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Compost: The Sustainable Solution

Not just for plant establishment, but for soil/water protection (and conservation), and green infrastructure BY RON ALEXANDER

The use of recycled organics is one of our nation's greatest assets, and we can utilize them to address several of society's vexing challenges. The commercialization of composting as an economic method to manage organic (carbon-based) "wastes," got its rebirth in the late 1970s, and has grown from coast to coast, with over 4,500 larger-scale facilities in operation. These facilities manufacture a unique soil-amending product—"compost"—which can be used in a multitude of applications (see Compost Applications, pg. 21) that provide many benefits (see Compost Benefits, pg. 24). Indeed, over the past 35 years+, compost has become a staple of the landscaping industry and a "fan favorite" of home gardeners. Of course, compost is also popular in many other markets, including turf establishment, and maintenance and agriculture. Compost has the ability to improve the physical, chemical, and biological characteristics of soil, allowing plants to better benefit from their relationship with the soil. "Healthy" soils assist plant health and sustainability by:

- reducing soil compaction in heavy soils,
- improving moisture holding capacity and availability,
- providing some nutrients (for both the plants and the soil microbes), and
- supplying stabilized carbon, which is food for soil microbes.

Some of these microbes work symbiotically with the soil roots to help plants better absorb nutrients and water, while others offer natural disease suppression. But there's much more to the story, as compost can be used in more sustainable landscaping practices, and in soil and water management techniques that are often less expensive and more effective than current techniques. Hence the concept of the "Compost: The Sustainable Solution" program, which is focused on landscaping, turf, general construction, and land management projects.

The three main components of the program are:

- the "Strive for 5%" concept—don't establish landscape plantings or turf before amending the soil to a 5% organic matter content,
- using compost (actually a coarse or woody version of compost) in erosion and sediment control applications, and
- using compost in low-impact development (LID) and green infrastructure type applications (e.g., component to green roof or bioswale media, etc.).

Interestingly, aside from helping plants establish and grow, all three of the applications above provide important environmental benefits related to water and soil protection and conservation, and stormwater management. The importance of mentioning these technical benefits is that with a changing climate, the general public will end up incurring greater costs related to managing the effects of both more frequent and severe droughts, as well as rainstorm events (e.g., flooding). Aside from the recent excessive drought conditions (e.g., California, Texas) that we have been experiencing which exacerbate the spreading of wild fires, and in the case of California post-fire conditions that lead to mudslides, many communities have also had to deal with the cost of managing ever-growing volumes of stormwater.

Two examples of coastal city chaos caused by these changing environmental conditions include New York City having to deal with two "500-year storms" which occurred in just three years *and* caused tens of billions of dollars of damage; and, Washington DC's 10-year, $2.5 billion stormwater infrastructure project. In these examples, we aren't suggesting that the use of compost in the applications outlined above will mitigate the effects of these devastating events and inadequate infrastructure, but we can surely prove that we can lessen their effects, and do so in an economic fashion—while adding more carbon to the soil, slowing the effects of climate change. Therefore, creating dual-purpose landscapes; those that have an environmental purpose as well as aesthetic one, is highly beneficial, as is the use of green infrastructure practices, alone and in conjunction with existing grey infrastructure.

Compost Applications

Soil Incorporation

- Turf establishment
- Garden bed preparation
- Reclamation/remediation
- Nursery production
- Roadside vegetation

Surface Applied

- 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
- Stormwater management (e.g., bioretention, rain garden, rooftop garden, bioswales)

Program Components/Techniques

"Strive for 5%". This technique entails completing an appropriate level of soil improvement on landscaping and construction projects to both improve the establishment and survival of plants (vegetation), while also achieving the environmental benefit of changing the soil structure enough to better manage "too much" and "too little" water. So, the creation of more healthy soils will allow for reductions in irrigation water usage in landscape settings, and to some extent the reduction of other chemically based inputs (e.g., fertilizer, pesticides, and surfactants). Research and practical experience have illustrated that creating soils containing 5% organic matter provide both the plant and water benefits described above, and compost is the most readily available and economic source of stabilized organic matter in the marketplace. Of course, these same soils resist water and wind erosion by creating large and small pore spaces, as well as enhancing soil aggregation (through microbial activity). It should be mentioned, however, that creating and maintaining 5% organic matter in soil is much more difficult in California, the southwest, and southeast regions of the US (where organic matter is mineralized at a greater rate).

Great examples of communities which have implemented related programs include Washington State and the City of Denver, CO, but there are many more. The Soils for Salmon program, which is law in western Washington through the state's stormwater regulation, requires soil improvement in most new construction projects. The ordinance requires the provision of 12 inches of uncompacted soil depth in order to improve stormwater absorption and infiltration, thus reducing the movement of chemical contaminants (which are soluble and attached to sediment) from reaching surface waters. The program was implemented to try to stop the extinction of certain salmon species in the Puget Sound caused by sedimentation and contamination of the fish spawning gravels.

