Compost for the Small and Midsize Farm

John Biernbaum
Michigan State University

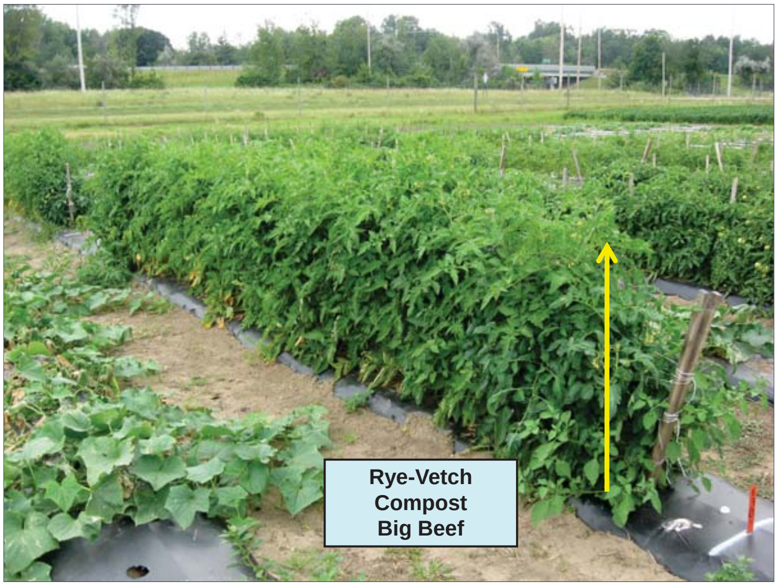
Participant Identification

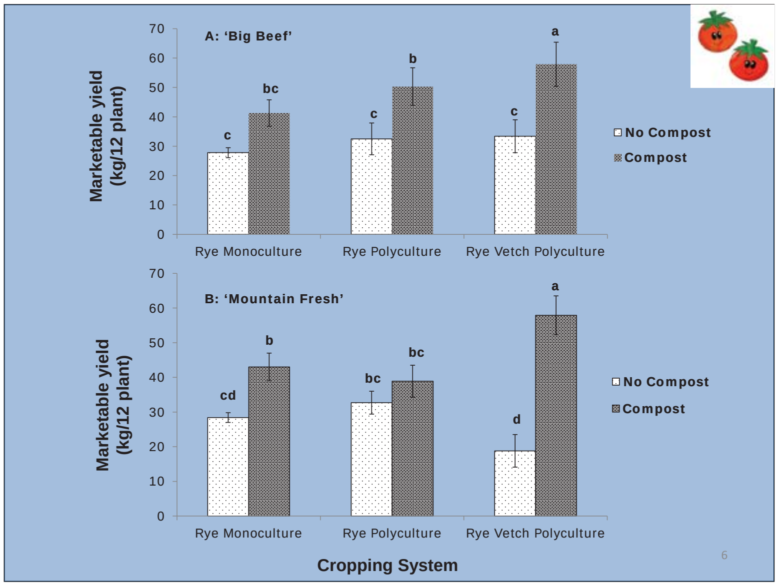
- Compost producers or suppliers?
- Vegetable and fruit farmers?
- Field crop, forage, and grain farmers?
- Animal husbandry / manure managers?
- Others?
- Making compost on farm?
- Purchasing compost?

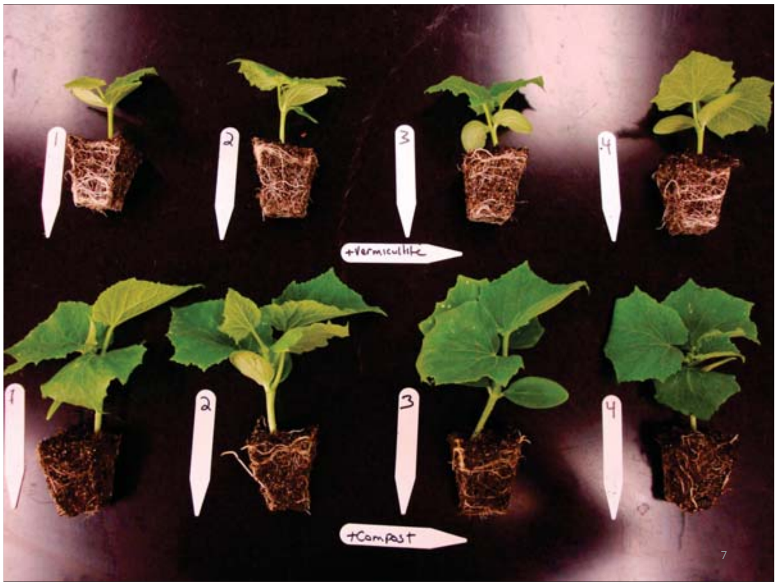
Motivations: Why use Compost?

