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Impacts of Aerated Compost Tea on Containerized *Acer saccharum* and *Quercus macrocarpa* Saplings and Soil Properties in Sand, Uncompacted Loam, and Compacted Loam Soils

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***Abstract*. Aerated compost teas (ACTs) are applied to soils with the intent of improving microbial properties and nutrient availability and stimulating plant growth. Anecdotal accounts of ACT for these purposes far outnumber controlled, replicated, and peer-viewed experiments that have examined the impacts of ACT on soil properties and plant growth responses. This research assessed the impacts of four rates of ACT compared with water on containerized *Acer saccharum* and *Quercus macrocarpa* saplings growing in loam, compacted loam, and sandy soils. No significant differences were found comparing water with ACT applied at rates of 2, 4, and 40 kL ACT/ha for any of the six tree responses and 21 soil responses. Microbial biomass nitrogen (N) and potassium (K) increased, and available N decreased, in soils treated with ACT at 400 kL·ha^{-1} compared with water. Shoot, root, total biomass, and the root/shoot ratio were significantly greater for *Quercus macrocarpa* trees growing in compact loam with the 400 kL ACT/ha treatment compared with water, but significant differences were not detected for this application rate compared with water in the other soil types and in no instances with *Acer saccharum* saplings. These results provide some support for claims of ACT being able to increase soil microbial biomass and K, but provide minimal support for ACT being able to increase tree growth across multiple species in a variety of soil types. An application rate of 400 kL ACT/ha may be attainable for trees in containers with limited soil volumes, but this application rate is likely cost-prohibitive, and not practical, in the landscape. At this application rate, ≈1000 L of ACT would be required to treat a typical, and relatively small, critical root zone of 25 m^2.**

Soil nutrient management is important for tree establishment, growth, and longevity. Nutrients are most often supplied to trees in the greenhouses, nurseries, and landscapes by inorganic fertilizers. Nutrient management with inorganic fertilizers poses some environmental risks such as eutrophication of fresh water from phosphorus (P) loading (Soldat et al., 2009), acidification of soils and surface waters, eutrophication of coastal water, and groundwater contamination from N (Vitousek et al., 1997), reductions in soil quality through salt accumulation (Finck, 1982; Follett et al., 1981), decreases soil carbon (C) and N with long-term synthetic fertilization (Khan et al., 2007), and greenhouse gas production during fertilizer synthesis and after applications through denitrification (Vitousek et al., 1997).

Given the potential risk associated with inorganic fertilizers, organic fertilization is becoming more common for supplying nutrients to trees. Organic fertilizers contain organic matter and encompass a diverse group of materials (e.g., animal or green manure, peat, bone meal, biosolids, compost) (Finck, 1982). The majority of the nutrients in these fertilizers is organically bound and slowly mineralized, so the potential for exceeding plant nutrient demands and associated environmental contamination is reduced relative to synthetic fertilization (Stratton et al., 1995). Because organic fertilizers have lower quantities of immediately available N compared with synthetic fertilizers, they may be less likely to speed up C losses from soil through N stimulation of microbial respiration (Follett et al., 1981; Triberti et al., 2008). The use of organic materials as fertilizer promotes useful recycling and removes potentially noxious waste products (Finck, 1982).

Aerated compost teas are one such organic fertilizer becoming more widely used with the hopes of improving soil quality and managing tree nutrition. Aerated compost tea is made by mixing compost with aerated water (National Organic Standards Board, 2004). Aeration during the brewing process distinguishes ACT from other compost extracts and is important considering the goal of increasing aerobic microorganisms. According to the National Organic Program (NOP), the predominant ACT production method in the United States involves one part compost in 10 to 50 parts water, constant aeration for 12 to 24 h, and immediate application (National Organic Standards Board, 2004). NOP standards specify that compost used to make ACT must be made from allowable feedstock materials and the entire pile must undergo an increase in temperature to at least 131 °F for at least 3 d (National Organic Standards Board, 2002). ACT additives such as molasses, yeast extract, and algal powders are used to encourage growth of beneficial microbes but can also have non-target negative effects by supporting the growth of bacterial human pathogens from undetectable levels in properly made compost to detectable in ACT. The National Organic Standards Board (2004) specifies that ACT made with additives can be applied to ornamental plants, not intended for human consumption, and is exempt from U.S. Environmental Protection Agency standards for a bacterial indicator of fecal contamination.

A growing body of research has been examining the effects of compost teas or extracts on plant growth and disease suppression (e.g., Al-Mughrabi, 2007; Duffy et al., 2004; Ezz El-Din and Hendawy, 2010; Hargreaves et al., 2008, 2009a, 2009b; Hendawy, 2008; Larkin, 2008; Pant et al., 2009, 2011; Puglisi et al., 2008; Scheuerell and Mahaffee, 2002, 2004, 2006; Segarra et al., 2009; Viator et al., 2008; Welke, 2005; Yohalem et al., 1996). These studies have examined ACTs, non-ACTs, teas applied as foliar sprays or soil drenches, and teas with and without additives. For the most part, mixed results have been reported for the effectiveness of compost teas to decrease disease and increase yield for a variety of agronomic and horticultural plants.

Few of these studies have focused on the specific impacts of ACT on soil quality (e.g., Hendawy, 2008; Larkin, 2008; Pant et al., 2009; Puglisi et al., 2008; Scharenbroch et al., 2011) and none have examined the impacts of ACT on examined tree growth. These studies have rarely compared ACT with water, which is known to be a major limiting factor for tree growth (e.g., Scharenbroch et al., 2011). Furthermore, no standards exist for application rates of ACT to trees. Current ACT application rates for agricultural and horticultural plants range from 4 to 400 kL ACT/ha (personal communication with E. Ingham formerly of Soil Foodweb, Inc., July 2008), albeit these rates are not based on scientific evidence.

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