

Compost: Characteristics and Uses

Southern New England Chapter of the Soil & Water Conservation Society

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Bear Path Farm (Whately, MA)
and UMass Amherst

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www.Agresourceinc.com



Agresource Inc.

Since 1984, providing organic waste management services to municipal and corporate clients

- Land application of biosolids, wastewater and water treatment residuals from municipal and industrial sources.
- Operation of regional composting facility in Ipswich MA
- Compost marketing services for municipal and private facilities



What is Compost?

Compost is a soil amendment that:

- Provides organic matter
- Supplies nutrients
- Stimulates microbial activity

Compost added to soil changes:

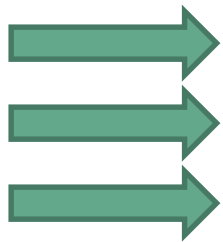
- Soil physical properties
- Soil chemistry
- Microbial activity



The Benefits of Using Compost

Improve soil physical properties by adding Organic Matter

- Increase water holding capacity
- Improve physical structure
- Lower soil bulk density



Reduce water use for irrigation

Improve water infiltration into soil surface

Reduce erosion



The Benefits of Using Compost

Add nutrients and improve nutrient holding capacity

- Increase Cation Exchange capacity
- Provides nutrients in organic or slow release form



Reduce use of fertilizer



Improve nutrient availability



Decrease loss of nutrients due to leaching



Improve plant growth and survival



The Benefits of Using Compost

Environmental benefits associated with sustainable landscape practices

- “Wastes” are recycled
- Carbon is returned to soil
- Metals such as lead are made less available
- Organic contaminants are degraded by microbial activity



Reduction in green house gas emissions



Contaminated soils are made safer



Compost

Product characteristics depend upon:

- Feedstocks: Biosolids vs. Food Wastes vs. Manures
- Bulking Agents: Wood chips vs. Sawdust vs. Leaves and Yard Wastes
- Type of processing: Screened vs. Unscreened
- Age: Active vs. Cured



What About Biosolids?

- Regulated by US EPA (Part 503) and by State Agencies
- Regulations require:
 - Industrial pretreatment programs
 - Testing for metals (As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, Zn)
 - Testing for organic contaminants such as PCB's
 - Process for Pathogen Reduction (Time/Temperature)
 - Vector Attraction Reduction (Time/Temperature)
 - Testing for pathogens (Fecal Coliform/Salmonella)
 - Labeling
 - Reporting



Compost Quality

Not all composts are the same

Moisture content

Texture and particle size

Organic matter content

pH, soluble salts, and nutrients



Compost Properties

- Organic Matter: Undecomposed residuals, active and dead microbes (Biomass) and the products of decomposition (Humic matter)
- Nutrients: macro (NPK) and micro nutrients (e.g. Ca, Cu, Bo, Fe, Mn, Mg, Ni, S, Zn)
- Ash and grit



Raising Soil Organic Matter

Percentage to Raise OM

by 1% by weight

2%

3%

4%

5%

6%

Compost Inclusion Rate

need 8% by volume

15%

22%

27%

32%

37%

All rates based on addition of AGRESOIL COMPOST to typical soil weighing 2600 lbs/cu. yd.



Compost Test Parameters

- pH
- Soluble Salts (Electrical Conductivity)
- Nutrients
- Forms of Nitrogen: Organic N, Nitrate - N, and Ammonium -N
- Particle Size
- Pathogens (fecal coliform and Salmonella)
- Metals/Contaminants



Compost Stability/Maturity

(When is compost done?)

- C:N ratio measures changes in ratio of high Carbon residues which are lost and Nitrogen which is conserved during the process; Low C:N ratio (less than 15) indicates finished compost that will not result in N immobilization.
- Microbial Respiration: Measurement of CO₂ under controlled conditions indicates presence of OM.
- Self Heating; High temperatures suggests that microbes are still active.
- Plant Growth Tests; measure effect of compost on germination and vigor



Compost is Alive

- Microbial populations continue to grow and decompose organic matter
- Activity declines with time but does not stop
- Thermophilic microbes will be replaced by mesophilic microbes when compost cools and when compost is added to soil
- Mesophilic microbes that colonize compost can be antagonistic to plant pathogens
- Addition of compost to soil stimulates the activity of the existing microbes in the soil



What about the “bugs”?

- Composts contain diverse communities of different microorganisms
- Quality of the organic matter and environmental conditions in the soil will determine which microbes grow and survive
- There is little evidence that the differences in microbial populations among composts will result in better plant growth
- The benefits of using compost to improve soil, physical and biochemical, are significant enough to justify using compost



Compost Uses

Examples of product use:

- Establishing lawns and turf
- Root zone mix for sports fields
- Top dressing lawns and sports fields
- Planting beds
- Tree and shrub planting mix
- Root zone mix for constructing golf greens
- Potting media component
- Soil amendment for vegetable production
- Wetland construction and remediation
- Infiltration basins for storm water management



Choosing the “Right” Compost

- Finer texture for topdressing (<1/2 inch acceptable; <3/8 inch preferable)
- Coarser texture for mulch (< 1 inch)
- pH, soluble salts: highly dependent on plant choice and application rates
- Aged for potting mixes
- Avoid compost with high silt/clay for sports field mixes
- Low nitrogen and phosphorus near water resources



General Guidance

- “A soil analysis should be completed by a reputable laboratory to determine any nutritional requirements, pH, and organic matter adjustments that may be necessary. Once these are determined, the soil can be appropriately amended to a range suitable for the particular plants being established.”
- “The nutrients contained in compost should be considered when applying fertilization. They will typically offset nutrient requirements, thereby reducing application rates.”