- Nutrients
- Stable Soil Organic Matter (SOM)
  - Including a growing medium
- Soil Biology

Composting as an essential
Resource Management Strategy
and not as a
Waste Management Strategy







SOM/Compost Contributions to Chemical Properties

- **Readily available nutrients (N, K, Ca, ?)**
- **Slowly releases nutrients (N,P,K, Ca, Mg, S)**
- **Micronutrients**
- **Soil pH**
- **Cation exchange capacity**

Rates of Compost Application

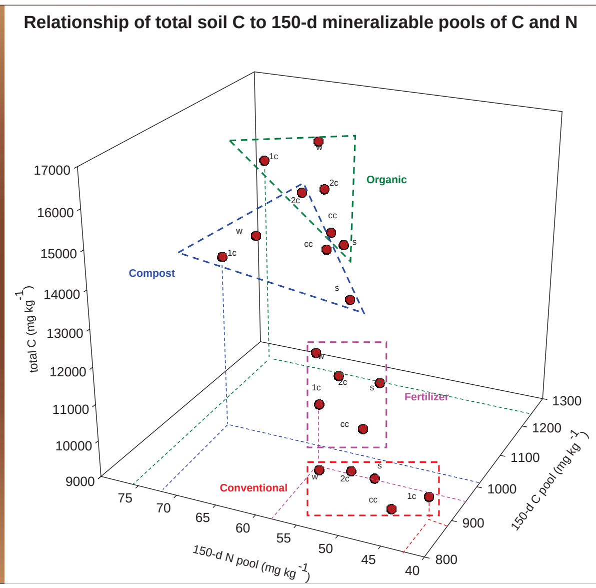
Rate	Cu yd/ acre	Ton/ acre	Cu ft/ 100 sqft	Gal/ 100 sqft	Inches deep	Lbs N (1%N)
Low	2	1	0.1	0.75	dusting	20
Mod	5	2.5	0.25	2	dusting	50
Mod	10	5	0.50	4	0.075 (1/16)	100
High	20	10	1.0	8	0.12 (1/8)	200

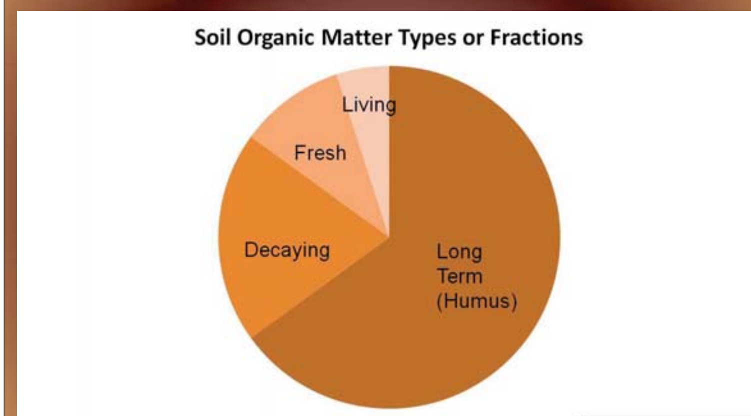
Assumes moist weight of 1000 lbs/cu yd
Not exactly equivalent rates due to rounding.

Does just estimating the amount of NPK applied explain the benefits of compost?

