

## Compost: Characteristics and Uses

### Southern New England Chapter of the Soil & Water Conservation Society

Friday August 5<sup>th</sup>, 2016  
Bear Path Farm (Whately, MA)  
and UMass Amherst

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Agresource Inc.  
www.Agresourceinc.com



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## 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



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## 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



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### 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



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### 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



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### 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



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## 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



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## 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



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## Compost Quality

### Not all composts are the same

Moisture content  
Texture and particle size  
Organic matter content  
pH, soluble salts, and nutrients



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### 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




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### Raising Soil Organic Matter

<u>Percentage to Raise OM</u>	<u>Compost Inclusion Rate</u>
by 1% by weight	need 8% by volume
2%	15%
3%	22%
4%	27%
5%	32%
6%	37%

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




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### 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




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### 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 CO<sub>2</sub> 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



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### 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



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### 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



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## 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



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## 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



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## 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](http://www.compostingcouncil.org)



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### 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



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### 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).



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### 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.



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### 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.




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### 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 %




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### Lawns and Turf




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### Sports Field Construction



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ROOTED IN SUCCESS

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### 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

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### 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

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### Topdressing



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### 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



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### Tree and Shrub Planting



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## 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.



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## 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%."**



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## Planting Beds



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## 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



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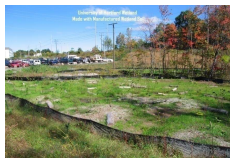
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## Wetlands



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## 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.



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### Green Roof



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### 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



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### Infiltration Basins and Rain Gardens



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### Infiltration Basin



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### 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



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### 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



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