BIORETENTION MEDIA

Compost Research & Education Foundation

USING COMPOST AS A COMPONENT

Description:

This work consists of blending compost into a sand-based media used for stormwater management. The media and overall feature are typically used to capture sheet flow generated water and treat it using natural processes. The system captures and slowly releases water, often removing sediment and chemical contaminants.

Key Benefits:

- Increases water-holding capacity, reducing irrigation requirements,
- Slowly releases nutrients, typically eliminating fertilization for 1-2 years,
- Increases cation exchange capacity, improving the capture of chemical contaminants,
- Enhances microbial processes, better degrading petroleum hydrocarbons, and
- Improves vegetation establishment and long-term sustainability.

Various communities and storm water management agencies require compost use in their bioretention media specifications.

Construction Requirements:

- Pre-treat the water flow to remove excess debris and sediment before it reaches the bioretention feature to help minimize on-going maintenance requirements.
  - When treating concentrated flows of water, it is important to reduce its velocity by running the flow over a bed of stone, rip rap, compost filter sock, or a similar material.
- Excavate biotreatment area, as outlined on the engineering plans.
- Where an inch or more of water is required to drain, install an under drain consisting of a 4 to 6-inch perforated pipe, surrounded by a 6 to10-inch layer of pea gravel/stone which leads to the discharge point.
  - Some bioretention features may require an additional layer of gravel, below the pea gravel/ stone and on top of the existing soil.
- Fill a basin with compost using a telebelt or slinger truck, not a bulldozer because a bulldozer would compact the soil. Place a 2 ½ foot layer (minimum) of media. The bioretention planting and treatment media should contain 20 to 40% compost (by volume), with the remainder being a coarse sand (0.02 in – 0.04 sizing), or mineral aggregate by volume. Some media recipes also contain 10 to 20% sandy loam soil. The media is typically required to possess a minimum infiltration rate of 2 to 5 inches per hour.
  - The sand or mineral aggregate used in the bioretention media should be specifically graded based on the goals of the bioretention feature. Often, materials containing over 5 or 10% fines (sized at No. 200 sieve) are avoided.
  - The compost inclusion rate is dependent upon the characteristics of the mineral components of the media and the goals of the treatment system. The compost should be highly stable and mature, containing low levels of mobile nitrogen and phosphorus. Lower nutrient containing compost may be required in some bioretention media.
- Rake soil surface smooth prior to planting, removing large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Plant shrubs, trees, or desired vegetation. Water thoroughly after planting.
- Apply 2–3 inches of mulch over the treatment area, covering the media, and water into place.
  - Using mulches possessing a higher bulk density will be less likely to migrate.
- Depending on the nutrient content of the compost, pre-plant fertilization may be reduced or avoided entirely.

Additional Information:

Plants in a bioretention facility help to bind and uptake pollutants, remove water through evapo-transpiration, encourage infiltration, and create an aesthetically pleasing landscape feature.

Compost Research & Education Foundation

BIORETENTION MEDIA
Using Compost as a Component

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and /or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the media should be appropriately amended to a range suitable for the plant species to be established and results desired.

Media Analysis: During production and before planting, analyze the media to assure that it meets the final media specifications and is acceptable to the plants being established.

References:

Filtrexx Bioretention System, SWPPP Cut Sheet, 1-1-2008.
Use of Bio-Soils Design, Kurt Kutter, P.E., Cochran Engineering, 10-12-2021.
Model Bioretention Soil Media Specifications–MRP Provision C.3.c.iii.(3), 12-1-2010.

***The Seal of Testing Assurance (STA) Certified Compost Program provides a comprehensive history of compost analysis results from proficiency-tested laboratories, list of ingredients, and suggested directions for using that unique product.** **www.compostingcouncil.org/participants**

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended media is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the media. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

LANDSCAPE GARDENS

USING COMPOST

Compost Research & Education Foundation

Description:

This work consists of incorporating compost within the plant-root zone in order to improve soil quality and plant growth. This specification applies to all types of plantings including trees, shrubs, vines, ground covers, and herbaceous plants.

Key Benefits/Return on Investment:

- Improves soil structure,
- Nutrient savings – minimum 75% (possibly for 2 years),
- Water savings – 25 - 50% annually,
- May reduce or eliminate lime/gypsum application, and
- Improves seed germination and transplant success.

Various research papers identify great benefits to amending planting beds with compost, and even better results are typically found when soil amending and mulching are used in conjunction.

Construction Requirements:

- Compost should be uniformly applied over the planting area at an average depth of 1 to 2 inches.
  - Lower compost application rates may be necessary for salt sensitive plants, where compost possessing higher salt levels are used, or where plants with low nutrient requirements are to be established.
  - May increase application rates (3-inch layer) where deeper (9–12 inches) incorporation is required, in sandy soils and where reduced water usage is desired. In these cases, a lower nutrient content compost is suggested (e.g., yard trimmings-based).
  - For native species not requiring much nutrition, use compost which are both stable (being stable to highly stable) and contain lower nitrogen contents.
- Incorporate uniformly to a depth of 6 inches using a rotary tiller or other appropriate equipment.
  - Avoid incorporation when soils are excessively wet or dry.
- Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied in conjunction with compost incorporation, but at a lower application rate.
- Rake soil surface smooth prior to planting.
- The soil surface should be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Water thoroughly after planting and apply mulch.

