

“Soil, Compost, and Mulch, Oh My!”

Improve water efficiency in your garden by fixing the soil




Presented by:
 Ron Alexander, President
 R. Alexander Associates, Inc.
 ACWD/BAWSCA Event

5/18/19  R. Alexander Associates, Inc.®

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Hosts





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Topics

- Product Usage Trends
- Composting and Product Specs
- Soil Testing and Soil Mgt Report
- Compost and Mulch Benefits to Plants and Soil
- How to Select / Spec Compost
- Compost and Mulch Applications

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...Various conservation (urban/agricultural) efforts...

Save water and protect the environment! **BAWSCA** offers a variety of rebates and programs to help Bay Area water users become more water efficient inside the home and outdoors. For water-wise gardening, visit Bay Area Water Wise Gardening.

Alameda County Water District offers a wide variety of rebates, incentives and technical assistance to our residential, commercial, industrial, institutional and large landscape customers.

Compost and mulch use is a great tool !

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Homeowners (and land managers) are forced to establish vegetation, landscapes and crops on problematic sites



Soil management is even more important with climate change (e.g., drought, flood, temp. extremes)

Need to use more sustainable soil management practices - for plants, economics, and environment



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Often Planting in Damaged and Depleted Soils

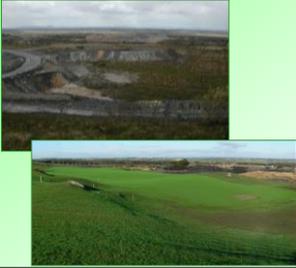
- Most soils have poor structure (fine texture)
 - Drainage, compacted, slow water percolation
 - Less water accepted (storm water management issue)
 - Significant erosion
- Some low in moisture-holding capacity (droughty)
 - Inefficient nutrient uptake, nutrient loss




IMPORTANT TO SOIL TEST

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Problem: not often creating landscapes in 'true' or higher quality topsoil, and trying to vegetate stressed (and sometimes) over-used land



- Poor structure
- Lacking macro pores (50% concept) and organic matter
- Reduced soil life

COMPOST CAN BE USED TO CREATE ACCEPTABLE LANDSCAPE GRADE SOILS AND IMPROVE OVERALL VEGETATION



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Sustainable Landscaping Trends, Green Building and Infrastructure

THE SUSTAINABLE SITES INITIATIVE





- Promotes Healthy Soils
- Recreate/mimic 'natural' systems
- Provide 'Water Efficiency Landscapes' (WELO), gain LEED/SSI credits




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Model Water Efficient Landscape Ordinance (WELO) is in Effect

- Applies to all **permitted** landscape projects with landscape area of:
 - 2,500 sf for landscape renovation
 - 500 sf for new construction
 - "Landscape area" includes pools, but not hardscape
- Projects must meet water budget, based on weather in project location
 - Water budget allows ~25% of area for high water use plants (lawn) or pool
 - Vegetable gardens get higher water budget
- Products
 - Requires 4 CY compost / 1,000 SF
 - Unless already have 6% OM already
 - Requires 3" (9 CY/1,000 SF) of mulch



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Same Trends in Agriculture WHY?... Food and Ag Sustainability



Soil Health Key Points



unlock the SECRETS IN THE SOIL

What's critical about soil health now?

1. World population is projected to increase from 7 billion in 2013 to more than 9 billion in 2050. To sustain this level of growth, food production will need to rise by 70 percent.
2. Between 1982-2007, 14 million acres of prime farmland in the U.S. were lost to development.
3. Improving soil health is key to long-term, sustainable agricultural production.

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Soil health matters because:

1. Healthy soils are high-performing, productive soils.
2. Healthy soils reduce production costs—and improve profits.
3. Healthy soils protect natural resources on and off the farm.
4. Franklin Roosevelt's statement, "The nation that destroys its soil destroys itself," is as true today as it was 75 years ago.
5. Healthy soils can reduce nutrient loading and sediment runoff, increase efficiencies, and sustain wildlife habitat.

What are the benefits of healthy soil?

1. Healthy soil holds more water (by binding it to organic matter), and loses less water to runoff and evaporation.
2. Organic matter builds as tillage declines and plants and residue cover the soil. Organic matter holds 16-20 times its weight in water and recycles nutrients for plants to use.
3. One percent of organic matter in the top six inches of soil would hold approximately 27,000 gallons of water per acre!
4. Most farmers can increase their soil organic matter in three to 10 years if they are motivated about adopting conservation practices to achieve this goal.

Many benefits

Climate change

Need more resilient soils

Reduced water usage

www.nrcs.usda.gov Helping People Help the Land
USDA is an equal opportunity provider and employer.