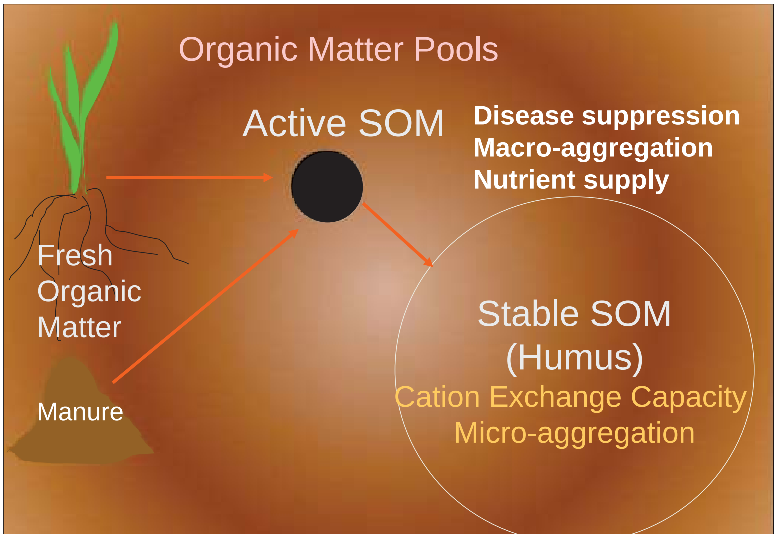
Historically, a critical or negative portrayal of organic farming and gardening was that you can't apply enough nutrients by applying organic matter or compost so why bother (the preverbial NPK mentality).

What are the additional benefits of adding compost?

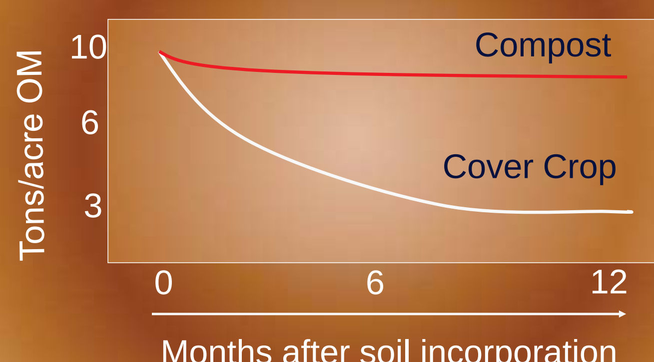




Organic Matter Pools



Compost vs. Cover Crop Effects on SOM



Compost and Green Manure 1 +1 > 2 ? Added Benefits?

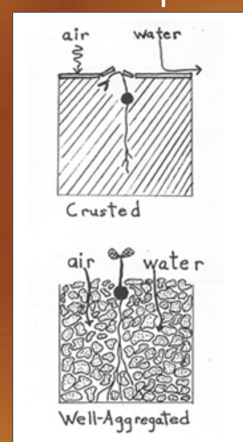
How many lbs of SOM/acre?

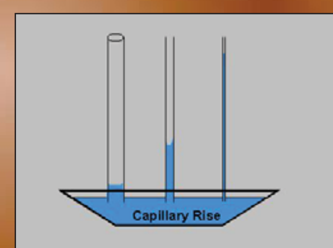
- **Acre furrow slice = 2,000,000 lbs Soil**
- **1% OM = 20,000 lbs/acre organic matter**
- **1 ton of compost = 2000lbs so OM increases 10%**
- **10 ton of compost = 20,000 lbs so OM doubles to 2%**

Stable SOM/Compost Contributions to Physical Properties

- Increased water absorption
- Increased water retention
- Improved drought tolerance
- Reduced soil erosion
- Improved root health

Organic Matter Increases Water Absorption and Retention





From Attra Publication

Water Absorption Increases

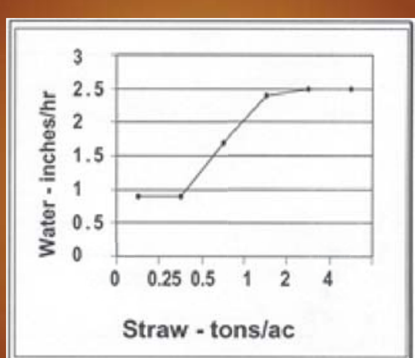


Figure 3. Effect of straw rate on water infiltration on a silt loam soil (7).