This same type of program could be implemented as a "green infrastructure" technique to assist communities managing excess stormwater anywhere in the US. The City of Denver created a water conservation program, which allows their residents to install irrigation systems, if they first improve their soil with a prescribed rate of compost. This program acknowledges compost's ability to hold water and make more of it available to plants. In fact, studies show that for every 1% increase in organic matter in the soil, you increase water-holding capacity by 16,500, to 27,000 gallons of water per acre (to vary, depending on soil type; USDA NCRS 2013).

Various voluntary "green" landscaping programs (e.g., Bay-Friendly Rated Landscapes, a third-party rating system administered by the Bay-Friendly Landscaping & Gardening Coalition, Bay Area, CA) have also been created throughout the country, using compost and mulch, to reduce water usage and/or reduce surface water contamination by reducing soil erosion and stormwater runoff. The use of compost and mulch is required for public and private projects throughout Alameda County, CA, as part of a set of sustainable landscape construction practices known as the Bay-Friendly Basics, developed by StopWaste (The Alameda County Waste Management Authority).

It should be mentioned that the agricultural usage of compost may also be encouraged in the future in order to improve the carbon content of soil (e.g., Marin Carbon Project), which provides a variety of crop production, soil conservation and climate change benefits.

Erosion and sediment control. Although still considered relatively unknown in certain regions of North America, the use of compost in erosion and sediment control has been a very successful landscaping practice for over 25 years. Compost blankets (the application of a layer of compost on hill slopes), compost berms, and compost filter socks are incredibly effective, enhance the long-term quality of the soil, and, in the case of compost blankets, have excellent stormwater reduction advantages. These innovative techniques have been thoroughly proven through university research, and have been recommended for use by the USEPA. National specifications exist for these applications through the American Association of State Highway and Transportation Officials. (Go to **www.alexassoc.net**, then "Library of Articles," and look under "Compost Specifications" to see the full specs.)

When used as a compost blanket, compost is typically placed on up to 2:1—and sometimes more severe—slopes at an application rate of 1–2 inches in depth. This technique is used and is highly effective in reducing and slowing the sheet flow of water. Lesser application rates are possible in areas of lower rainfall accumulation and intensity, on less severe slopes, and where vegetation is to be established. Once applied, the woody fraction of the compost increases surface roughness and slows the flow of runoff, thereby making it less erosive, more likely to induce infiltration into the soil and reduce the transport of pollutants. In addition, the woody fraction absorbs the energy of the rainfall, preventing soil particles from dislodging (the first stage of soil erosion), while the finer fraction beneath it absorbs a substantial volume of moisture, and is optimum for plant establishment and growth. Research completed at University of Georgia illustrated that a 2-inch application of compost onto a slope could absorb and hold 1–2 inches of rainfall.

Further, the unique properties of the product allow for extensive rooting of the grass and other vegetation, locking the blanket to the slope and protecting the soil beneath it. It should also be noted that compost blankets are effective with or without vegetation, but application rates of compost can often be reduced if it is applied with vegetation. University research consistently illustrates that compost blankets not only constantly outperform hydroseeding and conventional erosion control blankets (e.g., rolled fabric) in vegetation establishment, but also more effectively reduce stormwater runoff volume and peak flows, as well as total sediment and nutrient loads (Faucette et al. 2005; Faucette et al. 2007; and Faucette et al. 2009, “Large-scale performance and design...”).

Research performed for Portland Metro, an environmental regulatory body based in Portland, OR, and the USDA ARS further illustrated that yard trimmings compost was capable of not only controlling erosion, but also of filtering, binding, and degrading contaminants from the stormwater passing through the layer (Faucette et al. 2013; Faucette et al. 2009, “Storm water pollutant removal performance…”).

The benefit of using a compost blanket lies in its ability to:

- act as a buffer to absorb rainfall energy,
- reduce wind and water erosion,
- stimulate microbial activity to increase decomposition of organic materials in the soil thereby adding to the soil structure,
- prevent soil compaction and crusting, thereby facilitating percolation,
- slow the flow of water over the surface of the soil,

Compost Benefits

- Improves soil structure and porosity—creating a better plant root environment;
- Increases moisture infiltration and permeability, and reduces bulk density of heavy soils—improving water infiltration rates and reducing erosion and runoff;
- Improves the moisture holding capacity of light soils—reducing water loss and nutrient leaching, and improving moisture retention;
- Improves the cation exchange capacity (CEC) of soils;
- Supplies organic matter;
- Aids the proliferation of soil microorganisms;
- Supplies beneficial microorganisms to soils and growing media;
- Encourages vigorous root growth;
- Allows plants to more effectively utilize nutrients, while reducing nutrient loss by leaching;
- Enables soils to retain nutrients longer;
- Contains humus—assisting in soil aggregation and making nutrients more available for plant uptake;
- Buffers soil pH; and
- Supplies essential plant nutrients.