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Compost / Composting




Various types of composts in California

- 100 Commercial / Permitted sites, some unlicensed sites because of size / feedstock



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Definition

Compost is the product manufactured through the controlled aerobic, biological decomposition of biodegradable materials. The product has undergone mesophilic and thermophilic temperatures, which significantly reduces the viability of pathogens and weed seeds, and stabilizes the carbon, such that it is beneficial to plant growth. Compost is typically used as a soil amendment, but may also contribute plant nutrients. *Current AAPFCO definition*

Can test to prove the product is a 'real' compost, and will work for your application



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Use the Right Compost !

USE ONLY
U.S. Composting
Council

Seal of Testing
Assurance Program



COMPOST TECHNICAL DATA SHEET			
Compost Parameters	Adjusted or unadjusted	Test Results	Test Results
		As-is	As-is
Plant Nutrients	% by weight	% by weight	% by weight
Nitrogen	1.2-2.0	1.5	1.5
Phosphorus	0.10-0.20	0.15	0.15
Potassium	0.5-1.0	0.8	0.8
Calcium	1.0-2.0	1.5	1.5
Magnesium	0.5-1.0	0.8	0.8
Moisture Content	% by weight	42	42
Organic Matter Content	% by weight	55	55
pH	5.5-6.5	5.8	5.8
Electrical Conductivity	dS/m	1.0	1.0
Particle Size	20 mesh	95	95
Stability	mg CO ₂ -C/g OM per day	1.5	1.5
Maturity	Pass/Fail	Pass	Pass
Select Pathogens	Pass/Fail	Pass	Pass
Trace Metals	Pass/Fail	Pass	Pass



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Participating Composters:

- Complete on-going product testing
 - Operate on-going sampling/testing regime, larger facilities test more often
 - Using uniform sampling and analytical testing methods (from national testing manual - TMECC)
 - Using only STA Program certified labs
- Disclose test data results (lab analyses) on uniform label
- Provide appropriate end use instructions to end users

Many DOTs and other Specifiers (LAs) Require STA compost



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Important Parameters

Compost Parameters	Reported as
pH	N/A
Soluble salts	dS/m (mmhos/cm)
Primary plant nutrients	% as-is (wet) & dry weight basis
Nitrogen	Total N
Phosphorus	P ₂ O ₅
Potassium	K ₂ O
Calcium	Ca
Magnesium	Mg
Moisture content	% wet weight basis
Organic matter content	% dry weight basis
Particle size	Screen size passing through
Stability (respirometry)	mg CO ₂ -C/g OM per day
Maturity (Bioassay)	Pass/Fail
-Percent emergence	% (average)
-Relative seedling vigor	% (average)
Select Pathogens	Pass/Fail
Trace metals	Pass/Fail

HANDOUT AVAILABLE FOR MORE DETAIL



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US Composting Council
Seal of Testing Assurance Program

SOIL CONTROL LAB

Public Use Operating
1100 S. 10th St.
Madison, WI 53702
608-263-7878

Request # 201208-11-0038
Order No. 11-01
Shipping Date: March 26, 2012

COMPOST TECHNICAL DATA SHEET			
Compost Parameters	Adjusted or unadjusted	Test Results	Test Results
		As-is	As-is
Plant Nutrients	% by weight	% by weight	% by weight
Nitrogen	1.2-2.0	1.5	1.5
Phosphorus	0.10-0.20	0.15	0.15
Potassium	0.5-1.0	0.8	0.8
Calcium	1.0-2.0	1.5	1.5
Magnesium	0.5-1.0	0.8	0.8
Moisture Content	% by weight	42	42
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pH	5.5-6.5	5.8	5.8
Electrical Conductivity	dS/m	1.0	1.0
Particle Size	20 mesh	95	95
Stability	mg CO ₂ -C/g OM per day	1.5	1.5
Maturity	Pass/Fail	Pass	Pass
Select Pathogens	Pass/Fail	Pass	Pass
Trace Metals	Pass/Fail	Pass	Pass

