TechLink Research Summary #3341

Resilient Infrastructure & Restoration Under a Changing Climate with Filtrexx Compost-Based Best Management Practices

The definition of *resilience* is the ability to withstand or rapidly recover from shock, stress, or change. For decades ecosystem scientists have said the closer an ecosystem is to its natural steady state, the more stable and resilient it will be when placed under chronic or severe stress. Regional and global climate change has placed most of our ecosystems and the services they provide under immense stress. Two major impacts created by climate change are increased drought, particularly in drought-prone and arid regions (potentially leading to wild fires); and increased storm intensity, storm water, and flooding, particularly in humid regions (where tropical storms and hurricanes are also more prevalent). Replenishing and maintaining organic matter and carbon stores in our soils can have a profound impact on reducing these negative consequences of climate change.

Organic matter and carbon supplied by compost has the ability to increase soil water holding capacity and storage, thereby, retaining moisture longer during dry periods and requiring less irrigation when water is in high demand; while also providing the absorption capacity to hold and infiltrate high levels of rainfall that would normally result in storm water runoff. Furthermore, these materials help to establish and sustain an above and below ground ecosystem that allow soil organism and plant community ecological succession to occur, thereby stabilizing soils and reducing soil erosion - particularly under climate conditions that may reduce plant cover and biomass, leading to increased storm water and erosion. In addition, these materials also help to maintain natural evapotranspiration and surface water recharge rates thereby helping to maintain the water cycle and prevent *regional* climate change. The ecosystem services provided by soil organic matter and carbon play an integral part in sustaining a *resilient infrastructure* we now require in the face of uncertain climate change.

According to a Michigan State University report for every 1% of soil organic matter the soil is able to hold up to 16,500 gallons of plant available water per acre (Gould, 2015), and a white paper from the University of Georgia reported that compost amended soils can reduce irrigation requirements for various plants by 30% (Gaskin et al, 2003), lending evidence that compost can decrease irrigation requirements and improve plant survival under dry, water stressed climate conditions.

A compilation of studies from the University of Georgia have shown compost applied to the soil surface can absorb 80% of a 4 inch rainfall event, while reducing storm water runoff between 60% and 97% over multiple high intensity, high accumulation storm events (Faucette et al, 2005; Faucette et al, 2007). A study from San Diego State University reported compost applications reduced storm water by up to 94%, resulting in similar reductions in soil erosion (Faucette, 2009). Similarly, these studies showed compost could reduce storm water peak flows by up to 51%, a time when storm runoff is at is most erosive to soils and destructive to ecosystems and infrastructure (Faucette et al, 2005, Faucette et al, 2007). In a follow up study designed to evaluate the above and below ground influences from compost applications relative to conventional vegetation establishment practices on disturbed soils, scientists reported a 60% increase in soil microbial carbon and a 300% increase in plant cover, demonstrating the positive influence compost applications can have on building ecosystems that are more resilient in the face of environmental stress and change (Faucette et al, 2006).

In part because of this research compost has been widely used in sustainable storm water management applications, particularly Green Infrastructure, which is designed to minimize storm water, and maximize the native diversity and resilience of our landscapes and watersheds. These applications include compost erosion control blankets, biofilters, bioretention and rain gardens, green roofs, infiltration zones, and constructed wetlands. The idea that utilizing compost provides protection and resilience against climate change, while simultaneously helping to reduce the carbon based gases that are causing it, has put organics recycling and compost utilization at the forefront of carbon footprint and climate change action plans - from corporate policy to state and local legislation.

