ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/249993193

Compost tea production

Chapter · December 2011

CITATION
1

READS
3,123

3 authors, including:

Archana Pant
University of Hawai'i at Mānoa
33 PUBLICATIONS **646** CITATIONS
SEE PROFILE

Theodore J.K. Radovich
University of Hawai'i System
92 PUBLICATIONS **1,185** CITATIONS
SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Project Arsenic chemistry and phyto-availability in Hawaiian soils View project

Project Biochars as soil amendments View project

All content following this page was uploaded by Nguyen Hue on 21 May 2014.

The user has requested enhancement of the downloaded file.

Kupa'a On-Farm Trials

Objective: Quantify yield of specialty potatoes grown with and without compost tea in an organic production system on Maui.

Trial Set-up: Three potato varieties ('Cranberry', 'All Blue' and 'Onoway') were planted to 200 foot rows at approximately 2000 feet elevation in Kula Maui. A preceding barley cover crop, seeded at 70 lbs/acre, had been incorporated 6 days before potato planting. Seed pieces were cut to have 1-3 eyes then immediately coated in a commercial mycorrhizal preparation (Glomus interradices, www.mycorrhizae.com) and planted in raised beds with ~3 ounce of mature compost per seed piece. Potatoes were spaced 1 foot between seed pieces within rows, and 8 feet between hills. Compost tea was applied as per grower practice (see opposite page), but was withheld from four sections within each row (i.e. 4 replications per row). Compost tea was produced and applied three times during the crop cycle, about every 3 weeks. Potatoes were harvested 72 days after planting for a "Red, White and Blue" mix to marketed for 4th of July. Total and marketable yield per 90 ft2 plot (3ft wide x 30 ft long) and average weight of individual potatoes were determined for each variety.

Trial Duration: April 4, 2009 - July 1, 2009.

Results Summary: Yield and concentrations of total phenolic compounds were significantly influenced by variety. Tea applications did not have a significant effect on either marketable or unmarketable yields of the three varieties, nor did it significantly impact total phenol levels. Phenolic compounds are important because they contribute to the color and antioxidant potential of produce. In this on-farm trial, variety selection was more impactful on potato yield and quality than compost tea applications.

Chapter II - Compost Tea Production

Archana Pant, Theodore Radovich, Nguyen Hue

Extraction Methods

Two dominant approaches of compost tea production are aerated and non-aerated methods. Scheurell and Mahaffee (2002) and Ingham (2005) used the terms non-aerated compost teas (NCT) and aerated compost teas (ACT) to refer to the extracts produced by these methods. ACT refers to methods in which the mixture is actively aerated during extraction. NCT refer to methods that do not disturb or only minimally disturb the extraction after initial mixing. Other terms used to describe aerated and non-aerated compost teas are: aerobic and anaerobic, or active and passive. Aerated and non-aerated, however, seem to most accurately describe the different processes used in production as well as the end-product (Scheuerell and Mahaffee, 2002).

Both extraction methods involve the steeping of compost in water for a defined period at room temperature. Aerated compost tea requires aeration throughout the extraction period (Weltzien, 1991; Scheuerell and Mahaffee, 2002). Weltzein, as a pioneer in this area, focused primarily on non-aerated method of compost tea production in the late 1980's and early 1990's (Weltzein and Ketterer, 1986; Weltzien, 1991). However, in recent years, interest has shifted to the ACT method (Scheuerell and Mahaffee, 2002). From a grower's perspective, ACT has the distinct advantage that it can be prepared in 1-2 days and results in less odor problems, whereas, NCT requires 1-2 weeks steeping time (Ingham, 2005). Non-aerated compost tea does not require any special technology beyond a steeping vessel and is associated with low cost or low energy input, whereas, ACT requires constant stirring and aerating of large volumes of liquid. Proponents of ACT production argue that the risk of contamination by human pathogens is very low in ACT compared to that of NCT, as the human pathogens including E. coli are poorly competitive under aerobic conditions, however, there is no documented evidence to substantiate these claims (Brinton et al., 2004).

There is no agreement whether aeration is required. Several investigators have reported that non-aerated compost tea has consistently positive effects on disease control and plant growth in contrast to aerated compost tea (Weltzien, 1991; Cronin et al., 1996; Scheuerell and Mahaffee, 2006). Welke (2005) concluded that both aerated and non-aerated teas have similar effect on plant growth and disease suppression. In contrast, Arancon et al. (2007) reported that aerated vermicompost tea had a greater positive impact on plant growth than non aerated tea extracted for the same period of time (24 hrs). These varying reports of the impacts of compost tea production method on plant health and yield are crop specific and inferences about the superiority of one method over another on disease suppression or plant yield cannot be generalized. When recommended protocols for both methods were trialed concurrently no difference in plant growth were observed (Chapter 3).