Additional Information:

- Planting beds for woody ornamentals (trees and shrubs) typically prefer lower application rates of compost (and nutrients).
- Edible gardens (small fruits and vegetables), especially heavy feeders, prefer higher application rates of compost (and nutrients).

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil should be appropriately amended to a range suitable for the turf species to be established.

Compost inclusion rates depend on soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient-rich compost may eliminate (or greatly reduce) initial fertilizer requirements by the amount of available nutrients in the compost.

Compost Research & Education Foundation

LANDSCAPE GARDENS Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

References:

Alexander, R., Development of Suggested Compost Parameters & Compost Use Guidelines. Florida Department of Agriculture and Consumer Services, final report 5/23/1994.

Beeson, R, Enviro-Compo Utilization in Landscapes. University of Florida, IFAS, 1995.

Bilderback, TE & Powell, MA, Using Compost in Landscape Beds and Nursery Substrates, NC Cooperative. Extension Service, 9/1993.

Gouin, FR, Selecting Organic Soil Amendments for Landscaping. BioCycle 12-1993.

Smith, EM and Treaster, SA, Application of Composted Municipal Sludge in Landscapes. Department of Horticulture, The Ohio State University. 1989.

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[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

TOPSOIL MANUFACTURING

USING COMPOST AS A COMPONENT

Compost Research & Education Foundation

Description:

This work consists of blending compost with mineral soil components to create a landscape and turf grade topsoil. This specification refers to ex-site (off site) and in-situ (on site) topsoil manufacturing.

Key Benefits/Return on Investment:

- Allows for the reuse of substandard soil components,
- In-situ soil blending can reduce the cost of topsoil installation by 40-60%,
- Doubles/Improves water holding capacity of sandy, lighter soils,
- Improves porosity (air, water, nutrient movement) in clay/silt-based soils, and
- May reduce or eliminate the need for pH adjusting agents (e.g., lime, sulfur, gypsum).

Research and field experience has demonstrated compost's ability to reclaim subsoils, sands, rock dusts, etc. into productive landscape, turf, and agricultural soils.

Construction Requirements:

Ex Situ/Pile and Turn Method

- Visually inspect mineral blending components (e.g., imported soil, subsoil, sand, etc.) for physical contaminants and texture (where possible), and test for pH, soluble salts, organic matter content and any plant-toxic components.
- Place existing mineral blending component piles in close proximity to the compost pile.
- Determine compost inclusion rate and convert it into a blending ratio (e.g., 1 scoop of compost to every 3 scoops of soil, yielding a 25% inclusion rate).
  - Common compost inclusion rates are 20 to 33% but can be up to 50% where soils are poor, and the compost is stable and lower in soluble salt content.
- Following the blend ratio, create a bed of compost, then apply the appropriate number of scoops of mineral components evenly on top. Layer blend components from lightest to heaviest.
  - Whenever possible, blend on a hardened surface.
- Using a front-end loader, scoop up the layered material from underneath and dump it forward, past the soil bed.
  - Try to 'feather out' the material from the front-end loader bucket when dumping it so that it blends as it is falling.
- As you work through the middle of the soil bed, incorporate materials from either side of the bed. This should eventually displace the soil bed, moving it forward, as the blending continues.
- Continue to work the pile in this fashion until the materials are adequately mixed, then stockpile.
  - NOTE: Improved and faster blending may be achieved by bucket blending (quick flipping of ingredients), then running the blend through a trommel (or other) screening device. It can often blend and screen in one step.
- Age blended soils for 2-3 weeks and perform a soil test, when possible, before selling/using.

On Site Incorporation/In-Situ Method

- Test existing soil for texture, pH, soluble salts, organic matter content and any plant-toxic components.
  - This will help to determine the compost, and any other component, inclusion rate.
- Cultivate the soil to a 6-to-8-inch depth, and deeper where possible, when ground conditions are reasonably dry.
- Uniformly apply a 1-to-2-inch layer of compost over the treatment area. 3-inch application rates may be used when incorporating to a 12-inch depth.
- Incorporate the compost to a depth of 6-to-8 inches, and deeper, where appropriate.
  - Avoid excessive blending, especially when soil is dry, as it can damage soil structure.
- Smooth treated area, and once leveled, remove any stones or debris from the surface prior to planting.

Compost Research & Education Foundation

TOPSOIL MANUFACTURING
Using Compost as a Component

Additional Information:

- Testing the blended soil will help to assure that it meets the cultural requirements of the plants to be established.
- The addition of compost will reduce or eliminate the pre-plant fertilization needed before planting.
- Less stable and/or mature compost may be used in this application, but for best results, the blended soil should then be aged.
- Test mineral soil components which will be blended with the compost. This will assist in determining the appropriate compost inclusion rate.