Can often get more detailed (and historical) data from these composters

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ReScape Compost Spec

Property	Test Method	Unit of Measurement	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 slurry method pH	units	6-8.5
Soluble salts	TMECC 04.10-A Electrical conductivity 1:5 slurry method	dS/m (mmhos/cm)	0-5 or 0-10
Moisture content	TMECC 03.09-A Total solids & moisture at 70 ± 5 °C	% dry weight basis	30-60 (35-55)
Organic matter Content	TMECC 05.05-A Loss-on-ignition organic matter method (LOI)	% dry weight basis	30-60
Maturity	TMECC 05.05-A Germination and vigor	% relative to positive control	Seed emergence 80 or above Seedling vigor 80 or above
Stability	TMECC 05.05-B Carbon dioxide evolution rate	mg CO ₂ -C/g OM per day	5 or below
Pathogen	TMECC 07.01-B Salmonella < 3 MPN per 4 grams, dry weight basis	Pass/Fail	Pass
Pathogen	TMECC 07.01-B Fecal coliform bacteria < 1,000 MPN per gram, dry weight basis	Pass/Fail	Pass
Physical contaminants	TMECC 02.02-5 Man-made inert removal and classification: Plastic, glass, and metal % > 4 mm fraction	% dry weight basis	combined total: < 0.5% < 0.1%
Physical contaminants	TMECC 02.02-6 Man-made inert removal and classification: Sharps (sawing needles, straight pins and hypodermic needles) % > 4mm fraction	% dry weight basis	none detected
Particle size - fine for soil amendment	TMECC 02.02-5 Sample sieving for aggregate size classification	% dry weight basis	Pass 2"-inch sieve 98% min Pass 3/8-inch sieve 95% min

EXAMPLE



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ReScope Compost Spec

Arsenic	US EPA	mg/kg (ppm)	EPA 503 pass < 10 OMRI
Cadmium	US EPA	mg/kg (ppm)	EPA 503 pass < 20 OMRI
Chromium	US EPA	mg/kg (ppm)	EPA 503 pass < 100
Copper	US EPA	mg/kg (ppm)	EPA 503 pass < 400
Lead	US EPA	mg/kg (ppm)	EPA 503 pass < 90 OMRI
Mercury	US EPA	mg/kg (ppm)	EPA 503 pass < 4
Nickel	US EPA	mg/kg (ppm)	EPA 503 pass < 80
Selenium	US EPA	mg/kg (ppm)	EPA 503 pass < 5
Zinc		mg/kg (ppm)	EPA 503 pass < 2800
Ammonium (N or NH ₄ -N)		ppm or mg/kg dry weight	< 450
Sodium (Na)		% dry weight	< 0.5
Carbon : Nitrogen Ratio		Carbon : Nitrogen	320:1
Bulk Density		lbs/CY dry weight lbs/CF dry weight	> 19 and < 41 > 500 and < 1100

Note: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC). (Tables modified from the US Composting Council Landscape Architectural Specifications 2008.)



Heavy metal content spelled out
Additional parameters (?), participation req's.

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Caltrans Compost Specifications

Property	Test method *	Requirement
pH	TMECC 04.11-A Electrometric pH 1:5 slurry method	6-8.5
Soluble salts	TMECC 04.19-A Electrical conductivity 1:5 slurry method (dSm (mmho/cm))	0-10
Moisture content	TMECC 03.09-A Total solids & moisture at 70 ± 5 °C % wet weight basis	30-60 (40-60)
Organic matter Content	TMECC 05.05-A Loss-on-ignition organic matter method (LOI) % dry weight basis	30-70 (40-60)
Maturity	TMECC 05.05-A Germination and vigor % relative to positive control	--
	Seed emergence	80 or above
	Seedling vigor	80 or above
Stability	TMECC 05.08-B Carbon dioxide evolution rate mg CO ₂ -C/g OM per day	8 or below
Pathogen	TMECC 07.01-B Salmonella < 3 MPN per 4 grams, dry weight basis	Pass, < 3
Pathogen	TMECC 07.01-B Fecal coliform bacteria < 1,000 MPN per gram, dry weight basis	Pass, < 1,000
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Plastic, glass, and metal % > 4 mm fraction	Combined total: < 0.5% (0.25% film plastic)
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Sharps (sawing needles, hypodermic needles, etc.) % > 4mm fraction	None detected

EXAMPLE Replace extra text with numbers / table
May modify some of the numbers

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Caltrans Compost Specifications

	PARTICLE SIZING FOR	PARTICULAR PRODUCTS	
Fine compost (for soil incorporation)	TMECC 02.02-B Sample sieving for aggregate size classification % dry weight basis	Min	Max
	Pass 2-inch sieve	98%	--
	Pass 3/8-inch sieve	95%	--
Medium compost* (for erosion control blankets, native plant establishment, landscape mulching)	TMECC 02.02-B sample sieving for aggregate size classification % dry weight basis	Min	Max
	Pass 2-inch sieve	90%	--
	Pass 3/8-inch sieve (minimum 25% retained)	40%	75%
Coarse compost* (for compost filter socks)	TMECC 02.02-B sample sieving for aggregate size classification % dry weight basis	Min	Max
	Pass 2-inch sieve	95%	--
	Pass 3/8-inch sieve (minimum 60% retained)	0%	40%

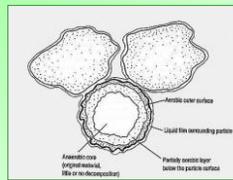
*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

EXAMPLE Particle size based on end use

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Commercial Composting Facility 'Walk Through'



Surface area phenomenon



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Various Methods (Technology levels, Sizes)



Microbes:
• Oxygen
• Food (C/N)
• Water

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Feedstock Reception



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Size Reduction



Feedstock preparation: grinding (and mixing if food waste, etc.)