Water Retention Increases

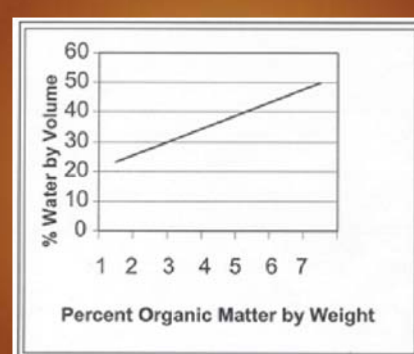
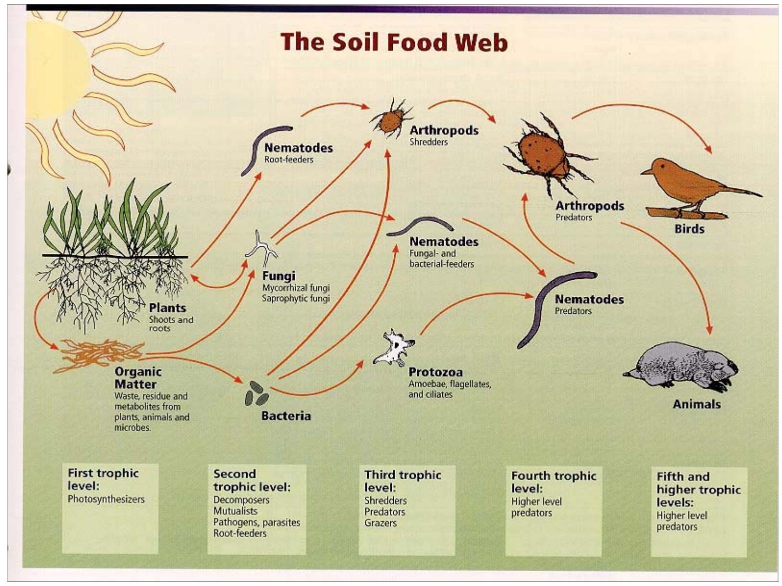


Figure 2. Available water content with increasing soil organic matter (6).

SOM/Compost Contributions to Physical Properties

- **Rodale Institute: 1 lb of carbon can lead to 40 lbs of water held**
- **OM is about 40% carbon.**
- **So, 1% OM = 20,000 lbs OM/ 40%C =8000 lbs C x 40 lbs water/lb C = 320,000 lbs water = 40,000 gallons**
- **10 ton/acre OM ~= 40,000 gallons per acre extra water holding capacity?**



Compost Uses and Application

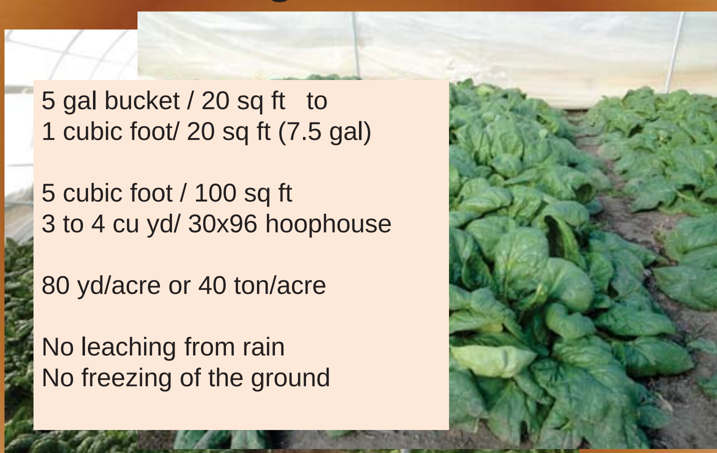
- Transplants
- High Tunnels
- Field Production
  - Higher rates
  - Lower rates

Soil Blocks

Compost Top Dressing

Compost Extracts or Tea

High Tunnels



5 gal bucket / 20 sq ft   to
1 cubic foot/ 20 sq ft (7.5 gal)

5 cubic foot / 100 sq ft
3 to 4 cu yd/ 30x96 hoophouse

80 yd/acre or 40 ton/acre

No leaching from rain
No freezing of the ground

With Manure Spreader

Factors influencing application rate include tractor speed, spreader settings and compost characteristics (moisture)