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and /or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

References:

Alexander, R.A., The Field Guide to Compost Use. The US Composting Council, 1996.

Landschoot, PJ., McNitt, AS. And Hoyland, BF, Evaluation of Compost Products as Soil Amendments for Turfgrasses. The Pennsylvania State University, Agronomy Department, July 1994.

Larsen, D. A., Field Trial Compost-Amended Soil (Manufactured-in-Place) Project 163-141 ROUTE 6, Windham & Chaplin, CT. University of Connecticut, January 1999.

Rawlinson, H., Royal Ordnance Munitions Factory, Chorley Transformed into the Village of Buckshaw. The Waste & Resources Action Programme funded report, January 2008.

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www.compostingcouncil.org/participants

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

UPGRADING MARGINAL SOILS

USING COMPOST

Compost
Research & Education Foundation

Description:

This work consists of incorporating compost within the root zone to improve soil quality and plant growth. This specification is intended to upgrade compacted, disturbed, un-irrigated, low-maintenance sites, or marginal soils.

Key Benefits/Return on Investment:

- May reclaim previously unusable land, potentially even salt damaged soil,
- Enhances the rate of vegetation establishment and overall appearance,
- Nutrient savings – 50% or more of starter fertilizer (possibly feeding native plants for multiple years),
- Water savings – 25 - 50% annually,
- May reduce or eliminate lime/gypsum application,
- Improves storm water infiltration and capture, and
- Can bind specific heavy metals.

Extensive research and practical experience illustrate great success using compost in reclaiming marginal soils.

Construction Requirements:

- Compost should be uniformly applied over the planting area at an average depth of 1 to 3 inches.
  - Lower compost application rates may be necessary where salt-sensitive species are being established, where compost possessing higher salt or nutrient levels are used, where moderate amounts of organic matter exist on the site to be treated, or where native plant species are to be established.
- Higher application rates (3-inch layer) may be required in sandy soils and where reduced water usage is desired. In these cases, a lower nutrient content compost may be necessary (e.g., yard trimmings-based). Higher rates of compost may also be used if deeper soil incorporation (12-inch depth) is possible or desired.
- Compost may be applied with a mechanical spreader (e.g., manure spreader, large broadcast spreader, etc.) or blower truck depending on the precision required.
- Incorporate uniformly to a minimum depth of 6 inches using a chisel plow or similar equipment. A rotary tiller or other small tillage equipment may be necessary for smaller sites.
  - Avoid incorporation when soils are excessively wet or dry.
  - On compacted sites and/or where more improved storm water infiltration is desired, deep ripping of the soil to a depth of 12 inches in a crisscross pattern with a chisel plow (or the similar) is desired.
- If fertilizer or pH adjusting agents (e.g., lime and sulfur) are necessary, apply pre-plant or in conjunction with compost incorporation. Reduced nitrogen and phosphate application is suggested.
- Prepare the soil surface to allow for seeding.
  - The soil surface should be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
  - Depending on the seed mix used, a small size native seed planter may be required.
- Water thoroughly after seeding.

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil should be appropriately amended to a range suitable for the turf species to be established.

Compost inclusion rates depend upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient-rich compost will reduce (or eliminate) initial fertilizer requirements by the amount of available nutrients in the compost.

Compost Research & Education Foundation

UPGRADING MARGINAL SOILS Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 1.0%
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and /or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

References:

Alexander, R.A., The Field Guide to Compost Use. The US Composting Council, 1996.

Alexander, R.A., The Use of Compost in Reclamation Activities. Funded by the City of Edmonton, March 2005.

Cogger, C.G., Potential Compost Benefits for Restoration of Soils Disturbed by Urban Development. Washington State University, Compost Science & Utilization, (2005), Vol. 13, No.4, 243-251.

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Schwartz, M., Bassuk, N., Bonhotal,, J., and Harrison, E., Highly Compoacted Soils Improved by Compost Use. BioCycle, July 2007.

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Developed for the CREF by R. Alexander Associates, Inc.

EROSION CONTROL BLANKET

Compost
Research & Education Foundation

USING COMPOST AS A MEDIA

Description:

This work consists of applying a coarser compost onto a sloped soil surface to prevent runoff, reduce erosion and enhance vegetation establishment for long-term slope stabilization.

Key Benefits/Return on Investment:

- Reductions in sediment movement: 67–99%,
- Stormwater runoff reductions: 60–97%,
- Nutrient savings: 50–100% for multiple years,
- Water savings – minimum of 25%,
- Enhances seed germination, plant establishment and slope cover percentage,
- Cost of 1 and 2 inch application is equal to single and double rolled erosion control blankets, and less if seeding, and
- Assists with building projects seeking LEED credits.

This technique can be used for both temporary and permanent erosion/sediment control applications in areas affected by sheet flow erosion patterns (not concentrated flow). It is appropriate for slopes up to a 2:1 grade (horizontal distance:vertical distance), but may also be used on up to 1:1 slopes with proper consideration to length of slope and compost application rates (depth). In severe cases, an erosion netting that is stapled/staked to the soil surface may be used under or over the blanket.

