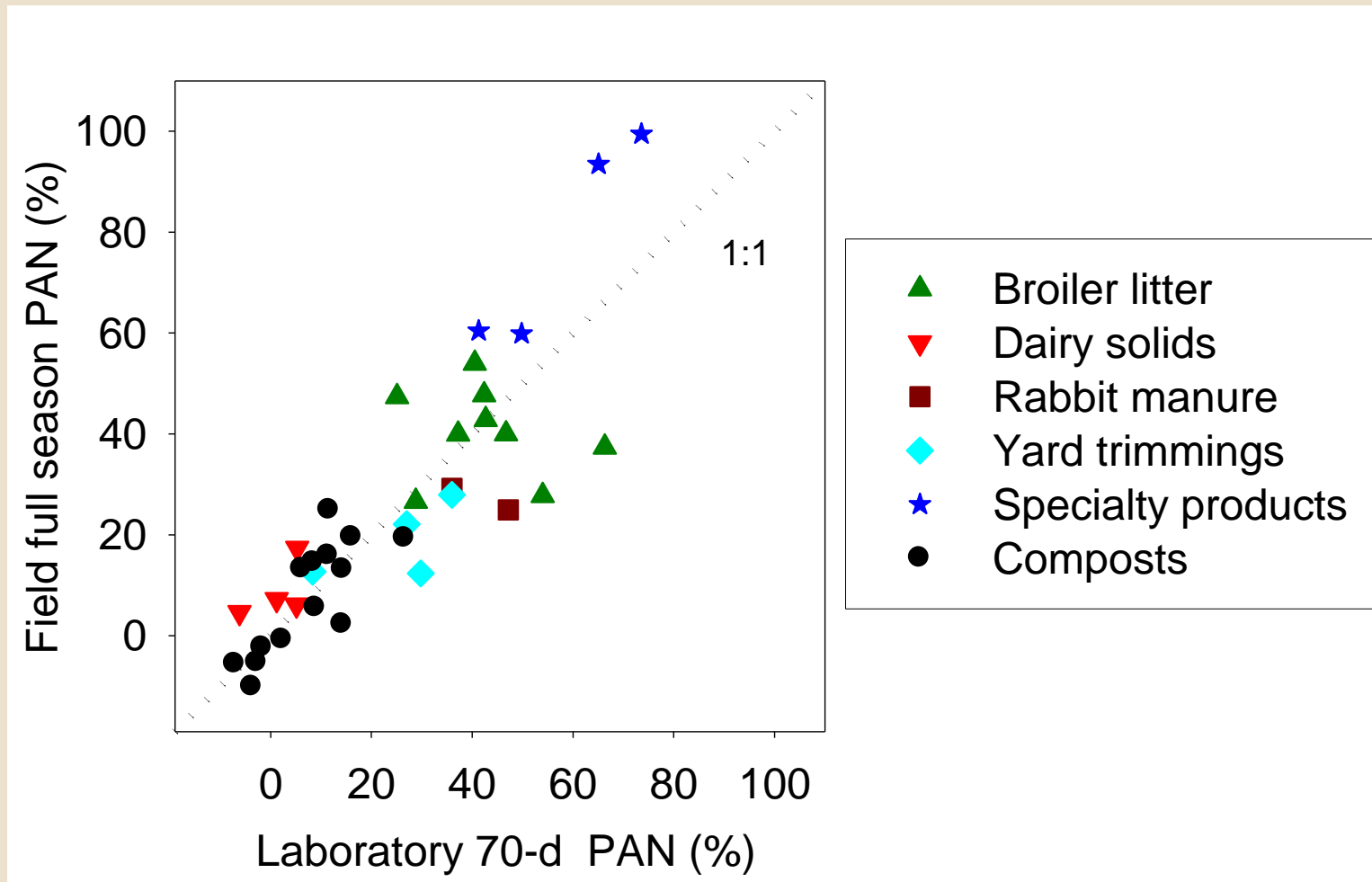
Amendment decomposition in soil



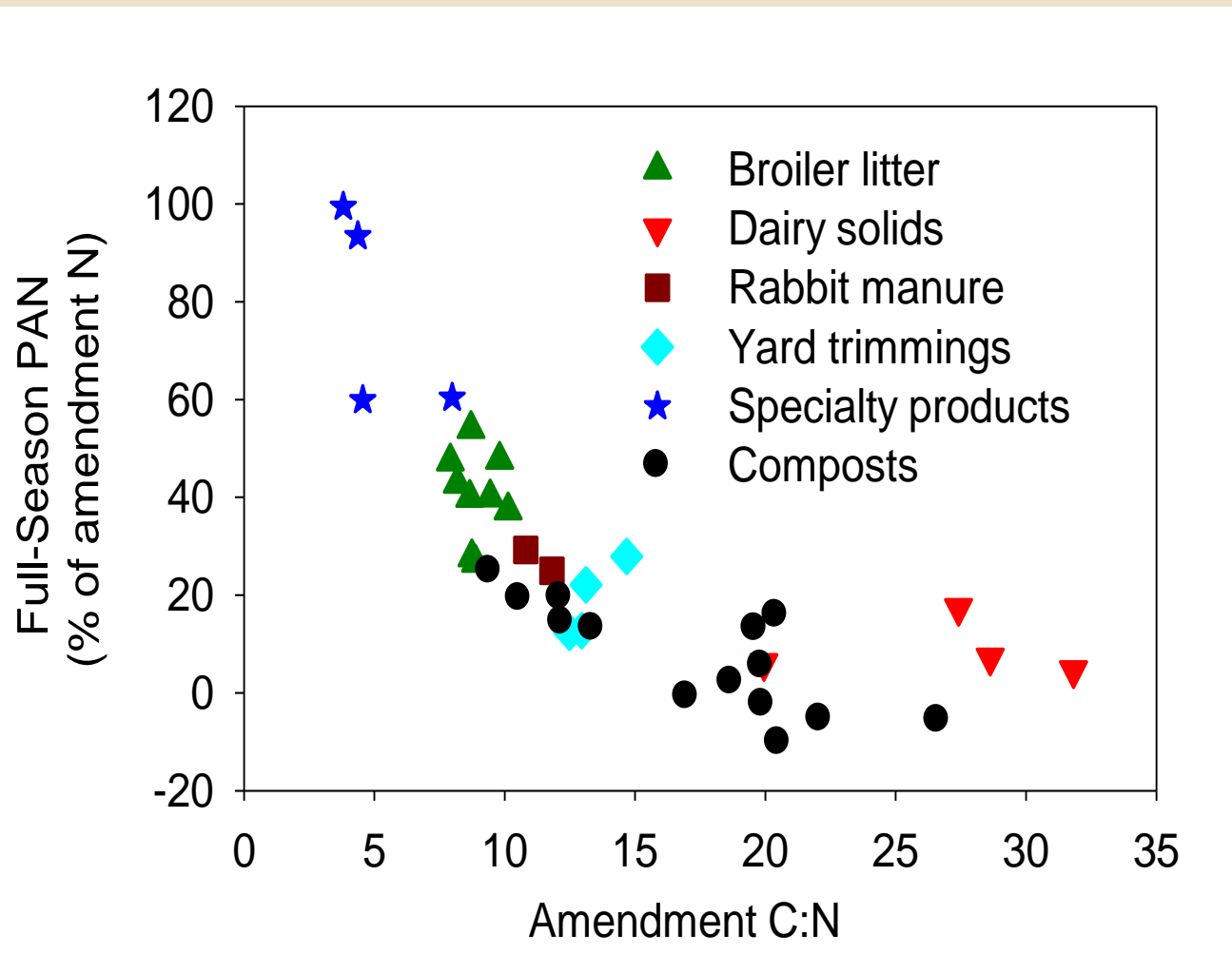
Plant Available N



Lab vs. full-season field PAN (4-site yr.)



Amendment C:N vs. plant-available N (field)



Gale et al., 2006. Journal of Environmental Quality 35:2321


ORGANIC FERTILIZER CALCULATOR

<http://smallfarms.oregonstate.edu>

Sample calculations

- How much of this fertilizer should I apply?
- How do these two fertilizers compare?
- What's the cheapest source of available N, P, K, etc.?
- Does this program match my fertilizer recommendation?