Ecosystem resilience is built upon maintaining and restoring the natural cycles in which ecosystems (and their inhabitants - including us) rely, including water, carbon, and nutrients. The *water (hydrologic) cycle* is typically broken when natural landscapes are developed and urbanized, reducing the cyclical pattern and ability to recharge surface waters, ground waters, and the atmosphere through evapotranspiration. Breaking this cycle by definition creates pollution (storm water, dryer regional climate, urban heat islands, less water above and below ground). Maintaining and restoring the water cycle prevents pollution *and* builds resilience to potential environmental and human disturbances – such as storms, drought, fire, disease, and other natural disasters. Compost-based Sustainable Management Practices (SMPs) restore the water cycle in our watersheds by maintaining and reestablishing natural water absorption, infiltration, and evaporation rates - and of course sustaining vegetation.

The *carbon cycle* is responsible for many things including, regulating climate, growing plants and crops, and degradation of our wastes. Similar to the water cycle, the carbon cycle has become increasingly out of balance by emitting too much carbon-based gases into the atmosphere, thereby affecting *global* climate. Organic waste in landfills emit methane gas, a carbon-based gas 25 times more concentrated in carbon relative to carbon dioxide, as landfills are the leading source of this potent greenhouse gas in the US and most developed nations. By utilizing compost we keep these organic wastes out of the landfill, thereby preventing methane from forming (a carbon source), and by applying to the soil the stable carbon in compost sequesters carbon from the atmosphere (a carbon sink). Furthermore, by helping to establish and sustain permanent vegetation with compost (via photosynthesis) even more carbon is sequestered (another carbon sink). By utilizing compost materials carbon based gases are simultaneously *prevented* and *removed* from the atmosphere, thereby helping to restore the natural carbon cycle, and slow the rate of global climate change.

Nutrient cycles are also affected by composting and compost use, particularly nitrogen (N). One of the many benefits of composting is that the process transforms different species of inorganic nitrogen (such as ammonium-N, nitrite-N, and nitrate-N) that are highly mobile and often lead to water pollution, into a more stable, less mobile form, known as organic nitrogen. This transformative process is an essential part of the nitrogen cycle, and creates an organic nutrient more suitable for short and long-term plant fertility requirements and sustainable growth, and is less likely to contribute to water pollution. Without this process (naturally occurring or managed at a composting facility), surface and ground water pollution of nitrogen from decaying organic wastes would be significantly higher than it is today. By collecting and managing these wastes through composting and compost use programs, the nitrogen cycle is maintained at a local or regional level, and pollution is thereby prevented. By applying organic materials and nutrients that are available to plants based on their natural demands, plant communities are healthier, ecological succession is more common and efficient, and the encompassing ecosystem becomes significantly more *resilient*.

Nature, science, and innovation have shown by restoring natural cycles we can have a profound impact on *resilience*. Leave it to nature to teach us that even cycles are not exclusive, closed loop systems, but are in fact naturally synergistic. Reducing carbon footprint and managing nutrient cycles improves water quality - and vice versa. Building the infrastructure of the future based on these natural models is a leading driver of innovation at Filtrexx International.

References

Faucette, L.B., C.F. Jordan, L.M. Risse, M. Cabrera, D.C. Coleman, and L.T. West. 2005. Evaluation of stormwater from compost and conventional erosion control practices in construction activities. Journal of Soil and Water Conservation. 60(6):288-297.

Faucette, L.B., C.F. Jordan, L.M. Risse, M.L. Cabrera, D.C. Coleman, and L.T. West. 2006. Vegetation and soil quality effects from hydroseed and compost blankets used for erosion control in construction activities. Journal of Soil and Water Conservation. 61(6):355-362.

Faucette, L.B., 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.

Faucette, L.B., B. Scholl, R.E. Beighley, and J. Governo. 2009. Large-scale performance and design for construction activity erosion control best management practices. Journal of Environmental Quality. 38:1248-1254.

Gaskin, J., J. Governo, B. Faucette, D. Borden. The Compost White Paper: Large Scale Composting in Georgia. College Agricultural and Environmental Sciences. The University of Georgia.

Gould, M.C., 2015. Compost increases the water holding capacity of droughty soils. Michigan State University Extension. http://msue.anr.msu.edu/news/compost_increases_the_water_holding_capacity_of_droughty_soils

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