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Site Layout



Organized, materials flow in one direction

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Turning Windrows

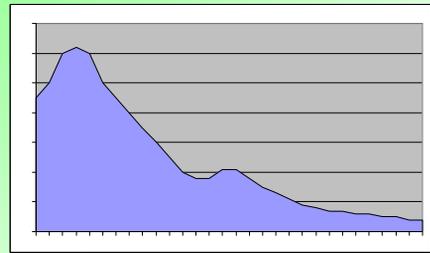


Forced air instead of turning

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Aerobic Process Oxygen Demand



Composting high rate and stabilization

Curing

Screening Storing

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Monitoring Temperature



High-temperature composting phase

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Lower-temperature curing phase

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Screening

Screening (sizing for specific applications)

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Typical Compost Feedstocks

- Yard trimmings
- Food residuals
- Manure
- Biosolids*
- Industrial by-products*
- MSW* (no SSO)

*Not OMRI Listable

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Feedstock differences, pros & cons (show examples later)

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Test to Understand Soil Characteristics

- **Physical (structural):**
 - Tilt, infiltration, porosity, bulk density, aggregation, texture* (mix of sand, silt and clay)
- **Chemical:**
 - Nutrient content, salinity, pH, organic matter, mineral content* (parent material)
- **Biological:**
 - Biomass, biodiversity, biological activity, disease suppressiveness

**Not affected by the addition of OM*

Help to prescribe remedies, and in plant selection

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Understand Your Soil

- Soil testing is very important and often forgotten
- Soil analysis shall include:
 - Soil texture, infiltration rate, pH, EC, Na, OM (basics)
 - Often provide recommendations
 - WELO recommends amending soil to get to 6% OM (dw), plus providing organic forms of fertility
- Testing done by universities and private labs

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Waypoint ANALYTICAL

Waypoint Analytical is a laboratory that provides soil testing services to landscapers and other professionals. We offer a wide range of soil testing services, including soil texture, pH, EC, Na, OM, and more. Our services are performed by trained and certified technicians using state-of-the-art equipment. We provide detailed reports and recommendations for soil improvement. For more information, please contact us at 1-800-368-3683.

Make sure that your landscaper tests the soil and Work with labs that provide adequate explanation of soil test data ...

Explain "why" and "what to do next!"

Ask questions – have them explain data to help in education

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Soil Report Tip

- Order organic recommendations, or WELO or "Bay-Friendly"
- Can ask for recommendations to bring SOM to 6%
- Call the soil scientist if you want help interpreting!

Resources:
List of Bay Area soil labs:
<http://cesonoma.ucan.edu/files/27431.pdf>

Waypoint
ANALYTICAL

Report 18-0081012 Updated

In terms of fertility, nitrogen, phosphorus and potassium are low. Calcium, magnesium and sulfur are sufficient for most soil cultures, except for monoculture crops like vineyards and rice.

Recommendations

Nitrogen fertilizer is recommended along with sulfur in the Coastal sample area. Addition of a commercial phosphate fertilizer is also recommended either to the Coastal sample area or to the Valley sample area. <http://www.cesonoma.ucan.edu/files/27431.pdf>

Soil pH is Low (Acidic)

Change of the soil pH should be improved by the liming the top 10 inches of any subsoil or composted soil. The following material should be used for every acre and thoroughly mixed with the top 8 inches of soil to form a homogeneous layer:

Material and Rate	Soil Conductivity
1.5 tons/acre	0.000000
1.0 tons/acre	0.000000
0.5 tons/acre	0.000000
0.25 tons/acre	0.000000

Soil Salinity

This site may change based on the analysis of the above organic amendment. This salt is based on 220 lbs. of dry weight of organic matter per acre per 1000 gal of water.

For areas where salinity will be reduced, the organic amendment and fertilizer must be reduced by half the listed rate should be used.

Soil Phosphorus

- Eliminate planting of all soil fertilizers on the date of the soil test.
- Use immediately when the soil test should be used to establish a program to support soil fertility and the bottom should be used to improve fertility.
- The top 10 inches of soil should be used to establish a program to support soil fertility.
- The top 10 inches of soil should be used to establish a program to support soil fertility.

Soil Nitrogen

The following table shows the level of the total of soil and nitrate nitrogen in the soil.

Depth	Soil Nitrogen Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Sulfur

The following table shows the level of the total of soil and sulfate sulfur in the soil.

Depth	Soil Sulfur Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Calcium

The following table shows the level of the total of soil and calcium in the soil.

Depth	Soil Calcium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Magnesium

The following table shows the level of the total of soil and magnesium in the soil.

