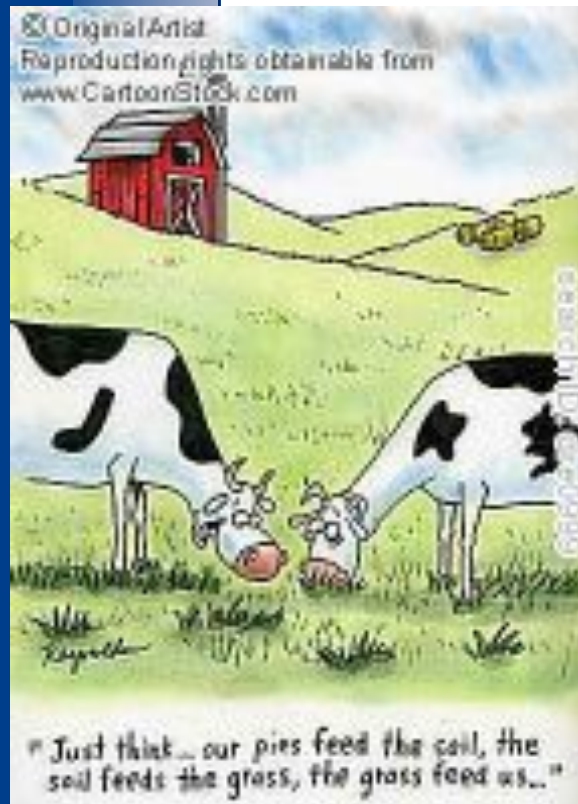




The Art of Composting ~ The Basics ~ Tin Mt. Conservation Center 5/23/13



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“A cloak of loose, soft material, held to the earth’s hard surface by gravity, is all that lies between life and lifelessness”

– Wallace H. Fuller, *Soils of the Desert Southwest*, 1975

- Why Compost
- How it works/the process
- Compost methods/design
- Concerns

A definition...

- “Composting is the practice of creating humuslike organic material outside of the soil by mixing, piling, or otherwise storing organic materials under conditions conducive to aerobic decomposition and nutrient conservation”