Construction Requirements:

- Coarse compost should be uniformly applied over the graded surface using a grading blade, pneumatic blower, slinger, or other spreading unit, to a depth described below. The goal is to achieve 100% soil coverage with the compost layer. Areas receiving greater precipitation, possessing a higher erosivity index, or which will remain unvegetated, will require greater application rates.
- Seed may be applied to the soil surface before compost application, during application (using specialized equipment) or after application. If applied after compost application, seeds should be covered to protect them from birds and desiccation (drying out).
- Apply compost layer uniformly, achieving 100% soil coverage, approximately 3 feet beyond the top of the slope or overlap it into existing vegetation. On highly unstable soils, use compost in conjunction with appropriate structural and diversion measures. Follow by seeding or ornamental planting if desired. Where possible, track (compact) the slope, before or after compost application, using a tracking bulldozer or other appropriate equipment. The indentations can capture water and prevent any water from moving between the soil-compost interface.

Product: Use only a well-composted product that contains no substances toxic to plants where immediately planting grass, wildflower, legume seeding or ornamental plants. Very coarse compost may need to be avoided if the slope is to be landscaped or seeded, as it will make planting and crop establishment more difficult. Compost containing fibrous particles that range in size produce a more stable compost blanket.

Annual Rainfall	Total Precipitation & Rainfall Erosivity Index	Application Rate for Vegetated* Compost Surface Mulch	Application Rate for Un-vegetated Compost Surface Mulch
Low	1-25″	½ - ¾″	1″ – 1 ½″
Average	26-50″	¾ - 1″	1 ½″ – 2″
High	51″ and above	1-2″	2-4″

Compost Research & Education Foundation

EROSION CONTROL BLANKET
Using Compost as a Media

Compost Parameters:

Parameters [1,2]	Reported as (Units of Measure)	Surface Mulch to Be Vegetated	Surface Mulch to Be Left Un-vegetated
pH[3]	pH units	6.0–8.5	N/A
Soluble Salt Concentration (Electrical Conductivity)	dS/m (mmhos/cm)	Max 5*	Max 10
Moisture Content	%, wet weight basis	30–60%	30–60%
Organic Matter Content	%, dry weight basis	25–65%	25–100%
Particle Size	% passing a selected mesh size, dry weight basis	3 in. (75 mm), 100% passing 1 in. (25 mm), 90% to 100% passing 3/4 in. (19 mm), 65% to 100% passing 1/4 in. (6.4 mm), 0% to 75% passing Max particle length of 6 in. (152 mm)	3 in. (75 mm), 100% passing 1 in. (25 mm), 90% to 100% passing 3/4 in. (19 mm), 65% to 100% passing 1/4 in. (6.4 mm), 0% to 75% passing Max particle length of 6 in. (152 mm)
Stability - Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4	< 8
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%	 N/A
Physical Contaminants (man-made Inerts)	%, dry weight basis	< 0.5 (0.25 film plastic)	< 0.5 (0.25 film plastic)
Chemical Contaminants[4]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[5] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	 MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

**Note: maximum salt allowances may be 10 dS/m if seed germination trials confirm both germination and vigor of 80% or more*

General:

The Engineer or Landscape Architect shall specify the compost application rate depending upon specific site (e.g., soil characteristics, existing vegetation) and climatic conditions, as well as particular project related requirements. The severity of slope grade, as well as slope length, will also influence compost application.

References:

Alexander, R. 2022. AASHTO Designation: R 52-10 specification.

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Faucette, L. Britt, J. Governo, C.F. Jordan, B. G Lockaby, H. F. Carino, and R. Governo. 2007. Erosion control and storm water quality from straw with pam, mulch, and compost blankets of varying particle sizes. Journal of Soil and Water Conservation. 62:6: 404-413.

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Gaskin, J., J. Governo, B. Faucette, Debbie Borden. 2002. Closing the Organic By-Product Loop Part 1: An Overview of Large-Scale Composting in Georgia.

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www.compostingcouncil.org/participants

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).
[2] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.
[3] Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements and how they relate to the compost in use.
[4] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.
[5] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

Developed for the CREF by R. Alexander Associates, Inc.

ROW CROP PRODUCTION

Compost Research & Education Foundation

USING COMPOST

Description:

This application consists of applying compost to agricultural land to improve soil quality and provide crop nutrition. There are a variety of row crops; including cereals (barley, wheat, oats), canola, corn, soybeans, cotton, etc., that may benefit from compost use.

Key Benefits/Return on Investment:

- Nutrient savings – up to 50-100% savings on specific starter fertilizer nutrients (depending on crop requirements*),
- Can replace organic matter volumes generated through cover cropping,
- May reduce or eliminate lime/gypsum application and,
- Research and field practical experience illustrates that the ongoing usage of compost
  - Improves water holding capacity, reducing irrigation requirements,
  - Increases cation exchange capacity, improving soil's ability to retain nutrients,
  - Reduces soil compaction and bulk density, providing fuel savings during tillage, and
  - Enhances microbial processes, nutrient cycling to plants.