Depth	Soil Magnesium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Potassium

The following table shows the level of the total of soil and potassium in the soil.

Depth	Soil Potassium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Boron

The following table shows the level of the total of soil and boron in the soil.

Depth	Soil Boron Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Zinc

The following table shows the level of the total of soil and zinc in the soil.

Depth	Soil Zinc Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Manganese

The following table shows the level of the total of soil and manganese in the soil.

Depth	Soil Manganese Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Iron

The following table shows the level of the total of soil and iron in the soil.

Depth	Soil Iron Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Copper

The following table shows the level of the total of soil and copper in the soil.

Depth	Soil Copper Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Nickel

The following table shows the level of the total of soil and nickel in the soil.

Depth	Soil Nickel Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Cadmium

The following table shows the level of the total of soil and cadmium in the soil.

Depth	Soil Cadmium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Lead

The following table shows the level of the total of soil and lead in the soil.

Depth	Soil Lead Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Chromium

The following table shows the level of the total of soil and chromium in the soil.

Depth	Soil Chromium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Molybdenum

The following table shows the level of the total of soil and molybdenum in the soil.

Depth	Soil Molybdenum Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Vanadium

The following table shows the level of the total of soil and vanadium in the soil.

Depth	Soil Vanadium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Cobalt

The following table shows the level of the total of soil and cobalt in the soil.

Depth	Soil Cobalt Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Selenium

The following table shows the level of the total of soil and selenium in the soil.

Depth	Soil Selenium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Arsenic

The following table shows the level of the total of soil and arsenic in the soil.

Depth	Soil Arsenic Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Barium

The following table shows the level of the total of soil and barium in the soil.

Depth	Soil Barium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Strontium

The following table shows the level of the total of soil and strontium in the soil.

Depth	Soil Strontium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Radium

The following table shows the level of the total of soil and radium in the soil.

Depth	Soil Radium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Thorium

The following table shows the level of the total of soil and thorium in the soil.

Depth	Soil Thorium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Uranium

The following table shows the level of the total of soil and uranium in the soil.

Depth	Soil Uranium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Plutonium

The following table shows the level of the total of soil and plutonium in the soil.

Depth	Soil Plutonium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Americium

The following table shows the level of the total of soil and americium in the soil.

Depth	Soil Americium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Curium

The following table shows the level of the total of soil and curium in the soil.

Depth	Soil Curium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Francium

The following table shows the level of the total of soil and francium in the soil.

Depth	Soil Francium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	0.000000
80-90 inches	0.000000
90-100 inches	0.000000

Soil Radium

The following table shows the level of the total of soil and radium in the soil.

Depth	Soil Radium Sample Area
0-10 inches	0.000000
10-20 inches	0.000000
20-30 inches	0.000000
30-40 inches	0.000000
40-50 inches	0.000000
50-60 inches	0.000000
60-70 inches	0.000000
70-80 inches	

Compost and Mulch as a Drought Management Tool

- Amending soil and/or mulching can help reduce the dependency on irrigation (reduce water usage volumes)
- Assist plant survival.... AND

Captures the FREE WATER that falls from the sky as precipitation



Why its included in the WELO ordinance, is key to field success



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Choosing the Proper Product

- Understand the application (specific end use, details of application)
- Obtain product test results (get help with interpretation)
- Buy certified / Listed products
- Know the Supplier (*are they educated?*)
- Get samples, test data and end use information from supplier – *up-front*
- If purchased in bulk, inspect the product before it is dumped

List of composters can be found on USCC website <https://compostingcouncil.org/participants/>



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A Comparison Between Mulch and Soil Amendment Properties

Property	Mulch	Amendment
Moisture conservation	Moderate to high	Low to moderate
Moisture retention	Low (in the mulch) High (in the soil under mulch)	High
Soil temperature	Immediate changes	Slight or unchanged
Soil structure	Changes with time	Changes immediately
Phytotoxicity potential	Low to medium	Low to high
Root contact	Low initially	High
Fertility	None to low	Low to moderate
Pathogens	Low to none	None to high
Nitrogen tie up	Low to none	None to high
Weed control	Moderate to high	Low to none

Source: Creating a Healthy Root Zone, James Downer and Ben Faber, University of California

N and O depletion when many mulches are mixed in soil

Not interchangeable products !!



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Soil Amending Compost (often 3/8" screened)



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Lots of carbon-based mulches are used...