USCC www.compostingcouncil.org



Compost Testing

- Must be representative sample
- Results will depend on lab methods

UMass Soil and Plant Tissue Testing
Laboratory, Amherst, MA

USCC Seal of Testing Approval (STA)
Laboratories



Nutrients in Compost

- Compost is a source of both Macro (NPK) and Micronutrients
- Nutrients are primarily in an organic form; e.g. proteins, carbohydrates and fats of living and dead microorganisms and plant material.
- Over-use of compost can supply excessive nutrients and result in build-up of nutrients in soils (e.g. P).



Nutrient Availability

- Nutrients are released over time as organic matter decays in the soil
- Nutrients may also be taken up by microbial growth stimulated by addition of organic matter (e.g. N immobilization)
- Organic matter can also make nutrients e.g. metals less available, less soluble and thus less likely to be lost from the soil.
- Stimulation of plant growth can also reduce losses by reducing loss of soil particles during rain.



What About Phosphorus ?

- Compost used on established turf must be used in compliance with state regulations regarding Phosphorus fertilizers.
- Soil must be tested to show need for P.
- In some states composts and organic products are exempted from rules that apply to fertilizers.
- Composts and organic products can be used when making repairs or seeding.



Only a small portion of the P in compost is water extractable

P2O5 lbs/cy	Total	Water Extractable	% Water Extractable
Biosolids	3.0 to 13.9	0.2 to 1.3	2.0 to 22 %
Leaf & Yard Waste	1.4 to 3.0	0.1 to 0.2	6.8 to 8.4 %
Gelatin residuals	10	0.2	2 %



Lawns and Turf



Sports Field Construction



Optimizing Organic Content in Soil Specifications

- 3% to 10% often specified
 - 3% unnecessarily low for lawn areas
 - 10% too high for lawns
- 5% to 8% for lawns, reduces risk, and saves water
- 3% to 5% for sports fields
 - Balance organic content with infiltration rate



All Composts are Not the Same

Comparison of Different Composts on Infiltration Rate

All Mixes: 80% Sand: 20% Compost

	<u>Silt</u>		<u>Clay</u>		<u>Total</u>		<u>Infiltration Rate</u>	
Compost A	3.33	%	1.06	%	4.39	%	16	In/Hr
Compost B	6.07	%	0.69	%	6.76	%	12	In/Hr
Compost C	5.43	%	2.03	%	7.46	%	4.6	In/Hr



Topdressing



University Research Programs

“DETERMINING THE IMPORTANCE OF LEAF COMPOST TOPDRESSING WHEN MANAGING ATHLETIC FIELDS ORGANICALLY”

Brian J. Tencza and Jason J. Henderson Department of Plant Science and Landscape Architecture University of Connecticut

Preliminary results of multi-year study show positive results on turf color, plant cover, and soil properties from annual topdressing with compost



Tree and Shrub Planting



Will adding compost to the back-fill soil improve survival and growth?

Popular press gives contradictory advice

Research studies under controlled conditions and field trials can show variable results depending on soil conditions, type of plant, planting conditions and care, but overall indicate significant benefits.



Case Study; CT DOT

“Field Trial – Compost Used with Planting Soil, Project 159-177, I-91/Route 3 Interchange, Wethersfield, CT”, Report No. 116(42)-2-99-3, January, 1999, Connecticut Department of Transportation

“An inventory was conducted in May, 1998... it was noted that none of the plants planted with compost needed replacement (i.e. the mortality rate was zero percent), compared to a mortality rate of approximately 40% in the standard ConnDOT control plants. Another inspection conducted in September, 1998 confirmed that the survival rate for the compost amended plants was still 100%.”



Planting Beds



Compost Mulch

Compost vs. Ground Wood

Lower C:N ratio of Compost



Higher Soil Nutrient Availability



Increased Plant Growth

see Lloyd et al., *Biocycle* 2002



Wetlands



Manufactured Wetland Soil

High Organic Matter Content

20% organic content, (=12 % org. carbon)

US Army Corp of Engineers

Due to relatively high rates of compost
require composts with low nutrient levels.



Green Roof



Green Roof Functions

- Reduce “heat island” effects
- Capture and filter rainwater and reduce flow to storm water systems

Soil Media Must:

- Support plant growth
- Allow for rapid infiltration of water
- Hold water but meet maximum bulk density when saturated



Infiltration Basins and Rain Gardens



Infiltration Basin



Infiltration Basins and Rain Gardens

- Designed to treat storm water
- Rapid water infiltration
- Ability to filter and absorb nutrients

Soils Must:

- Provide for rapid infiltration
- Have adequate Organic Matter to support plant growth and absorb nutrients



Conclusions

- Composts can be used in a variety of applications to improve soils
- Not all composts are the same
- The selection and the use of compost should be based on the specific properties of the compost and the needs of the end user

