



UNIVERSITY OF ILLINOIS
EXTENSION

**GROWING A NEW GENERATION
OF ILLINOIS FRUIT AND VEGETABLE FARMERS**

COMPOSTING

Ellen Phillips
June 2015

Illinois Migrant Council



Today's Objectives

- **Compost**
- Rules and Regs
- Methods of Composting
- Key Factors in Composting
- Using Compost



- **Compost:**

Organic residues, or a mixture of organic residues and soil, that have been mixed, piled, and moistened, with or without addition of fertilizer and lime, and generally allowed to undergo thermophilic decomposition until the original organic materials have been substantially altered or decomposed.

Sometimes called "artificial manure" or "synthetic manure." In Europe, the term may refer to a potting mix for container-grown plants.

- **Composting:**

A controlled biological process which converts organic constituents, usually wastes, into humus-like material suitable for use as a soil amendment or organic fertilizer.

Soil Science Society of America: Soil Glossary

<https://www.soils.org/publications/soils-glossary#>



Compost Benefits to Soil

- Improves soil structure and strength, increasing porosity and decreasing compaction
- Decreases bulk density
- Increases water infiltration, permeability and increased water holding capacity
- Increases cation exchange capacity
- Encourages soil biological community
- Modifies pH
- Suppresses plant diseases



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Local Municipality Rules/ Codes

- Does a compost pile require a license or approval?
- May have special requirements on location of bins, types of bins, etc.
- Some don't allow food scraps

Illinois EPA Composting Permit NOT Required if...



- Your farm/stable
 - your manure.
 - no additions to compost pile brought from off the farm.
- No setbacks for active composting area.
- Site is located on the farm in which the compost is applied.
- Site is operated by the farmer of the property.
- Farmland is in production of crops annually.
- Size of the compost site is less than 2% of the acreage of the property.



www.cityofchicago.org/city/en/depts/streets/supp_info/composting/composting_ordinance1.html



City of Chicago The City of Chicago's Official Site

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Recycling & Waste Management

Supporting Information Facts

Department:
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Sanitation and Waste Reduction (Garbage, Street Sweeping, Recycling, and Zero Waste)

People We Serve:
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Composting in Chicago

Composting turns organic waste such as leaves, food scraps, and lawn clippings into a dark, soil-like natural fertilizer. Learn about the City's composting ordinance and explore how you can compost in Chicago:

- **Composting Ordinance**
Read how this ordinance regulates small-scale compost operations.
- **Residential Composting**
Explore home composting programs and resources.
- **Commercial Composting**
Learn about companies that provide commercial composting services.

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Organic Rule for Compost



- process that combines plant and animal materials with
- in-vessel or static aerated pile system
 - must maintain at a temperature between 131 °F and 170 ° F for 3 days.
- windrow system
 - must maintain at a temperature between 131 °F and 170 °F for 15 days, during which time, the materials must be turned a minimum of five times

www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=2fbb9d9e19ad3c5e3266d55fec8743a9&mc=true&n=sp7.3.205.c&r=SUBPART&ty=HTML#se7.3.205_1201



Organic Guidelines

- The guidance document allows compost if
 - more flexibility in how compost piles are constructed and monitored.
 - assuming acceptable feedstocks are used
 - if the compost achieves 131°F for three days
 - the pile is mixed or managed to ensure that all of the mixture achieves this temperature
- the organic rule does NOT require that manures come from organic livestock farms to be used in organic compost production.
- National Organic Standards Board (NOSB) [addendum](#) (NOSB, 2010)

Finished Compost



- Field application based on nutrient application
- Illinois rules for applying compost
 - No setbacks
 - No permit for application
 - Default rate of 20 tons/acre/year
 - Applying more requires Illinois EPA permission

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Vermicomposting

Compost produced using red-wiggler worms to decompose materials

National Organic Program compost requirements can also be met by vermicompost

Requirements:

- a. It is made from allowed feedstock materials
(either nonsynthetic substances not prohibited at §205.602, or synthetics approved for use as plant or soil amendments);
- b. Aerobicity is maintained by regular additions of thin layers of organic matter at 1–3 day intervals
- c. Moisture is maintained at 70–90%
- d. The duration of vermicomposting is at
 - a. 6–12 months for outdoor windrows
 - b. 2–4 months for indoor container systems
 - c. 2–4 months for angled wedge systems
 - d. 30–60 days for continuous flow reactors

~ NOP, 2010b



In-Vessel Composting

- Uses a motor to turn
- Very rapid process
- Relatively high cost
- Can use everything from small barrel to cement mixer or larger



www7.tamu-commerce.edu/agscience/res-dlc/horse/horse.html

www.mn.nrcs.usda.gov/partnerships/pembina/in-vessel_composter.htm

Passively aerated windrows



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Tube for air flow
Either **inflow** or
suction