Bark and recycled wood is common



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Coarser Compost for Mulching



(and Erosion Control / Storm Water Management)

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Benefits of Compost Use to the Landscape World

- Physical:**
- Improves soil structure
 - Moisture management
- Chemical:**
- Modifies and stabilizes pH
 - Increases cation exchange capacity
 - Supplies nutrients
- Biological:**
- Supplies soil biota
 - Suppresses plant diseases
- Other:**
- Binds/degrades contaminants
 - Binds nutrients

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Soil Structure: Physical Modification

- Improves
- Water (oxygen, other) movement
 - Rooting – more extensive, faster
 - Pore spacing, soil aggregation

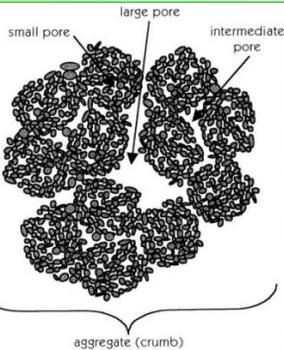


-Biological and physical mechanisms
-Less wind and water erosion, better salt movement

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Soil Aggregation



A well aggregated soil has a range of pore sizes. This medium size soil crumb is made up of many smaller ones. Very large pores occur between the medium size aggregates. Occurs physically and biologically.

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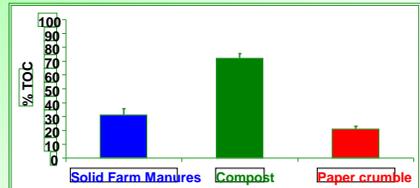


Improved

- Tilt (Workability)
- Reduced bulk density
- Improved rooting

Long Lasting Organic Matter -

Lignin as % of Total Organic Carbon



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Increased Soil Water Holding Capacity

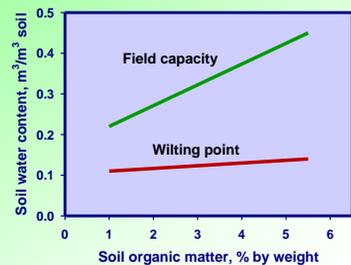


and Moisture Absorption

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Effect of Organic Matter on Available Soil Water



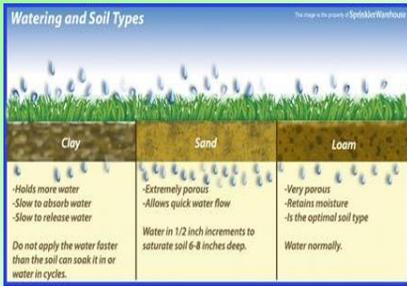
ATTRA – each increase of 1% OM can increase soil WHC by 16,500 gallons H₂O/A

Reduce irrigation 30-50% by 'fixing' soil first

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Soil Type Affects Irrigation Strategies



Organic matter benefits in several ways



55

Compost Restores Storm Water Infiltration Capacity



So, helps to recharge aquifers...



Source: University of Washington trials on glacial till soil. Reduce runoff by up to 50%



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Influence of Compost on Soil Water Management

Western Washington Loamy Sand (% dairy solids compost added)	OM (%)	Saturated Hydraulic Conductivity (in/hr)	Moisture at Field Capacity (weight %)	Moisture at Field Capacity (in/ft)	Bulk Density (g/cm ³)
0	2.0	4.3	21.5	2.2	1.20
10	2.0	4.3	26.8	2.7	1.28
20	2.4	5.4	37.0	3.7	1.09
30	4.4	7.5	50.9	5.1	0.99

Great tool for water management – too much, too little

WORC/ECY 2008



57

Compost Supplies Macro and Micro Nutrients



Also increases CEC (nutrients holding ability)

58

Composting Creates High Temperatures:

(Naturally)

- Weed free
- Human/animal pathogen, and
- Plant disease destruction



59

Supplies and Feeds Soil Biology

Responsible for

- Organic matter decomposition and nutrient cycling
- Increased nutrient supply to plant roots
- Formation and stabilization of soil structure
- Breakdown of organic contaminants
- Control of pests and pathogens

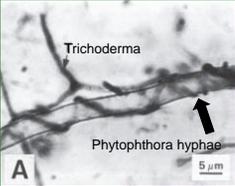
Microbial population and diversity are measures of soil quality

Microbes work in symbiosis with plants



60

Suppresses Soil-Borne Diseases




4 Mechanisms of Disease Suppression, via beneficial organisms:

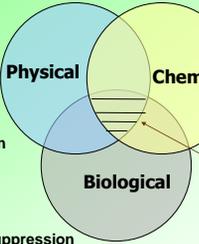
1. Induced systemic resistance (ISR) or systemic acquired resistance (SAR) – turns on plant's natural disease-fighting mechanisms
2. Antagonism (kills/harms disease organisms)
3. Competition for nutrients (and energy)
4. Competition for root colonization

Preventative, not curative (Malojczuk, 1983)  R. Alexander Associates, Inc.®

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Healthy Soils Improve Water Efficiency

- Root proliferation
- Aeration
- Water retention
- Water infiltration and transmission
- Erosion prevention



- Nutrient retention and release
- pH
- Energy (C) storage
- Toxicity prevention

Soil Health

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection

QUESTIONS?