Application Procedures:

- Complete a soil test before applying compost, fertilizer, or other amendments in order to determine the requirements of the soil as they relate to the specific crops being grown and products.
  - The addition of compost will typically reduce the addition of fertilizer, lime, and gypsum.
- Where appropriate, cultivate soil to condition it for planting using disc or similar implement.
- Uniformly apply compost throughout the field using a traditional manure spreader (flail/rear discharge or side discharge) or other specialized equipment.
  - Lower rates (4-8 ton/acre) of compost are typically used in multiple (successive) year applications as a nutrient supplement, organic matter source, and to improve water holding capacity.
  - Higher application rates (10-20 tons/acre) are used to modify soil structure and other properties in a short-term.
- Existing soil conditions, compost characteristics and the nutrient requirements of the crop will influence appropriate compost application rates. Most often, compost rates are calculated based on the nitrogen or phosphorus requirements of the crop, with supplemental nitrogen or phosphorus applied to balance the ratio of nutrients that the crop needs.
- Thoroughly incorporate the compost to a depth of 8 to 10 inches using a disc or mole board plow, or other tillage equipment.
- Plant crop seeds, then irrigate based on plant needs, soil moisture, and climatic conditions.

Compost may also be applied over crop land managed using a no-till management style. In these cases, apply the compost over the crop stubble before drill seeding, and water it in when possible. For forage crops which may be harvested (cut) several times during a growing season, apply compost when the crop foliage is dry, so the compost can easily filter to the soil surface, and water it in when possible.

Compost Research & Education Foundation

ROW CROP PRODUCTION Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 20
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability[3] Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[4]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[5] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	MPN per gram dry weight MPN per 4 grams dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary.

Compost application rates depend upon soil conditions and quality, product cost, and manufacturer's recommendations. The use of stable, nutrient rich compost will reduce initial fertilizer requirements by the amount of available nutrients in the compost. To gain the greatest nitrogen benefit, used compost possessing a C:N ratio of 15 or below.

*Note: certain nutrients contained in compost may release more slowly than a specific crop requires. Estimating compost nutrient release rate can be more difficult than with chemical/inorganic sources and is affected by regional climatic conditions.

References:

Baroldi, L., Personal Conversations. 4/18/2016.

Butler, T., Muir, J. and McFarland, M., Using Compost for Forage Production. Texas Water Resources Institute, 2004.

Sabey, B.R., Effect of MetroGro Application Rates on the Germination and Emergence and Growth of Corn, Wheat and Bluegrass. Colorado State Ubniversity, March 23, 1984.

Smiciklas, K.D., Walker, P.M., and Keller, T.R., Evaluation of Compost for Use as a Soil Amendment in Corn and Soybean Production. Illinois State University, Department of Agriculture. Compost Science & Utilization, Summer 2008.

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[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

TURF MAINTENANCE

Compost Research & Education Foundation

USING COMPOST

Description:

This work consists of spreading a uniform layer of compost over existing turf in order to improve soil and vegetation. This specification applies to both cool and warm season grass species and is most beneficial when done in conjunction with aerification.

Key Benefits/Return on Investment:

- Nutrient savings – 50% or more of fertilization for the first year,
- Water savings – may be significant with multiple compost applications, or when done along with core aeration,
- Reduces soil compaction when completed along with aerification,
- Assists in the degradation of thatch,
- Enhances the rate of establishment and overall appearance, and
- May provide soil-borne disease suppression, reducing pesticide applications.

Extensive practical experience illustrates successful turf top dressing on residential, commercial and sports turf.

Construction Requirements:

- Mow grass to preferred mowing height or slightly lower.
- Core-aerate the entire area to be treated with compost. Ideally, use deep (4 to 6 inch long, 1/2 inch wide, minimum), hollow tines for best results. Larger holes will more easily allow for compost to be backfilled into them.
  - Aeration may also be completed with solid tine aerators or a verti-drain.
  - Make 4 to 5 passes over the area to be treated, moving in two directions. If compaction is a significant problem, then 8 to 10 passes with the aerator may be beneficial.
- Uniformly apply approximately 1/4 to 1/2–inch of compost across the turf area to be treated.
  - Finer compost are required for this application, and lower application rates of compost should be used if the turf is mowed at a 1-inch height or below.
  - Various types of spreading equipment may be used for top dressing, including a farm manure (with rear flails) or large lime/fertilizer (with rear spinners) spreader. However, specialized turf top dressers (with rear rotating brushes) and blower trucks may be the best pieces of compost top dressing equipment, as they project the compost through the turf canopy and onto the soil surface.
  - Do not top dress if the grass is still wet from the rain or irrigation, as the compost will stick to the grass blades.
- Back drag the entire area with a weighted chain-link fence, rake, or specialized implement, to break up the cores and blend them with the compost to fill in the aerification holes.
- Overseeding may be completed before or after the compost is applied. If done after top dressing, then rake the seed into the compost layer to cover it.
- Water the treated area well.