| | A | B | C | E | F | I | J | K | L | M | N | O | P |
|----|--|--|---|--|---|-----------------------------------|----------------------------------|--------|--------|-------------------------------|-------|--------|--------|
| 1 | Version 3 | "As is" basis = weight or % nutrient in product at moisture level at which it is sold (i.e., wet weight) | | | | | "PAN" = plant-available nitrogen | | | Protection password = beavers | | | |
| 2 | Instructions: Enter your information in yellow cells. Results are in green cells. | | | | | | | | | | | | |
| 3 | MATERIAL | | FERTILIZER ANALYSIS (%) (ppm/10,000=%) | | | | | | | | | | |
| 4 |  | Total % N from label ("as-is" basis) (% of product) | Total % dry matter (% of product) | PAN at 28 days (% of amendment total N, dry wt basis) from Table 1 | PAN after full season (% of amendment total N, dry wt basis) from Table 1 | P ₂ O ₅ (%) | K ₂ O (%) | Ca (%) | Mg (%) | S (%) | B (%) | Cu (%) | Fe (%) |
| 23 | Perfect Blend (4-4-4) | 4.0 | 90 | 37 | 52 | 4.0 | 4.0 | 7.0 | 0.7 | 3.0 | 0.0 | 0.1 | 0.1 |
| 24 | Perfect Blend (7-2-2) | 7.0 | 90 | 60 | 75 | 2.0 | 2.0 | 7.0 | 1.5 | 1.5 | 0.0 | 0.1 | 0.1 |
| 25 | Soft rock phosphate (0-2-0) | 0.0 | 99 | 0 | 0 | 2.0 | 0.0 | | | | | | |
| 26 | Solubor (20.5% B) | 0.0 | 0 | 0 | 0 | | | | | | 20.5 | | |
| 27 | Soy meal (6.5-1.5-2.4) | 6.5 | 90 | 60 | 75 | 1.5 | 2.4 | | 3.0 | | | | |
| 28 | Sulfate of potash (0-0-50) | 0.0 | 99 | 0 | 0 | 0.0 | 50.0 | | 0.0 | 17.0 | | | |
| 29 | Sulfate of potash magnesia (0-0-22) | 0.0 | 99 | 0 | 0 | 0.0 | 22.0 | | 10.8 | 22.0 | | | |
| 30 | Sup-R-Green (3-2-2) | 3.0 | 73 | 32 | 47 | 2.0 | 2.0 | | | | | | |
| 31 | Zinc—Green Cypress (7% Zn) | 0.0 | 0 | 0 | 0 | | | | | 3.4 | | | |
| 32 | | | | 0 | 0 | | | | | | | | |
| 33 | | | | 0 | 0 | | | | | | | | |
| 34 | | | | 0 | 0 | | | | | | | | |
| 35 | | | | 0 | 0 | | | | | | | | |
| 36 | | | | 0 | 0 | | | | | | | | |
| 37 | COMPOSTED MATERIALS | | | | | | | | | | | | |
| 38 | Composted dairy manure (1.5-0.5-0.5) | 1.5 | 60 | 5 | 10 | 0.5 | 0.5 | 1.8 | | | | | |
| 39 | | | | 0 | 0 | | | | | | | | |
| 40 | | | | 0 | 0 | | | | | | | | |
| 41 | | | | 0 | 0 | | | | | | | | |
| 42 | | | | 0 | 0 | | | | | | | | |

| | A | B | C | D |
|----|--|------------------|----------------------------|--------------|
| 1 | Table 1. Plant-available nitrogen (PAN) estimates | | | |
| 2 | Amendment total N | Amendment C:N | Plant-available N estimate | |
| 3 | | | 28 days | full season |
| 4 | % dry wt. | | % of total N | % of total N |
| 5 | Uncomposted materials | | | |
| 6 | 1 | 35 | <0 | 0 |
| 7 | 2 | 18 | 0 | 15 |
| 8 | 3 | 12 | 15 | 30 |
| 9 | 4 | 9 | 30 | 45 |
| 10 | 5 | 7 | 45 | 60 |
| 11 | 6 | <6 | 60 | 75 |
| 12 | 7 | <6 | 60 | 75 |
| 13 | 8+ | <6 | 60 | 75 |
| 14 | Composts | | | |
| 15 | 1 | 30 | 0 | 5 |
| 16 | 2-3 | 15-10 | 5 | 10 |
| 17 | | | | |

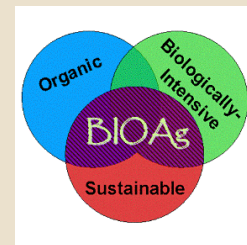
“Organic Fertilizer Calculator” estimates of plant-available N (PAN)

| Fresh Amendment total N | Example | Fresh Amendment C:N | PAN 28 days | PAN full season |
|-------------------------|------------------------|---------------------|--------------|-----------------|
| % dry wt. | | Approx. | % of total N | % of total N |
| 1 | Solid manure w/bedding | 35 | < 0 | 0 |
| 2 | Dairy solids | 18 | 0 | 15 |
| 1.7 | Yard Debris Compost | 16 | 3 | 7 |
| 6+ | Specialty products | less than 6 | 60 | 75 |



