Examining Compost Tea

Research Reveals Mixed Results

by ANDREA WATTS

Morton Arboretum Soil Science volunteer Mark Brown applies compost tea.

I anticipated that writing an article about compost tea would be relatively easy: an overview of what makes up compost tea with highlights of recent scientific studies that support its beneficial effects of increasing plant growth and reducing the severity of foliar diseases. Yet my initial search for scientific studies on compost tea instead yielded results devoted to sellers of compost tea and its benefits based upon anecdotal evidence. A subsequent search yielded a list that included a 2003 study conducted by Pennsylvania State University and The Rodale Institute and information on Dr. Linda Chalker-Scott. After reviewing the information, I realized I had a more difficult story to write. How do I explain that scientific studies have not yet substantially proven the faith that some people have in the effectiveness of compost tea?

While I only recently became aware of the mismatch between the scientific and public perception of compost tea, Chalker-Scott has been addressing this issue for 15 years. An urban horticulturist with the Washington State University (WSU) extension office in Puyallup, she also holds an associate professor position in WSU's Department of Horticulture and affiliate associate professor positions in the University of Washington's College of the Environment's Center for Urban Horticulture and the College of Built Environment's Department of Landscape Architecture. She crossed paths with compost tea in 1999, finding Master Gardeners selling the brew at their plant sale. Having already conducted a preliminary literature review and finding that research studies didn't support the benefits being touted, Chalker-Scott realized that she needed to address the issue head on. She has written a series of articles on compost tea over the years, providing updates as new findings emerge.

Part of the issue is clarifying the terminology used to describe compost tea. Nonaerated compost tea (NCT), which can also be called compost leaching or compost extract, is made by immersing animal and plant waste into water to leach out the nutrients and anaerobic microbes, a technique that has been used for centuries. This liquid fertilizer may then be used to water plants or be applied as a foliar spray. Studies conducted on NCT, when it is made from compost which includes active mushroom medium, have found that suppression of foliar disease does result when applied as a foliar spray, Chalker-Scott explained, and this might be because the organisms found in the mushroom medium may be antagonistic to disease. However, the suppression only affects the incidence, not the severity, and results obtained in the laboratory aren't consistently achieved in the field.

While NCT only costs the expense of a bucket, compost and water, aerated compost tea (ACT) requires the additional expenses associated with a brewer, electricity and additives (if desired). The National Organic Program describes the most common formula as 1 part compost to 10-50 parts water. Additives, such as molasses, yeast extract or algal powders, may be added to increase microbial biomass. The constant aeration for 12-24 hours is the crucial difference between these two forms of tea, and the ceasing of the aeration results in NCT.

Once brewed, ACT is applied in the same manner as NCT. Benefits attributed to ACT include suppressing disease, increasing microbial populations within the soil and improving plant growth. However, these benefits haven't been conclusively proven or substantiated during the course of numerous scientific studies. The 2003 Pennsylvania State University and The Rodale Institute study found that applying ACT as a foliar spray, compared to the other treatments of

a pesticide control and a no-spray control, suppressed the powdery mildew found on Chardonnay grapes by 50 percent. For pumpkins, which received treatments of a non-spray control, ACT, and "a non-compost tea application containing the nutrient ingredients but not the compost found in the tea," none of these treatments were found more effective than the others in reducing the severity of powdery mildew. However, potato plants receiving the ACT did yield larger, better potatoes, and their nutrient levels were also higher than compared to the treatments.

In her literature review, Chalker-Scott found that this Penn State and Rodale study was the only one exhibiting effectiveness in suppressing foliar disease. Other university studies including Cornell University studying *Septoria* on tomatoes and *Phomopsis* on wine grapes, and Ohio State University studying powdery mildew on squash found ACT ineffective. "None of [the studies] have consistent results …." Though Chalker-Scott says that some of the microbes in the compost could have beneficial properties as proponents suggest, more studies are required to isolate the microorganism in question to develop an effective form of biological control that could yield more consistent results.

PHOTOS COURTESY OF BRYANT SCHARENBROCH

Bryant Scharenbroch (MASS PI) and William Treasurer (MASS volunteer) running a microbial assay on compost tea treated soils.

During our conversation, Chalker-Scott mentioned ACT research being conducted at The Morton Arboretum by Dr. Bryant Scharenbroch. I spoke with Scharenbroch, a soil scientist with the arboretum's research department, to discuss his interest in compost tea and recent findings.

"This whole idea of compost tea was a pretty hot topic for arborists and urban foresters when I first started here [seven years ago] and was getting a lot of questions on efficacy of the compost teas and the whole science behind it," he explained.

A likely reason why arborists and urban foresters are interested in compost tea is driven by an awareness that more is needed to maintain soil quality than just applying fertilizers, something organic farmers have long known. People in the industry are recognizing the importance of overall soil quality and managing toward fixing physical, biological and chemical properties, and inorganic fertilizers are a bit limited in their ability to address physical properties and biological properties, he explained.

Just as organic farmers are concerned with applying treatments that don't affect water and atmospheric quality, these are shared goals for managers in the urban environment, and Scharenbroch wanted to study ACT's efficacy compared to traditional strategies of providing nutrients to trees. His research is scaled to all aspects of urban trees: from greenhouse seedlings/saplings to staging in a nursery and finally being planted in the landscape.