- Mixed materials built on bed with aeration tubes embedded
- Normally not turned
- Not as uniformly composted
- Aeration by mechanical blowers or vacuum
- Composting ~ 30 days
- Followed by curing ~ 30 days

Piles/ Windrow

- Flexible size
- Hand or machine turned



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Rotting vs. Composting

Decompose

- *verb* de·com·pose \,dē-kəm-'pōz\
: to cause something (such as dead plants and the bodies of dead animals) to be destroyed and broken down by natural biological processes, chemicals, etc.

<http://www.merriam-webster.com/dictionary/decompose>



Microbe Mix

- Bacteria
 - Primary decomposers
 - Create the heat in the pile
- Fungi
 - Primary decomposers
 - Better at decomposing wood materials
 - Important in curing and binding particles together
- Biological community
 - Everything else
 - Add soil to compost pile to inoculate

What do they need
live and multiply?

- Water films to live in
- Source of food
 - Need carbon for energy
 - Need nitrogen for proteins
- Need air

*Composting Goal!
Keep them happy and multiplying*

Passive/ Inactive/ Cold Compost

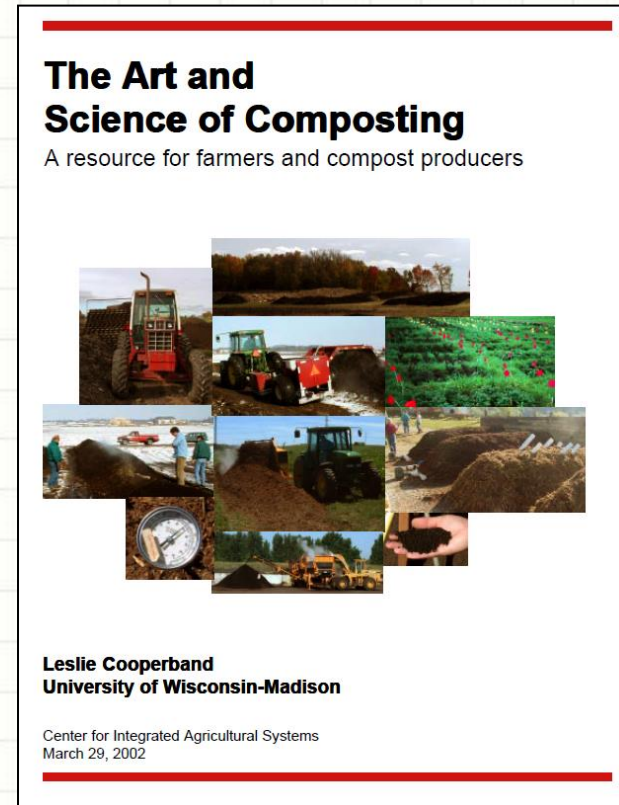
- Pile of organic materials left alone to decompose over an extended period of time
- may or may not use a compost recipe
- no attempt to adjust moisture content or the C:N ratio
- not aerated
- temperatures are not monitored
 - Pile may not heat to kill pathogens or weed seeds
- May turn anaerobic
 - Foul odors
- ***not approved for certified organic production.***

Active/ Hot Composting

- Encourage microbes to multiply and decompose organic materials
- Pay attention to:
 - Pile Size
 - Carbon to nitrogen ratio
 - pH
 - Moisture content
 - Aeration
 - Temperature

Sources of information

- Midwest Extension Composting School
 - Focus on the science of large-scale composting