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- capture and retain moisture, reducing soil moisture loss thereby facilitating plant growth,
- provide suitable microclimate for seed germination,
- capture blowing snow to increase the insulating effect of winter protection, and
- improve soil texture (Story et al. 1995).

Compost berms and filter socks are "3D" filters possessing huge sediment and biofiltration capabilities. Where the berms are used in sheet flow conditions, the filter socks (think pantyhose filled with coarse compost) can also be used in concentrated water flow situations. This is because filter socks can be staked into place, and the compost media is contained within a mesh netting material. Although both compost berms and filter socks are used as perimeter control devices for sediment, installed around the borders of construction sites and at the top and bottom of slopes, the filter sock technology is much more versatile (see **www.filtrexx.com**). They can even be used around stormwater inlets and to build "living" walls. One of the most important research findings pertaining to compost filter berms and socks, is that they are much more effective in capturing fine particles of sediment, which are not captured as efficiently by other more conventional sediment control devices (e.g., silt fences). This is very important in that fine particles of sediment have the potential to be much more damaging to the environment, since they transport further and stay in suspension longer, and also contain a greater amount of chemical contamination (e.g., petroleum hydrocarbons, heavy metals, nutrients) than larger particles of sediment.

The use of compost in erosion and sediment control projects has expanded significantly since the adoption of the National Pollutant Discharge Elimination System (NPDES) Phase II regulation for construction activities. This regulation requires that construction sites of 1 acre or greater to have erosion and sediment control plans in effect on a daily basis using prescribed best management practices (BMPs).

LID and green infrastructure. There has been a growing interest within the US landscaping industry to utilize environmentally sound and sustainable landscaping practices. As mentioned earlier, there are many programs throughout the country to promote these concepts and methods, and many cities are adopting them and requiring their contractors to meet their related requirements. This movement coincides well with the "Green Building" movement, which includes elements of sustainability and "low environmental impact." Compost-based BMPs are a natural fit for green buildings and have been increasingly incorporated in LEED-certified projects. From restoring habitat, decreasing stormwater, helping to decrease urban heat islands and water use, to using recycled and locally manufactured materials, compost-based products are helping design teams and developers achieve more LEED credits (Faucette 2009).

The LEED program, created and administered by the US Green Building Council, is a point accrual and rating system that promotes and certifies environmentally sustainable building projects

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to create a national standard, through third-party verification, in order to increase the value of green buildings in the marketplace (Faucette 2009).

In many federally and state funded building projects, LEED certification is required. Where LEED primarily focuses on the building envelope a conceptually similar program called the "Sustainable Sites Initiative" (SSI), developed by the American Society of Landscape Architects and the Ladybird Johnson Wildflower Center, focuses on the landscape and site management.

Compost is both a recycled product and is typically provided from local sources, both of which can be used to earn LEED and SSI credits. Further, the use of the Strive for 5% compost-based "soil manufacturing" concept or application of compost blankets for onsite stormwater management can also be used to recreate a habitat on a Green Building project, and earn LEED or SSI credits. However, within this arena, compost has also gained great popularity as the "organic" (carbon-based) component to a variety of "engineered soils" typically used in green infrastructure practices, such as bioretention, rain gardens, rooftop garden, bioswales, and green roofs. Compost is typically used at an inclusion rate of 10–30%, by volume, for its ability to; hold water, increase cation exchange, bind heavy metals, degrade petroleum hydrocarbons, and supply and feed soil microbes.

Conclusions

Compost is an incredibly versatile product, which provides many benefits for plant establishment and growth, but it is also a highly effective product for use in erosion and sediment control, as well as in stormwater management. Although compost is already a staple of the landscaping industry, its use in "land management," and in soil and water protection can only expand if specifying entities (e.g., engineers, communities, landscape architects, public agencies), policy makers, and project managers have the foresight to utilize it and get familiar with the many understood and ancillary benefits of compost.

Of course, compost is only a tool in these land management and green infrastructure projects, and must be properly used in a systematic approach. If so, these compost-based techniques will be shown as not only highly effective, but also very economical. As our project requirements (and perhaps the climate) change, we must adjust with them in order to provide the most effective and economical solutions to our land management projects. Compost, and compost-based techniques, can be a part of the solution.

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Acknowledgement

Thanks to Dr. Britt Faucette, CPESC, LEED AP, for providing technical editing to this article. Faucette is the Director of Research and Technical Services for Filtrexx International, and a consultant to the stormwater management and organics recycling industries. He serves on the Board of Trustees for the Composting Council Research and Education Foundation, with ASTM Erosion and Sediment Control Technology Committee, and Green Roof's for Healthy Cities Growing Media Development Committee. MSW

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