Additional information:

- Finer, low in odor, and nutrient rich (nitrogen and iron) compost are preferred for this application.
- If top dressing is being completed to level the turf surface, then blending compost with a mineral soil or sand (50/50 v/v) is preferred.
- When applied in the Fall, the compost top dressing should replace the Fall/Winter fertility application.

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the turf species to be established and results desired.

Compost Research & Education Foundation

TURF MAINTENANCE Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed to determine any nutritional or pH adjustment requirements necessary. Once determined, the soil should be appropriately amended to a range suitable for the turf species being managed.

Compost inclusion rates depend upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient rich compost will reduce initial fertilizer requirements by the amount of available nutrients in the compost.

References:

Alexander, R.A., Benton, C.H, and O'Shea, M., Best Management Practice Guide Using Compost for Sport Pitch Renovation in Ireland within a Sustainable Sport Pitch Maintenance & Management System. RX3 funded project, March 2012.

Landschoot, P, personal discussions. The Pennsylvania State University, Agronomy Department, 4/28/2021.

Lawson, D. and Brundage, J., Demonstration Trials of the Utilization of Composted Materials in the Maintenance of Sports and Amenity Turfgrass. The Waste & Resources Action Programme funded report, January 2006.

Le Strange, M., Topdressing Compost on Turfgrass: It's Effect on Turf Quality and Weeds. U.C. Cooperative Extension, Tulare & Kings Counties, 1996.

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[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

SUPPLEMENTING PLANT NUTRITION

Compost
Research & Education Foundation

USING COMPOST

Description:

This application consists of spreading a uniform layer of compost over a planting area to act as a supplemental nutrient source, which provides additional agronomic benefits.

Key Benefits:

- Supplies primary, secondary and micronutrients, primarily in slowly releasing form,
  - Typically releasing nitrogen over 3 to 4 years, phosphate 3 to 5 years, and the majority of potassium during the year of application.

Over Time

- Improves water holding capacity, reducing irrigation requirements,
- Increases cation exchange capacity, improving soil's ability to retain nutrients,
- Reduces soil compaction,
- Enhances microbial processes, nutrient cycling to plants, and
- May provide soil-borne disease suppression, reducing pesticide applications.

Application Instructions:

Agriculture

- Where appropriate, cultivate soil to condition it for planting using disc or similar implement. Uniformly apply compost throughout the field using a traditional manure spreader (flail/rear discharge or side discharge) or other specialized equipment. Seed and water.
- Compost may also be applied over crop land managed using a no-till management style. In these cases, apply the compost over the crop stubble before drill seeding, then water in when possible.
- For forage crops which may be harvested (cut) several times during a growing season, apply compost when the crop foliage is dry, so the compost can easily filter to the soil surface, and water it in when possible.

Immediate tillage and/or 'watering in' will help to conserve ammoniacal nitrogen found in the compost, helping it attach to soil particles.

Compost has been used in select applications (e.g., home gardens, organic farmers) as a primary crop nutrient source. This type of system requires larger amounts of compost, which are applied in consecutive years. Caution must be taken with this system, as it can cause soil nutrient imbalances over time.

Turf Top Dressing

- Prepare area by mowing grass to preferred height. When possible, core-aerate the area to be treated with compost.
- Uniformly apply compost, then back drag the area treated with a weighted chain link fence, rake, or specialized implement, and water. Apply compost when the turf foliage is dry, so the compost can easily filter to the soil surface, and water it in when possible.

Additional Information:

- The use of stable compost possessing a C:N ratio of 15:1 will allow more of the compost-based nitrogen to be used by the crop. Compost possessing higher levels of ammonia and nitrate nitrogen will more quickly provide nitrogen to the crop.
- Understand that nutrients are cycled out of compost over time, and that supplemental nutrient addition is typically required in order to grow high-quality crops or obtain acceptable yields.

  Note: certain nutrients contained in compost may release more slowly than a specific crop requires.
- Estimating compost's nutrient release rate can be more difficult than with chemical/inorganic sources and is affected by regional climatic conditions.

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Compost Research & Education Foundation

SUPPLEMENTING PLANT NUTRITION Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 20
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	MPN per gram dry weight MPN per 4 grams dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General:

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil should be appropriately amended to a range suitable for the crop species to be established. Compost application rates depend upon soil conditions and quality, plant tolerances, and manufacturer's recommendations.

NUTRIENT VALUE OF COMPOST
Valuing the nutrients found in compost is a moving target, as commercial nutrient values change on a monthly basis. Further, compost customers often value the specific nutrient that they require (e.g., nitrogen or sulfur) and not the full suite of nutrients in the product (especially secondary and micronutrients).

Example calculation: Yard Trimmings Compost with a nutrient content of 0.67-0.25-0.33 (on a wet wt. basis) yields
Nitrogen – 13.4 lbs/t x $0.65/lb. N value = $8.71/t
Phosphorus (P2O5) – 5 lbs/t x $0.70/lb. P value = $3.50/t
Potassium (K2O) – 6.6 lbs/t x $0.75/lb. K value = $4.95/t
Total N-P-K value per ton of compost = $17.16

References:

Agricultural Prices, National Agricultural Statistics Service, USDA. October 2012.