www.cias.wisc.edu/wp-content/uploads/2008/07/artofcompost.pdf

The Composting Process

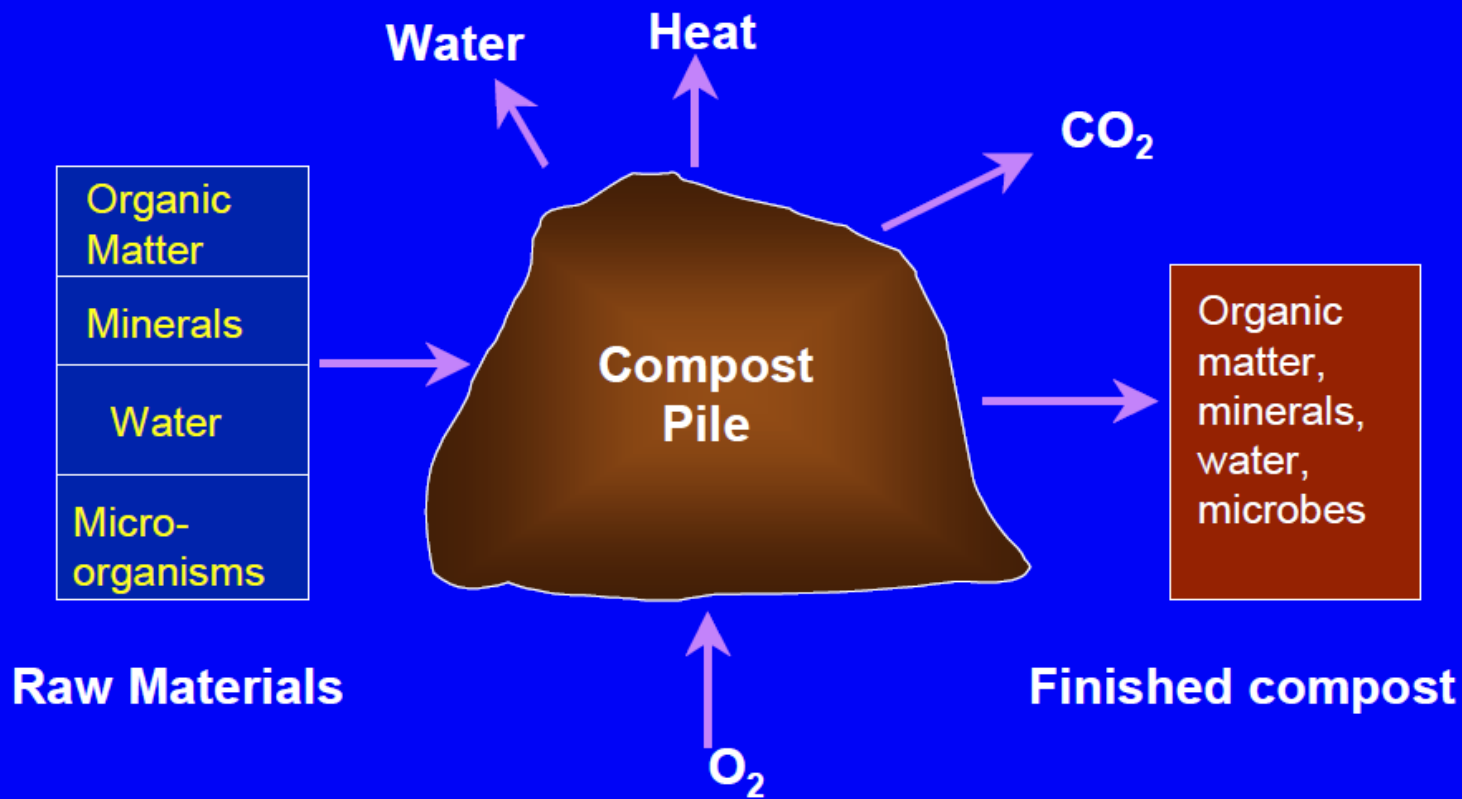


Figure 1. The Composting Process. Adapted from Rynk,

Recordkeeping

- Compost recipe
- Daily temperatures
- Moisture content
- Oxygen content
- Turning
- Curing time
- Use

Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- Aeration
- Temperature

Bins/ piles/ rows



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Bin Construction

- Bin size
 - Depends on equipment - width fit to your equipment
 - Minimum 3'x3', any length
 - Maximum – what equipment can turn 10'x10', any length
- Bin materials
 - Any materials
 - Do not need a bin, piles can do fine
 - A roof/ tarp gives control over moisture
- Durable slab
 - May be required depending on site conditions
 - Makes it easier to use equipment
- Water available to adjust moisture



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Where should the pile/row go?

- Away from surface water
- Space to turn equipment
- Access in bad weather
- Shade doesn't matter (heat comes from microbes)



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Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- Aeration
- Temperature

Carbon to Nitrogen Ratio

(What to put in the pile)

- Desired C:N ratio for pile 30:1
- Follow compost recipe
 - <http://www.klickitatcounty.org/solidwaste/fileshtml/organics/compostcalc.htm>
 - <http://compostingtechnology.com/resources/compost-calculator-tool/>
- **Don't add:** meat, dairy, oil based items, weed seeds, diseased plant materials, pet waste

web.extension.illinois.edu/manureshare

University of Illinois Extension **Manure Share**

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Illinois Manure Share is a free program that benefits livestock owners, gardeners, landscapers and the environment! It is a manure exchange program that brings gardeners and landscapers searching for organic materials for use in composting or field applications in contact with livestock owners who have excess manure.