Soil Quality in Intensive Organic Management Systems

Craig Cogger, Doug Collins,
Andy Bary, Ann-Marie Fortuna,
and Ann Kennedy



Three Cover Crop Treatments

Relay planted
Legume
(RLY)



Post-Harvest
Cereal & legume
(PH)



Short-term
Grass-legume
Pasture (LEY)



Two tillage treatments are included in the experiment

CONV = Conventional tillage
(plow, disc, rototill)

SPD = Modified tillage
(low-speed rotating spader)

Soil amendments include High-C compost and Low-C broiler litter.

Chicken (Broiler) litter: **(CKN)**

Low C application (1.8 - 3.1 dt/ac)

Mixed on-farm compost: **(OFC)**

High C application (8 - 17 dt/acre)





Soil quality measurements include physical, chemical, and biological indicators

Bulk Density

Infiltration

Compaction

Particulate OM

Enzyme activity

Nematodes

Collembola

Microbial biomass

Nitrogen cycling

Microbial community structure

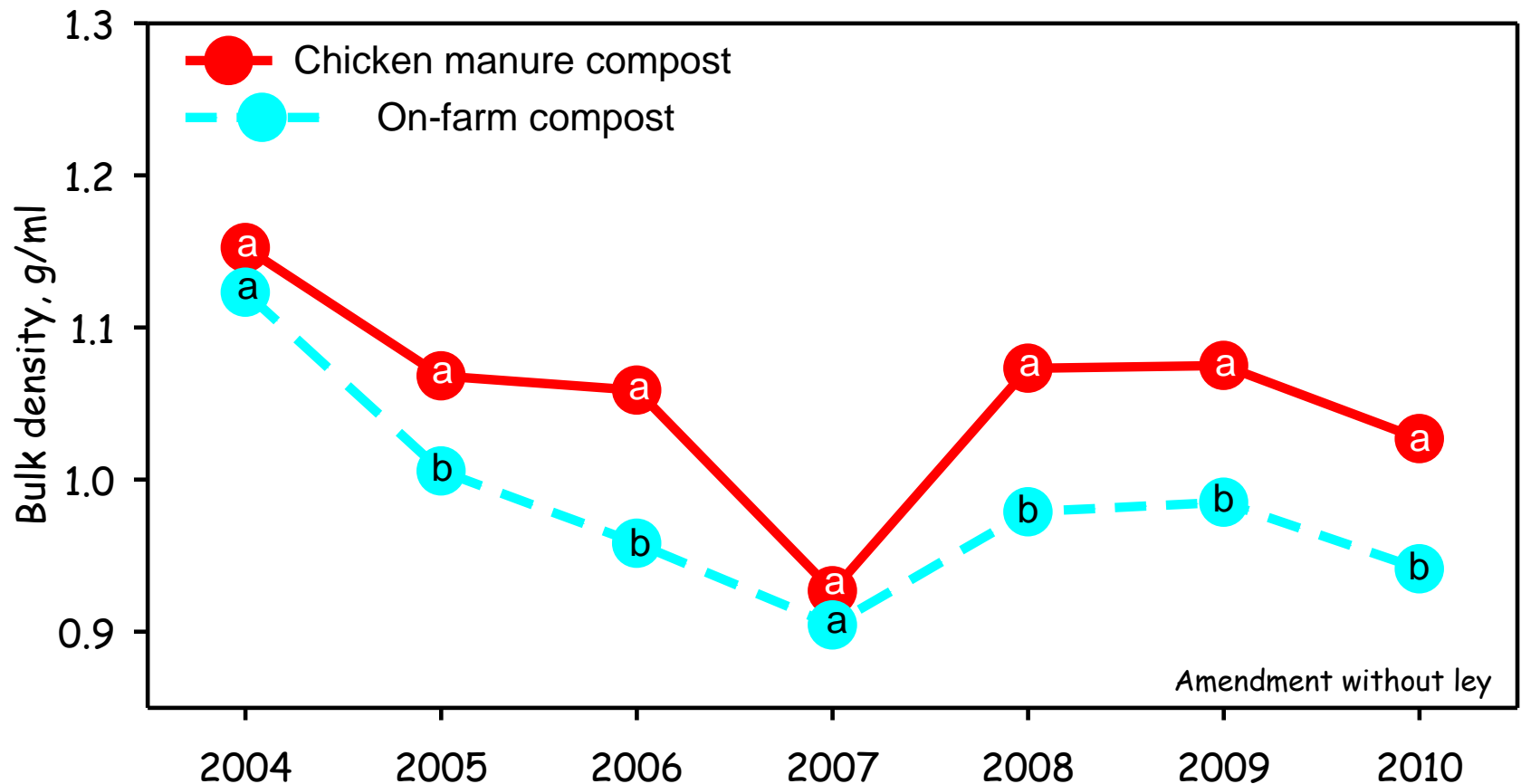
Nutrients and carbon



Bulk density is an indicator of porosity,
and organic matter.



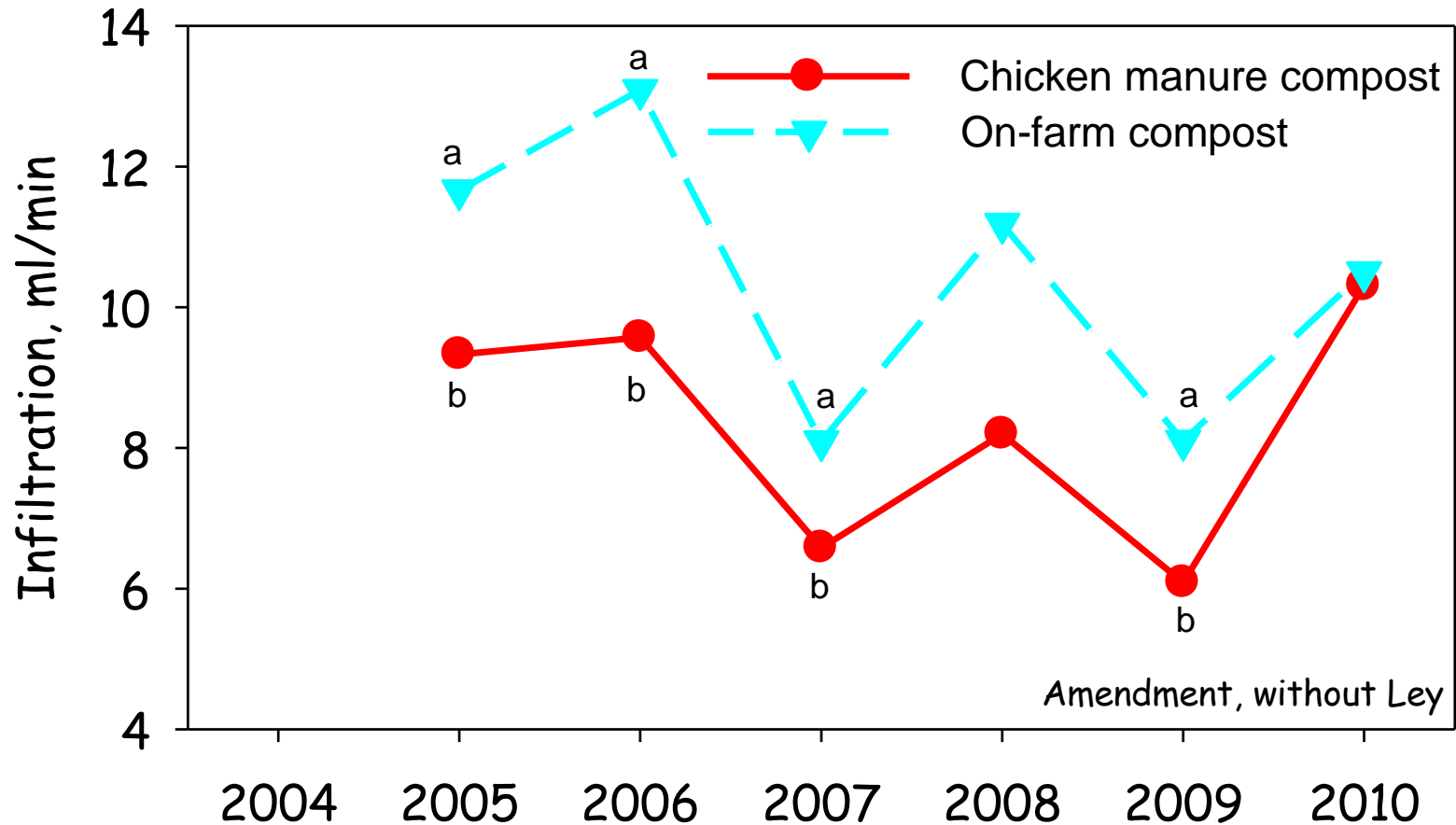
Bulk density is lower with high-C compost additions.