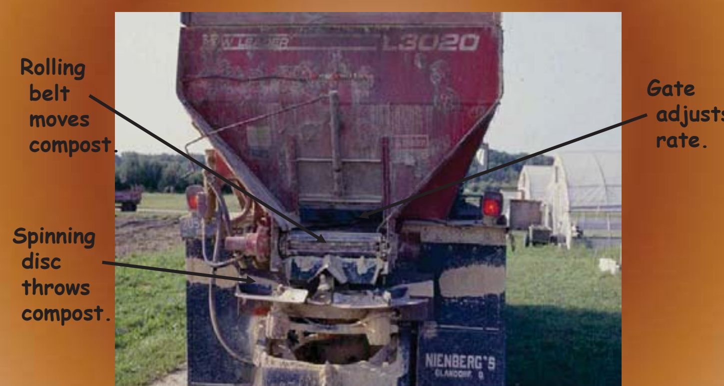
Uniform application can be a challenge, particularly at low rates. How uniform is necessary?

It is easier to see the uniformity of application on a cultivated field,

compared to a field with crop residue.

For lower rates of application, lime or fertilizer application equipment may be more practical.

Distribution is influenced by the weight and moisture content of the compost.



How much does it cost to purchase and apply compost?

How does the cost of purchasing compare to the cost of making compost?

Cost Estimates and Examples
(Assumes bulk density is 1000 lbs/yd moist.)

Rate	$ / Ton	$ / cu yd	$ / acre
1 ton	50	25	50
5 tons	50	25	250
10 tons	50	25	500
20 tons	50	25	1000

Composting Methods – So Many Options!

Fast or Slow? Patient or No?

Cool or Hot? Seeds or not?

Shallow Sheet or Piled Deep?

Walled Containers, Open Piles or Long & Winding Windrows?

Turned Weekly or Weakly Turned?

Pitchfork or Loader or Dedicated Turner?

Data from Will Brinton – Composting for Sustainability

Method	Cow Manure @ 120 Days		Poultry Manure @ 150 Days		Cost in $/wet ton
	Organic Matter Loss (%)	Nitrogen Loss (%)	Organic Matter Loss (%)	Nitrogen Loss (%)	
No-Turn	70	51	75	72	$3.05
Bucket Loader	78	60	79	76	$6.74
Turner at each 2 wk	73	53	79	78	$14.34
Turner 2x per week	80	64	88	86	$41.23

Pallet Compost: hay, straw, wood shavings, peat, etc – after 7 months with no turning or mixing but water has to be added.

January 2007

Pile made April 8, 2006
Picture Sept 27, 2006
6 months, no turning

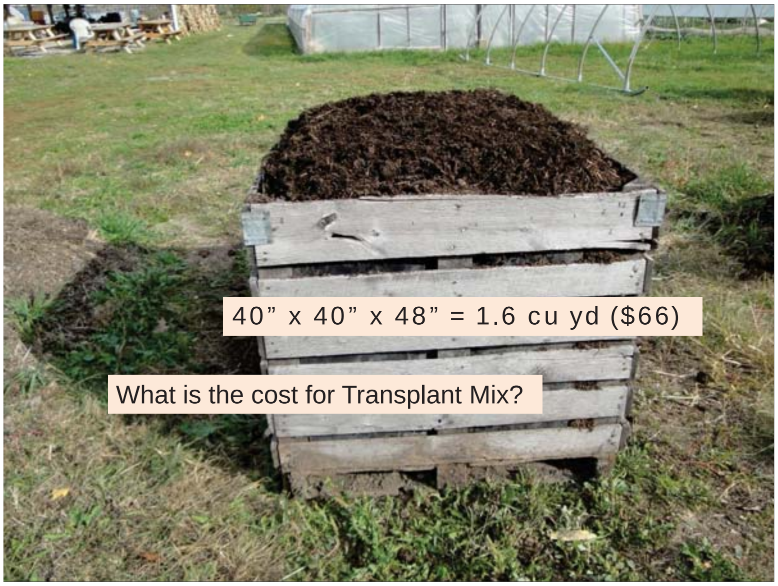
1 bale of each + ~ 100 gal water
Each ¼ bale absorbed about 5 gallons
160°F in 3 days (October 10, 2011)

Pear Tree Farm Transplant & Tea Mix

Amount of comfrey and soil shown used per bale of others.

These components are readily available to make a very reproducible mix, low N, good fungal activity

Cleaned up with a pitch fork, heats well.


40” x 40” x 48” = 1.6 cu yd ($66)
What is the cost for Transplant Mix?