The program's goal is to remove the manure from farms that do not have the acreage to adequately utilize its nutrients on their fields or pastures. This benefits water quality by removing excess nutrients from farms and by lowering the amount of commercial fertilizer used by gardeners and others.



How Does the Program Work?

For Farms with Manure To Remove

For Those Wanting Manure



Culls and other food/ produce waste

- Problems

- High moisture content resulting in wet pile and large amount of leachate
- Sometimes hard, thick shells, rinds, etc. that do not readily decompose
- Odor production -- mainly ammonia



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- Solution

- Absorb moisture by mixing with a bulking agent to increase density
 - Use high C:N ratio materials such as leaves, sawdust , shredded newspaper
- Check pile regularly for leachate, turn pile to distribute moisture
- Leachate can be reapplied to the compost
- Grind into finer materials for even distribution in pile and greater distribution of composting microbes to speed up decomposition
- Also, reduces animal interference with the pile
- Reduce Odor - good aeration is critical

Produce/ Food composting

- Need Grinder
- Dry, high carbon materials



Building pile

- Add soil to inoculate with microbes
- Mix/turn materials well
- May need to add nitrogen fertilizer to balance C:N
- Should heat up within hours



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Once a pile – it's a pile

Don't add anything else

Or

It won't finish composting!



C:N ratio of finished compost

- Finished Compost
 - C:N < 20:N will be released
 - C:N > 30:N will be tied up
 - C:N = 20:1-30:1 very slow release of N

Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- Aeration
- Temperature

pH

- pH indicates acidity or alkalinity
- pH affects nutrient availability and microbial activity
- Ideal compost between 6.0 – 8.0
- Compost range pH 5.5 – 9.0
 - Depends on source materials, compost process
 - Lime can be added to adjust pH higher
- Most manure composts have a pH of 7 or higher

Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- Aeration
- Temperature

Moisture content

- Optimal range 46% - 65%
- Monitor with moisture meter or by hand
- Dry
 - Not enough water for bacteria to live
 - Decomposition slows down
 - Solution: Add water
- Wet
 - Not enough air for microbes
 - Odor due to anaerobic digestion
 - Decomposition slows
 - Solution: turn pile, add dry materials



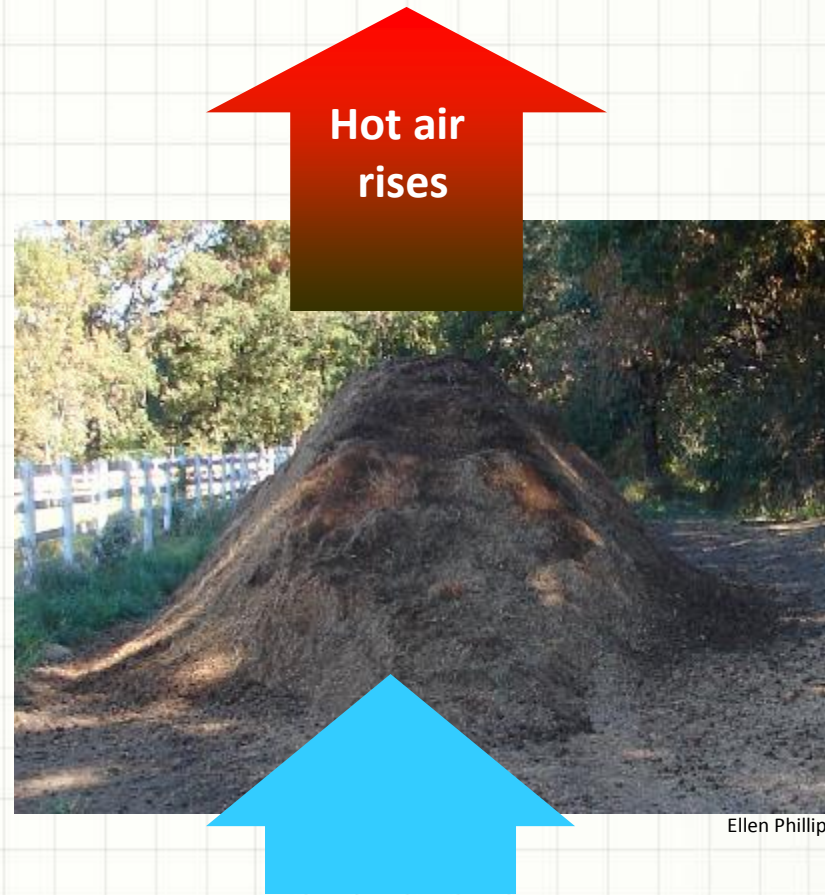
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Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- **Aeration**
- Temperature