What sets research apart from anecdotal trials is the appropriate use of water as a control, which may explain the improvements in growth that people are mistakenly attributing to ACT. "Many times just adding water to something, especially in the summertime, it's going to have a huge impact on it," Chalker-Scott said, something that Scharenbroch echoed. "We know when you water a tree, especially in a pretty stressful environment, you're going to get improvements in growth. That's also part of the story I think with the compost teas; you're also applying water to these trees."

In a 2011 study, published in *Arboriculture & Urban Forestry*, Scharenbroch examined the effects of ACT, synthetic fertilizer and deionized water on 15 biochemical properties of silt loam and clay loam soil after being saturated for 10 days. The results were mixed regarding ACT's effects compared to water and a synthetic fertilizer. While ACT increased the soil's potassium, ammonium and microbial respiration levels compared to water, fertilizer yielded superior results in increasing microbial biomass, microbial

RESOURCES

Dr. Linda Chalker-Scott:
puyallup.wsu.edu/~Linda%20Chalker-Scott/Curriculum%20vitae.html
Dr. Bryant Scharenbroch's studies and article:
Laboratory Assays on the Effects of Aerated Compost Tea and Fertilization on Biochemical Properties and Denitrification in a Silt Loam and Bt Clay Loam Soils
auf.isa-arbor.com/request.asp?JournalID=1&ArticleID=3214&Type=2
Effects of Organic and Inorganic Fertilizers on Soil Quality and Tree Growth in a Compacted Urban Soil
tcia.org/digital_magazine/tci-magazine/2013/10/index.htm#?page=22
Impacts of Aerated Compost Tea on Containerized *Acer saccharum* and *Quercus macrocarpa* Saplings and Soil Properties in Sand, Uncompacted Loam, and Compacted Loam Soils
www.masslaboratory.org/uploads/1/1/1/7/11172919/scharenbroch_2013_hortsci.pdf
Pennsylvania State University and The Rodale Institute update:
newfarm.rodaleinstitute.org/depts/NFfield_trials/0404/tea.shtml
National Organic Standards Report Compost Tea Task Force Report:
www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5058470

activity, phosphorus and dissolved organic nitrogen. However, with a greater microbial immobilization and lower denitrification with ACT compared to fertilizer, Scharenbroch suggests that applying ACT may have a greater potential nutrient retention in the long term.

When application of ACT was compared to water on sugar maples and bur oak saplings grown in sand, uncompacted loam and compacted loam soils, again mixed results were found. Application rates of 2, 4 and 40 kL ACT/ha resulted in no significant differences of the six tree responses and 21 soil responses compared to the control of water. (Tree responses included shoot, root and total biomass. Soil responses included pH, total organic matter, and available nitrogen.) Only at an application rate of 400 kL ACT/ha were increases of microbial biomass nitrogen and potassium noted, but this was coupled with a decrease in available nitrogen. While the bur oak saplings growing in the compact loam had significant greater biomass at the highest application rate compared to water, no other differences were found in the other soil types and the sugar maple saplings.

A recently concluded five-year study examined soil quality and tree growth of 2-year-old river birch and sugar maple in compacted urban soil, conditions typically found after development. Treatments included a control, ACT, commercial biological product applied as per label instruction, NPK fertilizer, compost as a top dressing and double-ground hardwood mulch. Though the full results of this study are pending publication, Scharenbroch published preliminary findings from this research in an article in *Tree Care Industry's* October 2013 issue. Preliminary results showed no significant soil and tree responses were found with ACT compared to the controls. "Our findings confirmed the hypothesis that improvements in soil biochemical properties would be greatest with compost [and wood-chip mulch]," Scharenbroch wrote. Improvements found with compost and wood chips included increased shoot, root and total tree biomass, increased microbial biomass and microbial respiration and increased plant-available water.

So what is the takeaway message regarding ACT? There may not be further in-depth research on ACT at the university level because the studies have demonstrated its ineffectiveness, and this ineffectiveness is likely a result of its application. The microbes in both forms of compost tea need organic material to live. Spraying them onto bare soil or leaves means they have no food source, which defeats the purpose of the microbes. "Compost tea is fast food; it doesn't have very many nutrients in it anyway," Chalker-Scott said. "You pour it on; it's gone, [while] compost is there for a long time. Stuff breaks down slowly, microbes break down nutrients slowly; [resulting in] slow food for your landscape." This sentiment is echoed by Scharenbroch at the conclusion of the *Arboriculture & Urban Forestry* paper: "The ACT contained only a fraction of the organisms found in the compost, and future research should examine compost and other organic fertilizer as soil amendments in comparison to ACT, synthetic fertilization or water."

This is also the cost to consider. Scharenbroch calculated the expense required to apply the treatments, and mulching and compost were the cheapest treatments at $17 and $22 per kilogram of tree biomass gained, while ACT (cost of brewer included) was the highest at $117 per kilogram of tree biomass gained. However, he thinks there could be application of ACT in a nursery setting where the costs might be more manageable since the plants are in containers.

The old-fashioned work of saving kitchen scraps, turning over compost piles and working the compost into the soil may be the best way to improve plant growth and reduce the incidence of foliar disease, whether your plants are growing in a backyard or on a farm. "There is a huge body of literature on the benefits of compost itself, the microbes it contains, the beneficial flow of nutrients, you name it," Chalker-Scott said. "And that's really the best thing people can do, is keep their soils mulched with compost."