Wayne Davis
Quality Bedding
Premium Wood Shavings
Kiln Dried
Organic
CANADIAN SPHAGNUM
PEAT MOSS
68


Wayne Davis
Quality Bedding
Premium Wood Shavings
Kiln Dried
Fafard
Organic
CANADIAN SPHAGNUM
PEAT MOSS
All Natural Solution
3.8 cubic feet 107 liters
69


PEAT MOSS
Organic
CANADIAN SPHAGNUM
70


72


July 16, 2008

Compost Example

Material	Quantity	$/Unit	$ Total	Est. cu yd
straw	40 bales	$3.00	$120	15
wood shavings	20 bales	$5.00	$100	6
sphagnum peat	10 bales (3.8)	$12.00	$120	2.5
alfalfa hay	20 bales	$4.00	$80	7
grass hay	20 bales	$3.00	$60	7
leaf mold	8 cu yd	15	$120	15
veg/weed “compost”	8 cu yd	10	$80	10
field soil	8 cu yd	5	$40	5
Total			$720	68

Small Batch Compost Example

Material	Lbs/cu ft (dry)	Cu ft comp/use	Lbs	% N	Lbs N	% C	Lbs C	Cost ($)
1 Grass hay (G)	9	5.5 / 7	40	2.0	0.8	45	18	1 @ $3
1 Alfalfa hay (G)	9	5.5 / 7	50	3.0	1.5	45	23	1 @ $4
2 Straw (B)	10	10 / 14	60	0.7	0.42	50	30	2 @ $3
2 Wood Shavings (B)	15	6.5 / 16	80	0.18	0.14	55	44	2 @ $5
2 Aged Leaves (B)	15	6.5 / 8	100	1.0	1.0	40	40	2 @ $2
Spaghnum Peat (N)	8	3.8 / 6	(40)					$10
Soil (N)	80	3.8 / 3.8	(300)					$3
Total		42 / 62	750		3.86		154	$40/yd

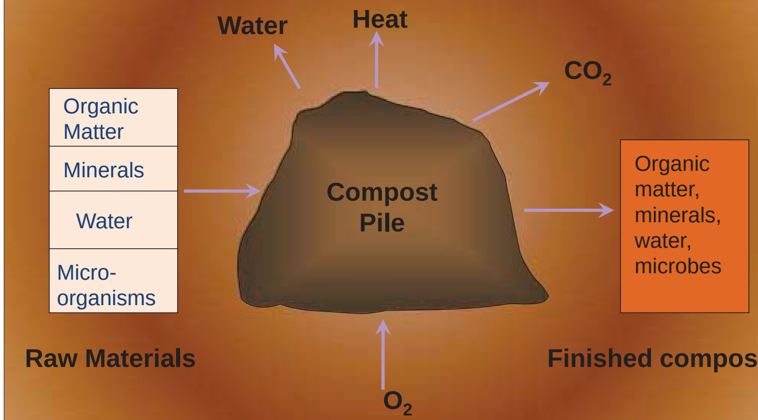
Windrows For Large Scale

Large Scale Windrows

Unfed or Molded Hay

Lots of Straw Roundbales

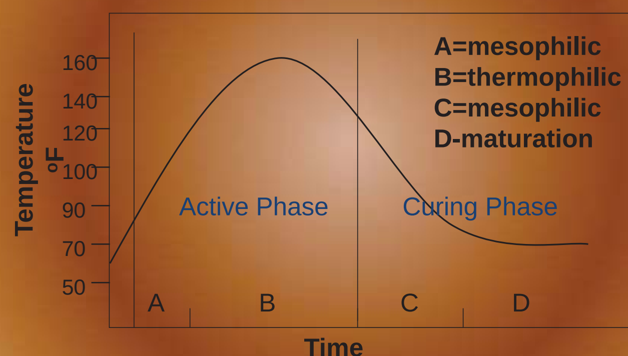
The Composting Process



Seven Manageable Factors

- What Microbes are present
- Substrate Carbon:Nitrogen Ratio
  - Density (weight), moisture
  - Availability, particle size
- Oxygen (Porosity and Bulk Density)
- Moisture
- Temperature
- pH
- Time

Microbial Populations Change Over Time



Which microbes?