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Compost Application

Soil Incorporant

- Ag crop establishment
- Turf establishment
- Garden bed preparation
- Reclamation/remediation
- Nursery production
- Roadside Vegetation

Surface Applied

- Fruit trees
- Garden bed mulch
- Erosion control media
- Turf topdressing

Growing Media Component

- Container/potting substrates
- Landscape (e.g. rooftop, raised planters)
- Backfill mixes (tree and shrub plantings)
- Golf course (e.g. tee, green, divot mixes)
- Manufactured topsoil

*Lots of applications,
Staple of landscape industry...
(future land mgt tool)*

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General Landscape Applications

- Planting Beds
- Tree/Shrub Planting
- Topsoil manufacturing
- Turf Establishment and Maintenance



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-Apply 1-2" layer and incorporate to a 6-8" depth (3-6 CY / 1,000 SF)

-Do not over incorporate

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-Water plants in well

(can reduce fertilizer, lime, gypsum, humic acid)

66



67



68



69



70



71



72



73



74



75



76



77



78



79



80



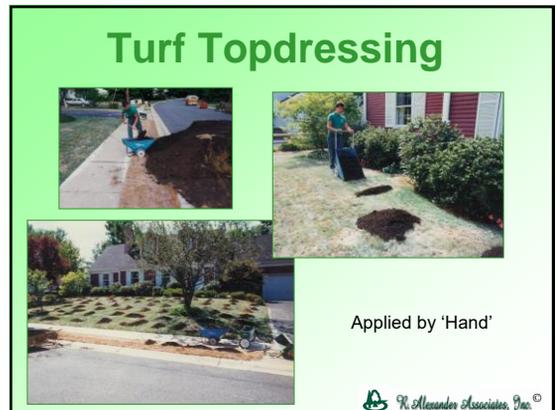
81



82



83



84

Turf Topdressing

...a Beautiful Green Sustainable Lawn



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Turf Topdressing

Compost is a great alternative to using chemicals resulting in a *true* Sustainable Approach!



Before Compost Applied



After Compost Applied

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Turf Topdressing

Using an Eco Lawn Applicator is a quick way to spread compost and more efficient spreading wetter product



Using compost in blower trucks has become a fast application alternative



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Athletic fields

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TOPSOIL MANUFACTURING

On-site soil blending / improvement



Use in landscaping, (subsoils/sand) reclamation, brownfields, contaminated sites, etc.

Great technique when have adequate volumes of 'soil' (mineral substrate) on-site



Financial savings, plus superior soil

Transport 270 CY, instead of 540-810 CY

Can be 1/2 the cost...



...but must make sure that the process is done properly, may need broadleaf weed control

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Off-site soil blending

Blend ratio depends on initial soil quality and goals

- Typically 20-30% inclusion rate (compost/soil mix by volume)

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Many soil blends available to homeowners at garden centers / ldsps. yards

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Really large-scale

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Mulching

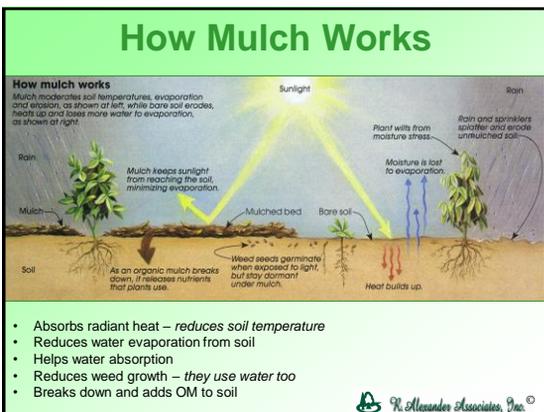
- Mulch applied to the soil surface
- Around planted materials and on slopes to both increase water holding capacity and reduce moisture evaporation, and for aesthetic purposes (and much more...)



(What's wrong with this picture)

94

How Mulch Works



How mulch works
Mulch moderates soil temperature, evaporation and erosion, as shown at left, while bare soil erodes, heats up and loses more water to evaporation, as shown at right.

- Absorbs radiant heat – *reduces soil temperature*
- Reduces water evaporation from soil
- Helps water absorption
- Reduces weed growth – *they use water too*
- Breaks down and adds OM to soil

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Mulching Provides Many Benefits... Well Documented

- **Conserves moisture**
 - Reduces irrigation by up to 70%
- **Reduces soil temperature (8-10-F) and temperature fluctuations**
- **Suppresses weed establishment**
- **Improve soil structure and increase soil fertility over time**
- **Improves erosion control**



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Preferences...
Often more related to 'look' (and cost) than efficacy




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Recycled mulch is required where available



Woody materials



Coarser Composts (and sometimes finer)



**Apply 3" layer
(9 CY / 1,000 SF)**

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Lots of options.... good and bad





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Mulching Volcanos




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Why are Stones being used?