Economics of Using Composted Dairy Manure, Texas Water Resources Institute, 2004.

Alexander, R., Strategies for Increasing the Value of Biosolids Compost, Water Environment Federation Conference 2006.

Maynard, A., Using Yard Trimmings Compost as Fertilizer on Vegetable Crops. BioCycle, May 2004.

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[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

EDIBLE GARDENS

Compost Research & Education Foundation

USING COMPOST

Description:

This effort consists of incorporating compost within the planting root zone in order to improve soil quality and plant growth. This specification applies to various types of vegetables, small fruits, herbs, and related items.

Key Benefits/Return on Investment:

- Improved soil structure,
- Nutrient savings – minimum 50%,
- Water savings – 25 - 50% annually,
- Reduction of plant loss, and
- May reduce pesticide usage through compost-induced disease suppression.

Various research papers and practical experience have demonstrated the benefit of amending edible gardens with compost in both conventional and organic production systems.

Construction Requirements:

- Since maximum crop production is the goal when establishing an edible food garden, special care should be given to the soil and location in which you plant. The location should not be low lying (where water can pool), should receive full or partial sun, and the soil should be free draining. Always test soil before establishing a new edible garden.
- Compost should be uniformly applied over the planting area at an average depth of 1– 2 inches.
  - Lower compost application rates may be necessary for salt sensitive crops or where compost possessing higher salt levels are used. An alternative is to heavily water after initial planting to leach potential excess salt from the crop's root zone.
  - May increase application rates (3-inch layer) in sandy soils and where reduced water usage is desired. Increased application rates are also suggested where medium and heavy feeding crops (e.g., tomatoes, broccoli) are established and where deeper soil incorporation (12-inch depth) is possible.
- Incorporate uniformly to a minimum depth of 6 inches using a rotary tiller or other appropriate equipment.
  - Avoid incorporation when soils are excessively wet or dry.
  - Deeper soil incorporation (in sandier and lower bulk density soils) is preferred when growing crops like potatoes and carrots, whose edible parts are grown in the soil.
  - NOTE: if creating a raised planting bed, establish a bed that can hold 12 inches of media depth, and place over soil that can drain. Compost can comprise up to 25 to 33% (by volume) of the media and should contain a similar volume of sand, bark fines, etc. which will allow drainage.
- pH adjusting agents (e.g., lime and sulfur) are important, where necessary, and may be applied in conjunction with compost incorporation. Preferably, do this a week before planting. Pre-plant fertilization may also be completed during this step, but higher nutrient compost may eliminate the need for pre-plant fertilization. Most vegetables require a soil pH of 6.0 to 7.0 and nitrogen requirements of 0.25 to 0.5 pound per 1,000 ft^2 per season. Half of a crop's nutrition is provided pre-planting, and the rest during the growing season.
  - Depending on the crop and the compost, it may be possible to eliminate the addition of supplemental nutrition during crop production. However, this can be tricky, and is most easily accomplished in gardens where compost has been incorporated for 3 years in a row, and crops are not heavy feeders.
- Rake soil surface smooth prior to planting.
- The soil surface should be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Water thoroughly after planting. Water and provide additional fertilization, as necessary, until the crop is harvested.

Compost Research & Education Foundation

EDIBLE GARDENS
Using Compost

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10**
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	 %, relative to positive control %, relative to positive control	 Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	 MPN per gram dry weight MPN per 4 grams dry weight	 Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Before any soil preparation procedures ensue, a soil analysis should be completed to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established. Compost inclusion rates depend upon soil conditions and quality, plant tolerances, and manufacturer's recommendations.

**Note: Higher soluble salt concentrations may be allowed where salt tolerant plants are established, or lower application rates are used. If concerned about soluble salt content, heavily water the planting bed after planting, allowing for the salts to leach. NOTE: compost possessing a higher soluble salt content, often also possess a higher amount of plant nutrients.

References:

Alexander, R., Development of Suggested Compost Parameters & Compost Use Guidelines. Florida Department of Agriculture and Consumer Services, final report 5/23/1994.
Maynard, A., Low Rates of Compost Increase Vegetable Yields. BioCycle, November 1995.
Traunfeld, J., Soil to Fill Raised Beds. University of Maryland Extension Technical Document, Spring, 2019.
Tyler, R., personal discussions. Green Horizons Consulting, 5/20/2021.
Maynard, A., Using Yard Trimmings Compost as Fertilizer on Vegetable Crops. BioCycle, May 2004.

***The Seal of Testing Assurance (STA) Certified Compost Program provides a comprehensive history of compost analysis results from proficiency-tested laboratories, list of ingredients, and suggested directions for using that unique product. www.compostingcouncil.org/participants**

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The Compost Research & Education Foundation).