Oxygen Content

- Atmospheric oxygen -21%
- Oxygen levels in compost air
 - < 6%, microbes die, odor
 - **Optimal 10-16%**
 - > 16% to minimize odors
- As pile heats up, more oxygen will be consumed



Adding air

- Heat in pile
- Turn pile
- Increase bulk density
- Put in air tubes (PVC pipes)

Key Factors in Composting

- Pile Size
- Carbon to nitrogen ratio
- pH
- Moisture content
- Aeration
- Temperature

Temperature

- Moisture moderates wide swings in temperature
- Monitor with a compost thermometer
- OPTIMAL temperature
 - 130 °F – 150 °F
 - heat-loving (thermophilic) bacteria vigorously decompose organic materials
- Pathogen reduction
 - 131°F pathogens are destroyed
 - 145°F fly larvae and most weed seeds are destroyed



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Temperature

- Low temperatures $<130^{\circ}\text{F}$
 - Microbes have run out of food
 - Solution: turn pile
- Excessively high temperatures
 - $> 160^{\circ}\text{F}$
 - Microbes begin to die
 - Solution: turn pile



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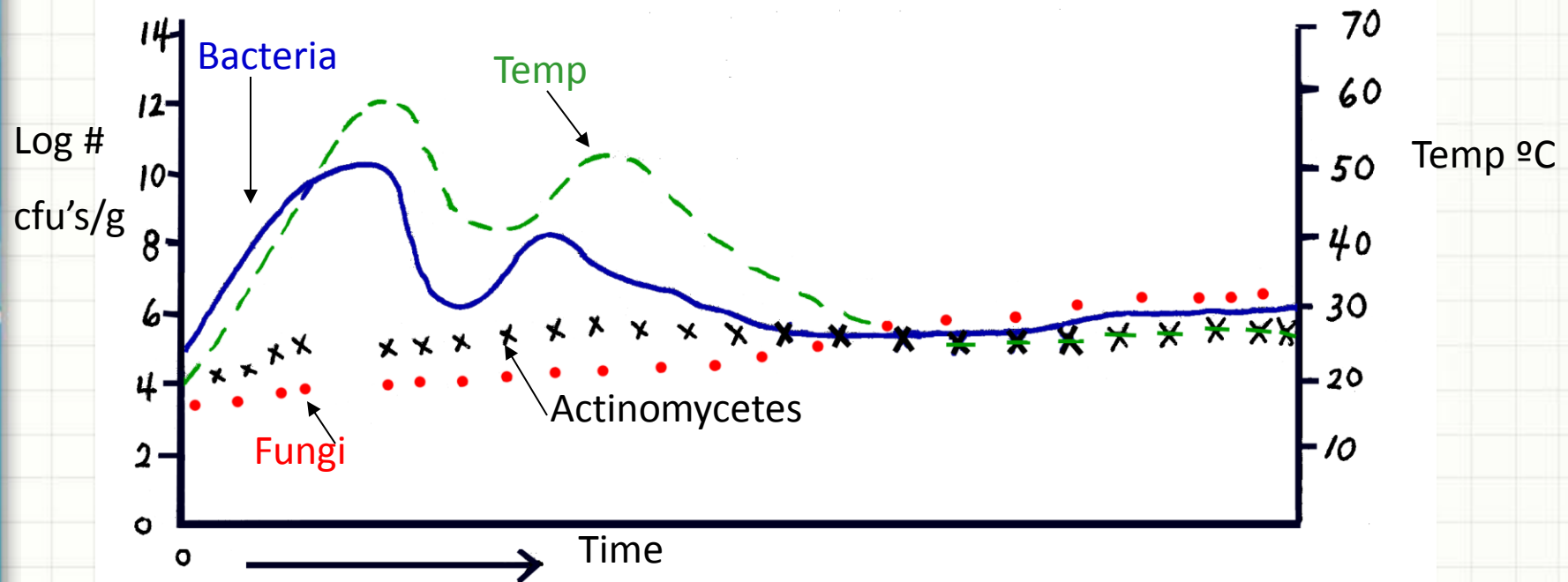