Measuring water infiltration using a simple field method.



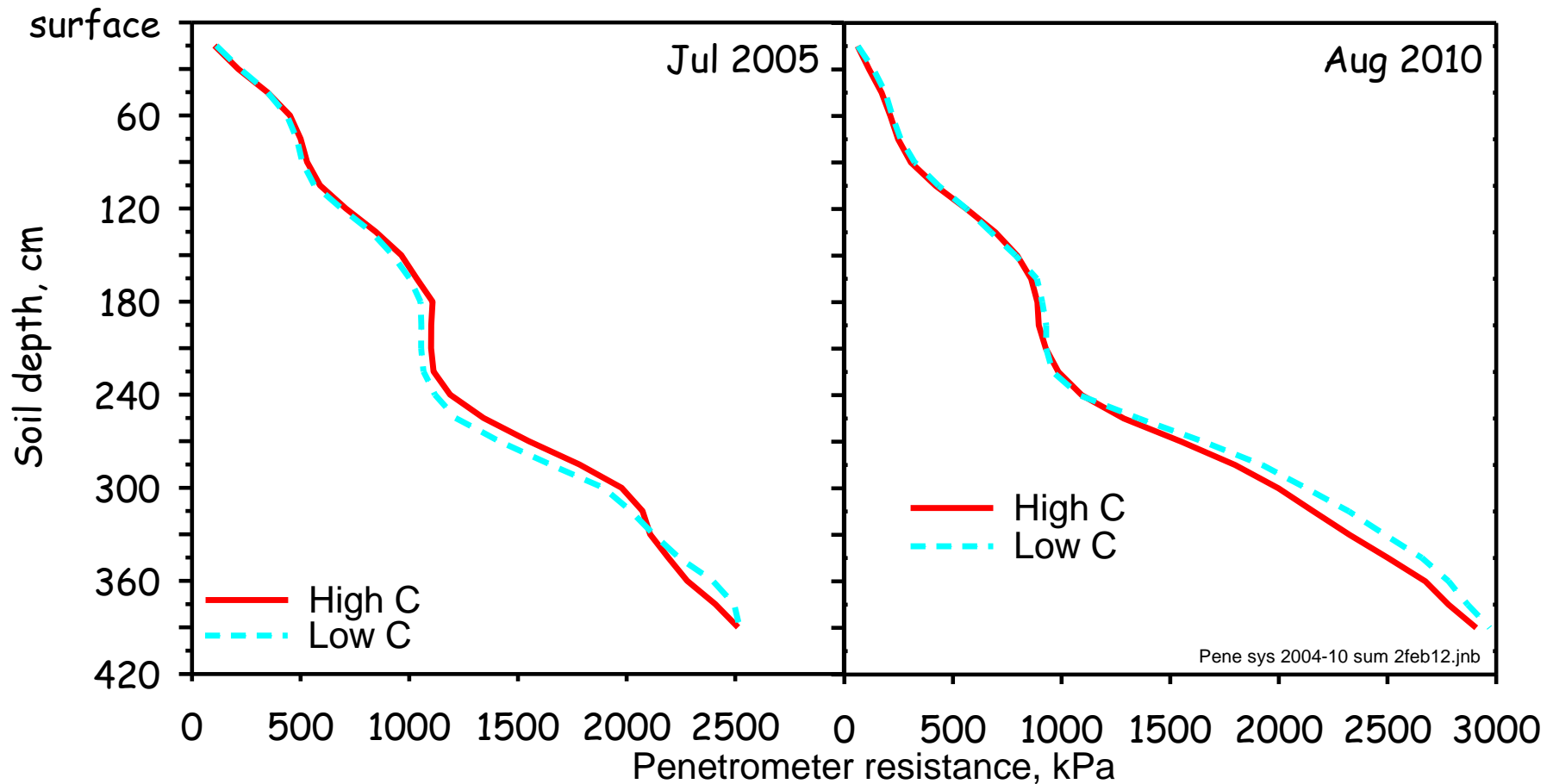
Infiltration is usually faster in plots treated with high-C compost.