The Controlled decomposition of Organic Wastes

Transformation of raw waste materials into biologically stable humic substances



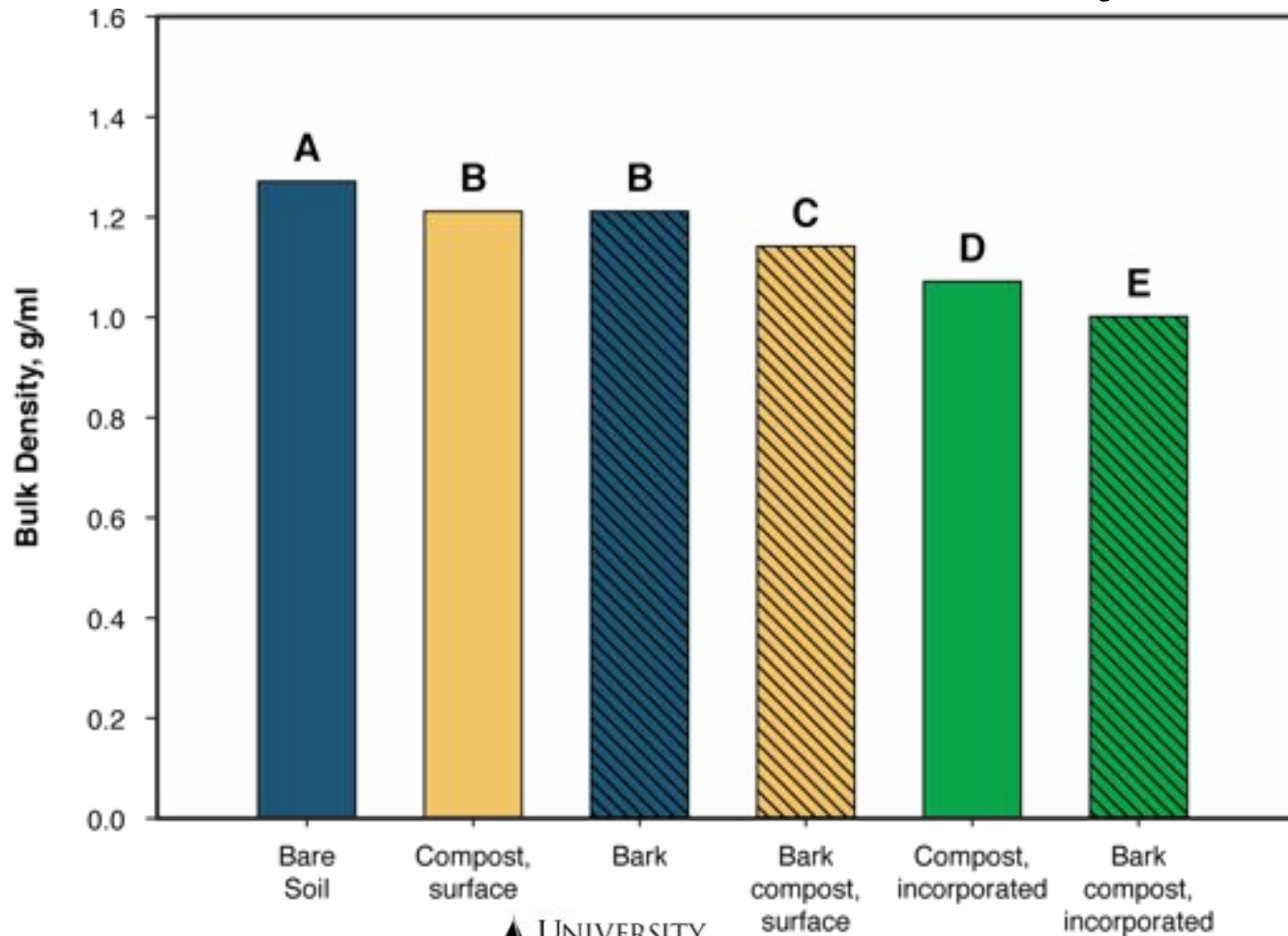
WHY

- Improve Soil Health
- Create high quality (slow release) fertilizers & soil amendments
- Lessen the reliance on commercial (imported) fertilizers, & water
- More resilient closed-loop system, captures nutrients that would otherwise be lost
- Produce energy & fertilizer through Anaerobic Digestion
- Destruction of weed seeds
- Reduced odors/nuisance complaints