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Microbial Population Dynamics During Composting



$$F = C^{\circ} \times 1.8 + 32$$

Curing

Curing

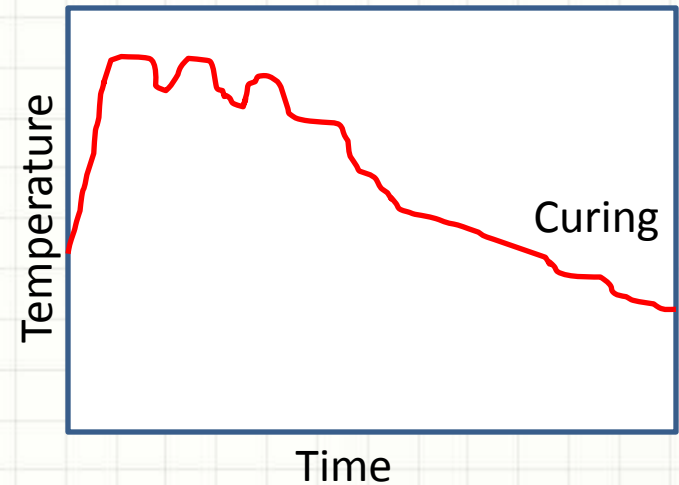
- Let it set
- Minimal time 1 month
- Reduces organic acids and other chemicals

Caution

- don't let pile go anaerobic

End

- Pile remains at air temperature
- Depends on intended use



<http://solvita.com/compost.html>



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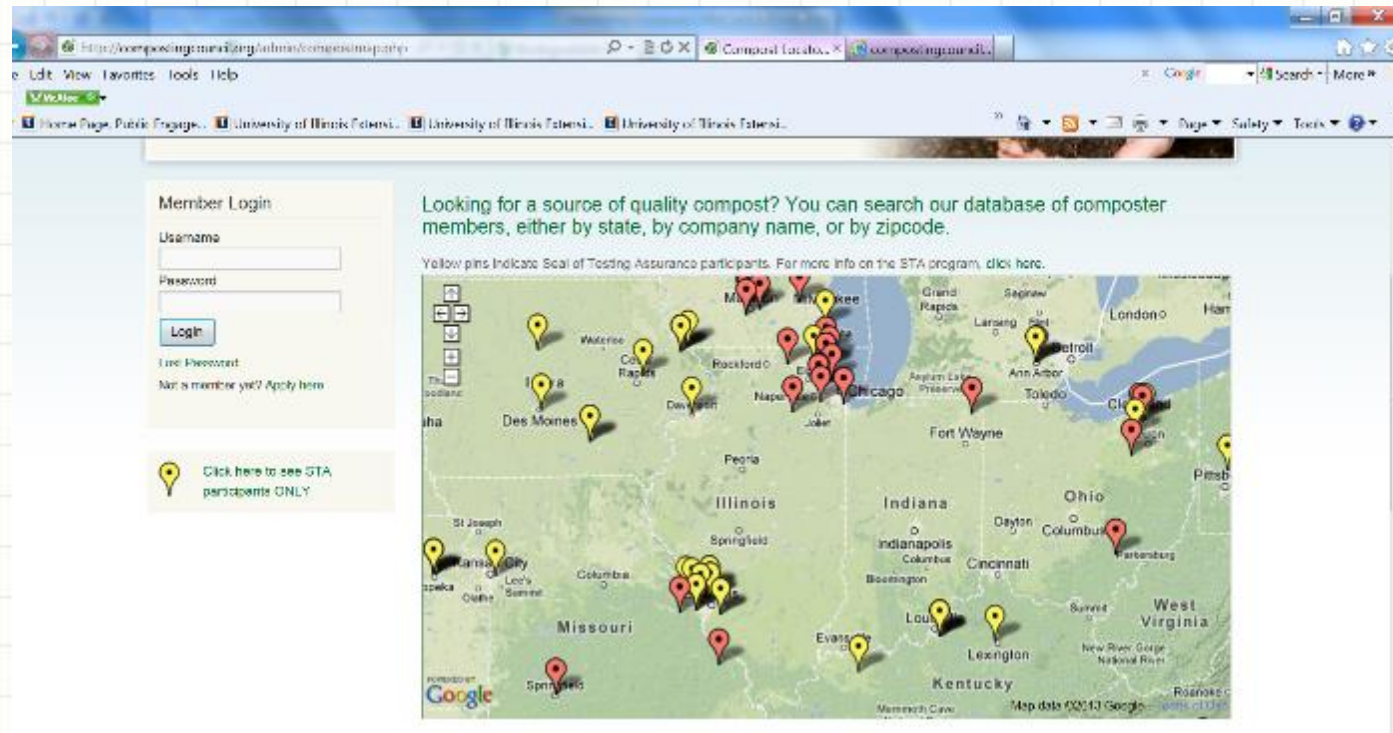
Today's Objectives

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Buying Compost

- Ask for compost test results
- Buy the correct grade of compost



compostingcouncil.org/admin/compostmap.php

Free Compost?

- If compost isn't produced in a satisfactory way *with records*
 - precautions similar to those for raw manure should be used when applying it



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Finished Composted

- Once compost is finished, cover the pile to protect it from contamination.



