Biosolids Use for Urban Landscapes

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Background

Soils in urban landscapes vary depending on the region where they are found due to local differences on climate, topography, vegetation, soil's parent material, among others. Urban landscapes are strongly influenced by human activities, resulting in soils that have some degree of disturbance (USDA, 2005). The extent of this disturbance can slightly or largely modify natural soil properties, making it difficult to revegetate and conserve soil.

Main types of disturbances of urban soils include compaction, topsoil removal, burial of foreign materials (e.g., asphalt, bricks, cement), and addition of inorganic and organic pollutants (Beniston and Lal, 2012; Craul, 1985). These alterations occur largely due to heavy vehicle traffic and construction activities, and can result in a greatly degraded urban soil with reduced ability to provide ecosystem services. Some of the properties of urban soils that reduce their productivity and provision of ecosystem services are (Beniston and Lal, 2012; Craul, 1985):

- high compaction
- reduced water holding capacity and infiltration
- low organic matter and nutrient availability
- interrupted nutrient cycling
- modified microorganism activity
- higher pH values from additions of cement and road salts

These properties affect the ability of urban soils to aid in storm water management, reduce erosion, and provide an adequate habitat with organic matter and nutrients for microorganisms and plants to grow.

Biosolids Use in Urban Landscapes

A potential advantage of urban areas is the large amount of organic residuals, principally in the form of biosolids, that can be locally reused to restore the commonly degraded properties of urban soils. In 2007, approximately 6.5 million dry tons of biosolids were produced in the United States (NEBRA, 2007).

The benefits of biosolids amendment application to soils have been demonstrated in agricultural, forested, and mine lands (Brown and Chaney, 2000; Sopper and Kerr, 1982; Binder et al., 2002). Organic amendments have shown to improve soil physical (reduce compaction, increase porosity, enhance water holding capacity), chemical (restore carbon and nutrient availability) and biological (help revegetate and increase microbial activity) properties (Beniston and Lal, 2012; Scharenbroch, 2009; Basta et al., 2016, Kumar and Hundal, 2016). Biosolids application can also help remediate potentially contaminated urban soils by providing a clean medium for plants to grow, and by increasing

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organic matter content which helps reduce the bioavailability of trace elements such as lead, arsenic, cadmium, copper, among others (Ge et al., 2000; Grimes et al., 1999; Brown et al., 2016).

Exceptional quality (EQ) biosolids can be applied to urban landscapes (Fact Sheet Wastewater Treatment Processes; USEPA, 1994). Class A biosolids are treated to reduce pathogen levels below detection by employing “Processes to Further Reduce Pathogens” (PFRPs), such as composting, heat-drying, pasteurization or thermal hydrolysis (high temperature and pressure), in conjunction with advanced anaerobic digestion (USEPA, 1994). Class A biosolids that additionally reduce the attraction to vectors (flies, rodents, etc.) and meet alternative pollutant limit requirements are termed EQ biosolids (Fact Sheet Wastewater Treatment Processes; USEPA, 1994). Such EQ biosolids can be applied by following soil test nutrient recommendations like any other inorganic fertilizer or soil amendment. These biosolids products should also be drier (5%-40% moisture) than biosolids previously used in agriculture, forestry, and mine land reclamation, so that they can be easily handled and applied in urban areas.

Exceptional Quality biosolids can be applied to public areas in cities such as public parks, golf courses, roadsides, lawns, home gardens, and plant nurseries (USEPA, 1994). Overall, research has found that biosolids improve properties of urban soils, which help enhance vegetation establishment (Sullivan et al. 2010; Basta et al., 2016; Kumar and Hundal, 2016; McIvor et al., 2012). Basta et al. (2016) applied biosolids (90 and 180 US tons/acre), and biosolids (90 US tons/acre) blended with drinking water treatment residual and biochar to an urban degraded soil. The authors found that biosolids amendments improved soil quality and nutrient availability, and helped establish a greater vegetation cover of a native seed mix containing grasses, legumes, and forbs. The amendments also increased soil microbial activity and measurements of earthworm reproduction. Scharenbroch et al. (2013) measured greater tree growth with biosolids applied to three urban soils of different soil type (pure sand, compacted clay, and silt loam). Tree growth was greater with biosolids amendments than with a non-fertilized control. Biosolids amendment application also increased soil organic carbon and nitrogen availability of a silt loam and clay compacted soil compared to an inorganic nitrogen treatment and a non-fertilized control (Scharenbroch et al., 2013).

Various municipalities have been switching to produce EQ biosolids that can be used locally in urban landscapes. These municipalities promote the use of EQ biosolids products for urban agriculture due to their beneficial effects on soil rehabilitation, vegetable production and carbon sequestration in the cities. The City of Tacoma (WA) has produced and marketed Tagro soilTM (https://www.cityoftacoma.org/cms/one.aspx?pageId=16884), which is an EQ biosolids blended with sand and sawdust. The use of thi product and a biosolids compost (GrocoTM, Kings County, WA) improved soil physical (water infiltration, lower compaction) and chemical (nitrogen and phosphorus availability) properties of soils in urban gardens in Washington compared to a non-amended soil (McIvor et al., 2012). Similar EQ biosolids products that are being generated ford for urban uses include BloomTM (Washington, DC; http://bloomsoil.com/about-bloom) and NutriflorTM (Vancouver, British Columbia, CA; http://www.metrovancouver.org/services/liquid-waste/innovation-wasterwater-reuse/biosolids/Topsoil/Pages/default.aspx). More research to evaluate the effect of these newer EQ biosolids products on urban soil properties, vegetable yield, and water quality when they are used in urban agriculture would be desirable.

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