- Bacteria
- Actinomycetes
- Fungi
- Amoeba
- Protozoa
- Nematodes
- Together are the "Soil Food Web"

Manageable Factors and Organisms

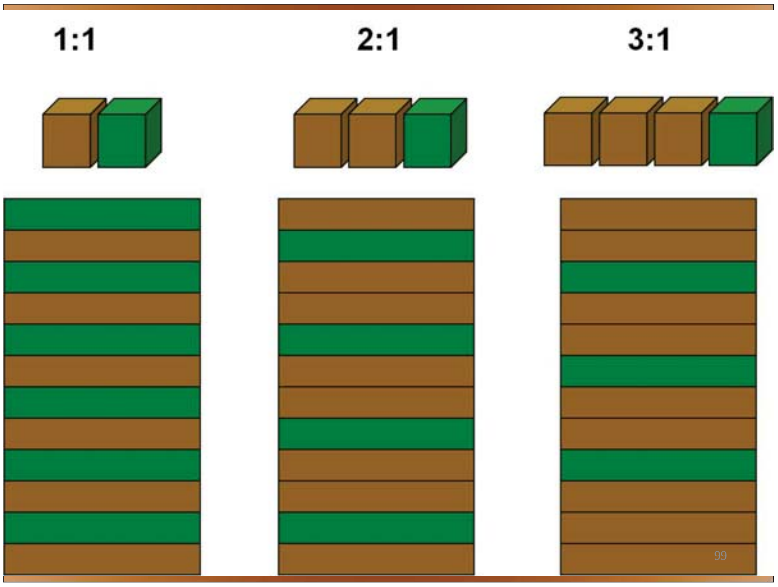
Factor	Bacteria	Fungi
C:N	Favored <20:1	Favored > 25:1
Water	High Moisture	Low Moisture
Oxygen	Survive low O_2	Need >6%
Temperature	Up to 170F	Most < 140F
pH	Slow at <5	Ok at pH <5
Time	Faster Reproduction	Slower Reproduction

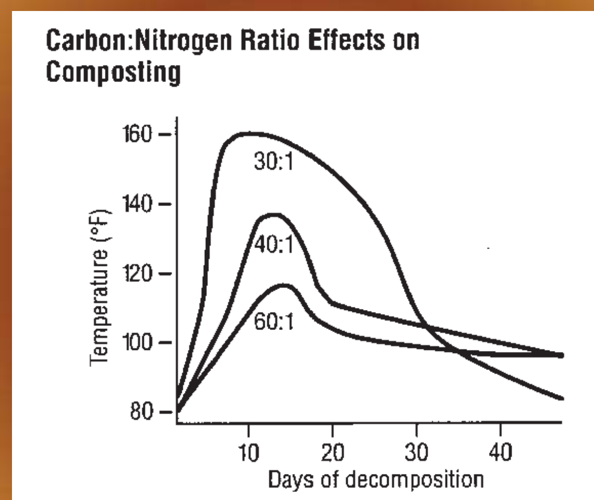
C:N of Manure Varies by Diet
grass vs alfalfa vs grain

Ease with which carbon compounds are broken down:

- **Carbohydrates**
- **Hemicellulose**
- **fats/oils**
- **cellulose, chitin**
- **lignin**