Homemade Brewers

The most basic brewer is a 5 gallon bucket with a mesh bag (see illustration). Many people find that using a nylon paint strainer made to fit over the top of the bucket is convenient. Brewers with higher volumes add spigots and support systems for easier draining. The obvious advantage of homemade, non-aerated brewers is lower costs. (See pages 19 for an overview of research comparing non-aerated and aerated tea.)

Non-aerated compost tea requires approximately a 1 week steeping time (Weltzien, 1991).

Aeration requires the addition of an air pump and a device to produce bubbles. Options include using pumps and air stones (see picture at left) from the aquarium industry and perforated PVC pipe or hosing. Many designs are available on-line, however, these have not been evaluated so individual judgement on their effectiveness is required.

Commercial Brewers

Commercial brewers are designed to provide uniform aeration and circulation. Check with individual retailers for information on circulation, oxygen levels and biomass growth. The brewers on the right were selected to demonstrate the range of designs on the market. Please see the suppliers list on page 67 for additional dealers.

Recommendations for brewing time and use of additives vary by manufacturer but are typically about 24 hours. .

Keep it Simple (KIS)

Their smallest system is designed to fit in standard 5 gal buckets. It consists of a pump and perforated PVC piping that is shaped to distribute air across the bottom of the bucket. It has been tested for a 12 hour brew time.

Greater Earth Organics (GEOTEA)

A high volume of rapidly rising bubbles exit a stainless steel air diffuser tube at the bottom of the tank to oxygenate and circulate the tea. At the same time, additional air is pumped out of holes from a tube extending into the compost in the submerged extractor dome.

Living Soils Organics

This design uses a conical tank and an external, vortex creating, aeration system. Each up-feed pipe has an air-stone for bubbles. The bubbles lift the tea up the pipes where it reenters the tank at an angle that results in a circular motion. More liquid is drawn from the bottom of the tank for constant circulation.

Growing Solutions

Aeration is achieved through Fine Bubble Diffusion. This technology was first developed for and has had long-term use by the waste water industry.

Ratio of compost to water

Optimum ratio of compost to water tends to vary, depending upon the brewing process, compost quality and purpose of compost tea application. Too little compost will result in dilute tea with low amounts of nutrients or organisms; whereas, too much compost may not allow maximum amounts of nutrients and microbial biomass of compost to be extracted (Ingham, 2005).

Studies on compost to water ratio have mainly focused on disease suppression effect of compost tea with diverse results. Most studies have followed the methodology developed by Weltzien (1990) that uses a 1:3 - 1:10 (vol:vol) compost to water ratio. Weltzien (1990) reported that there was a significant suppression of *Phytopthora infestans* with the application of compost tea, no difference in suppression was observed for compost to water ratios between 1:3 and 1:10. However, the suppression effect of compost tea was lower with 1:50 compared to 1:3 and 1:10 compost to water ratio (Weltzien, 1990). Welke (2005) observed that strawberry plants had higher yield and lower incidence of disease with the application of compost tea prepared with a 1:8 compared to that of 1:4 ratio. Edwards et al. (2006) reported a non-significant difference on plant growth response of tomato seedlings with the applications of vermicompost teas with 1:25, 1:12 and 1:10 ratios. Several studies indicated that limiting compost to water ratio to 1:10 is found to be effective on disease suppression and yield improvement although the exact mechanism is unclear (Weltzien, 1991; Touart, 2000; Scheuerell and Mahaffee, 2002).

Research at the University of Hawaii (Pant, 2011) showed that application of vermicompost tea with vermicompost to water ratios of 1:10 - 1:100 (by volume) increased plant yield and root growth, and the response to the ratio of vermicompost to water was generally linear. Similar effects were observed in tissue N, phytonutrient content and microbial activities in soil. The best plant growth response was observed with vermicompost to water ratios of 1:20 and 1:10, indicating that the optimal ratio of vermicompost to water ranges between 1:10 and 1:20.

Frequently Asked Questions:

Compost to water ratio and application rate

How much compost do I need to use?

A 1:10 - 1:20 ratio of compost to water is recommended. Benefits decrease in a linear fashion as the solution becomes more dilute, but some effect is seen with solutions as low as 1:100. The decision on concentration is generally based on compost cost and quantity of tea required. To get a 1:10 ratio you add a little over 1 1/2 cups compost for every gal of water.