[2] It should be noted that the pH and soluble salt content of the final amended soil is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of the specific compost used to amend the soil. The pH and soluble salt content of the compost is diluted when mixed with the native soil, so testing for these parameters in the amended soil is suggested. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Developed for the CREF by R. Alexander Associates, Inc.

TURF INSTALLATION

USING COMPOST

Compost Research & Education Foundation

Description:
This work consists of incorporating compost within the root zone to improve soil quality and plant growth. This specification applies to all types of turf establishment methods including seeding, sprigging, sodding, and hydroseeding.

Key Benefits/Return on Investment:

- Enhances the rate of establishment and overall appearance,
- Nutrient savings – up to 50 - 100% of fertilization for the first year (some compost may supply 75% of the N & P for 2 years of turf growth),
- Water savings – 25 - 50% annually,
- May reduce or eliminate lime/gypsum application,
- Improves storm water capture, and
- May provide soil-borne disease suppression, reducing pesticide applications.

Various research and extensive practical experience illustrate great benefits with amending turf soils with compost.

Construction Requirements:

- Compost should be uniformly applied over the planting area at an average depth of 1 to 2 inches.
  - Lower compost application rates may be necessary when salt sensitive grass species are being established or where compost possessing higher salt levels are used.
  - Increased application rates (3-inch layer) may be used in sandy soils and where reduced water usage is desired, but in these cases, a lower nutrient content compost may be recommended (e.g., yard trimmings-based). Larger application rates may also be used if deeper soil incorporation (12-inch depth) is possible.
- Incorporate uniformly to a depth of 6 inches using a rotary tiller or other appropriate equipment. Avoid incorporation when soils are excessively wet or dry.
- Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied in conjunction with compost incorporation, as necessary, but reduced nitrogen and phosphate application is suggested.
- Rake soil surface smooth prior to seeding, sprigging, sodding, or hydroseeding.
- The soil surface should be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Where necessary, top-dress newly seeded and sprigged turf areas with a 1/4-inch layer of fine compost (3/8-inch screen, minus), then water to protect against hot, dry weather or drying winds. Use as a substitute for straw/hay or burlap cover.
- Water thoroughly after seeding, sprigging, or sodding.

Compost Parameters:

Parameters[1,5]	Reported as (units of measure)	General Range
pH[2]	pH units	6.0 - 8.5
Soluble Salt Concentration[2] (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	95% pass through 3/8" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	< 4
Maturity (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (man-made inerts)	%, dry weight basis	< 0.5% (0.25% film plastic)
Chemical Contaminants[3]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Indicator Organisms Fecal Coliform Bacteria, and/or Salmonella	MPN per gram dry weight MPN per 4 grams dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

Additional Information – Popular Turf Species – Tolerances and Requirements *(for mature grass, 1 year old)*

	Kentucky Bluegrass	Turf -Type Tall Fescue	Perennial Ryegrass	Bermudagrass	St. Augustine	Zoyzia
pH Range	6.3-7.0	6.0-6.8	6.3-7.0	6.0-6.9	6.0-6.9	6.0-6.9
Salt Tolerance	High	High	High	High	High	High
Water	Drought tolerant	Very drought tolerant	Moderately drought tolerant	Very drought tolerant	Drought tolerant	Very drought resistant
Nitrogen* (lbs/1,000 ft2/year)	Low 2 - 3 High 4 - 5	Low 2 – 3 High 3 - 5	Low 2.5 – 3.5 High 5	Low 4 – 4.5 High 6 - 8	Low 2 - 3 High 4 - 5	Low 1 - 3 High 2 - 3
Require de-thatching	Yes	No	No	Yes, 2x/year	Yes	Yes

* Low N rates=residential, high N rates=commercial/specialty turf. When using compost possessing a C:N ratio above 15:1, some of the N will be used to further stabilize carbon in the compost.

General:

Compost Analysis: All compost products have different characteristics. Before selecting a compost product, a compost analysis should be completed by a reputable laboratory* to determine the characteristics of the material, so that the right material can be used for the appropriate purpose. Once determined, the soil should be appropriately amended to a range suitable for the plant species to be established and results desired.

Soil Analysis: Before any soil preparation procedures ensue, a soil analysis should be completed to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil should be amended to a range suitable for the turf species to be established.

Compost inclusion rates depend upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient rich compost will reduce initial fertilizer requirements by the amount of available nutrients in the compost.

References:

Alexander, R.A., The Field Guide to Compost Use. The US Composting Council, 1996.

Landschoot, PJ., McNitt, AS. And Hoyland, BF, Evaluation of Compost Products as Soil Amendments for Turfgrasses. The Pennsylvania State University, Agronomy Department, July 1994.

Larsen, D. A., Field Trial Compost-Amended Soil (Manufactured-in-Place) Project 163-141 ROUTE 6, Windham & Chaplin, CT. University of Connecticut, January 1999.

Rawlinson, H., Royal Ordnance Munitions Factory, Chorley Transformed into the Village of Buckshaw. The Waste & Resources Action Programme funded report, January 2008.

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3 US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

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5 Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

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