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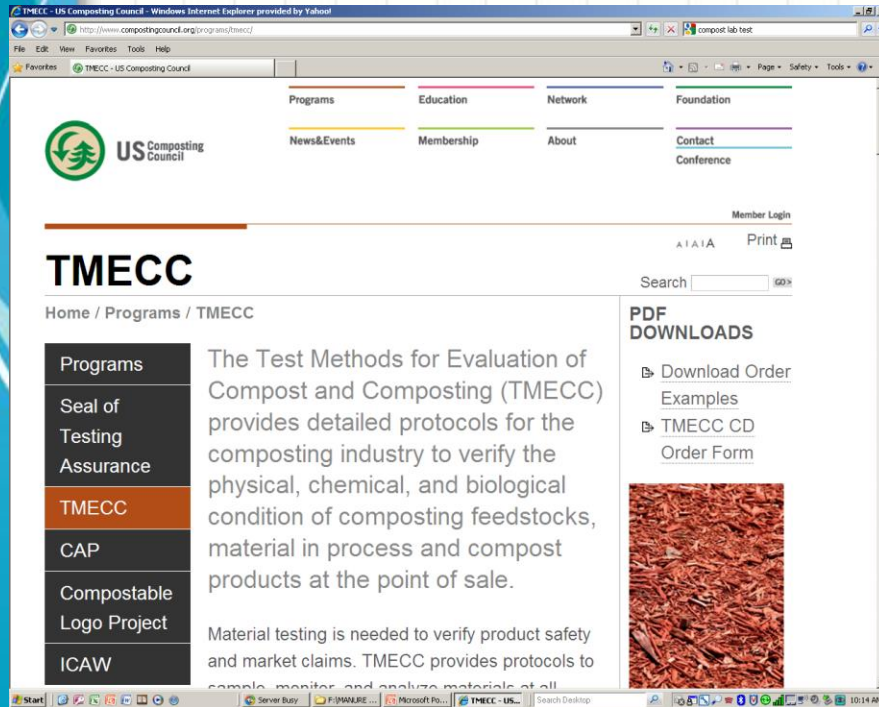
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GAPs for using Compost and Teas

- Manure and compost application rules are being evaluated, should be released fall 2015
- No manure teas
- Compost tea
 - safety dependent on compost used and protection from contamination
 - Heat treatment possible to lower microbial risks
 - Not recommended for GAP

Composting Council Seal of Testing Assurance

www.compostingcouncil.org/programs/tmecc/



Certified Compost Products analyzed for:

- pH
- soluble salts
- nutrient content (total N, P2O5, K2O, Ca, Mg)
- moisture content
- organic matter content
- bioassay (maturity)
- stability (respirometry)
- particle size (report only)
- pathogen (Fecal Coliform or Salmonella)
- trace metals (Part 503 regulated metals)

Compost testing

- Many labs
- Cost
 - \$30-400

Typical Compost Analysis

(dry weight basis)

- Total N: 3%
- NH₄-N: 500 ppm
- NO₃-N: <2 ppm
- Total P: 0.88%
- Total K: 0.83%
- pH; 7.2
- C:N ratio: 8:1
- Electrical conductivity: 3.5 mmhos/cm
- 503 metals: below EPA limits
- Moisture content: 40% water

U.S. Composting Council



Nutrient Availability from Compost

- Compost does not steadily release nutrients
 - During first year
 - 10 to 25% of compost N maybe plant-available
 - 40% and 60% for P and K may be available
- these are only estimates and actual availability depends on
 - quality of the compost
 - growing season environment that affects decomposition and N mineralization

<http://www.extension.org/article/18567>



Who's going to haul it?



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- 2" of compost per acre = 300 cubic yards or 150 tons



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Record keeping – Application

- Whenever compost is applied to your land, it is important to keep good records of:
 - the date
 - amount applied
 - nutrient content
 - soil test results
 - weather conditions

Selling Compost

Fertilizer Or Soil Amendment?

Watch your wording!

- Before selling compost check:
 - Illinois Fertilizer Act
 - Illinois Soil Amendment Act
 - Composting Permitting laws



Paul Walker

Illinois State University
compost




Summary

- Compost is an excellent soil amendment
- Know the Rules and Regs for composting in your municipality
- Key factors in composting
 - Pile size
 - Moisture content
 - Temperature
 - Carbon to nitrogen ratio
 - Aeration
 - pH
- There are numerous ways to use compost

Resources

- **Chicago home composting**
www.cityofchicago.org/city/en/depts/streets/supp_info/composting/home_composting.html
- **Making and Using Compost for Organic Farming**
www.extension.org/article/18567
- **On-farm Composting**
http://compost.css.cornell.edu/OnFarmHandbook/onfarm_TOC.html
- **Commercial On-Site Food Composting Systems**
 - The Earth Tub, by Green Mountain Technologies:
<http://compostingtechnology.com/products/compost-systems/earth-tub> (external)
 - The WISErg Harvester: <http://wiserg.com/> (external)
 - The Worm WigWam: <http://wormwigwam.com/> (external)

web.extension.illinois.edu/compostingcentral/



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Composting Central

Resources for the composting of livestock manure, food scraps, and yard waste.