Easy → Hard



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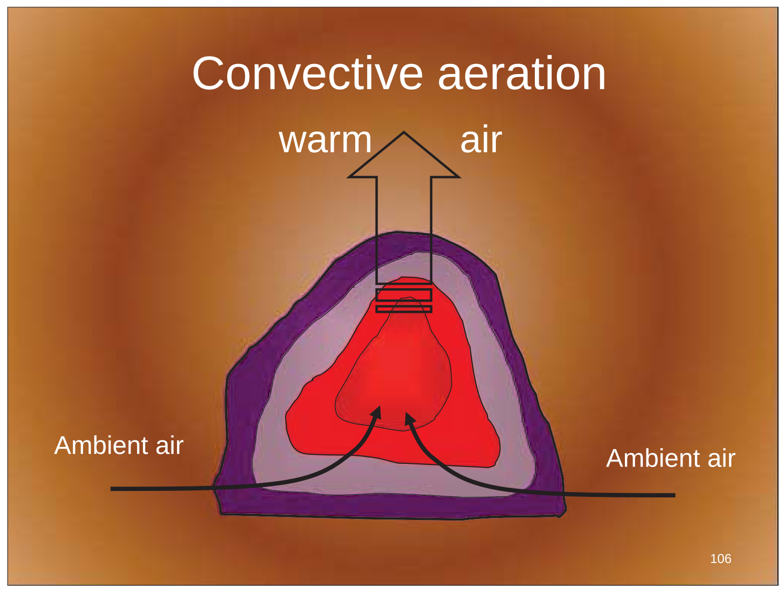
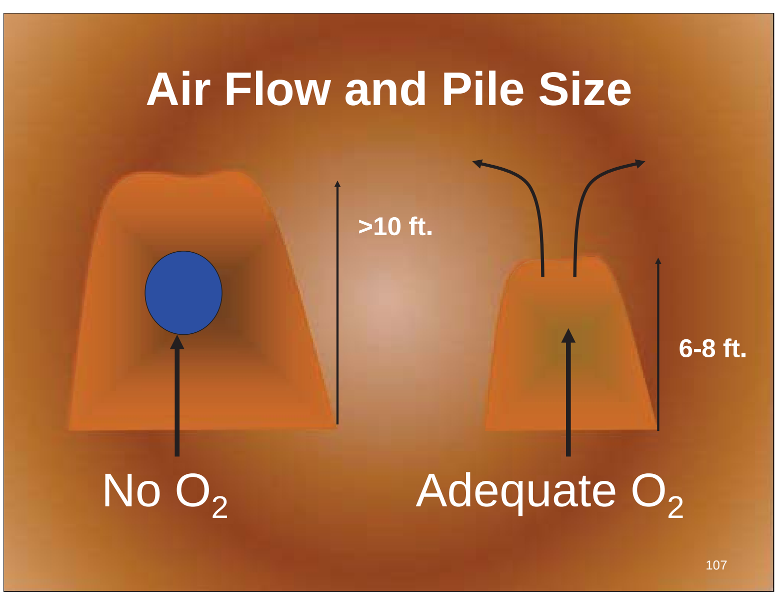
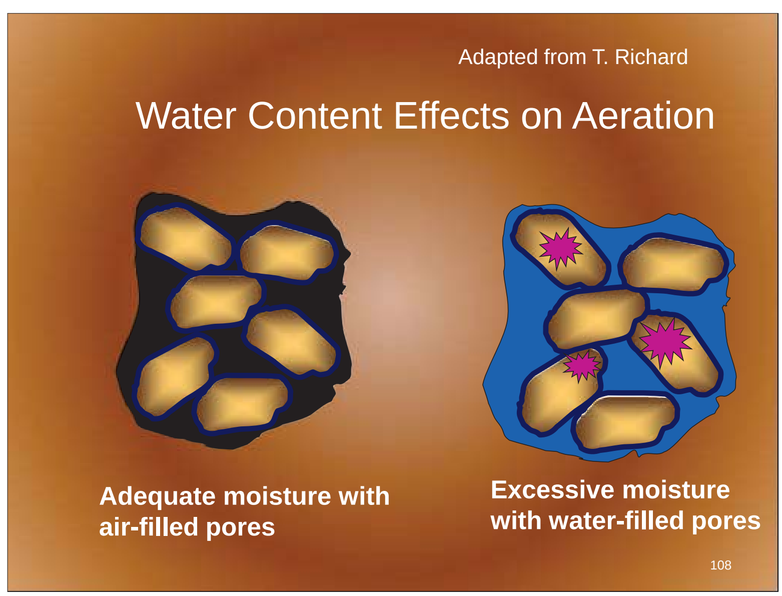

Convective aeration
warm air
Ambient air
Ambient air
106


Air Flow and Pile Size
>10 ft.
6-8 ft.
No O_2
Adequate O_2
107


Adapted from T. Richard
Water Content Effects on Aeration
Adequate moisture with air-filled pores
Excessive moisture with water-filled pores
108

Summary: Manageable Factors

- **Microbes**
- **Carbon:Nitrogen**
  - **Density (weight), moisture**
  - **Availability, particle size**
- **Oxygen (Porosity and Bulk Density)**
- **Moisture**
- **Temperature**
- **pH**
- **Time**

The Composting Process