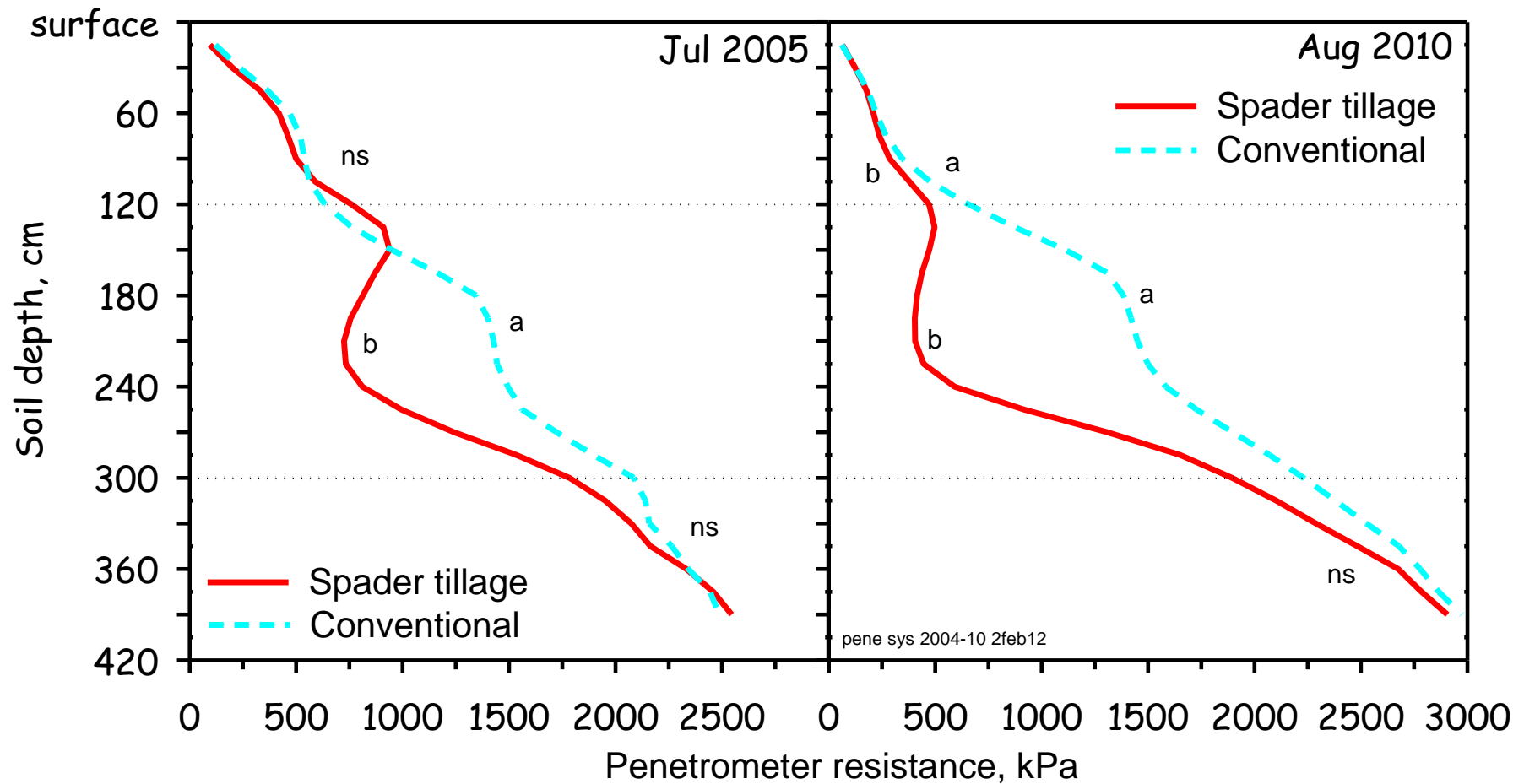
The penetrometer
measures
compaction to a
depth of 16 inches



Amendment had no effect on compaction in the soil profile.