Composting for the Homeowner
This site gives an excellent indepth discussion of the science of composting, why it is important to compost, how to build a compost pile, and materials needed for composting.




COMPOSTING in the HOME GARDEN
Composting in the Home Garden
Another resource to help you compost. The compost trouble shooting section can assist with common problems.

Contact Us

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Small Farms Manure Management



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Credits

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Dairy

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Sheep & Goats

Swine

What resources are available?

Small Farms Manure Management is aimed at livestock producers with small facilities less than 300 animal units. Horse owners, stable owners and managers, beef operations, dairy, goat and sheep, poultry and swine farms will all find information related to the following topics:

- Composting Manure: How To; Rules; Manure Share website; Using Finished Compost
- Environmental Rules and Regulations – State and Federal
- Facilities: Mortalities, Manure Management; Odor; ER plans; Lot Management
- Manure Land Application: Odor,

Featured Items

2010-11 Certified Livestock Manager Training Workshop Schedule

December 14, 2010 Bloomington

January 11, 2011 Effingham

January 12, 2011** Breese

this workshop has a beef/dairy emphasis

January 19, 2011 Galesburg

January 20, 2011 Quincy

February 9, 2011** Freeport

this workshop has a beef/dairy emphasis

February 10, 2011 Sycamore

March 10, 2011 Springfield

Visit www.livestocktraining.com/ CLMT Workshops
Workshops for details.

web.extension.illinois.edu/manureshare/

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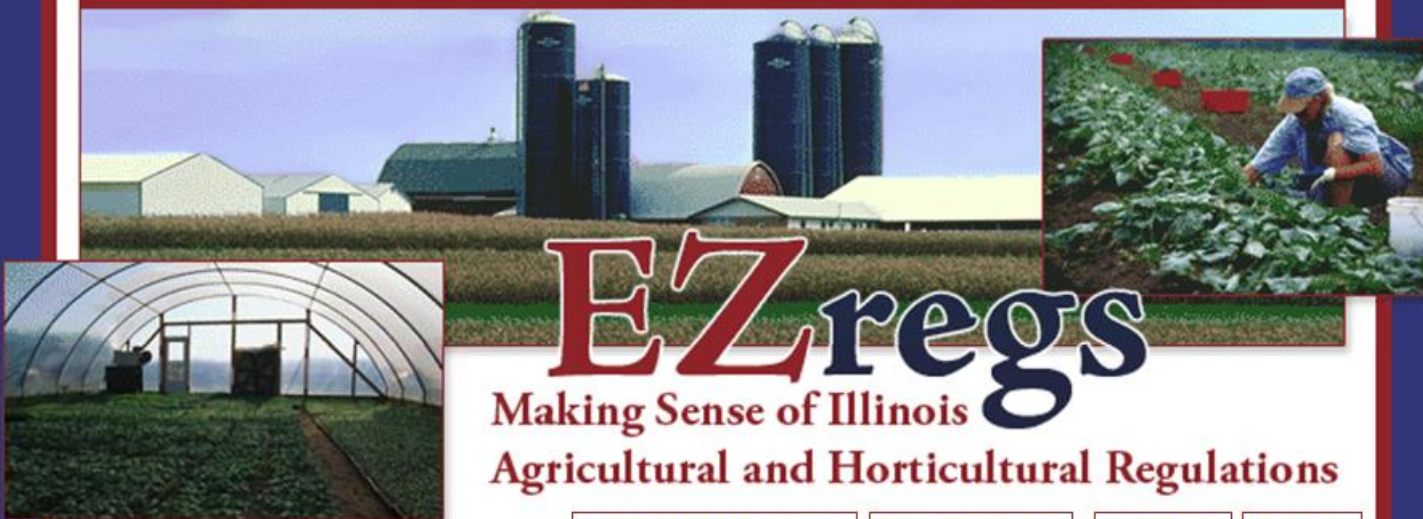
For Those Wanting Manure

See Manure Share Listings



web.extension.illinois.edu/ezregs/


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Making Sense of Illinois
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