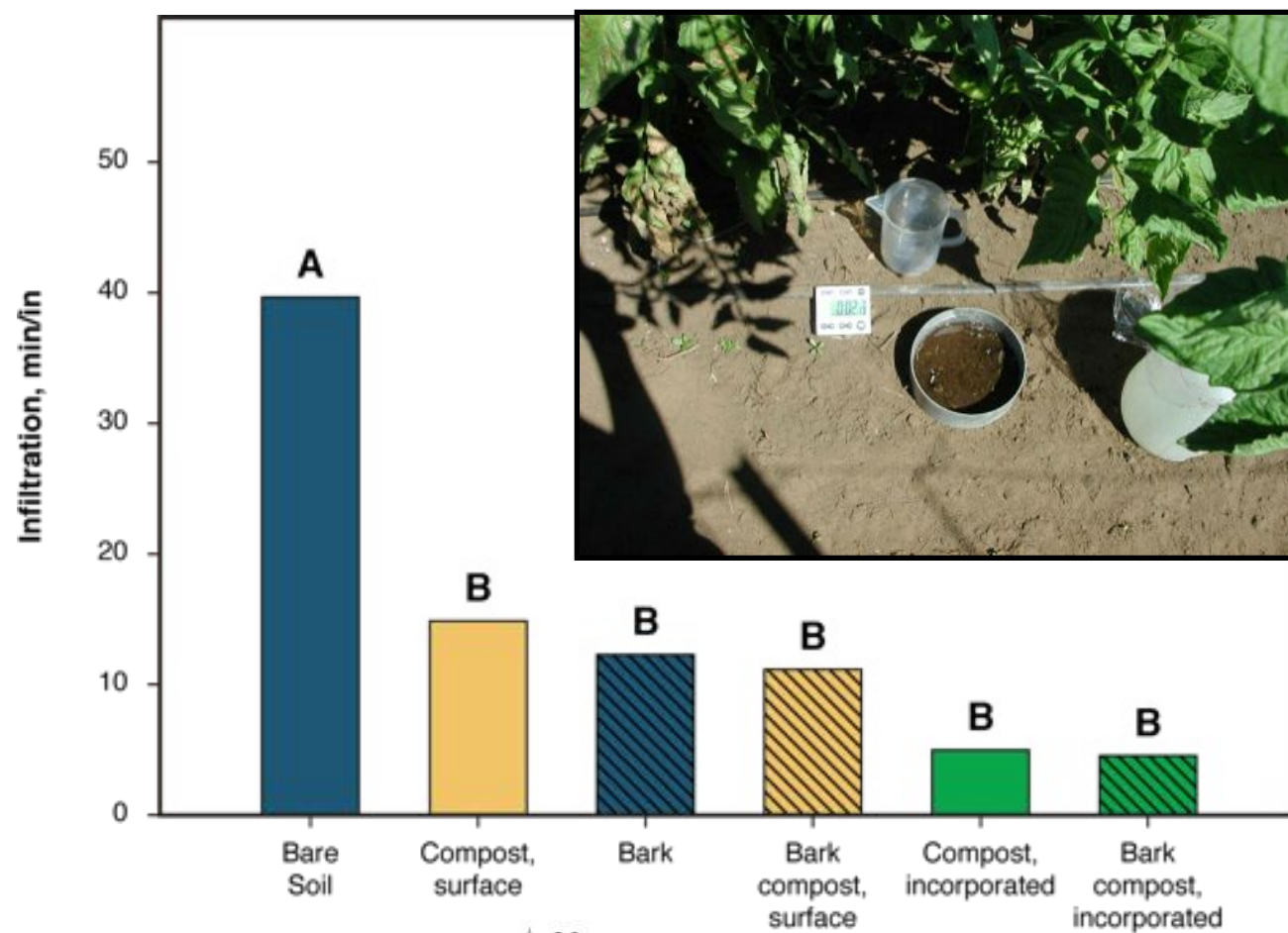
WHY

- Facilitate restoration of marginal soils
- Cost-effectively remediate soils contaminated by hazardous waste
- Avoids Methane and leachate formulation in landfills
- Serves as a marketable commodity and is a low-cost alternative to artificial soil amendments

Soil Bulk Density



Soil Infiltration rate



WHY

- Extends municipal landfill life by diverting organic materials from landfills
- Finite capacity of landfills
 - NH ban on yard trimmings in landfills
 - NH DES - **RSA 149-M** Solid Waste Management Act
- Proposal to ban commercial food waste from Massachusetts landfills in 2014
- Vermont House Bill 485 bans yard waste by July 2016, and all organic materials by July 1, 2020

The 3-Stage Process

1. Initial mesophilic stage
 - Sugars and readily nutrients consumed by microorganisms
 - Temperature gradually rises (ambient to 40°C)
2. Thermophilic stage (next few weeks/ months)
 - Temps rise to 50-60°C
 - Break down of cellulose, hemicellulose, proteins, fats & more resistant materials
 - Frequent mixing important during this stage

The 3-Stage Process

3. Curing - 2nd mesophilic stage

- Following several weeks or months
- Temp falls back to ambient
- Long, slow degradation of lignin and other resistant compounds, formation of humus



Five Primary Variables

- Feedstocks
- Particle Size
- Moisture
- Oxygen Flow
- Temperature



Feedstocks & Nutrient Balance

- Controlled decomposition requires a proper balance of
- “**Green**” organic materials (e.g., grass clippings, food scraps, manure)
 - *LOTS OF NITROGEN*
- “**Brown**” organic materials (e.g., dry leaves, wood chips, branches)
 - *LOTS OF CARBON* but little nitrogen
- Getting the right mix requires experimentation and patience and is part of the *art and science* of composting

'GREENS'

- Tea bags
- Grass cuttings
- Vegetable peelings (including lettuce and cabbage leaves)
- Old flowers



- Fruit scraps (including citrus peels)
- Nettles
- Coffee grounds & filter paper
- Spent bedding plants



- Comfrey leaves
- Rhubarb leaves
- Young annual weeds (e.g. chickweed and speedwell)
- Pond algae & seaweed (in moderation)



'BROWNS'

- Egg shells (crush them first to speed up composting)
- Egg boxes
- Cereal boxes
- Corrugated cardboard packaging (scrunched up in small amounts)
- Paper (scrunched up)
- Toilet & kitchen roll tubes
- Garden prunings
- Dry leaves, twigs & hedge clippings
- Straw & hay
- Bedding from vegetarian pets
- Wool



- Feathers
- Ashes from wood, paper, or lumpwood charcoal
- Woody clippings
- Cotton threads
- String (made from natural fibres)
- Tumble dryer lint (from natural fibre clothes)
- Old natural fibre clothes (e.g. woolly jumpers or cotton t-shirts – cut into small pieces)
- Vacuum bag contents (if you have natural fibre carpets)
- Tissues, paper towels & napkins (unless they have been in contact with meat, fats, oils or disease)



- Shredded confidential documents
- Corn cobs & stalks
- Pine needles & cones (slow to compost – don't put too much in)



Particle Size

- Grinding, chipping, and shredding materials increases the surface area on which the microorganism can feed.
- Smaller particles produce a more homogeneous mixture & improve pile insulation to help maintain optimum temperatures
- Particles too small may prevent air flow



Moisture

- Microorganisms need adequate amount of moisture to survive
- Water is the key element that helps transports substances within the compost pile and makes the nutrients in organic material accessible to the microbes
- Should feel as moist as a wrung out sponge
- Dry carbon layers can be watered as the pile is built, then with each turning, add more water as necessary.