Spader-tilled soils had a less compact profile than conventional tillage

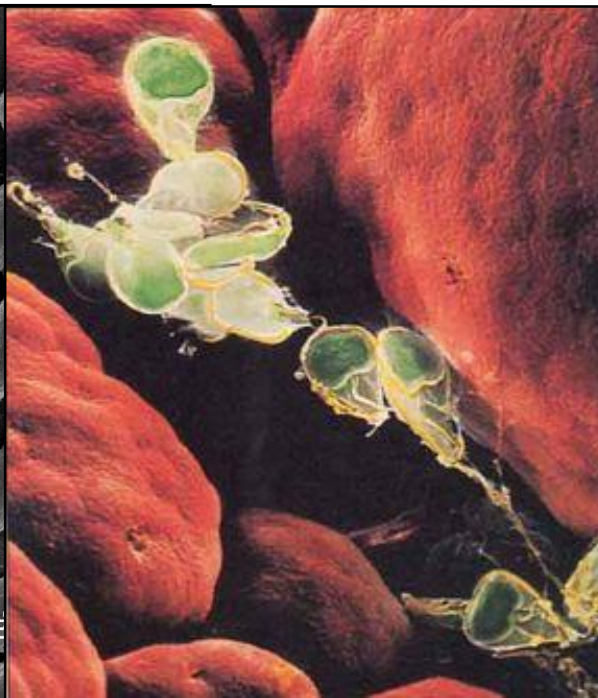
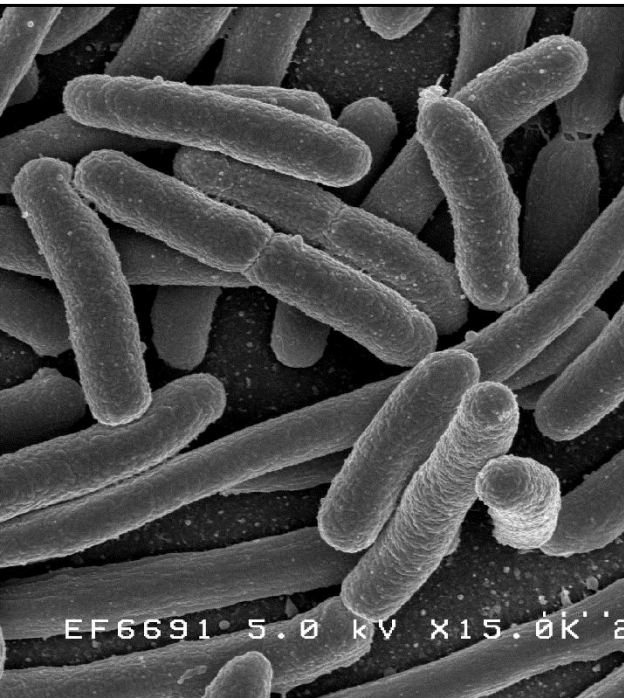




Compost & Manure Use/Management and Words of Wisdom

Manure and Pathogens

- Fresh manure can contain Salmonella, E. coli O157:H7, etc.
- We must use manure properly to avoid spreading diseases



Color-enhanced scanning electron micrograph showing *Salmonella typhimurium* (red) invading cultured human cells

Types of Organic Amendments

Hot stuff C:N < 10:1

Cool stuff C:N 15:1 to 25:1

Woody stuff C:N > 30:1



Hot Stuff C:N < 10:1



- Rapid N availability
- Use as a fertilizer
- Over application leads to excess nutrient levels in soil -- potentially harming crop and water quality.

Hot Stuff

- Poultry manure
- Seed meals
- Fish and feather meals
- Fresh grass clippings
- Fresh rabbit manure
- Dewatered or dried biosolids



Cool Stuff, C:N 15:1 to 25:1

- Slow N availability
- Can add large amounts without risk of over-fertilization
- Use as a soil amendment
- N immobilization (tie-up) likely with fresh materials in first few weeks after app.
- Compost organic matter lasts a long time in soil



Cool Stuff

- Compost (yard debris, most manures, biosolids)
- Fresh materials:
 - Yard debris
 - Cover crop residues
 - Dairy manure solids
 - Coffee grounds



Woody Stuff, C:N > 30:1

- N immobilization
- Need to add N along with organic amendment
- Use as mulch or bulking agent for compost



Woody Stuff

- Straw
- Sawdust
- Paper waste
- Horse manure
rich in bedding



**Feed the microbes and let
them do the work for you!**

Organic nutrient management

www.Soils1.org

Compost usage

Research updates

Manure Management

Field day announcements

Thank you

Questions