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Not All Mulches are the Same..

Material	Uses	Application Depth
Bark	Contains waxes that shed water moving it into the soil. Great to use in ornamental beds	2" Small chips/nuggets 3" Large chips/nuggets
Wood Chips	Compost fresh chips for a couple of months before use. Use in ornamental beds.	2" Small chips/nuggets 3" Large chips/nuggets
Leaves	Use dry, aged and shredded leaves. Use either in vegetable garden or ornamental bed.	4" loose 1"-2" settled
Grass Clippings	Only use grass from an herbicide free lawn. It is best when dried for a few days. A good source of nitrogen. Use in vegetable garden.	4" loose 1"-2" compressed
Compost	Inhibits plant disease, builds the soil, and provides plants with nutrients. Use in vegetable or ornamental beds.	1"-2"
Straw	Inhibits plant disease and is a good insulator. Use in vegetable gardens.	4" loose

- Type of mulch not specified in ordinance, so you may have to

The Holden Arboretum, 2003
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Research Shows Some Mulches Better than Others for WHC

Treatment and Depth	WHC (inches water)	WHC (inches water / foot appl. depth)	Std. Dev.
Gro-Mulch – 3"	0.91	3.64	0.11
Yard waste – 5"	1.13	2.72	0.17
Yard waste – 3"	0.63	2.51	0.11
Yard waste – 1"	0.20	2.34	0.04
Composted yard waste – 3"	0.40	1.59	0.15
Fabric + OGC – 3"	0.35	1.42	0.04
OGC – 3"	0.31	1.25	0.01
Bark – 3"	0.28	1.11	0.03
Xerimulch – 3"	0.02	0.81	0.01
1" Rock – 3"	0.02	0.09	0.01
Fabric	-	-	-
Control	-	-	-

Ref: Water retention & evaporative properties of landscape mulches.
Univ. of CA (Shaw, Pittenger, McMaster)

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Erosion Control and Storm Water Management Applications for Compost

Soil and Water Protection

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Erosion Control, Storm Water Mgt, Mulching Applications



Coarser, mulchy composts

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Erosion/Sediment Control

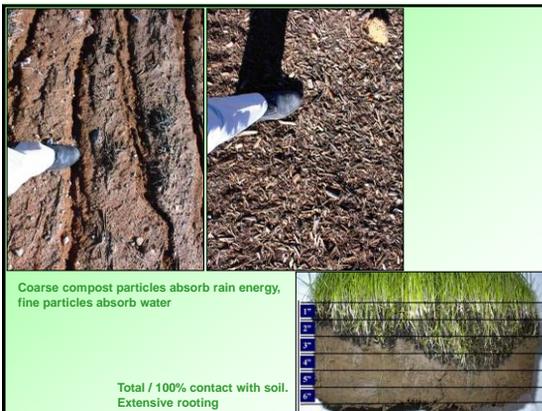


- National specs exist
- US EPA supports

Compost blankets
(berms and socks)

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Coarse compost particles absorb rain energy, fine particles absorb water

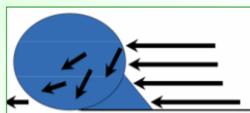
Total / 100% contact with soil.
Extensive rooting

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Can be staked into place, so work on concentrated flows

Act as a 3-dimensional filters, so large sediment capacity



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Caltrans uses...

Compost applications, over time, blend in with the natural landscape

Compost berms – sediment control

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Green Infrastructure Applications

Source: IDNR, Erth Products, LLC, Filtrrex

Storm water mgt.
Roof top gardens and bioretention features

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Rain Gardens

Stormwater media
Compost / sand mixes similar to bioretention features

Source: SOCCRA, RAA

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Bioretention Mulches

Composted, stringy (heavier) mulches are more non-floating

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Teach Customers to Invest in Water Efficiency and...

Physical

- Root proliferation
- Aeration
- Water retention
- Water infiltration and transmission
- Erosion prevention

Chemical

- Nutrient retention and release
- pH
- Energy (C) storage
- Toxicity prevention

Biological

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection

Healthy Soil

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Healthy Soils Improves...

- Plant growth and survival rates
 - Ability for 'plants' to better handle environmental stresses
 - Microbial life, many live symbiotically with plant life
- Sustainability of landscape / turf / slope
 - **Less water**, other inputs
 - Lower maintenance costs
- Erosion / sediment control and
- Storm water management

Compost and mulch usage assist in creating healthy and water efficient soils !

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QUESTIONS



More information:
- www.compostingcouncil.org
- www.lawntogarden.org/marketplace

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