Ideally, 40 - 60% moisture



Oxygen

- Turning the pile, placing the pile on a series of pipes, or including bulking agents such as wood chips and shredded newspaper all help aerate the pile
- Aerating speeds decomposition
- Too much oxygen will dry out the pile and impede the composting process



Temperature

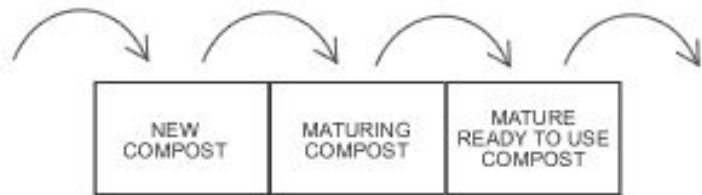
- Microorganisms require a certain temperature range for optimal activity
- Microbial activity can raise the temperature of the pile's core to at least 140° F (135°-160° F)
- If the temperature does not increase, anaerobic conditions (i.e., rotting) occur
- High Temp required for destruction of Pathogens
- Controlling the previous four factors can bring about the proper temperature

Temperature

National Organic Program (NOP) Standards for Compost				
OMRI Listed Category	Feedstocks	Time at 131°-170° F	Turning Frequency	C:N ration of initial uncomposted feedstocks
Compost (in-vessel, or Static Aerated)	Plant and/or animal materials	3 days	n/a	Between 25:1 to 40:1
Compost – Windrow	Plant and/or animal materials	15 days	5 times in 15 days	Between 25:1 to 40:1
Compost – Plant Materials	Plant materials only	3 days	Periodic	n/a

The End Product

- C/N ratio decreases until it is fairly stable
 - C/N of 10:1 to 20:1
- 50-70% of the initial carbon is lost during process
- Mineral nutrients mostly conserved
- Therefore finished compost = more concentrated in nutrients than raw materials
- 8-12 percent total nitrogen (N) is available the first year following its application
 - Nutrients from chemical fertilizer are nearly 100 percent available to growing plants





A note about herbicides

- Green Mountain Compost (and others)
- Positive sampling of trace amounts (less than 16 parts per billion) of herbicides Clopyralid and/or Picloram
- These systemic herbicides are typically designed for use in hayfields, horse pastures, golf courses, right-of-ways, and lawns to kill off unwanted weeds
- The Washington State Department of Agriculture banned the use of clopyralid on all turf, except for golf courses



More Prevalent Chemical Compounds	Less Prevalent compounds
Clopyralid (Dow Agrosciences)	fluroxypyr
Aminopyralid (Dow Agrosciences)	dopyralid
Aminocyclopyrachlor (DuPont)	triclopyr
Picloram (Dow Agrosciences)	

Not that easy...

- Despite the well-recognized value of compost the economics of composting may not always be favorable
- Composting operations can incur significant development & operating costs
- Facilities must be properly designed, operated, and monitored
- Need regulatory and public support to discourage unnecessary landfilling and promote the use of composting
- **How Can WE Support These Systems**
- 1) Financial support, reduced organic pickup costs, assistance to new compost producers
- 2) Directive
 - Ban on organics in waste stream
 - Legislative support for operations small & large

Lee's Living Will

If I should die before I wake
All my bone and sinew take
Put me in the compost pile
To decompose me for a while

Worms, water, sun will have their way,
Returning me to common clay
All that I am will feed the trees
The plants, the fishes in the seas

When radishes and corn you munch
You'll be having me for lunch
And then excrete me with a grin
Chortling "There goes Lee again!"

By Lee Hayes



"The soil is, as a matter of fact, full of live organisms. It is essential to conceive of it as something pulsating with life, not as a dead or inert mass."

- Albert Howard, *The Soil and Health*, 1947

Highfields
CENTER FOR
COMPOSTING



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Resources

- <http://www.epa.gov/waste/conserve/composting/types.htm#win>
- http://whatcom.wsu.edu/ag/compost/fundamentals/needs_temperature.htm
- <http://www.nesare.org/Dig-Deeper/Publications/Northeast-guides-books-and-videos/Marketing-On-Farm-Compost>
- <http://www.des.state.nh.us/organization/divisions/waste/swmb/index.htm>