How many gallons should I be using per 1000 square feet?

Optimal growth in our research was seen at an application rate of 7-14 gal per 1000 sq ft (300-600 gal per acre). This rate allows for some penetration into the root zone when applied foliarly. Weekly applications are recommended for at least 4 weeks in vegetable crops.

I buy vermicompost by the pound,what is the conversion?

One gallon of vermicompost weighs around 4-5 pounds. However, It is still best to measure the volume as the weight of compost varies by the moisture content.

What is the best way to apply compost tea?

For small areas, applying with a watering can is probably easiest. For larger areas, tea may be pumped through a hose or sprayer. Injection through drip lines is possible, but requires filtering and flushing of the lines with fresh water after application. We recommend that at least some portion of the compost tea be applied to the root zone.

How do get the most bang for my compost tea buck?

Research in Hawaii suggests that much of the impact on plant growth is due to improved nutrient availability, particularly nitrogen. Compost tea may have the greatest impact in low input environments where nitrogen availability is expected to be low. The use of high quality compost applied at the rates recommended above would be expected to improve plant nutrient status and growth.

Conversions:

1 gallon = 3.8 liters 1 pound = 0.45 kilograms

Brewing (extraction) period

Brewing (extraction) period is an important factor contributing to compost tea quality and efficacy. Compost tea should be brewed to an extent when most of the soluble nutrients and organisms from the compost are extracted or pulled out into the solution (Ingham, 2005). Too short brewing period may prevent maximum extraction of nutrients and microbial biomass from the compost whereas too long brewing period may favor microbial immobilization of extracted nutrients leading to microbes become inactive once all the available foods are immobilized (Ingham, 2005). Similarly, Scheurell and Mahaffee (2002) noted that effectiveness of compost tea increases with increasing brewing time to a maximum and then declines. Brewing period of compost tea may vary with brewing methods, compost source and purpose of compost tea application.

Non-aerated compost tea generally requires a longer brewing period compared to that of aerated tea (Brinton et al., 2004; Ingham, 2005; Diver, 2001). Weltzien (1991) reported that usually a 5 to 8 day period and up to a 16 day brewing time is needed for NCT, which has been hypothesized to allow sufficient time for facultative anaerobes to dominate and for their metabolites to accumulate. Ketterer et al. (1992) examined Botrytis suppression on detached grape leaves with 1, 3, 7 and 14-day brewed NCT, and that the maximum suppression was observed with the application of 7-day brewed tea.

Ingham (2005) suggests that the optimum brewing time for ACT co incides with maximum active microbial population in the tea, often 12-24 hours with commercial aerobic compost tea makers. Schurell and Mahaffee (2002) citing Cantisano (1998) stated that one day brewing of ACT would be effective for foliar feeding while longer brewing period up to 14 days is useful for disease control.

Research on compost tea brewing period have focused primarily on disease suppression effects; further research work on effect of compost tea brewing period on plant growth is needed.

View publication stats

Frequently Asked Questions:

Extraction and brewing

Do I need to use aeration?

Not necessarily. There is some evidence to suggest that if brewed for longer periods of time non-aerated teas can produce similar effects as aerated compost teas. The primary benefit to aeration is to shorten the extraction time. Other reasons for using aeration include increasing oxygenation to promote aerobic activity and to avoid potential for bad smells and phytotoxic compounds that can result from anaerobic activity. More research is needed to determine when aeration is ideal or necessary.

Do I need to add supplements to my brewer?

Not necessarily. While supplements, particularly sugar, can increase microbial populations, evidence linking increased microbial populations to enhanced plant growth is not conclusive. Teas made with high quality teas without supplements have been shown to be effective. Supplements may be an issue for growers with organic certification (see pages 14-15).

How long can I keep the tea after brewing?

The convention is to use the tea within 4 hours, however research at Ohio State University has shown that refrigeration can extend efficacy for up to 14 days. (citation Arancon)

What are the characteristics of high quality tea?

The characteristics of the tea reflect the characteristics of the compost used. Brewing, when properly managed, extracts the soluble nutrients and preserves the biological characteristics of the compost. Biological characteristics of high quality compost teas have been proposed (see Ingram, 2005). Chemical characteristics of high quality include high levels of available nitrogen, humate, and gibberelic acid.

What about chlorine or chloramine in the water?

Clorinated water can be degassed by allowing the water to sit overnight or letting the aerator run for several hours. Chloramine is chlorinated ammonia and is used as an alternative to chlorine in some situations. It is much more difficult to remove (check with your water supplier).